

## Road To Zero - The Microgrid Management Game

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# Chapter 1

## Hierarchical Index

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<a href="#">EnergyStorageSystem</a>	A settlement class (child class of <a href="#">TileImprovement</a> ) . . . . .	52
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source/ <a href="#">DieselGenerator.cpp</a>	Implementation file for the <a href="#">DieselGenerator</a> class . . . . .	315
source/ <a href="#">EnergyStorageSystem.cpp</a>	Implementation file for the <a href="#">EnergyStorageSystem</a> class . . . . .	316
source/ <a href="#">Game.cpp</a>	Implementation file for the <a href="#">Game</a> class . . . . .	323
source/ <a href="#">HexMap.cpp</a>	Implementation file for the <a href="#">HexMap</a> class . . . . .	323
source/ <a href="#">HexTile.cpp</a>	Implementation file for the <a href="#">HexTile</a> class . . . . .	324
source/ <a href="#">main.cpp</a>	Implementation file for <a href="#">main()</a> for Road To Zero . . . . .	324
source/ <a href="#">Settlement.cpp</a>	Implementation file for the <a href="#">Settlement</a> class . . . . .	329
source/ <a href="#">SolarPV.cpp</a>	Implementation file for the <a href="#">SolarPV</a> class . . . . .	329
source/ <a href="#">TidalTurbine.cpp</a>	Implementation file for the <a href="#">TidalTurbine</a> class . . . . .	330
source/ <a href="#">TileImprovement.cpp</a>	Implementation file for the <a href="#">TileImprovement</a> class . . . . .	330
source/ <a href="#">WaveEnergyConverter.cpp</a>	Implementation file for the <a href="#">WaveEnergyConverter</a> class . . . . .	331
source/ <a href="#">WindTurbine.cpp</a>	Implementation file for the <a href="#">WindTurbine</a> class . . . . .	331
source/ESC_core/ <a href="#">AssetsManager.cpp</a>	Implementation file for the <a href="#">AssetsManager</a> class . . . . .	316
source/ESC_core/ <a href="#">MessageHub.cpp</a>	Implementation file for the <a href="#">MessageHub</a> class . . . . .	316
source/ESC_core/ <a href="#">testing_utils.cpp</a>	Implementation file for various testing utilities . . . . .	317

## Chapter 4

# Class Documentation

### 4.1 AssetsManager Class Reference

A class which manages visual and sound assets.

```
#include <AssetsManager.h>
```

#### Public Member Functions

- [AssetsManager](#) (void)  
*Constructor for the [AssetsManager](#) class.*
- void [loadFont](#) (std::string, std::string)  
*Method to load a font and insert it into the font map.*
- void [loadTexture](#) (std::string, std::string)  
*Method to load a texture and insert it into the texture map.*
- void [loadSound](#) (std::string, std::string)  
*Method to load a sound and insert it into the sound map. Automatically creates a corresponding sf::SoundBuffer.*
- void [loadTrack](#) (std::string, std::string)  
*Method to load a track (sf::Music) and insert it into the track map.*
- sf::Font \* [getFont](#) (std::string)  
*Method to get font associated with given font key.*
- sf::Texture \* [getTexture](#) (std::string)  
*Method to get texture associated with given texture key.*
- sf::SoundBuffer \* [getSoundBuffer](#) (std::string)  
*Method to get soundbuffer associated with given sound key.*
- sf::Sound \* [getSound](#) (std::string)  
*Method to get sound associated with given sound key.*
- void [playTrack](#) (void)  
*Method to play the current track.*
- void [pauseTrack](#) (void)  
*Method to pause the current track.*
- void [stopTrack](#) (void)  
*Method to stop the current track.*
- void [nextTrack](#) (void)  
*Method to advance to the next track. Wraps around if the end of the track map is reached.*

- void [previousTrack](#) (void)  
*Method to return to the previous track. Wraps around if the beginning of the track map is reached.*
- std::string [getCurrentTrackKey](#) (void)  
*Method to get track key for current track.*
- sf::SoundSource::Status [getTrackStatus](#) (void)  
*Method to get the status of the current track.*
- void [clear](#) (void)  
*Method to clear all loaded assets.*
- [~AssetsManager](#) (void)  
*Destructor for the [AssetsManager](#) class.*

## Public Attributes

- std::map< std::string, sf::Font \* > [font\\_map](#)  
*A map of pointers to loaded fonts.*
- std::map< std::string, sf::Texture \* > [texture\\_map](#)  
*A map of pointers to loaded textures.*
- std::map< std::string, sf::SoundBuffer \* > [soundbuffer\\_map](#)  
*A map of pointers to sound buffers.*
- std::map< std::string, sf::Sound \* > [sound\\_map](#)  
*A map of pointers to loaded sounds.*
- std::map< std::string, sf::Music \* >::iterator [current\\_track](#)  
*A map iterator which corresponds to the current track (i.e., the track currently being played).*
- std::map< std::string, sf::Music \* > [track\\_map](#)  
*A map of pointers to opened tracks (i.e. sf::Music).*

## Private Member Functions

- void [\\_\\_loadSoundBuffer](#) (std::string, std::string)  
*Helper method to load a soundbuffer and insert it into the soundbuffer map. Should only be called by [loadSound\(\)](#), to create an sf::SoundBuffer corresponding to the loaded sf::Sound.*

### 4.1.1 Detailed Description

A class which manages visual and sound assets.

### 4.1.2 Constructor & Destructor Documentation

#### 4.1.2.1 AssetsManager()

```
AssetsManager::AssetsManager (
    void )
```

Constructor for the [AssetsManager](#) class.

```
142 {
143     //...
144
145     std::cout << "AssetsManager constructed at " << this << std::endl;
146
147     return;
148 } /* AssetsManager() */
```

### 4.1.2.2 ~AssetsManager()

```
AssetsManager::~AssetsManager (
    void )
```

Destructor for the [AssetsManager](#) class.

```
771 {
772     this->clear();
773
774     std::cout << "AssetsManager at " << this << " destroyed" << std::endl;
775
776     return;
777 } /* ~AssetsManager() */
```

## 4.1.3 Member Function Documentation

### 4.1.3.1 \_\_loadSoundBuffer()

```
void AssetsManager::__loadSoundBuffer (
    std::string path_2_sound,
    std::string sound_key ) [private]
```

Helper method to load a soundbuffer and insert it into the soundbuffer map. Should only be called by [loadSound\(\)](#), to create an `sf::SoundBuffer` corresponding to the loaded `sf::Sound`.

#### Parameters

<i>path_2_sound</i>	A path (either relative or absolute) to the sound file.
<i>sound_key</i>	A key associated with the sound (for indexing into the soundbuffer map).

```
79 {
80     // 1. check key, throw error if already in use
81     if (this->soundbuffer_map.count(sound_key) > 0) {
82         std::string error_str = "ERROR AssetsManager::__loadSoundBuffer() sound key ";
83         error_str += sound_key;
84         error_str += " is already in use";
85
86         this->clear();
87
88         #ifdef _WIN32
89             std::cout << error_str << std::endl;
90         #endif /* _WIN32 */
91
92         throw std::runtime_error(error_str);
93     }
94
95
96     // 2. load from file, throw error on fail
97     sf::SoundBuffer* soundbuffer_ptr = new sf::SoundBuffer();
98
99     if (not soundbuffer_ptr->loadFromFile(path_2_sound)) {
100         std::string error_str = "ERROR AssetsManager::__loadSoundBuffer() could not load ";
101         error_str += "soundbuffer at ";
102         error_str += path_2_sound;
103
104         this->clear();
105
106         #ifdef _WIN32
107             std::cout << error_str << std::endl;
108         #endif /* _WIN32 */
109
110         throw std::runtime_error(error_str);
111     }
112
113 }
```

```

114     // 3. insert into soundbuffer map
115     this->soundbuffer_map.insert(
116         std::pair<std::string, sf::SoundBuffer*>(sound_key, soundbuffer_ptr)
117     );
118
119     std::cout << "SoundBuffer " << sound_key << " inserted into soundbuffer map" <<
120         std::endl;
121
122     return;
123 } /* __loadSoundBuffer() */

```

#### 4.1.3.2 clear()

```

void AssetsManager::clear (
    void )

```

Method to clear all loaded assets.

```

678 {
679     // 1. clear fonts
680     std::map<std::string, sf::Font*>::iterator font_iter;
681     for (
682         font_iter = this->font_map.begin();
683         font_iter != this->font_map.end();
684         font_iter++
685     ) {
686         delete font_iter->second;
687
688         std::cout << "Font " << font_iter->first << " deleted from font map" <<
689             std::endl;
690     }
691     this->font_map.clear();
692
693     // 2. clear textures
694     std::map<std::string, sf::Texture*>::iterator texture_iter;
695     for (
696         texture_iter = this->texture_map.begin();
697         texture_iter != this->texture_map.end();
698         texture_iter++
699     ) {
700         delete texture_iter->second;
701
702         std::cout << "Texture " << texture_iter->first << " deleted from texture map" <<
703             std::endl;
704     }
705     this->texture_map.clear();
706
707     // 3. clear sound buffers
708     std::map<std::string, sf::SoundBuffer*>::iterator soundbuffer_iter;
709     for (
710         soundbuffer_iter = this->soundbuffer_map.begin();
711         soundbuffer_iter != this->soundbuffer_map.end();
712         soundbuffer_iter++
713     ) {
714         delete soundbuffer_iter->second;
715
716         std::cout << "SoundBuffer " << soundbuffer_iter->first <<
717             " deleted from soundbuffer map" << std::endl;
718     }
719     this->soundbuffer_map.clear();
720
721     // 4. clear sounds
722     std::map<std::string, sf::Sound*>::iterator sound_iter;
723     for (
724         sound_iter = this->sound_map.begin();
725         sound_iter != this->sound_map.end();
726         sound_iter++
727     ) {
728         sound_iter->second->stop();
729         delete sound_iter->second;
730
731         std::cout << "Sound " << sound_iter->first << " deleted from sound map" <<
732             std::endl;
733     }
734     this->sound_map.clear();
735
736 }
737
738

```



```

739
740 // 5. clear tracks
741 std::map<std::string, sf::Music*>::iterator track_iter;
742 for (
743     track_iter = this->track_map.begin();
744     track_iter != this->track_map.end();
745     track_iter++)
746 {
747     track_iter->second->stop();
748     delete track_iter->second;
749
750     std::cout << "Track " << track_iter->first << " deleted from track map" <<
751         std::endl;
752 }
753 this->track_map.clear();
754
755 return;
756 } /* clear() */

```

#### 4.1.3.3 getCurrentTrackKey()

```

std::string AssetsManager::getCurrentTrackKey (
    void )

```

Method to get track key for current track.

##### Returns

The track key for the current track.

```

642 {
643     return this->current_track->first;
644 } /* getCurrentTrackKey() */

```

#### 4.1.3.4 getFont()

```

sf::Font * AssetsManager::getFont (
    std::string font_key )

```

Method to get font associated with given font key.

##### Parameters

<i>font_key</i>	A key associated with the font (for indexing into the font map).
-----------------	--

##### Returns

A pointer to the corresponding font.

```

383 {
384     // 1. check key, throw error if not found
385     if (this->font_map.count(font_key) <= 0) {
386         std::string error_str = "ERROR AssetsManager::getFont() font key ";
387         error_str += font_key;
388         error_str += " is not contained in font map";
389
390         this->clear();
391
392         #ifdef _WIN32

```

```

393         std::cout << error_str << std::endl;
394     #endif /* _WIN32 */
395
396     throw std::runtime_error(error_str);
397 }
398
399 return this->font_map[font_key];
400 } /* getFont() */

```

#### 4.1.3.5 getSound()

```

sf::Sound * AssetsManager::getSound (
    std::string sound_key )

```

Method to get sound associated with given sound key.

##### Parameters

<i>sound_key</i>	A key associated with the sound (for indexing into the sound map).
------------------	--

##### Returns

A pointer to the corresponding sound.

```

493 {
494     // 1. check key, throw error if not found
495     if (this->sound_map.count(sound_key) <= 0) {
496         std::string error_str = "ERROR AssetsManager::getSound() sound key ";
497         error_str += sound_key;
498         error_str += " is not contained in sound map";
499
500         this->clear();
501
502         #ifdef _WIN32
503             std::cout << error_str << std::endl;
504         #endif /* _WIN32 */
505
506         throw std::runtime_error(error_str);
507     }
508
509     return this->sound_map[sound_key];
510 } /* getSound() */

```

#### 4.1.3.6 getSoundBuffer()

```

sf::SoundBuffer * AssetsManager::getSoundBuffer (
    std::string sound_key )

```

Method to get soundbuffer associated with given sound key.

##### Parameters

<i>sound_key</i>	A key associated with the soundbuffer (for indexing into the soundbuffer map).
------------------	--

**Returns**

A pointer to the corresponding soundbuffer.

```

457 {
458     // 1. check key, throw error if not found
459     if (this->soundbuffer_map.count(sound_key) <= 0) {
460         std::string error_str = "ERROR AssetsManager::getSoundBuffer() sound key ";
461         error_str += sound_key;
462         error_str += " is not contained in soundbuffer map";
463
464         this->clear();
465
466         #ifdef _WIN32
467             std::cout << error_str << std::endl;
468         #endif /* _WIN32 */
469
470         throw std::runtime_error(error_str);
471     }
472
473     return this->soundbuffer_map[sound_key];
474 } /* getSoundBuffer() */

```

**4.1.3.7 getTexture()**

```

sf::Texture * AssetsManager::getTexture (
    std::string texture_key )

```

Method to get texture associated with given texture key.

**Parameters**

<i>texture_key</i>	A key associated with the texture (for indexing into the texture map).
--------------------	--

**Returns**

A pointer to the corresponding texture.

```

420 {
421     // 1. check key, throw error if not found
422     if (this->texture_map.count(texture_key) <= 0) {
423         std::string error_str = "ERROR AssetsManager::getTexture() texture key ";
424         error_str += texture_key;
425         error_str += " is not contained in texture map";
426
427         this->clear();
428
429         #ifdef _WIN32
430             std::cout << error_str << std::endl;
431         #endif /* _WIN32 */
432
433         throw std::runtime_error(error_str);
434     }
435
436     return this->texture_map[texture_key];
437 } /* getTexture() */

```

**4.1.3.8 getTrackStatus()**

```

sf::SoundSource::Status AssetsManager::getTrackStatus (
    void )

```

Method to get the status of the current track.

**Returns**

The status of the current track.

```

661 {
662     return this->current_track->second->getStatus();
663 } /* getTrackStatus */

```

**4.1.3.9 loadFont()**

```

void AssetsManager::loadFont (
    std::string path_2_font,
    std::string font_key )

```

Method to load a font and insert it into the font map.

**Parameters**

<i>path_2_font</i>	A path (either relative or absolute) to the font file.
<i>font_key</i>	A key associated with the font (for indexing into the font map).

```

167 {
168     // 1. check key, throw error if already in use
169     if (this->font_map.count(font_key) > 0) {
170         std::string error_str = "ERROR AssetsManager::loadFont() font key ";
171         error_str += font_key;
172         error_str += " is already in use";
173
174         this->clear();
175
176         #ifdef _WIN32
177             std::cout << error_str << std::endl;
178         #endif /* _WIN32 */
179
180         throw std::runtime_error(error_str);
181     }
182
183
184     // 2. load from file, throw error on fail
185     sf::Font* font_ptr = new sf::Font();
186
187     if (not font_ptr->loadFromFile(path_2_font)) {
188         std::string error_str = "ERROR AssetsManager::loadFont() could not load ";
189         error_str += "font at ";
190         error_str += path_2_font;
191
192         this->clear();
193
194         #ifdef _WIN32
195             std::cout << error_str << std::endl;
196         #endif /* _WIN32 */
197
198         throw std::runtime_error(error_str);
199     }
200
201
202     // 3. insert into font map
203     this->font_map.insert(std::pair<std::string, sf::Font*>(font_key, font_ptr));
204
205     std::cout << "Font " << font_key << " inserted into font map" << std::endl;
206
207     return;
208 } /* loadFont() */

```

**4.1.3.10 loadSound()**

```

void AssetsManager::loadSound (

```

```
std::string path_2_sound,
std::string sound_key )
```

Method to load a sound and insert it into the sound map. Automatically creates a corresponding sf::SoundBuffer.

#### Parameters

<i>path_2_sound</i>	A path (either relative or absolute) to the sound file.
<i>sound_key</i>	A key associated with the sound (for indexing into the sound map).

```
291 {
292     // 1. create an associated sf::SoundBuffer
293     this->__loadSoundBuffer(path_2_sound, sound_key);
294
295     // 2. associate sf::Sound with sf::SoundBuffer
296     sf::Sound* sound_ptr = new sf::Sound();
297     sound_ptr->setBuffer(*(this->soundbuffer_map[sound_key]));
298
299     // 3. insert into sound map
300     this->sound_map.insert(std::pair<std::string, sf::Sound*>(sound_key, sound_ptr));
301
302     std::cout << "Sound " << sound_key << " inserted into sound map" << std::endl;
303
304     return;
305 } /* loadSound() */
```

#### 4.1.3.11 loadTexture()

```
void AssetsManager::loadTexture (
    std::string path_2_texture,
    std::string texture_key )
```

Method to load a texture and insert it into the texture map.

#### Parameters

<i>path_2_texture</i>	A path (either relative or absolute) to the texture file.
<i>texture_key</i>	A key associated with the texture (for indexing into the texture map).

```
228 {
229     // 1. check key, throw error if already in use
230     if (this->texture_map.count(texture_key) > 0) {
231         std::string error_str = "ERROR AssetsManager::loadTexture() texture key ";
232         error_str += texture_key;
233         error_str += " is already in use";
234
235         this->clear();
236
237         #ifdef _WIN32
238             std::cout << error_str << std::endl;
239         #endif /* _WIN32 */
240
241         throw std::runtime_error(error_str);
242     }
243
244     // 2. load from file, throw error on fail
245     sf::Texture* texture_ptr = new sf::Texture();
246
247     if (not texture_ptr->loadFromFile(path_2_texture)) {
248         std::string error_str = "ERROR AssetsManager::loadTexture() could not load ";
249         error_str += "texture at ";
250         error_str += path_2_texture;
251
252         this->clear();
253
254         #ifdef _WIN32
255             std::cout << error_str << std::endl;
256         #endif
```

```

257         #endif /* _WIN32 */
258
259         throw std::runtime_error(error_str);
260     }
261
262
263     // 3. insert into texture map
264     this->texture_map.insert(
265         std::pair<std::string, sf::Texture*>(texture_key, texture_ptr)
266     );
267
268     std::cout << "Texture " << texture_key << " inserted into texture map" << std::endl;
269
270     return;
271 } /* loadTexture() */

```

#### 4.1.3.12 loadTrack()

```

void AssetsManager::loadTrack (
    std::string path_2_track,
    std::string track_key )

```

Method to load a track (sf::Music) and insert it into the track map.

##### Parameters

<i>path_2_track</i>	A path (either relative or absolute) to the track file.
<i>track_key</i>	A key associated with the track (for indexing into the track map).

```

324 {
325     // 1. check key, throw error if already in use
326     if (this->track_map.count(track_key) > 0) {
327         std::string error_str = "ERROR AssetsManager::loadTrack() track key ";
328         error_str += track_key;
329         error_str += " is already in use";
330
331         this->clear();
332
333         #ifdef _WIN32
334             std::cout << error_str << std::endl;
335         #endif /* _WIN32 */
336
337         throw std::runtime_error(error_str);
338     }
339
340     // 2. open from file, throw error on fail
341     sf::Music* track_ptr = new sf::Music();
342
343     if (not track_ptr->openFromFile(path_2_track)) {
344         std::string error_str = "ERROR AssetsManager::loadTrack() could not open ";
345         error_str += "track at ";
346         error_str += path_2_track;
347
348         this->clear();
349
350         #ifdef _WIN32
351             std::cout << error_str << std::endl;
352         #endif /* _WIN32 */
353
354         throw std::runtime_error(error_str);
355     }
356
357     // 3. insert into track map
358     this->track_map.insert(std::pair<std::string, sf::Music*>(track_key, track_ptr));
359     this->current_track = this->track_map.begin();
360
361     std::cout << "Track " << track_key << " inserted into track map" << std::endl;
362
363     return;
364 } /* loadTrack() */

```

#### 4.1.3.13 nextTrack()

```
void AssetsManager::nextTrack (
    void )
```

Method to advance to the next track. Wraps around if the end of the track map is reached.

```
583 {
584     // 1. stop current track
585     this->stopTrack();
586
587     // 2. increment current track
588     this->current_track++;
589
590     // 3. handle wrap around
591     if (this->current_track == this->track_map.end()) {
592         this->current_track = this->track_map.begin();
593     }
594
595     return;
596 } /* nextTrack() */
```

#### 4.1.3.14 pauseTrack()

```
void AssetsManager::pauseTrack (
    void )
```

Method to pause the current track.

```
544 {
545     this->current_track->second->pause();
546
547     return;
548 } /* pauseTrack() */
```

#### 4.1.3.15 playTrack()

```
void AssetsManager::playTrack (
    void )
```

Method to play the current track.

```
525 {
526     this->current_track->second->play();
527
528     return;
529 } /* playTrack() */
```

#### 4.1.3.16 previousTrack()

```
void AssetsManager::previousTrack (
    void )
```

Method to return to the previous track. Wraps around if the beginning of the track map is reached.

```
612 {
613     // 1. stop current track
614     this->stopTrack();
615
616     // 2. handle wrap around
617     if (this->current_track == this->track_map.begin()) {
618         this->current_track = this->track_map.end();
619     }
620
621     // 3. decrement current track
622     this->current_track--;
623
624     return;
625 } /* previousTrack() */
```

#### 4.1.3.17 stopTrack()

```
void AssetsManager::stopTrack (
    void )
```

Method to stop the current track.

```
563 {
564     this->current_track->second->stop();
565
566     return;
567 } /* stopTrack() */
```

### 4.1.4 Member Data Documentation

#### 4.1.4.1 current\_track

```
std::map<std::string, sf::Music*>::iterator AssetsManager::current_track
```

A map iterator which corresponds to the current track (i.e., the track currently being played).

#### 4.1.4.2 font\_map

```
std::map<std::string, sf::Font*> AssetsManager::font_map
```

A map of pointers to loaded fonts.

#### 4.1.4.3 sound\_map

```
std::map<std::string, sf::Sound*> AssetsManager::sound_map
```

A map of pointers to loaded sounds.

#### 4.1.4.4 soundbuffer\_map

```
std::map<std::string, sf::SoundBuffer*> AssetsManager::soundbuffer_map
```

A map of pointers to sound buffers.



#### 4.1.4.5 texture\_map

```
std::map<std::string, sf::Texture*> AssetsManager::texture_map
```

A map of pointers to loaded textures.

#### 4.1.4.6 track\_map

```
std::map<std::string, sf::Music*> AssetsManager::track_map
```

A map of pointers to opened tracks (i.e. sf::Music).

The documentation for this class was generated from the following files:

- header/ESC\_core/[AssetsManager.h](#)
- source/ESC\_core/[AssetsManager.cpp](#)

## 4.2 ContextMenu Class Reference

A class which defines a context menu for the game.

```
#include <ContextMenu.h>
```

Collaboration diagram for ContextMenu:



### Public Member Functions

- [ContextMenu](#) (sf::Event \*, sf::RenderWindow \*, [AssetsManager](#) \*, [MessageHub](#) \*)  
*Constructor for the [ContextMenu](#) class.*
- void [processEvent](#) (void)  
*Method to processEvent [ContextMenu](#). To be called once per event.*
- void [processMessage](#) (void)  
*Method to processMessage [ContextMenu](#). To be called once per message.*
- void [draw](#) (void)  
*Method to draw the hex tile to the render window. To be called once per frame.*
- [~ContextMenu](#) (void)  
*Destructor for the [ContextMenu](#) class.*

## Public Attributes

- [ConsoleState console\\_state](#)  
*The current state of the console screen.*
- bool [console\\_string\\_changed](#)  
*Boolean which indicates if console string just changed.*
- bool [game\\_menu\\_up](#)  
*Indicates whether or not the game menu is up.*
- size\_t [console\\_substring\\_idx](#)  
*The current final index of the console string draw.*
- unsigned long long int [frame](#)  
*The current frame of this object.*
- double [position\\_x](#)  
*The position of the object.*
- double [position\\_y](#)  
*The position of the object.*
- std::string [console\\_string](#)  
*The string to be printed to the console screen.*
- sf::RectangleShape [menu\\_frame](#)  
*The frame of the context menu.*
- sf::RectangleShape [visual\\_screen](#)  
*The context menu screen for visuals.*
- sf::ConvexShape [visual\\_screen\\_frame\\_top](#)  
*The top framing of the visual screen.*
- sf::ConvexShape [visual\\_screen\\_frame\\_left](#)  
*The left framing of the visual screen.*
- sf::ConvexShape [visual\\_screen\\_frame\\_bottom](#)  
*The bottom framing of the visual screen.*
- sf::ConvexShape [visual\\_screen\\_frame\\_right](#)  
*The right framing of the visual screen.*
- sf::RectangleShape [console\\_screen](#)  
*The context menu console screen (for animated text output).*
- sf::ConvexShape [console\\_screen\\_frame\\_top](#)  
*The top framing of the console screen.*
- sf::ConvexShape [console\\_screen\\_frame\\_left](#)  
*The left framing of the console screen.*
- sf::ConvexShape [console\\_screen\\_frame\\_bottom](#)  
*The bottom framing of the console screen.*
- sf::ConvexShape [console\\_screen\\_frame\\_right](#)  
*The right framing of the console screen.*

## Private Member Functions

- void [\\_\\_setUpMenuFrame](#) (void)  
*Helper method to set up context menu frame (drawable).*
- void [\\_\\_setUpVisualScreen](#) (void)  
*Helper method to set up context menu visual screen (drawable).*
- void [\\_\\_setUpVisualScreenFrame](#) (void)  
*Helper method to set up framing for context menu visual screen (drawable).*
- void [\\_\\_drawVisualScreenFrame](#) (void)

- Helper method to draw visual screen frame.*
- void [\\_\\_setUpConsoleScreen](#) (void)
- Helper method to set up context menu console screen (drawable).*
- void [\\_\\_setUpConsoleScreenFrame](#) (void)
- Helper method to set up framing for context menu console screen (drawable).*
- void [\\_\\_drawConsoleScreenFrame](#) (void)
- Helper method to draw console screen frame.*
- void [\\_\\_setConsoleState](#) (ConsoleState)
- Helper method to set state of console screen and update string if necessary.*
- void [\\_\\_setConsoleString](#) (void)
- Helper method to set console string depending on console state.*
- void [\\_\\_drawConsoleText](#) (void)
- Helper method to draw animated text to context menu console screen.*
- void [\\_\\_handleKeyPressEvents](#) (void)
- Helper method to handle key press events.*
- void [\\_\\_handleMouseButtonEvents](#) (void)
- Helper method to handle mouse button events.*
- void [\\_\\_sendQuitGameMessage](#) (void)
- Helper method to format and send a quit game message.*
- void [\\_\\_sendRestartGameMessage](#) (void)
- Helper method to format and send a restart game message.*

## Private Attributes

- sf::Event \* [event\\_ptr](#)
- A pointer to the event class.*
- sf::RenderWindow \* [render\\_window\\_ptr](#)
- A pointer to the render window.*
- [AssetsManager](#) \* [assets\\_manager\\_ptr](#)
- A pointer to the assets manager.*
- [MessageHub](#) \* [message\\_hub\\_ptr](#)
- A pointer to the message hub.*

### 4.2.1 Detailed Description

A class which defines a context menu for the game.

### 4.2.2 Constructor & Destructor Documentation

#### 4.2.2.1 ContextMenu()

```
ContextMenu::ContextMenu (
    sf::Event * event_ptr,
    sf::RenderWindow * render_window_ptr,
    AssetsManager * assets_manager_ptr,
    MessageHub * message_hub_ptr )
```

Constructor for the [ContextMenu](#) class.

## Parameters

<i>event_ptr</i>	Pointer to the event class.
<i>render_window_ptr</i>	Pointer to the render window.
<i>assets_manager_ptr</i>	Pointer to the assets manager.
<i>message_hub_ptr</i>	Pointer to the message hub.

```

849 {
850     // 1. set attributes
851
852     // 1.1. private
853     this->event_ptr = event_ptr;
854     this->render_window_ptr = render_window_ptr;
855
856     this->assets_manager_ptr = assets_manager_ptr;
857     this->message_hub_ptr = message_hub_ptr;
858
859     // 1.2. public
860     this->console_state = ConsoleState :: NONE_STATE;
861     this->__setConsoleState(ConsoleState :: READY);
862
863     this->console_string_changed = true;
864     this->game_menu_up = false;
865
866     this->frame = 0;
867
868     this->position_x = GAME_WIDTH;
869     this->position_y = 0;
870
871     // 2. set up and position drawable attributes
872     this->__setUpMenuFrame();
873     this->__setUpVisualScreen();
874     this->__setUpVisualScreenFrame();
875     this->__setUpConsoleScreen();
876     this->__setUpConsoleScreenFrame();
877
878     std::cout << "ContextMenu constructed at " << this << std::endl;
879
880     return;
881 } /* ContextMenu() */

```

## 4.2.2.2 ~ContextMenu()

```

ContextMenu::~ContextMenu (
    void )

```

Destructor for the [ContextMenu](#) class.

```

1031 {
1032     std::cout << "ContextMenu at " << this << " destroyed" << std::endl;
1033
1034     return;
1035 } /* ~ContextMenu() */

```

## 4.2.3 Member Function Documentation

## 4.2.3.1 \_\_drawConsoleScreenFrame()

```

void ContextMenu::__drawConsoleScreenFrame (
    void ) [private]

```

Helper method to draw console screen frame.

```

467 {
468     this->render_window_ptr->draw(this->console_screen_frame_top);
469     this->render_window_ptr->draw(this->console_screen_frame_left);
470     this->render_window_ptr->draw(this->console_screen_frame_bottom);
471     this->render_window_ptr->draw(this->console_screen_frame_right);
472
473     return;
474 } /* __drawContextScreenFrame() */

```

#### 4.2.3.2 \_\_drawConsoleText()

```

void ContextMenu::__drawConsoleText (
    void ) [private]

```

Helper method to draw animated text to context menu console screen.

```

590 {
591     // 1. set up console text (drawable)
592     sf::Text console_text;
593
594     if (this->console_string_changed) {
595         this->assets_manager_ptr->getSound("console string print")->play();
596
597         console_text.setString(this->console_string.substr(0, this->console_substring_idx));
598
599         this->console_substring_idx++;
600
601         while (
602             (this->console_string.substr(0, this->console_substring_idx).back() == ' ') or
603             (this->console_string.substr(0, this->console_substring_idx).back() == '\n')
604         ) {
605             this->console_substring_idx++;
606
607             if (this->console_substring_idx >= this->console_string.size()) {
608                 break;
609             }
610         }
611
612         if (this->console_substring_idx >= this->console_string.size()) {
613             this->console_string_changed = false;
614         }
615     }
616
617     else {
618         console_text.setString(this->console_string);
619     }
620
621     console_text.setFont(*(this->assets_manager_ptr->getFont("Glass_TTY_VT220")));
622     console_text.setCharacterSize(16);
623     console_text.setFillColor(MONOCROME_TEXT_GREEN);
624
625     console_text.setPosition(
626         this->position_x - 50 - 300 + 16,
627         this->position_y + GAME_HEIGHT - 50 - 340 + 16
628     );
629
630
631     // 2. draw console text
632     this->render_window_ptr->draw(console_text);
633
634
635     // 3. assemble and draw blinking console cursor
636     if ((this->frame % FRAMES_PER_SECOND) > FRAMES_PER_SECOND / 2) {
637         sf::RectangleShape console_cursor(sf::Vector2f(10, 16));
638
639         console_cursor.setFillColor(MONOCROME_TEXT_GREEN);
640
641         console_cursor.setPosition(
642             console_text.getPosition().x,
643             console_text.getPosition().y + console_text.getLocalBounds().height + 10
644         );
645
646         this->render_window_ptr->draw(console_cursor);
647     }
648
649     // 4. updating frame count if console is in menu state
650     if (this->console_state == ConsoleState::MENU) {
651         std::string frame_count_string = "FRAME: ";
652         frame_count_string += std::to_string(this->frame);

```

```

653
654     sf::Text frame_count_text(
655         frame_count_string,
656         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
657         16
658     );
659
660     frame_count_text.setFillColor(MONOCHROME_TEXT_GREEN);
661
662     frame_count_text.setPosition(
663         console_text.getPosition().x,
664         console_text.getPosition().y + console_text.getLocalBounds().height - 10
665     );
666
667     this->render_window_ptr->draw(frame_count_text);
668 }
669
670 return;
671 } /* __drawConsoleText() */

```

#### 4.2.3.3 \_\_drawVisualScreenFrame()

```

void ContextMenu::__drawVisualScreenFrame (
    void ) [private]

```

Helper method to draw visual screen frame.

```

242 {
243     this->render_window_ptr->draw(this->visual_screen_frame_top);
244     this->render_window_ptr->draw(this->visual_screen_frame_left);
245     this->render_window_ptr->draw(this->visual_screen_frame_bottom);
246     this->render_window_ptr->draw(this->visual_screen_frame_right);
247
248     return;
249 } /* __drawVisualScreenFrame() */

```

#### 4.2.3.4 \_\_handleKeyPressEvents()

```

void ContextMenu::__handleKeyPressEvents (
    void ) [private]

```

Helper method to handle key press events.

```

686 {
687     switch (this->event_ptr->key.code) {
688         case (sf::Keyboard::Escape): {
689             if (this->console_state == ConsoleState :: MENU) {
690                 this->__setConsoleState(ConsoleState :: READY);
691             }
692
693             else {
694                 this->__setConsoleState(ConsoleState :: MENU);
695             }
696
697             break;
698         }
699
700         case (sf::Keyboard::Q): {
701             if (this->console_state == ConsoleState :: MENU) {
702                 this->__sendQuitGameMessage();
703             }
704         }
705
706         case (sf::Keyboard::R): {
707             if (this->console_state == ConsoleState :: MENU) {
708                 this->__sendRestartGameMessage();
709             }
710         }
711     }
712 }
713

```

```

714
715         default: {
716             // do nothing!
717
718             break;
719         }
720     }
721
722     return;
723 } /* __handleKeyPressEvents() */

```

#### 4.2.3.5 \_\_handleMouseButtonEvents()

```

void ContextMenu::__handleMouseButtonEvents (
    void ) [private]

```

Helper method to handle mouse button events.

```

738 {
739     switch (this->event_ptr->mouseButton.button) {
740         case (sf::Mouse::Left): {
741             //...
742
743             break;
744         }
745
746         case (sf::Mouse::Right): {
747             //...
748
749             break;
750         }
751     }
752
753     default: {
754         // do nothing!
755
756         break;
757     }
758 }
759
760
761 return;
762 } /* __handleMouseButtonEvents() */

```

#### 4.2.3.6 \_\_sendQuitGameMessage()

```

void ContextMenu::__sendQuitGameMessage (
    void ) [private]

```

Helper method to format and send a quit game message.

```

777 {
778     Message quit_game_message;
779
780     quit_game_message.channel = GAME_CHANNEL;
781     quit_game_message.subject = "quit game";
782
783     this->message_hub_ptr->sendMessage(quit_game_message);
784
785     std::cout << "Quit game message sent by " << this << std::endl;
786     return;
787 } /* __sendQuitGameMessage() */

```

#### 4.2.3.7 \_\_sendRestartGameMessage()

```
void ContextMenu::__sendRestartGameMessage (
    void ) [private]
```

Helper method to format and send a restart game message.

```
802 {
803     Message restart_game_message;
804
805     restart_game_message.channel = GAME_CHANNEL;
806     restart_game_message.subject = "restart game";
807
808     this->message_hub_ptr->sendMessage(restart_game_message);
809
810     std::cout << "Restart game message sent by " << this << std::endl;
811     return;
812 } /* __sendRestartGameMessage() */
```

#### 4.2.3.8 \_\_setConsoleState()

```
void ContextMenu::__setConsoleState (
    ConsoleState console_state ) [private]
```

Helper method to set state of console screen and update string if necessary.

##### Parameters

<i>console_state</i>	The state (ConsoleState) to set the console to.
----------------------	---

```
491 {
492     // 1. if no change, do nothing
493     if (this->console_state == console_state) {
494         return;
495     }
496
497     // 2. update console state, set console string accordingly
498     this->console_state = console_state;
499     this->__setConsoleString();
500
501     return;
502 } /* __setConsoleState() */
```

#### 4.2.3.9 \_\_setConsoleString()

```
void ContextMenu::__setConsoleString (
    void ) [private]
```

Helper method to set console string depending on console state.

```
517 {
518     this->console_string_changed = true;
519     this->console_substring_idx = 0;
520
521     this->console_string.clear();
522
523     switch (this->console_state) {
524     case (ConsoleState :: MENU): {
525         // 32 char x 17 line console "-----\n";
526         this->console_string = "          **** MENU ****\n";
527         this->console_string += "          \n";
528         this->console_string += "[ENTER]:  END TURN\n";
529         this->console_string += "          \n";
530         this->console_string += "[R]:    RESTART\n";
531     }
```



```

531         this->console_string += "\n";
532         this->console_string += "[TAB]: TOGGLE RESOURCE OVERLAY\n";
533         this->console_string += "[T]: TUTORIAL\n";
534         this->console_string += "\n";
535         this->console_string += "\n";
536         this->console_string += "\n";
537         this->console_string += "\n";
538         this->console_string += "\n";
539         this->console_string += "[Q]: QUIT\n";
540         this->console_string += "[ESC]: CLOSE MENU\n";
541         this->console_string += "\n";
542
543         break;
544     }
545
546     case (ConsoleState :: TILE): {
547         // take console string from tile state message
548
549         break;
550     }
551
552     default: {
553         // 32 char x 17 line console "-----\n";
554         this->console_string = " **** RTZ 64 CONTEXT V12 **** \n";
555         this->console_string += "\n";
556         this->console_string += "64K RAM SYSTEM 38911 BYTES FREE\n";
557         this->console_string += "\n";
558         this->console_string += "[TAB]: TOGGLE RESOURCE OVERLAY\n";
559         this->console_string += "\n";
560         this->console_string += "[ESC]: MENU\n";
561         this->console_string += "[LEFT CLICK]: TILE INFO/OPTIONS\n";
562         this->console_string += "[RIGHT CLICK]: CLEAR SELECTION\n";
563         this->console_string += "\n";
564         this->console_string += "[ENTER]: END TURN\n";
565         this->console_string += "\n";
566         this->console_string += "READY.\n";
567         this->console_string += "\n";
568         break;
569     }
570 }
571 }
572 }
573
574 return;
575 } /* __setConsoleString() */

```

#### 4.2.3.10 \_\_setUpConsoleScreen()

```

void ContextMenu::__setUpConsoleScreen (
    void ) [private]

```

Helper method to set up context menu console screen (drawable).

```

264 {
265     this->console_screen.setSize(sf::Vector2f(300, 340));
266     this->console_screen.setOrigin(300, 340);
267     this->console_screen.setPosition(
268         this->position_x - 50,
269         this->position_y + GAME_HEIGHT - 50
270     );
271     this->console_screen.setFillColor(MONOCHROME_SCREEN_BACKGROUND);
272
273     return;
274 } /* __setUpConsoleScreen() */

```

#### 4.2.3.11 \_\_setUpConsoleScreenFrame()

```

void ContextMenu::__setUpConsoleScreenFrame (
    void ) [private]

```

Helper method to set up framing for context menu console screen (drawable).

```

289 {
290     int n_points = 4;
291
292     // 1. top framing
293     this->console_screen_frame_top.setPointCount(n_points);
294
295     this->console_screen_frame_top.setPoint(
296         0,
297         sf::Vector2f(
298             this->position_x - 50,
299             this->position_y + GAME_HEIGHT - 50 - 340
300         )
301     );
302     this->console_screen_frame_top.setPoint(
303         1,
304         sf::Vector2f(
305             this->position_x - 50 + 16,
306             this->position_y + GAME_HEIGHT - 50 - 340 - 16
307         )
308     );
309     this->console_screen_frame_top.setPoint(
310         2,
311         sf::Vector2f(
312             this->position_x - 350 - 16,
313             this->position_y + GAME_HEIGHT - 50 - 340 - 16
314         )
315     );
316     this->console_screen_frame_top.setPoint(
317         3,
318         sf::Vector2f(
319             this->position_x - 350,
320             this->position_y + GAME_HEIGHT - 50 - 340
321         )
322     );
323
324     this->console_screen_frame_top.setFill_color(VISUAL_SCREEN_FRAME_GREY);
325
326     this->console_screen_frame_top.setOutlineThickness(2);
327     this->console_screen_frame_top.setOutlineColor(sf::Color(0, 0, 0, 255));
328
329     this->console_screen_frame_top.move(0, -2);
330
331
332     // 2. left framing
333     this->console_screen_frame_left.setPointCount(n_points);
334
335     this->console_screen_frame_left.setPoint(
336         0,
337         sf::Vector2f(
338             this->position_x - 350,
339             this->position_y + GAME_HEIGHT - 50 - 340
340         )
341     );
342     this->console_screen_frame_left.setPoint(
343         1,
344         sf::Vector2f(
345             this->position_x - 350 - 16,
346             this->position_y + GAME_HEIGHT - 50 - 340 - 16
347         )
348     );
349     this->console_screen_frame_left.setPoint(
350         2,
351         sf::Vector2f(
352             this->position_x - 350 - 16,
353             this->position_y + GAME_HEIGHT - 50 + 16
354         )
355     );
356     this->console_screen_frame_left.setPoint(
357         3,
358         sf::Vector2f(
359             this->position_x - 350,
360             this->position_y + GAME_HEIGHT - 50
361         )
362     );
363
364     this->console_screen_frame_left.setFill_color(VISUAL_SCREEN_FRAME_GREY);
365
366     this->console_screen_frame_left.setOutlineThickness(2);
367     this->console_screen_frame_left.setOutlineColor(sf::Color(0, 0, 0, 255));
368
369     this->console_screen_frame_left.move(-2, 0);
370
371
372     // 3. bottom framing
373     this->console_screen_frame_bottom.setPointCount(n_points);
374

```

```

375     this->console_screen_frame_bottom.setPoint(
376         0,
377         sf::Vector2f(
378             this->position_x - 350,
379             this->position_y + GAME_HEIGHT - 50
380         )
381     );
382     this->console_screen_frame_bottom.setPoint(
383         1,
384         sf::Vector2f(
385             this->position_x - 350 - 16,
386             this->position_y + GAME_HEIGHT - 50 + 16
387         )
388     );
389     this->console_screen_frame_bottom.setPoint(
390         2,
391         sf::Vector2f(
392             this->position_x - 50 + 16,
393             this->position_y + GAME_HEIGHT - 50 + 16
394         )
395     );
396     this->console_screen_frame_bottom.setPoint(
397         3,
398         sf::Vector2f(
399             this->position_x - 50,
400             this->position_y + GAME_HEIGHT - 50
401         )
402     );
403
404     this->console_screen_frame_bottom.setFillColor(VISUAL_SCREEN_FRAME_GREY);
405
406     this->console_screen_frame_bottom.setOutlineThickness(2);
407     this->console_screen_frame_bottom.setOutlineColor(sf::Color(0, 0, 0, 255));
408
409     this->console_screen_frame_bottom.move(0, 2);
410
411     // 4. right framing
412     this->console_screen_frame_right.setPointCount(n_points);
413
414     this->console_screen_frame_right.setPoint(
415         0,
416         sf::Vector2f(
417             this->position_x - 50,
418             this->position_y + GAME_HEIGHT - 50
419         )
420     );
421
422     this->console_screen_frame_right.setPoint(
423         1,
424         sf::Vector2f(
425             this->position_x - 50 + 16,
426             this->position_y + GAME_HEIGHT - 50 + 16
427         )
428     );
429     this->console_screen_frame_right.setPoint(
430         2,
431         sf::Vector2f(
432             this->position_x - 50 + 16,
433             this->position_y + GAME_HEIGHT - 50 - 340 - 16
434         )
435     );
436     this->console_screen_frame_right.setPoint(
437         3,
438         sf::Vector2f(
439             this->position_x - 50,
440             this->position_y + GAME_HEIGHT - 50 - 340
441         )
442     );
443
444     this->console_screen_frame_right.setFillColor(VISUAL_SCREEN_FRAME_GREY);
445
446     this->console_screen_frame_right.setOutlineThickness(2);
447     this->console_screen_frame_right.setOutlineColor(sf::Color(0, 0, 0, 255));
448
449     this->console_screen_frame_right.move(2, 0);
450
451     return;
452 } /* __setUpConsoleScreenFrame() */

```

#### 4.2.3.12 \_\_setUpMenuFrame()

```
void ContextMenu::__setUpMenuFrame (
```

```
void ) [private]
```

Helper method to set up context menu frame (drawable).

```
68 {
69     this->menu_frame.setSize(sf::Vector2f(400, GAME_HEIGHT));
70     this->menu_frame.setOrigin(400, 0);
71     this->menu_frame.setPosition(this->position_x, this->position_y);
72     this->menu_frame.setFillColor(MENU_FRAME_GREY);
73
74     return;
75 } /* __setUpMenuFrame() */
```

#### 4.2.3.13 \_\_setUpVisualScreen()

```
void ContextMenu::__setUpVisualScreen (
    void ) [private]
```

Helper method to set up context menu visual screen (drawable).

```
90 {
91     this->visual_screen.setSize(sf::Vector2f(300, 300));
92     this->visual_screen.setOrigin(300, 0);
93     this->visual_screen.setPosition(this->position_x - 50, this->position_y + 50);
94     this->visual_screen.setFillColor(MONochrome_SCREEN_BACKGROUND);
95
96     return;
97 } /* __setUpVisualScreen() */
```

#### 4.2.3.14 \_\_setUpVisualScreenFrame()

```
void ContextMenu::__setUpVisualScreenFrame (
    void ) [private]
```

Helper method to set up framing for context menu visual screen (drawable).

```
112 {
113     int n_points = 4;
114
115     // 1. top framing
116     this->visual_screen_frame_top.setPointCount(n_points);
117
118     this->visual_screen_frame_top.setPoint(
119         0,
120         sf::Vector2f(this->position_x - 50, this->position_y + 50)
121     );
122     this->visual_screen_frame_top.setPoint(
123         1,
124         sf::Vector2f(this->position_x - 50 + 16, this->position_y + 50 - 16)
125     );
126     this->visual_screen_frame_top.setPoint(
127         2,
128         sf::Vector2f(this->position_x - 350 - 16, this->position_y + 50 - 16)
129     );
130     this->visual_screen_frame_top.setPoint(
131         3,
132         sf::Vector2f(this->position_x - 350, this->position_y + 50)
133     );
134
135     this->visual_screen_frame_top.setFillColor(VISUAL_SCREEN_FRAME_GREY);
136
137     this->visual_screen_frame_top.setOutlineThickness(2);
138     this->visual_screen_frame_top.setOutlineColor(sf::Color(0, 0, 0, 255));
139
140     this->visual_screen_frame_top.move(0, -2);
141
142
143     // 2. left framing
144     this->visual_screen_frame_left.setPointCount(n_points);
145
146     this->visual_screen_frame_left.setPoint(
```

```

147         0,
148         sf::Vector2f(this->position_x - 350, this->position_y + 50)
149     );
150     this->visual_screen_frame_left.setPoint(
151         1,
152         sf::Vector2f(this->position_x - 350 - 16, this->position_y + 50 - 16)
153     );
154     this->visual_screen_frame_left.setPoint(
155         2,
156         sf::Vector2f(this->position_x - 350 - 16, this->position_y + 350 + 16)
157     );
158     this->visual_screen_frame_left.setPoint(
159         3,
160         sf::Vector2f(this->position_x - 350, this->position_y + 350)
161     );
162
163     this->visual_screen_frame_left.setFillColor(VISUAL_SCREEN_FRAME_GREY);
164
165     this->visual_screen_frame_left.setOutlineThickness(2);
166     this->visual_screen_frame_left.setOutlineColor(sf::Color(0, 0, 0, 255));
167
168     this->visual_screen_frame_left.move(-2, 0);
169
170
171     // 3. bottom framing
172     this->visual_screen_frame_bottom.setPointCount(n_points);
173
174     this->visual_screen_frame_bottom.setPoint(
175         0,
176         sf::Vector2f(this->position_x - 350, this->position_y + 350)
177     );
178     this->visual_screen_frame_bottom.setPoint(
179         1,
180         sf::Vector2f(this->position_x - 350 - 16, this->position_y + 350 + 16)
181     );
182     this->visual_screen_frame_bottom.setPoint(
183         2,
184         sf::Vector2f(this->position_x - 50 + 16, this->position_y + 350 + 16)
185     );
186     this->visual_screen_frame_bottom.setPoint(
187         3,
188         sf::Vector2f(this->position_x - 50, this->position_y + 350)
189     );
190
191     this->visual_screen_frame_bottom.setFillColor(VISUAL_SCREEN_FRAME_GREY);
192
193     this->visual_screen_frame_bottom.setOutlineThickness(2);
194     this->visual_screen_frame_bottom.setOutlineColor(sf::Color(0, 0, 0, 255));
195
196     this->visual_screen_frame_bottom.move(0, 2);
197
198
199     // 4. right framing
200     this->visual_screen_frame_right.setPointCount(n_points);
201
202     this->visual_screen_frame_right.setPoint(
203         0,
204         sf::Vector2f(this->position_x - 50, this->position_y + 350)
205     );
206     this->visual_screen_frame_right.setPoint(
207         1,
208         sf::Vector2f(this->position_x - 50 + 16, this->position_y + 350 + 16)
209     );
210     this->visual_screen_frame_right.setPoint(
211         2,
212         sf::Vector2f(this->position_x - 50 + 16, this->position_y + 50 - 16)
213     );
214     this->visual_screen_frame_right.setPoint(
215         3,
216         sf::Vector2f(this->position_x - 50, this->position_y + 50)
217     );
218
219     this->visual_screen_frame_right.setFillColor(VISUAL_SCREEN_FRAME_GREY);
220
221     this->visual_screen_frame_right.setOutlineThickness(2);
222     this->visual_screen_frame_right.setOutlineColor(sf::Color(0, 0, 0, 255));
223
224     this->visual_screen_frame_right.move(2, 0);
225
226     return;
227 } /* __setUpVisualScreenFrame() */

```

#### 4.2.3.15 draw()

```
void ContextMenu::draw (
    void )
```

Method to draw the hex tile to the render window. To be called once per frame.

```
1001 {
1002     // 1. menu frame
1003     this->render_window_ptr->draw(this->menu_frame);
1004
1005     // 2. visual screen
1006     this->render_window_ptr->draw(this->visual_screen);
1007     this->__drawVisualScreenFrame();
1008
1009     // 3. console screen
1010     this->render_window_ptr->draw(this->console_screen);
1011     this->__drawConsoleScreenFrame();
1012     this->__drawConsoleText();
1013
1014     this->frame++;
1015     return;
1016 } /* draw() */
```

#### 4.2.3.16 processEvent()

```
void ContextMenu::processEvent (
    void )
```

Method to processEvent [ContextMenu](#). To be called once per event.

```
896 {
897     if (this->event_ptr->type == sf::Event::KeyPressed) {
898         this->__handleKeyPressEvents();
899     }
900
901     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
902         this->__handleMouseButtonEvents();
903     }
904
905     return;
906 } /* processEvent() */
```

#### 4.2.3.17 processMessage()

```
void ContextMenu::processMessage (
    void )
```

Method to processMessage [ContextMenu](#). To be called once per message.

```
921 {
922     switch (this->console_state) {
923         case (ConsoleState :: TILE): {
924             // process no tile selected
925             if (not this->message_hub_ptr->isEmpty(NO_TILE_SELECTED_CHANNEL)) {
926                 Message no_tile_selected_message = this->message_hub_ptr->receiveMessage(
927                     NO_TILE_SELECTED_CHANNEL
928                 );
929
930                 if (no_tile_selected_message.subject == "no tile selected") {
931                     this->__setConsoleState(ConsoleState :: READY);
932
933                     std::cout << "No tile selected message received by " << this <<
934                         std::endl;
935                     this->message_hub_ptr->popMessage(NO_TILE_SELECTED_CHANNEL);
936                 }
937             }
938
939             // process tile state
```

```

940         if (not this->message_hub_ptr->isEmpty(TILE_STATE_CHANNEL)) {
941             Message tile_state_message = this->message_hub_ptr->receiveMessage(
942                 TILE_STATE_CHANNEL
943             );
944
945             if (tile_state_message.subject == "tile state") {
946                 this->console_string = tile_state_message.string_payload["console string"];
947
948                 this->console_string_changed = true;
949                 this->console_substring_idx = 0;
950
951                 std::cout << "Tile state message received by " << this << std::endl;
952                 this->message_hub_ptr->popMessage(TILE_STATE_CHANNEL);
953             }
954         }
955
956         // process tile selected (subsequent left clicks causing program to hang)
957         if (not this->message_hub_ptr->isEmpty(TILE_SELECTED_CHANNEL)) {
958             this->message_hub_ptr->popMessage(TILE_SELECTED_CHANNEL);
959         }
960
961         break;
962     }
963
964     default: {
965         // process tile selected
966         if (not this->message_hub_ptr->isEmpty(TILE_SELECTED_CHANNEL)) {
967             Message tile_selected_message = this->message_hub_ptr->receiveMessage(
968                 TILE_SELECTED_CHANNEL
969             );
970
971             if (tile_selected_message.subject == "tile selected") {
972                 this->__setConsoleState(ConsoleState :: TILE);
973
974                 std::cout << "Tile selected message received by " << this <<
975                     std::endl;
976                 this->message_hub_ptr->popMessage(TILE_SELECTED_CHANNEL);
977             }
978         }
979
980         break;
981     }
982 }
983
984 return;
985 } /* processMessage() */

```

## 4.2.4 Member Data Documentation

### 4.2.4.1 assets\_manager\_ptr

`AssetsManager*` ContextMenu::assets\_manager\_ptr [private]

A pointer to the assets manager.

### 4.2.4.2 console\_screen

`sf::RectangleShape` ContextMenu::console\_screen

The context menu console screen (for animated text output).

#### 4.2.4.3 console\_screen\_frame\_bottom

```
sf::ConvexShape ContextMenu::console_screen_frame_bottom
```

The bottom framing of the console screen.

#### 4.2.4.4 console\_screen\_frame\_left

```
sf::ConvexShape ContextMenu::console_screen_frame_left
```

The left framing of the console screen.

#### 4.2.4.5 console\_screen\_frame\_right

```
sf::ConvexShape ContextMenu::console_screen_frame_right
```

The right framing of the console screen.

#### 4.2.4.6 console\_screen\_frame\_top

```
sf::ConvexShape ContextMenu::console_screen_frame_top
```

The top framing of the console screen.

#### 4.2.4.7 console\_state

```
ConsoleState ContextMenu::console_state
```

The current state of the console screen.

#### 4.2.4.8 console\_string

```
std::string ContextMenu::console_string
```

The string to be printed to the console screen.



#### 4.2.4.9 console\_string\_changed

```
bool ContextMenu::console_string_changed
```

Boolean which indicates if console string just changed.

#### 4.2.4.10 console\_substring\_idx

```
size_t ContextMenu::console_substring_idx
```

The current final index of the console string draw.

#### 4.2.4.11 event\_ptr

```
sf::Event* ContextMenu::event_ptr [private]
```

A pointer to the event class.

#### 4.2.4.12 frame

```
unsigned long long int ContextMenu::frame
```

The current frame of this object.

#### 4.2.4.13 game\_menu\_up

```
bool ContextMenu::game_menu_up
```

Indicates whether or not the game menu is up.

#### 4.2.4.14 menu\_frame

```
sf::RectangleShape ContextMenu::menu_frame
```

The frame of the context menu.

#### 4.2.4.15 message\_hub\_ptr

```
MessageHub* ContextMenu::message_hub_ptr [private]
```

A pointer to the message hub.

#### 4.2.4.16 position\_x

```
double ContextMenu::position_x
```

The position of the object.

#### 4.2.4.17 position\_y

```
double ContextMenu::position_y
```

The position of the object.

#### 4.2.4.18 render\_window\_ptr

```
sf::RenderWindow* ContextMenu::render_window_ptr [private]
```

A pointer to the render window.

#### 4.2.4.19 visual\_screen

```
sf::RectangleShape ContextMenu::visual_screen
```

The context menu screen for visuals.

#### 4.2.4.20 visual\_screen\_frame\_bottom

```
sf::ConvexShape ContextMenu::visual_screen_frame_bottom
```

The bottom framing of the visual screen.

#### 4.2.4.21 visual\_screen\_frame\_left

```
sf::ConvexShape ContextMenu::visual_screen_frame_left
```

The left framing of the visual screen.

#### 4.2.4.22 visual\_screen\_frame\_right

```
sf::ConvexShape ContextMenu::visual_screen_frame_right
```

The right framing of the visual screen.

#### 4.2.4.23 visual\_screen\_frame\_top

```
sf::ConvexShape ContextMenu::visual_screen_frame_top
```

The top framing of the visual screen.

The documentation for this class was generated from the following files:

- header/[ContextMenu.h](#)
- source/[ContextMenu.cpp](#)

## 4.3 DieselGenerator Class Reference

A settlement class (child class of [TileImprovement](#)).

```
#include <DieselGenerator.h>
```

Inheritance diagram for DieselGenerator:



Collaboration diagram for DieselGenerator:



## Public Member Functions

- [DieselGenerator](#) (double, double, int, sf::Event \*, sf::RenderWindow \*, [AssetsManager](#) \*, [MessageHub](#) \*)  
*Constructor for the [DieselGenerator](#) class.*
- std::string [getTileOptionsSubstring](#) (void)  
*Helper method to assemble and return tile options substring.*
- void [setIsSelected](#) (bool)  
*Method to set the is selected attribute.*
- void [advanceTurn](#) (void)  
*Method to handle turn advance.*
- void [processEvent](#) (void)  
*Method to process [DieselGenerator](#). To be called once per event.*
- void [processMessage](#) (void)  
*Method to process [DieselGenerator](#). To be called once per message.*
- void [draw](#) (void)  
*Method to draw the hex tile to the render window. To be called once per frame.*
- virtual [~DieselGenerator](#) (void)  
*Destructor for the [DieselGenerator](#) class.*

## Public Attributes

- int [capacity\\_kW](#)  
*The rated production capacity [kW] of the diesel generator.*
- int [production\\_MWh](#)  
*The current production [MWh] of the diesel generator.*
- int [max\\_production\\_MWh](#)  
*The maximum production [MWh] for this turn.*
- double [smoke\\_da](#)  
*The per frame delta in smoke particle alpha value.*

- double [smoke\\_dx](#)  
*The per frame delta in smoke particle x position.*
- double [smoke\\_dy](#)  
*The per frame delta in smoke particle y position.*
- double [smoke\\_prob](#)  
*The probability of spawning a new smoke prob in any given frame.*
- std::list< sf::Sprite > [smoke\\_sprite\\_list](#)  
*A list of smoke sprite (for exhaust animation).*
- int [fuel\\_cost](#)  
*The fuel costs for this turn.*
- int [emissions\\_tonnes\\_CO2e](#)  
*The emissions for this turn.*

## Private Member Functions

- void [\\_\\_setUpTileImprovementSpriteAnimated](#) (void)  
*Helper method to set up tile improvement sprite (static).*
- void [\\_\\_drawProductionMenu](#) (void)  
*Helper method to draw production menu assets.*
- void [\\_\\_upgrade](#) (void)  
*Helper method to upgrade the diesel generator.*
- void [\\_\\_computeProductionCosts](#) (void)  
*Helper method to compute production costs (fuel, O&M, emissions) based on current production level.*
- void [\\_\\_breakdown](#) (void)  
*Helper method to trigger an equipment breakdown.*
- void [\\_\\_repair](#) (void)  
*Helper method to repair the diesel generator.*
- void [\\_\\_handleKeyPressEvents](#) (void)  
*Helper method to handle key press events.*
- void [\\_\\_handleMouseButtonEvents](#) (void)  
*Helper method to handle mouse button events.*
- void [\\_\\_sendImprovementStateMessage](#) (void)  
*Helper method to format and sent improvement state message.*

## Additional Inherited Members

### 4.3.1 Detailed Description

A settlement class (child class of [TileImprovement](#)).

### 4.3.2 Constructor & Destructor Documentation

### 4.3.2.1 DieselGenerator()

```
DieselGenerator::DieselGenerator (
    double position_x,
    double position_y,
    int tile_resource,
    sf::Event * event_ptr,
    sf::RenderWindow * render_window_ptr,
    AssetsManager * assets_manager_ptr,
    MessageHub * message_hub_ptr )
```

Constructor for the [DieselGenerator](#) class.

Ref: [Wikipedia \[2023\]](#)

#### Parameters

<i>position_x</i>	The x position of the tile.
<i>position_y</i>	The y position of the tile.
<i>tile_resource</i>	The renewable resource quality of the tile.
<i>event_ptr</i>	Pointer to the event class.
<i>render_window_ptr</i>	Pointer to the render window.
<i>assets_manager_ptr</i>	Pointer to the assets manager.
<i>message_hub_ptr</i>	Pointer to the message hub.

```
502 :
503 TileImprovement (
504     position_x,
505     position_y,
506     tile_resource,
507     event_ptr,
508     render_window_ptr,
509     assets_manager_ptr,
510     message_hub_ptr
511 )
512 {
513     // 1. set attributes
514
515     // 1.1. private
516     //...
517
518     // 1.2. public
519     this->tile_improvement_type = TileImprovementType :: DIESEL_GENERATOR;
520
521     this->is_running = false;
522
523     this->health = 100;
524
525     this->capacity_kW = 100;
526     this->upgrade_level = 1;
527
528     this->production_MWh = 0;
529     this->max_production_MWh = 72;
530
531     this->smoke_da = 1e-8 * SECONDS_PER_FRAME;
532     this->smoke_dx = 5 * SECONDS_PER_FRAME;
533     this->smoke_dy = -10 * SECONDS_PER_FRAME;
534     this->smoke_prob = 16 * SECONDS_PER_FRAME;
535
536     this->smoke_sprite_list = {};
537
538     this->fuel_cost = 0;
539     this->emissions_tonnes_CO2e = 0;
540
541     this->tile_improvement_string = "DIESEL GEN";
542
543     this->__setUpTileImprovementSpriteAnimated();
544
545     std::cout << "DieselGenerator constructed at " << this << std::endl;
546
547     return;
```

```
548 }    /* DieselGenerator() */
```

#### 4.3.2.2 ~DieselGenerator()

```
DieselGenerator::~~DieselGenerator (
    void ) [virtual]
```

Destructor for the [DieselGenerator](#) class.

```
930 {
931     std::cout << "DieselGenerator at " << this << " destroyed" << std::endl;
932
933     return;
934 }    /* ~DieselGenerator() */
```

### 4.3.3 Member Function Documentation

#### 4.3.3.1 \_\_breakdown()

```
void DieselGenerator::__breakdown (
    void ) [private]
```

Helper method to trigger an equipment breakdown.

```
264 {
265     TileImprovement :: __breakdown();
266
267     this->production_MWh = 0;
268     this->fuel_cost = 0;
269     this->operation_maintenance_cost = 0;
270     this->emissions_tonnes_CO2e = 0;
271
272     return;
273 }    /* __breakdown() */
```

#### 4.3.3.2 \_\_computeProductionCosts()

```
void DieselGenerator::__computeProductionCosts (
    void ) [private]
```

Helper method to compute production costs (fuel, O&M, emissions) based on current production level.

```
233 {
234     double litres_diesel = this->production_MWh * LITRES_DIESEL_PER_MWH_PRODUCTION;
235
236     double fuel_cost = (litres_diesel * COST_PER_LITRE_DIESEL) / 1000;
237     this->fuel_cost = round(fuel_cost);
238
239     double emissions_tonnes_CO2e = (litres_diesel * KG_CO2E_PER_LITRE_DIESEL) / 1000;
240     this->emissions_tonnes_CO2e = round(emissions_tonnes_CO2e);
241
242     double operation_maintenance_cost =
243         (this->production_MWh * DIESEL_OP_MAINT_COST_PER_MWH_PRODUCTION) / 1000;
244     this->operation_maintenance_cost = round(operation_maintenance_cost);
245
246     this->__sendTileStateRequest();
247
248     return;
249 }    /* __computeProductionCosts() */
```

#### 4.3.3.3 \_\_drawProductionMenu()

```
void DieselGenerator::__drawProductionMenu (
    void ) [private]
```

Helper method to draw production menu assets.

```
114 {
115     // 1. draw animated sprite (in off state)
116     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
117         sf::Vector2f initial_position = this->tile_improvement_sprite_animated[i].getPosition();
118         this->tile_improvement_sprite_animated[i].setPosition(400 - 138, 400 + 16);
119
120         sf::Color initial_colour = this->tile_improvement_sprite_animated[i].getColor();
121         this->tile_improvement_sprite_animated[i].setColor(sf::Color(255, 255, 255, 255));
122
123         sf::Vector2f initial_scale = this->tile_improvement_sprite_animated[i].getScale();
124         this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1, 1));
125
126         this->render_window_ptr->draw(this->tile_improvement_sprite_animated[i]);
127
128         this->tile_improvement_sprite_animated[i].setPosition(initial_position);
129         this->tile_improvement_sprite_animated[i].setColor(initial_colour);
130         this->tile_improvement_sprite_animated[i].setScale(initial_scale);
131     }
132
133     // 2. draw production text
134     std::string production_string = "[W]: INCREASE PRODUCTION\n";
135     production_string += "[S]: DECREASE PRODUCTION\n";
136     production_string += "\n";
137
138     production_string += "PRODUCTION: ";
139     production_string += std::to_string(this->production_MWh);
140     production_string += " MWh (MAX ";
141     production_string += std::to_string(this->max_production_MWh);
142     production_string += ")\n";
143
144     production_string += "FUEL COST: ";
145     production_string += std::to_string(this->fuel_cost);
146     production_string += " K\n";
147
148     production_string += "O&M COST: ";
149     production_string += std::to_string(this->operation_maintenance_cost);
150     production_string += " K\n";
151
152     production_string += "EMISSIONS: ";
153     production_string += std::to_string(this->emissions_tonnes_CO2e);
154     production_string += " tonnes (CO2e)\n";
155
156     sf::Text production_text(
157         production_string,
158         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
159         16
160     );
161
162     production_text.setOrigin(production_text.getLocalBounds().width / 2, 0);
163     production_text.setFillColor(MONochrome_TEXT_GREEN);
164
165     production_text.setPosition(400 + 30, 400 - 55);
166
167     this->render_window_ptr->draw(production_text);
168
169     return;
170 } /* __drawProductionMenu() */
```

#### 4.3.3.4 \_\_handleKeyPressEvents()

```
void DieselGenerator::__handleKeyPressEvents (
    void ) [private]
```

Helper method to handle key press events.

```
321 {
322     if (this->just_built) {
323         return;
324     }
325 }
```



```

326
327     switch (this->event_ptr->key.code) {
328         case (sf::Keyboard::U): {
329             this->__upgrade();
330
331             break;
332         }
333
334
335         case (sf::Keyboard::W): {
336             if (this->production_menu_open) {
337                 this->production_MWh++;
338
339                 if (this->production_MWh > this->max_production_MWh) {
340                     this->production_MWh = 0;
341                 }
342
343                 this->__computeProductionCosts();
344                 this->assets_manager_ptr->getSound("interface click")->play();
345             }
346
347             break;
348         }
349
350
351         case (sf::Keyboard::S): {
352             if (this->production_menu_open) {
353                 this->production_MWh--;
354
355                 if (this->production_MWh < 0) {
356                     this->production_MWh = this->max_production_MWh;
357                 }
358
359                 this->__computeProductionCosts();
360                 this->assets_manager_ptr->getSound("interface click")->play();
361             }
362
363             break;
364         }
365
366         default: {
367             // do nothing!
368
369             break;
370         }
371     }
372 }
373
374
375 return;
376 } /* __handleKeyPressEvents() */

```

#### 4.3.3.5 \_\_handleMouseButtonEvents()

```

void DieselGenerator::__handleMouseButtonEvents (
    void ) [private]

```

Helper method to handle mouse button events.

```

391 {
392     if (this->just_built) {
393         return;
394     }
395
396     switch (this->event_ptr->mouseButton.button) {
397         case (sf::Mouse::Left): {
398             //...
399
400             break;
401         }
402
403
404         case (sf::Mouse::Right): {
405             //...
406
407             break;
408         }
409     }
410

```

```

411         default: {
412             // do nothing!
413
414             break;
415         }
416     }
417
418     return;
419 } /* __handleMouseButtonEvents() */

```

#### 4.3.3.6 \_\_repair()

```

void DieselGenerator::__repair (
    void ) [private], [virtual]

```

Helper method to repair the diesel generator.

Reimplemented from [TileImprovement](#).

```

288 {
289     if (this->credits < DIESEL_GENERATOR_BUILD_COST) {
290         std::cout << "Cannot repair diesel generator: insufficient credits (need "
291             << DIESEL_GENERATOR_BUILD_COST << " K)" << std::endl;
292
293         this->__sendInsufficientCreditsMessage();
294         return;
295     }
296
297     TileImprovement :: __repair();
298
299     this->just_upgraded = true;
300
301     this->__sendCreditsSpentMessage(DIESEL_GENERATOR_BUILD_COST);
302     this->__sendTileStateRequest();
303     this->__sendGameStateRequest();
304
305     return;
306 } /* __repair() */

```

#### 4.3.3.7 \_\_sendImprovementStateMessage()

```

void DieselGenerator::__sendImprovementStateMessage (
    void ) [private]

```

Helper method to format and sent improvement state message.

```

434 {
435     Message improvement_state_message;
436
437     improvement_state_message.channel = GAME_CHANNEL;
438     improvement_state_message.subject = "improvement state";
439
440     improvement_state_message.int_payload["dispatch_MWh"] = this->production_MWh;
441     improvement_state_message.int_payload["fuel_cost"] = this->fuel_cost;
442     improvement_state_message.int_payload["operation_maintenance_cost"] =
443         this->operation_maintenance_cost;
444     improvement_state_message.int_payload["emissions_tonnes_CO2e"] =
445         this->emissions_tonnes_CO2e;
446
447     this->message_hub_ptr->sendMessage(improvement_state_message);
448
449     std::cout << "Improvement state message sent by " << this << std::endl;
450
451     return;
452 } /* __sendImprovementStateMessage() */

```

#### 4.3.3.8 \_\_setUpTileImprovementSpriteAnimated()

```
void DieselGenerator::__setUpTileImprovementSpriteAnimated (
    void ) [private]
```

Helper method to set up tile improvement sprite (static).

```
68 {
69     sf::Sprite diesel_generator_sheet (
70         *(this->assets_manager_ptr->getTexture("diesel generator"))
71     );
72
73     int n_elements = diesel_generator_sheet.getLocalBounds().height / 64;
74
75     for (int i = 0; i < n_elements; i++) {
76         this->tile_improvement_sprite_animated.push_back(
77             sf::Sprite(
78                 *(this->assets_manager_ptr->getTexture("diesel generator")),
79                 sf::IntRect(0, i * 64, 64, 64)
80             )
81         );
82
83         this->tile_improvement_sprite_animated.back().setOrigin(
84             this->tile_improvement_sprite_animated.back().getLocalBounds().width / 2,
85             this->tile_improvement_sprite_animated.back().getLocalBounds().height
86         );
87
88         this->tile_improvement_sprite_animated.back().setPosition(
89             this->position_x,
90             this->position_y - 32
91         );
92
93         this->tile_improvement_sprite_animated.back().setColor(
94             sf::Color(255, 255, 255, 0)
95         );
96     }
97
98     return;
99 } /* __setUpTileImprovementSpriteAnimated() */
```

#### 4.3.3.9 \_\_upgrade()

```
void DieselGenerator::__upgrade (
    void ) [private]
```

Helper method to upgrade the diesel generator.

```
185 {
186     if (this->credits < DIESEL_GENERATOR_BUILD_COST) {
187         std::cout << "Cannot upgrade diesel generator: insufficient credits (need "
188             << DIESEL_GENERATOR_BUILD_COST << " K)" << std::endl;
189
190         this->__sendInsufficientCreditsMessage();
191         return;
192     }
193
194     if (this->upgrade_level >= MAX_UPGRADE_LEVELS) {
195         return;
196     }
197
198     this->is_running = false;
199
200     TileImprovement :: __repair();
201
202     this->capacity_kW += 100;
203     this->upgrade_level++;
204
205     this->production_MWh = 0;
206     this->max_production_MWh += 72;
207
208     this->just_upgraded = true;
209
210     this->assets_manager_ptr->getSound("upgrade")->play();
211
212     this->__sendCreditsSpentMessage(DIESEL_GENERATOR_BUILD_COST);
213     this->__sendTileStateRequest();
214     this->__sendGameStateRequest();
215
216     return;
217 } /* __upgrade() */
```

#### 4.3.3.10 advanceTurn()

```
void DieselGenerator::advanceTurn (
    void ) [virtual]
```

Method to handle turn advance.

Reimplemented from [TileImprovement](#).

```
658 {
659     // 1. send improvement state message
660     this->__sendImprovementStateMessage();
661
662     // 2. handle start/stop
663     if ((not this->is_running) and (this->production_MWh > 0)) {
664         this->is_running = true;
665         this->assets_manager_ptr->getSound("diesel start")->play();
666     }
667
668     else if (this->is_running and (this->production_MWh <= 0)) {
669         this->is_running = false;
670         this->tile_improvement_sprite_animated[1].setScale(sf::Vector2f(1, 1));
671     }
672
673     // 3. handle equipment health
674     if (this->is_running) {
675         this->health--;
676
677         if (this->health <= 0) {
678             this->__breakdown();
679         }
680     }
681
682     // 4. close menus
683     if (this->production_menu_open) {
684         this->__closeProductionMenu();
685     }
686
687     if (this->upgrade_menu_open) {
688         this->__closeUpgradeMenu();
689     }
690
691     // 5. send tile state request (if selected)
692     if (this->is_selected) {
693         this->__sendTileStateRequest();
694     }
695
696     return;
697 } /* advanceTurn() */
```

#### 4.3.3.11 draw()

```
void DieselGenerator::draw (
    void ) [virtual]
```

Method to draw the hex tile to the render window. To be called once per frame.

Reimplemented from [TileImprovement](#).

```
761 {
762     // 1. if just built, call base method and return
763     if (this->just_built) {
764         TileImprovement::draw();
765
766         return;
767     }
768
769     // 2. handle upgrade effects
770     if (this->just_upgraded) {
771         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
772             this->tile_improvement_sprite_animated[i].setColor(
773                 sf::Color(
774                     255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
775                     255,
776                     255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
```

```

777         255
778     )
779 );
780
781     this->tile_improvement_sprite_animated[i].setScale(
782         sf::Vector2f(
783             1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
784             1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2)
785         )
786     );
787 }
788
789     this->upgrade_frame++;
790 }
791
792     if (this->upgrade_frame >= 2 * FRAMES_PER_SECOND) {
793         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
794             this->tile_improvement_sprite_animated[i].setColor(
795                 sf::Color(255,255,255,255)
796             );
797
798             this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1,1));
799         }
800
801         this->just_upgraded = false;
802         this->upgrade_frame = 0;
803     }
804
805
806     // 3. draw first element of animated sprite
807     this->render_window_ptr->draw(this->tile_improvement_sprite_animated[0]);
808
809
810     // 4. draw second element of animated sprite
811     double move_x = 0;
812     double move_y = 0;
813
814     if (this->is_running) {
815         this->tile_improvement_sprite_animated[1].setScale(
816             sf::Vector2f(
817                 1 + 0.05 * pow(cos((6 * M_PI * this->frame) / FRAMES_PER_SECOND), 2),
818                 1 + 0.05 * pow(cos((6 * M_PI * this->frame) / FRAMES_PER_SECOND), 2)
819             )
820         );
821
822         move_x = 1 * ((double)rand() / RAND_MAX) - 0.5;
823         move_y = 1 * ((double)rand() / RAND_MAX) - 0.5;
824
825         this->tile_improvement_sprite_animated[1].move(move_x, move_y);
826     }
827
828     this->render_window_ptr->draw(this->tile_improvement_sprite_animated[1]);
829
830     if (this->is_running) {
831         this->tile_improvement_sprite_animated[1].move(-1 * move_x, -1 * move_y);
832     }
833
834
835     // 5. draw smoke effects
836     if (this->is_running) {
837         if ((double)rand() / RAND_MAX < smoke_prob) {
838             this->smoke_sprite_list.push_back(
839                 sf::Sprite(*(this->assets_manager_ptr->getTexture("emissions")))
840             );
841
842             this->smoke_sprite_list.back().setOrigin(
843                 this->smoke_sprite_list.back().getLocalBounds().width / 2,
844                 this->smoke_sprite_list.back().getLocalBounds().height / 2
845             );
846
847             this->smoke_sprite_list.back().setPosition(
848                 this->position_x + 9 + 4 * ((double)rand() / RAND_MAX) - 2,
849                 this->position_y - 33
850             );
851         }
852     }
853
854     std::list<sf::Sprite>::iterator iter = this->smoke_sprite_list.begin();
855
856     double alpha = 255;
857
858     while (iter != this->smoke_sprite_list.end()) {
859         this->render_window_ptr->draw(*iter);
860
861         alpha = (*iter).getColor().a;
862
863         alpha -= this->smoke_da;

```

```

864
865     if (alpha <= 0) {
866         iter = this->smoke_sprite_list.erase(iter);
867         continue;
868     }
869
870     (*iter).setColor(sf::Color(255, 255, 255, alpha));
871
872     (*iter).move(
873         this->smoke_dx + 2 * (((double)rand() / RAND_MAX) - 1) / FRAMES_PER_SECOND,
874         this->smoke_dy
875     );
876
877     (*iter).rotate((((double)rand() / RAND_MAX)));
878
879     iter++;
880 }
881
882
883 // 6. handle dispatch illustration
884 if (this->production_MWh > 0) {
885     this->dispatch_text.setString(std::to_string(this->production_MWh));
886     this->__drawDispatch();
887 }
888
889
890 // 7. draw production menu
891 if (this->production_menu_open) {
892     this->render_window_ptr->draw(this->production_menu_backing);
893     this->render_window_ptr->draw(this->production_menu_backing_text);
894
895     this->__drawProductionMenu();
896 }
897
898
899 // 8. handle broken effects
900 if (this->is_broken) {
901     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
902         this->tile_improvement_sprite_animated[i].setColor(
903             sf::Color(
904                 255,
905                 255 * pow(cos((M_PI * this->frame) / FRAMES_PER_SECOND), 2),
906                 255 * pow(cos((M_PI * this->frame) / FRAMES_PER_SECOND), 2),
907                 255
908             )
909         );
910     }
911 }
912
913 this->frame++;
914 return;
915 } /* draw() */

```

#### 4.3.3.12 getTileOptionsSubstring()

```

std::string DieselGenerator::getTileOptionsSubstring (
    void ) [virtual]

```

Helper method to assemble and return tile options substring.

#### Returns

Tile options substring.

Reimplemented from [TileImprovement](#).

```

565 {
566     int upgrade_cost = DIESEL_GENERATOR_BUILD_COST;
567
568     // 32 char x 17 line console "-----\n";
569     std::string options_substring = "CAPACITY: ";
570     options_substring += std::to_string(this->capacity_kW);
571     options_substring += " kW (level ";
572     options_substring += std::to_string(this->upgrade_level);
573     options_substring += ")\n";

```

```

574
575 options_substring      += "PRODUCTION: ";
576 options_substring      += std::to_string(this->production_MWh);
577 options_substring      += " MWh (MAX ";
578 options_substring      += std::to_string(this->max_production_MWh);
579 options_substring      += ")\n";
580
581 options_substring      += "HEALTH: ";
582 options_substring      += std::to_string(this->health);
583 options_substring      += "/100";
584
585 if (this->health <= 0) {
586     options_substring      += " ** BROKEN! **\n";
587 }
588
589 else {
590     options_substring      += "\n";
591 }
592
593 options_substring      += "
594 options_substring      += " **** DIESEL GEN OPTIONS ****
595 options_substring      += "
596
597 if (this->is_broken) {
598     options_substring      += " [R]: REPAIR (";
599     options_substring      += std::to_string(DIESEL_GENERATOR_BUILD_COST);
600     options_substring      += " K)\n";
601 }
602
603 else {
604     options_substring      += " [E]: OPEN PRODUCTION MENU \n";
605 }
606
607 if (this->upgrade_level < MAX_UPGRADE_LEVELS) {
608     options_substring      += " [U]: + 100 kW (";
609     options_substring      += std::to_string(upgrade_cost);
610     options_substring      += " K)\n";
611 }
612
613 options_substring      += "HOLD [P]: SCRAP (";
614 options_substring      += std::to_string(SCRAP_COST);
615 options_substring      += " K)";
616
617 return options_substring;
618 } /* getTileOptionsSubstring() */

```

#### 4.3.3.13 processEvent()

```

void DieselGenerator::processEvent (
    void ) [virtual]

```

Method to process [DieselGenerator](#). To be called once per event.

Reimplemented from [TileImprovement](#).

```

712 {
713     TileImprovement :: processEvent ();
714
715     if (this->event_ptr->type == sf::Event::KeyPressed) {
716         this->__handleKeyPressEvents ();
717     }
718
719     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
720         this->__handleMouseButtonEvents ();
721     }
722
723     return;
724 } /* processEvent() */

```

#### 4.3.3.14 processMessage()

```
void DieselGenerator::processMessage (
    void ) [virtual]
```

Method to process [DieselGenerator](#). To be called once per message.

Reimplemented from [TileImprovement](#).

```
739 {
740     TileImprovement :: processMessage ();
741
742     //...
743
744     return;
745 } /* processMessage() */
```

#### 4.3.3.15 setIsSelected()

```
void DieselGenerator::setIsSelected (
    bool is_selected ) [virtual]
```

Method to set the is selected attribute.

##### Parameters

<i>is_selected</i>	The value to set the is selected attribute to.
--------------------	--

Reimplemented from [TileImprovement](#).

```
635 {
636     TileImprovement :: setIsSelected(is_selected);
637
638     if (this->is_running and this->is_selected) {
639         this->assets_manager_ptr->getSound("diesel running")->play();
640     }
641
642     return;
643 } /* setIsSelected() */
```

### 4.3.4 Member Data Documentation

#### 4.3.4.1 capacity\_kW

```
int DieselGenerator::capacity_kW
```

The rated production capacity [kW] of the diesel generator.

#### 4.3.4.2 emissions\_tonnes\_CO2e

```
int DieselGenerator::emissions_tonnes_CO2e
```

The emissions for this turn.



#### 4.3.4.3 fuel\_cost

```
int DieselGenerator::fuel_cost
```

The fuel costs for this turn.

#### 4.3.4.4 max\_production\_MWh

```
int DieselGenerator::max_production_MWh
```

The maximum production [MWh] for this turn.

#### 4.3.4.5 production\_MWh

```
int DieselGenerator::production_MWh
```

The current production [MWh] of the diesel generator.

#### 4.3.4.6 smoke\_da

```
double DieselGenerator::smoke_da
```

The per frame delta in smoke particle alpha value.

#### 4.3.4.7 smoke\_dx

```
double DieselGenerator::smoke_dx
```

The per frame delta in smoke particle x position.

#### 4.3.4.8 smoke\_dy

```
double DieselGenerator::smoke_dy
```

The per frame delta in smoke particle y position.

#### 4.3.4.9 smoke\_prob

```
double DieselGenerator::smoke_prob
```

The probability of spawning a new smoke prob in any given frame.

#### 4.3.4.10 smoke\_sprite\_list

```
std::list<sf::Sprite> DieselGenerator::smoke_sprite_list
```

A list of smoke sprite (for exhaust animation).

The documentation for this class was generated from the following files:

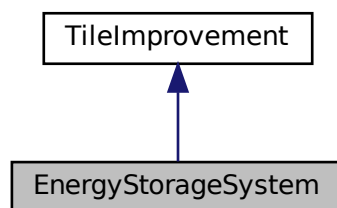
- header/[DieselGenerator.h](#)
- source/[DieselGenerator.cpp](#)

## 4.4 EnergyStorageSystem Class Reference

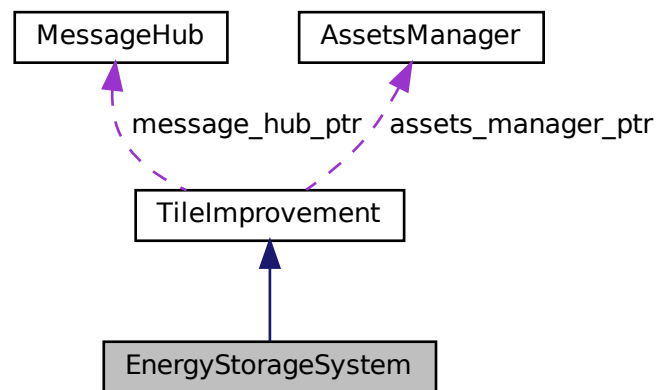
A settlement class (child class of [TileImprovement](#)).

```
#include <EnergyStorageSystem.h>
```

Inheritance diagram for EnergyStorageSystem:



Collaboration diagram for EnergyStorageSystem:



## Public Member Functions

- [EnergyStorageSystem](#) (double, double, sf::Event \*, sf::RenderWindow \*, [AssetsManager](#) \*, [MessageHub](#) \*)  
*Constructor for the [EnergyStorageSystem](#) class.*
- void [setIsSelected](#) (bool)  
*Method to set the is selected attribute.*
- std::string [getTileOptionsSubstring](#) (void)  
*Helper method to assemble and return tile options substring.*
- void [processEvent](#) (void)  
*Method to process [EnergyStorageSystem](#). To be called once per event.*
- void [processMessage](#) (void)  
*Method to process [EnergyStorageSystem](#). To be called once per message.*
- void [draw](#) (void)  
*Method to draw the hex tile to the render window. To be called once per frame.*
- virtual [~EnergyStorageSystem](#) (void)  
*Destructor for the [EnergyStorageSystem](#) class.*

## Public Attributes

- int [capacity\\_MWh](#)  
*The rated energy capacity [MWh] of the energy storage system.*
- int [charge\\_MWh](#)  
*The charge [MWh] in the energy storage system.*

## Private Member Functions

- void [\\_\\_setUpTileImprovementSpriteStatic](#) (void)  
*Helper method to set up tile improvement sprite (static).*
- void [\\_\\_setUpProductionMenu](#) (void)  
*Helper method to set up and position production menu assets (drawable).*
- void [\\_\\_upgrade](#) (void)  
*Helper method to upgrade the diesel generator.*
- void [\\_\\_handleKeyPressEvents](#) (void)  
*Helper method to handle key press events.*
- void [\\_\\_handleMouseButtonEvents](#) (void)  
*Helper method to handle mouse button events.*

## Additional Inherited Members

### 4.4.1 Detailed Description

A settlement class (child class of [TileImprovement](#)).

### 4.4.2 Constructor & Destructor Documentation

#### 4.4.2.1 EnergyStorageSystem()

```
EnergyStorageSystem::EnergyStorageSystem (
    double position_x,
    double position_y,
    sf::Event * event_ptr,
    sf::RenderWindow * render_window_ptr,
    AssetsManager * assets_manager_ptr,
    MessageHub * message_hub_ptr )
```

Constructor for the [EnergyStorageSystem](#) class.

Ref: [Wikipedia \[2023\]](#)

#### Parameters

<i>position_x</i>	The x position of the tile.
<i>position_y</i>	The y position of the tile.
<i>event_ptr</i>	Pointer to the event class.
<i>render_window_ptr</i>	Pointer to the render window.
<i>assets_manager_ptr</i>	Pointer to the assets manager.
<i>message_hub_ptr</i>	Pointer to the message hub.

```
291 :
292 TileImprovement (
```

```

293     position_x,
294     position_y,
295     event_ptr,
296     render_window_ptr,
297     assets_manager_ptr,
298     message_hub_ptr
299 )
300 {
301     // 1. set attributes
302
303     // 1.1. private
304     //...
305
306     // 1.2. public
307     this->tile_improvement_type = TileImprovementType :: ENERGY_STORAGE_SYSTEM;
308
309     this->is_running = false;
310
311     this->health = 100;
312
313     this->capacity_MWh = 1;
314     this->upgrade_level = 1;
315
316     this->charge_MWh = 0;
317
318     this->tile_improvement_string = "ENERGY STORAGE";
319
320     this->__setUpTileImprovementSpriteStatic();
321     this->__setUpProductionMenu();
322
323     std::cout << "EnergyStorageSystem constructed at " << this << std::endl;
324
325     return;
326 } /* EnergyStorageSystem() */

```

#### 4.4.2.2 ~EnergyStorageSystem()

```

EnergyStorageSystem::~EnergyStorageSystem (
    void ) [virtual]

```

Destructor for the [EnergyStorageSystem](#) class.

```

504 {
505     std::cout << "EnergyStorageSystem at " << this << " destroyed" << std::endl;
506
507     return;
508 } /* ~EnergyStorageSystem() */

```

### 4.4.3 Member Function Documentation

#### 4.4.3.1 \_\_handleKeyPressEvents()

```

void EnergyStorageSystem::__handleKeyPressEvents (
    void ) [private]

```

Helper method to handle key press events.

```

179 {
180     if (this->just_built) {
181         return;
182     }
183
184     switch (this->event_ptr->key.code) {
185         case (sf::Keyboard::U): {
186             if (this->upgrade_level < MAX_UPGRADE_LEVELS) {
187                 this->__upgrade();
188             }
189         }
190     }
191 }

```

```

189
190         break;
191     }
192
193     default: {
194         // do nothing!
195
196         break;
197     }
198 }
199
200
201 return;
202 } /* __handleKeyPressEvents() */

```

#### 4.4.3.2 \_\_handleMouseButtonEvents()

```

void EnergyStorageSystem::__handleMouseButtonEvents (
    void ) [private]

```

Helper method to handle mouse button events.

```

217 {
218     if (this->just_built) {
219         return;
220     }
221
222     switch (this->event_ptr->mouseButton.button) {
223     case (sf::Mouse::Left): {
224         //...
225
226         break;
227     }
228
229     case (sf::Mouse::Right): {
230         //...
231
232         break;
233     }
234
235     default: {
236         // do nothing!
237
238         break;
239     }
240 }
241
242 return;
243 } /* __handleMouseButtonEvents() */

```

#### 4.4.3.3 \_\_setUpProductionMenu()

```

void EnergyStorageSystem::__setUpProductionMenu (
    void ) [private]

```

Helper method to set up and position production menu assets (drawable).

```

103 {
104     // 1. modify production menu text
105     this->production_menu_backing_text.setString("**** DISCHARGE MENU ****");
106     this->production_menu_backing_text.setFont (
107         *(this->assets_manager_ptr->getFont ("Glass_TTY_VT220"))
108     );
109     this->production_menu_backing_text.setCharacterSize(16);
110     this->production_menu_backing_text.setFillColor(MONOCROME_TEXT_GREEN);
111     this->production_menu_backing_text.setOrigin(
112         this->production_menu_backing_text.getLocalBounds().width / 2, 0
113     );
114     this->production_menu_backing_text.setPosition(400, 400 - 128 + 4);
115
116     return;
117 } /* __setUpProductionMenu() */

```

#### 4.4.3.4 \_\_setUpTileImprovementSpriteStatic()

```
void EnergyStorageSystem::__setUpTileImprovementSpriteStatic (
    void ) [private]
```

Helper method to set up tile improvement sprite (static).

```
68 {
69     this->tile_improvement_sprite_static.setTexture(
70         *(this->assets_manager_ptr->getTexture("energy storage system"))
71     );
72
73     this->tile_improvement_sprite_static.setOrigin(
74         this->tile_improvement_sprite_static.getLocalBounds().width / 2,
75         this->tile_improvement_sprite_static.getLocalBounds().height
76     );
77
78     this->tile_improvement_sprite_static.setPosition(
79         this->position_x,
80         this->position_y - 32
81     );
82
83     this->tile_improvement_sprite_static.setColor(
84         sf::Color(255, 255, 255, 0)
85     );
86
87     return;
88 } /* __setUpTileImprovementSpriteStatic() */
```

#### 4.4.3.5 \_\_upgrade()

```
void EnergyStorageSystem::__upgrade (
    void ) [private]
```

Helper method to upgrade the diesel generator.

```
132 {
133     /*
134     int upgrade_cost = DIESEL_GENERATOR_BUILD_COST;
135
136     if (this->credits < upgrade_cost) {
137         std::cout << "Cannot upgrade diesel generator: insufficient credits (need "
138             << upgrade_cost << " K)" << std::endl;
139
140         this->__sendInsufficientCreditsMessage();
141         return;
142     }
143
144     this->is_running = false;
145
146     this->health = 100;
147
148     this->capacity_kW += 100;
149     this->upgrade_level++;
150
151     this->production_MWh = 0;
152     this->max_production_MWh += 72;
153
154     this->just_upgraded = true;
155
156     this->assets_manager_ptr->getSound("upgrade")->play();
157
158     this->__sendCreditsSpentMessage(upgrade_cost);
159     this->__sendTileStateRequest();
160     this->__sendGameStateRequest();
161     */
162
163     return;
164 } /* __upgrade() */
```

#### 4.4.3.6 draw()

```
void EnergyStorageSystem::draw (
    void ) [virtual]
```

Method to draw the hex tile to the render window. To be called once per frame.

Reimplemented from [TileImprovement](#).

```
466 {
467     // 1. if just built, call base method and return
468     if (this->just_built) {
469         TileImprovement :: draw();
470
471         return;
472     }
473
474     // 2. draw static sprite
475     this->render_window_ptr->draw(this->tile_improvement_sprite_static);
476
477     // 3. draw production menu
478     if (this->production_menu_open) {
479         this->render_window_ptr->draw(this->production_menu_backing);
480         this->render_window_ptr->draw(this->production_menu_backing_text);
481
482         //...
483     }
484
485     this->frame++;
486     return;
487 }
488 /* draw() */
```

#### 4.4.3.7 getTileOptionsSubstring()

```
std::string EnergyStorageSystem::getTileOptionsSubstring (
    void ) [virtual]
```

Helper method to assemble and return tile options substring.

#### Returns

Tile options substring.

Reimplemented from [TileImprovement](#).

```
368 {
369     int upgrade_cost = ENERGY_STORAGE_SYSTEM_BUILD_COST;
370
371     // 32 char x 17 line console "-----\n";
372     std::string options_substring = "CAPACITY: ";
373     options_substring += std::to_string(this->capacity_MWh);
374     options_substring += " MWh (level ";
375     options_substring += std::to_string(this->upgrade_level);
376     options_substring += ")\n";
377
378     options_substring += "CHARGE: ";
379     options_substring += std::to_string(this->charge_MWh);
380     options_substring += " MWh\n";
381
382     options_substring += "HEALTH: ";
383     options_substring += std::to_string(this->health);
384     options_substring += "/100\n";
385
386     options_substring += "
387     options_substring += "**** ENERGY STORAGE OPTIONS ****\n";
388     options_substring += "
389     options_substring += "      [E]:  OPEN DISCHARGE MENU  \n";
390
391     if (this->upgrade_level < MAX_UPGRADE_LEVELS) {
392         options_substring += "      [U]:  UPGRADE  (";
```



```

393         options_substring          += std::to_string(upgrade_cost);
394         options_substring          += " K)\n";
395     }
396
397     options_substring               += "HOLD [P]:  SCRAP (";
398     options_substring               += std::to_string(SCRAP_COST);
399     options_substring               += " K)";
400
401     return options_substring;
402 } /* getTileOptionsSubstring() */

```

#### 4.4.3.8 processEvent()

```

void EnergyStorageSystem::processEvent (
    void ) [virtual]

```

Method to process [EnergyStorageSystem](#). To be called once per event.

Reimplemented from [TileImprovement](#).

```

417 {
418     TileImprovement :: processEvent();
419
420     if (this->event_ptr->type == sf::Event::KeyPressed) {
421         this->__handleKeyPressEvents();
422     }
423
424     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
425         this->__handleMouseButtonEvents();
426     }
427
428     return;
429 } /* processEvent() */

```

#### 4.4.3.9 processMessage()

```

void EnergyStorageSystem::processMessage (
    void ) [virtual]

```

Method to process [EnergyStorageSystem](#). To be called once per message.

Reimplemented from [TileImprovement](#).

```

444 {
445     TileImprovement :: processMessage();
446
447     //...
448
449     return;
450 } /* processMessage() */

```

#### 4.4.3.10 setIsSelected()

```

void EnergyStorageSystem::setIsSelected (
    bool is_selected ) [virtual]

```

Method to set the is selected attribute.

## Parameters

<i>is_selected</i>	The value to set the is selected attribute to.
--------------------	--

Reimplemented from [TileImprovement](#).

```

343 {
344     TileImprovement :: setIsSelected(is_selected);
345
346     if (this->is_selected) {
347         this->assets_manager_ptr->getSound("energy storage system")->play();
348     }
349
350     return;
351 } /* setIsSelected() */

```

## 4.4.4 Member Data Documentation

### 4.4.4.1 capacity\_MWh

```
int EnergyStorageSystem::capacity_MWh
```

The rated energy capacity [MWh] of the energy storage system.

### 4.4.4.2 charge\_MWh

```
int EnergyStorageSystem::charge_MWh
```

The charge [MWh] in the energy storage system.

The documentation for this class was generated from the following files:

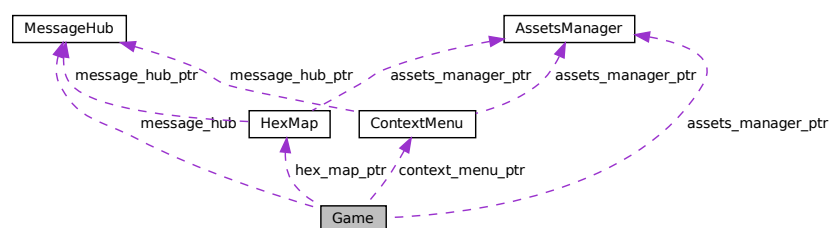
- header/[EnergyStorageSystem.h](#)
- source/[EnergyStorageSystem.cpp](#)

## 4.5 Game Class Reference

A class which acts as the central class for the game, by containing all other classes and implementing the game loop.

```
#include <Game.h>
```

Collaboration diagram for Game:



## Public Member Functions

- [Game](#) (sf::RenderWindow \*, [AssetsManager](#) \*)  
*Constructor for the [Game](#) class.*
- bool [run](#) (void)  
*Method to run game (defines game loop).*
- [~Game](#) (void)  
*Destructor for the [Game](#) class.*

## Public Attributes

- [GamePhase](#) [game\\_phase](#)  
*The current phase of the game.*
- bool [quit\\_game](#)  
*Boolean indicating whether to quit (true) or create a new [Game](#) instance (false).*
- bool [game\\_loop\\_broken](#)  
*Boolean indicating whether or not the game loop is broken.*
- bool [show\\_frame\\_clock\\_overlay](#)  
*Boolean indicating whether or not to show frame and clock overlay.*
- bool [check\\_terminating\\_conditions](#)  
*Boolean indicating whether or not to check terminating conditions.*
- bool [message\\_deadlock](#)  
*A boolean indicating whether a message deadlock has been detected.*
- bool [show\\_tutorial](#)  
*A boolean indicating whether or not to show the tutorial.*
- bool [turn\\_end](#)  
*A boolean indicating a turn end.*
- unsigned long long int [frame](#)  
*The current frame of the game.*
- double [time\\_since\\_start\\_s](#)  
*The time elapsed [s] since the start of the game.*
- int [year](#)  
*Current game year.*
- int [month](#)  
*Current game month.*
- int [population](#)  
*Current population.*
- int [credits](#)  
*Current balance of credits.*
- int [demand\\_MWh](#)  
*Current energy demand [MWh].*
- int [cumulative\\_emissions\\_tonnes](#)  
*Cumulative emissions [tonnes] (1 tonne = 1000 kg).*
- int [past\\_demand\\_MWh](#)  
*The demand in the previous turn.*
- int [demand\\_served\\_MWh](#)  
*The demand served at the end of a turn.*
- int [demand\\_remaining\\_MWh](#)  
*The demand remaining at the end of a turn.*
- int [overproduction\\_MWh](#)

- *The amount of overproduction at the end of a turn.*
- int [turn\\_fuel\\_cost](#)  
*The cost of fuel at the end of a turn.*
- int [turn\\_operation\\_maintenance\\_cost](#)  
*The cost of operation and maintenance at the end of a turn.*
- int [turn\\_emissions\\_tonnes](#)  
*The amount of emissions at the end of a turn.*
- int [dispatch\\_income](#)  
*The amount earned from dispatch at the end of a turn.*
- int [overproduction\\_penalty](#)  
*The penalty for overproduction.*
- int [net\\_credit\\_flow](#)  
*The net credit flow at the end of a turn.*
- int [consecutive\\_zero\\_emissions\\_months](#)  
*The number of recent, consecutive zero emission months.*
- size\_t [substring\\_idx](#)  
*The index of the turn summary substring.*
- std::string [turn\\_summary\\_string](#)  
*A string representation of the end of turn summary.*
- sf::Text [turn\\_summary\\_text](#)  
*A text representation (drawable) of the end of turn summary.*
- int [message\\_deadlock\\_frame](#)  
*A frame counter for detecting message deadlock.*
- int [turn](#) = 0  
*The current game turn.*
- std::vector< double > [demand\\_vec\\_MWh](#)  
*A vector of daily demands [MWh] for the current month.*
- sf::Clock [clock](#)  
*The game clock.*
- sf::Event [event](#)  
*The game events class.*
- [MessageHub](#) [message\\_hub](#)  
*The message hub (for inter-object message traffic).*
- [HexMap](#) \* [hex\\_map\\_ptr](#)  
*Pointer to the hex map (defines game world).*
- [ContextMenu](#) \* [context\\_menu\\_ptr](#)  
*Pointer to the context menu.*

## Private Member Functions

- void [\\_\\_toggleFrameClockOverlay](#) (void)  
*Helper method to toggle frame clock overlay.*
- void [\\_\\_checkTerminatingConditions](#) (void)  
*Helper method to check terminating conditions (i.e., loss or victory conditions).*
- void [\\_\\_advanceTurn](#) (void)  
*Helper method to advance turn.*
- void [\\_\\_computeCurrentDemand](#) (void)  
*Helper method to compute current energy demand.*
- void [\\_\\_handleKeyPressEvents](#) (void)  
*Helper method to handle key press events.*

- void [\\_\\_handleMouseButtonEvents](#) (void)  
*Helper method to handle mouse button events.*
- void [\\_\\_handleImprovementStateMessage](#) (Message)  
*Helper method to handle improvement state messages.*
- void [\\_\\_processEvent](#) (void)  
*Helper method to process [Game](#). To be called once per event.*
- void [\\_\\_processMessage](#) (void)  
*Helper method to process [Game](#). To be called once per message.*
- void [\\_\\_sendGameStateMessage](#) (void)  
*Helper method to format and send a game state message.*
- void [\\_\\_sendTurnAdvanceMessage](#) (void)  
*Helper method to format and send a turn advance message.*
- void [\\_\\_sendCreditsEarnedMessage](#) (void)  
*Helper method to format and send a credits earned message.*
- void [\\_\\_insufficientCreditsAlarm](#) (void)  
*Helper method to sound and display and insufficient credits alarm.*
- void [\\_\\_summarizeTurn](#) (void)  
*Helper method to generate end of turn summary.*
- void [\\_\\_drawLossDemand](#) (void)  
*Helper method to draw loss (demand) pop-up.*
- void [\\_\\_drawLossCredits](#) (void)  
*Helper method to draw loss (credits) pop-up.*
- void [\\_\\_drawLossEmissions](#) (void)  
*Helper method to draw loss (emissions) pop-up.*
- void [\\_\\_drawVictory](#) (void)  
*Helper method to draw victory pop-up.*
- void [\\_\\_drawTurnSummary](#) (void)  
*Helper method to draw turn summary.*
- void [\\_\\_drawFrameClockOverlay](#) (void)  
*Helper method to draw frame clock overlay.*
- void [\\_\\_drawHUD](#) (void)  
*Helper method to heads-up display (HUD).*
- void [\\_\\_draw](#) (void)  
*Helper method to draw game to the render window. To be called once per frame.*

## Private Attributes

- sf::RenderWindow \* [render\\_window\\_ptr](#)  
*A pointer to the render window.*
- [AssetsManager](#) \* [assets\\_manager\\_ptr](#)  
*A pointer to the assets manager.*

### 4.5.1 Detailed Description

A class which acts as the central class for the game, by containing all other classes and implementing the game loop.

## 4.5.2 Constructor & Destructor Documentation

### 4.5.2.1 Game()

```
Game::Game (
    sf::RenderWindow * render_window_ptr,
    AssetsManager * assets_manager_ptr )
```

Constructor for the [Game](#) class.

```
1435 {
1436     // 1. set attributes
1437
1438     // 1.1. private
1439     this->render_window_ptr = render_window_ptr;
1440
1441     this->assets_manager_ptr = assets_manager_ptr;
1442
1443     // 1.2. public
1444     this->game_phase = GamePhase :: BUILD_SETTLEMENT;
1445
1446     this->quit_game = false;
1447     this->game_loop_broken = false;
1448     this->show_frame_clock_overlay = false;
1449     this->check_terminating_conditions = false;
1450     this->show_tutorial = false;
1451     this->turn_end = false;
1452
1453     this->frame = 0;
1454     this->time_since_start_s = 0;
1455
1456     this->message_deadlock = false;
1457     this->message_deadlock_frame = 0;
1458
1459     double seconds_since_epoch = time(NULL);
1460     double years_since_epoch = seconds_since_epoch / SECONDS_PER_YEAR;
1461
1462     this->year = 1970 + (int)years_since_epoch;
1463     this->month = (years_since_epoch - (int)years_since_epoch) * 12 + 1;
1464     while (this->month > 12) {
1465         this->month -= 12;
1466     }
1467
1468     this->population = 0;
1469     this->credits = STARTING_CREDITS;
1470     this->demand_MWh = 0;
1471     this->cumulative_emissions_tonnes = 0;
1472
1473     this->past_demand_MWh = 0;
1474
1475     this->demand_vec_MWh.resize(30, 0);
1476
1477     this->demand_served_MWh = 0;
1478     this->demand_remaining_MWh = 0;
1479     this->overproduction_MWh = 0;
1480     this->turn_fuel_cost = 0;
1481     this->turn_operation_maintenance_cost = 0;
1482     this->turn_emissions_tonnes = 0;
1483
1484     this->overproduction_penalty = 0;
1485     this->dispatch_income = 0;
1486     this->net_credit_flow = 0;
1487
1488     this->consecutive_zero_emissions_months = 0;
1489
1490     this->substring_idx = 0;
1491     this->turn_summary_string = "";
1492
1493     this->turn_summary_text.setFont(
1494         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220"))
1495     );
1496     this->turn_summary_text.setCharacterSize(16);
1497     this->turn_summary_text.setFillColor(MONOCROME_TEXT_GREEN);
1498     this->turn_summary_text.setPosition(GAME_WIDTH - 400 + 64, 64);
1499
1500     this->hex_map_ptr = new HexMap(
1501         6,
1502         &(this->event),
```

```

1503         this->render_window_ptr,
1504         this->assets_manager_ptr,
1505         &(this->message_hub)
1506     );
1507
1508     this->context_menu_ptr = new ContextMenu(
1509         &(this->event),
1510         this->render_window_ptr,
1511         this->assets_manager_ptr,
1512         &(this->message_hub)
1513     );
1514
1515     // 2. add message channel(s)
1516     this->message_hub.addChannel(GAME_CHANNEL);
1517     this->message_hub.addChannel(GAME_STATE_CHANNEL);
1518
1519     this->__sendGameStateMessage();
1520
1521     std::cout << "Game constructed at " << this << std::endl;
1522
1523     return;
1524 } /* Game() */

```

#### 4.5.2.2 ~Game()

```

Game::~~Game (
    void )

```

Destructor for the [Game](#) class.

```

1650 {
1651     // 1. clean up attributes
1652     delete this->hex_map_ptr;
1653     delete this->context_menu_ptr;
1654
1655     std::cout << "Game at " << this << " destroyed" << std::endl;
1656
1657     return;
1658 } /* ~Game() */

```

### 4.5.3 Member Function Documentation

#### 4.5.3.1 \_\_advanceTurn()

```

void Game::__advanceTurn (
    void ) [private]

```

Helper method to advance turn.

```

137 {
138     // 1. advance turn, raise turn end flag
139     this->turn++;
140     this->turn_end = true;
141
142     // 2. reset turn summary attributes
143     this->demand_served_MWh = 0;
144     this->demand_remaining_MWh = 0;
145     this->overproduction_MWh = 0;
146     this->turn_fuel_cost = 0;
147     this->turn_operation_maintenance_cost = 0;
148     this->turn_emissions_tonnes = 0;
149
150     this->overproduction_penalty = 0;
151     this->dispatch_income = 0;
152     this->net_credit_flow = 0;
153
154     // 3. advance month/year

```

```

155     this->month++;
156     if (this->month > 12) {
157         this->year++;
158         this->month = 1;
159     }
160
161     // 4. update population
162     if (this->turn == 1) {
163         this->population = STARTING_POPULATION;
164     }
165
166     else {
167         this->population = ceil(this->population * POPULATION_MONTHLY_GROWTH_RATE);
168     }
169
170     // 5. update demand
171     this->__computeCurrentDemand();
172
173     // 6. send turn advance message
174     this->__sendTurnAdvanceMessage();
175     this->__sendGameStateMessage();
176
177 } /* __advanceTurn() */

```

#### 4.5.3.2 \_\_checkTerminatingConditions()

```

void Game::__checkTerminatingConditions (
    void ) [private]

```

Helper method to check terminating conditions (i.e., loss or victory conditions).

```

94 {
95     std::cout << "Game :: __checkTerminatingConditions()" << std::endl;
96
97     // 1. loss emissions
98     if (this->cumulative_emissions_tonnes >= EMISSIONS_LIFETIME_LIMIT_TONNES) {
99         this->assets_manager_ptr->getSound("loss")->play();
100         this->game_phase = GamePhase :: LOSS_EMISSIONS;
101     }
102
103     // 2. loss demand
104     else if (this->demand_remaining_MWh > 0) {
105         this->assets_manager_ptr->getSound("loss")->play();
106         this->game_phase = GamePhase :: LOSS_DEMAND;
107     }
108
109     // 3. loss credits
110     else if (this->credits < 0) {
111         this->assets_manager_ptr->getSound("loss")->play();
112         this->game_phase = GamePhase :: LOSS_CREDITS;
113     }
114
115     // 4. victory
116     else if (this->consecutive_zero_emissions_months >= 12) {
117         this->assets_manager_ptr->getSound("victory")->play();
118         this->game_phase = GamePhase :: VICTORY;
119     }
120
121     return;
122 } /* __checkTerminatingConditions() */

```

#### 4.5.3.3 \_\_computeCurrentDemand()

```

void Game::__computeCurrentDemand (
    void ) [private]

```

Helper method to compute current energy demand.

```

192 {
193     this->past_demand_MWh = this->demand_MWh;
194

```



```

195     unsigned seed = std::chrono::system_clock::now().time_since_epoch().count();
196     std::default_random_engine generator(seed);
197
198     std::normal_distribution<double> normal_dist(
199         MEAN_DAILY_DEMAND_RATIOS[this->month - 1],
200         STDEV_DAILY_DEMAND_RATIOS[this->month - 1]
201     );
202
203     double demand_MWh = 0;
204
205     for (int i = 0; i < 30; i++) {
206         this->demand_vec_MWh[i] =
207             normal_dist(generator) * MAXIMUM_DAILY_DEMAND_PER_CAPITA * this->population;
208
209         demand_MWh += this->demand_vec_MWh[i];
210     }
211
212     this->demand_MWh = round(demand_MWh);
213
214     return;
215 } /* __computeCurrentDemand() */

```

#### 4.5.3.4 \_\_draw()

```

void Game::__draw (
    void ) [private]

```

Helper method to draw game to the render window. To be called once per frame.

```

1358 {
1359     this->__drawHUD();
1360
1361     if (this->show_frame_clock_overlay) {
1362         this->__drawFrameClockOverlay();
1363     }
1364
1365     if (this->show_tutorial) {
1366
1367     }
1368
1369     else if (not this->turn_summary_string.empty()) {
1370         this->__drawTurnSummary();
1371     }
1372
1373     switch (this->game_phase) {
1374         case (GamePhase :: LOSS_DEMAND): {
1375             this->__drawLossDemand();
1376
1377             break;
1378         }
1379
1380
1381         case (GamePhase :: LOSS_CREDITS): {
1382             this->__drawLossCredits();
1383
1384             break;
1385         }
1386
1387
1388         case (GamePhase :: LOSS_EMISSIONS): {
1389             this->__drawLossEmissions();
1390
1391             break;
1392         }
1393
1394
1395         case (GamePhase :: VICTORY): {
1396             this->__drawVictory();
1397
1398             break;
1399         }
1400
1401
1402         default: {
1403             // do nothing!
1404
1405             break;
1406         }
1407     }

```

```

1408
1409     return;
1410 } /* draw() */

```

#### 4.5.3.5 \_\_drawFrameClockOverlay()

```

void Game::__drawFrameClockOverlay (
    void ) [private]

```

Helper method to draw frame clock overlay.

```

1181 {
1182     std::string frame_clock_string = "FRAME: ";
1183     frame_clock_string += std::to_string(this->frame);
1184     frame_clock_string += "\nTIME SINCE START [s]: ";
1185     frame_clock_string += std::to_string(this->time_since_start_s);
1186
1187     sf::Text frame_clock_text(
1188         frame_clock_string,
1189         *(this->assets_manager_ptr->getFont("DroidSansMono")),
1190         16
1191     );
1192
1193     sf::RectangleShape frame_clock_backing(
1194         sf::Vector2f(
1195             1.02 * frame_clock_text.getLocalBounds().width,
1196             1.20 * frame_clock_text.getLocalBounds().height
1197         )
1198     );
1199     frame_clock_backing.setFillColor(sf::Color(0, 0, 0, 255));
1200
1201     this->render_window_ptr->draw(frame_clock_backing);
1202     this->render_window_ptr->draw(frame_clock_text);
1203
1204     return;
1205 } /* __drawFrameClockOverlay() */

```

#### 4.5.3.6 \_\_drawHUD()

```

void Game::__drawHUD (
    void ) [private]

```

Helper method to heads-up display (HUD).

```

1220 {
1221     // 1. first line (top)
1222     std::string HUD_string = "YEAR: ";
1223     HUD_string += std::to_string(this->year);
1224
1225     HUD_string += "    MONTH: ";
1226     HUD_string += std::to_string(this->month);
1227
1228     HUD_string += "    POPULATION: ";
1229     HUD_string += std::to_string(this->population);
1230
1231     HUD_string += "    CREDITS: ";
1232     HUD_string += std::to_string(this->credits);
1233     HUD_string += " K";
1234
1235     HUD_string += "    CURRENT DEMAND: ";
1236     HUD_string += std::to_string(this->demand_MWh);
1237     HUD_string += " MWh";
1238
1239     sf::Text HUD_text(
1240         HUD_string,
1241         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
1242         16
1243     );
1244
1245     HUD_text.setPosition(
1246         (800 - HUD_text.getLocalBounds().width) / 2,

```

```

1247         8
1248     );
1249
1250     HUD_text.setFillColor(MONOCROME_TEXT_GREEN);
1251
1252     this->render_window_ptr->draw(HUD_text);
1253
1254
1255     // 2. second line (top)
1256     HUD_string = "CUMULATIVE EMISSIONS: ";
1257     HUD_string += std::to_string(this->cumulative_emissions_tonnes);
1258     HUD_string += " tonnes (CO2e)";
1259
1260     HUD_string += "      LIFETIME LIMIT: ";
1261     HUD_string += std::to_string(EMISSIONS_LIFETIME_LIMIT_TONNES);
1262     HUD_string += " tonnes (CO2e)";
1263
1264     HUD_text.setString(HUD_string);
1265
1266     HUD_text.setPosition(
1267         (800 - HUD_text.getLocalBounds().width) / 2,
1268         35
1269     );
1270
1271     this->render_window_ptr->draw(HUD_text);
1272
1273
1274     // 3. third line (bottom)
1275     HUD_string = "GAME PHASE: ";
1276
1277     switch (this->game_phase) {
1278     case (GamePhase :: BUILD_SETTLEMENT): {
1279         HUD_string += "BUILD SETTLEMENT";
1280
1281         break;
1282     }
1283
1284     case (GamePhase :: SYSTEM_MANAGEMENT): {
1285         HUD_string += "SYSTEM MANAGEMENT";
1286
1287         break;
1288     }
1289
1290     case (GamePhase :: LOSS_EMISSIONS): {
1291         HUD_string += "LOSS (EMISSIONS)";
1292
1293         break;
1294     }
1295
1296     case (GamePhase :: LOSS_DEMAND): {
1297         HUD_string += "LOSS (DEMAND)";
1298
1299         break;
1300     }
1301
1302     case (GamePhase :: LOSS_CREDITS): {
1303         HUD_string += "LOSS (CREDITS)";
1304
1305         break;
1306     }
1307
1308     case (GamePhase :: VICTORY): {
1309         HUD_string += "VICTORY";
1310
1311         break;
1312     }
1313
1314     default: {
1315         HUD_string += "???";
1316
1317         break;
1318     }
1319
1320     }
1321
1322     HUD_string += "      TURN: ";
1323     HUD_string += std::to_string(this->turn);
1324
1325     HUD_string += "      CONSECUTIVE ZERO EMISSIONS MONTHS: ";
1326     HUD_string += std::to_string(this->consecutive_zero_emissions_months);
1327
1328     HUD_text.setString(HUD_string);
1329
1330

```

```

1334
1335     HUD_text.setPosition(
1336         (800 - HUD_text.getLocalBounds().width) / 2,
1337         GAME_HEIGHT - 35
1338     );
1339
1340     this->render_window_ptr->draw(HUD_text);
1341
1342     return;
1343 } /* __drawHUD() */

```

#### 4.5.3.7 \_\_drawLossCredits()

```

void Game::__drawLossCredits (
    void ) [private]

```

Helper method to draw loss (credits) pop-up.

```

951 {
952     // 1. construct loss text and backing rectangle
953     std::string loss_credits_string = "    LOSS! - RAN OUT OF CREDITS    \n";
954     loss_credits_string += "    press any key to restart    ";
955
956     sf::Text loss_credits_text(
957         loss_credits_string,
958         (*this->assets_manager_ptr->getFont("DroidSansMono")),
959         32
960     );
961
962     loss_credits_text.setOrigin(
963         loss_credits_text.getLocalBounds().width / 2,
964         loss_credits_text.getLocalBounds().height / 2
965     );
966
967     loss_credits_text.setPosition(400, GAME_HEIGHT / 2);
968
969     sf::RectangleShape backing_rectangle(
970         sf::Vector2f(
971             1.1 * loss_credits_text.getLocalBounds().width,
972             1.5 * loss_credits_text.getLocalBounds().height
973         )
974     );
975
976     backing_rectangle.setFillColor(RESOURCE_CHIP_GREY);
977
978     backing_rectangle.setOrigin(
979         backing_rectangle.getLocalBounds().width / 2,
980         backing_rectangle.getLocalBounds().height / 2
981     );
982
983     backing_rectangle.setPosition(400, (GAME_HEIGHT / 2) + 8);
984
985     // 3. colour cycle and draw
986     if (this->frame % FRAMES_PER_SECOND <= FRAMES_PER_SECOND / 2) {
987         loss_credits_text.setFillColor(MONochrome_TEXT_RED);
988     }
989
990     else {
991         loss_credits_text.setFillColor(sf::Color(255, 255, 255, 255));
992     }
993
994     this->render_window_ptr->draw(backing_rectangle);
995     this->render_window_ptr->draw(loss_credits_text);
996
997     return;
998 } /* __drawLossCredits() */

```

#### 4.5.3.8 \_\_drawLossDemand()

```

void Game::__drawLossDemand (
    void ) [private]

```

Helper method to draw loss (demand) pop-up.

```

889 {
890     // 1. construct alarm text and backing rectangle
891     std::string loss_demand_string = "    LOSS! - FAILED TO MEET DEMAND    \n";
892     loss_demand_string += "    press any key to restart    ";
893
894     sf::Text loss_demand_text(
895         loss_demand_string,
896         (*(this->assets_manager_ptr->getFont("DroidSansMono"))),
897         32
898     );
899
900     loss_demand_text.setOrigin(
901         loss_demand_text.getLocalBounds().width / 2,
902         loss_demand_text.getLocalBounds().height / 2
903     );
904
905     loss_demand_text.setPosition(400, GAME_HEIGHT / 2);
906
907     sf::RectangleShape backing_rectangle(
908         sf::Vector2f(
909             1.1 * loss_demand_text.getLocalBounds().width,
910             1.5 * loss_demand_text.getLocalBounds().height
911         )
912     );
913
914     backing_rectangle.setFillColor(RESOURCE_CHIP_GREY);
915
916     backing_rectangle.setOrigin(
917         backing_rectangle.getLocalBounds().width / 2,
918         backing_rectangle.getLocalBounds().height / 2
919     );
920
921     backing_rectangle.setPosition(400, (GAME_HEIGHT / 2) + 8);
922
923     // 3. colour cycle and draw
924     if (this->frame % FRAMES_PER_SECOND <= FRAMES_PER_SECOND / 2) {
925         loss_demand_text.setFillColor(MONochrome_TEXT_RED);
926     }
927
928     else {
929         loss_demand_text.setFillColor(sf::Color(255, 255, 255, 255));
930     }
931
932     this->render_window_ptr->draw(backing_rectangle);
933     this->render_window_ptr->draw(loss_demand_text);
934
935     return;
936 } /* __drawLossDemand() */

```

#### 4.5.3.9 \_\_drawLossEmissions()

```

void Game::__drawLossEmissions (
    void ) [private]

```

Helper method to draw loss (emissions) pop-up.

```

1013 {
1014     // 1. construct loss text and backing rectangle
1015     std::string loss_emissions_string = "    LOSS! - EXCESSIVE EMISSIONS    \n";
1016     loss_emissions_string += "    press any key to restart    ";
1017
1018     sf::Text loss_emissions_text(
1019         loss_emissions_string,
1020         (*(this->assets_manager_ptr->getFont("DroidSansMono"))),
1021         32
1022     );
1023
1024     loss_emissions_text.setOrigin(
1025         loss_emissions_text.getLocalBounds().width / 2,
1026         loss_emissions_text.getLocalBounds().height / 2
1027     );
1028
1029     loss_emissions_text.setPosition(400, GAME_HEIGHT / 2);
1030
1031     sf::RectangleShape backing_rectangle(
1032         sf::Vector2f(
1033             1.1 * loss_emissions_text.getLocalBounds().width,
1034             1.5 * loss_emissions_text.getLocalBounds().height

```

```

1035     )
1036   );
1037
1038   backing_rectangle.setFillColor(RESOURCE_CHIP_GREY);
1039
1040   backing_rectangle.setOrigin(
1041     backing_rectangle.getLocalBounds().width / 2,
1042     backing_rectangle.getLocalBounds().height / 2
1043   );
1044
1045   backing_rectangle.setPosition(400, (GAME_HEIGHT / 2) + 8);
1046
1047   // 3. colour cycle and draw
1048   if (this->frame % FRAMES_PER_SECOND <= FRAMES_PER_SECOND / 2) {
1049     loss_emissions_text.setFillColor(MONOCROME_TEXT_RED);
1050   }
1051
1052   else {
1053     loss_emissions_text.setFillColor(sf::Color(255, 255, 255, 255));
1054   }
1055
1056   this->render_window_ptr->draw(backing_rectangle);
1057   this->render_window_ptr->draw(loss_emissions_text);
1058
1059   return;
1060 } /* __drawLossEmissions() */

```

#### 4.5.3.10 \_\_drawTurnSummary()

```

void Game::__drawTurnSummary (
    void ) [private]

```

Helper method to draw turn summary.

```

1137 {
1138     if (this->substring_idx < this->turn_summary_string.size()) {
1139         this->assets_manager_ptr->getSound("console string print")->play();
1140
1141         this->turn_summary_text.setString(
1142             this->turn_summary_string.substr(0, this->substring_idx)
1143         );
1144
1145         while (
1146             (this->turn_summary_string.substr(0, this->substring_idx).back() == ' ') or
1147             (this->turn_summary_string.substr(0, this->substring_idx).back() == '\n')
1148         ) {
1149             this->substring_idx++;
1150
1151             if (this->substring_idx == this->turn_summary_string.size() - 1) {
1152                 this->turn_summary_text.setString(
1153                     this->turn_summary_string.substr(0, this->substring_idx)
1154                 );
1155
1156                 break;
1157             }
1158         }
1159
1160         this->substring_idx++;
1161     }
1162
1163     this->render_window_ptr->draw(this->turn_summary_text);
1164
1165     return;
1166 } /* __drawTurnSummary() */

```

#### 4.5.3.11 \_\_drawVictory()

```

void Game::__drawVictory (
    void ) [private]

```

Helper method to draw victory pop-up.

```

1075 {
1076     // 1. construct victory text and backing rectangle
1077     std::string victory_string = "      **** VICTORY! ****      \n";
1078     victory_string += "      press any key to restart      ";
1079
1080     sf::Text victory_text(
1081         victory_string,
1082         (*(this->assets_manager_ptr->getFont("DroidSansMono"))),
1083         32
1084     );
1085
1086     victory_text.setOrigin(
1087         victory_text.getLocalBounds().width / 2,
1088         victory_text.getLocalBounds().height / 2
1089     );
1090
1091     victory_text.setPosition(400, GAME_HEIGHT / 2);
1092
1093     sf::RectangleShape backing_rectangle(
1094         sf::Vector2f(
1095             1.1 * victory_text.getLocalBounds().width,
1096             1.5 * victory_text.getLocalBounds().height
1097         )
1098     );
1099
1100     backing_rectangle.setFillColor(RESOURCE_CHIP_GREY);
1101
1102     backing_rectangle.setOrigin(
1103         backing_rectangle.getLocalBounds().width / 2,
1104         backing_rectangle.getLocalBounds().height / 2
1105     );
1106
1107     backing_rectangle.setPosition(400, (GAME_HEIGHT / 2) + 8);
1108
1109     // 3. colour cycle and draw
1110     if (this->frame % FRAMES_PER_SECOND <= FRAMES_PER_SECOND / 2) {
1111         victory_text.setFillColor(MONOCHROME_TEXT_GREEN);
1112     }
1113
1114     else {
1115         victory_text.setFillColor(sf::Color(255, 255, 255, 255));
1116     }
1117
1118     this->render_window_ptr->draw(backing_rectangle);
1119     this->render_window_ptr->draw(victory_text);
1120
1121     return;
1122 } /* __drawVictory() */

```

#### 4.5.3.12 \_\_handleImprovementStateMessage()

```

void Game::__handleImprovementStateMessage (
    Message improvement_state_message ) [private]

```

Helper method to handle improvement state messages.

```

317 {
318     // 1. dispatch
319     if (improvement_state_message.int_payload.count("dispatch_MWh") > 0) {
320         this->demand_served_MWh += improvement_state_message.int_payload["dispatch_MWh"];
321     }
322
323     // 2. fuel costs
324     if (improvement_state_message.int_payload.count("fuel_cost") > 0) {
325         this->turn_fuel_cost += improvement_state_message.int_payload["fuel_cost"];
326     }
327
328     // 3. operation and maintenance costs
329     if (improvement_state_message.int_payload.count("operation_maintenance_cost") > 0) {
330         this->turn_operation_maintenance_cost +=
331             improvement_state_message.int_payload["operation_maintenance_cost"];
332     }
333
334     // 4. emissions
335     if (improvement_state_message.int_payload.count("emissions_tonnes_CO2e") > 0) {
336         double emissions_tonnes_CO2e =
337             improvement_state_message.int_payload["emissions_tonnes_CO2e"];
338     }

```

```

339         this->cumulative_emissions_tonnes += emissions_tonnes_CO2e;
340         this->turn_emissions_tonnes += emissions_tonnes_CO2e;
341     }
342
343     return;
344 } /* __handleImprovementStateMessage() */

```

#### 4.5.3.13 \_\_handleKeyPressEvents()

```

void Game::__handleKeyPressEvents (
    void ) [private]

```

Helper method to handle key press events.

```

230 {
231     switch (this->event.key.code) {
232         case (sf::Keyboard::Enter): {
233             if (this->game_phase == GamePhase :: SYSTEM_MANAGEMENT) {
234                 this->__advanceTurn();
235             }
236
237             break;
238         }
239
240         case (sf::Keyboard::Tilde): {
241             this->__toggleFrameClockOverlay();
242
243             break;
244         }
245
246         case (sf::Keyboard::Tab): {
247             this->hex_map_ptr->toggleResourceOverlay();
248
249             break;
250         }
251
252         default: {
253             // do nothing!
254
255             break;
256         }
257     }
258
259     return;
260 } /* __handleKeyPressEvents() */

```

#### 4.5.3.14 \_\_handleMouseButtonEvents()

```

void Game::__handleMouseButtonEvents (
    void ) [private]

```

Helper method to handle mouse button events.

```

278 {
279     switch (this->event.mouseButton.button) {
280         case (sf::Mouse::Left): {
281             //...
282
283             break;
284         }
285
286         case (sf::Mouse::Right): {
287             //...
288
289             break;
290         }
291     }
292

```



```

293
294         default: {
295             // do nothing!
296
297             break;
298         }
299     }
300
301     return;
302 } /* __handleMouseButtonEvents() */

```

#### 4.5.3.15 \_\_insufficientCreditsAlarm()

```

void Game::__insufficientCreditsAlarm (
    void ) [private]

```

Helper method to sound and display and insufficient credits alarm.

```

659 {
660     // 1. sound buzzer
661     this->assets_manager_ptr->getSound("insufficient credits")->play();
662
663     // 2. construct alarm text and backing rectangle
664     sf::Text insufficient_credits_text(
665         "INSUFFICIENT CREDITS",
666         (*this->assets_manager_ptr->getFont("DroidSansMono")),
667         32
668     );
669
670     insufficient_credits_text.setOrigin(
671         insufficient_credits_text.getLocalBounds().width / 2,
672         insufficient_credits_text.getLocalBounds().height / 2
673     );
674
675     insufficient_credits_text.setPosition(400, GAME_HEIGHT / 2);
676
677     sf::RectangleShape backing_rectangle(
678         sf::Vector2f(
679             1.1 * insufficient_credits_text.getLocalBounds().width,
680             1.5 * insufficient_credits_text.getLocalBounds().height
681         )
682     );
683
684     backing_rectangle.setFillColor(RESOURCE_CHIP_GREY);
685
686     backing_rectangle.setOrigin(
687         backing_rectangle.getLocalBounds().width / 2,
688         backing_rectangle.getLocalBounds().height / 2
689     );
690
691     backing_rectangle.setPosition(400, (GAME_HEIGHT / 2) + 8);
692
693     // 3. display loop (blocking ~3 seconds)
694     bool red_flag = true;
695     int alarm_frame = 0;
696     double time_since_alarm_s = 0;
697
698     sf::Clock alarm_clock;
699
700     while (alarm_frame < 2.5 * FRAMES_PER_SECOND) {
701
702         time_since_alarm_s = alarm_clock.getElapsedTime().asSeconds();
703
704         if (time_since_alarm_s >= (alarm_frame + 1) * SECONDS_PER_FRAME) {
705             while (this->render_window_ptr->pollEvent(this->event)) {
706                 // do nothing!
707             }
708
709             this->render_window_ptr->clear();
710
711             this->hex_map_ptr->draw();
712             this->context_menu_ptr->draw();
713             this->__draw();
714
715             if (alarm_frame % (FRAMES_PER_SECOND / 3) == 0) {
716                 if (red_flag) {
717                     red_flag = false;
718                 }
719             }

```

```

720
721         else {
722             red_flag = true;
723         }
724     }
725
726     if (red_flag) {
727         insufficient_credits_text.setFillColor(MONOCROME_TEXT_RED);
728     }
729
730     else {
731         insufficient_credits_text.setFillColor(sf::Color(255, 255, 255));
732     }
733
734     this->render_window_ptr->draw(backing_rectangle);
735     this->render_window_ptr->draw(insufficient_credits_text);
736
737     this->render_window_ptr->display();
738
739     alarm_frame++;
740     this->frame++;
741 }
742
743 // check track status, move to next if stopped
744 if (this->assets_manager_ptr->getTrackStatus() == sf::SoundSource::Stopped) {
745     this->assets_manager_ptr->nextTrack();
746     this->assets_manager_ptr->playTrack();
747 }
748 }
749
750 return;
751 } /* __insufficientCreditsAlarm( */

```

#### 4.5.3.16 \_\_processEvent()

```

void Game::__processEvent (
    void ) [private]

```

Helper method to process [Game](#). To be called once per event.

```

359 {
360     if (this->event.type == sf::Event::Closed) {
361         this->quit_game = true;
362         this->game_loop_broken = true;
363     }
364
365     if (this->event.type == sf::Event::KeyPressed) {
366         this->__handleKeyPressEvents();
367     }
368
369     if (this->event.type == sf::Event::MouseButtonPressed) {
370         this->__handleMouseButtonEvents();
371     }
372
373     return;
374 } /* __processEvent() */

```

#### 4.5.3.17 \_\_processMessage()

```

void Game::__processMessage (
    void ) [private]

```

Helper method to process [Game](#). To be called once per message.

```

530 {
531     if (not this->message_hub.isEmpty(GAME_CHANNEL)) {
532         Message game_channel_message = this->message_hub.receiveMessage(GAME_CHANNEL);
533
534         if (game_channel_message.subject == "quit game") {
535             this->quit_game = true;
536             this->game_loop_broken = true;

```

```

537
538         std::cout << "Quit game message received by " << this << std::endl;
539         this->message_hub.popMessage(GAME_CHANNEL);
540     }
541
542     if (game_channel_message.subject == "restart game") {
543         this->game_loop_broken = true;
544
545         std::cout << "Restart game message received by " << this << std::endl;
546         this->message_hub.popMessage(GAME_CHANNEL);
547     }
548
549     if (game_channel_message.subject == "state request") {
550         std::cout << "Game state request message received by " << this << std::endl;
551
552         this->__sendGameStateMessage();
553         this->message_hub.popMessage(GAME_CHANNEL);
554     }
555
556     if (game_channel_message.subject == "credits spent") {
557         this->credits -= game_channel_message.int_payload["credits spent"];
558
559         std::cout << "Credits spent message (" <<
560             game_channel_message.int_payload["credits spent"] << ") received by "
561             << this << std::endl;
562
563         std::cout << "Current credits (Game): " << this->credits << " K" <<
564             std::endl;
565
566         this->message_hub.popMessage(GAME_CHANNEL);
567     }
568
569     if (game_channel_message.subject == "insufficient credits") {
570         std::cout << "Insufficient credits message received by " << this <<
571             std::endl;
572
573         this->__insufficientCreditsAlarm();
574
575         this->message_hub.popMessage(GAME_CHANNEL);
576     }
577
578     if (game_channel_message.subject == "update game phase") {
579         std::cout << "Update game phase message received by " << this << std::endl;
580
581         if (
582             game_channel_message.string_payload["game phase"] == "system management"
583         ) {
584             this->game_phase = GamePhase :: SYSTEM_MANAGEMENT;
585             this->__advanceTurn();
586         }
587
588         else if (
589             game_channel_message.string_payload["game phase"] == "loss emissions"
590         ) {
591             this->game_phase = GamePhase :: LOSS_EMISSIONS;
592         }
593
594         else if (
595             game_channel_message.string_payload["game phase"] == "loss demand"
596         ) {
597             this->game_phase = GamePhase :: LOSS_DEMAND;
598         }
599
600         else if (
601             game_channel_message.string_payload["game phase"] == "loss credits"
602         ) {
603             this->game_phase = GamePhase :: LOSS_CREDITS;
604         }
605
606         else if (
607             game_channel_message.string_payload["game phase"] == "victory"
608         ) {
609             this->game_phase = GamePhase :: VICTORY;
610         }
611
612         this->message_hub.popMessage(GAME_CHANNEL);
613     }
614
615     if (game_channel_message.subject == "improvement state") {
616         std::cout << "Improvement state message received by " << this << std::endl;
617
618         this->__handleImprovementStateMessage(game_channel_message);
619
620         this->message_hub.popMessage(GAME_CHANNEL);
621     }
622 }
623

```

```

624     if (not this->message_hub.isEmpty(GAME_STATE_CHANNEL)) {
625         Message game_state_message =
626             this->message_hub.receiveMessage(GAME_STATE_CHANNEL);
627
628         if (game_state_message.subject == "turn advance") {
629             if (game_state_message.number_of_reads > 0) {
630                 std::cout << "Turn advance message received by " << this << std::endl;
631                 this->message_hub.popMessage(GAME_STATE_CHANNEL);
632             }
633         }
634
635         if (game_state_message.subject == "game state") {
636             if (game_state_message.number_of_reads > 0) {
637                 std::cout << "Game state message received by " << this << std::endl;
638                 this->message_hub.popMessage(GAME_STATE_CHANNEL);
639             }
640         }
641     }
642
643     return;
644 } /* __processMessage() */

```

#### 4.5.3.18 \_\_sendCreditsEarnedMessage()

```

void Game::__sendCreditsEarnedMessage (
    void ) [private]

```

Helper method to format and send a credits earned message.

```

505 {
506     Message credits_earned_message;
507
508     credits_earned_message.channel = SETTLEMENT_CHANNEL;
509     credits_earned_message.subject = "credits earned";
510
511     this->message_hub.sendMessage(credits_earned_message);
512
513     std::cout << "Credits earned message sent by " << this << std::endl;
514     return;
515 } /* __sendCreditsEarnedMessage() */

```

#### 4.5.3.19 \_\_sendGameStateMessage()

```

void Game::__sendGameStateMessage (
    void ) [private]

```

Helper method to format and send a game state message.

```

389 {
390     Message game_state_message;
391
392     game_state_message.channel = GAME_STATE_CHANNEL;
393     game_state_message.subject = "game state";
394
395     game_state_message.int_payload["year"] = this->year;
396     game_state_message.int_payload["month"] = this->month;
397     game_state_message.int_payload["population"] = this->population;
398     game_state_message.int_payload["credits"] = this->credits;
399     game_state_message.int_payload["demand_MWh"] = this->demand_MWh;
400     game_state_message.int_payload["cumulative_emissions_tonnes"] =
401         this->cumulative_emissions_tonnes;
402
403     game_state_message.int_payload["reads"] = 0;
404
405     switch (this->game_phase) {
406         case (GamePhase :: BUILD_SETTLEMENT): {
407             game_state_message.string_payload["game phase"] = "build settlement";
408
409             break;
410         }
411     }

```

```

412
413     case (GamePhase :: SYSTEM_MANAGEMENT): {
414         game_state_message.string_payload["game phase"] = "system management";
415         break;
416     }
417
418
419
420     case (GamePhase :: LOSS_EMISSIONS): {
421         game_state_message.string_payload["game phase"] = "loss emissions";
422         break;
423     }
424
425
426
427     case (GamePhase :: LOSS_DEMAND): {
428         game_state_message.string_payload["game phase"] = "loss demand";
429         break;
430     }
431
432
433
434     case (GamePhase :: LOSS_CREDITS): {
435         game_state_message.string_payload["game phase"] = "loss credits";
436         break;
437     }
438
439
440
441     case (GamePhase :: VICTORY): {
442         game_state_message.string_payload["game phase"] = "victory";
443         break;
444     }
445
446
447
448     default: {
449         // do nothing!
450         break;
451     }
452 }
453
454
455 game_state_message.vector_payload["demand_vec_MWh"] = this->demand_vec_MWh;
456
457 this->message_hub.sendMessage(game_state_message);
458
459 std::cout << "Game state message sent by " << this << std::endl;
460 return;
461 } /* __sendGameStateMessage() */

```

#### 4.5.3.20 \_\_sendTurnAdvanceMessage()

```

void Game::__sendTurnAdvanceMessage (
    void ) [private]

```

Helper method to format and send a turn advance message.

```

476 {
477     Message turn_advance_message;
478
479     turn_advance_message.channel = GAME_STATE_CHANNEL;
480     turn_advance_message.subject = "turn advance";
481
482     turn_advance_message.int_payload["credits"] = this->credits;
483     turn_advance_message.int_payload["month"] = this->month;
484     turn_advance_message.int_payload["demand_MWh"] = this->demand_MWh;
485
486     this->message_hub.sendMessage(turn_advance_message);
487
488     std::cout << "Turn advance message sent by " << this << std::endl;
489     return;
490 } /* __sendTurnAdvanceMessage() */

```

#### 4.5.3.21 \_\_summarizeTurn()

```
void Game::__summarizeTurn (
    void ) [private]
```

Helper method to generate end of turn summary.

```
766 {
767     if (this->turn - 1 == 0) {
768         return;
769     }
770     this->substring_idx = 0;
771
772     // 1. handle dispatch and demand
773     if (this->demand_served_MWh > this->past_demand_MWh) {
774         this->overproduction_MWh = this->demand_served_MWh - this->past_demand_MWh;
775         this->demand_served_MWh -= this->overproduction_MWh;
776
777         this->overproduction_penalty =
778             round(CREDITS_PER_MWH_SERVED * this->overproduction_MWh);
779     }
780
781     else if (this->demand_served_MWh < this->past_demand_MWh) {
782         this->demand_remaining_MWh = this->past_demand_MWh - this->demand_served_MWh;
783     }
784
785     // 2. compute dispatch income
786     this->dispatch_income = round(CREDITS_PER_MWH_SERVED * this->demand_served_MWh);
787
788     if (this->dispatch_income > 0) {
789         this->__sendCreditsEarnedMessage();
790     }
791
792     // 3. compute net credit flow
793     this->net_credit_flow = this->dispatch_income -
794         this->overproduction_penalty -
795         this->turn_fuel_cost -
796         this->turn_operation_maintenance_cost;
797
798     this->credits += this->net_credit_flow;
799
800     // 4. assemble turn summary string
801     this->turn_summary_string.clear();
802
803     //16 line x 32 char console
804     this->turn_summary_string = "          **** TURN ";\n";
805     this->turn_summary_string += std::to_string(this->turn - 1);
806     this->turn_summary_string += " SUMMARY **** \n";
807     this->turn_summary_string += "\n";
808
809     this->turn_summary_string += "DEMAND: ";
810     this->turn_summary_string += std::to_string(this->past_demand_MWh);
811     this->turn_summary_string += " MWh\n";
812
813     this->turn_summary_string += "DEMAND SERVED: ";
814     this->turn_summary_string += std::to_string(this->demand_served_MWh);
815     this->turn_summary_string += " MWh\n";
816
817     if (this->overproduction_MWh > 0) {
818         this->turn_summary_string += "OVERPRODUCTION: ";
819         this->turn_summary_string += std::to_string(this->overproduction_MWh);
820         this->turn_summary_string += " MWh\n";
821     }
822
823     else if (this->demand_remaining_MWh > 0) {
824         this->turn_summary_string += "DEMAND REMAINING: ";
825         this->turn_summary_string += std::to_string(this->demand_remaining_MWh);
826         this->turn_summary_string += " MWh\n";
827     }
828
829     this->turn_summary_string += "\n";
830     this->turn_summary_string += "\n";
831
832     this->turn_summary_string += "DISPATCH INCOME: +";
833     this->turn_summary_string += std::to_string(this->dispatch_income);
834     this->turn_summary_string += " K\n";
835
836     this->turn_summary_string += "FUEL COST: -";
837     this->turn_summary_string += std::to_string(this->turn_fuel_cost);
838     this->turn_summary_string += " K\n";
839
840     this->turn_summary_string += "OP & MAINT COST: -";
841     this->turn_summary_string += std::to_string(this->turn_operation_maintenance_cost);
842     this->turn_summary_string += " K\n";
843 }
```

```

844
845     this->turn_summary_string += "OVERPRODUCTION:  -";
846     this->turn_summary_string += std::to_string(this->overproduction_penalty);
847     this->turn_summary_string += " K\n";
848
849     this->turn_summary_string += "-----\n";
850
851     this->turn_summary_string += "NET:                ";
852
853     if (this->net_credit_flow > 0) {
854         this->turn_summary_string += "+";
855     }
856
857     this->turn_summary_string += std::to_string(this->net_credit_flow);
858     this->turn_summary_string += " K\n";
859
860     this->turn_summary_string += "                                \n";
861
862     this->turn_summary_string += "EMISSIONS: ";
863     this->turn_summary_string += std::to_string(this->turn_emissions_tonnes);
864     this->turn_summary_string += " tonnes CO2e\n";
865
866     if (this->turn_emissions_tonnes <= 0) {
867         this->consecutive_zero_emissions_months++;
868     }
869
870     else {
871         this->consecutive_zero_emissions_months = 0;
872     }
873
874     return;
875 } /* __summarizeTurn() */

```

#### 4.5.3.22 \_\_toggleFrameClockOverlay()

```

void Game::__toggleFrameClockOverlay (
    void ) [private]

```

Helper method to toggle frame clock overlay.

```

68 {
69     if (this->show_frame_clock_overlay) {
70         this->show_frame_clock_overlay = false;
71     }
72
73     else {
74         this->show_frame_clock_overlay = true;
75     }
76
77     return;
78 } /* __toggleFrameClockOverlay() */

```

#### 4.5.3.23 run()

```

bool Game::run (
    void )

```

Method to run game (defines game loop).

## Returns

Boolean indicating whether to quit (true) or create a new [Game](#) instance (false).

```

1542 {
1543     // 1. play brand animation
1544     //...
1545
1546     // 2. show splash screen
1547     //...
1548
1549     // 3. start game loop
1550     while (not this->game_loop_broken) {
1551         this->time_since_start_s = this->clock.getElapsedTime().asSeconds();
1552
1553         if (this->time_since_start_s >= (this->frame + 1) * SECONDS_PER_FRAME) {
1554             // 6.1. process events
1555             while (this->render_window_ptr->pollEvent(this->event)) {
1556                 if {
1557                     (this->game_phase == GamePhase::BUILD_SETTLEMENT) or
1558                     (this->game_phase == GamePhase::SYSTEM_MANAGEMENT)
1559                 } {
1560                     this->hex_map_ptr->processEvent();
1561                     this->context_menu_ptr->processEvent();
1562                     this->__processEvent();
1563                 }
1564                 else {
1565                     if (this->event.type == sf::Event::KeyPressed) {
1566                         this->game_loop_broken = true;
1567                     }
1568                 }
1569             }
1570         }
1571
1572         // 6.2. process messages
1573         while (this->message_hub.hasTraffic()) {
1574             this->hex_map_ptr->processMessage();
1575             this->context_menu_ptr->processMessage();
1576             this->__processMessage();
1577
1578             this->check_terminating_conditions = true;
1579
1580             if (not this->message_deadlock) {
1581                 this->message_deadlock_frame++;
1582
1583                 if (this->message_deadlock_frame > 5 * FRAMES_PER_SECOND) {
1584                     this->message_hub.printState();
1585                     this->message_deadlock = true;
1586                 }
1587             }
1588         }
1589         this->message_deadlock = false;
1590         this->message_deadlock_frame = 0;
1591
1592         // 6.3. handle turn end summary
1593         if (this->turn_end) {
1594             std::cout << "**** END OF TURN " << std::to_string(this->turn - 1) <<
1595                 " ****" << std::endl;
1596
1597             this->__summarizeTurn();
1598
1599             this->turn_end = false;
1600         }
1601
1602         // 6.4. check terminating conditions
1603         if (this->check_terminating_conditions) {
1604             this->__checkTerminatingConditions();
1605             this->check_terminating_conditions = false;
1606         }
1607
1608         // 6.5. draw frame
1609         this->render_window_ptr->clear();
1610
1611         this->hex_map_ptr->draw();
1612         this->context_menu_ptr->draw();
1613         this->__draw();
1614
1615         this->render_window_ptr->display();
1616
1617         // 6.6. increment frame
1618         this->frame++;
1619     }
1620 }
1621
1622
1623
1624
1625

```



```
1626         // check track status, move to next if stopped
1627         if (this->assets_manager_ptr->getTrackStatus() == sf::SoundSource::Stopped) {
1628             this->assets_manager_ptr->nextTrack();
1629             this->assets_manager_ptr->playTrack();
1630         }
1631     }
1632 }
1633
1634 return this->quit_game;
1635 } /* run() */
```

## 4.5.4 Member Data Documentation

### 4.5.4.1 assets\_manager\_ptr

`AssetsManager*` Game::assets\_manager\_ptr [private]

A pointer to the assets manager.

### 4.5.4.2 check\_terminating\_conditions

`bool` Game::check\_terminating\_conditions

Boolean indicating whether or not to check terminating conditions.

### 4.5.4.3 clock

`sf::Clock` Game::clock

The game clock.

### 4.5.4.4 consecutive\_zero\_emissions\_months

`int` Game::consecutive\_zero\_emissions\_months

The number of recent, consecutive zero emission months.

### 4.5.4.5 context\_menu\_ptr

`ContextMenu*` Game::context\_menu\_ptr

Pointer to the context menu.

#### 4.5.4.6 credits

```
int Game::credits
```

Current balance of credits.

#### 4.5.4.7 cumulative\_emissions\_tonnes

```
int Game::cumulative_emissions_tonnes
```

Cumulative emissions [tonnes] (1 tonne = 1000 kg).

#### 4.5.4.8 demand\_MWh

```
int Game::demand_MWh
```

Current energy demand [MWh].

#### 4.5.4.9 demand\_remaining\_MWh

```
int Game::demand_remaining_MWh
```

The demand remaining at the end of a turn.

#### 4.5.4.10 demand\_served\_MWh

```
int Game::demand_served_MWh
```

The demand served at the end of a turn.

#### 4.5.4.11 demand\_vec\_MWh

```
std::vector<double> Game::demand_vec_MWh
```

A vector of daily demands [MWh] for the current month.

#### 4.5.4.12 dispatch\_income

```
int Game::dispatch_income
```

The amount earned from dispatch at the end of a turn.

#### 4.5.4.13 event

```
sf::Event Game::event
```

The game events class.

#### 4.5.4.14 frame

```
unsigned long long int Game::frame
```

The current frame of the game.

#### 4.5.4.15 game\_loop\_broken

```
bool Game::game_loop_broken
```

Boolean indicating whether or not the game loop is broken.

#### 4.5.4.16 game\_phase

```
GamePhase Game::game_phase
```

The current phase of the game.

#### 4.5.4.17 hex\_map\_ptr

```
HexMap* Game::hex_map_ptr
```

Pointer to the hex map (defines game world).

#### 4.5.4.18 message\_deadlock

```
bool Game::message_deadlock
```

A boolean indicating whether a message deadlock has been detected.

#### 4.5.4.19 message\_deadlock\_frame

```
int Game::message_deadlock_frame
```

A frame counter for detecting message deadlock.

#### 4.5.4.20 message\_hub

```
MessageHub Game::message_hub
```

The message hub (for inter-object message traffic).

#### 4.5.4.21 month

```
int Game::month
```

Current game month.

#### 4.5.4.22 net\_credit\_flow

```
int Game::net_credit_flow
```

The net credit flow at the end of a turn.

#### 4.5.4.23 overproduction\_MWh

```
int Game::overproduction_MWh
```

The amount of overproduction at the end of a turn.

**4.5.4.24 overproduction\_penalty**

```
int Game::overproduction_penalty
```

The penalty for overproduction.

**4.5.4.25 past\_demand\_MWh**

```
int Game::past_demand_MWh
```

The demand in the previous turn.

**4.5.4.26 population**

```
int Game::population
```

Current population.

**4.5.4.27 quit\_game**

```
bool Game::quit_game
```

Boolean indicating whether to quit (true) or create a new [Game](#) instance (false).

**4.5.4.28 render\_window\_ptr**

```
sf::RenderWindow* Game::render_window_ptr [private]
```

A pointer to the render window.

**4.5.4.29 show\_frame\_clock\_overlay**

```
bool Game::show_frame_clock_overlay
```

Boolean indicating whether or not to show frame and clock overlay.

#### 4.5.4.30 show\_tutorial

```
bool Game::show_tutorial
```

A boolean indicating whether or not to show the tutorial.

#### 4.5.4.31 substring\_idx

```
size_t Game::substring_idx
```

The index of the turn summary substring.

#### 4.5.4.32 time\_since\_start\_s

```
double Game::time_since_start_s
```

The time elapsed [s] since the start of the game.

#### 4.5.4.33 turn

```
int Game::turn = 0
```

The current game turn.

#### 4.5.4.34 turn\_emissions\_tonnes

```
int Game::turn_emissions_tonnes
```

The amount of emissions at the end of a turn.

#### 4.5.4.35 turn\_end

```
bool Game::turn_end
```

A boolean indicating a turn end.

#### 4.5.4.36 turn\_fuel\_cost

```
int Game::turn_fuel_cost
```

The cost of fuel at the end of a turn.

#### 4.5.4.37 turn\_operation\_maintenance\_cost

```
int Game::turn_operation_maintenance_cost
```

The cost of operation and maintenance at the end of a turn.

#### 4.5.4.38 turn\_summary\_string

```
std::string Game::turn_summary_string
```

A string representation of the end of turn summary.

#### 4.5.4.39 turn\_summary\_text

```
sf::Text Game::turn_summary_text
```

A text representation (drawable) of the end of turn summary.

#### 4.5.4.40 year

```
int Game::year
```

Current game year.

The documentation for this class was generated from the following files:

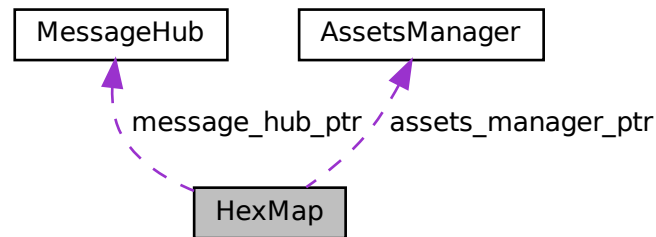
- header/[Game.h](#)
- source/[Game.cpp](#)

## 4.6 HexMap Class Reference

A class which defines a hex map of hex tiles.

```
#include <HexMap.h>
```

Collaboration diagram for HexMap:



### Public Member Functions

- [HexMap](#) (int, sf::Event \*, sf::RenderWindow \*, [AssetsManager](#) \*, [MessageHub](#) \*)  
*Constructor (intended) for the [HexMap](#) class.*
- void [assess](#) (void)  
*Method to assess the resource of the selected tile.*
- void [reroll](#) (void)  
*Method to re-roll the hex map.*
- void [toggleResourceOverlay](#) (void)  
*Method to toggle the hex map resource overlay.*
- void [processEvent](#) (void)  
*Method to process [HexMap](#). To be called once per event.*
- void [processMessage](#) (void)  
*Method to process [HexMap](#). To be called once per message.*
- void [draw](#) (void)  
*Method to draw the hex map to the render window. To be called once per frame.*
- void [clear](#) (void)  
*Method to clear the hex map.*
- [~HexMap](#) (void)  
*Destructor for the [HexMap](#) class.*



## Public Attributes

- bool [show\\_resource](#)  
*A boolean which indicates whether or not to show resource value.*
- bool [tile\\_selected](#)  
*A boolean which indicates if a tile is currently selected.*
- int [n\\_layers](#)  
*The number of layers in the hex map.*
- int [n\\_tiles](#)  
*The number of tiles in the hex map.*
- unsigned long long int [frame](#)  
*The current frame of this object.*
- double [position\\_x](#)  
*The x position of the hex map's origin (i.e. central) tile.*
- double [position\\_y](#)  
*The y position of the hex map's origin (i.e. central) tile.*
- sf::RectangleShape [glass\\_screen](#)  
*To give the effect of an old glass screen over the hex map.*
- std::vector< double > [tile\\_position\\_x\\_vec](#)  
*A vector of tile x positions.*
- std::vector< double > [tile\\_position\\_y\\_vec](#)  
*A vector of tile y position.*
- std::vector< [HexTile](#) \* > [border\\_tiles\\_vec](#)  
*A vector of pointers to the border tiles.*
- std::map< double, std::map< double, [HexTile](#) \* > > [hex\\_map](#)  
*A position-indexed, nested map of hex tiles.*
- std::vector< [HexTile](#) \* > [hex\\_draw\\_order\\_vec](#)  
*A vector of hex tiles, in drawing order.*

## Private Member Functions

- void [\\_\\_setUpGlassScreen](#) (void)  
*Helper method to set up glass screen effect (drawable).*
- void [\\_\\_layTiles](#) (void)  
*Helper method to lay the hex tiles down to generate the game world.*
- void [\\_\\_buildDrawOrderVector](#) (void)  
*Helper method to build tile drawing order vector.*
- std::vector< double > [\\_\\_getNoise](#) (int, int=128)  
*Helper method to generate a vector of noise, with values mapped to the closed interval [0, 1]. Applies a random cosine series approach.*
- void [\\_\\_procedurallyGenerateTileTypes](#) (void)  
*Helper method to procedurally generate tile types and set tiles accordingly.*
- std::vector< double > [\\_\\_getValidMapIndexPositions](#) (double, double)  
*Helper method to translate given position into valid index position for a.*
- std::vector< [HexTile](#) \* > [\\_\\_getNeighboursVector](#) ([HexTile](#) \*)  
*Helper method to assemble a vector pointers to all neighbours of the given tile.*
- [TileType](#) [\\_\\_getMajorityTileType](#) ([HexTile](#) \*)  
*Function to return majority tile type of a tile and its neighbours. If no clear majority, simply returns the type of the given tile.*
- void [\\_\\_smoothTileTypes](#) (void)  
*Helper method to smooth tile types using a majority rules approach.*

- bool [\\_\\_isLakeTouchingOcean](#) (HexTile \*)
- void [\\_\\_enforceOceanContinuity](#) (void)  
*Helper method to scan tiles and enforce ocean continuity. That is to say, if a lake tile is found to be in contact with an ocean tile, then it becomes ocean.*
- void [\\_\\_procedurallyGenerateTileResources](#) (void)  
*Helper method to procedurally generate tile resources and set tiles accordingly.*
- void [\\_\\_assembleHexMap](#) (void)  
*Helper method to assemble the hex map.*
- HexTile \* [\\_\\_getSelectedTile](#) (void)  
*Helper method to get pointer to selected tile.*
- void [\\_\\_handleKeyPressEvents](#) (void)  
*Helper method to handle key press events.*
- void [\\_\\_handleMouseButtonEvents](#) (void)  
*Helper method to handle mouse button events.*
- void [\\_\\_sendNoTileSelectedMessage](#) (void)  
*Helper method to format and send message on no tile selected.*
- void [\\_\\_assessNeighbours](#) (HexTile \*)  
*Helper method to assess all neighbours of the given tile.*

## Private Attributes

- sf::Event \* [event\\_ptr](#)  
*A pointer to the event class.*
- sf::RenderWindow \* [render\\_window\\_ptr](#)  
*A pointer to the render window.*
- AssetsManager \* [assets\\_manager\\_ptr](#)  
*A pointer to the assets manager.*
- MessageHub \* [message\\_hub\\_ptr](#)  
*A pointer to the message hub.*

### 4.6.1 Detailed Description

A class which defines a hex map of hex tiles.

### 4.6.2 Constructor & Destructor Documentation

#### 4.6.2.1 HexMap()

```
HexMap::HexMap (
    int n_layers,
    sf::Event * event_ptr,
    sf::RenderWindow * render_window_ptr,
    AssetsManager * assets_manager_ptr,
    MessageHub * message_hub_ptr )
```

Constructor (intended) for the [HexMap](#) class.

## Parameters

<i>n_layers</i>	The number of layers in the <a href="#">HexMap</a> .
<i>event_ptr</i>	Pointer to the event class.
<i>render_window_ptr</i>	Pointer to the render window.
<i>assets_manager_ptr</i>	Pointer to the assets manager.
<i>message_hub_ptr</i>	Pointer to the message hub.

```

1116 {
1117     // 1. set attributes
1118
1119     // 1.1. private
1120     this->event_ptr = event_ptr;
1121     this->render_window_ptr = render_window_ptr;
1122
1123     this->assets_manager_ptr = assets_manager_ptr;
1124     this->message_hub_ptr = message_hub_ptr;
1125
1126     // 1.2. public
1127     this->show_resource = false;
1128     this->tile_selected = false;
1129
1130     this->frame = 0;
1131
1132     this->n_layers = n_layers;
1133     if (this->n_layers < 0) {
1134         this->n_layers = 0;
1135     }
1136
1137     this->position_x = 400;
1138     this->position_y = 400;
1139
1140     // 2. assemble n layer hex map
1141     this->__assembleHexMap();
1142
1143     // 3. set up and position drawable attributes
1144     this->__setUpGlassScreen();
1145
1146     // 4. add message channel(s)
1147     this->message_hub_ptr->addChannel(TILE_SELECTED_CHANNEL);
1148     this->message_hub_ptr->addChannel(NO_TILE_SELECTED_CHANNEL);
1149     this->message_hub_ptr->addChannel(TILE_STATE_CHANNEL);
1150     this->message_hub_ptr->addChannel(HEX_MAP_CHANNEL);
1151
1152     std::cout << "HexMap constructed at " << this << std::endl;
1153
1154     return;
1155 } /* HexMap(), intended */

```

## 4.6.2.2 ~HexMap()

```

HexMap::~HexMap (
    void )

```

Destructor for the [HexMap](#) class.

```

1449 {
1450     this->clear();
1451
1452     std::cout << "HexMap at " << this << " destroyed" << std::endl;
1453
1454     return;
1455 } /* ~HexMap() */

```

## 4.6.3 Member Function Documentation

#### 4.6.3.1 \_\_assembleHexMap()

```
void HexMap::__assembleHexMap (
    void ) [private]
```

Helper method to assemble the hex map.

```
875 {
876     // 1. seed RNG (using milliseconds since 1 Jan 1970)
877     unsigned long long int milliseconds_since_epoch =
878         std::chrono::duration_cast<std::chrono::milliseconds>(
879             std::chrono::system_clock::now().time_since_epoch()
880         ).count();
881     srand(milliseconds_since_epoch);
882
883     // 2. lay tiles
884     this->__layTiles();
885     this->__buildDrawOrderVector();
886
887     // 3. procedurally generate types
888     this->__procedurallyGenerateTileTypes();
889
890     // 4. procedurally generate resources
891     this->__procedurallyGenerateTileResources();
892
893     return;
894 } /* __assembleHexMap() */
```

#### 4.6.3.2 \_\_assessNeighbours()

```
void HexMap::__assessNeighbours (
    HexTile * hex_ptr ) [private]
```

Helper method to assess all neighbours of the given tile.

##### Parameters

<i>Pointer</i>	to the tile whose neighbours are to be assessed.
----------------	--

```
1067 {
1068     std::vector<HexTile*> neighbours_vec = this->__getNeighboursVector(hex_ptr);
1069
1070     for (size_t i = 0; i < neighbours_vec.size(); i++) {
1071         neighbours_vec[i]->assess();
1072     }
1073
1074     return;
1075 } /* __assessNeighbours() */
```

#### 4.6.3.3 \_\_buildDrawOrderVector()

```
void HexMap::__buildDrawOrderVector (
    void ) [private]
```

Helper method to build tile drawing order vector.

```
273 {
274     // 1. build temp list of tiles
275     std::list<HexTile*> temp_list;
276
277     std::map<double, std::map<double, HexTile*>::iterator hex_map_iter_x;
278     std::map<double, HexTile*>::iterator hex_map_iter_y;
279     for (
280         hex_map_iter_x = this->hex_map.begin();
```

```

281         hex_map_iter_x != this->hex_map.end();
282         hex_map_iter_x++
283     ) {
284         for (
285             hex_map_iter_y = hex_map_iter_x->second.begin();
286             hex_map_iter_y != hex_map_iter_x->second.end();
287             hex_map_iter_y++
288         ) {
289             temp_list.push_back(hex_map_iter_y->second);
290         }
291     }
292
293     // 2. move elements from temp list to drawing order vector
294     double min_position_y = 0;
295     std::list<HexTile*>::iterator list_iter;
296
297     while (not temp_list.empty()) {
298         // 2.1. determine min y position
299         min_position_y = std::numeric_limits<double>::infinity();
300
301         for (
302             list_iter = temp_list.begin();
303             list_iter != temp_list.end();
304             list_iter++
305         ) {
306             if ((*list_iter)->position_y < min_position_y) {
307                 min_position_y = (*list_iter)->position_y;
308             }
309         }
310
311         // 2.2 move min y list elements to drawing order vec
312         list_iter = temp_list.begin();
313         while (list_iter != temp_list.end()) {
314             if ((*list_iter)->position_y == min_position_y) {
315                 this->hex_draw_order_vec.push_back((*list_iter));
316                 list_iter = temp_list.erase(list_iter);
317             }
318             else {
319                 list_iter++;
320             }
321         }
322     }
323 }
324
325 return;
326 } /* __buildDrawOrderVector() */

```

#### 4.6.3.4 \_\_enforceOceanContinuity()

```

void HexMap::__enforceOceanContinuity (
    void ) [private]

```

Helper method to scan tiles and enforce ocean continuity. That is to say, if a lake tile is found to be in contact with an ocean tile, then it becomes ocean.

```

786 {
787     std::cout << "enforcing ocean continuity ..." << std::endl;
788
789     bool tile_changed = false;
790
791     // 1. scan tiles and enforce (where appropriate)
792     std::map<double, std::map<double, HexTile*>::iterator hex_map_iter_x;
793     std::map<double, HexTile*>::iterator hex_map_iter_y;
794     HexTile* hex_ptr;
795     for (
796         hex_map_iter_x = this->hex_map.begin();
797         hex_map_iter_x != this->hex_map.end();
798         hex_map_iter_x++
799     ) {
800         for (
801             hex_map_iter_y = hex_map_iter_x->second.begin();
802             hex_map_iter_y != hex_map_iter_x->second.end();
803             hex_map_iter_y++
804         ) {
805             hex_ptr = hex_map_iter_y->second;
806
807             if (this->__isLakeTouchingOcean(hex_ptr)) {
808                 hex_ptr->setTileType(TileType :: OCEAN);
809                 tile_changed = true;

```

```

810         }
811     }
812 }
813
814 if (tile_changed) {
815     this->__enforceOceanContinuity();
816 }
817 else {
818     return;
819 }
820 } /* __enforceOceanContinuity() */

```

#### 4.6.3.5 \_\_getMajorityTileType()

```

TileType HexMap::__getMajorityTileType (
    HexTile * hex_ptr ) [private]

```

Function to return majority tile type of a tile and its neighbours. If no clear majority, simply returns the type of the given tile.

##### Parameters

<i>hex_ptr</i>	Pointer to the given tile.
----------------	----------------------------

##### Returns

The majority tile type of the tile and its neighbours. If no clear majority type, then the type of the given tile is simply returned.

```

642 {
643     // 1. init type count map
644     std::map<TileType, int> type_count_map;
645     type_count_map[hex_ptr->tile_type] = 1;
646
647     // 2. survey neighbours, count type instances
648     std::vector<HexTile*> neighbours_vec = this->__getNeighboursVector(hex_ptr);
649
650     for (size_t i = 0; i < neighbours_vec.size(); i++) {
651         if (type_count_map.count(neighbours_vec[i]->tile_type) <= 0) {
652             type_count_map[neighbours_vec[i]->tile_type] = 1;
653         }
654         else {
655             type_count_map[neighbours_vec[i]->tile_type] += 1;
656         }
657     }
658
659     // 3. find majority tile type
660     int max_count = -1 * std::numeric_limits<int>::infinity();
661     TileType majority_tile_type = hex_ptr->tile_type;
662
663     std::map<TileType, int>::iterator map_iter;
664     for (
665         map_iter = type_count_map.begin();
666         map_iter != type_count_map.end();
667         map_iter++
668     ){
669         if (map_iter->second > max_count) {
670             max_count = map_iter->second;
671             majority_tile_type = map_iter->first;
672         }
673     }
674
675     // 4. detect ties
676     for (
677         map_iter = type_count_map.begin();
678         map_iter != type_count_map.end();
679         map_iter++
680     ){
681         if (
682             map_iter->second == max_count and
683             map_iter->first != majority_tile_type

```

```

684         ) {
685             majority_tile_type = hex_ptr->tile_type;
686             break;
687         }
688     }
689
690     return majority_tile_type;
691 } /* __getMajorityTileType() */

```

#### 4.6.3.6 \_\_getNeighboursVector()

```

std::vector< HexTile * > HexMap::__getNeighboursVector (
    HexTile * hex_ptr ) [private]

```

Helper method to assemble a vector pointers to all neighbours of the given tile.

##### Parameters

<i>hex_ptr</i>	A pointer to the given tile.
----------------	------------------------------

##### Returns

A vector of pointers to all neighbours of the given tile.

```

584 {
585     std::vector<HexTile*> neighbours_vec;
586
587     // 1. build potential neighbour positions
588     std::vector<double> potential_neighbour_x_vec(6, 0);
589     std::vector<double> potential_neighbour_y_vec(6, 0);
590
591     for (int i = 0; i < 6; i++) {
592         potential_neighbour_x_vec[i] = hex_ptr->position_x +
593             2 * hex_ptr->minor_radius * cos((60 * i) * (M_PI / 180));
594
595         potential_neighbour_y_vec[i] = hex_ptr->position_y +
596             2 * hex_ptr->minor_radius * sin((60 * i) * (M_PI / 180));
597     }
598
599     // 2. populate neighbours vector
600     std::vector<double> map_index_positions;
601     double potential_x = 0;
602     double potential_y = 0;
603
604     for (int i = 0; i < 6; i++) {
605         potential_x = potential_neighbour_x_vec[i];
606         potential_y = potential_neighbour_y_vec[i];
607
608         map_index_positions = this->__getValidMapIndexPositions(
609             potential_x,
610             potential_y
611         );
612
613         if (not (map_index_positions[0] == -1)) {
614             neighbours_vec.push_back(
615                 this->hex_map[map_index_positions[0]][map_index_positions[1]]
616             );
617         }
618     }
619
620     return neighbours_vec;
621 } /* __getNeighbourVector() */

```

#### 4.6.3.7 \_\_getNoise()

```

std::vector< double > HexMap::__getNoise (
    int n_elements,
    int n_components = 128 ) [private]

```

Helper method to generate a vector of noise, with values mapped to the closed interval [0, 1]. Applies a random cosine series approach.

#### Parameters

<i>n_elements</i>	The number of elements in the generated noise vector.
<i>n_components</i>	The number of components to use in the random cosine series. Defaults to 64.

#### Returns

A vector of noise, with values mapped to the closed interval [0, 1].

```

349 {
350     // 1. generate random amplitude, wave number, direction, and phase vectors
351     std::vector<double> random_amplitude_vec(n_components, 0);
352     std::vector<double> random_wave_number_vec(n_components, 0);
353     std::vector<double> random_frequency_vec(n_components, 0);
354     std::vector<double> random_direction_vec(n_components, 0);
355     std::vector<double> random_phase_vec(n_components, 0);
356
357     for (int i = 0; i < n_components; i++) {
358         random_amplitude_vec[i] = 10 * ((double)rand() / RAND_MAX);
359
360         random_wave_number_vec[i] = 2 * M_PI * ((double)rand() / RAND_MAX);
361
362         random_frequency_vec[i] = ((double)rand() / RAND_MAX);
363
364         random_direction_vec[i] = 2 * M_PI * ((double)rand() / RAND_MAX);
365
366         random_phase_vec[i] = 2 * M_PI * ((double)rand() / RAND_MAX);
367     }
368
369     // 2. generate noise vec
370     double amp = 0;
371     double wave_no = 0;
372     double freq = 0;
373     double dir = 0;
374     double phase = 0;
375
376     double x = 0;
377     double y = 0;
378     double t = time(NULL);
379
380     double max_noise = -1 * std::numeric_limits<double>::infinity();
381     double min_noise = std::numeric_limits<double>::infinity();
382
383     double noise = 0;
384     std::vector<double> noise_vec(n_elements, 0);
385
386     for (int i = 0; i < n_elements; i++) {
387         x = this->tile_position_x_vec[i] - this->position_x;
388         y = this->tile_position_y_vec[i] - this->position_y;
389
390         for (int j = 0; j < n_components; j++) {
391             amp = random_amplitude_vec[j];
392             wave_no = random_wave_number_vec[j];
393             freq = random_frequency_vec[j];
394             dir = random_direction_vec[j];
395             phase = random_phase_vec[j];
396
397             noise += (amp / (j + 1)) * cos(
398                 wave_no * (j + 1) * (x * sin(dir) + y * cos(dir)) +
399                 2 * M_PI * (j + 1) * freq * t +
400                 phase
401             );
402         }
403
404         noise_vec[i] = noise;
405
406         if (noise > max_noise) {
407             max_noise = noise;
408         }
409
410         else if (noise < min_noise) {
411             min_noise = noise;
412         }
413
414         noise = 0;
415     }
416

```



```

417 // 3. normalize noise vec
418 for (int i = 0; i < n_elements; i++) {
419     noise_vec[i] = (noise_vec[i] - min_noise) / (max_noise - min_noise);
420
421     if (noise_vec[i] < 0) {
422         noise_vec[i] = 0;
423     }
424     else if (noise_vec[i] > 1) {
425         noise_vec[i] = 1;
426     }
427 }
428
429 return noise_vec;
430 } /* __getNoise() */

```

#### 4.6.3.8 \_\_getSelectedTile()

```

HexTile * HexMap::__getSelectedTile (
    void ) [private]

```

Helper method to get pointer to selected tile.

##### Returns

Pointer to selected tile (or NULL if no tile selected).

```

911 {
912     HexTile* selected_tile_ptr = NULL;
913
914     bool break_flag = false;
915     std::map<double, std::map<double, HexTile*>::iterator hex_map_iter_x;
916     std::map<double, HexTile*>::iterator hex_map_iter_y;
917
918     for (
919         hex_map_iter_x = this->hex_map.begin();
920         hex_map_iter_x != this->hex_map.end();
921         hex_map_iter_x++
922     ) {
923         for (
924             hex_map_iter_y = hex_map_iter_x->second.begin();
925             hex_map_iter_y != hex_map_iter_x->second.end();
926             hex_map_iter_y++
927         ) {
928             if (hex_map_iter_y->second->is_selected) {
929                 selected_tile_ptr = hex_map_iter_y->second;
930                 break_flag = true;
931             }
932
933             if (break_flag) {
934                 break;
935             }
936         }
937
938         if (break_flag) {
939             break;
940         }
941     }
942
943     return selected_tile_ptr;
944 } /* __getSelectedTile() */

```

#### 4.6.3.9 \_\_getValidMapIndexPositions()

```

std::vector< double > HexMap::__getValidMapIndexPositions (
    double potential_x,
    double potential_y ) [private]

```

Helper method to translate given position into valid index position for a.

## Parameters

<i>potential</i> ↔ _x	The potential x position of the tile.
<i>potential</i> ↔ _y	The potential y position of the tile.

## Returns

A vector of positions, either valid for indexing into the hex map, or sentinel values (-1) if invalid.

```

530 {
531     std::vector<double> map_index_positions = {-1, -1};
532
533     std::map<double, std::map<double, HexTile*>::iterator hex_map_iter_x;
534     std::map<double, HexTile*>::iterator hex_map_iter_y;
535     HexTile* hex_ptr;
536
537     double distance = 0;
538
539     for (
540         hex_map_iter_x = this->hex_map.begin();
541         hex_map_iter_x != this->hex_map.end();
542         hex_map_iter_x++
543     ) {
544         for (
545             hex_map_iter_y = hex_map_iter_x->second.begin();
546             hex_map_iter_y != hex_map_iter_x->second.end();
547             hex_map_iter_y++
548         ) {
549             hex_ptr = hex_map_iter_y->second;
550
551             distance = sqrt(
552                 pow(hex_ptr->position_x - potential_x, 2) +
553                 pow(hex_ptr->position_y - potential_y, 2)
554             );
555
556             if (distance <= hex_ptr->minor_radius / 4) {
557                 map_index_positions = {hex_ptr->position_x, hex_ptr->position_y};
558                 return map_index_positions;
559             }
560         }
561     }
562
563     return map_index_positions;
564 } /* __isInHexMap() */

```

## 4.6.3.10 \_\_handleKeyPressEvents()

```

void HexMap::__handleKeyPressEvents (
    void ) [private]

```

Helper method to handle key press events.

```

959 {
960     switch (this->event_ptr->key.code) {
961         case (sf::Keyboard::Escape): {
962             this->tile_selected = false;
963         }
964
965         default: {
966             // do nothing!
967
968             break;
969         }
970     }
971 }
972
973 return;
974 } /* __handleKeyPressEvents() */

```

**4.6.3.11 \_\_handleMouseButtonEvents()**

```
void HexMap::__handleMouseButtonEvents (
    void ) [private]
```

Helper method to handle mouse button events.

```
989 {
990     switch (this->event_ptr->mouseButton.button) {
991         case (sf::Mouse::Left): {
992             HexTile* hex_ptr = this->__getSelectedTile();
993
994             if (hex_ptr != NULL) {
995                 this->tile_selected = true;
996             }
997
998             else if (this->tile_selected) {
999                 this->tile_selected = false;
1000                 this->__sendNoTileSelectedMessage();
1001             }
1002
1003             break;
1004         }
1005
1006         case (sf::Mouse::Right): {
1007             if (this->tile_selected) {
1008                 this->tile_selected = false;
1009                 this->__sendNoTileSelectedMessage();
1010             }
1011
1012             break;
1013         }
1014
1015         default: {
1016             // do nothing!
1017
1018             break;
1019         }
1020     }
1021
1022     return;
1023 }
1024 /* __handleMouseButtonEvents() */
1025 }
```

**4.6.3.12 \_\_isLakeTouchingOcean()**

```
bool HexMap::__isLakeTouchingOcean (
    HexTile * hex_ptr ) [private]

753 {
754     // 1. if not lake tile, return
755     if (not (hex_ptr->tile_type == TileType::LAKE)) {
756         return false;
757     }
758
759     // 2. scan neighbours for ocean tiles
760     std::vector<HexTile*> neighbours_vec = this->__getNeighboursVector(hex_ptr);
761
762     for (size_t i = 0; i < neighbours_vec.size(); i++) {
763         if (neighbours_vec[i]->tile_type == TileType::OCEAN) {
764             return true;
765         }
766     }
767
768     return false;
769 }
/* __isLakeTouchingOcean() */
```

#### 4.6.3.13 \_\_layTiles()

```
void HexMap::__layTiles (
    void ) [private]
```

Helper method to lay the hex tiles down to generate the game world.

```
88 {
89     this->n_tiles = 0;
90
91     // 1. add origin tile
92     HexTile* hex_ptr = new HexTile(
93         this->position_x,
94         this->position_y,
95         this->event_ptr,
96         this->render_window_ptr,
97         this->assets_manager_ptr,
98         this->message_hub_ptr
99     );
100
101     this->hex_map[hex_ptr->position_x][hex_ptr->position_y] = hex_ptr;
102     this->tile_position_x_vec.push_back(hex_ptr->position_x);
103     this->tile_position_y_vec.push_back(hex_ptr->position_y);
104     this->n_tiles++;
105
106
107     // 2. fill out first row (reflect across origin tile)
108     for (int i = 0; i < this->n_layers; i++) {
109         hex_ptr = new HexTile(
110             this->position_x + 2 * (i + 1) * hex_ptr->minor_radius,
111             this->position_y,
112             this->event_ptr,
113             this->render_window_ptr,
114             this->assets_manager_ptr,
115             this->message_hub_ptr
116         );
117
118         this->hex_map[hex_ptr->position_x][hex_ptr->position_y] = hex_ptr;
119         this->tile_position_x_vec.push_back(hex_ptr->position_x);
120         this->tile_position_y_vec.push_back(hex_ptr->position_y);
121         this->n_tiles++;
122
123         if (i == this->n_layers - 1) {
124             this->border_tiles_vec.push_back(hex_ptr);
125         }
126
127         hex_ptr = new HexTile(
128             this->position_x - 2 * (i + 1) * hex_ptr->minor_radius,
129             this->position_y,
130             this->event_ptr,
131             this->render_window_ptr,
132             this->assets_manager_ptr,
133             this->message_hub_ptr
134         );
135
136         this->hex_map[hex_ptr->position_x][hex_ptr->position_y] = hex_ptr;
137         this->tile_position_x_vec.push_back(hex_ptr->position_x);
138         this->tile_position_y_vec.push_back(hex_ptr->position_y);
139         this->n_tiles++;
140
141         if (i == this->n_layers - 1) {
142             this->border_tiles_vec.push_back(hex_ptr);
143         }
144     }
145
146
147     // 3. fill out subsequent rows (reflect across first row)
148     HexTile* first_row_left_tile = hex_ptr;
149
150     int offset_count = 1;
151
152     double x_offset = 0;
153     double y_offset = 0;
154
155     for (
156         int row_width = 2 * this->n_layers;
157         row_width > this->n_layers;
158         row_width--
159     ) {
160         // 3.1. upper row
161         x_offset = first_row_left_tile->position_x +
162             2 * offset_count * first_row_left_tile->minor_radius *
163             cos(60 * (M_PI / 180));
164
165         y_offset = first_row_left_tile->position_y -
```

```

166         2 * offset_count * first_row_left_tile->minor_radius *
167         sin(60 * (M_PI / 180));
168
169     hex_ptr = new HexTile(
170         x_offset,
171         y_offset,
172         this->event_ptr,
173         this->render_window_ptr,
174         this->assets_manager_ptr,
175         this->message_hub_ptr
176     );
177
178     this->hex_map[hex_ptr->position_x][hex_ptr->position_y] = hex_ptr;
179     this->tile_position_x_vec.push_back(hex_ptr->position_x);
180     this->tile_position_y_vec.push_back(hex_ptr->position_y);
181     this->n_tiles++;
182
183     this->border_tiles_vec.push_back(hex_ptr);
184
185     for (int i = 1; i < row_width; i++) {
186         x_offset += 2 * first_row_left_tile->minor_radius;
187
188         hex_ptr = new HexTile(
189             x_offset,
190             y_offset,
191             this->event_ptr,
192             this->render_window_ptr,
193             this->assets_manager_ptr,
194             this->message_hub_ptr
195         );
196
197         this->hex_map[hex_ptr->position_x][hex_ptr->position_y] = hex_ptr;
198         this->tile_position_x_vec.push_back(hex_ptr->position_x);
199         this->tile_position_y_vec.push_back(hex_ptr->position_y);
200         this->n_tiles++;
201
202         if (row_width == this->n_layers + 1 or i == row_width - 1) {
203             this->border_tiles_vec.push_back(hex_ptr);
204         }
205     }
206
207     // 3.2. lower row
208     x_offset = first_row_left_tile->position_x +
209         2 * offset_count * first_row_left_tile->minor_radius *
210         cos(60 * (M_PI / 180));
211
212     y_offset = first_row_left_tile->position_y +
213         2 * offset_count * first_row_left_tile->minor_radius *
214         sin(60 * (M_PI / 180));
215
216     hex_ptr = new HexTile(
217         x_offset,
218         y_offset,
219         this->event_ptr,
220         this->render_window_ptr,
221         this->assets_manager_ptr,
222         this->message_hub_ptr
223     );
224
225     this->hex_map[hex_ptr->position_x][hex_ptr->position_y] = hex_ptr;
226     this->tile_position_x_vec.push_back(hex_ptr->position_x);
227     this->tile_position_y_vec.push_back(hex_ptr->position_y);
228     this->n_tiles++;
229
230     this->border_tiles_vec.push_back(hex_ptr);
231
232     for (int i = 1; i < row_width; i++) {
233         x_offset += 2 * first_row_left_tile->minor_radius;
234
235         hex_ptr = new HexTile(
236             x_offset,
237             y_offset,
238             this->event_ptr,
239             this->render_window_ptr,
240             this->assets_manager_ptr,
241             this->message_hub_ptr
242         );
243
244         this->hex_map[hex_ptr->position_x][hex_ptr->position_y] = hex_ptr;
245         this->tile_position_x_vec.push_back(hex_ptr->position_x);
246         this->tile_position_y_vec.push_back(hex_ptr->position_y);
247         this->n_tiles++;
248
249         if (row_width == this->n_layers + 1 or i == row_width - 1) {
250             this->border_tiles_vec.push_back(hex_ptr);
251         }
252     }

```

```

253
254         offset_count++;
255     }
256
257     return;
258 } /* __layTiles() */

```

#### 4.6.3.14 \_\_procedurallyGenerateTileResources()

```

void HexMap::__procedurallyGenerateTileResources (
    void ) [private]

```

Helper method to procedurally generate tile resources and set tiles accordingly.

```

835 {
836     // 1. get random cosine series noise vec
837     std::vector<double> noise_vec = this->__getNoise(this->n_tiles);
838
839     // 2. set tile resources based on random cosine series noise
840     int noise_idx = 0;
841
842     std::map<double, std::map<double, HexTile*>>::iterator hex_map_iter_x;
843     std::map<double, HexTile*>::iterator hex_map_iter_y;
844     for (
845         hex_map_iter_x = this->hex_map.begin();
846         hex_map_iter_x != this->hex_map.end();
847         hex_map_iter_x++
848     ) {
849         for (
850             hex_map_iter_y = hex_map_iter_x->second.begin();
851             hex_map_iter_y != hex_map_iter_x->second.end();
852             hex_map_iter_y++
853         ) {
854             hex_map_iter_y->second->setTileResource(noise_vec[noise_idx]);
855             noise_idx++;
856         }
857     }
858
859     return;
860 } /* __procedurallyGenerateTileResources() */

```

#### 4.6.3.15 \_\_procedurallyGenerateTileTypes()

```

void HexMap::__procedurallyGenerateTileTypes (
    void ) [private]

```

Helper method to procedurally generate tile types and set tiles accordingly.

```

445 {
446     // 1. get random cosine series noise vec
447     std::vector<double> noise_vec = this->__getNoise(this->n_tiles);
448
449     // 2. set initial tile types based on either random cosine series noise or white
450     //     noise (decided by coin toss)
451     int noise_idx = 0;
452
453     std::map<double, std::map<double, HexTile*>>::iterator hex_map_iter_x;
454     std::map<double, HexTile*>::iterator hex_map_iter_y;
455     for (
456         hex_map_iter_x = this->hex_map.begin();
457         hex_map_iter_x != this->hex_map.end();
458         hex_map_iter_x++
459     ) {
460         for (
461             hex_map_iter_y = hex_map_iter_x->second.begin();
462             hex_map_iter_y != hex_map_iter_x->second.end();
463             hex_map_iter_y++
464         ) {
465             if ((double)rand() / RAND_MAX > 0.5) {
466                 hex_map_iter_y->second->setTileType(noise_vec[noise_idx]);
467             }

```

```

468         else {
469             hex_map_iter_y->second->setTileType((double)rand() / RAND_MAX);
470         }
471         noise_idx++;
472     }
473 }
474
475 // 3. smooth tile types (majority rules)
476 this->__smoothTileTypes();
477
478 // 4. set border tile type to ocean
479 for (size_t i = 0; i < this->border_tiles_vec.size(); i++) {
480     this->border_tiles_vec[i]->setTileType(TileType :: OCEAN);
481 }
482
483 // 5. enforce ocean continuity (i.e. all lake tiles touching ocean become ocean)
484 this->__enforceOceanContinuity();
485
486 // 6. decorate tiles
487 for (
488     hex_map_iter_x = this->hex_map.begin();
489     hex_map_iter_x != this->hex_map.end();
490     hex_map_iter_x++
491 ) {
492     for (
493         hex_map_iter_y = hex_map_iter_x->second.begin();
494         hex_map_iter_y != hex_map_iter_x->second.end();
495         hex_map_iter_y++
496     ) {
497         hex_map_iter_y->second->decorateTile();
498     }
499 }
500
501 return;
502 } /* __procedurallyGenerateTileTypes() */

```

#### 4.6.3.16 \_\_sendNoTileSelectedMessage()

```

void HexMap::__sendNoTileSelectedMessage (
    void ) [private]

```

Helper method to format and send message on no tile selected.

```

1040 {
1041     Message no_tile_selected_message;
1042
1043     no_tile_selected_message.channel = NO_TILE_SELECTED_CHANNEL;
1044     no_tile_selected_message.subject = "no tile selected";
1045
1046     this->message_hub_ptr->sendMessage(no_tile_selected_message);
1047
1048     std::cout << "No tile selected message sent by " << this << std::endl;
1049     return;
1050 } /* __sendNoTileSelectedMessage() */

```

#### 4.6.3.17 \_\_setUpGlassScreen()

```

void HexMap::__setUpGlassScreen (
    void ) [private]

```

Helper method to set up glass screen effect (drawable).

```

68 {
69     this->glass_screen.setSize(sf::Vector2f(GAME_WIDTH, GAME_HEIGHT));
70     this->glass_screen.setFillColor(sf::Color(MONOCROME_SCREEN_BACKGROUND));
71
72     return;
73 } /* __setUpGlassScreen() */

```

#### 4.6.3.18 \_\_smoothTileTypes()

```
void HexMap::__smoothTileTypes (
    void ) [private]
```

Helper method to smooth tile types using a majority rules approach.

```
706 {
707     std::cout << "smoothing ..." << std::endl;
708
709     std::map<double, std::map<double, HexTile*>::iterator hex_map_iter_x;
710     std::map<double, HexTile*>::iterator hex_map_iter_y;
711     HexTile* hex_ptr;
712     TileType majority_tile_type;
713
714     for (
715         hex_map_iter_x = this->hex_map.begin();
716         hex_map_iter_x != this->hex_map.end();
717         hex_map_iter_x++
718     ) {
719         for (
720             hex_map_iter_y = hex_map_iter_x->second.begin();
721             hex_map_iter_y != hex_map_iter_x->second.end();
722             hex_map_iter_y++
723         ) {
724             hex_ptr = hex_map_iter_y->second;
725             majority_tile_type = this->__getMajorityTileType(hex_ptr);
726
727             if (majority_tile_type != hex_ptr->tile_type) {
728                 hex_ptr->setTileType(majority_tile_type);
729             }
730         }
731     }
732
733     return;
734 } /* __smoothTileTypes() */
```

#### 4.6.3.19 assess()

```
void HexMap::assess (
    void )
```

Method to assess the resource of the selected tile.

```
1170 {
1171     HexTile* selected_tile_ptr = this->__getSelectedTile();
1172     if (selected_tile_ptr != NULL) {
1173         selected_tile_ptr->assess();
1174     }
1175
1176     return;
1177 } /* assess() */
```

#### 4.6.3.20 clear()

```
void HexMap::clear (
    void )
```

Method to clear the hex map.

```
1411 {
1412     std::map<double, std::map<double, HexTile*>::iterator hex_map_iter_x;
1413     std::map<double, HexTile*>::iterator hex_map_iter_y;
1414     for (
1415         hex_map_iter_x = this->hex_map.begin();
1416         hex_map_iter_x != this->hex_map.end();
1417         hex_map_iter_x++
1418     ) {
1419         for (
```



```

1420         hex_map_iter_y = hex_map_iter_x->second.begin();
1421         hex_map_iter_y != hex_map_iter_x->second.end();
1422         hex_map_iter_y++
1423     ) {
1424         delete hex_map_iter_y->second;
1425     }
1426 }
1427 this->hex_map.clear();
1428
1429 this->tile_position_x_vec.clear();
1430 this->tile_position_y_vec.clear();
1431 this->border_tiles_vec.clear();
1432
1433 return;
1434 } /* clear() */

```

#### 4.6.3.21 draw()

```

void HexMap::draw (
    void )

```

Method to draw the hex map to the render window. To be called once per frame.

```

1348 {
1349     // 1. draw background
1350     sf::Color glass_screen_colour = this->glass_screen.getFillColor();
1351     glass_screen_colour.a = 255;
1352     this->glass_screen.setFillColor(glass_screen_colour);
1353
1354     this->render_window_ptr->draw(this->glass_screen);
1355
1356     // 2. draw tiles (other than the selected tile) in drawing order
1357     for (size_t i = 0; i < this->hex_draw_order_vec.size(); i++) {
1358         if (not this->hex_draw_order_vec[i]->is_selected) {
1359             this->hex_draw_order_vec[i]->draw();
1360         }
1361     }
1362
1363     // 3. draw selected tile
1364     HexTile* selected_tile_ptr = this->__getSelectedTile();
1365     if (selected_tile_ptr != NULL) {
1366         selected_tile_ptr->draw();
1367     }
1368
1369     // 4. draw resource overlay text indication
1370     if (this->show_resource) {
1371         sf::Text resource_overlay_text(
1372             "**** RENEWABLE RESOURCE OVERLAY ****",
1373             *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
1374             16
1375         );
1376
1377         resource_overlay_text.setPosition(
1378             (800 - resource_overlay_text.getLocalBounds().width) / 2,
1379             GAME_HEIGHT - 70
1380         );
1381
1382         resource_overlay_text.setFillColor(MONOCROME_TEXT_GREEN);
1383
1384         this->render_window_ptr->draw(resource_overlay_text);
1385     }
1386
1387     // 5. draw glass screen
1388     glass_screen_colour = this->glass_screen.getFillColor();
1389     glass_screen_colour.a = 40;
1390     this->glass_screen.setFillColor(glass_screen_colour);
1391
1392     this->render_window_ptr->draw(this->glass_screen);
1393
1394     this->frame++;
1395     return;
1396 } /* draw() */

```

#### 4.6.3.22 processEvent()

```
void HexMap::processEvent (
    void )
```

Method to process [HexMap](#). To be called once per event.

```
1255 {
1256     // 1. process HexTile events
1257     std::map<double, std::map<double, HexTile*>::iterator hex_map_iter_x;
1258     std::map<double, HexTile*>::iterator hex_map_iter_y;
1259     for (
1260         hex_map_iter_x = this->hex_map.begin();
1261         hex_map_iter_x != this->hex_map.end();
1262         hex_map_iter_x++
1263     ) {
1264         for (
1265             hex_map_iter_y = hex_map_iter_x->second.begin();
1266             hex_map_iter_y != hex_map_iter_x->second.end();
1267             hex_map_iter_y++
1268         ) {
1269             hex_map_iter_y->second->processEvent();
1270         }
1271     }
1272
1273     // 2. process HexMap events
1274     if (this->event_ptr->type == sf::Event::KeyPressed) {
1275         this->__handleKeyPressEvents();
1276     }
1277
1278     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
1279         this->__handleMouseButtonEvents();
1280     }
1281
1282     return;
1283 } /* processEvent() */
```

#### 4.6.3.23 processMessage()

```
void HexMap::processMessage (
    void )
```

Method to process [HexMap](#). To be called once per message.

```
1298 {
1299     // 1. process HexTile messages
1300     std::map<double, std::map<double, HexTile*>::iterator hex_map_iter_x;
1301     std::map<double, HexTile*>::iterator hex_map_iter_y;
1302     for (
1303         hex_map_iter_x = this->hex_map.begin();
1304         hex_map_iter_x != this->hex_map.end();
1305         hex_map_iter_x++
1306     ) {
1307         for (
1308             hex_map_iter_y = hex_map_iter_x->second.begin();
1309             hex_map_iter_y != hex_map_iter_x->second.end();
1310             hex_map_iter_y++
1311         ) {
1312             hex_map_iter_y->second->processMessage();
1313         }
1314     }
1315
1316     // 2. process HexMap messages
1317     if (not this->message_hub_ptr->isEmpty(HEX_MAP_CHANNEL)) {
1318         Message hex_map_message = this->message_hub_ptr->receiveMessage(
1319             HEX_MAP_CHANNEL
1320         );
1321
1322         if (hex_map_message.subject == "assess neighbours") {
1323             HexTile* hex_ptr = this->__getSelectedTile();
1324             this->__assessNeighbours(hex_ptr);
1325
1326             std::cout << "Assess neighbours message received by " << this << std::endl;
1327             this->message_hub_ptr->popMessage(HEX_MAP_CHANNEL);
1328         }
1329     }
1330
1331     return;
1332 } /* processMessage() */
```

#### 4.6.3.24 reroll()

```
void HexMap::reroll (
    void )
```

Method to re-roll the hex map.

```
1192 {
1193     this->clear();
1194     this->__assembleHexMap();
1195
1196     return;
1197 } /* reroll() */
```

#### 4.6.3.25 toggleResourceOverlay()

```
void HexMap::toggleResourceOverlay (
    void )
```

Method to toggle the hex map resource overlay.

```
1212 {
1213     std::map<double, std::map<double, HexTile*>::iterator hex_map_iter_x;
1214     std::map<double, HexTile*>::iterator hex_map_iter_y;
1215     for (
1216         hex_map_iter_x = this->hex_map.begin();
1217         hex_map_iter_x != this->hex_map.end();
1218         hex_map_iter_x++
1219     ) {
1220         for (
1221             hex_map_iter_y = hex_map_iter_x->second.begin();
1222             hex_map_iter_y != hex_map_iter_x->second.end();
1223             hex_map_iter_y++
1224         ) {
1225             hex_map_iter_y->second->toggleResourceOverlay();
1226         }
1227     }
1228
1229     if (this->show_resource) {
1230         this->show_resource = false;
1231         this->assets_manager_ptr->getSound("resource overlay toggle off")->play();
1232     }
1233
1234     else {
1235         this->show_resource = true;
1236         this->assets_manager_ptr->getSound("resource overlay toggle on")->play();
1237     }
1238
1239     return;
1240 } /* toggleResourceOverlay() */
```

### 4.6.4 Member Data Documentation

#### 4.6.4.1 assets\_manager\_ptr

```
AssetsManager* HexMap::assets_manager_ptr [private]
```

A pointer to the assets manager.

#### 4.6.4.2 border\_tiles\_vec

```
std::vector<HexTile*> HexMap::border_tiles_vec
```

A vector of pointers to the border tiles.

#### 4.6.4.3 event\_ptr

```
sf::Event* HexMap::event_ptr [private]
```

A pointer to the event class.

#### 4.6.4.4 frame

```
unsigned long long int HexMap::frame
```

The current frame of this object.

#### 4.6.4.5 glass\_screen

```
sf::RectangleShape HexMap::glass_screen
```

To give the effect of an old glass screen over the hex map.

#### 4.6.4.6 hex\_draw\_order\_vec

```
std::vector<HexTile*> HexMap::hex_draw_order_vec
```

A vector of hex tiles, in drawing order.

#### 4.6.4.7 hex\_map

```
std::map<double, std::map<double, HexTile*> > HexMap::hex_map
```

A position-indexed, nested map of hex tiles.

#### 4.6.4.8 message\_hub\_ptr

```
MessageHub* HexMap::message_hub_ptr [private]
```

A pointer to the message hub.

#### 4.6.4.9 n\_layers

```
int HexMap::n_layers
```

The number of layers in the hex map.

#### 4.6.4.10 n\_tiles

```
int HexMap::n_tiles
```

The number of tiles in the hex map.

#### 4.6.4.11 position\_x

```
double HexMap::position_x
```

The x position of the hex map's origin (i.e. central) tile.

#### 4.6.4.12 position\_y

```
double HexMap::position_y
```

The y position of the hex map's origin (i.e. central) tile.

#### 4.6.4.13 render\_window\_ptr

```
sf::RenderWindow* HexMap::render_window_ptr [private]
```

A pointer to the render window.

#### 4.6.4.14 show\_resource

```
bool HexMap::show_resource
```

A boolean which indicates whether or not to show resource value.

#### 4.6.4.15 tile\_position\_x\_vec

```
std::vector<double> HexMap::tile_position_x_vec
```

A vector of tile x positions.

#### 4.6.4.16 tile\_position\_y\_vec

```
std::vector<double> HexMap::tile_position_y_vec
```

A vector of tile y position.

#### 4.6.4.17 tile\_selected

```
bool HexMap::tile_selected
```

A boolean which indicates if a tile is currently selected.

The documentation for this class was generated from the following files:

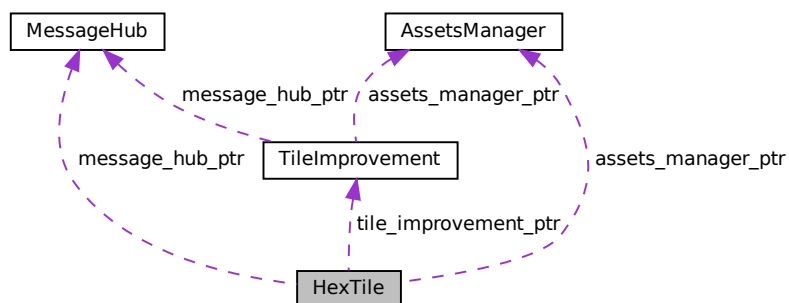
- header/[HexMap.h](#)
- source/[HexMap.cpp](#)

## 4.7 HexTile Class Reference

A class which defines a hex tile of the hex map.

```
#include <HexTile.h>
```

Collaboration diagram for HexTile:



## Public Member Functions

- [HexTile](#) (double, double, sf::Event \*, sf::RenderWindow \*, [AssetsManager](#) \*, [MessageHub](#) \*)  
*Constructor for the [HexTile](#) class.*
- void [setTileType](#) ([TileType](#))  
*Method to set the tile type (by enum value).*
- void [setTileType](#) (double)  
*Method to set the tile type (by numeric input).*
- void [setTileResource](#) ([TileResource](#))  
*Method to set the tile resource (by enum value).*
- void [setTileResource](#) (double)  
*Method to set the tile resource (by numeric input).*
- void [decorateTile](#) (void)  
*Method to decorate tile.*
- void [toggleResourceOverlay](#) (void)  
*Method to toggle the tile resource overlay.*
- void [assess](#) (void)  
*Method to assess the tile's resource.*
- void [processEvent](#) (void)  
*Method to process [HexTile](#). To be called once per event.*
- void [processMessage](#) (void)  
*Method to process [HexTile](#). To be called once per message.*
- void [draw](#) (void)  
*Method to draw the hex tile to the render window. To be called once per frame.*
- [~HexTile](#) (void)  
*Destructor for the [HexTile](#) class.*

## Public Attributes

- [TileType](#) [tile\\_type](#)  
*The terrain type of the tile.*
- [TileResource](#) [tile\\_resource](#)  
*The renewable resource quality of the tile.*
- bool [show\\_node](#)  
*A boolean which indicates whether or not to show the tile node.*
- bool [show\\_resource](#)  
*A boolean which indicates whether or not to show resource value.*
- bool [resource\\_assessed](#)  
*A boolean which indicates whether or not the resource has been assessed.*
- bool [resource\\_assessment](#)  
*A boolean which triggers a resource assessment notification.*
- bool [is\\_selected](#)  
*A boolean which indicates whether or not the tile is selected.*
- bool [draw\\_explosion](#)  
*A boolean which indicates whether or not to draw a tile explosion.*
- bool [decoration\\_cleared](#)  
*A boolean which indicates if the tile decoration has been cleared.*
- bool [has\\_improvement](#)  
*A boolean which indicates if tile has improvement or not.*
- [TileImprovement](#) \* [tile\\_improvement\\_ptr](#)

- A pointer to the improvement for this tile.*
- bool [build\\_menu\\_open](#)

*A boolean which indicates if the tile build menu is open.*
  - size\_t [explosion\\_frame](#)

*The current frame of the explosion animation.*
  - unsigned long long int [frame](#)

*The current frame of this object.*
  - int [credits](#)

*The current balance of credits.*
  - int [scrap\\_improvement\\_frame](#)

*A frame for key-hold to confirm scrapping.*
  - double [position\\_x](#)

*The x position of the tile.*
  - double [position\\_y](#)

*The y position of the tile.*
  - double [major\\_radius](#)

*The radius of the smallest bounding circle.*
  - double [minor\\_radius](#)

*The radius of the largest inscribed circle.*
  - std::string [game\\_phase](#)

*The current phase of the game.*
  - sf::CircleShape [node\\_sprite](#)

*A circle shape to mark the tile node.*
  - sf::ConvexShape [tile\\_sprite](#)

*A convex shape which represents the tile.*
  - sf::ConvexShape [select\\_outline\\_sprite](#)

*A convex shape which outlines the tile when selected.*
  - sf::CircleShape [resource\\_chip\\_sprite](#)

*A circle shape which represents a resource chip.*
  - sf::Text [resource\\_text](#)

*A text representation of the resource.*
  - sf::Sprite [tile\\_decoration\\_sprite](#)

*A tile decoration sprite.*
  - sf::Sprite [magnifying\\_glass\\_sprite](#)

*A magnifying glass sprite.*
  - std::vector< sf::Sprite > [explosion\\_sprite\\_reel](#)

*A reel of sprites for a tile explosion animation.*
  - sf::RectangleShape [build\\_menu\\_backing](#)

*A backing for the tile build menu.*
  - sf::Text [build\\_menu\\_backing\\_text](#)

*A text label for the build menu.*
  - std::vector< std::vector< sf::Sprite > > [build\\_menu\\_options\\_vec](#)

*A vector of sprites for illustrating the tile build options.*
  - std::vector< sf::Text > [build\\_menu\\_options\\_text\\_vec](#)

*A vector of text for the tile build options.*



## Private Member Functions

- void [\\_\\_setUpNodeSprite](#) (void)  
*Helper method to set up node sprite.*
- void [\\_\\_setUpTileSprite](#) (void)  
*Helper method to set up tile sprite.*
- void [\\_\\_setUpSelectOutlineSprite](#) (void)  
*Helper method to set up select outline sprite.*
- void [\\_\\_setUpResourceChipSprite](#) (void)  
*Helper method to set up resource chip sprite.*
- void [\\_\\_setResourceText](#) (void)  
*Helper method to set up resource text.*
- void [\\_\\_setUpMagnifyingGlassSprite](#) (void)  
*Helper method to set up and position magnifying glass sprite.*
- void [\\_\\_setUpTileExplosionReel](#) (void)  
*Helper method to set up tile explosion sprite reel.*
- void [\\_\\_setUpBuildOption](#) (std::string, std::string)  
*Helper method to set up and position the sprite and text for a build option.*
- void [\\_\\_setUpDieselGeneratorBuildOption](#) (void)  
*Helper method to set up and position the diesel generator build option.*
- void [\\_\\_setUpWindTurbineBuildOption](#) (bool=false, bool=false)  
*Helper method to set up and position the wind turbine build option.*
- void [\\_\\_setUpSolarPVBuildOption](#) (bool=false)  
*Helper method to set up and position the solar PV array build option.*
- void [\\_\\_setUpTidalTurbineBuildOption](#) (void)  
*Helper method to set up and position the tidal turbine build option.*
- void [\\_\\_setUpWaveEnergyConverterBuildOption](#) (void)  
*Helper method to set up and position the wave energy converter build option.*
- void [\\_\\_setUpEnergyStorageSystemBuildOption](#) (void)  
*Helper method to set up and position the wave energy converter build option.*
- void [\\_\\_setUpBuildMenu](#) (void)  
*Helper method to set up and place build menu assets (drawable).*
- void [\\_\\_setIsSelected](#) (bool)  
*Helper method to set the is selected attribute (of tile and improvement).*
- void [\\_\\_clearDecoration](#) (void)  
*Helper method to clear tile decoration.*
- bool [\\_\\_isClicked](#) (void)  
*Helper method to determine if tile was clicked on.*
- void [\\_\\_handleKeyPressEvents](#) (void)  
*Helper method to handle key press events.*
- void [\\_\\_handleKeyReleaseEvents](#) (void)
- void [\\_\\_handleMouseButtonEvents](#) (void)  
*Helper method to handle mouse button events.*
- void [\\_\\_openBuildMenu](#) (void)  
*Helper method to open the tile improvement build menu.*
- void [\\_\\_closeBuildMenu](#) (void)  
*Helper method to close the tile improvement build menu.*
- void [\\_\\_buildSettlement](#) (void)  
*Helper method to build a settlement on this tile.*
- void [\\_\\_buildDieselGenerator](#) (void)  
*Helper method to build a diesel generator on this tile.*

- void [\\_\\_buildSolarPV](#) (void)  
*Helper method to build a solar PV array on this tile.*
- void [\\_\\_buildWindTurbine](#) (void)  
*Helper method to build a wind turbine on this tile.*
- void [\\_\\_buildTidalTurbine](#) (void)  
*Helper method to build a tidal turbine on this tile.*
- void [\\_\\_buildWaveEnergyConverter](#) (void)  
*Helper method to build a wave energy converter on this tile.*
- void [\\_\\_buildEnergyStorage](#) (void)  
*Helper method to build an energy storage system on this tile.*
- void [\\_\\_scrapImprovement](#) (void)  
*Helper method to scrap the tile improvement ([Settlement](#) cannot be scrapped). Requires the mapped key to be held continuously to confirm.*
- void [\\_\\_sendTileSelectedMessage](#) (void)  
*Helper method to format and send message on tile selection.*
- std::string [\\_\\_getTileCoordsSubstring](#) (void)  
*Helper method to assemble and return tile coordinates substring.*
- std::string [\\_\\_getTileTypeSubstring](#) (void)  
*Helper method to assemble and return tile type substring.*
- std::string [\\_\\_getTileResourceSubstring](#) (void)  
*Helper method to assemble and return tile resource substring.*
- std::string [\\_\\_getTileImprovementSubstring](#) (void)  
*Helper method to assemble and return the tile improvement substring.*
- std::string [\\_\\_getTileOptionsSubstring](#) (void)  
*Helper method to assemble and return tile options substring.*
- void [\\_\\_sendTileStateMessage](#) (void)  
*Helper method to format and send tile state message.*
- void [\\_\\_sendAssessNeighboursMessage](#) (void)  
*Helper method to format and send assess neighbours message.*
- void [\\_\\_sendGameStateRequest](#) (void)  
*Helper method to format and send a game state request (message).*
- void [\\_\\_sendUpdateGamePhaseMessage](#) (std::string)  
*Helper method to format and send update game phase message.*
- void [\\_\\_sendCreditsSpentMessage](#) (int)  
*Helper method to format and send a credits spent message.*
- void [\\_\\_sendInsufficientCreditsMessage](#) (void)  
*Helper method to format and send an insufficient credits message.*

## Private Attributes

- sf::Event \* [event\\_ptr](#)  
*A pointer to the event class.*
- sf::RenderWindow \* [render\\_window\\_ptr](#)  
*A pointer to the render window.*
- [AssetsManager](#) \* [assets\\_manager\\_ptr](#)  
*A pointer to the assets manager.*
- [MessageHub](#) \* [message\\_hub\\_ptr](#)  
*A pointer to the message hub.*

### 4.7.1 Detailed Description

A class which defines a hex tile of the hex map.

### 4.7.2 Constructor & Destructor Documentation

#### 4.7.2.1 HexTile()

```
HexTile::HexTile (
    double position_x,
    double position_y,
    sf::Event * event_ptr,
    sf::RenderWindow * render_window_ptr,
    AssetsManager * assets_manager_ptr,
    MessageHub * message_hub_ptr )
```

Constructor for the [HexTile](#) class.

Ref: [Wikipedia \[2023\]](#)

#### Parameters

<i>position_x</i>	The x position of the tile.
<i>position_y</i>	The y position of the tile.
<i>event_ptr</i>	Pointer to the event class.
<i>render_window_ptr</i>	Pointer to the render window.
<i>assets_manager_ptr</i>	Pointer to the assets manager.
<i>message_hub_ptr</i>	Pointer to the message hub.

```
2310 {
2311     // 1. set attributes
2312
2313     // 1.1. private
2314     this->event_ptr = event_ptr;
2315     this->render_window_ptr = render_window_ptr;
2316
2317     this->assets_manager_ptr = assets_manager_ptr;
2318     this->message_hub_ptr = message_hub_ptr;
2319
2320     // 1.2. public
2321     this->show_node = false;
2322     this->show_resource = false;
2323     this->resource_assessed = false;
2324     this->resource_assessment = false;
2325     this->is_selected = false;
2326     this->draw_explosion = false;
2327
2328     this->decoration_cleared = false;
2329     this->has_improvement = false;
2330     this->tile_improvement_ptr = NULL;
2331
2332     this->build_menu_open = false;
2333
2334     this->explosion_frame = 0;
2335
2336     this->frame = 0;
2337     this->credits = 0;
2338
2339     this->scrap_improvement_frame = 0;
2340 }
```

```

2341     this->position_x = position_x;
2342     this->position_y = position_y;
2343
2344     this->major_radius = 32;
2345     this->minor_radius = (sqrt(3) / 2) * this->major_radius;
2346
2347     this->game_phase = "build settlement";
2348
2349     // 2. set up and position drawable attributes
2350     this->__setUpNodeSprite();
2351     this->__setUpTileSprite();
2352     this->__setUpSelectOutlineSprite();
2353     this->__setUpResourceChipSprite();
2354     this->__setUpResourceText();
2355     this->__setUpMagnifyingGlassSprite();
2356     this->__setUpTileExplosionReel();
2357
2358     // 3. set tile type and resource (default to none type and average)
2359     this->setTileType(TileType :: NONE_TYPE);
2360     this->setTileResource(TileResource :: AVERAGE);
2361
2362     std::cout << "HexTile constructed at " << this << std::endl;
2363
2364     return;
2365 } /* HexTile() */

```

#### 4.7.2.2 ~HexTile()

```

HexTile::~HexTile (
    void )

```

Destructor for the [HexTile](#) class.

```

2931 {
2932     if (this->tile_improvement_ptr != NULL) {
2933         delete this->tile_improvement_ptr;
2934     }
2935
2936     std::cout << "HexTile at " << this << " destroyed" << std::endl;
2937
2938     return;
2939 } /* ~HexTile() */

```

### 4.7.3 Member Function Documentation

#### 4.7.3.1 \_\_buildDieselGenerator()

```

void HexTile::__buildDieselGenerator (
    void ) [private]

```

Helper method to build a diesel generator on this tile.

```

1411 {
1412     int build_cost = DIESEL_GENERATOR_BUILD_COST;
1413
1414     if (this->credits < build_cost) {
1415         std::cout << "Cannot build diesel generator: insufficient credits (need "
1416             << build_cost << " K)" << std::endl;
1417
1418         this->__sendInsufficientCreditsMessage();
1419         return;
1420     }
1421
1422     this->tile_improvement_ptr = new DieselGenerator(
1423         this->position_x,
1424         this->position_y,
1425         this->tile_resource,

```

```

1426         this->event_ptr,
1427         this->render_window_ptr,
1428         this->assets_manager_ptr,
1429         this->message_hub_ptr
1430     );
1431
1432     this->has_improvement = true;
1433     this->__closeBuildMenu();
1434
1435     this->__sendCreditsSpentMessage(build_cost);
1436     this->__sendTileStateMessage();
1437     this->__sendGameStateRequest();
1438
1439     return;
1440 } /* __buildDieselGenerator() */

```

#### 4.7.3.2 \_\_buildEnergyStorage()

```

void HexTile::__buildEnergyStorage (
    void ) [private]

```

Helper method to build an energy storage system on this tile.

```

1659 {
1660     /*
1661     int build_cost = ENERGY_STORAGE_SYSTEM_BUILD_COST;
1662
1663     if (this->credits < build_cost) {
1664         std::cout << "Cannot build energy storage system: insufficient credits (need "
1665             << build_cost << " K)" << std::endl;
1666
1667         this->__sendInsufficientCreditsMessage();
1668         return;
1669     }
1670
1671     this->tile_improvement_ptr = new EnergyStorageSystem(
1672         this->position_x,
1673         this->position_y,
1674         this->event_ptr,
1675         this->render_window_ptr,
1676         this->assets_manager_ptr,
1677         this->message_hub_ptr
1678     );
1679
1680     this->has_improvement = true;
1681     this->__closeBuildMenu();
1682
1683     this->__sendCreditsSpentMessage(build_cost);
1684     this->__sendTileStateMessage();
1685     this->__sendGameStateRequest();
1686     */
1687     return;
1688 } /* __buildEnergyStorage() */

```

#### 4.7.3.3 \_\_buildSettlement()

```

void HexTile::__buildSettlement (
    void ) [private]

```

Helper method to build a settlement on this tile.

```

1364 {
1365     if (this->credits < BUILD_SETTLEMENT_COST) {
1366         std::cout << "Cannot build settlement: insufficient credits (need "
1367             << BUILD_SETTLEMENT_COST << " K)" << std::endl;
1368
1369         this->__sendInsufficientCreditsMessage();
1370         return;
1371     }
1372
1373     this->__clearDecoration();

```

```

1374
1375     this->tile_improvement_ptr = new Settlement(
1376         this->position_x,
1377         this->position_y,
1378         this->tile_resource,
1379         this->event_ptr,
1380         this->render_window_ptr,
1381         this->assets_manager_ptr,
1382         this->message_hub_ptr
1383     );
1384
1385     this->has_improvement = true;
1386
1387     this->assess();
1388     this->__sendAssessNeighboursMessage();
1389
1390     this->__sendUpdateGamePhaseMessage("system management");
1391     this->__sendCreditsSpentMessage(BUILD_SETTLEMENT_COST);
1392     this->__sendTileStateMessage();
1393     this->__sendGameStateRequest();
1394
1395     return;
1396 } /* __buildSettlement() */

```

#### 4.7.3.4 \_\_buildSolarPV()

```

void HexTile::__buildSolarPV (
    void ) [private]

```

Helper method to build a solar PV array on this tile.

```

1455 {
1456     int build_cost = SOLAR_PV_BUILD_COST;
1457
1458     if (this->tile_type == TileType :: LAKE) {
1459         build_cost *= SOLAR_PV_WATER_BUILD_MULTIPLIER;
1460     }
1461
1462     if (this->credits < build_cost) {
1463         std::cout << "Cannot build solar PV array: insufficient credits (need "
1464             << build_cost << " K)" << std::endl;
1465
1466         this->__sendInsufficientCreditsMessage();
1467         return;
1468     }
1469
1470     this->tile_improvement_ptr = new SolarPV(
1471         this->position_x,
1472         this->position_y,
1473         this->tile_resource,
1474         this->event_ptr,
1475         this->render_window_ptr,
1476         this->assets_manager_ptr,
1477         this->message_hub_ptr
1478     );
1479
1480     this->has_improvement = true;
1481     this->__closeBuildMenu();
1482
1483     if (this->tile_type == TileType :: LAKE) {
1484         this->decoration_cleared = true;
1485         this->assets_manager_ptr->getSound("splash")->play();
1486     }
1487
1488     this->__sendCreditsSpentMessage(build_cost);
1489     this->__sendTileStateMessage();
1490     this->__sendGameStateRequest();
1491
1492     return;
1493 } /* __buildSolarPV() */

```

## 4.7.3.5 \_\_buildTidalTurbine()

```
void HexTile::__buildTidalTurbine (
    void ) [private]
```

Helper method to build a tidal turbine on this tile.

```
1567 {
1568     int build_cost = TIDAL_TURBINE_BUILD_COST;
1569
1570     if (this->credits < build_cost) {
1571         std::cout << "Cannot build tidal turbine: insufficient credits (need "
1572             << build_cost << " K)" << std::endl;
1573
1574         this->__sendInsufficientCreditsMessage();
1575         return;
1576     }
1577
1578     this->tile_improvement_ptr = new TidalTurbine(
1579         this->position_x,
1580         this->position_y,
1581         this->tile_resource,
1582         this->event_ptr,
1583         this->render_window_ptr,
1584         this->assets_manager_ptr,
1585         this->message_hub_ptr
1586     );
1587
1588     this->has_improvement = true;
1589     this->decoration_cleared = true;
1590     this->assets_manager_ptr->getSound("splash")->play();
1591     this->__closeBuildMenu();
1592
1593     this->__sendCreditsSpentMessage(build_cost);
1594     this->__sendTileStateMessage();
1595     this->__sendGameStateRequest();
1596
1597     return;
1598 } /* __buildTidalTurbine() */
```

## 4.7.3.6 \_\_buildWaveEnergyConverter()

```
void HexTile::__buildWaveEnergyConverter (
    void ) [private]
```

Helper method to build a wave energy converter on this tile.

```
1613 {
1614     int build_cost = WAVE_ENERGY_CONVERTER_BUILD_COST;
1615
1616     if (this->credits < build_cost) {
1617         std::cout << "Cannot build wave energy converter: insufficient credits (need "
1618             << build_cost << " K)" << std::endl;
1619
1620         this->__sendInsufficientCreditsMessage();
1621         return;
1622     }
1623
1624     this->tile_improvement_ptr = new WaveEnergyConverter(
1625         this->position_x,
1626         this->position_y,
1627         this->tile_resource,
1628         this->event_ptr,
1629         this->render_window_ptr,
1630         this->assets_manager_ptr,
1631         this->message_hub_ptr
1632     );
1633
1634     this->has_improvement = true;
1635     this->decoration_cleared = true;
1636     this->assets_manager_ptr->getSound("splash")->play();
1637     this->__closeBuildMenu();
1638
1639     this->__sendCreditsSpentMessage(build_cost);
1640     this->__sendTileStateMessage();
1641     this->__sendGameStateRequest();
1642
1643     return;
1644 } /* __buildWaveEnergyConverter() */
```

#### 4.7.3.7 \_\_buildWindTurbine()

```
void HexTile::__buildWindTurbine (
    void ) [private]
```

Helper method to build a wind turbine on this tile.

```
1508 {
1509     int build_cost = WIND_TURBINE_BUILD_COST;
1510
1511     if (
1512         (this->tile_type == TileType :: LAKE) or
1513         (this->tile_type == TileType :: OCEAN)
1514     ) {
1515         build_cost *= WIND_TURBINE_WATER_BUILD_MULTIPLIER;
1516     }
1517
1518     if (this->credits < build_cost) {
1519         std::cout << "Cannot build wind turbine: insufficient credits (need "
1520             << build_cost << " K)" << std::endl;
1521
1522         this->__sendInsufficientCreditsMessage();
1523         return;
1524     }
1525
1526     this->tile_improvement_ptr = new WindTurbine(
1527         this->position_x,
1528         this->position_y,
1529         this->tile_resource,
1530         this->event_ptr,
1531         this->render_window_ptr,
1532         this->assets_manager_ptr,
1533         this->message_hub_ptr
1534     );
1535
1536     this->has_improvement = true;
1537     this->__closeBuildMenu();
1538
1539     if (
1540         (this->tile_type == TileType :: LAKE) or
1541         (this->tile_type == TileType :: OCEAN)
1542     ) {
1543         this->decoration_cleared = true;
1544         this->assets_manager_ptr->getSound("splash")->play();
1545     }
1546
1547     this->__sendCreditsSpentMessage(build_cost);
1548     this->__sendTileStateMessage();
1549     this->__sendGameStateRequest();
1550
1551     return;
1552 } /* __buildWindTurbine() */
```

#### 4.7.3.8 \_\_clearDecoration()

```
void HexTile::__clearDecoration (
    void ) [private]
```

Helper method to clear tile decoration.

```
792 {
793     this->decoration_cleared = true;
794     this->draw_explosion = true;
795
796     switch (this->tile_type) {
797         case (TileType :: FOREST): {
798             this->assets_manager_ptr->getSound("clear non-mountains tile")->play();
799
800             break;
801         }
802
803         case (TileType :: MOUNTAINS): {
804             this->assets_manager_ptr->getSound("clear mountains tile")->play();
805
806             break;
807         }
808     }
```



```

809
810
811         case (TileType :: PLAINS): {
812             this->assets_manager_ptr->getSound("clear non-mountains tile")->play();
813
814             break;
815         }
816
817
818         default: {
819             // do nothing!
820
821             break;
822         }
823     }
824
825     return;
826 } /* __clearDecoration() */

```

#### 4.7.3.9 \_\_closeBuildMenu()

```

void HexTile::__closeBuildMenu (
    void ) [private]

```

Helper method to close the tile improvement build menu.

```

1339 {
1340     if (not this->build_menu_open) {
1341         return;
1342     }
1343
1344     this->build_menu_open = false;
1345     this->assets_manager_ptr->getSound("build menu close")->play();
1346
1347     return;
1348 } /* __closeBuildMenu() */

```

#### 4.7.3.10 \_\_getTileCoordsSubstring()

```

std::string HexTile::__getTileCoordsSubstring (
    void ) [private]

```

Helper method to assemble and return tile coordinates substring.

##### Returns

Tile coordinates substring.

```

1805 {
1806     std::string coords_substring = "TILE COORDS: (";
1807     coords_substring += std::to_string(int(this->position_x - 400));
1808     coords_substring += ", ";
1809     coords_substring += std::to_string(int(this->position_y - 400));
1810     coords_substring += ")\n";
1811
1812     return coords_substring;
1813 } /* __getTileCoordsSubstring() */

```

#### 4.7.3.11 \_\_getTileImprovementSubstring()

```
std::string HexTile::__getTileImprovementSubstring (
    void ) [private]
```

Helper method to assemble and return the tile improvement substring.

##### Returns

Tile improvement substring.

```
1964 {
1965     std::string improvement_substring = "TILE IMPROVEMENT: ";
1966
1967     if (this->has_improvement) {
1968         improvement_substring += this->tile_improvement_ptr->tile_improvement_string;
1969         improvement_substring += "\n";
1970     }
1971
1972     else {
1973         improvement_substring += "NONE\n";
1974     }
1975
1976     return improvement_substring;
1977 } /* __getTileImprovementSubstring() */
```

#### 4.7.3.12 \_\_getTileOptionsSubstring()

```
std::string HexTile::__getTileOptionsSubstring (
    void ) [private]
```

Helper method to assemble and return tile options substring.

##### Returns

Tile options substring.

```
1994 {
1995     //          32 char x 17 line console "-----\n";
1996     std::string options_substring          = "      **** TILE OPTIONS ****      \n";
1997     options_substring                     += "                                     \n";
1998
1999     if (this->game_phase == "build settlement") {
2000         if (
2001             (this->tile_type != TileType :: OCEAN) and
2002             (this->tile_type != TileType :: LAKE)
2003         ) {
2004             options_substring += "[B]:  BUILD SETTLEMENT (";
2005             options_substring += std::to_string(BUILD_SETTLEMENT_COST);
2006             options_substring += " K)\n";
2007         }
2008     }
2009
2010
2011     else if (this->game_phase == "system management") {
2012         if (this->has_improvement) {
2013             options_substring.clear();
2014             options_substring = this->tile_improvement_ptr->getTileOptionsSubstring();
2015         }
2016
2017
2018         else if (not this->resource_assessed) {
2019             options_substring += "[A]:  ASSESS RESOURCE (";
2020             options_substring += std::to_string(RESOURCE_ASSESSMENT_COST);
2021             options_substring += " K)\n";
2022         }
2023
2024
2025         else if (
2026             (not this->decoration_cleared) and
2027             (this->tile_type != TileType :: OCEAN) and
```

```

2028         (this->tile_type != TileType :: LAKE)
2029     ) {
2030         options_substring += "[C]:  CLEAR TILE (";
2031
2032         switch (this->tile_type) {
2033             case (TileType :: FOREST): {
2034                 options_substring += std::to_string(CLEAR_FOREST_COST);
2035
2036                 break;
2037             }
2038
2039
2040             case (TileType :: MOUNTAINS): {
2041                 options_substring += std::to_string(CLEAR_MOUNTAINS_COST);
2042
2043                 break;
2044             }
2045
2046
2047             case (TileType :: PLAINS): {
2048                 options_substring += std::to_string(CLEAR_PLAINS_COST);
2049
2050                 break;
2051             }
2052
2053
2054             default: {
2055                 //do nothing!
2056
2057                 break;
2058             }
2059         }
2060
2061         options_substring += " K)\n";
2062     }
2063
2064
2065     else if (
2066         (this->decoration_cleared) or
2067         (this->tile_type == TileType :: OCEAN) or
2068         (this->tile_type == TileType :: LAKE)
2069     ) {
2070         options_substring += "[B]:  OPEN BUILD MENU\n";
2071     }
2072 }
2073
2074
2075     else if (this->game_phase == "victory") {
2076         options_substring += "          **** VICTORY ****          \n";
2077     }
2078
2079
2080     else {
2081         options_substring += "          **** LOSS ****          \n";
2082     }
2083
2084     return options_substring;
2085 } /* __getTileOptionsString() */

```

#### 4.7.3.13 \_\_getTileResourceSubstring()

```

std::string HexTile::__getTileResourceSubstring (
    void ) [private]

```

Helper method to assemble and return tile resource substring.

#### Returns

Tile resource substring.

```

1894 {
1895     std::string resource_substring = "TILE RESOURCE:      ";
1896
1897     if (this->resource_assessed) {
1898         switch (this->tile_resource) {
1899             case (TileResource :: POOR): {

```

```

1900         resource_substring += "POOR\n";
1901
1902         break;
1903     }
1904
1905
1906     case (TileResource ::BELOW_AVERAGE): {
1907         resource_substring += "BELOW AVERAGE\n";
1908
1909         break;
1910     }
1911
1912
1913     case (TileResource :: AVERAGE): {
1914         resource_substring += "AVERAGE\n";
1915
1916         break;
1917     }
1918
1919
1920     case (TileResource :: ABOVE_AVERAGE): {
1921         resource_substring += "ABOVE AVERAGE\n";
1922
1923         break;
1924     }
1925
1926
1927     case (TileResource :: GOOD): {
1928         resource_substring += "GOOD\n";
1929
1930         break;
1931     }
1932
1933
1934     default: {
1935         resource_substring += "???\n";
1936
1937         break;
1938     }
1939 }
1940
1941
1942 else {
1943     resource_substring += "???\n";
1944 }
1945
1946 return resource_substring;
1947 } /* __getTileResourceSubstring() */

```

#### 4.7.3.14 \_\_getTileTypeSubstring()

```

std::string HexTile::__getTileTypeSubstring (
    void ) [private]

```

Helper method to assemble and return tile type substring.

#### Returns

Tile type substring.

```

1830 {
1831     std::string type_substring = "TILE TYPE: ";
1832
1833     switch (this->tile_type) {
1834         case (TileType :: FOREST): {
1835             type_substring += "FOREST\n";
1836
1837             break;
1838         }
1839
1840
1841         case (TileType :: LAKE): {
1842             type_substring += "LAKE\n";
1843
1844             break;
1845         }

```

```

1846
1847
1848     case (TileType :: MOUNTAINS): {
1849         type_substring += "MOUNTAINS\n";
1850
1851         break;
1852     }
1853
1854
1855     case (TileType :: OCEAN): {
1856         type_substring += "OCEAN\n";
1857
1858         break;
1859     }
1860
1861
1862     case (TileType :: PLAINS): {
1863         type_substring += "PLAINS\n";
1864
1865         break;
1866     }
1867
1868
1869     default: {
1870         type_substring += "???\n";
1871
1872         break;
1873     }
1874 }
1875
1876 return type_substring;
1877 } /* __getTileTypeSubstring() */

```

#### 4.7.3.15 \_\_handleKeyPressEvents()

```

void HexTile::__handleKeyPressEvents (
    void ) [private]

```

Helper method to handle key press events.

```

875 {
876     if (not this->is_selected) {
877         return;
878     }
879
880
881     if (this->event_ptr->key.code == sf::Keyboard::Escape) {
882         this->__setIsSelected(false);
883     }
884
885
886     if (this->build_menu_open) {
887         switch (this->tile_type) {
888             case (TileType :: FOREST): {
889                 switch (this->event_ptr->key.code) {
890                     case (sf::Keyboard::D): {
891                         this->__buildDieselGenerator();
892
893                         break;
894                     }
895
896
897                     case (sf::Keyboard::S): {
898                         this->__buildSolarPV();
899
900                         break;
901                     }
902
903
904                     case (sf::Keyboard::W): {
905                         this->__buildWindTurbine();
906
907                         break;
908                     }
909
910
911                     case (sf::Keyboard::E): {
912                         this->__buildEnergyStorage();
913

```

```
914             break;
915         }
916
917         default: {
918             // do nothing!
919
920             break;
921         }
922     }
923 }
924
925 break;
926 }
927
928
929 case (TileType :: LAKE): {
930     switch (this->event_ptr->key.code) {
931         case (sf::Keyboard::S): {
932             this->__buildSolarPV();
933
934             break;
935         }
936
937         case (sf::Keyboard::W): {
938             this->__buildWindTurbine();
939
940             break;
941         }
942
943         default: {
944             // do nothing!
945
946             break;
947         }
948     }
949 }
950
951 break;
952 }
953
954
955 case (TileType :: MOUNTAINS): {
956     switch (this->event_ptr->key.code) {
957         case (sf::Keyboard::D): {
958             this->__buildDieselGenerator();
959
960             break;
961         }
962
963         case (sf::Keyboard::S): {
964             this->__buildSolarPV();
965
966             break;
967         }
968
969         case (sf::Keyboard::W): {
970             this->__buildWindTurbine();
971
972             break;
973         }
974
975         case (sf::Keyboard::E): {
976             this->__buildEnergyStorage();
977
978             break;
979         }
980
981         default: {
982             // do nothing!
983
984             break;
985         }
986     }
987 }
988
989 break;
990 }
991
992
993 case (TileType :: OCEAN): {
994     switch (this->event_ptr->key.code) {
995         case (sf::Keyboard::W): {
996             this->__buildWindTurbine();
997
998             break;
999         }
1000     }
```

```

1001
1002         break;
1003     }
1004
1005
1006     case (sf::Keyboard::T): {
1007         this->__buildTidalTurbine();
1008
1009         break;
1010     }
1011
1012
1013     case (sf::Keyboard::A): {
1014         this->__buildWaveEnergyConverter();
1015
1016         break;
1017     }
1018
1019
1020     default: {
1021         // do nothing!
1022
1023         break;
1024     }
1025 }
1026
1027 break;
1028 }
1029
1030
1031 case (TileType :: PLAINS): {
1032     switch (this->event_ptr->key.code) {
1033         case (sf::Keyboard::D): {
1034             this->__buildDieselGenerator();
1035
1036             break;
1037         }
1038
1039
1040         case (sf::Keyboard::S): {
1041             this->__buildSolarPV();
1042
1043             break;
1044         }
1045
1046
1047         case (sf::Keyboard::W): {
1048             this->__buildWindTurbine();
1049
1050             break;
1051         }
1052
1053
1054         case (sf::Keyboard::E): {
1055             this->__buildEnergyStorage();
1056
1057             break;
1058         }
1059
1060
1061         default: {
1062             // do nothing!
1063
1064             break;
1065         }
1066     }
1067
1068     break;
1069 }
1070
1071
1072 default: {
1073     //do nothing!
1074
1075     break;
1076 }
1077 }
1078 }
1079
1080
1081 if (this->game_phase == "build settlement") {
1082     if (
1083         (this->tile_type != TileType :: OCEAN) and
1084         (this->tile_type != TileType :: LAKE)
1085     ) {
1086         if (this->event_ptr->key.code == sf::Keyboard::B) {
1087             this->__buildSettlement();

```

```

1088         }
1089     }
1090 }
1091
1092
1093     else if (this->game_phase == "system management") {
1094         if (this->has_improvement) {
1095             if (this->tile_improvement_ptr->tile_improvement_type != TileImprovementType :: SETTLEMENT)
1096             {
1097                 if (this->event_ptr->key.code == sf::Keyboard::P) {
1098                     this->__scrapImprovement();
1099                 }
1100             }
1101
1102             /*
1103              * All other inputs will be caught and handled by
1104              * this->tile_improvement_ptr->processEvent()
1105              */
1106         }
1107
1108     else if (not this->resource_assessed) {
1109         if (this->event_ptr->key.code == sf::Keyboard::A) {
1110             if (this->credits < RESOURCE_ASSESSMENT_COST) {
1111                 std::cout << "Cannot assess resource: insufficient credits (need "
1112                     << RESOURCE_ASSESSMENT_COST << " K)" << std::endl;
1113
1114                 this->__sendInsufficientCreditsMessage();
1115             }
1116
1117             else {
1118                 this->assess();
1119                 this->__sendCreditsSpentMessage(RESOURCE_ASSESSMENT_COST);
1120                 this->__sendTileStateMessage();
1121                 this->__sendGameStateRequest();
1122             }
1123         }
1124     }
1125
1126
1127     else if (
1128         (not this->decoration_cleared) and
1129         (this->tile_type != TileType :: OCEAN) and
1130         (this->tile_type != TileType :: LAKE)
1131     ) {
1132         if (this->event_ptr->key.code == sf::Keyboard::C) {
1133             int clear_cost = 0;
1134
1135             switch (this->tile_type) {
1136                 case (TileType :: FOREST): {
1137                     clear_cost = CLEAR_FOREST_COST;
1138
1139                     break;
1140                 }
1141
1142                 case (TileType :: MOUNTAINS): {
1143                     clear_cost = CLEAR_MOUNTAINS_COST;
1144
1145                     break;
1146                 }
1147
1148                 case (TileType :: PLAINS): {
1149                     clear_cost = CLEAR_PLAINS_COST;
1150
1151                     break;
1152                 }
1153
1154                 default: {
1155                     // do nothing!
1156
1157                     break;
1158                 }
1159             }
1160
1161             if (this->credits < clear_cost) {
1162                 std::cout << "Cannot clear tile: insufficient credits (need "
1163                     << clear_cost << " K)" << std::endl;
1164
1165                 this->__sendInsufficientCreditsMessage();
1166             }
1167
1168             else {
1169                 this->__clearDecoration();
1170                 this->__sendCreditsSpentMessage(clear_cost);
1171             }
1172         }
1173     }

```



```

1174             this->__sendTileStateMessage();
1175             this->__sendGameStateRequest();
1176         }
1177     }
1178 }
1179
1180
1181     else if (
1182         (this->decoration_cleared) or
1183         (this->tile_type == TileType :: OCEAN) or
1184         (this->tile_type == TileType :: LAKE)
1185     ) {
1186         if (this->event_ptr->key.code == sf::Keyboard::B) {
1187             this->__openBuildMenu();
1188         }
1189     }
1190 }
1191
1192 return;
1193 } /* __handleKeyPressEvents() */

```

#### 4.7.3.16 \_\_handleKeyReleaseEvents()

```

void HexTile::__handleKeyReleaseEvents (
    void ) [private]
1199 {
1200     if (not this->is_selected) {
1201         return;
1202     }
1203
1204     switch (this->event_ptr->key.code) {
1205         case (sf::Keyboard::P): {
1206             if (this->has_improvement) {
1207                 this->scrap_improvement_frame = 0;
1208
1209                 if (
1210                     this->tile_improvement_ptr->tile_improvement_sprite_static.getTexture() != NULL
1211                 ) {
1212                     this->tile_improvement_ptr->tile_improvement_sprite_static.setColor(
1213                         sf::Color(255, 255, 255, 255)
1214                     );
1215                 }
1216             }
1217             else {
1218                 for (
1219                     size_t i = 0;
1220                     i < this->tile_improvement_ptr->tile_improvement_sprite_animated.size();
1221                     i++
1222                 ) {
1223                     this->tile_improvement_ptr->tile_improvement_sprite_animated[i].setColor(
1224                         sf::Color(255, 255, 255, 255)
1225                     );
1226                 }
1227             }
1228         }
1229     }
1230
1231     break;
1232 }
1233
1234     default: {
1235         // do nothing!
1236
1237         break;
1238     }
1239 }
1240
1241 }
1242
1243 /*
1244 if (this->event_ptr->key.code == sf::Keyboard::P) {
1245
1246 }
1247 */
1248
1249 return;
1250 } /* __handleKeyReleaseEvents() */

```

#### 4.7.3.17 \_\_handleMouseButtonEvents()

```
void HexTile::__handleMouseButtonEvents (
    void ) [private]
```

Helper method to handle mouse button events.

```
1263 {
1264     switch (this->event_ptr->mouseButton.button) {
1265         case (sf::Mouse::Left): {
1266             if (this->__isClicked()) {
1267                 std::cout << "Tile (" << this->position_x << ", " <<
1268                     this->position_y << ") was selected" << std::endl;
1269
1270                 this->__setIsSelected(true);
1271
1272                 this->__sendTileSelectedMessage();
1273                 this->__sendTileStateMessage();
1274                 this->__sendGameStateRequest();
1275             }
1276
1277             else {
1278                 this->__setIsSelected(false);
1279             }
1280
1281             break;
1282         }
1283
1284         case (sf::Mouse::Right): {
1285             this->__setIsSelected(false);
1286
1287             break;
1288         }
1289
1290         default: {
1291             // do nothing!
1292
1293             break;
1294         }
1295     }
1296
1297     return;
1298 }
1299
1300 } /* __handleMouseButtonEvents() */
```

#### 4.7.3.18 \_\_isClicked()

```
bool HexTile::__isClicked (
    void ) [private]
```

Helper method to determine if tile was clicked on.

##### Returns

Boolean indicating whether or not tile was clicked on.

```
843 {
844     sf::Vector2i mouse_position = sf::Mouse::getPosition(*render_window_ptr);
845
846     double mouse_x = mouse_position.x;
847     double mouse_y = mouse_position.y;
848
849     double distance = sqrt(
850         pow(this->position_x - mouse_x, 2) +
851         pow(this->position_y - mouse_y, 2)
852     );
853
854     if (distance < this->minor_radius) {
855         return true;
856     }
857     else {
858         return false;
859     }
860 } /* __isClicked() */
```

**4.7.3.19 \_\_openBuildMenu()**

```
void HexTile::__openBuildMenu (
    void ) [private]
```

Helper method to open the tile improvement build menu.

```
1315 {
1316     if (this->build_menu_open) {
1317         return;
1318     }
1319     this->build_menu_open = true;
1320     this->assets_manager_ptr->getSound("build menu open")->play();
1321     return;
1322 } /* __openBuildMenu() */
```

**4.7.3.20 \_\_scrapImprovement()**

```
void HexTile::__scrapImprovement (
    void ) [private]
```

Helper method to scrap the tile improvement ([Settlement](#) cannot be scrapped). Requires the mapped key to be held continuously to confirm.

```
1704 {
1705     // 1. implement key hold confirmation
1706     if (this->scrap_improvement_frame <= FRAMES_PER_SECOND) {
1707         double colour_scalar =
1708             1 - ((double)(this->scrap_improvement_frame) / (FRAMES_PER_SECOND));
1709
1710         if (
1711             this->tile_improvement_ptr->tile_improvement_sprite_static.getTexture() != NULL
1712         ) {
1713             this->tile_improvement_ptr->tile_improvement_sprite_static.setColor(
1714                 sf::Color(255, 255 * colour_scalar, 255 * colour_scalar, 255)
1715             );
1716         }
1717         else {
1718             for (
1719                 size_t i = 0;
1720                 i < this->tile_improvement_ptr->tile_improvement_sprite_animated.size();
1721                 i++
1722             ) {
1723                 this->tile_improvement_ptr->tile_improvement_sprite_animated[i].setColor(
1724                     sf::Color(255, 255 * colour_scalar, 255 * colour_scalar, 255)
1725                 );
1726             }
1727         }
1728     }
1729     this->scrap_improvement_frame += 4;
1730 }
1731
1732 // 2. carry out scrapping
1733 else {
1734     this->draw_explosion = true;
1735     this->assets_manager_ptr->getSound("clear non-mountains tile")->play();
1736
1737     if (this->tile_improvement_ptr->production_menu_open) {
1738         this->tile_improvement_ptr->production_menu_open = false;
1739         this->assets_manager_ptr->getSound("build menu close")->play();
1740     }
1741
1742     delete this->tile_improvement_ptr;
1743     this->tile_improvement_ptr = NULL;
1744
1745     this->has_improvement = false;
1746
1747     this->scrap_improvement_frame = 0;
1748
1749     if (
1750         (this->tile_type == TileType :: LAKE) or
1751         (this->tile_type == TileType :: OCEAN)
1752     )
```

```

1754         ) {
1755             this->decoration_cleared = false;
1756         }
1757
1758         this->__sendCreditsSpentMessage(SCRAP_COST);
1759         this->__sendTileStateMessage();
1760         this->__sendGameStateRequest();
1761     }
1762
1763     return;
1764 } /* __scrapImprovement() */

```

#### 4.7.3.21 \_\_sendAssessNeighboursMessage()

```

void HexTile::__sendAssessNeighboursMessage (
    void ) [private]

```

Helper method to format and send assess neighbours message.

```

2141 {
2142     Message assess_neighbours_message;
2143
2144     assess_neighbours_message.channel = HEX_MAP_CHANNEL;
2145     assess_neighbours_message.subject = "assess neighbours";
2146
2147     this->message_hub_ptr->sendMessage(assess_neighbours_message);
2148
2149     std::cout << "Assess neighbours message sent by " << this << std::endl;
2150
2151     return;
2152 } /* __sendAssessNeighboursMessage() */

```

#### 4.7.3.22 \_\_sendCreditsSpentMessage()

```

void HexTile::__sendCreditsSpentMessage (
    int credits_spent ) [private]

```

Helper method to format and send a credits spent message.

##### Parameters

<i>credits_spent</i>	The number of credits that were spent.
----------------------	--

```

2224 {
2225     Message credits_spent_message;
2226
2227     credits_spent_message.channel = GAME_CHANNEL;
2228     credits_spent_message.subject = "credits spent";
2229
2230     credits_spent_message.int_payload["credits spent"] = credits_spent;
2231
2232     this->message_hub_ptr->sendMessage(credits_spent_message);
2233
2234     std::cout << "Credits spent (" << credits_spent << ") message sent by " << this
2235         << std::endl;
2236     return;
2237 } /* __sendCreditsSpentMessage() */

```

#### 4.7.3.23 \_\_sendGameStateRequest()

```

void HexTile::__sendGameStateRequest (

```

```
void ) [private]
```

Helper method to format and send a game state request (message).

```
2167 {
2168     Message game_state_request;
2169
2170     game_state_request.channel = GAME_CHANNEL;
2171     game_state_request.subject = "state request";
2172
2173     this->message_hub_ptr->sendMessage(game_state_request);
2174
2175     std::cout << "Game state request message sent by " << this << std::endl;
2176     return;
2177 } /* __sendGameStateRequest() */
```

#### 4.7.3.24 \_\_sendInsufficientCreditsMessage()

```
void HexTile::__sendInsufficientCreditsMessage (
    void ) [private]
```

Helper method to format and send an insufficient credits message.

```
2252 {
2253     Message insufficient_credits_message;
2254
2255     insufficient_credits_message.channel = GAME_CHANNEL;
2256     insufficient_credits_message.subject = "insufficient credits";
2257
2258     this->message_hub_ptr->sendMessage(insufficient_credits_message);
2259
2260     std::cout << "Insufficient credits message sent by " << this << std::endl;
2261
2262     return;
2263 } /* __sendInsufficientCreditsMessage() */
```

#### 4.7.3.25 \_\_sendTileSelectedMessage()

```
void HexTile::__sendTileSelectedMessage (
    void ) [private]
```

Helper method to format and send message on tile selection.

```
1779 {
1780     Message tile_selected_message;
1781
1782     tile_selected_message.channel = TILE_SELECTED_CHANNEL;
1783     tile_selected_message.subject = "tile selected";
1784
1785     this->message_hub_ptr->sendMessage(tile_selected_message);
1786
1787     return;
1788 } /* __sendTileSelectedMessage() */
```

#### 4.7.3.26 \_\_sendTileStateMessage()

```
void HexTile::__sendTileStateMessage (
    void ) [private]
```

Helper method to format and send tile state message.

```
2100 {
2101     Message tile_state_message;
2102
2103     tile_state_message.channel = TILE_STATE_CHANNEL;
2104     tile_state_message.subject = "tile state";
2105
2106
2107     //          32 char x 17 line console "-----\n";
2108     std::string console_string = "      **** TILE INFO **** \n";
2109
2110     console_string += this->__getTileCoordsSubstring();
2111     console_string += " \n";
2112
2113     console_string += this->__getTileTypeSubstring();
2114     console_string += this->__getTileResourceSubstring();
2115     console_string += this->__getTileImprovementSubstring();
2116     console_string += " \n";
2117
2118     console_string += this->__getTileOptionsSubstring();
2119
2120     tile_state_message.string_payload["console string"] = console_string;
2121
2122     this->message_hub_ptr->sendMessage(tile_state_message);
2123
2124     std::cout << "Tile state message sent by " << this << std::endl;
2125     return;
2126 } /* __sendTileStateMessage() */
```

#### 4.7.3.27 \_\_sendUpdateGamePhaseMessage()

```
void HexTile::__sendUpdateGamePhaseMessage (
    std::string game_phase ) [private]
```

Helper method to format and send update game phase message.

##### Parameters

<i>game_phase</i>	The updated game phase.
-------------------	-------------------------

```
2194 {
2195     Message update_game_phase_message;
2196
2197     update_game_phase_message.channel = GAME_CHANNEL;
2198     update_game_phase_message.subject = "update game phase";
2199
2200     update_game_phase_message.string_payload["game phase"] = game_phase;
2201
2202     this->message_hub_ptr->sendMessage(update_game_phase_message);
2203
2204     std::cout << "Update game phase message sent by " << this << std::endl;
2205
2206     return;
2207 } /* __sendUpdateGamePhaseMessage() */
```

#### 4.7.3.28 \_\_setIsSelected()

```
void HexTile::__setIsSelected (
    bool is_selected ) [private]
```

Helper method to set the is selected attribute (of tile and improvement).

## Parameters

<i>is_selected</i>	The value to set the is selected attribute to.
--------------------	--

```

764 {
765     this->is_selected = is_selected;
766
767     if (this->tile_improvement_ptr != NULL) {
768         this->tile_improvement_ptr->setIsSelected(is_selected);
769         this->tile_improvement_ptr->update();
770     }
771
772     if ((not is_selected) and this->build_menu_open) {
773         this->__closeBuildMenu();
774     }
775
776     return;
777 } /* __setIsSelected() */

```

## 4.7.3.29 \_\_setResourceText()

```

void HexTile::__setResourceText (
    void ) [private]

```

Helper method to set up resource text.

```

193 {
194     this->resource_text.setFont(*(assets_manager_ptr->getFont("DroidSansMono")));
195
196     this->resource_text.setFillColor(sf::Color(0, 0, 0, 255));
197
198     if (this->resource_assessed) {
199         switch (this->tile_resource) {
200             case (TileResource :: POOR): {
201                 this->resource_text.setString("-2");
202                 this->resource_text.setFillColor(MONOCHROME_TEXT_RED);
203
204                 break;
205             }
206
207             case (TileResource :: BELOW_AVERAGE): {
208                 this->resource_text.setString("-1");
209                 this->resource_text.setFillColor(MONOCHROME_TEXT_RED);
210
211                 break;
212             }
213
214             case (TileResource :: AVERAGE): {
215                 this->resource_text.setString("+0");
216
217                 break;
218             }
219
220             case (TileResource :: ABOVE_AVERAGE): {
221                 this->resource_text.setString("+1");
222                 this->resource_text.setFillColor(MONOCHROME_TEXT_GREEN);
223
224                 break;
225             }
226
227             case (TileResource :: GOOD): {
228                 this->resource_text.setString("+2");
229                 this->resource_text.setFillColor(MONOCHROME_TEXT_GREEN);
230
231                 break;
232             }
233
234             default: {
235                 this->resource_text.setString("");
236
237                 break;
238             }
239         }
240     }
241
242     else {
243         this->resource_text.setString("");

```



```

244     }
245
246     this->resource_text.setCharacterSize(20);
247
248     this->resource_text.setOrigin(
249         this->resource_text.getLocalBounds().width / 2,
250         this->resource_text.getLocalBounds().height / 2
251     );
252
253     this->resource_text.setPosition(
254         this->position_x,
255         this->position_y - 4
256     );
257
258     this->resource_text.setOutlineThickness(1);
259     this->resource_text.setOutlineColor(sf::Color(0, 0, 0, 255));
260
261     return;
262 } /* __setResourceText() */

```

#### 4.7.3.30 \_\_setUpBuildMenu()

```

void HexTile::__setUpBuildMenu (
    void ) [private]

```

Helper method to set up and place build menu assets (drawable).

```

667 {
668     this->build_menu_options_vec.clear();
669     this->build_menu_options_text_vec.clear();
670
671     // 1. set up and place build menu backing and text
672     this->build_menu_backing.setSize(sf::Vector2f(600, 256));
673     this->build_menu_backing.setOrigin(300, 128);
674     this->build_menu_backing.setPosition(400, 400);
675     this->build_menu_backing.setFillColor(MONOCROME_SCREEN_BACKGROUND);
676     this->build_menu_backing.setOutlineColor(MENU_FRAME_GREY);
677     this->build_menu_backing.setOutlineThickness(4);
678
679     this->build_menu_backing_text.setString("**** BUILD MENU ****");
680     this->build_menu_backing_text.setFont(
681         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220"))
682     );
683     this->build_menu_backing_text.setCharacterSize(16);
684     this->build_menu_backing_text.setFillColor(MONOCROME_TEXT_GREEN);
685     this->build_menu_backing_text.setOrigin(
686         this->build_menu_backing_text.getLocalBounds().width / 2, 0
687     );
688     this->build_menu_backing_text.setPosition(400, 400 - 128 + 4);
689
690     // 2. set up and place build menu option sprites and text
691     switch (this->tile_type) {
692     case (TileType :: FOREST): {
693         this->__setUpDieselGeneratorBuildOption();
694         this->__setUpSolarPVBuildOption();
695         this->__setUpWindTurbineBuildOption();
696         //this->__setUpEnergyStorageSystemBuildOption();
697
698         break;
699     }
700
701     case (TileType :: LAKE): {
702         this->__setUpSolarPVBuildOption(true);
703         this->__setUpWindTurbineBuildOption(true);
704
705         break;
706     }
707
708     case (TileType :: MOUNTAINS): {
709         this->__setUpDieselGeneratorBuildOption();
710         this->__setUpSolarPVBuildOption();
711         this->__setUpWindTurbineBuildOption();
712         //this->__setUpEnergyStorageSystemBuildOption();
713
714         break;
715     }
716
717     }
718 }

```

```

719
720     case (TileType :: OCEAN): {
721         this->__setUpWindTurbineBuildOption(false, true);
722         this->__setUpTidalTurbineBuildOption();
723         this->__setUpWaveEnergyConverterBuildOption();
724
725         break;
726     }
727
728     case (TileType :: PLAINS): {
729         this->__setUpDieselGeneratorBuildOption();
730         this->__setUpSolarPVBUILDOption();
731         this->__setUpWindTurbineBuildOption();
732         //this->__setUpEnergyStorageSystemBuildOption();
733
734         break;
735     }
736
737     default: {
738         // do nothing!
739
740         break;
741     }
742 }
743
744 return;
745
746 } /* __setUpBuildMenu() */

```

#### 4.7.3.31 \_\_setUpBuildOption()

```

void HexTile::__setUpBuildOption (
    std::string texture_key,
    std::string option_string ) [private]

```

Helper method to set up and position the sprite and text for a build option.

##### Parameters

<i>texture_key</i>	The key for the appropriate illustration asset for the build option.
<i>option_string</i>	A string for the build option.

```

357 {
358     size_t n_options = this->build_menu_options_vec.size();
359
360     // 1. set up option sprite(s)
361     this->build_menu_options_vec.push_back({});
362
363     if (not texture_key.empty()) {
364         sf::Sprite texture_sheet(
365             *(this->assets_manager_ptr->getTexture(texture_key))
366         );
367
368         int sheet_height = texture_sheet.getLocalBounds().height;
369         int n_subrects = sheet_height / 64;
370
371         for (int i = 0; i < n_subrects; i++) {
372             this->build_menu_options_vec.back().push_back(
373                 sf::Sprite(
374                     *(this->assets_manager_ptr->getTexture(texture_key)),
375                     sf::IntRect(0, i * 64, 64, 64)
376                 )
377             );
378
379             this->build_menu_options_vec.back().back().setOrigin(
380                 this->build_menu_options_vec.back().back().getLocalBounds().width / 2,
381                 this->build_menu_options_vec.back().back().getLocalBounds().height
382             );
383
384             this->build_menu_options_vec.back().back().setPosition(
385                 400 - 300 + 75 + n_options * 150,
386                 400 - 32

```

```

387         );
388     }
389 }
390
391 else {
392     this->build_menu_options_vec.back().push_back(sf::Sprite());
393 }
394
395
396 // 2. set up option text
397 this->build_menu_options_text_vec.push_back(
398     sf::Text(
399         option_string,
400         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
401         16
402     )
403 );
404
405 this->build_menu_options_text_vec.back().setOrigin(
406     this->build_menu_options_text_vec.back().getLocalBounds().width / 2,
407     0
408 );
409
410 this->build_menu_options_text_vec.back().setPosition(
411     400 - 300 + 75 + n_options * 150,
412     400 - 16 - 4
413 );
414
415 this->build_menu_options_text_vec.back().setFillColor(MONOCROME_TEXT_GREEN);
416
417 return;
418 } /* __setUpBuildOption() */

```

#### 4.7.3.32 \_\_setUpDieselGeneratorBuildOption()

```

void HexTile::__setUpDieselGeneratorBuildOption (
    void ) [private]

```

Helper method to set up and position the diesel generator build option.

```

433 {
434     // 1. set up option sprite(s)
435     std::string texture_key = "diesel generator";
436
437     // 2. set up option string (up to 16 chars wide)
438     // -----\n"
439     std::string diesel_generator_string = "DIESEL GENERATOR\n";
440     diesel_generator_string += "\n";
441     diesel_generator_string += "CAPACITY: 100 kW\n";
442     diesel_generator_string += "COST: ";
443     diesel_generator_string += std::to_string(DIESEL_GENERATOR_BUILD_COST);
444     diesel_generator_string += " K\n\n";
445     diesel_generator_string += "BUILD: [D] \n";
446
447     // 3. call general method
448     this->__setUpBuildOption(texture_key, diesel_generator_string);
449
450     return;
451 } /* __setUpDieselGeneratorBuildOption() */

```

#### 4.7.3.33 \_\_setUpEnergyStorageSystemBuildOption()

```

void HexTile::__setUpEnergyStorageSystemBuildOption (
    void ) [private]

```

Helper method to set up and position the wave energy converter build option.

```

633 {
634     /*
635     // 1. set up option sprite(s)
636     std::string texture_key = "energy storage system";

```

```

637
638 // 2. set up option string (up to 16 chars wide)
639 // "-----\n"
640 std::string energy_storage_system_string = " ENERGY STORAGE \n";
641 energy_storage_system_string += " \n";
642 energy_storage_system_string += "CAPCTY: 1 MWh\n";
643 energy_storage_system_string += "COST: ";
644 energy_storage_system_string += std::to_string(ENERGY_STORAGE_SYSTEM_BUILD_COST);
645 energy_storage_system_string += " K\n\n";
646 energy_storage_system_string += "BUILD: [E] \n";
647
648 // 3. call general method
649 this->__setUpBuildOption(texture_key, energy_storage_system_string);
650 */
651 return;
652 } /* __setUpEnergyStorageSystemBuildOption() */

```

#### 4.7.3.34 \_\_setUpMagnifyingGlassSprite()

```

void HexTile::__setUpMagnifyingGlassSprite (
    void ) [private]

```

Helper method to set up and position magnifying glass sprite.

```

277 {
278     this->magnifying_glass_sprite.setTexture(
279         *(this->assets_manager_ptr->getTexture("magnifying_glass_64x64_1"))
280     );
281
282     this->magnifying_glass_sprite.setOrigin(
283         this->magnifying_glass_sprite.getLocalBounds().width / 2,
284         this->magnifying_glass_sprite.getLocalBounds().height / 2
285     );
286
287     this->magnifying_glass_sprite.setPosition(
288         this->position_x,
289         this->position_y
290     );
291
292     return;
293 } /* __setUpMagnifyingGlassSprite() */

```

#### 4.7.3.35 \_\_setUpNodeSprite()

```

void HexTile::__setUpNodeSprite (
    void ) [private]

```

Helper method to set up node sprite.

```

68 {
69     this->node_sprite.setRadius(4);
70
71     this->node_sprite.setOrigin(
72         this->node_sprite.getLocalBounds().width / 2,
73         this->node_sprite.getLocalBounds().height / 2
74     );
75
76     this->node_sprite.setPosition(this->position_x, this->position_y);
77
78     this->node_sprite.setFillColor(sf::Color(255, 0, 0, 255));
79
80     return;
81 } /* __setUpNodeSprite() */

```

**4.7.3.36 \_\_setUpResourceChipSprite()**

```
void HexTile::__setUpResourceChipSprite (
    void ) [private]
```

Helper method to set up resource chip sprite.

```
166 {
167     this->resource_chip_sprite.setRadius(2 * this->minor_radius / 3);
168
169     this->resource_chip_sprite.setOrigin(
170         this->resource_chip_sprite.getLocalBounds().width / 2,
171         this->resource_chip_sprite.getLocalBounds().height / 2
172     );
173
174     this->resource_chip_sprite.setPosition(this->position_x, this->position_y);
175
176     this->resource_chip_sprite.setFillColor(RESOURCE_CHIP_GREY);
177
178     return;
179 } /* __setUpResourceChip() */
```

**4.7.3.37 \_\_setUpSelectOutlineSprite()**

```
void HexTile::__setUpSelectOutlineSprite (
    void ) [private]
```

Helper method to set up select outline sprite.

```
130 {
131     int n_points = 6;
132
133     this->select_outline_sprite.setPointCount(n_points);
134
135     for (int i = 0; i < n_points; i++) {
136         this->select_outline_sprite.setPoint(
137             i,
138             sf::Vector2f(
139                 this->position_x + this->major_radius * cos((30 + 60 * i) * (M_PI / 180)),
140                 this->position_y + this->major_radius * sin((30 + 60 * i) * (M_PI / 180))
141             )
142         );
143     }
144
145     this->select_outline_sprite.setOutlineThickness(4);
146     this->select_outline_sprite.setOutlineColor(MONOCHROME_TEXT_RED);
147
148     this->select_outline_sprite.setFillColor(sf::Color(0, 0, 0, 0));
149
150     return;
151 } /* __setUpSelectOutline() */
```

**4.7.3.38 \_\_setUpSolarPVBuildOption()**

```
void HexTile::__setUpSolarPVBuildOption (
    bool is_lake = false ) [private]
```

Helper method to set up and position the solar PV array build option.

**Parameters**

<i>is_lake</i>	If being built on a lake.
----------------	---------------------------

```

521 {
522     // 1. set up option sprite(s)
523     std::string texture_key = "solar PV array";
524
525     // 2. set up option string (up to 16 chars wide)
526     int build_cost = SOLAR_PV_BUILD_COST;
527     if (is_lake) {
528         build_cost *= SOLAR_PV_WATER_BUILD_MULTIPLIER;
529     }
530
531     //
532     std::string solar_PV_string = "-----\n"
533     solar_PV_string = " SOLAR PV ARRAY \n";
534     solar_PV_string += "CAPACITY: 100 kW\n";
535     solar_PV_string += "COST: ";
536     solar_PV_string += std::to_string(build_cost);
537     solar_PV_string += " K";
538
539     if (is_lake) {
540         solar_PV_string += "\n** LAKE BUILD **\n\n";
541     }
542     else {
543         solar_PV_string += "\n\n\n";
544     }
545
546     solar_PV_string += "BUILD: [S] \n";
547
548     // 3. call general method
549     this->__setUpBuildOption(texture_key, solar_PV_string);
550
551     return;
552 } /* __setUpSolarPVBuildOption() */

```

#### 4.7.3.39 \_\_setUpTidalTurbineBuildOption()

```

void HexTile::__setUpTidalTurbineBuildOption (
    void ) [private]

```

Helper method to set up and position the tidal turbine build option.

```

567 {
568     // 1. set up option sprite(s)
569     std::string texture_key = "tidal turbine";
570
571     // 2. set up option string (up to 16 chars wide)
572     //
573     std::string tidal_turbine_string = "-----\n"
574     tidal_turbine_string = " TIDAL TURBINE \n";
575     tidal_turbine_string += "CAPACITY: 100 kW\n";
576     tidal_turbine_string += "COST: ";
577     tidal_turbine_string += std::to_string(TIDAL_TURBINE_BUILD_COST);
578     tidal_turbine_string += " K\n\n";
579     tidal_turbine_string += "BUILD: [T] \n";
580
581     // 3. call general method
582     this->__setUpBuildOption(texture_key, tidal_turbine_string);
583
584     return;
585 } /* __setUpTidalTurbineBuildOption() */

```

#### 4.7.3.40 \_\_setUpTileExplosionReel()

```

void HexTile::__setUpTileExplosionReel (
    void ) [private]

```

Helper method to set up tile explosion sprite reel.

```

308 {
309     for (int i = 0; i < 4; i++) {
310         for (int j = 0; j < 4; j++) {
311             this->explosion_sprite_reel.push_back(

```

```

312         sf::Sprite(
313             *(this->assets_manager_ptr->getTexture("tile clear explosion")),
314             sf::IntRect(j * 64, i * 64, 64, 64)
315         )
316     );
317
318     this->explosion_sprite_reel.back().setOrigin(
319         this->explosion_sprite_reel.back().getLocalBounds().width / 2,
320         this->explosion_sprite_reel.back().getLocalBounds().height / 2
321     );
322
323     this->explosion_sprite_reel.back().setPosition(
324         this->position_x,
325         this->position_y
326     );
327 }
328 }
329
330 return;
331 } /* __setUpTileExplosionReel() */

```

#### 4.7.3.41 \_\_setUpTileSprite()

```

void HexTile::__setUpTileSprite (
    void ) [private]

```

Helper method to set up tile sprite.

```

96 {
97     int n_points = 6;
98
99     this->tile_sprite.setPointCount(n_points);
100
101     for (int i = 0; i < n_points; i++) {
102         this->tile_sprite.setPoint(
103             i,
104             sf::Vector2f(
105                 this->position_x + this->major_radius * cos((30 + 60 * i) * (M_PI / 180)),
106                 this->position_y + this->major_radius * sin((30 + 60 * i) * (M_PI / 180))
107             )
108         );
109     }
110
111     this->tile_sprite.setOutlineThickness(1);
112     this->tile_sprite.setOutlineColor(sf::Color(175, 175, 175, 255));
113
114     return;
115 } /* __setUpTileSprite() */

```

#### 4.7.3.42 \_\_setUpWaveEnergyConverterBuildOption()

```

void HexTile::__setUpWaveEnergyConverterBuildOption (
    void ) [private]

```

Helper method to set up and position the wave energy converter build option.

```

600 {
601     // 1. set up option sprite(s)
602     std::string texture_key = "wave energy converter";
603
604     // 2. set up option string (up to 16 chars wide)
605     // -----\n"
606     std::string wave_energy_converter_string = "WAVE ENERGY CVTR\n";
607     wave_energy_converter_string += " \n";
608     wave_energy_converter_string += "CAPACITY: 100 kW\n";
609     wave_energy_converter_string += "COST: ";
610     wave_energy_converter_string += std::to_string(WAVE_ENERGY_CONVERTER_BUILD_COST);
611     wave_energy_converter_string += " K\n\n";
612     wave_energy_converter_string += "BUILD: [A] \n";
613
614     // 3. call general method
615     this->__setUpBuildOption(texture_key, wave_energy_converter_string);
616
617     return;
618 } /* __setUpWaveEnergyConverterBuildOption() */

```

#### 4.7.3.43 \_\_setUpWindTurbineBuildOption()

```
void HexTile::__setUpWindTurbineBuildOption (
    bool is_lake = false,
    bool is_ocean = false ) [private]
```

Helper method to set up and position the wind turbine build option.

##### Parameters

<i>is_lake</i>	If being built on a lake tile.
<i>is_ocean</i>	If being built on an ocean tile.

```
470 {
471     // 1. set up option sprite(s)
472     std::string texture_key = "wind turbine";
473
474     // 2. set up option string (up to 16 chars wide)
475     int build_cost = WIND_TURBINE_BUILD_COST;
476     if (is_lake or is_ocean) {
477         build_cost *= WIND_TURBINE_WATER_BUILD_MULTIPLIER;
478     }
479
480     // ----- \n"
481     std::string wind_turbine_string = " WIND TURBINE \n";
482     wind_turbine_string += " \n";
483     wind_turbine_string += "CAPACITY: 100 kW\n";
484     wind_turbine_string += "COST: ";
485     wind_turbine_string += std::to_string(build_cost);
486     wind_turbine_string += " K";
487
488     if (is_lake) {
489         wind_turbine_string += "\n** LAKE BUILD **\n\n";
490     }
491     else if (is_ocean) {
492         wind_turbine_string += "\n* OCEAN BUILD * \n\n";
493     }
494     else {
495         wind_turbine_string += "\n\n\n";
496     }
497
498     wind_turbine_string += "BUILD: [W] \n";
499
500     // 3. call general method
501     this->__setUpBuildOption(texture_key, wind_turbine_string);
502
503     return;
504 } /* __setUpWindTurbineBuildOption() */
```

#### 4.7.3.44 assess()

```
void HexTile::assess (
    void )
```

Method to assess the tile's resource.

```
2686 {
2687     this->resource_assessed = true;
2688     this->resource_assessment = true;
2689
2690     this->assets_manager_ptr->getSound("resource assessment")->play();
2691
2692     this->__setResourceText();
2693     this->__sendTileStateMessage();
2694
2695     return;
2696 } /* assess() */
```



## 4.7.3.45 decorateTile()

```
void HexTile::decorateTile (
    void )
```

Method to decorate tile.

```
2564 {
2565     switch (this->tile_type) {
2566     case (TileType :: FOREST): {
2567         this->tile_decoration_sprite.setTexture(
2568             *(this->assets_manager_ptr->getTexture("pine_tree_64x64_1"))
2569         );
2570     }
2571     break;
2572     }
2573
2574     case (TileType :: LAKE): {
2575         this->tile_decoration_sprite.setTexture(
2576             *(this->assets_manager_ptr->getTexture("water_shimmer_64x64_1"))
2577         );
2578     }
2579     break;
2580     }
2581
2582     case (TileType :: MOUNTAINS): {
2583         this->tile_decoration_sprite.setTexture(
2584             *(this->assets_manager_ptr->getTexture("mountain_64x64_1"))
2585         );
2586     }
2587     break;
2588     }
2589
2590     case (TileType :: OCEAN): {
2591         this->tile_decoration_sprite.setTexture(
2592             *(this->assets_manager_ptr->getTexture("water_waves_64x64_1"))
2593         );
2594     }
2595     break;
2596     }
2597
2598     case (TileType :: PLAINS): {
2599         this->tile_decoration_sprite.setTexture(
2600             *(this->assets_manager_ptr->getTexture("wheat_64x64_1"))
2601         );
2602     }
2603     break;
2604     }
2605
2606     default: {
2607         // do nothing!
2608     }
2609     break;
2610     }
2611 }
2612
2613
2614 if (this->tile_type == TileType :: OCEAN or this->tile_type == TileType :: LAKE) {
2615     this->tile_decoration_sprite.setOrigin(
2616         this->tile_decoration_sprite.getLocalBounds().width / 2,
2617         this->tile_decoration_sprite.getLocalBounds().height / 2
2618     );
2619
2620     this->tile_decoration_sprite.setPosition(
2621         this->position_x,
2622         this->position_y
2623     );
2624
2625     if ((double)rand() / RAND_MAX > 0.5) {
2626         this->tile_decoration_sprite.setScale(sf::Vector2f(-1, 1));
2627     }
2628 }
2629
2630 else {
2631     this->tile_decoration_sprite.setOrigin(
2632         this->tile_decoration_sprite.getLocalBounds().width / 2,
2633         this->tile_decoration_sprite.getLocalBounds().height
2634     );
2635
2636     this->tile_decoration_sprite.setPosition(
2637         this->position_x,
2638         this->position_y + 12
2639     );
2640
2641     if ((double)rand() / RAND_MAX > 0.5) {
```

```

2642         this->tile_decoration_sprite.setScale(sf::Vector2f(-1, 1));
2643     }
2644 }
2645
2646 return;
2647 } /* decorateTile(void) */

```

#### 4.7.3.46 draw()

```

void HexTile::draw (
    void )

```

Method to draw the hex tile to the render window. To be called once per frame.

```

2825 {
2826     // 1. draw hex
2827     this->render_window_ptr->draw(this->tile_sprite);
2828
2829     // 2. draw node
2830     if (this->show_node) {
2831         this->render_window_ptr->draw(this->node_sprite);
2832     }
2833
2834     // 3. draw tile decoration
2835     if (not this->decoration_cleared) {
2836         this->render_window_ptr->draw(this->tile_decoration_sprite);
2837     }
2838
2839     // 4. draw selection outline
2840     if (this->is_selected) {
2841         sf::Color outline_colour = this->select_outline_sprite.getOutlineColor();
2842
2843         outline_colour.a =
2844             255 * pow(cos((M_PI * this->frame) / FRAMES_PER_SECOND), 2);
2845
2846         this->select_outline_sprite.setOutlineColor(outline_colour);
2847
2848         this->render_window_ptr->draw(this->select_outline_sprite);
2849     }
2850
2851     // 5. draw tile improvement
2852     if (this->has_improvement) {
2853         if (not this->tile_improvement_ptr->just_built) {
2854             this->tile_improvement_ptr->draw();
2855         }
2856     }
2857
2858     // 6. draw resource
2859     if (this->show_resource) {
2860         this->render_window_ptr->draw(this->resource_chip_sprite);
2861         this->render_window_ptr->draw(this->resource_text);
2862     }
2863
2864     // 7. draw resource assessment notification
2865     if (this->resource_assessment) {
2866         int alpha = this->magnifying_glass_sprite.getColor().a;
2867
2868         alpha -= 0.05 * FRAMES_PER_SECOND;
2869         if (alpha < 0) {
2870             alpha = 0;
2871             this->resource_assessment = false;
2872         }
2873
2874         this->magnifying_glass_sprite.setColor(
2875             sf::Color(255, 255, 255, alpha)
2876         );
2877
2878         this->render_window_ptr->draw(this->magnifying_glass_sprite);
2879     }
2880
2881     // 8. draw explosion, then settlement placement
2882     if (this->draw_explosion) {
2883         this->render_window_ptr->draw(this->explosion_sprite_reel[this->explosion_frame]);
2884
2885         if (this->frame % (FRAMES_PER_SECOND / 20) == 0) {
2886             this->explosion_frame++;
2887         }
2888
2889         if (this->explosion_frame >= this->explosion_sprite_reel.size()) {

```

```

2890         this->draw_explosion = false;
2891         this->explosion_frame = 0;
2892     }
2893 }
2894
2895 else if (this->has_improvement) {
2896     if (this->tile_improvement_ptr->just_built) {
2897         this->tile_improvement_ptr->draw();
2898     }
2899 }
2900
2901 // 9. build menu
2902 if (this->build_menu_open) {
2903     this->render_window_ptr->draw(this->build_menu_backing);
2904     this->render_window_ptr->draw(this->build_menu_backing_text);
2905
2906     for (size_t i = 0; i < this->build_menu_options_vec.size(); i++) {
2907         for (size_t j = 0; j < this->build_menu_options_vec[i].size(); j++) {
2908             this->render_window_ptr->draw(this->build_menu_options_vec[i][j]);
2909         }
2910         this->render_window_ptr->draw(this->build_menu_options_text_vec[i]);
2911     }
2912 }
2913
2914 this->frame++;
2915 return;
2916 } /* draw() */

```

#### 4.7.3.47 processEvent()

```

void HexTile::processEvent (
    void )

```

Method to process [HexTile](#). To be called once per event.

```

2711 {
2712     // 1. process TileImprovement events
2713     if (
2714         this->is_selected and
2715         this->tile_improvement_ptr != NULL
2716     ) {
2717         this->tile_improvement_ptr->processEvent();
2718     }
2719
2720     // 2. process HexTile events
2721     if (this->event_ptr->type == sf::Event::KeyPressed) {
2722         this->__handleKeyPressEvents();
2723     }
2724
2725     if (this->event_ptr->type == sf::Event::KeyReleased) {
2726         this->__handleKeyReleaseEvents();
2727     }
2728
2729     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
2730         this->__handleMouseButtonEvents();
2731     }
2732
2733     return;
2734 } /* processEvent() */

```

#### 4.7.3.48 processMessage()

```

void HexTile::processMessage (
    void )

```

Method to process [HexTile](#). To be called once per message.

```

2749 {
2750     // 1. process TileImprovement messages
2751     if (this->tile_improvement_ptr != NULL) {
2752         this->tile_improvement_ptr->processMessage();

```

```

2753     }
2754
2755     // 2. process HexTile messages
2756     if (this->is_selected) {
2757         if (not this->message_hub_ptr->isEmpty(TILE_STATE_CHANNEL)) {
2758             Message tile_state_message = this->message_hub_ptr->receiveMessage(
2759                 TILE_STATE_CHANNEL
2760             );
2761
2762             if (tile_state_message.subject == "state request") {
2763                 this->__sendTileStateMessage();
2764
2765                 std::cout << "Tile state request received by " << this << std::endl;
2766                 this->message_hub_ptr->popMessage(TILE_STATE_CHANNEL);
2767             }
2768         }
2769
2770         std::cout << "Current credits (HexTile): " << this->credits << " K" <<
2771             std::endl;
2772     }
2773
2774     if (not this->message_hub_ptr->isEmpty(GAME_STATE_CHANNEL)) {
2775         Message game_state_message = this->message_hub_ptr->receiveMessage(
2776             GAME_STATE_CHANNEL
2777         );
2778
2779         if (game_state_message.subject == "game state") {
2780             this->credits = game_state_message.int_payload["credits"];
2781             this->game_phase = game_state_message.string_payload["game phase"];
2782
2783             if (this->tile_improvement_ptr != NULL) {
2784                 this->tile_improvement_ptr->credits = this->credits;
2785                 this->tile_improvement_ptr->game_phase = this->game_phase;
2786
2787                 this->tile_improvement_ptr->month =
2788                     game_state_message.int_payload["month"];
2789
2790                 this->tile_improvement_ptr->demand_MWh =
2791                     game_state_message.int_payload["demand_MWh"];
2792
2793                 this->tile_improvement_ptr->demand_vec_MWh =
2794                     game_state_message.vector_payload["demand_vec_MWh"];
2795
2796                 this->tile_improvement_ptr->update();
2797             }
2798
2799             this->message_hub_ptr->incrementMessageRead(GAME_STATE_CHANNEL);
2800             std::cout << "Game state message read and passed by " << this << std::endl;
2801
2802             if (this->is_selected) {
2803                 this->__sendTileStateMessage();
2804             }
2805         }
2806     }
2807
2808     return;
2809 } /* processMessage() */

```

#### 4.7.3.49 setTileResource() [1/2]

```

void HexTile::setTileResource (
    double input_value )

```

Method to set the tile resource (by numeric input).

##### Parameters

<i>input_value</i>	A numerical input in the closed interval [0, 1].
--------------------	--

```

2513 {
2514     // 1. check input
2515     if (input_value < 0 or input_value > 1) {
2516         std::string error_str = "ERROR HexTile::setTileResource() given input value is ";
2517         error_str += "not in the closed interval [0, 1]";
2518     }

```

```

2519         #ifdef _WIN32
2520             std::cout << error_str << std::endl;
2521         #endif /* _WIN32 */
2522
2523         throw std::runtime_error(error_str);
2524     }
2525
2526     // 2. convert input value to tile resource
2527     TileResource tile_resource;
2528
2529     if (input_value <= TILE_RESOURCE_CUMULATIVE_PROBABILITIES[0]) {
2530         tile_resource = TileResource :: POOR;
2531     }
2532     else if (input_value <= TILE_RESOURCE_CUMULATIVE_PROBABILITIES[1]) {
2533         tile_resource = TileResource :: BELOW_AVERAGE;
2534     }
2535     else if (input_value <= TILE_RESOURCE_CUMULATIVE_PROBABILITIES[2]) {
2536         tile_resource = TileResource :: AVERAGE;
2537     }
2538     else if (input_value <= TILE_RESOURCE_CUMULATIVE_PROBABILITIES[3]) {
2539         tile_resource = TileResource :: ABOVE_AVERAGE;
2540     }
2541     else {
2542         tile_resource = TileResource :: GOOD;
2543     }
2544
2545     // 3. call alternate method
2546     this->setTileResource(tile_resource);
2547
2548     return;
2549 } /* setTileResource(double) */

```

#### 4.7.3.50 setTileResource() [2/2]

```

void HexTile::setTileResource (
    TileResource tile_resource )

```

Method to set the tile resource (by enum value).

##### Parameters

<i>tile_resource</i>	The resource (TileResource) value to attribute to the tile.
----------------------	---

```

2491 {
2492     this->tile_resource = tile_resource;
2493     this->__setResourceText();
2494
2495     return;
2496 } /* setTileResource(TileResource) */

```

#### 4.7.3.51 setTileType() [1/2]

```

void HexTile::setTileType (
    double input_value )

```

Method to set the tile type (by numeric input).

##### Parameters

<i>input_value</i>	A numerical input in the closed interval [0, 1].
--------------------	--

```

2441 {

```

```

2442 // 1. check input
2443 if (input_value < 0 or input_value > 1) {
2444     std::string error_str = "ERROR HexTile::setTileType() given input value is ";
2445     error_str += "not in the closed interval [0, 1]";
2446
2447     #ifdef _WIN32
2448         std::cout << error_str << std::endl;
2449     #endif /* _WIN32 */
2450
2451     throw std::runtime_error(error_str);
2452 }
2453
2454 // 2. convert input value to tile type
2455 TileType tile_type;
2456
2457 if (input_value <= TILE_TYPE_CUMULATIVE_PROBABILITIES[0]) {
2458     tile_type = TileType :: LAKE;
2459 }
2460 else if (input_value <= TILE_TYPE_CUMULATIVE_PROBABILITIES[1]) {
2461     tile_type = TileType :: PLAINS;
2462 }
2463 else if (input_value <= TILE_TYPE_CUMULATIVE_PROBABILITIES[2]) {
2464     tile_type = TileType :: FOREST;
2465 }
2466 else {
2467     tile_type = TileType :: MOUNTAINS;
2468 }
2469
2470 // 3. call alternate method
2471 this->setTileType(tile_type);
2472
2473 return;
2474 } /* setTileType(double) */

```

#### 4.7.3.52 setTileType() [2/2]

```

void HexTile::setTileType (
    TileType tile_type )

```

Method to set the tile type (by enum value).

##### Parameters

<i>tile_type</i>	The type (TileType) to set the tile to.
------------------	---

```

2380 {
2381     this->tile_type = tile_type;
2382
2383     switch (this->tile_type) {
2384         case (TileType :: FOREST): {
2385             this->tile_sprite.setFillColor(FOREST_GREEN);
2386
2387             break;
2388         }
2389
2390         case (TileType :: LAKE): {
2391             this->tile_sprite.setFillColor(LAKE_BLUE);
2392
2393             break;
2394         }
2395
2396         case (TileType :: MOUNTAINS): {
2397             this->tile_sprite.setFillColor(MOUNTAINS_GREY);
2398
2399             break;
2400         }
2401
2402         case (TileType :: OCEAN): {
2403             this->tile_sprite.setFillColor(OCEAN_BLUE);
2404
2405             break;
2406         }
2407
2408         case (TileType :: PLAINS): {
2409             this->tile_sprite.setFillColor(PLAINS_YELLOW);

```

```

2410
2411         break;
2412     }
2413
2414     default: {
2415         // do nothing!
2416
2417         break;
2418     }
2419 }
2420
2421 this->__setUpBuildMenu();
2422
2423 return;
2424 } /* setTileType(TileType) */

```

#### 4.7.3.53 toggleResourceOverlay()

```

void HexTile::toggleResourceOverlay (
    void )

```

Method to toggle the tile resource overlay.

```

2662 {
2663     if (this->show_resource) {
2664         this->show_resource = false;
2665     }
2666     else {
2667         this->show_resource = true;
2668     }
2669
2670     return;
2671 } /* toggleResourceOverlay() */

```

### 4.7.4 Member Data Documentation

#### 4.7.4.1 assets\_manager\_ptr

```
AssetsManager* HexTile::assets_manager_ptr [private]
```

A pointer to the assets manager.

#### 4.7.4.2 build\_menu\_backing

```
sf::RectangleShape HexTile::build_menu_backing
```

A backing for the tile build menu.

#### 4.7.4.3 build\_menu\_backing\_text

```
sf::Text HexTile::build_menu_backing_text
```

A text label for the build menu.

#### 4.7.4.4 build\_menu\_open

```
bool HexTile::build_menu_open
```

A boolean which indicates if the tile build menu is open.

#### 4.7.4.5 build\_menu\_options\_text\_vec

```
std::vector<sf::Text> HexTile::build_menu_options_text_vec
```

A vector of text for the tile build options.

#### 4.7.4.6 build\_menu\_options\_vec

```
std::vector<std::vector<sf::Sprite> > HexTile::build_menu_options_vec
```

A vector of sprites for illustrating the tile build options.

#### 4.7.4.7 credits

```
int HexTile::credits
```

The current balance of credits.

#### 4.7.4.8 decoration\_cleared

```
bool HexTile::decoration_cleared
```

A boolean which indicates if the tile decoration has been cleared.



#### 4.7.4.9 draw\_explosion

```
bool HexTile::draw_explosion
```

A boolean which indicates whether or not to draw a tile explosion.

#### 4.7.4.10 event\_ptr

```
sf::Event* HexTile::event_ptr [private]
```

A pointer to the event class.

#### 4.7.4.11 explosion\_frame

```
size_t HexTile::explosion_frame
```

The current frame of the explosion animation.

#### 4.7.4.12 explosion\_sprite\_reel

```
std::vector<sf::Sprite> HexTile::explosion_sprite_reel
```

A reel of sprites for a tile explosion animation.

#### 4.7.4.13 frame

```
unsigned long long int HexTile::frame
```

The current frame of this object.

#### 4.7.4.14 game\_phase

```
std::string HexTile::game_phase
```

The current phase of the game.

#### 4.7.4.15 has\_improvement

```
bool HexTile::has_improvement
```

A boolean which indicates if tile has improvement or not.

#### 4.7.4.16 is\_selected

```
bool HexTile::is_selected
```

A boolean which indicates whether or not the tile is selected.

#### 4.7.4.17 magnifying\_glass\_sprite

```
sf::Sprite HexTile::magnifying_glass_sprite
```

A magnifying glass sprite.

#### 4.7.4.18 major\_radius

```
double HexTile::major_radius
```

The radius of the smallest bounding circle.

#### 4.7.4.19 message\_hub\_ptr

```
MessageHub* HexTile::message_hub_ptr [private]
```

A pointer to the message hub.

#### 4.7.4.20 minor\_radius

```
double HexTile::minor_radius
```

The radius of the largest inscribed circle.

#### 4.7.4.21 node\_sprite

```
sf::CircleShape HexTile::node_sprite
```

A circle shape to mark the tile node.

#### 4.7.4.22 position\_x

```
double HexTile::position_x
```

The x position of the tile.

#### 4.7.4.23 position\_y

```
double HexTile::position_y
```

The y position of the tile.

#### 4.7.4.24 render\_window\_ptr

```
sf::RenderWindow* HexTile::render_window_ptr [private]
```

A pointer to the render window.

#### 4.7.4.25 resource\_assessed

```
bool HexTile::resource_assessed
```

A boolean which indicates whether or not the resource has been assessed.

#### 4.7.4.26 resource\_assessment

```
bool HexTile::resource_assessment
```

A boolean which triggers a resource assessment notification.

#### 4.7.4.27 resource\_chip\_sprite

```
sf::CircleShape HexTile::resource_chip_sprite
```

A circle shape which represents a resource chip.

#### 4.7.4.28 resource\_text

```
sf::Text HexTile::resource_text
```

A text representation of the resource.

#### 4.7.4.29 scrap\_improvement\_frame

```
int HexTile::scrap_improvement_frame
```

A frame for key-hold to confirm scrapping.

#### 4.7.4.30 select\_outline\_sprite

```
sf::ConvexShape HexTile::select_outline_sprite
```

A convex shape which outlines the tile when selected.

#### 4.7.4.31 show\_node

```
bool HexTile::show_node
```

A boolean which indicates whether or not to show the tile node.

#### 4.7.4.32 show\_resource

```
bool HexTile::show_resource
```

A boolean which indicates whether or not to show resource value.

#### 4.7.4.33 tile\_decoration\_sprite

```
sf::Sprite HexTile::tile_decoration_sprite
```

A tile decoration sprite.

#### 4.7.4.34 tile\_improvement\_ptr

```
TileImprovement* HexTile::tile_improvement_ptr
```

A pointer to the improvement for this tile.

#### 4.7.4.35 tile\_resource

```
TileResource HexTile::tile_resource
```

The renewable resource quality of the tile.

#### 4.7.4.36 tile\_sprite

```
sf::ConvexShape HexTile::tile_sprite
```

A convex shape which represents the tile.

#### 4.7.4.37 tile\_type

```
TileType HexTile::tile_type
```

The terrain type of the tile.

The documentation for this class was generated from the following files:

- header/[HexTile.h](#)
- source/[HexTile.cpp](#)

## 4.8 Message Struct Reference

A structure which defines a standard message format.

```
#include <MessageHub.h>
```

## Public Attributes

- `std::string channel = ""`  
*A string identifying the appropriate channel for this message.*
- `std::string subject = ""`  
*A string describing the message subject.*
- `unsigned int number_of_reads = 0`  
*The number of times the message has been read.*
- `std::map< std::string, bool > bool_payload = {}`  
*A boolean payload.*
- `std::map< std::string, int > int_payload = {}`  
*An int payload.*
- `std::map< std::string, double > double_payload = {}`  
*A double payload.*
- `std::map< std::string, std::vector< double > > vector_payload = {}`  
*A vector (double) payload.*
- `std::map< std::string, std::string > string_payload = {}`  
*A string payload.*

### 4.8.1 Detailed Description

A structure which defines a standard message format.

### 4.8.2 Member Data Documentation

#### 4.8.2.1 bool\_payload

```
std::map<std::string, bool> Message::bool_payload = {}
```

A boolean payload.

#### 4.8.2.2 channel

```
std::string Message::channel = ""
```

A string identifying the appropriate channel for this message.

#### 4.8.2.3 double\_payload

```
std::map<std::string, double> Message::double_payload = {}
```

A double payload.

#### 4.8.2.4 int\_payload

```
std::map<std::string, int> Message::int_payload = {}
```

An int payload.

#### 4.8.2.5 number\_of\_reads

```
unsigned int Message::number_of_reads = 0
```

The number of times the message has been read.

#### 4.8.2.6 string\_payload

```
std::map<std::string, std::string> Message::string_payload = {}
```

A string payload.

#### 4.8.2.7 subject

```
std::string Message::subject = ""
```

A string describing the message subject.

#### 4.8.2.8 vector\_payload

```
std::map<std::string, std::vector<double> > Message::vector_payload = {}
```

A vector (double) payload.

The documentation for this struct was generated from the following file:

- header/ESC\_core/[MessageHub.h](#)

## 4.9 MessageHub Class Reference

A class which acts as a central hub for inter-object message traffic.

```
#include <MessageHub.h>
```

## Public Member Functions

- [MessageHub](#) (void)  
*Constructor for the [MessageHub](#) class.*
- bool [hasTraffic](#) (void)  
*Method to determine if there remains any message traffic.*
- void [addChannel](#) (std::string)  
*Method to add channel to message map.*
- void [removeChannel](#) (std::string)  
*Method to remove channel from message map.*
- void [printStats](#) (void)  
*Method for printing message hub state information (mostly for troubleshooting message deadlocks).*
- void [sendMessage](#) ([Message](#))  
*Method to send a message to the message map. Channels are implemented in a first in, first out manner (i.e. message queue).*
- bool [isEmpty](#) (std::string)  
*Method to check if channel is empty.*
- [Message](#) [receiveMessage](#) (std::string)  
*Method to receive the first message in the channel. Channels are implemented in a first in, first out manner (i.e. message queue).*
- void [incrementMessageRead](#) (std::string)  
*Method to increment the number of times the first message in the channel has been read. Channels are implemented in a first in, first out manner (i.e. message queue).*
- void [popMessage](#) (std::string)  
*Method to pop first message off of the given channel. Channels are implemented in a first in, first out manner (i.e. message queue).*
- void [clearMessages](#) (void)  
*Method to clear messages from the [MessageHub](#).*
- void [clear](#) (void)  
*Method to clear the [MessageHub](#).*
- [~MessageHub](#) (void)  
*Destructor for the [MessageHub](#) class.*

## Private Attributes

- std::map< std::string, std::list< [Message](#) > > [message\\_map](#)  
*A map <string, list of [Message](#)> for sending and receiving messages. Here the key is the channel, and each channel maintains a list (history) of messages.*

### 4.9.1 Detailed Description

A class which acts as a central hub for inter-object message traffic.

### 4.9.2 Constructor & Destructor Documentation



#### 4.9.2.1 MessageHub()

```
MessageHub::MessageHub (
    void )
```

Constructor for the [MessageHub](#) class.

```
78 {
79     //...
80
81     std::cout << "MessageHub constructed at " << this << std::endl;
82
83     return;
84 } /* MessageHub() */
```

#### 4.9.2.2 ~MessageHub()

```
MessageHub::~~MessageHub (
    void )
```

Destructor for the [MessageHub](#) class.

```
526 {
527     this->clear();
528
529     std::cout << "MessageHub at " << this << " destroyed" << std::endl;
530
531     return;
532 } /* ~MessageHub() */
```

### 4.9.3 Member Function Documentation

#### 4.9.3.1 addChannel()

```
void MessageHub::addChannel (
    std::string channel )
```

Method to add channel to message map.

##### Parameters

<i>channel</i>	The key for the message channel being added.
----------------	--

```
129 {
130     // 1. check if channel is in map (if so, throw error)
131     if (this->message_map.count(channel) > 0) {
132         std::string error_str = "ERROR MessageHub::addChannel() channel ";
133         error_str += channel;
134         error_str += " is already in message map";
135
136         #ifdef _WIN32
137             std::cout << error_str << std::endl;
138         #endif /* _WIN32 */
139
140         throw std::runtime_error(error_str);
141     }
142
143     // 2. add channel to map
144     this->message_map[channel] = {};
```

```

145
146     std::cout << "Channel " << channel << " added to message hub" << std::endl;
147
148     return;
149 } /* addChannel() */

```

#### 4.9.3.2 clear()

```

void MessageHub::clear (
    void )

```

Method to clear the [MessageHub](#).

```

506 {
507
508     this->clearMessages();
509     this->message_map.clear();
510
511     return;
512 } /* clear() */

```

#### 4.9.3.3 clearMessages()

```

void MessageHub::clearMessages (
    void )

```

Method to clear messages from the [MessageHub](#).

```

480 {
481     std::map<std::string, std::list<Message>::iterator map_iter;
482     for (
483         map_iter = this->message_map.begin();
484         map_iter != this->message_map.end();
485         map_iter++
486     ) {
487         map_iter->second.clear();
488     }
489
490     return;
491 } /* clearMessages() */

```

#### 4.9.3.4 hasTraffic()

```

bool MessageHub::hasTraffic (
    void )

```

Method to determine if there remains any message traffic.

```

99 {
100     std::map<std::string, std::list<Message>::iterator map_iter;
101     for (
102         map_iter = this->message_map.begin();
103         map_iter != this->message_map.end();
104         map_iter++
105     ) {
106         if (not map_iter->second.empty()) {
107             return true;
108         }
109     }
110
111     return false;
112 } /* hasTraffic() */

```

#### 4.9.3.5 incrementMessageRead()

```
void MessageHub::incrementMessageRead (
    std::string channel )
```

Method to increment the number of times the first message in the channel has been read. Channels are implemented in a first in, first out manner (i.e. message queue).

##### Parameters

<i>channel</i>	The key for the message channel being received from.
----------------	--

```
385 {
386     // 1. check if channel is in map (if not, throw error)
387     if (this->message_map.count(channel) <= 0) {
388         std::string error_str = "ERROR MessageHub::incrementMessageRead() channel ";
389         error_str += channel;
390         error_str += " is not in message map";
391
392         #ifdef _WIN32
393             std::cout << error_str << std::endl;
394         #endif /* _WIN32 */
395
396         throw std::runtime_error(error_str);
397     }
398
399     // 2. check if channel is empty (if so, throw error)
400     if (this->message_map[channel].empty()) {
401         std::string error_str = "ERROR MessageHub::incrementMessageRead() channel ";
402         error_str += channel;
403         error_str += " is empty";
404
405         #ifdef _WIN32
406             std::cout << error_str << std::endl;
407         #endif /* _WIN32 */
408
409         throw std::runtime_error(error_str);
410     }
411
412     // 3. increment number of reads
413     this->message_map[channel].front().number_of_reads++;
414
415     return;
416 } /* incrementMessageRead( */
```

#### 4.9.3.6 isEmpty()

```
bool MessageHub::isEmpty (
    std::string channel )
```

Method to check if channel is empty.

##### Parameters

<i>channel</i>	The key for the message channel being checked.
----------------	--

##### Returns

A boolean indicating whether the channel is empty or not.

```
295 {
296     // 1. check if channel is in map (if not, throw error)
297     if (this->message_map.count(channel) <= 0) {
298         std::string error_str = "ERROR MessageHub::isEmpty() channel ";
```

```

299         error_str += channel;
300         error_str += " is not in message map";
301
302         #ifdef _WIN32
303             std::cout << error_str << std::endl;
304         #endif /* _WIN32 */
305
306         throw std::runtime_error(error_str);
307     }
308
309     if (this->message_map[channel].empty()) {
310         return true;
311     }
312     else {
313         return false;
314     }
315 } /* isEmpty() */

```

#### 4.9.3.7 popMessage()

```

void MessageHub::popMessage (
    std::string channel )

```

Method to pop first message off of the given channel. Channels are implemented in a first in, first out manner (i.e. message queue).

##### Parameters

<i>channel</i>	The key for the message channel being popped.
----------------	---

```

434 {
435     // 1. check if channel is in map (if not, throw error)
436     if (this->message_map.count(channel) <= 0) {
437         std::string error_str = "ERROR MessageHub::receiveMessage() channel ";
438         error_str += channel;
439         error_str += " is not in message map";
440
441         #ifdef _WIN32
442             std::cout << error_str << std::endl;
443         #endif /* _WIN32 */
444
445         throw std::runtime_error(error_str);
446     }
447
448     // 2. check if channel is empty (if so, throw error)
449     if (this->message_map[channel].empty()) {
450         std::string error_str = "ERROR MessageHub::receiveMessage() channel ";
451         error_str += channel;
452         error_str += " is empty";
453
454         #ifdef _WIN32
455             std::cout << error_str << std::endl;
456         #endif /* _WIN32 */
457
458         throw std::runtime_error(error_str);
459     }
460
461     // 3. pop message
462     this->message_map[channel].pop_front();
463
464     return;
465 } /* popMessage() */

```

#### 4.9.3.8 printState()

```

void MessageHub::printState (
    void )

```

Method for printing message hub state information (mostly for troubleshooting message deadlocks).

```

203 {
204     std::cout << "\n\n    **** MESSAGE HUB STATE ****    \n" << std::endl;
205
206     std::map<std::string, std::list<Message>::iterator> channel_iterator;
207
208     for (
209         channel_iterator = this->message_map.begin();
210         channel_iterator != this->message_map.end();
211         channel_iterator++
212     ) {
213         std::string channel = channel_iterator->first;
214         std::list<Message> message_queue = channel_iterator->second;
215
216         std::cout << "-----" << std::endl;
217         std::cout << "\tCHANNEL: " << channel << std::endl;
218         std::cout << "\tMESSAGE QUEUE LENGTH: " << message_queue.size() << std::endl;
219         std::cout << std::endl;
220
221         std::list<Message>::iterator message_queue_iterator;
222
223         for (
224             message_queue_iterator = message_queue.begin();
225             message_queue_iterator != message_queue.end();
226             message_queue_iterator++
227         ) {
228             std::cout << "\tSUBJECT: " << (*message_queue_iterator).subject <<
229                 std::endl;
230         }
231
232         std::cout << std::endl;
233     }
234
235     std::cout << std::endl;
236
237     return;
238 } /* printState() */

```

#### 4.9.3.9 receiveMessage()

```

Message MessageHub::receiveMessage (
    std::string channel )

```

Method to receive the first message in the channel. Channels are implemented in a first in, first out manner (i.e. message queue).

##### Parameters

<i>channel</i>	The key for the message channel being received from.
----------------	--

##### Returns

The first message in the given channel.

```

335 {
336     // 1. check if channel is in map (if not, throw error)
337     if (this->message_map.count(channel) <= 0) {
338         std::string error_str = "ERROR MessageHub::receiveMessage() channel ";
339         error_str += channel;
340         error_str += " is not in message map";
341
342         #ifdef _WIN32
343             std::cout << error_str << std::endl;
344         #endif /* _WIN32 */
345
346         throw std::runtime_error(error_str);
347     }
348
349     // 2. check if channel is empty (if so, throw error)
350     if (this->message_map[channel].empty()) {
351         std::string error_str = "ERROR MessageHub::receiveMessage() channel ";

```

```

352         error_str += channel;
353         error_str += " is empty";
354
355         #ifdef _WIN32
356             std::cout << error_str << std::endl;
357         #endif /* _WIN32 */
358
359         throw std::runtime_error(error_str);
360     }
361
362     // 3. receive message
363     Message message = this->message_map[channel].front();
364
365     return message;
366 } /* receiveMessage() */

```

#### 4.9.3.10 removeChannel()

```

void MessageHub::removeChannel (
    std::string channel )

```

Method to remove channel from message map.

##### Parameters

<i>channel</i>	The key for the message channel being removed.
----------------	--

```

166 {
167     // 1. check if channel is in map (if not, throw error)
168     if (this->message_map.count(channel) <= 0) {
169         std::string error_str = "ERROR MessageHub::removeChannel() channel ";
170         error_str += channel;
171         error_str += " is not in message map";
172
173         #ifdef _WIN32
174             std::cout << error_str << std::endl;
175         #endif /* _WIN32 */
176
177         throw std::runtime_error(error_str);
178     }
179
180     // 2. remove channel from map
181     this->message_map[channel].clear();
182     this->message_map.erase(channel);
183
184     std::cout << "Channel " << channel << " removed from message hub" << std::endl;
185
186     return;
187 } /* removeChannel() */

```

#### 4.9.3.11 sendMessage()

```

void MessageHub::sendMessage (
    Message message )

```

Method to send a message to the message map. Channels are implemented in a first in, first out manner (i.e. message queue).

##### Parameters

<i>message</i>	The message to be sent.
----------------	-------------------------

```

256 {
257     // 1. check if channel is in map (if not, throw error)
258     std::string channel = message.channel;
259
260     if (this->message_map.count(channel) <= 0) {
261         std::string error_str = "ERROR MessageHub::sendMessage() channel ";
262         error_str += channel;
263         error_str += " is not in message map";
264
265         #ifdef _WIN32
266             std::cout << error_str << std::endl;
267         #endif /* _WIN32 */
268
269         throw std::runtime_error(error_str);
270     }
271
272     // 2. send message to message map
273     this->message_map[channel].push_back(message);
274
275     return;
276 } /* sendMessage() */

```

## 4.9.4 Member Data Documentation

### 4.9.4.1 message\_map

```
std::map<std::string, std::list<Message> > MessageHub::message_map [private]
```

A map <string, list of [Message](#)> for sending and receiving messages. Here the key is the channel, and each channel maintains a list (history) of messages.

The documentation for this class was generated from the following files:

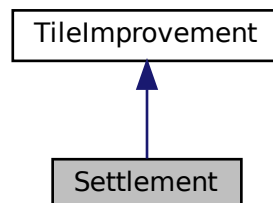
- header/ESC\_core/[MessageHub.h](#)
- source/ESC\_core/[MessageHub.cpp](#)

## 4.10 Settlement Class Reference

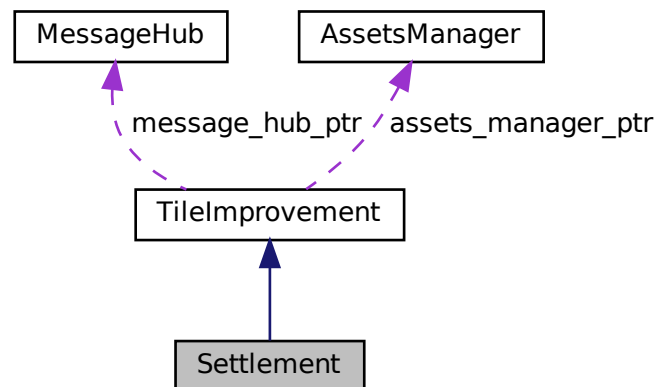
A settlement class (child class of [TileImprovement](#)).

```
#include <Settlement.h>
```

Inheritance diagram for Settlement:



Collaboration diagram for Settlement:



## Public Member Functions

- [Settlement](#) (double, double, int, sf::Event \*, sf::RenderWindow \*, [AssetsManager](#) \*, [MessageHub](#) \*)  
*Constructor for the [Settlement](#) class.*
- void [setIsSelected](#) (bool)  
*Method to set the is selected attribute.*
- std::string [getTileOptionsSubstring](#) (void)  
*Helper method to assemble and return tile options substring.*
- void [processEvent](#) (void)  
*Method to process [Settlement](#). To be called once per event.*
- void [processMessage](#) (void)  
*Method to process [Settlement](#). To be called once per message.*
- void [draw](#) (void)  
*Method to draw the hex tile to the render window. To be called once per frame.*
- virtual [~Settlement](#) (void)  
*Destructor for the [Settlement](#) class.*

## Public Attributes

- bool [draw\\_coin](#)  
*Boolean indicating whether or not to draw credits earned coin.*
- double [smoke\\_da](#)  
*The per frame delta in smoke particle alpha value.*
- double [smoke\\_dx](#)  
*The per frame delta in smoke particle x position.*
- double [smoke\\_dy](#)  
*The per frame delta in smoke particle y position.*
- double [smoke\\_prob](#)  
*The probability of spawning a new smoke prob in any given frame.*
- std::list< sf::Sprite > [smoke\\_sprite\\_list](#)  
*A list of smoke sprite (for chimney animation).*
- sf::Sprite [coin\\_sprite](#)  
*A coin sprite (for credits earned animation).*



## Private Member Functions

- void [\\_\\_setUpTileImprovementSpriteStatic](#) (void)  
*Helper method to set up tile improvement sprite (static).*
- void [\\_\\_setUpCoinSprite](#) (void)  
*Helper method to set up and place coin sprite.*
- void [\\_\\_handleKeyPressEvents](#) (void)  
*Helper method to handle key press events.*
- void [\\_\\_handleMouseButtonEvents](#) (void)  
*Helper method to handle mouse button events.*

## Additional Inherited Members

### 4.10.1 Detailed Description

A settlement class (child class of [TileImprovement](#)).

### 4.10.2 Constructor & Destructor Documentation

#### 4.10.2.1 Settlement()

```
Settlement::Settlement (
    double position_x,
    double position_y,
    int tile_resource,
    sf::Event * event_ptr,
    sf::RenderWindow * render_window_ptr,
    AssetsManager * assets_manager_ptr,
    MessageHub * message_hub_ptr )
```

Constructor for the [Settlement](#) class.

Ref: [Wikipedia](#) [2023]

#### Parameters

<i>position_x</i>	The x position of the tile.
<i>position_y</i>	The y position of the tile.
<i>tile_resource</i>	The renewable resource quality of the tile.
<i>event_ptr</i>	Pointer to the event class.
<i>render_window_ptr</i>	Pointer to the render window.
<i>assets_manager_ptr</i>	Pointer to the assets manager.
<i>message_hub_ptr</i>	Pointer to the message hub.

```
241 :
242 TileImprovement (
```

```

243     position_x,
244     position_y,
245     tile_resource,
246     event_ptr,
247     render_window_ptr,
248     assets_manager_ptr,
249     message_hub_ptr
250 )
251 {
252     // 1. set attributes
253
254     // 1.1. private
255     //...
256
257     // 1.2. public
258     this->tile_improvement_type = TileImprovementType :: SETTLEMENT;
259
260     this->draw_coin = false;
261
262     this->smoke_da = SECONDS_PER_FRAME / 4;
263     this->smoke_dx = 5 * SECONDS_PER_FRAME;
264     this->smoke_dy = -10 * SECONDS_PER_FRAME;
265     this->smoke_prob = 3 * SECONDS_PER_FRAME;
266
267     this->smoke_sprite_list = {};
268
269     this->tile_improvement_string = "SETTLEMENT";
270
271     this->__setUpTileImprovementSpriteStatic();
272     this->__setUpCoinSprite();
273
274     this->message_hub_ptr->addChannel(SETTLEMENT_CHANNEL);
275
276     std::cout << "Settlement constructed at " << this << std::endl;
277
278     return;
279 } /* Settlement() */

```

#### 4.10.2.2 ~Settlement()

```

Settlement::~Settlement (
    void ) [virtual]

```

Destructor for the [Settlement](#) class.

```

502 {
503     std::cout << "Settlement at " << this << " destroyed" << std::endl;
504
505     return;
506 } /* ~Settlement() */

```

### 4.10.3 Member Function Documentation

#### 4.10.3.1 \_\_handleKeyPressEvents()

```

void Settlement::__handleKeyPressEvents (
    void ) [private]

```

Helper method to handle key press events.

```

131 {
132     if (this->just_built) {
133         return;
134     }
135
136     switch (this->event_ptr->key.code) {
137         //...

```

```

138
139
140         default: {
141             // do nothing!
142
143             break;
144         }
145     }
146
147     return;
148 } /* __handleKeyPressEvents() */

```

#### 4.10.3.2 \_\_handleMouseButtonEvents()

```

void Settlement::__handleMouseButtonEvents (
    void ) [private]

```

Helper method to handle mouse button events.

```

163 {
164     if (this->just_built) {
165         return;
166     }
167
168     switch (this->event_ptr->mouseButton.button) {
169         case (sf::Mouse::Left): {
170             //...
171
172             break;
173         }
174
175         case (sf::Mouse::Right): {
176             //...
177
178             break;
179         }
180     }
181
182     default: {
183         // do nothing!
184
185         break;
186     }
187 }
188
189 return;
191 } /* __handleMouseButtonEvents() */

```

#### 4.10.3.3 \_\_setUpCoinSprite()

```

void Settlement::__setUpCoinSprite (
    void ) [private]

```

Helper method to set up and place coin sprite.

```

103 {
104     this->coin_sprite.setTexture(
105         *(this->assets_manager_ptr->getTexture("coin"))
106     );
107
108     this->coin_sprite.setOrigin(
109         this->coin_sprite.getLocalBounds().width / 2,
110         this->coin_sprite.getLocalBounds().height / 2
111     );
112
113     this->coin_sprite.setPosition(this->position_x, this->position_y);
114
115     return;
116 } /* __setUpCoinSprite() */

```

#### 4.10.3.4 \_\_setUpTileImprovementSpriteStatic()

```
void Settlement::__setUpTileImprovementSpriteStatic (
    void ) [private]
```

Helper method to set up tile improvement sprite (static).

```
68 {
69     this->tile_improvement_sprite_static.setTexture(
70         *(this->assets_manager_ptr->getTexture("brick_house_64x64_1"))
71     );
72
73     this->tile_improvement_sprite_static.setOrigin(
74         this->tile_improvement_sprite_static.getLocalBounds().width / 2,
75         this->tile_improvement_sprite_static.getLocalBounds().height
76     );
77
78     this->tile_improvement_sprite_static.setPosition(
79         this->position_x,
80         this->position_y - 32
81     );
82
83     this->tile_improvement_sprite_static.setColor(
84         sf::Color(255, 255, 255, 0)
85     );
86
87     return;
88 } /* __setUpTileImprovementSpriteStatic() */
```

#### 4.10.3.5 draw()

```
void Settlement::draw (
    void ) [virtual]
```

Method to draw the hex tile to the render window. To be called once per frame.

Reimplemented from [TileImprovement](#).

```
409 {
410     // 1. if just built, call base method and return
411     if (this->just_built) {
412         TileImprovement :: draw();
413
414         return;
415     }
416
417     // 2. draw static sprite and chimney smoke effects
418     this->render_window_ptr->draw(this->tile_improvement_sprite_static);
419
420     std::list<sf::Sprite>::iterator iter = this->smoke_sprite_list.begin();
421
422     double alpha = 255;
423
424     while (iter != this->smoke_sprite_list.end()) {
425         this->render_window_ptr->draw(*iter);
426
427         alpha = (*iter).getColor().a;
428
429         alpha -= this->smoke_da;
430
431         if (alpha <= 0) {
432             iter = this->smoke_sprite_list.erase(iter);
433             continue;
434         }
435
436         (*iter).setColor(sf::Color(255, 255, 255, alpha));
437
438         (*iter).move(
439             this->smoke_dx + 2 * (((double)rand() / RAND_MAX) - 1) / FRAMES_PER_SECOND,
440             this->smoke_dy
441         );
442
443         (*iter).rotate((((double)rand() / RAND_MAX)));
444
445         iter++;
446     }
```

```

447
448
449     if ((double)rand() / RAND_MAX < smoke_prob) {
450         this->smoke_sprite_list.push_back(
451             sf::Sprite(*(this->assets_manager_ptr->getTexture("emissions")))
452         );
453
454         this->smoke_sprite_list.back().setOrigin(
455             this->smoke_sprite_list.back().getLocalBounds().width / 2,
456             this->smoke_sprite_list.back().getLocalBounds().height / 2
457         );
458
459         this->smoke_sprite_list.back().setPosition(
460             this->position_x + 9 + 4 * ((double)rand() / RAND_MAX) - 2,
461             this->position_y - 33
462         );
463     }
464
465
466
467     // 4. draw coin
468     if (this->draw_coin) {
469         double alpha = this->coin_sprite.getColor().a;
470
471         alpha -= this->smoke_da;
472
473         if (alpha <= 0) {
474             this->coin_sprite.setColor(sf::Color(255, 255, 255, 255));
475             this->coin_sprite.setPosition(this->position_x, this->position_y);
476             this->draw_coin = false;
477         }
478
479         this->coin_sprite.move(0, this->smoke_dy);
480         this->coin_sprite.setColor(sf::Color(255, 255, 255, alpha));
481
482         this->render_window_ptr->draw(this->coin_sprite);
483     }
484
485     this->frame++;
486     return;
487 } /* draw() */

```

#### 4.10.3.6 getTileOptionsSubstring()

```

std::string Settlement::getTileOptionsSubstring (
    void ) [virtual]

```

Helper method to assemble and return tile options substring.

#### Returns

Tile options substring.

Reimplemented from [TileImprovement](#).

```

321 {
322     //          32 char x 17 line console "-----\n";
323     std::string options_substring = "    **** SETTLEMENT OPTIONS **** \n";
324     options_substring += " \n";
325     options_substring += " \n";
326     options_substring += " \n";
327     options_substring += " \n";
328     options_substring += " \n";
329     options_substring += " \n";
330     options_substring += " \n";
331
332     return options_substring;
333 } /* getTileOptionsSubstring() */

```

#### 4.10.3.7 processEvent()

```
void Settlement::processEvent (
    void ) [virtual]
```

Method to process [Settlement](#). To be called once per event.

Reimplemented from [TileImprovement](#).

```
348 {
349     TileImprovement :: processEvent();
350
351     if (this->event_ptr->type == sf::Event::KeyPressed) {
352         this->__handleKeyPressEvents();
353     }
354
355     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
356         this->__handleMouseButtonEvents();
357     }
358
359     return;
360 } /* processEvent() */
```

#### 4.10.3.8 processMessage()

```
void Settlement::processMessage (
    void ) [virtual]
```

Method to process [Settlement](#). To be called once per message.

Reimplemented from [TileImprovement](#).

```
375 {
376     TileImprovement :: processMessage();
377
378     if (not this->message_hub_ptr->isEmpty(SETTLEMENT_CHANNEL)) {
379         Message settlement_message = this->message_hub_ptr->receiveMessage(
380             SETTLEMENT_CHANNEL
381         );
382
383         if (settlement_message.subject == "credits earned") {
384             this->draw_coin = true;
385             this->assets_manager_ptr->getSound("coin ring")->play();
386
387             std::cout << "Credits earned message received by " << this << std::endl;
388             this->message_hub_ptr->popMessage(SETTLEMENT_CHANNEL);
389         }
390     }
391
392     return;
393 } /* processMessage() */
```

#### 4.10.3.9 setIsSelected()

```
void Settlement::setIsSelected (
    bool is_selected ) [virtual]
```

Method to set the is selected attribute.

##### Parameters

<i>is_selected</i>	The value to set the is selected attribute to.
--------------------	--

Reimplemented from [TileImprovement](#).

```
296 {  
297     TileImprovement :: setIsSelected(is_selected);  
298  
299     if (this->is_selected) {  
300         this->assets_manager_ptr->getSound("people and children")->play();  
301     }  
302  
303     return;  
304 } /* setIsSelected() */
```

## 4.10.4 Member Data Documentation

### 4.10.4.1 coin\_sprite

`sf::Sprite Settlement::coin_sprite`

A coin sprite (for credits earned animation).

### 4.10.4.2 draw\_coin

`bool Settlement::draw_coin`

Boolean indicating whether or not to draw credits earned coin.

### 4.10.4.3 smoke\_da

`double Settlement::smoke_da`

The per frame delta in smoke particle alpha value.

### 4.10.4.4 smoke\_dx

`double Settlement::smoke_dx`

The per frame delta in smoke particle x position.

### 4.10.4.5 smoke\_dy

`double Settlement::smoke_dy`

The per frame delta in smoke particle y position.

#### 4.10.4.6 smoke\_prob

```
double Settlement::smoke_prob
```

The probability of spawning a new smoke prob in any given frame.

#### 4.10.4.7 smoke\_sprite\_list

```
std::list<sf::Sprite> Settlement::smoke_sprite_list
```

A list of smoke sprite (for chimney animation).

The documentation for this class was generated from the following files:

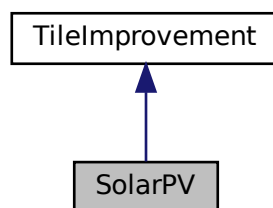
- header/[Settlement.h](#)
- source/[Settlement.cpp](#)

## 4.11 SolarPV Class Reference

A settlement class (child class of [TileImprovement](#)).

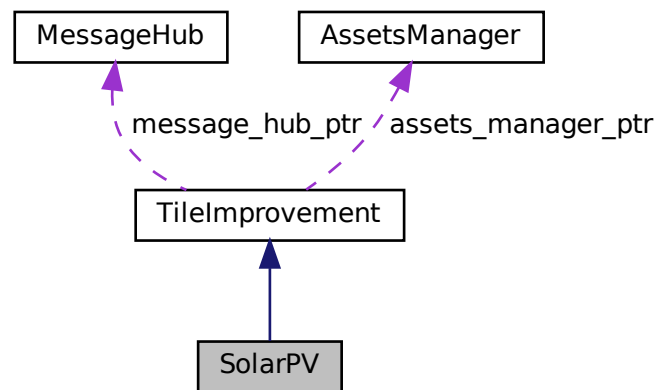
```
#include <SolarPV.h>
```

Inheritance diagram for SolarPV:





Collaboration diagram for SolarPV:



## Public Member Functions

- [SolarPV](#) (double, double, int, sf::Event \*, sf::RenderWindow \*, [AssetsManager](#) \*, [MessageHub](#) \*)  
*Constructor for the [SolarPV](#) class.*
- std::string [getTileOptionsSubstring](#) (void)  
*Helper method to assemble and return tile options substring.*
- void [setIsSelected](#) (bool)  
*Method to set the is selected attribute.*
- void [advanceTurn](#) (void)  
*Method to handle turn advance.*
- void [update](#) (void)  
*Method to trigger production and dispatchable updates.*
- void [processEvent](#) (void)  
*Method to process [SolarPV](#). To be called once per event.*
- void [processMessage](#) (void)  
*Method to process [SolarPV](#). To be called once per message.*
- void [draw](#) (void)  
*Method to draw the hex tile to the render window. To be called once per frame.*
- virtual [~SolarPV](#) (void)  
*Destructor for the [SolarPV](#) class.*

## Public Attributes

- int [capacity\\_kW](#)  
*The rated production capacity [kW] of the solar PV array.*
- int [production\\_MWh](#)  
*The current production [MWh] of the solar PV array.*
- int [dispatch\\_MWh](#)  
*The current dispatch [MWh] of the solar PV array.*

- int [dispatchable\\_MWh](#)  
*The amount of production that is directly dispatchable to the grid (i.e. production correlated with demand).*
- double [max\\_daily\\_production\\_MWh](#)  
*The maximum daily production [MWh] of the solar PV array.*
- std::vector< double > [capacity\\_factor\\_vec](#)  
*A vector of daily capacity factors for the current month.*
- std::vector< double > [production\\_vec\\_MWh](#)  
*A vector of daily production [MWh] for the current month.*
- std::vector< double > [dispatch\\_vec\\_MWh](#)  
*A vector of daily dispatch [MWh] for the current month.*

## Private Member Functions

- void [\\_\\_setUpTileImprovementSpriteStatic](#) (void)  
*Helper method to set up tile improvement sprite (static).*
- void [\\_\\_drawProductionMenu](#) (void)  
*Helper method to draw production menu assets.*
- void [\\_\\_upgradePowerCapacity](#) (void)  
*Helper method to upgrade power capacity.*
- void [\\_\\_computeProductionCosts](#) (void)  
*Helper method to compute production costs (O&M) based on current production level.*
- void [\\_\\_breakdown](#) (void)  
*Helper method to trigger an equipment breakdown.*
- void [\\_\\_repair](#) (void)  
*Helper method to repair the solar PV array.*
- void [\\_\\_computeCapacityFactors](#) (void)  
*Helper method to compute capacity factors.*
- void [\\_\\_computeProduction](#) (void)  
*Helper method to compute production values.*
- void [\\_\\_computeDispatch](#) (void)  
*Helper method to compute dispatch values.*
- void [\\_\\_handleKeyPressEvents](#) (void)  
*Helper method to handle key press events.*
- void [\\_\\_handleMouseButtonEvents](#) (void)  
*Helper method to handle mouse button events.*
- void [\\_\\_drawUpgradeOptions](#) (void)  
*Helper method to set up and draw upgrade options.*
- void [\\_\\_sendImprovementStateMessage](#) (void)  
*Helper method to format and sent improvement state message.*

## Additional Inherited Members

### 4.11.1 Detailed Description

A settlement class (child class of [TileImprovement](#)).

## 4.11.2 Constructor & Destructor Documentation

### 4.11.2.1 SolarPV()

```
SolarPV::SolarPV (
    double position_x,
    double position_y,
    int tile_resource,
    sf::Event * event_ptr,
    sf::RenderWindow * render_window_ptr,
    AssetsManager * assets_manager_ptr,
    MessageHub * message_hub_ptr )
```

Constructor for the [SolarPV](#) class.

Ref: [Wikipedia \[2023\]](#)

#### Parameters

<i>position_x</i>	The x position of the tile.
<i>position_y</i>	The y position of the tile.
<i>tile_resource</i>	The renewable resource quality of the tile.
<i>event_ptr</i>	Pointer to the event class.
<i>render_window_ptr</i>	Pointer to the render window.
<i>assets_manager_ptr</i>	Pointer to the assets manager.
<i>message_hub_ptr</i>	Pointer to the message hub.

```
745 :
746 TileImprovement (
747     position_x,
748     position_y,
749     tile_resource,
750     event_ptr,
751     render_window_ptr,
752     assets_manager_ptr,
753     message_hub_ptr
754 )
755 {
756     // 1. set attributes
757
758     // 1.1. private
759     //...
760
761     // 1.2. public
762     this->tile_improvement_type = TileImprovementType :: SOLAR_PV;
763
764     this->is_running = false;
765
766     this->health = 100;
767
768     this->capacity_kW = 100;
769     this->upgrade_level = 1;
770
771     this->storage_kWh = 0;
772     this->storage_level = 0;
773
774     this->production_MWh = 0;
775     this->dispatch_MWh = 0;
776     this->dispatchable_MWh = 0;
777
778     this->max_daily_production_MWh = (double)(24 * this->capacity_kW) / 1000;
779
780     this->capacity_factor_vec.resize(30, 0);
781     this->production_vec_MWh.resize(30, 0);
```

```

782     this->dispatch_vec_MWh.resize(30, 0);
783
784     this->tile_improvement_string = "SOLAR PV ARRAY";
785
786     this->__setUpTileImprovementSpriteStatic();
787     this->__computeCapacityFactors();
788     this->update();
789
790     std::cout << "SolarPV constructed at " << this << std::endl;
791
792     return;
793 } /* SolarPV() */

```

#### 4.11.2.2 ~SolarPV()

```

SolarPV::~~SolarPV (
    void ) [virtual]

```

Destructor for the [SolarPV](#) class.

```

1125 {
1126     std::cout << "SolarPV at " << this << " destroyed" << std::endl;
1127
1128     return;
1129 } /* ~SolarPV() */

```

### 4.11.3 Member Function Documentation

#### 4.11.3.1 \_\_breakdown()

```

void SolarPV::__breakdown (
    void ) [private]

```

Helper method to trigger an equipment breakdown.

```

233 {
234     TileImprovement :: __breakdown();
235
236     this->production_MWh = 0;
237     this->dispatch_MWh = 0;
238     this->dispatchable_MWh = 0;
239     this->operation_maintenance_cost = 0;
240
241     return;
242 } /* __breakdown() */

```

## 4.11.3.2 \_\_computeCapacityFactors()

```
void SolarPV::__computeCapacityFactors (
    void ) [private]
```

Helper method to compute capacity factors.

```
290 {
291     unsigned seed = std::chrono::system_clock::now().time_since_epoch().count();
292     std::default_random_engine generator(seed);
293
294     double mean =
295         this->tile_resource_scalar * MEAN_DAILY_SOLAR_CAPACITY_FACTORS[this->month - 1];
296
297     double stdev = STDEV_DAILY_SOLAR_CAPACITY_FACTORS[this->month - 1];
298
299     if (this->tile_resource_scalar > 1) {
300         stdev /= this->tile_resource_scalar;
301     }
302
303     std::normal_distribution<double> normal_dist(mean, stdev);
304
305     double capacity_factor = 0;
306
307     for (int i = 0; i < 30; i++) {
308         capacity_factor = normal_dist(generator);
309
310         if (capacity_factor < 0) {
311             capacity_factor = 0;
312         }
313
314         this->capacity_factor_vec[i] = capacity_factor;
315     }
316
317     return;
318 } /* __computeCapacityFactors() */
```

## 4.11.3.3 \_\_computeDispatch()

```
void SolarPV::__computeDispatch (
    void ) [private]
```

Helper method to compute dispatch values.

```
361 {
362     double stored_energy_MWh = 0;
363     double storage_capacity_MWh = (double)(this->storage_kWh) / 1000;
364
365     double demand_MWh = 0;
366     double production_MWh = 0;
367     double dispatchable_MWh = 0;
368     double difference_MWh = 0;
369
370     double room_MWh = 0;
371
372     for (int i = 0; i < 30; i++) {
373         demand_MWh = this->demand_vec_MWh[i];
374         production_MWh = this->production_vec_MWh[i];
375
376         if (production_MWh <= demand_MWh) {
377             this->dispatch_vec_MWh[i] = production_MWh;
378             dispatchable_MWh += this->dispatch_vec_MWh[i];
379
380             difference_MWh = demand_MWh - production_MWh;
381
382             if ((storage_capacity_MWh > 0) and (stored_energy_MWh > 0)) {
383                 if (difference_MWh > stored_energy_MWh) {
384                     this->dispatch_vec_MWh[i] += stored_energy_MWh;
385                     dispatchable_MWh += stored_energy_MWh;
386                     stored_energy_MWh = 0;
387                 }
388
389                 else {
390                     this->dispatch_vec_MWh[i] += difference_MWh;
391                     dispatchable_MWh += difference_MWh;
392                     stored_energy_MWh -= difference_MWh;
393                 }
394             }
395         }
396     }
397 }
```

```

394         }
395     }
396
397     else {
398         this->dispatch_vec_MWh[i] = demand_MWh;
399         dispatchable_MWh += this->dispatch_vec_MWh[i];
400
401         difference_MWh = production_MWh - demand_MWh;
402
403         if (
404             (storage_capacity_MWh > 0) and
405             (stored_energy_MWh < storage_capacity_MWh)
406         ) {
407             room_MWh = storage_capacity_MWh - stored_energy_MWh;
408
409             if (difference_MWh > room_MWh) {
410                 stored_energy_MWh += room_MWh;
411             }
412
413             else {
414                 stored_energy_MWh += difference_MWh;
415             }
416         }
417     }
418 }
419
420 this->dispatchable_MWh = round(dispatchable_MWh);
421
422 if (this->dispatch_MWh != this->dispatchable_MWh) {
423     this->dispatch_MWh = this->dispatchable_MWh;
424 }
425
426 return;
427 } /* __computeDispatch() */

```

#### 4.11.3.4 \_\_computeProduction()

```

void SolarPV::__computeProduction (
    void ) [private]

```

Helper method to compute production values.

```

333 {
334     double production_MWh = 0;
335
336     for (int i = 0; i < 30; i++) {
337         this->production_vec_MWh[i] =
338             this->max_daily_production_MWh * this->capacity_factor_vec[i];
339
340         production_MWh += this->production_vec_MWh[i];
341     }
342
343     this->production_MWh = round(production_MWh);
344
345     return;
346 } /* __computeProduction() */

```

#### 4.11.3.5 \_\_computeProductionCosts()

```

void SolarPV::__computeProductionCosts (
    void ) [private]

```

Helper method to compute production costs (O&M) based on current production level.

```

212 {
213     double operation_maintenance_cost =
214         (this->production_MWh * SOLAR_OP_MAINT_COST_PER_MWH_PRODUCTION) / 1000;
215     this->operation_maintenance_cost = round(operation_maintenance_cost);
216
217     return;
218 } /* __computeProductionCosts() */

```

## 4.11.3.6 \_\_drawProductionMenu()

```
void SolarPV::__drawProductionMenu (
    void ) [private]
```

Helper method to draw production menu assets.

```
103 {
104     // 1. draw static sprite
105     sf::Vector2f initial_position = this->tile_improvement_sprite_static.getPosition();
106     this->tile_improvement_sprite_static.setPosition(400 - 138, 400 + 16);
107
108     sf::Color initial_colour = this->tile_improvement_sprite_static.getColor();
109     this->tile_improvement_sprite_static.setColor(sf::Color(255, 255, 255, 255));
110
111     sf::Vector2f initial_scale = this->tile_improvement_sprite_static.getScale();
112     this->tile_improvement_sprite_static.setScale(sf::Vector2f(1, 1));
113
114     this->render_window_ptr->draw(this->tile_improvement_sprite_static);
115
116     this->tile_improvement_sprite_static.setPosition(initial_position);
117     this->tile_improvement_sprite_static.setColor(initial_colour);
118     this->tile_improvement_sprite_static.setScale(initial_scale);
119
120     // 2. draw production text
121     std::string production_string = "[W]:  INCREASE DISPATCH\n";
122     production_string             += "[S]:  DECREASE DISPATCH\n";
123     production_string             += "      \n";
124
125     production_string             += "DISPATCH:  ";
126     production_string             += std::to_string(this->dispatch_MWh);
127     production_string             += " MWh (MAX ";
128     production_string             += std::to_string(this->dispatchable_MWh);
129     production_string             += ")\n";
130
131     production_string             += "O&M COST:  ";
132     production_string             += std::to_string(this->operation_maintenance_cost);
133     production_string             += " K\n";
134
135     sf::Text production_text(
136         production_string,
137         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
138         16
139     );
140
141     production_text.setOrigin(production_text.getLocalBounds().width / 2, 0);
142     production_text.setFillColor(MONOCROME_TEXT_GREEN);
143
144     production_text.setPosition(400 + 30, 400 - 45);
145
146     this->render_window_ptr->draw(production_text);
147
148     return;
149 } /* __drawProductionMenu() */
```

## 4.11.3.7 \_\_drawUpgradeOptions()

```
void SolarPV::__drawUpgradeOptions (
    void ) [private]
```

Helper method to set up and draw upgrade options.

```
568 {
569     // 1. draw power capacity upgrade sprite
570     sf::Vector2f initial_position = this->tile_improvement_sprite_static.getPosition();
571     this->tile_improvement_sprite_static.setPosition(400 - 100, 400 - 32);
572
573     sf::Color initial_colour = this->tile_improvement_sprite_static.getColor();
574     this->tile_improvement_sprite_static.setColor(sf::Color(255, 255, 255, 255));
575
576     sf::Vector2f initial_scale = this->tile_improvement_sprite_static.getScale();
577     this->tile_improvement_sprite_static.setScale(sf::Vector2f(1, 1));
578
579     this->render_window_ptr->draw(this->tile_improvement_sprite_static);
580
581     this->tile_improvement_sprite_static.setPosition(initial_position);
582     this->tile_improvement_sprite_static.setColor(initial_colour);
```

```

583     this->tile_improvement_sprite_static.setScale(initial_scale);
584
585     this->render_window_ptr->draw(this->upgrade_arrow_sprite);
586
587
588     // 2. draw power capacity upgrade text
589     //      16 char line = "          \n"
590     std::string power_upgrade_string = "POWER CAPACITY \n";
591     power_upgrade_string             += "          \n";
592
593     power_upgrade_string             += "CAPACITY: ";
594     power_upgrade_string             += std::to_string(this->capacity_kW);
595     power_upgrade_string             += " kW\n";
596
597     power_upgrade_string             += "LEVEL: ";
598     power_upgrade_string             += std::to_string(this->upgrade_level);
599     power_upgrade_string             += "\n\n";
600
601     if (this->upgrade_level < MAX_UPGRADE_LEVELS) {
602         power_upgrade_string         += "[W]: + 100 kW (";
603         power_upgrade_string         += std::to_string(SOLAR_PV_BUILD_COST);
604         power_upgrade_string         += " K)\n";
605     }
606
607     else {
608         power_upgrade_string         += " * MAX LEVEL * \n";
609     }
610
611     sf::Text power_upgrade_text = sf::Text(
612         power_upgrade_string,
613         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
614         16
615     );
616
617     power_upgrade_text.setOrigin(power_upgrade_text.getLocalBounds().width / 2, 0);
618     power_upgrade_text.setPosition(400 - 100, 400 - 32 + 16);
619     power_upgrade_text.setFillColor(MONOCROME_TEXT_GREEN);
620
621     this->render_window_ptr->draw(power_upgrade_text);
622
623
624     // 3. draw energy capacity (storage) upgrade sprite
625     this->render_window_ptr->draw(this->storage_upgrade_sprite);
626     this->render_window_ptr->draw(this->upgrade_plus_sprite);
627
628
629     // 4. draw energy capacity (storage) upgrade text
630     //      16 char line = "          \n"
631     std::string energy_upgrade_string = "ENERGY CAPACITY \n";
632     energy_upgrade_string             += "          \n";
633
634     energy_upgrade_string             += "CAPACITY: ";
635     energy_upgrade_string             += std::to_string(this->storage_level * 200);
636     energy_upgrade_string             += " kWh\n";
637
638     energy_upgrade_string             += "LEVEL: ";
639     energy_upgrade_string             += std::to_string(this->storage_level);
640     energy_upgrade_string             += "\n\n";
641
642     if (this->storage_level < MAX_STORAGE_LEVELS) {
643         energy_upgrade_string         += "[D]: + 200 kWh (";
644         energy_upgrade_string         += std::to_string(ENERGY_STORAGE_SYSTEM_BUILD_COST);
645         energy_upgrade_string         += " K)\n";
646     }
647
648     else {
649         energy_upgrade_string += " * MAX LEVEL * \n";
650     }
651
652     sf::Text energy_upgrade_text = sf::Text(
653         energy_upgrade_string,
654         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
655         16
656     );
657
658     energy_upgrade_text.setOrigin(energy_upgrade_text.getLocalBounds().width / 2, 0);
659     energy_upgrade_text.setPosition(400 + 100, 400 - 32 + 16);
660     energy_upgrade_text.setFillColor(MONOCROME_TEXT_GREEN);
661
662     this->render_window_ptr->draw(energy_upgrade_text);
663
664     return;
665 } /* __drawUpgradeOptions() */

```



#### 4.11.3.8 \_\_handleKeyPressEvents()

```
void SolarPV::__handleKeyPressEvents (
    void ) [private]
```

Helper method to handle key press events.

```
442 {
443     if (this->just_built) {
444         return;
445     }
446
447     switch (this->event_ptr->key.code) {
448         case (sf::Keyboard::U): {
449             this->__openUpgradeMenu();
450
451             break;
452         }
453
454
455         case (sf::Keyboard::W): {
456             if (this->production_menu_open) {
457                 this->dispatch_MWh++;
458
459                 if (this->dispatch_MWh > this->dispatchable_MWh) {
460                     this->dispatch_MWh = 0;
461                 }
462
463                 this->__computeProductionCosts();
464                 this->assets_manager_ptr->getSound("interface click")->play();
465             }
466
467             else if (this->upgrade_menu_open) {
468                 this->__upgradePowerCapacity();
469             }
470
471             break;
472         }
473
474
475         case (sf::Keyboard::S): {
476             if (this->production_menu_open) {
477                 this->dispatch_MWh--;
478
479                 if (this->dispatch_MWh < 0) {
480                     this->dispatch_MWh = this->dispatchable_MWh;
481                 }
482
483                 this->__computeProductionCosts();
484                 this->assets_manager_ptr->getSound("interface click")->play();
485             }
486
487             break;
488         }
489
490
491         case (sf::Keyboard::D): {
492             if (this->upgrade_menu_open) {
493                 this->__upgradeStorageCapacity();
494                 this->__computeProduction();
495                 this->__computeDispatch();
496             }
497
498             break;
499         }
500
501
502         default: {
503             // do nothing!
504
505             break;
506         }
507     }
508
509     return;
510 } /* __handleKeyPressEvents() */
```

#### 4.11.3.9 \_\_handleMouseButtonEvents()

```
void SolarPV::__handleMouseButtonEvents (
    void ) [private]
```

Helper method to handle mouse button events.

```

525 {
526     if (this->just_built) {
527         return;
528     }
529
530     switch (this->event_ptr->mouseButton.button) {
531         case (sf::Mouse::Left): {
532             //...
533
534             break;
535         }
536
537         case (sf::Mouse::Right): {
538             //...
539
540             break;
541         }
542
543         default: {
544             // do nothing!
545
546             break;
547         }
548     }
549 }
550
551 return;
552 }
553 } /* __handleMouseButtonEvents() */

```

#### 4.11.3.10 \_\_repair()

```

void SolarPV::__repair (
    void ) [private], [virtual]

```

Helper method to repair the solar PV array.

Reimplemented from [TileImprovement](#).

```

257 {
258     if (this->credits < SOLAR_PV_BUILD_COST) {
259         std::cout << "Cannot repair solar PV: insufficient credits (need "
260             << SOLAR_PV_BUILD_COST << " K)" << std::endl;
261
262         this->__sendInsufficientCreditsMessage();
263         return;
264     }
265
266     TileImprovement :: __repair();
267
268     this->just_upgraded = true;
269
270     this->__sendCreditsSpentMessage(SOLAR_PV_BUILD_COST);
271     this->__sendTileStateRequest();
272     this->__sendGameStateRequest();
273
274     return;
275 } /* __repair() */

```

#### 4.11.3.11 \_\_sendImprovementStateMessage()

```

void SolarPV::__sendImprovementStateMessage (
    void ) [private]

```

Helper method to format and sent improvement state message.

```

680 {
681     Message improvement_state_message;
682

```

```

683     improvement_state_message.channel = GAME_CHANNEL;
684     improvement_state_message.subject = "improvement state";
685
686     improvement_state_message.int_payload["dispatch_MWh"] = this->dispatch_MWh;
687     improvement_state_message.int_payload["operation_maintenance_cost"] =
688         this->operation_maintenance_cost;
689
690     this->message_hub_ptr->sendMessage(improvement_state_message);
691
692     std::cout << "Improvement state message sent by " << this << std::endl;
693
694     return;
695 } /* __sendImprovementStateMessage() */

```

#### 4.11.3.12 \_\_setUpTileImprovementSpriteStatic()

```

void SolarPV::__setUpTileImprovementSpriteStatic (
    void ) [private]

```

Helper method to set up tile improvement sprite (static).

```

68 {
69     this->tile_improvement_sprite_static.setTexture(
70         *(this->assets_manager_ptr->getTexture("solar PV array"))
71     );
72
73     this->tile_improvement_sprite_static.setOrigin(
74         this->tile_improvement_sprite_static.getLocalBounds().width / 2,
75         this->tile_improvement_sprite_static.getLocalBounds().height
76     );
77
78     this->tile_improvement_sprite_static.setPosition(
79         this->position_x,
80         this->position_y - 32
81     );
82
83     this->tile_improvement_sprite_static.setColor(
84         sf::Color(255, 255, 255, 0)
85     );
86
87     return;
88 } /* __setUpTileImprovementSpriteStatic() */

```

#### 4.11.3.13 \_\_upgradePowerCapacity()

```

void SolarPV::__upgradePowerCapacity (
    void ) [private]

```

Helper method to upgrade power capacity.

```

164 {
165     if (this->credits < SOLAR_PV_BUILD_COST) {
166         std::cout << "Cannot upgrade solar PV: insufficient credits (need "
167             << SOLAR_PV_BUILD_COST << " K)" << std::endl;
168
169         this->__sendInsufficientCreditsMessage();
170         return;
171     }
172
173     if (this->upgrade_level >= MAX_UPGRADE_LEVELS) {
174         return;
175     }
176
177     TileImprovement :: __repair();
178
179     this->capacity_kW += 100;
180     this->upgrade_level++;
181
182     this->max_daily_production_MWh = (double)(24 * this->capacity_kW) / 1000;
183
184     this->__computeProduction();

```

```

185     this->__computeDispatch();
186
187     this->just_upgraded = true;
188
189     this->assets_manager_ptr->getSound("upgrade")->play();
190
191     this->__sendCreditsSpentMessage(SOLAR_PV_BUILD_COST);
192     this->__sendTileStateRequest();
193     this->__sendGameStateRequest();
194
195     return;
196 } /* __upgradePowerCapacity() */

```

#### 4.11.3.14 advanceTurn()

```

void SolarPV::advanceTurn (
    void ) [virtual]

```

Method to handle turn advance.

Reimplemented from [TileImprovement](#).

```

898 {
899     // 1. send improvement state message
900     this->__sendImprovementStateMessage();
901
902     // 2. update
903     this->__computeCapacityFactors();
904     this->update();
905
906     // 3. handle start/stop
907     if ((not this->is_running) and (this->dispatch_MWh > 0)) {
908         this->is_running = true;
909     }
910
911     else if (this->is_running and (this->dispatch_MWh <= 0)) {
912         this->is_running = false;
913     }
914
915     // 4. handle equipment health
916     if (this->is_running) {
917         this->health--;
918
919         if (this->health <= 0) {
920             this->__breakdown();
921         }
922     }
923
924     // 5. send tile state request (if selected)
925     if (this->is_selected) {
926         this->__sendTileStateRequest();
927     }
928
929     return;
930 } /* advanceTurn() */

```

#### 4.11.3.15 draw()

```

void SolarPV::draw (
    void ) [virtual]

```

Method to draw the hex tile to the render window. To be called once per frame.

Reimplemented from [TileImprovement](#).

```

1019 {
1020     // 1. if just built, call base method and return
1021     if (this->just_built) {
1022         TileImprovement::draw();

```

```

1023
1024     return;
1025 }
1026
1027 // 2. handle upgrade effects
1028 if (this->just_upgraded) {
1029     this->tile_improvement_sprite_static.setColor(
1030         sf::Color(
1031             255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
1032             255,
1033             255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
1034             255
1035         )
1036     );
1037
1038     this->tile_improvement_sprite_static.setScale(
1039         sf::Vector2f(
1040             1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
1041             1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2)
1042         )
1043     );
1044
1045     this->upgrade_frame++;
1046 }
1047
1048 if (this->upgrade_frame >= 2 * FRAMES_PER_SECOND) {
1049     this->tile_improvement_sprite_static.setColor(
1050         sf::Color(255,255,255,255)
1051     );
1052
1053     this->tile_improvement_sprite_static.setScale(sf::Vector2f(1,1));
1054
1055     this->just_upgraded = false;
1056     this->upgrade_frame = 0;
1057 }
1058
1059 // 3. draw static sprite
1060 this->render_window_ptr->draw(this->tile_improvement_sprite_static);
1061
1062 // 4. draw storage upgrades
1063 for (size_t i = 0; i < this->storage_upgrade_sprite_vec.size(); i++) {
1064     this->render_window_ptr->draw(this->storage_upgrade_sprite_vec[i]);
1065 }
1066
1067 // 5. handle dispatch illustration
1068 if (this->dispatch_MWh > 0) {
1069     this->dispatch_text.setString(std::to_string(this->dispatch_MWh));
1070     this->__drawDispatch();
1071 }
1072
1073 // 6. draw production menu
1074 if (this->production_menu_open) {
1075     this->render_window_ptr->draw(this->production_menu_backing);
1076     this->render_window_ptr->draw(this->production_menu_backing_text);
1077
1078     this->__drawProductionMenu();
1079 }
1080
1081 // 7. draw upgrade menu
1082 if (this->upgrade_menu_open) {
1083     this->render_window_ptr->draw(this->upgrade_menu_backing);
1084     this->render_window_ptr->draw(this->upgrade_menu_backing_text);
1085
1086     this->__drawUpgradeOptions();
1087 }
1088
1089 // 10. handle broken effects
1090 if (this->is_broken) {
1091     this->tile_improvement_sprite_static.setColor(
1092         sf::Color(
1093             255,
1094             255 * pow(cos((M_PI * this->frame) / FRAMES_PER_SECOND), 2),
1095             255 * pow(cos((M_PI * this->frame) / FRAMES_PER_SECOND), 2),
1096             255
1097         )
1098     );
1099
1100     this->frame++;
1101 }
1102 return;

```

```
1110 }    /* draw() */
```

#### 4.11.3.16 getTileOptionsSubstring()

```
std::string SolarPV::getTileOptionsSubstring (
    void ) [virtual]
```

Helper method to assemble and return tile options substring.

##### Returns

Tile options substring.

Reimplemented from [TileImprovement](#).

```
810 {
811     //          32 char x 17 line console "-----\n";
812     std::string options_substring = "CAPACITY: ";
813     options_substring += std::to_string(this->capacity_kW);
814     options_substring += " kW (level ";
815     options_substring += std::to_string(this->upgrade_level);
816     options_substring += ")\n";
817
818     options_substring += "PRODUCTION: ";
819     options_substring += std::to_string(this->production_MWh);
820     options_substring += " MWh\n";
821
822     options_substring += "DISPATCHABLE: ";
823     options_substring += std::to_string(this->dispatchable_MWh);
824     options_substring += " MWh\n";
825
826     options_substring += "HEALTH: ";
827     options_substring += std::to_string(this->health);
828     options_substring += "/100";
829
830     if (this->health <= 0) {
831         options_substring += " ** BROKEN! **\n";
832     }
833
834     else {
835         options_substring += "\n";
836     }
837
838     options_substring += "
839     options_substring += "      **** SOLAR PV OPTIONS ****
840     options_substring += "
841
842     if (this->is_broken) {
843         options_substring += "      [R]: REPAIR (";
844         options_substring += std::to_string(SOLAR_PV_BUILD_COST);
845         options_substring += " K)\n";
846     }
847
848     else {
849         options_substring += "      [E]: OPEN PRODUCTION MENU \n";
850     }
851
852     options_substring += "      [U]: OPEN UPGRADE MENU \n";
853     options_substring += "HOLD [P]: SCRAP (";
854     options_substring += std::to_string(SCRAP_COST);
855     options_substring += " K)";
856
857     return options_substring;
858 } /* getTileOptionsSubstring() */
```

#### 4.11.3.17 processEvent()

```
void SolarPV::processEvent (
    void ) [virtual]
```

Method to process [SolarPV](#). To be called once per event.

Reimplemented from [TileImprovement](#).

```
970 {
971     TileImprovement :: processEvent();
972
973     if (this->event_ptr->type == sf::Event::KeyPressed) {
974         this->__handleKeyPressEvents();
975     }
976
977     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
978         this->__handleMouseButtonEvents();
979     }
980
981     return;
982 } /* processEvent() */
```

#### 4.11.3.18 processMessage()

```
void SolarPV::processMessage (
    void ) [virtual]
```

Method to process [SolarPV](#). To be called once per message.

Reimplemented from [TileImprovement](#).

```
997 {
998     TileImprovement :: processMessage();
999
1000     //...
1001
1002     return;
1003 } /* processMessage() */
```

#### 4.11.3.19 setIsSelected()

```
void SolarPV::setIsSelected (
    bool is_selected ) [virtual]
```

Method to set the is selected attribute.

##### Parameters

<i>is_selected</i>	The value to set the is selected attribute to.
--------------------	--

Reimplemented from [TileImprovement](#).

```
875 {
876     TileImprovement :: setIsSelected(is_selected);
877
878     if (this->is_running and this->is_selected) {
879         this->assets_manager_ptr->getSound("solar hum")->play();
880     }
881 }
```

```
882     return;  
883 } /* setIsSelected() */
```

#### 4.11.3.20 update()

```
void SolarPV::update (  
    void ) [virtual]
```

Method to trigger production and dispatchable updates.

Reimplemented from [TileImprovement](#).

```
945 {  
946     this->__computeProduction();  
947     this->__computeProductionCosts();  
948     this->__computeDispatch();  
949  
950     if (this->is_selected) {  
951         this->__sendTileStateRequest();  
952     }  
953  
954     return;  
955 } /* update() */
```

### 4.11.4 Member Data Documentation

#### 4.11.4.1 capacity\_factor\_vec

```
std::vector<double> SolarPV::capacity_factor_vec
```

A vector of daily capacity factors for the current month.

#### 4.11.4.2 capacity\_kW

```
int SolarPV::capacity_kW
```

The rated production capacity [kW] of the solar PV array.

#### 4.11.4.3 dispatch\_MWh

```
int SolarPV::dispatch_MWh
```

The current dispatch [MWh] of the solar PV array.



#### 4.11.4.4 dispatch\_vec\_MWh

```
std::vector<double> SolarPV::dispatch_vec_MWh
```

A vector of daily dispatch [MWh] for the current month.

#### 4.11.4.5 dispatchable\_MWh

```
int SolarPV::dispatchable_MWh
```

The amount of production that is directly dispatchable to the grid (i.e. production correlated with demand).

#### 4.11.4.6 max\_daily\_production\_MWh

```
double SolarPV::max_daily_production_MWh
```

The maximum daily production [MWh] of the solar PV array.

#### 4.11.4.7 production\_MWh

```
int SolarPV::production_MWh
```

The current production [MWh] of the solar PV array.

#### 4.11.4.8 production\_vec\_MWh

```
std::vector<double> SolarPV::production_vec_MWh
```

A vector of daily production [MWh] for the current month.

The documentation for this class was generated from the following files:

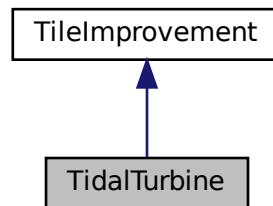
- header/[SolarPV.h](#)
- source/[SolarPV.cpp](#)

## 4.12 TidalTurbine Class Reference

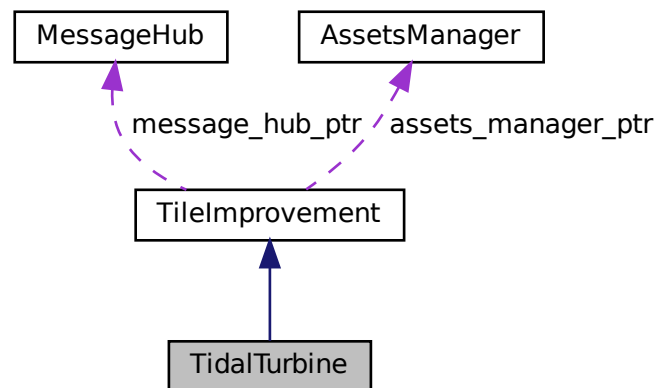
A settlement class (child class of [TileImprovement](#)).

```
#include <TidalTurbine.h>
```

Inheritance diagram for TidalTurbine:



Collaboration diagram for TidalTurbine:



### Public Member Functions

- [TidalTurbine](#) (double, double, int, sf::Event \*, sf::RenderWindow \*, [AssetsManager](#) \*, [MessageHub](#) \*)  
*Constructor for the [TidalTurbine](#) class.*
- std::string [getTileOptionsSubstring](#) (void)  
*Helper method to assemble and return tile options substring.*
- void [setIsSelected](#) (bool)  
*Method to set the is selected attribute.*
- void [advanceTurn](#) (void)

- *Method to handle turn advance.*
- void [update](#) (void)
- *Method to trigger production and dispatchable updates.*
- void [processEvent](#) (void)
- *Method to process [TidalTurbine](#). To be called once per event.*
- void [processMessage](#) (void)
- *Method to process [TidalTurbine](#). To be called once per message.*
- void [draw](#) (void)
- *Method to draw the hex tile to the render window. To be called once per frame.*
- virtual [~TidalTurbine](#) (void)
- *Destructor for the [TidalTurbine](#) class.*

## Public Attributes

- int [capacity\\_kW](#)
- *The rated production capacity [kW] of the solar PV array.*
- int [production\\_MWh](#)
- *The current production [MWh] of the solar PV array.*
- int [dispatch\\_MWh](#)
- *The current dispatch [MWh] of the solar PV array.*
- int [dispatchable\\_MWh](#)
- *The amount of production that is directly dispatchable to the grid (i.e. production correlated with demand).*
- double [max\\_daily\\_production\\_MWh](#)
- *The maximum daily production [MWh] of the solar PV array.*
- double [rotor\\_drotation](#)
- *The rotation rate of the rotor.*
- double [bobbing\\_y](#)
- *The bobbing extent of the tidal turbine.*
- std::vector< double > [capacity\\_factor\\_vec](#)
- *A vector of daily capacity factors for the current month.*
- std::vector< double > [production\\_vec\\_MWh](#)
- *A vector of daily production [MWh] for the current month.*
- std::vector< double > [dispatch\\_vec\\_MWh](#)
- *A vector of daily dispatch [MWh] for the current month.*

## Private Member Functions

- void [\\_\\_setUpTileImprovementSpriteAnimated](#) (void)
- *Helper method to set up tile improvement sprite (static).*
- void [\\_\\_drawProductionMenu](#) (void)
- *Helper method to draw production menu assets.*
- void [\\_\\_upgradePowerCapacity](#) (void)
- *Helper method to upgrade power capacity.*
- void [\\_\\_computeProductionCosts](#) (void)
- *Helper method to compute production costs (O&M) based on current production level.*
- void [\\_\\_breakdown](#) (void)
- *Helper method to trigger an equipment breakdown.*
- void [\\_\\_repair](#) (void)
- *Helper method to repair the tidal turbine.*

- void [\\_\\_computeCapacityFactors](#) (void)  
*Helper method to compute capacity factors.*
- void [\\_\\_computeProduction](#) (void)  
*Helper method to compute production values.*
- void [\\_\\_computeDispatch](#) (void)  
*Helper method to compute dispatch values.*
- void [\\_\\_handleKeyPressEvents](#) (void)  
*Helper method to handle key press events.*
- void [\\_\\_handleMouseButtonEvents](#) (void)  
*Helper method to handle mouse button events.*
- void [\\_\\_drawUpgradeOptions](#) (void)  
*Helper method to set up and draw upgrade options.*
- void [\\_\\_sendImprovementStateMessage](#) (void)  
*Helper method to format and sent improvement state message.*

## Additional Inherited Members

### 4.12.1 Detailed Description

A settlement class (child class of [TileImprovement](#)).

### 4.12.2 Constructor & Destructor Documentation

#### 4.12.2.1 TidalTurbine()

```
TidalTurbine::TidalTurbine (
    double position_x,
    double position_y,
    int tile_resource,
    sf::Event * event_ptr,
    sf::RenderWindow * render_window_ptr,
    AssetsManager * assets_manager_ptr,
    MessageHub * message_hub_ptr )
```

Constructor for the [TidalTurbine](#) class.

Ref: [Wikipedia \[2023\]](#)

#### Parameters

<i>position_x</i>	The x position of the tile.
<i>position_y</i>	The y position of the tile.
<i>tile_resource</i>	The renewable resource quality of the tile.
<i>event_ptr</i>	Pointer to the event class.
<i>render_window_ptr</i>	Pointer to the render window.
<i>assets_manager_ptr</i>	Pointer to the assets manager.
<i>message_hub_ptr</i>	Pointer to the message hub.

```

747 :
748 TileImprovement (
749     position_x,
750     position_y,
751     tile_resource,
752     event_ptr,
753     render_window_ptr,
754     assets_manager_ptr,
755     message_hub_ptr
756 )
757 {
758     // 1. set attributes
759
760     // 1.1. private
761     //...
762
763     // 1.2. public
764     this->tile_improvement_type = TileImprovementType :: TIDAL_TURBINE;
765
766     this->is_running = false;
767
768     this->health = 100;
769
770     this->capacity_kW = 100;
771     this->upgrade_level = 1;
772
773     this->storage_kWh = 0;
774     this->storage_level = 0;
775
776     this->production_MWh = 0;
777     this->dispatch_MWh = 0;
778     this->dispatchable_MWh = 0;
779
780     this->max_daily_production_MWh = (double)(24 * this->capacity_kW) / 1000;
781
782     this->rotor_drotation = 64 * SECONDS_PER_FRAME;
783     this->bobbing_y = 4;
784
785     this->capacity_factor_vec.resize(30, 0);
786     this->production_vec_MWh.resize(30, 0);
787     this->dispatch_vec_MWh.resize(30, 0);
788
789     this->tile_improvement_string = "TIDAL TURBINE";
790
791     this->__setUpTileImprovementSpriteAnimated();
792     this->__computeCapacityFactors();
793     this->update();
794
795     std::cout << "TidalTurbine constructed at " << this << std::endl;
796
797     return;
798 } /* TidalTurbine() */

```

#### 4.12.2.2 ~TidalTurbine()

```

TidalTurbine::~TidalTurbine (
    void ) [virtual]

```

Destructor for the [TidalTurbine](#) class.

```

1156 {
1157     std::cout << "TidalTurbine at " << this << " destroyed" << std::endl;
1158
1159     return;
1160 } /* ~TidalTurbine() */

```

### 4.12.3 Member Function Documentation

#### 4.12.3.1 \_\_breakdown()

```
void TidalTurbine::__breakdown (
    void ) [private]
```

Helper method to trigger an equipment breakdown.

```
250 {
251     TileImprovement :: __breakdown();
252
253     this->production_MWh = 0;
254     this->dispatch_MWh = 0;
255     this->dispatchable_MWh = 0;
256     this->operation_maintenance_cost = 0;
257
258     return;
259 } /* __breakdown() */
```

#### 4.12.3.2 \_\_computeCapacityFactors()

```
void TidalTurbine::__computeCapacityFactors (
    void ) [private]
```

Helper method to compute capacity factors.

```
307 {
308     for (int i = 0; i < 30; i++) {
309         this->capacity_factor_vec[i] =
310             this->tile_resource_scalar * DAILY_TIDAL_CAPACITY_FACTOR;
311     }
312
313     return;
314 } /* __computeCapacityFactors() */
```

#### 4.12.3.3 \_\_computeDispatch()

```
void TidalTurbine::__computeDispatch (
    void ) [private]
```

Helper method to compute dispatch values.

```
357 {
358     double stored_energy_MWh = 0;
359     double storage_capacity_MWh = (double)(this->storage_kWh) / 1000;
360
361     double demand_MWh = 0;
362     double production_MWh = 0;
363     double dispatchable_MWh = 0;
364     double difference_MWh = 0;
365
366     double room_MWh = 0;
367
368     for (int i = 0; i < 30; i++) {
369         demand_MWh = this->demand_vec_MWh[i];
370         production_MWh = this->production_vec_MWh[i];
371
372         if (production_MWh <= demand_MWh) {
373             this->dispatch_vec_MWh[i] = production_MWh;
374             dispatchable_MWh += this->dispatch_vec_MWh[i];
375
376             difference_MWh = demand_MWh - production_MWh;
377
378             if ((storage_capacity_MWh > 0) and (stored_energy_MWh > 0)) {
379                 if (difference_MWh > stored_energy_MWh) {
380                     this->dispatch_vec_MWh[i] += stored_energy_MWh;
381                     dispatchable_MWh += stored_energy_MWh;
382                     stored_energy_MWh = 0;
383                 }
384             }
385         }
386     }
387 }
```

```

385         else {
386             this->dispatch_vec_MWh[i] += difference_MWh;
387             dispatchable_MWh += difference_MWh;
388             stored_energy_MWh -= difference_MWh;
389         }
390     }
391 }
392
393 else {
394     this->dispatch_vec_MWh[i] = demand_MWh;
395     dispatchable_MWh += this->dispatch_vec_MWh[i];
396
397     difference_MWh = production_MWh - demand_MWh;
398
399     if (
400         (storage_capacity_MWh > 0) and
401         (stored_energy_MWh < storage_capacity_MWh)
402     ) {
403         room_MWh = storage_capacity_MWh - stored_energy_MWh;
404
405         if (difference_MWh > room_MWh) {
406             stored_energy_MWh += room_MWh;
407         }
408
409         else {
410             stored_energy_MWh += difference_MWh;
411         }
412     }
413 }
414 }
415
416 this->dispatchable_MWh = round(dispatchable_MWh);
417
418 if (this->dispatch_MWh != this->dispatchable_MWh) {
419     this->dispatch_MWh = this->dispatchable_MWh;
420 }
421
422 return;
423 } /* __computeDispatch() */

```

#### 4.12.3.4 \_\_computeProduction()

```

void TidalTurbine::__computeProduction (
    void ) [private]

```

Helper method to compute production values.

```

329 {
330     double production_MWh = 0;
331
332     for (int i = 0; i < 30; i++) {
333         this->production_vec_MWh[i] =
334             this->max_daily_production_MWh * this->capacity_factor_vec[i];
335
336         production_MWh += this->production_vec_MWh[i];
337     }
338
339     this->production_MWh = round(production_MWh);
340
341     return;
342 } /* __computeProduction() */

```

#### 4.12.3.5 \_\_computeProductionCosts()

```

void TidalTurbine::__computeProductionCosts (
    void ) [private]

```

Helper method to compute production costs (O&M) based on current production level.

```

229 {
230     double operation_maintenance_cost =
231         (this->production_MWh * TIDAL_OP_MAINT_COST_PER_MWH_PRODUCTION) / 1000;
232     this->operation_maintenance_cost = round(operation_maintenance_cost);
233
234     return;
235 } /* __computeProductionCosts() */

```

#### 4.12.3.6 \_\_drawProductionMenu()

```
void TidalTurbine::__drawProductionMenu (
    void ) [private]
```

Helper method to draw production menu assets.

```
114 {
115     // 1. draw static sprite
116     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
117         sf::Vector2f initial_position = this->tile_improvement_sprite_animated[i].getPosition();
118         this->tile_improvement_sprite_animated[i].setPosition(400 - 138, 400 + 16);
119
120         sf::Color initial_colour = this->tile_improvement_sprite_animated[i].getColor();
121         this->tile_improvement_sprite_animated[i].setColor(sf::Color(255, 255, 255, 255));
122
123         sf::Vector2f initial_scale = this->tile_improvement_sprite_animated[i].getScale();
124         this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1, 1));
125
126         double initial_rotation = this->tile_improvement_sprite_animated[i].getRotation();
127         this->tile_improvement_sprite_animated[i].setRotation(0);
128
129         this->render_window_ptr->draw(this->tile_improvement_sprite_animated[i]);
130
131         this->tile_improvement_sprite_animated[i].setPosition(initial_position);
132         this->tile_improvement_sprite_animated[i].setColor(initial_colour);
133         this->tile_improvement_sprite_animated[i].setScale(initial_scale);
134         this->tile_improvement_sprite_animated[i].setRotation(initial_rotation);
135     }
136
137     // 2. draw production text
138     std::string production_string = "[W]: INCREASE DISPATCH\n";
139     production_string += "[S]: DECREASE DISPATCH\n";
140     production_string += "\n";
141
142     production_string += "DISPATCH: ";
143     production_string += std::to_string(this->dispatch_MWh);
144     production_string += " MWh (MAX ";
145     production_string += std::to_string(this->dispatchable_MWh);
146     production_string += ")\n";
147
148     production_string += "O&M COST: ";
149     production_string += std::to_string(this->operation_maintenance_cost);
150     production_string += " K\n";
151
152     sf::Text production_text(
153         production_string,
154         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
155         16
156     );
157
158     production_text.setOrigin(production_text.getLocalBounds().width / 2, 0);
159     production_text.setFillColor(MONOCROME_TEXT_GREEN);
160
161     production_text.setPosition(400 + 30, 400 - 45);
162
163     this->render_window_ptr->draw(production_text);
164
165     return;
166 } /* __drawProductionMenu() */
```

#### 4.12.3.7 \_\_drawUpgradeOptions()

```
void TidalTurbine::__drawUpgradeOptions (
    void ) [private]
```

Helper method to set up and draw upgrade options.

```
564 {
565     // 1. draw power capacity upgrade sprite
566     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
567         sf::Vector2f initial_position = this->tile_improvement_sprite_animated[i].getPosition();
568         this->tile_improvement_sprite_animated[i].setPosition(400 - 100, 400 - 32 - 8);
569
570         sf::Color initial_colour = this->tile_improvement_sprite_animated[i].getColor();
571         this->tile_improvement_sprite_animated[i].setColor(sf::Color(255, 255, 255, 255));
572     }
```



```

573         sf::Vector2f initial_scale = this->tile_improvement_sprite_animated[i].getScale();
574         this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1, 1));
575
576         double initial_rotation = this->tile_improvement_sprite_animated[i].getRotation();
577         this->tile_improvement_sprite_animated[i].setRotation(0);
578
579         this->render_window_ptr->draw(this->tile_improvement_sprite_animated[i]);
580
581         this->tile_improvement_sprite_animated[i].setPosition(initial_position);
582         this->tile_improvement_sprite_animated[i].setColor(initial_colour);
583         this->tile_improvement_sprite_animated[i].setScale(initial_scale);
584         this->tile_improvement_sprite_animated[i].setRotation(initial_rotation);
585     }
586
587     this->render_window_ptr->draw(this->upgrade_arrow_sprite);
588
589
590     // 2. draw power capacity upgrade text
591     //      16 char line = "
592     std::string power_upgrade_string = "POWER CAPACITY \n";
593     power_upgrade_string += "
594
595     power_upgrade_string += "CAPACITY: ";
596     power_upgrade_string += std::to_string(this->capacity_kW);
597     power_upgrade_string += " kW\n";
598
599     power_upgrade_string += "LEVEL: ";
600     power_upgrade_string += std::to_string(this->upgrade_level);
601     power_upgrade_string += "\n\n";
602
603     if (this->upgrade_level < MAX_UPGRADE_LEVELS) {
604         power_upgrade_string += "[W]: + 100 kW (";
605         power_upgrade_string += std::to_string(TIDAL_TURBINE_BUILD_COST);
606         power_upgrade_string += " K)\n";
607     }
608
609     else {
610         power_upgrade_string += " * MAX LEVEL * \n";
611     }
612
613     sf::Text power_upgrade_text = sf::Text(
614         power_upgrade_string,
615         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
616         16
617     );
618
619     power_upgrade_text.setOrigin(power_upgrade_text.getLocalBounds().width / 2, 0);
620     power_upgrade_text.setPosition(400 - 100, 400 - 32 + 16);
621     power_upgrade_text.setFillColor(MONOCROME_TEXT_GREEN);
622
623     this->render_window_ptr->draw(power_upgrade_text);
624
625
626     // 3. draw energy capacity (storage) upgrade sprite
627     this->render_window_ptr->draw(this->storage_upgrade_sprite);
628     this->render_window_ptr->draw(this->upgrade_plus_sprite);
629
630
631     // 4. draw energy capacity (storage) upgrade text
632     //      16 char line = "
633     std::string energy_upgrade_string = "ENERGY CAPACITY \n";
634     energy_upgrade_string += "
635
636     energy_upgrade_string += "CAPACITY: ";
637     energy_upgrade_string += std::to_string(this->storage_level * 200);
638     energy_upgrade_string += " kWh\n";
639
640     energy_upgrade_string += "LEVEL: ";
641     energy_upgrade_string += std::to_string(this->storage_level);
642     energy_upgrade_string += "\n\n";
643
644     if (this->storage_level < MAX_STORAGE_LEVELS) {
645         energy_upgrade_string += "[D]: + 200 kWh (";
646         energy_upgrade_string += std::to_string(ENERGY_STORAGE_SYSTEM_BUILD_COST);
647         energy_upgrade_string += " K)\n";
648     }
649
650     else {
651         energy_upgrade_string += " * MAX LEVEL * \n";
652     }
653
654     sf::Text energy_upgrade_text = sf::Text(
655         energy_upgrade_string,
656         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
657         16
658     );
659

```

```

660     energy_upgrade_text.setOrigin(energy_upgrade_text.getLocalBounds().width / 2, 0);
661     energy_upgrade_text.setPosition(400 + 100, 400 - 32 + 16);
662     energy_upgrade_text.setFillColor(MONOCROME_TEXT_GREEN);
663
664     this->render_window_ptr->draw(energy_upgrade_text);
665
666     return;
667 } /* __drawUpgradeOptions() */

```

#### 4.12.3.8 \_\_handleKeyPressEvents()

```

void TidalTurbine::__handleKeyPressEvents (
    void ) [private]

```

Helper method to handle key press events.

```

438 {
439     if (this->just_built) {
440         return;
441     }
442
443     switch (this->event_ptr->key.code) {
444         case (sf::Keyboard::U): {
445             this->__openUpgradeMenu();
446
447             break;
448         }
449
450
451         case (sf::Keyboard::W): {
452             if (this->production_menu_open) {
453                 this->dispatch_MWh++;
454
455                 if (this->dispatch_MWh > this->dispatchable_MWh) {
456                     this->dispatch_MWh = 0;
457                 }
458
459                 this->__computeProductionCosts();
460                 this->assets_manager_ptr->getSound("interface click")->play();
461             }
462
463             else if (this->upgrade_menu_open) {
464                 this->__upgradePowerCapacity();
465             }
466
467             break;
468         }
469
470
471         case (sf::Keyboard::S): {
472             if (this->production_menu_open) {
473                 this->dispatch_MWh--;
474
475                 if (this->dispatch_MWh < 0) {
476                     this->dispatch_MWh = this->dispatchable_MWh;
477                 }
478
479                 this->__computeProductionCosts();
480                 this->assets_manager_ptr->getSound("interface click")->play();
481             }
482
483             break;
484         }
485
486
487         case (sf::Keyboard::D): {
488             if (this->upgrade_menu_open) {
489                 this->__upgradeStorageCapacity();
490                 this->__computeProduction();
491                 this->__computeDispatch();
492             }
493
494             break;
495         }
496
497
498         default: {
499             // do nothing!
500

```

```

501         break;
502     }
503 }
504
505 return;
506 } /* __handleKeyPressEvents() */

```

#### 4.12.3.9 \_\_handleMouseButtonEvents()

```

void TidalTurbine::__handleMouseButtonEvents (
    void ) [private]

```

Helper method to handle mouse button events.

```

521 {
522     if (this->just_built) {
523         return;
524     }
525
526     switch (this->event_ptr->mouseButton.button) {
527         case (sf::Mouse::Left): {
528             //...
529
530             break;
531         }
532
533         case (sf::Mouse::Right): {
534             //...
535
536             break;
537         }
538     }
539
540     default: {
541         // do nothing!
542
543         break;
544     }
545 }
546
547 return;
548 } /* __handleMouseButtonEvents() */

```

#### 4.12.3.10 \_\_repair()

```

void TidalTurbine::__repair (
    void ) [private], [virtual]

```

Helper method to repair the tidal turbine.

Reimplemented from [TileImprovement](#).

```

274 {
275     if (this->credits < TIDAL_TURBINE_BUILD_COST) {
276         std::cout << "Cannot repair tidal turbine: insufficient credits (need "
277             << TIDAL_TURBINE_BUILD_COST << " K)" << std::endl;
278
279         this->__sendInsufficientCreditsMessage();
280         return;
281     }
282
283     TileImprovement :: __repair();
284
285     this->just_upgraded = true;
286
287     this->__sendCreditsSpentMessage(TIDAL_TURBINE_BUILD_COST);
288     this->__sendTileStateRequest();
289     this->__sendGameStateRequest();
290
291     return;
292 } /* __repair() */

```

#### 4.12.3.11 \_\_sendImprovementStateMessage()

```
void TidalTurbine::__sendImprovementStateMessage (
    void ) [private]
```

Helper method to format and sent improvement state message.

```
682 {
683     Message improvement_state_message;
684
685     improvement_state_message.channel = GAME_CHANNEL;
686     improvement_state_message.subject = "improvement state";
687
688     improvement_state_message.int_payload["dispatch_MWh"] = this->dispatch_MWh;
689     improvement_state_message.int_payload["operation_maintenance_cost"] =
690         this->operation_maintenance_cost;
691
692     this->message_hub_ptr->sendMessage(improvement_state_message);
693
694     std::cout << "Improvement state message sent by " << this << std::endl;
695
696     return;
697 } /* __sendImprovementStateMessage() */
```

#### 4.12.3.12 \_\_setUpTileImprovementSpriteAnimated()

```
void TidalTurbine::__setUpTileImprovementSpriteAnimated (
    void ) [private]
```

Helper method to set up tile improvement sprite (static).

```
68 {
69     sf::Sprite diesel_generator_sheet (
70         *(this->assets_manager_ptr->getTexture("tidal turbine"))
71     );
72
73     int n_elements = diesel_generator_sheet.getLocalBounds().height / 64;
74
75     for (int i = 0; i < n_elements; i++) {
76         this->tile_improvement_sprite_animated.push_back(
77             sf::Sprite(
78                 *(this->assets_manager_ptr->getTexture("tidal turbine")),
79                 sf::IntRect(0, i * 64, 64, 64)
80             )
81         );
82
83         this->tile_improvement_sprite_animated.back().setOrigin(
84             this->tile_improvement_sprite_animated.back().getLocalBounds().width / 2,
85             this->tile_improvement_sprite_animated.back().getLocalBounds().height
86         );
87
88         this->tile_improvement_sprite_animated.back().setPosition(
89             this->position_x,
90             this->position_y - 32
91         );
92
93         this->tile_improvement_sprite_animated.back().setColor(
94             sf::Color(255, 255, 255, 0)
95         );
96     }
97
98     return;
99 } /* __setUpTileImprovementSpriteAnimated() */
```

**4.12.3.13 \_\_upgradePowerCapacity()**

```
void TidalTurbine::__upgradePowerCapacity (
    void ) [private]
```

Helper method to upgrade power capacity.

```
181 {
182     if (this->credits < TIDAL_TURBINE_BUILD_COST) {
183         std::cout << "Cannot upgrade tidal turbine: insufficient credits (need "
184             << TIDAL_TURBINE_BUILD_COST << " K)" << std::endl;
185
186         this->__sendInsufficientCreditsMessage();
187         return;
188     }
189
190     if (this->upgrade_level >= MAX_UPGRADE_LEVELS) {
191         return;
192     }
193
194     TileImprovement :: __repair();
195
196     this->capacity_kW += 100;
197     this->upgrade_level++;
198
199     this->max_daily_production_MWh = (double) (24 * this->capacity_kW) / 1000;
200
201     this->__computeProduction();
202     this->__computeDispatch();
203
204     this->just_upgraded = true;
205
206     this->assets_manager_ptr->getSound("upgrade")->play();
207
208     this->__sendCreditsSpentMessage(TIDAL_TURBINE_BUILD_COST);
209     this->__sendTileStateRequest();
210     this->__sendGameStateRequest();
211
212     return;
213 } /* __upgradePowerCapacity() */
```

**4.12.3.14 advanceTurn()**

```
void TidalTurbine::advanceTurn (
    void ) [virtual]
```

Method to handle turn advance.

Reimplemented from [TileImprovement](#).

```
904 {
905     // 1. send improvement state message
906     this->__sendImprovementStateMessage();
907
908     // 2. update
909     this->__computeCapacityFactors();
910     this->update();
911
912     // 3. handle start/stop
913     if ((not this->is_running) and (this->dispatch_MWh > 0)) {
914         this->is_running = true;
915     }
916
917     else if (this->is_running and (this->dispatch_MWh <= 0)) {
918         this->is_running = false;
919     }
920
921     // 4. handle equipment health
922     if (this->is_running) {
923         this->health--;
924
925         if (this->health <= 0) {
926             this->__breakdown();
927         }
928     }
929 }
```

```

930 // 5. send tile state request (if selected)
931 if (this->is_selected) {
932     this->__sendTileStateRequest();
933 }
934
935 return;
936 } /* advanceTurn() */

```

#### 4.12.3.15 draw()

```

void TidalTurbine::draw (
    void ) [virtual]

```

Method to draw the hex tile to the render window. To be called once per frame.

Reimplemented from [TileImprovement](#).

```

1025 {
1026     // 1. if just built, call base method and return
1027     if (this->just_built) {
1028         TileImprovement :: draw();
1029
1030         return;
1031     }
1032
1033     // 2. handle upgrade effects
1034     if (this->just_upgraded) {
1035         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
1036             this->tile_improvement_sprite_animated[i].setColor(
1037                 sf::Color(
1038                     255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
1039                     255,
1040                     255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
1041                     255
1042                 )
1043             );
1044
1045             this->tile_improvement_sprite_animated[i].setScale(
1046                 sf::Vector2f(
1047                     1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
1048                     1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2)
1049                 )
1050             );
1051         }
1052
1053         this->upgrade_frame++;
1054     }
1055
1056     if (this->upgrade_frame >= 2 * FRAMES_PER_SECOND) {
1057         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
1058             this->tile_improvement_sprite_animated[i].setColor(
1059                 sf::Color(255,255,255,255)
1060             );
1061
1062             this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1,1));
1063         }
1064
1065         this->just_upgraded = false;
1066         this->upgrade_frame = 0;
1067     }
1068
1069     // 3. handle bobbing
1070     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
1071         this->tile_improvement_sprite_animated[i].setPosition(
1072             this->position_x,
1073             this->position_y + this->bobbing_y * cos(
1074                 (double)(0.4 * M_PI * this->frame) / FRAMES_PER_SECOND
1075             )
1076         );
1077     }
1078
1079     // 4. draw first element of animated sprite
1080     this->render_window_ptr->draw(this->tile_improvement_sprite_animated[0]);
1081
1082 }
1083
1084
1085

```

```

1086 // 5. draw second element of animated sprite
1087 if (this->is_running) {
1088     this->tile_improvement_sprite_animated[1].rotate(this->rotor_drotation);
1089 }
1090
1091 this->render_window_ptr->draw(this->tile_improvement_sprite_animated[1]);
1092
1093
1094 // 6. draw storage upgrades
1095 for (size_t i = 0; i < this->storage_upgrade_sprite_vec.size(); i++) {
1096     this->render_window_ptr->draw(this->storage_upgrade_sprite_vec[i]);
1097 }
1098
1099
1100 // 7. handle dispatch illustration
1101 if (this->dispatch_MWh > 0) {
1102     this->dispatch_text.setString(std::to_string(this->dispatch_MWh));
1103     this->__drawDispatch();
1104 }
1105
1106
1107 // 8. draw production menu
1108 if (this->production_menu_open) {
1109     this->render_window_ptr->draw(this->production_menu_backing);
1110     this->render_window_ptr->draw(this->production_menu_backing_text);
1111
1112     this->__drawProductionMenu();
1113 }
1114
1115
1116 // 9. draw upgrade menu
1117 if (this->upgrade_menu_open) {
1118     this->render_window_ptr->draw(this->upgrade_menu_backing);
1119     this->render_window_ptr->draw(this->upgrade_menu_backing_text);
1120
1121     this->__drawUpgradeOptions();
1122 }
1123
1124
1125 // 10. handle broken effects
1126 if (this->is_broken) {
1127     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
1128         this->tile_improvement_sprite_animated[i].setColor(
1129             sf::Color(
1130                 255,
1131                 255 * pow(cos((M_PI * this->frame) / FRAMES_PER_SECOND), 2),
1132                 255 * pow(cos((M_PI * this->frame) / FRAMES_PER_SECOND), 2),
1133                 255
1134             )
1135         );
1136     }
1137 }
1138
1139 this->frame++;
1140 return;
1141 } /* draw() */

```

#### 4.12.3.16 getTileOptionsSubstring()

```

std::string TidalTurbine::getTileOptionsSubstring (
    void ) [virtual]

```

Helper method to assemble and return tile options substring.

#### Returns

Tile options substring.

Reimplemented from [TileImprovement](#).

```

815 {
816     // 32 char x 17 line console "-----\n";
817     std::string options_substring = "CAPACITY: ";
818     options_substring += std::to_string(this->capacity_kW);
819     options_substring += " kW (level ";

```

```

820     options_substring          += std::to_string(this->upgrade_level);
821     options_substring          += ") \n";
822
823     options_substring          += "PRODUCTION:      ";
824     options_substring          += std::to_string(this->production_MWh);
825     options_substring          += " MWh\n";
826
827     options_substring          += "DISPATCHABLE:  ";
828     options_substring          += std::to_string(this->dispatchable_MWh);
829     options_substring          += " MWh\n";
830
831     options_substring          += "HEALTH:        ";
832     options_substring          += std::to_string(this->health);
833     options_substring          += "/100";
834
835     if (this->health <= 0) {
836         options_substring
837     }
838
839     else {
840         options_substring
841     }
842
843     options_substring          += "
844     options_substring          += "**** TIDAL TURBINE OPTIONS **** \n";
845     options_substring          += "
846
847     if (this->is_broken) {
848         options_substring
849         options_substring
850         options_substring
851     }
852
853     else {
854         options_substring
855     }
856
857     options_substring          += "
858     options_substring          += "HOLD [P]:  SCRAP (";
859     options_substring          += std::to_string(SCRAP_COST);
860     options_substring          += " K)\n";
861
862     return options_substring;
863 } /* getTileOptionsSubstring() */

```

#### 4.12.3.17 processEvent()

```

void TidalTurbine::processEvent (
    void ) [virtual]

```

Method to process [TidalTurbine](#). To be called once per event.

Reimplemented from [TileImprovement](#).

```

976 {
977     TileImprovement :: processEvent ();
978
979     if (this->event_ptr->type == sf::Event::KeyPressed) {
980         this->__handleKeyPressEvents();
981     }
982
983     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
984         this->__handleMouseButtonEvents();
985     }
986
987     return;
988 } /* processEvent() */

```



#### 4.12.3.18 processMessage()

```
void TidalTurbine::processMessage (
    void ) [virtual]
```

Method to process [TidalTurbine](#). To be called once per message.

Reimplemented from [TileImprovement](#).

```
1003 {
1004     TileImprovement :: processMessage();
1005
1006     //...
1007
1008     return;
1009 } /* processMessage() */
```

#### 4.12.3.19 setIsSelected()

```
void TidalTurbine::setIsSelected (
    bool is_selected ) [virtual]
```

Method to set the is selected attribute.

##### Parameters

<i>is_selected</i>	The value to set the is selected attribute to.
--------------------	--

Reimplemented from [TileImprovement](#).

```
880 {
881     TileImprovement :: setIsSelected(is_selected);
882
883     if (this->is_running and this->is_selected) {
884         this->assets_manager_ptr->getSound("water flow")->play();
885     }
886
887     return;
888 } /* setIsSelected() */
```

#### 4.12.3.20 update()

```
void TidalTurbine::update (
    void ) [virtual]
```

Method to trigger production and dispatchable updates.

Reimplemented from [TileImprovement](#).

```
951 {
952     this->__computeProduction();
953     this->__computeProductionCosts();
954     this->__computeDispatch();
955
956     if (this->is_selected) {
957         this->__sendTileStateRequest();
958     }
959
960     return;
961 } /* update() */
```

## 4.12.4 Member Data Documentation

### 4.12.4.1 bobbing\_y

```
double TidalTurbine::bobbing_y
```

The bobbing extent of the tidal turbine.

### 4.12.4.2 capacity\_factor\_vec

```
std::vector<double> TidalTurbine::capacity_factor_vec
```

A vector of daily capacity factors for the current month.

### 4.12.4.3 capacity\_kW

```
int TidalTurbine::capacity_kW
```

The rated production capacity [kW] of the solar PV array.

### 4.12.4.4 dispatch\_MWh

```
int TidalTurbine::dispatch_MWh
```

The current dispatch [MWh] of the solar PV array.

### 4.12.4.5 dispatch\_vec\_MWh

```
std::vector<double> TidalTurbine::dispatch_vec_MWh
```

A vector of daily dispatch [MWh] for the current month.

#### 4.12.4.6 dispatchable\_MWh

```
int TidalTurbine::dispatchable_MWh
```

The amount of production that is directly dispatchable to the grid (i.e. production correlated with demand).

#### 4.12.4.7 max\_daily\_production\_MWh

```
double TidalTurbine::max_daily_production_MWh
```

The maximum daily production [MWh] of the solar PV array.

#### 4.12.4.8 production\_MWh

```
int TidalTurbine::production_MWh
```

The current production [MWh] of the solar PV array.

#### 4.12.4.9 production\_vec\_MWh

```
std::vector<double> TidalTurbine::production_vec_MWh
```

A vector of daily production [MWh] for the current month.

#### 4.12.4.10 rotor\_drotation

```
double TidalTurbine::rotor_drotation
```

The rotation rate of the rotor.

The documentation for this class was generated from the following files:

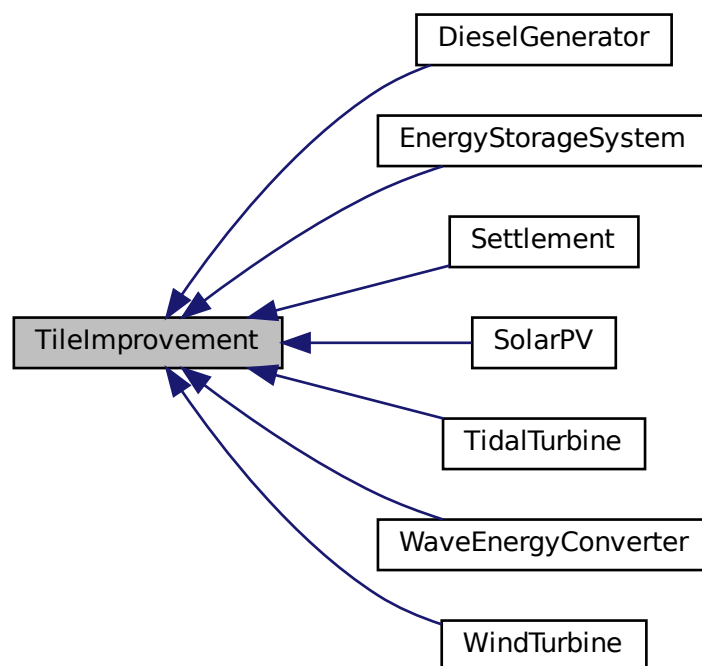
- header/[TidalTurbine.h](#)
- source/[TidalTurbine.cpp](#)

## 4.13 TileImprovement Class Reference

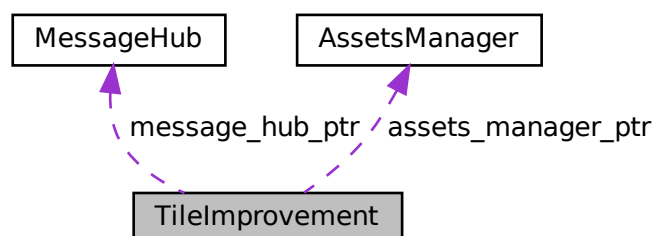
A base class for the tile improvement hierarchy.

```
#include <TileImprovement.h>
```

Inheritance diagram for TileImprovement:



Collaboration diagram for TileImprovement:



## Public Member Functions

- [TileImprovement](#) (double, double, int, sf::Event \*, sf::RenderWindow \*, [AssetsManager](#) \*, [MessageHub](#) \*)  
*Constructor for the [TileImprovement](#) class.*
- virtual void [setIsSelected](#) (bool)  
*Method to set the is selected attribute.*
- virtual void [advanceTurn](#) (void)
- virtual void [update](#) (void)
- virtual std::string [getTileOptionsSubstring](#) (void)
- virtual void [processEvent](#) (void)  
*Method to process [TileImprovement](#). To be called once per event.*
- virtual void [processMessage](#) (void)  
*Method to process [TileImprovement](#). To be called once per message.*
- virtual void [draw](#) (void)  
*Method to draw the hex tile to the render window. To be called once per frame.*
- virtual [~TileImprovement](#) (void)  
*Destructor for the [TileImprovement](#) class.*

## Public Attributes

- [TileImprovementType](#) [tile\\_improvement\\_type](#)  
*The type of the tile improvement.*
- bool [is\\_running](#)  
*A boolean which indicates whether or not the improvement is running.*
- bool [is\\_selected](#)  
*A boolean which indicates whether or not the tile is selected.*
- bool [just\\_built](#)  
*A boolean which indicates that the improvement was just built.*
- bool [just\\_upgraded](#)  
*A boolean which indicates that the improvement was just upgraded.*
- bool [production\\_menu\\_open](#)  
*A boolean which indicates whether or not the production menu is open.*
- bool [upgrade\\_menu\\_open](#)  
*A boolean which indicates whether or not the build menu is open.*
- bool [is\\_broken](#)  
*A boolean which indicated whether or not improvement is broken.*
- unsigned long long int [frame](#)  
*The current frame of this object.*
- int [credits](#)  
*The current balance of credits.*
- int [month](#)  
*The current month of play.*
- int [demand\\_MWh](#)  
*The current demand [MWh].*
- int [health](#)  
*The health of the improvement.*
- int [upgrade\\_level](#)  
*The upgrade level of the improvement.*
- int [upgrade\\_frame](#)  
*The frame of the upgrade animation.*

- int [storage\\_kWh](#)  
*The rated energy capacity [kWh] of the storage.*
- int [storage\\_level](#)  
*The level of storage installed alongside the tile improvement.*
- int [operation\\_maintenance\\_cost](#)  
*The operation and maintenance costs for this turn.*
- int [tile\\_resource](#)  
*The renewable resource quality of the tile.*
- double [tile\\_resource\\_scalar](#)  
*A scalar associated with the renewable resource quality.*
- double [position\\_x](#)  
*The x position of the tile improvement.*
- double [position\\_y](#)  
*The y position of the tile improvement.*
- std::vector< double > [demand\\_vec\\_MWh](#)  
*A vector of daily demands [MWh] for the current month.*
- std::string [game\\_phase](#)  
*The current phase of the game.*
- std::string [tile\\_improvement\\_string](#)  
*A string representation of the tile improvement type.*
- sf::Sprite [tile\\_improvement\\_sprite\\_static](#)  
*A static sprite, for decorating the tile.*
- std::vector< sf::Sprite > [tile\\_improvement\\_sprite\\_animated](#)  
*An animated sprite, for the [ContextMenu](#) visual screen.*
- sf::RectangleShape [production\\_menu\\_backing](#)  
*A backing for the production menu.*
- sf::Text [production\\_menu\\_backing\\_text](#)  
*Text for the production menu backing.*
- sf::RectangleShape [upgrade\\_menu\\_backing](#)  
*A backing for the upgrade menu.*
- sf::Text [upgrade\\_menu\\_backing\\_text](#)  
*Text for the upgrade menu backing.*
- sf::Sprite [storage\\_upgrade\\_sprite](#)  
*A sprite for illustrating storage (in upgrade menu).*
- std::vector< sf::Sprite > [storage\\_upgrade\\_sprite\\_vec](#)  
*A vector of sprites for illustrating the storage upgrade level (on tile).*
- sf::Sprite [upgrade\\_arrow\\_sprite](#)  
*An upgrade arrow sprite.*
- sf::Sprite [upgrade\\_plus\\_sprite](#)  
*An upgrade plus sprite.*
- sf::CircleShape [dispatch\\_backing](#)  
*A backing circle for dispatch text illustration.*
- sf::Text [dispatch\\_text](#)  
*Text for illustrating dispatch.*

## Protected Member Functions

- void [\\_\\_setUpProductionMenu](#) (void)  
*Helper method to set up and position production menu assets (drawable).*
- void [\\_\\_setUpUpgradeMenu](#) (void)  
*Helper method to set up and position upgrade menu assets (drawable).*
- void [\\_\\_setUpDispatchIllustration](#) (void)  
*Helper method to set up and position dispatch assets (drawable).*
- void [\\_\\_upgradeStorageCapacity](#) (void)  
*Helper method to upgrade storage capacity.*
- void [\\_\\_handleKeyPressEvents](#) (void)  
*Helper method to handle key press events.*
- void [\\_\\_handleMouseButtonEvents](#) (void)  
*Helper method to handle mouse button events.*
- void [\\_\\_openProductionMenu](#) (void)  
*Helper method to open the production menu.*
- void [\\_\\_closeProductionMenu](#) (void)  
*Helper method to close the production menu.*
- void [\\_\\_breakdown](#) (void)  
*Helper method to trigger an equipment breakdown.*
- virtual void [\\_\\_repair](#) (void)  
*Helper method to repair a tile improvement.*
- void [\\_\\_openUpgradeMenu](#) (void)  
*Helper method to open the upgrade menu.*
- void [\\_\\_closeUpgradeMenu](#) (void)  
*Helper method to close the build menu.*
- void [\\_\\_sendTileStateRequest](#) (void)  
*Helper method to format and send a request for the parent [HexTile](#) to send a tile state message.*
- void [\\_\\_sendGameStateRequest](#) (void)  
*Helper method to format and send a game state request (message).*
- void [\\_\\_sendCreditsSpentMessage](#) (int)  
*Helper method to format and send a credits spent message.*
- void [\\_\\_sendInsufficientCreditsMessage](#) (void)  
*Helper method to format and send an insufficient credits message.*
- void [\\_\\_drawDispatch](#) (void)  
*Helper method to draw dispatch illustration.*

## Protected Attributes

- sf::Event \* [event\\_ptr](#)  
*A pointer to the event class.*
- sf::RenderWindow \* [render\\_window\\_ptr](#)  
*A pointer to the render window.*
- [AssetsManager](#) \* [assets\\_manager\\_ptr](#)  
*A pointer to the assets manager.*
- [MessageHub](#) \* [message\\_hub\\_ptr](#)  
*A pointer to the message hub.*

### 4.13.1 Detailed Description

A base class for the tile improvement hierarchy.

### 4.13.2 Constructor & Destructor Documentation

#### 4.13.2.1 TileImprovement()

```
TileImprovement::TileImprovement (
    double position_x,
    double position_y,
    int tile_resource,
    sf::Event * event_ptr,
    sf::RenderWindow * render_window_ptr,
    AssetsManager * assets_manager_ptr,
    MessageHub * message_hub_ptr )
```

Constructor for the [TileImprovement](#) class.

Ref: [Wikipedia \[2023\]](#)

#### Parameters

<i>position_x</i>	The x position of the tile.
<i>position_y</i>	The y position of the tile.
<i>tile_resource</i>	The renewable resource quality of the tile.
<i>event_ptr</i>	Pointer to the event class.
<i>render_window_ptr</i>	Pointer to the render window.
<i>assets_manager_ptr</i>	Pointer to the assets manager.
<i>message_hub_ptr</i>	Pointer to the message hub.

```
726 {
727     // 1. set attributes
728
729     // 1.1. protected
730     this->event_ptr = event_ptr;
731     this->render_window_ptr = render_window_ptr;
732
733     this->assets_manager_ptr = assets_manager_ptr;
734     this->message_hub_ptr = message_hub_ptr;
735
736     // 1.2. public
737     this->is_selected = true;
738     this->just_built = true;
739     this->production_menu_open = false;
740     this->upgrade_menu_open = false;
741     this->is_broken = false;
742
743     this->just_upgraded = false;
744     this->upgrade_frame = 0;
745
746     this->frame = 0;
747     this->credits = 0;
748     this->month = 1;
749     this->demand_MWh = 0;
750
751     this->demand_vec_MWh.resize(30, 0);
752 }
```



```

753     this->operation_maintenance_cost = 0;
754
755     this->tile_resource = tile_resource;
756
757     switch (this->tile_resource) {
758     case (0): {
759         this->tile_resource_scalar = 0.7;
760
761         break;
762     }
763
764
765     case (1): {
766         this->tile_resource_scalar = 0.85;
767
768         break;
769     }
770
771
772     case (2): {
773         this->tile_resource_scalar = 1;
774
775         break;
776     }
777
778
779     case (3): {
780         this->tile_resource_scalar = 1.15;
781
782         break;
783     }
784
785
786     case (4): {
787         this->tile_resource_scalar = 1.3;
788
789         break;
790     }
791
792
793     default: {
794         this->tile_resource_scalar = 1;
795     }
796 }
797
798 this->position_x = position_x;
799 this->position_y = position_y;
800
801 this->game_phase = "build settlement";
802
803 this->__setUpProductionMenu();
804 this->__setUpUpgradeMenu();
805 this->__setUpDispatchIllustration();
806
807 std::cout << "TileImprovement constructed at " << this << std::endl;
808
809 return;
810 } /* TileImprovement() */

```

#### 4.13.2.2 ~TileImprovement()

```

TileImprovement::~TileImprovement (
    void ) [virtual]

```

Destructor for the [TileImprovement](#) class.

```

1043 {
1044     std::cout << "TileImprovement at " << this << " destroyed" << std::endl;
1045
1046     return;
1047 } /* ~TileImprovement() */

```

### 4.13.3 Member Function Documentation

#### 4.13.3.1 \_\_breakdown()

```
void TileImprovement::__breakdown (
    void ) [protected]
```

Helper method to trigger an equipment breakdown.

```
431 {
432     this->is_broken = true;
433     this->is_running = false;
434     this->assets_manager_ptr->getSound("breakdown")->play();
435
436     return;
437 } /* __breakdown() */
```

#### 4.13.3.2 \_\_closeProductionMenu()

```
void TileImprovement::__closeProductionMenu (
    void ) [protected]
```

Helper method to close the production menu.

```
407 {
408     if (not this->production_menu_open) {
409         return;
410     }
411
412     this->production_menu_open = false;
413     this->assets_manager_ptr->getSound("build menu close")->play();
414
415     return;
416 } /* __closeProductionMenu() */
```

#### 4.13.3.3 \_\_closeUpgradeMenu()

```
void TileImprovement::__closeUpgradeMenu (
    void ) [protected]
```

Helper method to close the build menu.

```
516 {
517     if (not this->upgrade_menu_open) {
518         return;
519     }
520
521     this->upgrade_menu_open = false;
522     this->assets_manager_ptr->getSound("build menu close")->play();
523
524     return;
525 } /* __closeUpgradeMenu() */
```

## 4.13.3.4 \_\_drawDispatch()

```
void TileImprovement::__drawDispatch (
    void ) [protected]
```

Helper method to draw dispatch illustration.

```
647 {
648     double alpha = 255 * pow(cos((0.5 * M_PI * this->frame) / FRAMES_PER_SECOND), 2);
649
650
651     // 1. dispatch backing
652     sf::Color backing_colour = this->dispatch_backing.getFillColor();
653
654     backing_colour.a = alpha;
655
656     this->dispatch_backing.setFillColor(backing_colour);
657     this->dispatch_backing.setOutlineColor(sf::Color(0, 0, 0, alpha));
658
659     this->render_window_ptr->draw(this->dispatch_backing);
660
661
662     // 2. dispatch text
663     this->dispatch_text.setOrigin(
664         this->dispatch_text.getLocalBounds().width / 2,
665         this->dispatch_text.getLocalBounds().height / 2
666     );
667
668     this->dispatch_text.setFillColor(
669         sf::Color(0, 0, 0, alpha)
670     );
671
672     this->render_window_ptr->draw(this->dispatch_text);
673
674     return;
675 } /* __drawDispatch() */
```

## 4.13.3.5 \_\_handleKeyPressEvents()

```
void TileImprovement::__handleKeyPressEvents (
    void ) [protected]
```

Helper method to handle key press events.

```
277 {
278     if (this->tile_improvement_type == TileImprovementType :: SETTLEMENT) {
279         return;
280     }
281
282     if (this->just_built) {
283         return;
284     }
285
286     switch (this->event_ptr->key.code) {
287         case (sf::Keyboard::E): {
288             if (this->is_broken) {
289                 this->assets_manager_ptr->getSound("breakdown")->play();
290             }
291
292             else {
293                 this->__openProductionMenu();
294             }
295
296             break;
297         }
298
299
300         case (sf::Keyboard::R): {
301             if (this->is_broken) {
302                 this->__repair();
303             }
304
305             break;
306         }
307
308
309         default: {
```

```

310             // do nothing!
311
312             break;
313         }
314     }
315
316     return;
317 } /* __handleKeyPressEvents() */

```

#### 4.13.3.6 \_\_handleMouseButtonEvents()

```

void TileImprovement::__handleMouseButtonEvents (
    void ) [protected]

```

Helper method to handle mouse button events.

```

332 {
333     if (this->tile_improvement_type == TileImprovementType :: SETTLEMENT) {
334         return;
335     }
336
337     if (this->just_built) {
338         return;
339     }
340
341     switch (this->event_ptr->mouseButton.button) {
342         case (sf::Mouse::Left): {
343             //...
344
345             break;
346         }
347
348         case (sf::Mouse::Right): {
349             //...
350
351             break;
352         }
353     }
354
355     default: {
356         // do nothing!
357
358         break;
359     }
360 }
361
362 return;
363 } /* __handleMouseButtonEvents() */

```

#### 4.13.3.7 \_\_openProductionMenu()

```

void TileImprovement::__openProductionMenu (
    void ) [protected]

```

Helper method to open the production menu.

```

379 {
380     if (this->production_menu_open) {
381         return;
382     }
383
384     if (this->upgrade_menu_open) {
385         this->__closeUpgradeMenu();
386     }
387
388     this->production_menu_open = true;
389     this->assets_manager_ptr->getSound("build menu open")->play();
390
391     return;
392 } /* __openProductionMenu() */

```

#### 4.13.3.8 \_\_openUpgradeMenu()

```
void TileImprovement::__openUpgradeMenu (
    void ) [protected]
```

Helper method to open the upgrade menu.

```
488 {
489     if (this->upgrade_menu_open) {
490         return;
491     }
492     if (this->production_menu_open) {
493         this->__closeProductionMenu();
494     }
495     this->upgrade_menu_open = true;
496     this->assets_manager_ptr->getSound("build menu open")->play();
497     return;
498 }
499
500 /* __openUpgradeMenu() */
501 }
```

#### 4.13.3.9 \_\_repair()

```
void TileImprovement::__repair (
    void ) [protected], [virtual]
```

Helper method to repair a tile improvement.

Reimplemented in [WindTurbine](#), [WaveEnergyConverter](#), [TidalTurbine](#), [SolarPV](#), and [DieselGenerator](#).

```
452 {
453     this->health = 100;
454     if (this->is_broken) {
455         this->is_broken = false;
456         this->assets_manager_ptr->getSound("positive notification")->play();
457     }
458     if (this->tile_improvement_sprite_static.getTexture() != NULL) {
459         this->tile_improvement_sprite_static.setColor(sf::Color(255, 255, 255, 255));
460     }
461     else {
462         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
463             this->tile_improvement_sprite_animated[i].setColor(
464                 sf::Color(255, 255, 255, 255)
465             );
466         }
467     }
468     return;
469 }
470
471 /* __repair() */
472 }
```

#### 4.13.3.10 \_\_sendCreditsSpentMessage()

```
void TileImprovement::__sendCreditsSpentMessage (
    int credits_spent ) [protected]
```

Helper method to format and send a credits spent message.

##### Parameters

<i>credits_spent</i>	The number of credits that were spent.
----------------------	--

```

593 {
594     Message credits_spent_message;
595
596     credits_spent_message.channel = GAME_CHANNEL;
597     credits_spent_message.subject = "credits spent";
598
599     credits_spent_message.int_payload["credits spent"] = credits_spent;
600
601     this->message_hub_ptr->sendMessage(credits_spent_message);
602
603     std::cout << "Credits spent (" << credits_spent << ") message sent by " << this
604               << std::endl;
605     return;
606 } /* __sendCreditsSpentMessage() */

```

#### 4.13.3.11 \_\_sendGameStateRequest()

```

void TileImprovement::__sendGameStateRequest (
    void ) [protected]

```

Helper method to format and send a game state request (message).

```

566 {
567     Message game_state_request;
568
569     game_state_request.channel = GAME_CHANNEL;
570     game_state_request.subject = "state request";
571
572     this->message_hub_ptr->sendMessage(game_state_request);
573
574     std::cout << "Game state request message sent by " << this << std::endl;
575     return;
576 } /* __sendGameStateRequest() */

```

#### 4.13.3.12 \_\_sendInsufficientCreditsMessage()

```

void TileImprovement::__sendInsufficientCreditsMessage (
    void ) [protected]

```

Helper method to format and send an insufficient credits message.

```

621 {
622     Message insufficient_credits_message;
623
624     insufficient_credits_message.channel = GAME_CHANNEL;
625     insufficient_credits_message.subject = "insufficient credits";
626
627     this->message_hub_ptr->sendMessage(insufficient_credits_message);
628
629     std::cout << "Insufficient credits message sent by " << this << std::endl;
630
631     return;
632 } /* __sendInsufficientCreditsMessage() */

```

#### 4.13.3.13 \_\_sendTileStateRequest()

```

void TileImprovement::__sendTileStateRequest (
    void ) [protected]

```

Helper method to format and send a request for the parent [HexTile](#) to send a tile state message.

```

541 {
542     Message tile_state_request;
543
544     tile_state_request.channel = TILE_STATE_CHANNEL;
545     tile_state_request.subject = "state request";
546
547     this->message_hub_ptr->sendMessage(tile_state_request);
548
549     std::cout << "Tile state request sent by " << this << std::endl;
550     return;
551 } /* __sendTileStateRequest() */

```

**4.13.3.14 \_\_setUpDispatchIllustration()**

```
void TileImprovement::__setUpDispatchIllustration (
    void ) [protected]
```

Helper method to set up and position dispatch assets (drawable).

```
178 {
179     // 1. set up backing
180     this->dispatch_backing.setRadius(16);
181
182     this->dispatch_backing.setOrigin(
183         this->dispatch_backing.getLocalBounds().width / 2,
184         this->dispatch_backing.getLocalBounds().height / 2
185     );
186
187     this->dispatch_backing.setPosition(
188         this->position_x,
189         this->position_y
190     );
191
192     this->dispatch_backing.setFillColor(RESOURCE_CHIP_GREY);
193     this->dispatch_backing.setOutlineThickness(1);
194     this->dispatch_backing.setOutlineColor(sf::Color(0, 0, 0, 255));
195
196
197     // 2. set up text
198     this->dispatch_text.setFont(*(assets_manager_ptr->getFont("DroidSansMono")));
199     this->dispatch_text.setFillColor(sf::Color(0, 0, 0, 255));
200     this->dispatch_text.setCharacterSize(16);
201     this->dispatch_text.setPosition(
202         this->position_x,
203         this->position_y - 4
204     );
205
206     return;
207 } /* __setUpDispatchIllustration() */
```

**4.13.3.15 \_\_setUpProductionMenu()**

```
void TileImprovement::__setUpProductionMenu (
    void ) [protected]
```

Helper method to set up and position production menu assets (drawable).

```
68 {
69     // 1. set up and place production menu backing and text
70     this->production_menu_backing.setSize(sf::Vector2f(400, 256));
71     this->production_menu_backing.setOrigin(200, 128);
72     this->production_menu_backing.setPosition(400, 400);
73     this->production_menu_backing.setFillColor(MONOCROME_SCREEN_BACKGROUND);
74     this->production_menu_backing.setOutlineColor(MENU_FRAME_GREY);
75     this->production_menu_backing.setOutlineThickness(4);
76
77     this->production_menu_backing_text.setString("**** PRODUCTION MENU ****");
78     this->production_menu_backing_text.setFont(
79         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220"))
80     );
81     this->production_menu_backing_text.setCharacterSize(16);
82     this->production_menu_backing_text.setFillColor(MONOCROME_TEXT_GREEN);
83     this->production_menu_backing_text.setOrigin(
84         this->production_menu_backing_text.getLocalBounds().width / 2, 0
85     );
86     this->production_menu_backing_text.setPosition(400, 400 - 128 + 4);
87
88     return;
89 } /* __setUpProductionMenu() */
```

#### 4.13.3.16 \_\_setUpUpgradeMenu()

```
void TileImprovement::__setUpUpgradeMenu (
    void ) [protected]
```

Helper method to set up and position upgrade menu assets (drawable).

```
104 {
105     // 1. set up and place upgrade menu backing and text
106     this->upgrade_menu_backing.setSize(sf::Vector2f(400, 256));
107     this->upgrade_menu_backing.setOrigin(200, 128);
108     this->upgrade_menu_backing.setPosition(400, 400);
109     this->upgrade_menu_backing.setFillColor(MONOCHROME_SCREEN_BACKGROUND);
110     this->upgrade_menu_backing.setOutlineColor(MENU_FRAME_GREY);
111     this->upgrade_menu_backing.setOutlineThickness(4);
112
113     this->upgrade_menu_backing_text.setString("**** UPGRADE MENU ****");
114     this->upgrade_menu_backing_text.setFont(
115         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220"))
116     );
117     this->upgrade_menu_backing_text.setCharacterSize(16);
118     this->upgrade_menu_backing_text.setFillColor(MONOCHROME_TEXT_GREEN);
119     this->upgrade_menu_backing_text.setOrigin(
120         this->upgrade_menu_backing_text.getLocalBounds().width / 2, 0
121     );
122     this->upgrade_menu_backing_text.setPosition(400, 400 - 128 + 4);
123
124
125     // 2. set up and place storage upgrade sprite (with upgrade plus)
126     this->storage_upgrade_sprite = sf::Sprite(
127         *(this->assets_manager_ptr->getTexture("energy storage system"))
128     );
129
130     this->storage_upgrade_sprite.setOrigin(
131         this->storage_upgrade_sprite.getLocalBounds().width / 2,
132         this->storage_upgrade_sprite.getLocalBounds().height
133     );
134
135     this->storage_upgrade_sprite.setPosition(400 + 100, 400 - 32);
136
137     this->upgrade_plus_sprite = sf::Sprite(
138         *(this->assets_manager_ptr->getTexture("upgrade plus"))
139     );
140
141     this->upgrade_plus_sprite.setOrigin(
142         this->upgrade_plus_sprite.getLocalBounds().width / 2,
143         this->upgrade_plus_sprite.getLocalBounds().height / 2
144     );
145
146     this->upgrade_plus_sprite.setPosition(400 + 130, 400 - 64);
147
148
149     // 3. set up and place upgrade arrow sprite
150     this->upgrade_arrow_sprite = sf::Sprite(
151         *(this->assets_manager_ptr->getTexture("upgrade arrow"))
152     );
153
154     this->upgrade_arrow_sprite.setOrigin(
155         this->upgrade_arrow_sprite.getLocalBounds().width / 2,
156         this->upgrade_arrow_sprite.getLocalBounds().height / 2
157     );
158
159     this->upgrade_arrow_sprite.setPosition(400 - 64, 400 - 64);
160
161     return;
162 } /* __setUpUpgradeMenu() */
```

#### 4.13.3.17 \_\_upgradeStorageCapacity()

```
void TileImprovement::__upgradeStorageCapacity (
    void ) [protected]
```

Helper method to upgrade storage capacity.

```
222 {
223     if (this->credits < ENERGY_STORAGE_SYSTEM_BUILD_COST) {
```



```

224         std::cout << "Cannot add energy storage: insufficient credits (need "
225             << ENERGY_STORAGE_SYSTEM_BUILD_COST << " K)" << std::endl;
226
227         this->__sendInsufficientCreditsMessage();
228         return;
229     }
230
231     if (this->storage_level >= MAX_STORAGE_LEVELS) {
232         return;
233     }
234
235     this->storage_level++;
236     this->storage_kWh += 200;
237
238     this->storage_upgrade_sprite_vec.push_back(
239         sf::Sprite(
240             *(this->assets_manager_ptr->getTexture("storage_level"))
241         )
242     );
243
244     this->storage_upgrade_sprite_vec.back().setOrigin(
245         this->storage_upgrade_sprite_vec.back().getLocalBounds().width / 2,
246         this->storage_upgrade_sprite_vec.back().getLocalBounds().height
247     );
248
249     this->storage_upgrade_sprite_vec.back().setPosition(
250         this->position_x + 18,
251         this->position_y + 25 - 7 * this->storage_upgrade_sprite_vec.size()
252     );
253
254     this->just_upgraded = true;
255
256     this->assets_manager_ptr->getSound("upgrade")->play();
257
258     this->__sendCreditsSpentMessage(ENERGY_STORAGE_SYSTEM_BUILD_COST);
259     this->__sendTileStateRequest();
260
261     return;
262 } /* __upgradeStorageCapacity() */

```

#### 4.13.3.18 advanceTurn()

```

virtual void TileImprovement::advanceTurn (
    void ) [inline], [virtual]

```

Reimplemented in [WindTurbine](#), [WaveEnergyConverter](#), [TidalTurbine](#), [SolarPV](#), and [DieselGenerator](#).

```
191 {return;}
```

#### 4.13.3.19 draw()

```

void TileImprovement::draw (
    void ) [virtual]

```

Method to draw the hex tile to the render window. To be called once per frame.

Reimplemented in [WindTurbine](#), [WaveEnergyConverter](#), [TidalTurbine](#), [SolarPV](#), [Settlement](#), [EnergyStorageSystem](#), and [DieselGenerator](#).

```

914 {
915     if (this->tile_improvement_sprite_static.getTexture() != NULL) {
916         int alpha = this->tile_improvement_sprite_static.getColor().a;
917
918         alpha += 0.08 * FRAMES_PER_SECOND;
919
920         this->tile_improvement_sprite_static.setColor(
921             sf::Color(255, 255, 255, alpha)
922         );
923
924         this->tile_improvement_sprite_static.move(0, 50 * SECONDS_PER_FRAME);

```

```

925
926     if (
927         (alpha >= 255) or
928         (this->tile_improvement_sprite_static.getPosition().y >= this->position_y + 12)
929     ) {
930         this->tile_improvement_sprite_static.setColor(
931             sf::Color(255, 255, 255, 255)
932         );
933
934         this->tile_improvement_sprite_static.setPosition(
935             this->position_x,
936             this->position_y + 12
937         );
938
939         this->just_built = false;
940         this->assets_manager_ptr->getSound("place improvement")->play();
941     }
942
943     this->render_window_ptr->draw(this->tile_improvement_sprite_static);
944 }
945
946
947 else {
948     int alpha = 0;
949
950     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
951         alpha = this->tile_improvement_sprite_animated[i].getColor().a;
952
953         alpha += 0.08 * FRAMES_PER_SECOND;
954
955         this->tile_improvement_sprite_animated[i].setColor(
956             sf::Color(255, 255, 255, alpha)
957         );
958
959         this->tile_improvement_sprite_animated[i].move(0, 50 * SECONDS_PER_FRAME);
960
961         if (
962             (alpha >= 255) or
963             (this->tile_improvement_sprite_animated[i].getPosition().y >= this->position_y + 12)
964         ) {
965             this->tile_improvement_sprite_animated[i].setColor(
966                 sf::Color(255, 255, 255, 255)
967             );
968
969             this->tile_improvement_sprite_animated[i].setPosition(
970                 this->position_x,
971                 this->position_y + 12
972             );
973         }
974
975         this->render_window_ptr->draw(this->tile_improvement_sprite_animated[i]);
976     }
977
978     if (
979         (alpha >= 255) or
980         (this->tile_improvement_sprite_animated[0].getPosition().y >= this->position_y + 12)
981     ) {
982         this->just_built = false;
983         this->assets_manager_ptr->getSound("place improvement")->play();
984
985         switch (this->tile_improvement_type) {
986             case (TileImprovementType :: WIND_TURBINE): {
987                 for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
988                     this->tile_improvement_sprite_animated[i].setOrigin(32, 32);
989                     this->tile_improvement_sprite_animated[i].move(0, -32);
990                 }
991
992                 break;
993             }
994
995             case (TileImprovementType :: TIDAL_TURBINE): {
996                 for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
997                     this->tile_improvement_sprite_animated[i].setOrigin(32, 45);
998                     this->tile_improvement_sprite_animated[i].move(0, -19);
999                 }
1000
1001                 break;
1002             }
1003
1004             case (TileImprovementType :: WAVE_ENERGY_CONVERTER): {
1005                 for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
1006                     this->tile_improvement_sprite_animated[i].setOrigin(32, 32);
1007                     this->tile_improvement_sprite_animated[i].move(0, -32);
1008                 }
1009             }
1010         }
1011

```

```

1012             break;
1013         }
1014
1015
1016         default: {
1017             // do nothing!
1018
1019             break;
1020         }
1021     }
1022 }
1023 }
1024
1025
1026     this->frame++;
1027     return;
1028 } /* draw() */

```

#### 4.13.3.20 getTileOptionsSubstring()

```

virtual std::string TileImprovement::getTileOptionsSubstring (
    void ) [inline], [virtual]

```

Reimplemented in [WindTurbine](#), [WaveEnergyConverter](#), [TidalTurbine](#), [SolarPV](#), [Settlement](#), [EnergyStorageSystem](#), and [DieselGenerator](#).

```

195 {return "";}

```

#### 4.13.3.21 processEvent()

```

void TileImprovement::processEvent (
    void ) [virtual]

```

Method to process [TileImprovement](#). To be called once per event.

Reimplemented in [WindTurbine](#), [WaveEnergyConverter](#), [TidalTurbine](#), [SolarPV](#), [Settlement](#), [EnergyStorageSystem](#), and [DieselGenerator](#).

```

854 {
855     if (this->event_ptr->type == sf::Event::KeyPressed) {
856         this->__handleKeyPressEvents();
857     }
858
859     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
860         this->__handleMouseButtonEvents();
861     }
862
863     return;
864 } /* processEvent() */

```

#### 4.13.3.22 processMessage()

```
void TileImprovement::processMessage (
    void ) [virtual]
```

Method to process [TileImprovement](#). To be called once per message.

Reimplemented in [WindTurbine](#), [WaveEnergyConverter](#), [TidalTurbine](#), [SolarPV](#), [Settlement](#), [EnergyStorageSystem](#), and [DieselGenerator](#).

```
879 {
880     if (not this->message_hub_ptr->isEmpty(GAME_STATE_CHANNEL)) {
881         Message game_state_message = this->message_hub_ptr->receiveMessage(
882             GAME_STATE_CHANNEL
883         );
884
885         if (game_state_message.subject == "turn advance") {
886             this->credits = game_state_message.int_payload["credits"];
887             this->month = game_state_message.int_payload["month"];
888             this->demand_MWh = game_state_message.int_payload["demand_MWh"];
889
890             this->advanceTurn();
891
892             this->message_hub_ptr->incrementMessageRead(GAME_STATE_CHANNEL);
893             std::cout << "Turn advance message read and passed by " << this << std::endl;
894         }
895     }
896
897     return;
898 } /* processMessage() */
```

#### 4.13.3.23 setIsSelected()

```
void TileImprovement::setIsSelected (
    bool is_selected ) [virtual]
```

Method to set the is selected attribute.

##### Parameters

<i>is_selected</i>	The value to set the is selected attribute to.
--------------------	--

Reimplemented in [WindTurbine](#), [WaveEnergyConverter](#), [TidalTurbine](#), [SolarPV](#), [Settlement](#), [EnergyStorageSystem](#), and [DieselGenerator](#).

```
827 {
828     this->is_selected = is_selected;
829
830     if ((not is_selected) and this->production_menu_open) {
831         this->__closeProductionMenu();
832     }
833
834     if ((not is_selected) and this->upgrade_menu_open) {
835         this->__closeUpgradeMenu();
836     }
837
838     return;
839 } /* setIsSelected() */
```

#### 4.13.3.24 update()

```
virtual void TileImprovement::update (
    void ) [inline], [virtual]
```

Reimplemented in [WindTurbine](#), [WaveEnergyConverter](#), [TidalTurbine](#), and [SolarPV](#).  
193 {return;}

## 4.13.4 Member Data Documentation

### 4.13.4.1 assets\_manager\_ptr

`AssetsManager* TileImprovement::assets_manager_ptr [protected]`

A pointer to the assets manager.

### 4.13.4.2 credits

`int TileImprovement::credits`

The current balance of credits.

### 4.13.4.3 demand\_MWh

`int TileImprovement::demand_MWh`

The current demand [MWh].

### 4.13.4.4 demand\_vec\_MWh

`std::vector<double> TileImprovement::demand_vec_MWh`

A vector of daily demands [MWh] for the current month.

### 4.13.4.5 dispatch\_backing

`sf::CircleShape TileImprovement::dispatch_backing`

A backing circle for dispatch text illustration.

#### 4.13.4.6 dispatch\_text

```
sf::Text TileImprovement::dispatch_text
```

Text for illustrating dispatch.

#### 4.13.4.7 event\_ptr

```
sf::Event* TileImprovement::event_ptr [protected]
```

A pointer to the event class.

#### 4.13.4.8 frame

```
unsigned long long int TileImprovement::frame
```

The current frame of this object.

#### 4.13.4.9 game\_phase

```
std::string TileImprovement::game_phase
```

The current phase of the game.

#### 4.13.4.10 health

```
int TileImprovement::health
```

The health of the improvement.

#### 4.13.4.11 is\_broken

```
bool TileImprovement::is_broken
```

A boolean which indicated whether or not improvement is broken.

#### 4.13.4.12 is\_running

```
bool TileImprovement::is_running
```

A boolean which indicates whether or not the improvement is running.

#### 4.13.4.13 is\_selected

```
bool TileImprovement::is_selected
```

A boolean which indicates whether or not the tile is selected.

#### 4.13.4.14 just\_built

```
bool TileImprovement::just_built
```

A boolean which indicates that the improvement was just built.

#### 4.13.4.15 just\_upgraded

```
bool TileImprovement::just_upgraded
```

A boolean which indicates that the improvement was just upgraded.

#### 4.13.4.16 message\_hub\_ptr

```
MessageHub* TileImprovement::message_hub_ptr [protected]
```

A pointer to the message hub.

#### 4.13.4.17 month

```
int TileImprovement::month
```

The current month of play.

#### 4.13.4.18 operation\_maintenance\_cost

```
int TileImprovement::operation_maintenance_cost
```

The operation and maintenance costs for this turn.

#### 4.13.4.19 position\_x

```
double TileImprovement::position_x
```

The x position of the tile improvement.

#### 4.13.4.20 position\_y

```
double TileImprovement::position_y
```

The y position of the tile improvement.

#### 4.13.4.21 production\_menu\_backing

```
sf::RectangleShape TileImprovement::production_menu_backing
```

A backing for the production menu.

#### 4.13.4.22 production\_menu\_backing\_text

```
sf::Text TileImprovement::production_menu_backing_text
```

Text for the production menu backing.

#### 4.13.4.23 production\_menu\_open

```
bool TileImprovement::production_menu_open
```

A boolean which indicates whether or not the production menu is open.



#### 4.13.4.24 render\_window\_ptr

```
sf::RenderWindow* TileImprovement::render_window_ptr [protected]
```

A pointer to the render window.

#### 4.13.4.25 storage\_kWh

```
int TileImprovement::storage_kWh
```

The rated energy capacity [kWh] of the storage.

#### 4.13.4.26 storage\_level

```
int TileImprovement::storage_level
```

The level of storage installed alongside the tile improvement.

#### 4.13.4.27 storage\_upgrade\_sprite

```
sf::Sprite TileImprovement::storage_upgrade_sprite
```

A sprite for illustrating storage (in upgrade menu).

#### 4.13.4.28 storage\_upgrade\_sprite\_vec

```
std::vector<sf::Sprite> TileImprovement::storage_upgrade_sprite_vec
```

A vector of sprites for illustrating the storage upgrade level (on tile).

#### 4.13.4.29 tile\_improvement\_sprite\_animated

```
std::vector<sf::Sprite> TileImprovement::tile_improvement_sprite_animated
```

An animated sprite, for the [ContextMenu](#) visual screen.

#### 4.13.4.30 tile\_improvement\_sprite\_static

```
sf::Sprite TileImprovement::tile_improvement_sprite_static
```

A static sprite, for decorating the tile.

#### 4.13.4.31 tile\_improvement\_string

```
std::string TileImprovement::tile_improvement_string
```

A string representation of the tile improvement type.

#### 4.13.4.32 tile\_improvement\_type

```
TileImprovementType TileImprovement::tile_improvement_type
```

The type of the tile improvement.

#### 4.13.4.33 tile\_resource

```
int TileImprovement::tile_resource
```

The renewable resource quality of the tile.

#### 4.13.4.34 tile\_resource\_scalar

```
double TileImprovement::tile_resource_scalar
```

A scalar associated with the renewable resource quality.

#### 4.13.4.35 upgrade\_arrow\_sprite

```
sf::Sprite TileImprovement::upgrade_arrow_sprite
```

An upgrade arrow sprite.

**4.13.4.36 upgrade\_frame**

```
int TileImprovement::upgrade_frame
```

The frame of the upgrade animation.

**4.13.4.37 upgrade\_level**

```
int TileImprovement::upgrade_level
```

The upgrade level of the improvement.

**4.13.4.38 upgrade\_menu\_backing**

```
sf::RectangleShape TileImprovement::upgrade_menu_backing
```

A backing for the upgrade menu.

**4.13.4.39 upgrade\_menu\_backing\_text**

```
sf::Text TileImprovement::upgrade_menu_backing_text
```

Text for the upgrade menu backing.

**4.13.4.40 upgrade\_menu\_open**

```
bool TileImprovement::upgrade_menu_open
```

A boolean which indicates whether or not the build menu is open.

**4.13.4.41 upgrade\_plus\_sprite**

```
sf::Sprite TileImprovement::upgrade_plus_sprite
```

An upgrade plus sprite.

The documentation for this class was generated from the following files:

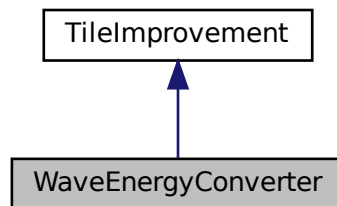
- header/[TileImprovement.h](#)
- source/[TileImprovement.cpp](#)

## 4.14 WaveEnergyConverter Class Reference

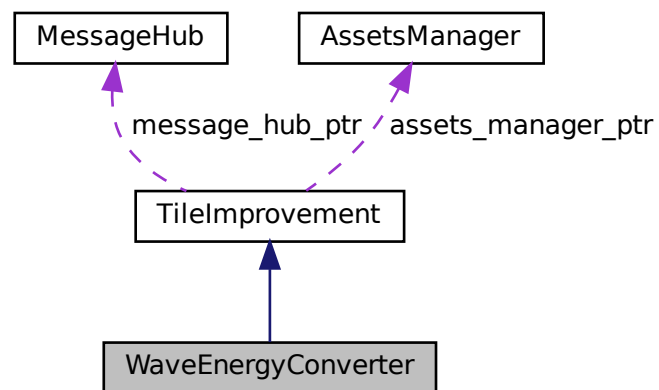
A settlement class (child class of [TileImprovement](#)).

```
#include <WaveEnergyConverter.h>
```

Inheritance diagram for WaveEnergyConverter:



Collaboration diagram for WaveEnergyConverter:



### Public Member Functions

- [WaveEnergyConverter](#) (double, double, int, sf::Event \*, sf::RenderWindow \*, [AssetsManager](#) \*, [MessageHub](#) \*)  
*Constructor for the [WaveEnergyConverter](#) class.*
- std::string [getTileOptionsSubstring](#) (void)  
*Helper method to assemble and return tile options substring.*
- void [setIsSelected](#) (bool)  
*Method to set the is selected attribute.*

- void [advanceTurn](#) (void)  
*Method to handle turn advance.*
- void [update](#) (void)  
*Method to trigger production and dispatchable updates.*
- void [processEvent](#) (void)  
*Method to process [WaveEnergyConverter](#). To be called once per event.*
- void [processMessage](#) (void)  
*Method to process [WaveEnergyConverter](#). To be called once per message.*
- void [draw](#) (void)  
*Method to draw the hex tile to the render window. To be called once per frame.*
- virtual [~WaveEnergyConverter](#) (void)  
*Destructor for the [WaveEnergyConverter](#) class.*

## Public Attributes

- int [capacity\\_kW](#)  
*The rated production capacity [kW] of the solar PV array.*
- int [production\\_MWh](#)  
*The current production [MWh] of the solar PV array.*
- int [dispatch\\_MWh](#)  
*The current dispatch [MWh] of the solar PV array.*
- int [dispatchable\\_MWh](#)  
*The amount of production that is directly dispatchable to the grid (i.e. production correlated with demand).*
- double [max\\_daily\\_production\\_MWh](#)  
*The maximum daily production [MWh] of the solar PV array.*
- double [bobbing\\_y](#)  
*The bobbing extent of the wave energy converter.*
- std::vector< double > [capacity\\_factor\\_vec](#)  
*A vector of daily capacity factors for the current month.*
- std::vector< double > [production\\_vec\\_MWh](#)  
*A vector of daily production [MWh] for the current month.*
- std::vector< double > [dispatch\\_vec\\_MWh](#)  
*A vector of daily dispatch [MWh] for the current month.*

## Private Member Functions

- void [\\_\\_setUpTileImprovementSpriteAnimated](#) (void)  
*Helper method to set up tile improvement sprite (static).*
- void [\\_\\_drawProductionMenu](#) (void)  
*Helper method to draw production menu assets.*
- void [\\_\\_upgradePowerCapacity](#) (void)  
*Helper method to upgrade power capacity.*
- void [\\_\\_computeProductionCosts](#) (void)  
*Helper method to compute production costs (O&M) based on current production level.*
- void [\\_\\_breakdown](#) (void)  
*Helper method to trigger an equipment breakdown.*
- void [\\_\\_repair](#) (void)  
*Helper method to repair the wave energy converter.*
- void [\\_\\_computeCapacityFactors](#) (void)

- Helper method to compute capacity factors.*
- void [\\_\\_computeProduction](#) (void)
- Helper method to compute production values.*
- void [\\_\\_computeDispatch](#) (void)
- Helper method to compute dispatch values.*
- void [\\_\\_handleKeyPressEvents](#) (void)
- Helper method to handle key press events.*
- void [\\_\\_handleMouseButtonEvents](#) (void)
- Helper method to handle mouse button events.*
- void [\\_\\_drawUpgradeOptions](#) (void)
- Helper method to set up and draw upgrade options.*
- void [\\_\\_sendImprovementStateMessage](#) (void)
- Helper method to format and sent improvement state message.*

## Additional Inherited Members

### 4.14.1 Detailed Description

A settlement class (child class of [TileImprovement](#)).

### 4.14.2 Constructor & Destructor Documentation

#### 4.14.2.1 WaveEnergyConverter()

```
WaveEnergyConverter::WaveEnergyConverter (
    double position_x,
    double position_y,
    int tile_resource,
    sf::Event * event_ptr,
    sf::RenderWindow * render_window_ptr,
    AssetsManager * assets_manager_ptr,
    MessageHub * message_hub_ptr )
```

Constructor for the [WaveEnergyConverter](#) class.

Ref: [Wikipedia](#) [2023]

#### Parameters

<i>position_x</i>	The x position of the tile.
<i>position_y</i>	The y position of the tile.
<i>tile_resource</i>	The renewable resource quality of the tile.
<i>event_ptr</i>	Pointer to the event class.
<i>render_window_ptr</i>	Pointer to the render window.
<i>assets_manager_ptr</i>	Pointer to the assets manager.
<i>message_hub_ptr</i>	Pointer to the message hub.

```

763 :
764 TileImprovement (
765     position_x,
766     position_y,
767     tile_resource,
768     event_ptr,
769     render_window_ptr,
770     assets_manager_ptr,
771     message_hub_ptr
772 )
773 {
774     // 1. set attributes
775
776     // 1.1. private
777     //...
778
779     // 1.2. public
780     this->tile_improvement_type = TileImprovementType :: WAVE_ENERGY_CONVERTER;
781
782     this->is_running = false;
783
784     this->health = 100;
785
786     this->capacity_kW = 100;
787     this->upgrade_level = 1;
788
789     this->storage_kWh = 0;
790     this->storage_level = 0;
791
792     this->production_MWh = 0;
793     this->dispatch_MWh = 0;
794     this->dispatchable_MWh = 0;
795
796     this->max_daily_production_MWh = (double)(24 * this->capacity_kW) / 1000;
797
798     this->bobbing_y = 4;
799
800     this->capacity_factor_vec.resize(30, 0);
801     this->production_vec_MWh.resize(30, 0);
802     this->dispatch_vec_MWh.resize(30, 0);
803
804     this->tile_improvement_string = "WAVE ENERGY";
805
806     this->__setUpTileImprovementSpriteAnimated();
807     this->__computeCapacityFactors();
808     this->update();
809
810     std::cout << "WaveEnergyConverter constructed at " << this << std::endl;
811
812     return;
813 } /* WaveEnergyConverter() */

```

#### 4.14.2.2 ~WaveEnergyConverter()

```

WaveEnergyConverter::~WaveEnergyConverter (
    void ) [virtual]

```

Destructor for the [WaveEnergyConverter](#) class.

```

1182 {
1183     std::cout << "WaveEnergyConverter at " << this << " destroyed" << std::endl;
1184
1185     return;
1186 } /* ~WaveEnergyConverter() */

```

#### 4.14.3 Member Function Documentation

#### 4.14.3.1 \_\_breakdown()

```
void WaveEnergyConverter::__breakdown (
    void ) [private]
```

Helper method to trigger an equipment breakdown.

```
250 {
251     TileImprovement :: __breakdown();
252
253     this->production_MWh = 0;
254     this->dispatch_MWh = 0;
255     this->dispatchable_MWh = 0;
256     this->operation_maintenance_cost = 0;
257
258     return;
259 } /* __breakdown() */
```

#### 4.14.3.2 \_\_computeCapacityFactors()

```
void WaveEnergyConverter::__computeCapacityFactors (
    void ) [private]
```

Helper method to compute capacity factors.

```
307 {
308     unsigned seed = std::chrono::system_clock::now().time_since_epoch().count();
309     std::default_random_engine generator(seed);
310
311     double mean =
312         this->tile_resource_scalar * MEAN_DAILY_WAVE_CAPACITY_FACTORS[this->month - 1];
313
314     double stdev = STDEV_DAILY_WAVE_CAPACITY_FACTORS[this->month - 1];
315
316     if (this->tile_resource_scalar > 1) {
317         stdev /= this->tile_resource_scalar;
318     }
319
320     std::normal_distribution<double> normal_dist(mean, stdev);
321
322     double capacity_factor = 0;
323
324     for (int i = 0; i < 30; i++) {
325         capacity_factor = normal_dist(generator);
326
327         if (capacity_factor < 0) {
328             capacity_factor = 0;
329         }
330
331         this->capacity_factor_vec[i] = capacity_factor;
332     }
333
334     return;
335 } /* __computeCapacityFactors() */
```

#### 4.14.3.3 \_\_computeDispatch()

```
void WaveEnergyConverter::__computeDispatch (
    void ) [private]
```

Helper method to compute dispatch values.

```
378 {
379     double stored_energy_MWh = 0;
380     double storage_capacity_MWh = (double)(this->storage_kWh) / 1000;
381
382     double demand_MWh = 0;
383     double production_MWh = 0;
384     double dispatchable_MWh = 0;
```



```

385     double difference_MWh = 0;
386
387     double room_MWh = 0;
388
389     for (int i = 0; i < 30; i++) {
390         demand_MWh = this->demand_vec_MWh[i];
391         production_MWh = this->production_vec_MWh[i];
392
393         if (production_MWh <= demand_MWh) {
394             this->dispatch_vec_MWh[i] = production_MWh;
395             dispatchable_MWh += this->dispatch_vec_MWh[i];
396
397             difference_MWh = demand_MWh - production_MWh;
398
399             if ((storage_capacity_MWh > 0) and (stored_energy_MWh > 0)) {
400                 if (difference_MWh > stored_energy_MWh) {
401                     this->dispatch_vec_MWh[i] += stored_energy_MWh;
402                     dispatchable_MWh += stored_energy_MWh;
403                     stored_energy_MWh = 0;
404                 }
405
406                 else {
407                     this->dispatch_vec_MWh[i] += difference_MWh;
408                     dispatchable_MWh += difference_MWh;
409                     stored_energy_MWh -= difference_MWh;
410                 }
411             }
412         }
413
414         else {
415             this->dispatch_vec_MWh[i] = demand_MWh;
416             dispatchable_MWh += this->dispatch_vec_MWh[i];
417
418             difference_MWh = production_MWh - demand_MWh;
419
420             if (
421                 (storage_capacity_MWh > 0) and
422                 (stored_energy_MWh < storage_capacity_MWh)
423             ) {
424                 room_MWh = storage_capacity_MWh - stored_energy_MWh;
425
426                 if (difference_MWh > room_MWh) {
427                     stored_energy_MWh += room_MWh;
428                 }
429
430                 else {
431                     stored_energy_MWh += difference_MWh;
432                 }
433             }
434         }
435     }
436
437     this->dispatchable_MWh = round(dispatchable_MWh);
438
439     if (this->dispatch_MWh != this->dispatchable_MWh) {
440         this->dispatch_MWh = this->dispatchable_MWh;
441     }
442
443     return;
444 } /* __computeDispatch() */

```

#### 4.14.3.4 \_\_computeProduction()

```

void WaveEnergyConverter::__computeProduction (
    void ) [private]

```

Helper method to compute production values.

```

350 {
351     double production_MWh = 0;
352
353     for (int i = 0; i < 30; i++) {
354         this->production_vec_MWh[i] =
355             this->max_daily_production_MWh * this->capacity_factor_vec[i];
356
357         production_MWh += this->production_vec_MWh[i];
358     }
359
360     this->production_MWh = round(production_MWh);

```

```

361
362     return;
363 } /* __computeProduction() */

```

#### 4.14.3.5 \_\_computeProductionCosts()

```

void WaveEnergyConverter::__computeProductionCosts (
    void ) [private]

```

Helper method to compute production costs (O&M) based on current production level.

```

229 {
230     double operation_maintenance_cost =
231         (this->production_MWh * WAVE_OP_MAINT_COST_PER_MWH_PRODUCTION) / 1000;
232     this->operation_maintenance_cost = round(operation_maintenance_cost);
233
234     return;
235 } /* __computeProductionCosts() */

```

#### 4.14.3.6 \_\_drawProductionMenu()

```

void WaveEnergyConverter::__drawProductionMenu (
    void ) [private]

```

Helper method to draw production menu assets.

```

114 {
115     // 1. draw static sprite
116     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
117         sf::Vector2f initial_position = this->tile_improvement_sprite_animated[i].getPosition();
118         this->tile_improvement_sprite_animated[i].setPosition(400 - 138, 400 + 16);
119
120         sf::Color initial_colour = this->tile_improvement_sprite_animated[i].getColor();
121         this->tile_improvement_sprite_animated[i].setColor(sf::Color(255, 255, 255, 255));
122
123         sf::Vector2f initial_scale = this->tile_improvement_sprite_animated[i].getScale();
124         this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1, 1));
125
126         double initial_rotation = this->tile_improvement_sprite_animated[i].getRotation();
127         this->tile_improvement_sprite_animated[i].setRotation(0);
128
129         this->render_window_ptr->draw(this->tile_improvement_sprite_animated[i]);
130
131         this->tile_improvement_sprite_animated[i].setPosition(initial_position);
132         this->tile_improvement_sprite_animated[i].setColor(initial_colour);
133         this->tile_improvement_sprite_animated[i].setScale(initial_scale);
134         this->tile_improvement_sprite_animated[i].setRotation(initial_rotation);
135     }
136
137     // 2. draw production text
138     std::string production_string = "[W]: INCREASE DISPATCH\n";
139     production_string += "[S]: DECREASE DISPATCH\n";
140     production_string += "\n";
141
142     production_string += "DISPATCH: ";
143     production_string += std::to_string(this->dispatch_MWh);
144     production_string += " MWh (MAX ";
145     production_string += std::to_string(this->dispatchable_MWh);
146     production_string += ")\n";
147
148     production_string += "O&M COST: ";
149     production_string += std::to_string(this->operation_maintenance_cost);
150     production_string += " K\n";
151
152     sf::Text production_text(
153         production_string,
154         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
155         16
156     );
157
158     production_text.setOrigin(production_text.getLocalBounds().width / 2, 0);

```

```

159     production_text.setFillColor(MONOCROME_TEXT_GREEN);
160
161     production_text.setPosition(400 + 30, 400 - 45);
162
163     this->render_window_ptr->draw(production_text);
164
165     return;
166 } /* __drawProductionMenu() */

```

#### 4.14.3.7 \_\_drawUpgradeOptions()

```

void WaveEnergyConverter::__drawUpgradeOptions (
    void ) [private]

```

Helper method to set up and draw upgrade options.

```

584 {
585     // 1. draw power capacity upgrade sprite
586     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
587         sf::Vector2f initial_position = this->tile_improvement_sprite_animated[i].getPosition();
588         this->tile_improvement_sprite_animated[i].setPosition(400 - 100, 400 - 32 - 20);
589
590         sf::Color initial_colour = this->tile_improvement_sprite_animated[i].getColor();
591         this->tile_improvement_sprite_animated[i].setColor(sf::Color(255, 255, 255, 255));
592
593         sf::Vector2f initial_scale = this->tile_improvement_sprite_animated[i].getScale();
594         this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1, 1));
595
596         this->render_window_ptr->draw(this->tile_improvement_sprite_animated[i]);
597
598         this->tile_improvement_sprite_animated[i].setPosition(initial_position);
599         this->tile_improvement_sprite_animated[i].setColor(initial_colour);
600         this->tile_improvement_sprite_animated[i].setScale(initial_scale);
601     }
602
603     this->render_window_ptr->draw(this->upgrade_arrow_sprite);
604
605
606     // 2. draw power capacity upgrade text
607     // 16 char line = "\n"
608     std::string power_upgrade_string = "POWER CAPACITY \n";
609     power_upgrade_string += "\n";
610
611     power_upgrade_string += "CAPACITY: ";
612     power_upgrade_string += std::to_string(this->capacity_kW);
613     power_upgrade_string += " kW\n";
614
615     power_upgrade_string += "LEVEL: ";
616     power_upgrade_string += std::to_string(this->upgrade_level);
617     power_upgrade_string += "\n\n";
618
619     if (this->upgrade_level < MAX_UPGRADE_LEVELS) {
620         power_upgrade_string += "[W]: + 100 kW (";
621         power_upgrade_string += std::to_string(WAVE_ENERGY_CONVERTER_BUILD_COST);
622         power_upgrade_string += " K)\n";
623     }
624
625     else {
626         power_upgrade_string += " * MAX LEVEL * \n";
627     }
628
629     sf::Text power_upgrade_text = sf::Text(
630         power_upgrade_string,
631         * (this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
632         16
633     );
634
635     power_upgrade_text.setOrigin(power_upgrade_text.getLocalBounds().width / 2, 0);
636     power_upgrade_text.setPosition(400 - 100, 400 - 32 + 16);
637     power_upgrade_text.setFillColor(MONOCROME_TEXT_GREEN);
638
639     this->render_window_ptr->draw(power_upgrade_text);
640
641
642     // 3. draw energy capacity (storage) upgrade sprite
643     this->render_window_ptr->draw(this->storage_upgrade_sprite);
644     this->render_window_ptr->draw(this->upgrade_plus_sprite);
645
646

```

```

647 // 4. draw energy capacity (storage) upgrade text
648 // 16 char line = " \n"
649 std::string energy_upgrade_string = "ENERGY CAPACITY \n";
650 energy_upgrade_string += " \n";
651
652 energy_upgrade_string += "CAPACITY: ";
653 energy_upgrade_string += std::to_string(this->storage_level * 200);
654 energy_upgrade_string += " kWh\n";
655
656 energy_upgrade_string += "LEVEL: ";
657 energy_upgrade_string += std::to_string(this->storage_level);
658 energy_upgrade_string += "\n\n";
659
660 if (this->storage_level < MAX_STORAGE_LEVELS) {
661     energy_upgrade_string += "[D]: + 200 kWh (";
662     energy_upgrade_string += std::to_string(ENERGY_STORAGE_SYSTEM_BUILD_COST);
663     energy_upgrade_string += " K)\n";
664 }
665
666 else {
667     energy_upgrade_string += " * MAX LEVEL * \n";
668 }
669
670 sf::Text energy_upgrade_text = sf::Text(
671     energy_upgrade_string,
672     *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
673     16
674 );
675
676 energy_upgrade_text.setOrigin(energy_upgrade_text.getLocalBounds().width / 2, 0);
677 energy_upgrade_text.setPosition(400 + 100, 400 - 32 + 16);
678 energy_upgrade_text.setFillColor(MONOCHROME_TEXT_GREEN);
679
680 this->render_window_ptr->draw(energy_upgrade_text);
681
682 return;
683 } /* __drawUpgradeOptions() */

```

#### 4.14.3.8 \_\_handleKeyPressEvents()

```

void WaveEnergyConverter::__handleKeyPressEvents (
    void ) [private]

```

Helper method to handle key press events.

```

459 {
460     if (this->just_built) {
461         return;
462     }
463
464     switch (this->event_ptr->key.code) {
465         case (sf::Keyboard::U): {
466             this->__openUpgradeMenu();
467
468             break;
469         }
470
471         case (sf::Keyboard::W): {
472             if (this->production_menu_open) {
473                 this->dispatch_MWh++;
474
475                 if (this->dispatch_MWh > this->dispatchable_MWh) {
476                     this->dispatch_MWh = 0;
477                 }
478
479                 this->__computeProductionCosts();
480                 this->assets_manager_ptr->getSound("interface click")->play();
481             }
482
483             else if (this->upgrade_menu_open) {
484                 this->__upgradePowerCapacity();
485             }
486
487             break;
488         }
489     }
490
491     case (sf::Keyboard::S): {

```

```

493         if (this->production_menu_open) {
494             this->dispatch_MWh--;
495
496             if (this->dispatch_MWh < 0) {
497                 this->dispatch_MWh = this->dispatchable_MWh;
498             }
499
500             this->__computeProductionCosts();
501             this->assets_manager_ptr->getSound("interface click")->play();
502         }
503
504         break;
505     }
506
507
508     case (sf::Keyboard::D): {
509         if (this->upgrade_menu_open) {
510             this->__upgradeStorageCapacity();
511             this->__computeProduction();
512             this->__computeDispatch();
513         }
514
515         break;
516     }
517
518     default: {
519         // do nothing!
520
521         break;
522     }
523 }
524 }
525
526 return;
527 } /* __handleKeyPressEvents() */

```

#### 4.14.3.9 \_\_handleMouseButtonEvents()

```

void WaveEnergyConverter::__handleMouseButtonEvents (
    void ) [private]

```

Helper method to handle mouse button events.

```

542 {
543     if (this->just_built) {
544         return;
545     }
546     switch (this->event_ptr->mouseButton.button) {
547         case (sf::Mouse::Left): {
548             //...
549
550             break;
551         }
552
553         case (sf::Mouse::Right): {
554             //...
555
556             break;
557         }
558     }
559
560     default: {
561         // do nothing!
562
563         break;
564     }
565 }
566 }
567
568 return;
569 } /* __handleMouseButtonEvents() */

```

#### 4.14.3.10 \_\_repair()

```
void WaveEnergyConverter::__repair (
    void ) [private], [virtual]
```

Helper method to repair the wave energy converter.

Reimplemented from [TileImprovement](#).

```
274 {
275     if (this->credits < WAVE_ENERGY_CONVERTER_BUILD_COST) {
276         std::cout << "Cannot repair wave energy converter: insufficient credits (need "
277             << WAVE_ENERGY_CONVERTER_BUILD_COST << " K)" << std::endl;
278
279         this->__sendInsufficientCreditsMessage();
280         return;
281     }
282
283     TileImprovement :: __repair();
284
285     this->just_upgraded = true;
286
287     this->__sendCreditsSpentMessage(WAVE_ENERGY_CONVERTER_BUILD_COST);
288     this->__sendTileStateRequest();
289     this->__sendGameStateRequest();
290
291     return;
292 } /* __repair() */
```

#### 4.14.3.11 \_\_sendImprovementStateMessage()

```
void WaveEnergyConverter::__sendImprovementStateMessage (
    void ) [private]
```

Helper method to format and sent improvement state message.

```
698 {
699     Message improvement_state_message;
700
701     improvement_state_message.channel = GAME_CHANNEL;
702     improvement_state_message.subject = "improvement state";
703
704     improvement_state_message.int_payload["dispatch_MWh"] = this->dispatch_MWh;
705     improvement_state_message.int_payload["operation_maintenance_cost"] =
706         this->operation_maintenance_cost;
707
708     this->message_hub_ptr->sendMessage(improvement_state_message);
709
710     std::cout << "Improvement state message sent by " << this << std::endl;
711
712     return;
713 } /* __sendImprovementStateMessage() */
```

#### 4.14.3.12 \_\_setUpTileImprovementSpriteAnimated()

```
void WaveEnergyConverter::__setUpTileImprovementSpriteAnimated (
    void ) [private]
```

Helper method to set up tile improvement sprite (static).

```
68 {
69     sf::Sprite diesel_generator_sheet (
70         *(this->assets_manager_ptr->getTexture("wave energy converter"))
71     );
72
73     int n_elements = diesel_generator_sheet.getLocalBounds().height / 64;
74
75     for (int i = 0; i < n_elements; i++) {
```

```

76         this->tile_improvement_sprite_animated.push_back(
77             sf::Sprite(
78                 *(this->assets_manager_ptr->getTexture("wave energy converter")),
79                 sf::IntRect(0, i * 64, 64, 64)
80             )
81         );
82
83         this->tile_improvement_sprite_animated.back().setOrigin(
84             this->tile_improvement_sprite_animated.back().getLocalBounds().width / 2,
85             this->tile_improvement_sprite_animated.back().getLocalBounds().height
86         );
87
88         this->tile_improvement_sprite_animated.back().setPosition(
89             this->position_x,
90             this->position_y - 32
91         );
92
93         this->tile_improvement_sprite_animated.back().setColor(
94             sf::Color(255, 255, 255, 0)
95         );
96     }
97
98     return;
99 } /* __setUpTileImprovementSpriteAnimated() */

```

#### 4.14.3.13 \_\_upgradePowerCapacity()

```

void WaveEnergyConverter::__upgradePowerCapacity (
    void ) [private]

```

Helper method to upgrade power capacity.

```

181 {
182     if (this->credits < WAVE_ENERGY_CONVERTER_BUILD_COST) {
183         std::cout << "Cannot upgrade wave energy converter: insufficient credits (need "
184             << WAVE_ENERGY_CONVERTER_BUILD_COST << " K)" << std::endl;
185
186         this->__sendInsufficientCreditsMessage();
187         return;
188     }
189
190     if (this->upgrade_level >= MAX_UPGRADE_LEVELS) {
191         return;
192     }
193
194     TileImprovement :: __repair();
195
196     this->capacity_kW += 100;
197     this->upgrade_level++;
198
199     this->max_daily_production_MWh = (double)(24 * this->capacity_kW) / 1000;
200
201     this->__computeProduction();
202     this->__computeDispatch();
203
204     this->just_upgraded = true;
205
206     this->assets_manager_ptr->getSound("upgrade")->play();
207
208     this->__sendCreditsSpentMessage(WAVE_ENERGY_CONVERTER_BUILD_COST);
209     this->__sendTileStateRequest();
210     this->__sendGameStateRequest();
211
212     return;
213 } /* __upgradePowerCapacity() */

```

#### 4.14.3.14 advanceTurn()

```

void WaveEnergyConverter::advanceTurn (
    void ) [virtual]

```

Method to handle turn advance.

Reimplemented from [TileImprovement](#).

```

918 {
919     // 1. send improvement state message
920     this->__sendImprovementStateMessage();
921
922     // 2. update
923     this->__computeCapacityFactors();
924     this->update();
925
926     // 3. handle start/stop
927     if ((not this->is_running) and (this->dispatch_MWh > 0)) {
928         this->is_running = true;
929     }
930
931     else if (this->is_running and (this->dispatch_MWh <= 0)) {
932         this->is_running = false;
933     }
934
935     // 4. handle equipment health
936     if (this->is_running) {
937         this->health--;
938
939         if (this->health <= 0) {
940             this->__breakdown();
941         }
942     }
943
944     // 5. send tile state request (if selected)
945     if (this->is_selected) {
946         this->__sendTileStateRequest();
947     }
948
949     return;
950 } /* advanceTurn() */

```

#### 4.14.3.15 draw()

```

void WaveEnergyConverter::draw (
    void ) [virtual]

```

Method to draw the hex tile to the render window. To be called once per frame.

Reimplemented from [TileImprovement](#).

```

1039 {
1040     // 1. if just built, call base method and return
1041     if (this->just_built) {
1042         TileImprovement :: draw();
1043
1044         return;
1045     }
1046
1047
1048     // 2. handle upgrade effects
1049     if (this->just_upgraded) {
1050         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
1051             this->tile_improvement_sprite_animated[i].setColor(
1052                 sf::Color(
1053                     255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
1054                     255,
1055                     255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
1056                     255
1057                 )
1058             );
1059
1060             this->tile_improvement_sprite_animated[i].setScale(
1061                 sf::Vector2f(
1062                     1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
1063                     1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2)
1064                 )
1065             );
1066         }
1067
1068         this->upgrade_frame++;
1069     }

```



```

1070
1071     if (this->upgrade_frame >= 2 * FRAMES_PER_SECOND) {
1072         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
1073             this->tile_improvement_sprite_animated[i].setColor(
1074                 sf::Color(255,255,255,255)
1075             );
1076             this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1,1));
1077         }
1078
1079         this->just_upgraded = false;
1080         this->upgrade_frame = 0;
1081     }
1082 }
1083
1084
1085 // 3. draw first element of animated sprite
1086 this->render_window_ptr->draw(this->tile_improvement_sprite_animated[0]);
1087
1088
1089 // 4. draw second element of animated sprite
1090 if (this->is_running) {
1091     this->tile_improvement_sprite_animated[0].setPosition(
1092         this->position_x,
1093         this->position_y + this->bobbing_y * cos(
1094             (double)(0.4 * M_PI * this->frame) / FRAMES_PER_SECOND
1095         )
1096     );
1097
1098     this->tile_improvement_sprite_animated[1].setPosition(
1099         this->position_x,
1100         this->position_y + 1.25 * this->bobbing_y * sin(
1101             (double)(0.4 * M_PI * this->frame) / FRAMES_PER_SECOND
1102         )
1103     );
1104 }
1105
1106 else {
1107     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
1108         this->tile_improvement_sprite_animated[i].setPosition(
1109             this->position_x,
1110             this->position_y + this->bobbing_y * cos(
1111                 (double)(0.4 * M_PI * this->frame) / FRAMES_PER_SECOND
1112             )
1113         );
1114     }
1115 }
1116
1117 this->render_window_ptr->draw(this->tile_improvement_sprite_animated[1]);
1118
1119
1120 // 5. draw storage upgrades
1121 for (size_t i = 0; i < this->storage_upgrade_sprite_vec.size(); i++) {
1122     this->render_window_ptr->draw(this->storage_upgrade_sprite_vec[i]);
1123 }
1124
1125
1126 // 6. handle dispatch illustration
1127 if (this->dispatch_MWh > 0) {
1128     this->dispatch_text.setString(std::to_string(this->dispatch_MWh));
1129     this->__drawDispatch();
1130 }
1131
1132
1133 // 7. draw production menu
1134 if (this->production_menu_open) {
1135     this->render_window_ptr->draw(this->production_menu_backing);
1136     this->render_window_ptr->draw(this->production_menu_backing_text);
1137
1138     this->__drawProductionMenu();
1139 }
1140
1141
1142 // 8. draw upgrade menu
1143 if (this->upgrade_menu_open) {
1144     this->render_window_ptr->draw(this->upgrade_menu_backing);
1145     this->render_window_ptr->draw(this->upgrade_menu_backing_text);
1146
1147     this->__drawUpgradeOptions();
1148 }
1149
1150
1151 // 9. handle broken effects
1152 if (this->is_broken) {
1153     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
1154         this->tile_improvement_sprite_animated[i].setColor(
1155             sf::Color(
1156                 255,

```

```

1157             255 * pow(cos((M_PI * this->frame) / FRAMES_PER_SECOND), 2),
1158             255 * pow(cos((M_PI * this->frame) / FRAMES_PER_SECOND), 2),
1159             255
1160         )
1161     );
1162 }
1163 }
1164
1165     this->frame++;
1166     return;
1167 } /* draw() */

```

#### 4.14.3.16 getTileOptionsSubstring()

```

std::string WaveEnergyConverter::getTileOptionsSubstring (
    void ) [virtual]

```

Helper method to assemble and return tile options substring.

#### Returns

Tile options substring.

Reimplemented from [TileImprovement](#).

```

830 {
831     //          32 char x 17 line console "-----\n";
832     std::string options_substring = "CAPACITY: ";
833     options_substring += std::to_string(this->capacity_kW);
834     options_substring += " kW (level ";
835     options_substring += std::to_string(this->upgrade_level);
836     options_substring += ")\n";
837
838     options_substring += "PRODUCTION: ";
839     options_substring += std::to_string(this->production_MWh);
840     options_substring += " MWh\n";
841
842     options_substring += "DISPATCHABLE: ";
843     options_substring += std::to_string(this->dispatchable_MWh);
844     options_substring += " MWh\n";
845
846     options_substring += "HEALTH: ";
847     options_substring += std::to_string(this->health);
848     options_substring += "/100";
849
850     if (this->health <= 0) {
851         options_substring += " ** BROKEN! **\n";
852     }
853
854     else {
855         options_substring += "\n";
856     }
857
858     options_substring += "
859     options_substring += " **** WAVE ENERGY OPTIONS ****
860     options_substring += "
861
862     if (this->is_broken) {
863         options_substring += " [R]: REPAIR ";
864         options_substring += std::to_string(WAVE_ENERGY_CONVERTER_BUILD_COST);
865         options_substring += " K)\n";
866     }
867
868     else {
869         options_substring += " [E]: OPEN PRODUCTION MENU \n";
870     }
871
872     options_substring += " [U]: OPEN UPGRADE MENU \n";
873     options_substring += "HOLD [P]: SCRAP ";
874     options_substring += std::to_string(SCRAP_COST);
875     options_substring += " K)";
876
877     return options_substring;
878 } /* getTileOptionsSubstring() */

```

**4.14.3.17 processEvent()**

```
void WaveEnergyConverter::processEvent (
    void ) [virtual]
```

Method to process [WaveEnergyConverter](#). To be called once per event.

Reimplemented from [TileImprovement](#).

```
990 {
991     TileImprovement :: processEvent();
992
993     if (this->event_ptr->type == sf::Event::KeyPressed) {
994         this->__handleKeyPressEvents();
995     }
996
997     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
998         this->__handleMouseButtonEvents();
999     }
1000
1001     return;
1002 } /* processEvent() */
```

**4.14.3.18 processMessage()**

```
void WaveEnergyConverter::processMessage (
    void ) [virtual]
```

Method to process [WaveEnergyConverter](#). To be called once per message.

Reimplemented from [TileImprovement](#).

```
1017 {
1018     TileImprovement :: processMessage();
1019
1020     //...
1021
1022     return;
1023 } /* processMessage() */
```

**4.14.3.19 setIsSelected()**

```
void WaveEnergyConverter::setIsSelected (
    bool is_selected ) [virtual]
```

Method to set the is selected attribute.

**Parameters**

<i>is_selected</i>	The value to set the is selected attribute to.
--------------------	--

Reimplemented from [TileImprovement](#).

```
895 {
896     TileImprovement :: setIsSelected(is_selected);
897
898     if (this->is_running and this->is_selected) {
899         this->assets_manager_ptr->getSound("ocean waves")->play();
900     }
901 }
```

```
902     return;  
903 } /* setIsSelected() */
```

#### 4.14.3.20 update()

```
void WaveEnergyConverter::update (  
    void ) [virtual]
```

Method to trigger production and dispatchable updates.

Reimplemented from [TileImprovement](#).

```
965 {  
966     this->__computeProduction();  
967     this->__computeProductionCosts();  
968     this->__computeDispatch();  
969  
970     if (this->is_selected) {  
971         this->__sendTileStateRequest();  
972     }  
973  
974     return;  
975 } /* update() */
```

### 4.14.4 Member Data Documentation

#### 4.14.4.1 bobbing\_y

```
double WaveEnergyConverter::bobbing_y
```

The bobbing extent of the wave energy converter.

#### 4.14.4.2 capacity\_factor\_vec

```
std::vector<double> WaveEnergyConverter::capacity_factor_vec
```

A vector of daily capacity factors for the current month.

#### 4.14.4.3 capacity\_kW

```
int WaveEnergyConverter::capacity_kW
```

The rated production capacity [kW] of the solar PV array.

#### 4.14.4.4 dispatch\_MWh

```
int WaveEnergyConverter::dispatch_MWh
```

The current dispatch [MWh] of the solar PV array.

#### 4.14.4.5 dispatch\_vec\_MWh

```
std::vector<double> WaveEnergyConverter::dispatch_vec_MWh
```

A vector of daily dispatch [MWh] for the current month.

#### 4.14.4.6 dispatchable\_MWh

```
int WaveEnergyConverter::dispatchable_MWh
```

The amount of production that is directly dispatchable to the grid (i.e. production correlated with demand).

#### 4.14.4.7 max\_daily\_production\_MWh

```
double WaveEnergyConverter::max_daily_production_MWh
```

The maximum daily production [MWh] of the solar PV array.

#### 4.14.4.8 production\_MWh

```
int WaveEnergyConverter::production_MWh
```

The current production [MWh] of the solar PV array.

#### 4.14.4.9 production\_vec\_MWh

```
std::vector<double> WaveEnergyConverter::production_vec_MWh
```

A vector of daily production [MWh] for the current month.

The documentation for this class was generated from the following files:

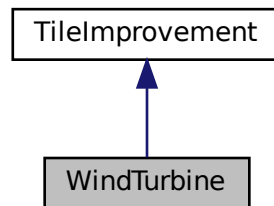
- header/[WaveEnergyConverter.h](#)
- source/[WaveEnergyConverter.cpp](#)

## 4.15 WindTurbine Class Reference

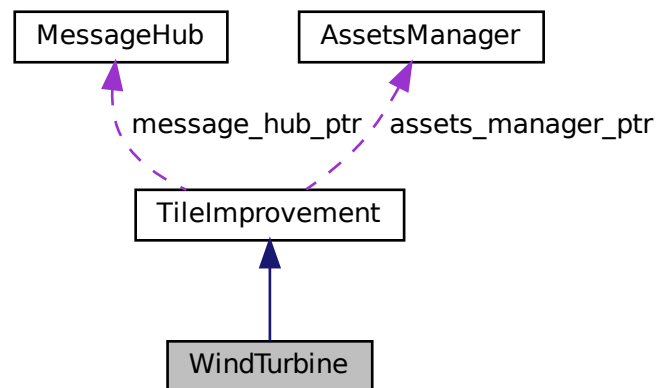
A settlement class (child class of [TileImprovement](#)).

```
#include <WindTurbine.h>
```

Inheritance diagram for WindTurbine:



Collaboration diagram for WindTurbine:



### Public Member Functions

- [WindTurbine](#) (double, double, int, sf::Event \*, sf::RenderWindow \*, [AssetsManager](#) \*, [MessageHub](#) \*)  
*Constructor for the [WindTurbine](#) class.*
- std::string [getTileOptionsSubstring](#) (void)  
*Helper method to assemble and return tile options substring.*
- void [setIsSelected](#) (bool)  
*Method to set the is selected attribute.*
- void [advanceTurn](#) (void)

- *Method to handle turn advance.*
- void [update](#) (void)
- *Method to trigger production and dispatchable updates.*
- void [processEvent](#) (void)
- *Method to process [WindTurbine](#). To be called once per event.*
- void [processMessage](#) (void)
- *Method to process [WindTurbine](#). To be called once per message.*
- void [draw](#) (void)
- *Method to draw the hex tile to the render window. To be called once per frame.*
- virtual [~WindTurbine](#) (void)
- *Destructor for the [WindTurbine](#) class.*

## Public Attributes

- int [capacity\\_kW](#)
- *The rated production capacity [kW] of the solar PV array.*
- int [production\\_MWh](#)
- *The current production [MWh] of the solar PV array.*
- int [dispatch\\_MWh](#)
- *The current dispatch [MWh] of the solar PV array.*
- int [dispatchable\\_MWh](#)
- *The amount of production that is directly dispatchable to the grid (i.e. production correlated with demand).*
- double [max\\_daily\\_production\\_MWh](#)
- *The maximum daily production [MWh] of the solar PV array.*
- double [rotor\\_drotation](#)
- *The rotation rate of the rotor.*
- std::vector< double > [capacity\\_factor\\_vec](#)
- *A vector of daily capacity factors for the current month.*
- std::vector< double > [production\\_vec\\_MWh](#)
- *A vector of daily production [MWh] for the current month.*
- std::vector< double > [dispatch\\_vec\\_MWh](#)
- *A vector of daily dispatch [MWh] for the current month.*

## Private Member Functions

- void [\\_\\_setUpTileImprovementSpriteAnimated](#) (void)
- *Helper method to set up tile improvement sprite (static).*
- void [\\_\\_drawProductionMenu](#) (void)
- *Helper method to draw production menu assets.*
- void [\\_\\_upgradePowerCapacity](#) (void)
- *Helper method to upgrade the power capacity.*
- void [\\_\\_computeProductionCosts](#) (void)
- *Helper method to compute production costs (O&M) based on current production level.*
- void [\\_\\_breakdown](#) (void)
- *Helper method to trigger an equipment breakdown.*
- void [\\_\\_repair](#) (void)
- *Helper method to repair the wind turbine.*
- void [\\_\\_computeCapacityFactors](#) (void)
- *Helper method to compute capacity factors.*

- void [\\_\\_computeProduction](#) (void)  
*Helper method to compute production values.*
- void [\\_\\_computeDispatch](#) (void)  
*Helper method to compute dispatch values.*
- void [\\_\\_handleKeyPressEvents](#) (void)  
*Helper method to handle key press events.*
- void [\\_\\_handleMouseButtonEvents](#) (void)  
*Helper method to handle mouse button events.*
- void [\\_\\_drawUpgradeOptions](#) (void)  
*Helper method to set up and draw upgrade options.*
- void [\\_\\_sendImprovementStateMessage](#) (void)  
*Helper method to format and sent improvement state message.*

## Additional Inherited Members

### 4.15.1 Detailed Description

A settlement class (child class of [TileImprovement](#)).

### 4.15.2 Constructor & Destructor Documentation

#### 4.15.2.1 WindTurbine()

```
WindTurbine::WindTurbine (
    double position_x,
    double position_y,
    int tile_resource,
    sf::Event * event_ptr,
    sf::RenderWindow * render_window_ptr,
    AssetsManager * assets_manager_ptr,
    MessageHub * message_hub_ptr )
```

Constructor for the [WindTurbine](#) class.

Ref: [Wikipedia \[2023\]](#)

#### Parameters

<a href="#">position_x</a>	The x position of the tile.
<a href="#">position_y</a>	The y position of the tile.
<a href="#">tile_resource</a>	The renewable resource quality of the tile.
<a href="#">event_ptr</a>	Pointer to the event class.
<a href="#">render_window_ptr</a>	Pointer to the render window.
<a href="#">assets_manager_ptr</a>	Pointer to the assets manager.
<a href="#">message_hub_ptr</a>	Pointer to the message hub.



```

768 :
769 TileImprovement (
770     position_x,
771     position_y,
772     tile_resource,
773     event_ptr,
774     render_window_ptr,
775     assets_manager_ptr,
776     message_hub_ptr
777 )
778 {
779     // 1. set attributes
780
781     // 1.1. private
782     //...
783
784     // 1.2. public
785     this->tile_improvement_type = TileImprovementType :: WIND_TURBINE;
786
787     this->is_running = false;
788
789     this->health = 100;
790
791     this->capacity_kW = 100;
792     this->upgrade_level = 1;
793
794     this->storage_kWh = 0;
795     this->storage_level = 0;
796
797     this->production_MWh = 0;
798     this->dispatch_MWh = 0;
799     this->dispatchable_MWh = 0;
800
801     this->max_daily_production_MWh = (double)(24 * this->capacity_kW) / 1000;
802
803     this->rotor_drotation = 256 * SECONDS_PER_FRAME;
804
805     this->capacity_factor_vec.resize(30, 0);
806     this->production_vec_MWh.resize(30, 0);
807     this->dispatch_vec_MWh.resize(30, 0);
808
809     this->tile_improvement_string = "WIND TURBINE";
810
811     this->__setUpTileImprovementSpriteAnimated();
812     this->__computeCapacityFactors();
813     this->update();
814
815     std::cout << "WindTurbine constructed at " << this << std::endl;
816
817     return;
818 } /* WindTurbine() */

```

#### 4.15.2.2 ~WindTurbine()

```

WindTurbine::~WindTurbine (
    void ) [virtual]

```

Destructor for the [WindTurbine](#) class.

```

1164 {
1165     std::cout << "WindTurbine at " << this << " destroyed" << std::endl;
1166
1167     return;
1168 } /* ~WindTurbine() */

```

### 4.15.3 Member Function Documentation

#### 4.15.3.1 \_\_breakdown()

```
void WindTurbine::__breakdown (
    void ) [private]
```

Helper method to trigger an equipment breakdown.

```
250 {
251     TileImprovement :: __breakdown();
252
253     this->production_MWh = 0;
254     this->dispatch_MWh = 0;
255     this->dispatchable_MWh = 0;
256     this->operation_maintenance_cost = 0;
257
258     return;
259 } /* __breakdown() */
```

#### 4.15.3.2 \_\_computeCapacityFactors()

```
void WindTurbine::__computeCapacityFactors (
    void ) [private]
```

Helper method to compute capacity factors.

```
307 {
308     unsigned seed = std::chrono::system_clock::now().time_since_epoch().count();
309     std::default_random_engine generator(seed);
310
311     double mean =
312         this->tile_resource_scalar * MEAN_DAILY_WIND_CAPACITY_FACTORS[this->month - 1];
313
314     double stdev = STDEV_DAILY_WIND_CAPACITY_FACTORS[this->month - 1];
315
316     if (this->tile_resource_scalar > 1) {
317         stdev /= this->tile_resource_scalar;
318     }
319
320     std::normal_distribution<double> normal_dist(mean, stdev);
321
322     double capacity_factor = 0;
323
324     for (int i = 0; i < 30; i++) {
325         capacity_factor = normal_dist(generator);
326
327         if (capacity_factor < 0) {
328             capacity_factor = 0;
329         }
330
331         this->capacity_factor_vec[i] = capacity_factor;
332     }
333
334     return;
335 } /* __computeCapacityFactors() */
```

#### 4.15.3.3 \_\_computeDispatch()

```
void WindTurbine::__computeDispatch (
    void ) [private]
```

Helper method to compute dispatch values.

```
378 {
379     double stored_energy_MWh = 0;
380     double storage_capacity_MWh = (double)(this->storage_kWh) / 1000;
381
382     double demand_MWh = 0;
383     double production_MWh = 0;
384     double dispatchable_MWh = 0;
```

```

385     double difference_MWh = 0;
386
387     double room_MWh = 0;
388
389     for (int i = 0; i < 30; i++) {
390         demand_MWh = this->demand_vec_MWh[i];
391         production_MWh = this->production_vec_MWh[i];
392
393         if (production_MWh <= demand_MWh) {
394             this->dispatch_vec_MWh[i] = production_MWh;
395             dispatchable_MWh += this->dispatch_vec_MWh[i];
396
397             difference_MWh = demand_MWh - production_MWh;
398
399             if ((storage_capacity_MWh > 0) and (stored_energy_MWh > 0)) {
400                 if (difference_MWh > stored_energy_MWh) {
401                     this->dispatch_vec_MWh[i] += stored_energy_MWh;
402                     dispatchable_MWh += stored_energy_MWh;
403                     stored_energy_MWh = 0;
404                 }
405
406                 else {
407                     this->dispatch_vec_MWh[i] += difference_MWh;
408                     dispatchable_MWh += difference_MWh;
409                     stored_energy_MWh -= difference_MWh;
410                 }
411             }
412         }
413
414         else {
415             this->dispatch_vec_MWh[i] = demand_MWh;
416             dispatchable_MWh += this->dispatch_vec_MWh[i];
417
418             difference_MWh = production_MWh - demand_MWh;
419
420             if (
421                 (storage_capacity_MWh > 0) and
422                 (stored_energy_MWh < storage_capacity_MWh)
423             ) {
424                 room_MWh = storage_capacity_MWh - stored_energy_MWh;
425
426                 if (difference_MWh > room_MWh) {
427                     stored_energy_MWh += room_MWh;
428                 }
429
430                 else {
431                     stored_energy_MWh += difference_MWh;
432                 }
433             }
434         }
435     }
436
437     this->dispatchable_MWh = round(dispatchable_MWh);
438
439     if (this->dispatch_MWh != this->dispatchable_MWh) {
440         this->dispatch_MWh = this->dispatchable_MWh;
441     }
442
443     return;
444 } /* __computeDispatch() */

```

#### 4.15.3.4 \_\_computeProduction()

```

void WindTurbine::__computeProduction (
    void ) [private]

```

Helper method to compute production values.

```

350 {
351     double production_MWh = 0;
352
353     for (int i = 0; i < 30; i++) {
354         this->production_vec_MWh[i] =
355             this->max_daily_production_MWh * this->capacity_factor_vec[i];
356
357         production_MWh += this->production_vec_MWh[i];
358     }
359
360     this->production_MWh = round(production_MWh);

```

```

361
362     return;
363 } /* __computeProduction() */

```

#### 4.15.3.5 \_\_computeProductionCosts()

```

void WindTurbine::__computeProductionCosts (
    void ) [private]

```

Helper method to compute production costs (O&M) based on current production level.

```

229 {
230     double operation_maintenance_cost =
231         (this->production_MWh * WIND_OP_MAINT_COST_PER_MWH_PRODUCTION) / 1000;
232     this->operation_maintenance_cost = round(operation_maintenance_cost);
233
234     return;
235 } /* __computeProductionCosts() */

```

#### 4.15.3.6 \_\_drawProductionMenu()

```

void WindTurbine::__drawProductionMenu (
    void ) [private]

```

Helper method to draw production menu assets.

```

114 {
115     // 1. draw static sprite
116     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
117         sf::Vector2f initial_position = this->tile_improvement_sprite_animated[i].getPosition();
118         this->tile_improvement_sprite_animated[i].setPosition(400 - 138, 400 + 16);
119
120         sf::Color initial_colour = this->tile_improvement_sprite_animated[i].getColor();
121         this->tile_improvement_sprite_animated[i].setColor(sf::Color(255, 255, 255, 255));
122
123         sf::Vector2f initial_scale = this->tile_improvement_sprite_animated[i].getScale();
124         this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1, 1));
125
126         double initial_rotation = this->tile_improvement_sprite_animated[i].getRotation();
127         this->tile_improvement_sprite_animated[i].setRotation(0);
128
129         this->render_window_ptr->draw(this->tile_improvement_sprite_animated[i]);
130
131         this->tile_improvement_sprite_animated[i].setPosition(initial_position);
132         this->tile_improvement_sprite_animated[i].setColor(initial_colour);
133         this->tile_improvement_sprite_animated[i].setScale(initial_scale);
134         this->tile_improvement_sprite_animated[i].setRotation(initial_rotation);
135     }
136
137     // 2. draw production text
138     std::string production_string = "[W]: INCREASE DISPATCH\n";
139     production_string += "[S]: DECREASE DISPATCH\n";
140     production_string += "\n";
141
142     production_string += "DISPATCH: ";
143     production_string += std::to_string(this->dispatch_MWh);
144     production_string += " MWh (MAX ";
145     production_string += std::to_string(this->dispatchable_MWh);
146     production_string += ")\n";
147
148     production_string += "O&M COST: ";
149     production_string += std::to_string(this->operation_maintenance_cost);
150     production_string += " K\n";
151
152     sf::Text production_text(
153         production_string,
154         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
155         16
156     );
157
158     production_text.setOrigin(production_text.getLocalBounds().width / 2, 0);

```

```

159     production_text.setFillColor(MONOCROME_TEXT_GREEN);
160
161     production_text.setPosition(400 + 30, 400 - 45);
162
163     this->render_window_ptr->draw(production_text);
164
165     return;
166 } /* __drawProductionMenu() */

```

#### 4.15.3.7 \_\_drawUpgradeOptions()

```

void WindTurbine::__drawUpgradeOptions (
    void ) [private]

```

Helper method to set up and draw upgrade options.

```

585 {
586     // 1. draw power capacity upgrade sprite
587     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
588         sf::Vector2f initial_position = this->tile_improvement_sprite_animated[i].getPosition();
589         this->tile_improvement_sprite_animated[i].setPosition(400 - 100, 400 - 56);
590
591         sf::Color initial_colour = this->tile_improvement_sprite_animated[i].getColor();
592         this->tile_improvement_sprite_animated[i].setColor(sf::Color(255, 255, 255, 255));
593
594         sf::Vector2f initial_scale = this->tile_improvement_sprite_animated[i].getScale();
595         this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1, 1));
596
597         double initial_rotation = this->tile_improvement_sprite_animated[i].getRotation();
598         this->tile_improvement_sprite_animated[i].setRotation(0);
599
600         this->render_window_ptr->draw(this->tile_improvement_sprite_animated[i]);
601
602         this->tile_improvement_sprite_animated[i].setPosition(initial_position);
603         this->tile_improvement_sprite_animated[i].setColor(initial_colour);
604         this->tile_improvement_sprite_animated[i].setScale(initial_scale);
605         this->tile_improvement_sprite_animated[i].setRotation(initial_rotation);
606     }
607
608     this->render_window_ptr->draw(this->upgrade_arrow_sprite);
609
610
611     // 2. draw power capacity upgrade text
612     //          16 char line = "                \n"
613     std::string power_upgrade_string = "POWER CAPACITY \n";
614     power_upgrade_string           += "                \n";
615
616     power_upgrade_string           += "CAPACITY: ";
617     power_upgrade_string           += std::to_string(this->capacity_kw);
618     power_upgrade_string           += " kW\n";
619
620     power_upgrade_string           += "LEVEL: ";
621     power_upgrade_string           += std::to_string(this->upgrade_level);
622     power_upgrade_string           += "\n\n";
623
624     if (this->upgrade_level < MAX_UPGRADE_LEVELS) {
625         power_upgrade_string           += "[W]: + 100 kW (";
626         power_upgrade_string           += std::to_string(WIND_TURBINE_BUILD_COST);
627         power_upgrade_string           += " K)\n";
628     }
629
630     else {
631         power_upgrade_string           += " * MAX LEVEL * \n";
632     }
633
634     sf::Text power_upgrade_text = sf::Text(
635         power_upgrade_string,
636         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
637         16
638     );
639
640     power_upgrade_text.setOrigin(power_upgrade_text.getLocalBounds().width / 2, 0);
641     power_upgrade_text.setPosition(400 - 100, 400 - 32 + 16);
642     power_upgrade_text.setFillColor(MONOCROME_TEXT_GREEN);
643
644     this->render_window_ptr->draw(power_upgrade_text);
645
646
647     // 3. draw energy capacity (storage) upgrade sprite

```

```

648     this->render_window_ptr->draw(this->storage_upgrade_sprite);
649     this->render_window_ptr->draw(this->upgrade_plus_sprite);
650
651
652     // 4. draw energy capacity (storage) upgrade text
653     // 16 char line = " \n"
654     std::string energy_upgrade_string = "ENERGY CAPACITY \n";
655     energy_upgrade_string += " \n";
656
657     energy_upgrade_string += "CAPACITY: ";
658     energy_upgrade_string += std::to_string(this->storage_level * 200);
659     energy_upgrade_string += " kWh\n";
660
661     energy_upgrade_string += "LEVEL: ";
662     energy_upgrade_string += std::to_string(this->storage_level);
663     energy_upgrade_string += "\n\n";
664
665     if (this->storage_level < MAX_STORAGE_LEVELS) {
666         energy_upgrade_string += "[D]: + 200 kWh (";
667         energy_upgrade_string += std::to_string(ENERGY_STORAGE_SYSTEM_BUILD_COST);
668         energy_upgrade_string += " K)\n";
669     }
670
671     else {
672         energy_upgrade_string += " * MAX LEVEL * \n";
673     }
674
675     sf::Text energy_upgrade_text = sf::Text(
676         energy_upgrade_string,
677         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
678         16
679     );
680
681     energy_upgrade_text.setOrigin(energy_upgrade_text.getLocalBounds().width / 2, 0);
682     energy_upgrade_text.setPosition(400 + 100, 400 - 32 + 16);
683     energy_upgrade_text.setFillColor(MONOCHROME_TEXT_GREEN);
684
685     this->render_window_ptr->draw(energy_upgrade_text);
686
687     return;
688 } /* __drawUpgradeOptions() */

```

#### 4.15.3.8 \_\_handleKeyPressEvents()

```

void WindTurbine::__handleKeyPressEvents (
    void ) [private]

```

Helper method to handle key press events.

```

459 {
460     if (this->just_built) {
461         return;
462     }
463
464     switch (this->event_ptr->key.code) {
465         case (sf::Keyboard::U): {
466             this->__openUpgradeMenu();
467
468             break;
469         }
470
471
472         case (sf::Keyboard::W): {
473             if (this->production_menu_open) {
474                 this->dispatch_MWh++;
475
476                 if (this->dispatch_MWh > this->dispatchable_MWh) {
477                     this->dispatch_MWh = 0;
478                 }
479
480                 this->__computeProductionCosts();
481                 this->assets_manager_ptr->getSound("interface click")->play();
482             }
483
484             else if (this->upgrade_menu_open) {
485                 this->__upgradePowerCapacity();
486             }
487
488             break;

```

```

489     }
490
491
492     case (sf::Keyboard::S): {
493         if (this->production_menu_open) {
494             this->dispatch_MWh--;
495
496             if (this->dispatch_MWh < 0) {
497                 this->dispatch_MWh = this->dispatchable_MWh;
498             }
499
500             this->__computeProductionCosts();
501             this->assets_manager_ptr->getSound("interface click")->play();
502         }
503
504         break;
505     }
506
507
508     case (sf::Keyboard::D): {
509         if (this->upgrade_menu_open) {
510             this->__upgradeStorageCapacity();
511             this->__computeProduction();
512             this->__computeDispatch();
513         }
514
515         break;
516     }
517
518
519     default: {
520         // do nothing!
521
522         break;
523     }
524 }
525
526 return;
527 } /* __handleKeyPressEvents() */

```

#### 4.15.3.9 \_\_handleMouseButtonEvents()

```

void WindTurbine::__handleMouseButtonEvents (
    void ) [private]

```

Helper method to handle mouse button events.

```

542 {
543     if (this->just_built) {
544         return;
545     }
546
547     switch (this->event_ptr->mouseButton.button) {
548         case (sf::Mouse::Left): {
549             //...
550
551             break;
552         }
553
554
555         case (sf::Mouse::Right): {
556             //...
557
558             break;
559         }
560
561
562         default: {
563             // do nothing!
564
565             break;
566         }
567     }
568
569     return;
570 } /* __handleMouseButtonEvents() */

```

#### 4.15.3.10 \_\_repair()

```
void WindTurbine::__repair (
    void ) [private], [virtual]
```

Helper method to repair the wind turbine.

Reimplemented from [TileImprovement](#).

```
274 {
275     if (this->credits < WIND_TURBINE_BUILD_COST) {
276         std::cout << "Cannot repair wind turbine: insufficient credits (need "
277             << WIND_TURBINE_BUILD_COST << " K)" << std::endl;
278
279         this->__sendInsufficientCreditsMessage();
280         return;
281     }
282
283     TileImprovement :: __repair();
284
285     this->just_upgraded = true;
286
287     this->__sendCreditsSpentMessage(WIND_TURBINE_BUILD_COST);
288     this->__sendTileStateRequest();
289     this->__sendGameStateRequest();
290
291     return;
292 } /* __repair() */
```

#### 4.15.3.11 \_\_sendImprovementStateMessage()

```
void WindTurbine::__sendImprovementStateMessage (
    void ) [private]
```

Helper method to format and sent improvement state message.

```
703 {
704     Message improvement_state_message;
705
706     improvement_state_message.channel = GAME_CHANNEL;
707     improvement_state_message.subject = "improvement state";
708
709     improvement_state_message.int_payload["dispatch_MWh"] = this->dispatch_MWh;
710     improvement_state_message.int_payload["operation_maintenance_cost"] =
711         this->operation_maintenance_cost;
712
713     this->message_hub_ptr->sendMessage(improvement_state_message);
714
715     std::cout << "Improvement state message sent by " << this << std::endl;
716
717     return;
718 } /* __sendImprovementStateMessage() */
```

#### 4.15.3.12 \_\_setUpTileImprovementSpriteAnimated()

```
void WindTurbine::__setUpTileImprovementSpriteAnimated (
    void ) [private]
```

Helper method to set up tile improvement sprite (static).

```
68 {
69     sf::Sprite diesel_generator_sheet (
70         *(this->assets_manager_ptr->getTexture("wind turbine"))
71     );
72
73     int n_elements = diesel_generator_sheet.getLocalBounds().height / 64;
74
75     for (int i = 0; i < n_elements; i++) {
```



```

76         this->tile_improvement_sprite_animated.push_back(
77             sf::Sprite(
78                 *(this->assets_manager_ptr->getTexture("wind turbine")),
79                 sf::IntRect(0, i * 64, 64, 64)
80             )
81         );
82
83         this->tile_improvement_sprite_animated.back().setOrigin(
84             this->tile_improvement_sprite_animated.back().getLocalBounds().width / 2,
85             this->tile_improvement_sprite_animated.back().getLocalBounds().height
86         );
87
88         this->tile_improvement_sprite_animated.back().setPosition(
89             this->position_x,
90             this->position_y - 32
91         );
92
93         this->tile_improvement_sprite_animated.back().setColor(
94             sf::Color(255, 255, 255, 0)
95         );
96     }
97
98     return;
99 } /* __setUpTileImprovementSpriteAnimated() */

```

#### 4.15.3.13 \_\_upgradePowerCapacity()

```

void WindTurbine::__upgradePowerCapacity (
    void ) [private]

```

Helper method to upgrade the power capacity.

```

181 {
182     if (this->credits < WIND_TURBINE_BUILD_COST) {
183         std::cout << "Cannot upgrade wind turbine: insufficient credits (need "
184             << WIND_TURBINE_BUILD_COST << " K)" << std::endl;
185
186         this->__sendInsufficientCreditsMessage();
187         return;
188     }
189
190     if (this->upgrade_level >= MAX_UPGRADE_LEVELS) {
191         return;
192     }
193
194     TileImprovement :: __repair();
195
196     this->capacity_kW += 100;
197     this->upgrade_level++;
198
199     this->max_daily_production_MWh = (double)(24 * this->capacity_kW) / 1000;
200
201     this->__computeProduction();
202     this->__computeDispatch();
203
204     this->just_upgraded = true;
205
206     this->assets_manager_ptr->getSound("upgrade")->play();
207
208     this->__sendCreditsSpentMessage(WIND_TURBINE_BUILD_COST);
209     this->__sendTileStateRequest();
210     this->__sendGameStateRequest();
211
212     return;
213 } /* __upgradePowerCapacity() */

```

#### 4.15.3.14 advanceTurn()

```

void WindTurbine::advanceTurn (
    void ) [virtual]

```

Method to handle turn advance.

Reimplemented from [TileImprovement](#).

```

923 {
924     // 1. send improvement state message
925     this->__sendImprovementStateMessage();
926
927     // 2. update
928     this->__computeCapacityFactors();
929     this->update();
930
931     // 3. handle start/stop
932     if ((not this->is_running) and (this->dispatch_MWh > 0)) {
933         this->is_running = true;
934     }
935
936     else if (this->is_running and (this->dispatch_MWh <= 0)) {
937         this->is_running = false;
938     }
939
940     // 4. handle equipment health
941     if (this->is_running) {
942         this->health--;
943
944         if (this->health <= 0) {
945             this->__breakdown();
946         }
947     }
948
949     // 5. send tile state request (if selected)
950     if (this->is_selected) {
951         this->__sendTileStateRequest();
952     }
953
954     return;
955 } /* advanceTurn() */

```

#### 4.15.3.15 draw()

```

void WindTurbine::draw (
    void ) [virtual]

```

Method to draw the hex tile to the render window. To be called once per frame.

Reimplemented from [TileImprovement](#).

```

1044 {
1045     // 1. if just built, call base method and return
1046     if (this->just_built) {
1047         TileImprovement :: draw();
1048
1049         return;
1050     }
1051
1052
1053     // 2. handle upgrade effects
1054     if (this->just_upgraded) {
1055         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
1056             this->tile_improvement_sprite_animated[i].setColor(
1057                 sf::Color(
1058                     255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
1059                     255,
1060                     255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
1061                     255
1062                 )
1063             );
1064
1065             this->tile_improvement_sprite_animated[i].setScale(
1066                 sf::Vector2f(
1067                     1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
1068                     1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2)
1069                 )
1070             );
1071         }
1072
1073         this->upgrade_frame++;
1074     }

```

```

1075
1076     if (this->upgrade_frame >= 2 * FRAMES_PER_SECOND) {
1077         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
1078             this->tile_improvement_sprite_animated[i].setColor(
1079                 sf::Color(255,255,255,255)
1080             );
1081             this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1,1));
1082         }
1083
1084         this->just_upgraded = false;
1085         this->upgrade_frame = 0;
1086     }
1087 }
1088
1089
1090 // 3. draw first element of animated sprite
1091 this->render_window_ptr->draw(this->tile_improvement_sprite_animated[0]);
1092
1093
1094 // 4. draw second element of animated sprite
1095 if (this->is_running) {
1096     this->tile_improvement_sprite_animated[1].rotate(this->rotor_drotation);
1097 }
1098
1099 this->render_window_ptr->draw(this->tile_improvement_sprite_animated[1]);
1100
1101
1102 // 5. draw storage upgrades
1103 for (size_t i = 0; i < this->storage_upgrade_sprite_vec.size(); i++) {
1104     this->render_window_ptr->draw(this->storage_upgrade_sprite_vec[i]);
1105 }
1106
1107
1108 // 6. handle dispatch illustration
1109 if (this->dispatch_MWh > 0) {
1110     this->dispatch_text.setString(std::to_string(this->dispatch_MWh));
1111     this->__drawDispatch();
1112 }
1113
1114
1115 // 7. draw production menu
1116 if (this->production_menu_open) {
1117     this->render_window_ptr->draw(this->production_menu_backing);
1118     this->render_window_ptr->draw(this->production_menu_backing_text);
1119
1120     this->__drawProductionMenu();
1121 }
1122
1123
1124 // 8. draw upgrade menu
1125 if (this->upgrade_menu_open) {
1126     this->render_window_ptr->draw(this->upgrade_menu_backing);
1127     this->render_window_ptr->draw(this->upgrade_menu_backing_text);
1128
1129     this->__drawUpgradeOptions();
1130 }
1131
1132
1133 // 9. handle broken effects
1134 if (this->is_broken) {
1135     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
1136         this->tile_improvement_sprite_animated[i].setColor(
1137             sf::Color(
1138                 255,
1139                 255 * pow(cos((M_PI * this->frame) / FRAMES_PER_SECOND), 2),
1140                 255 * pow(cos((M_PI * this->frame) / FRAMES_PER_SECOND), 2),
1141                 255
1142             )
1143         );
1144     }
1145 }
1146
1147 this->frame++;
1148 return;
1149 } /* draw() */

```

#### 4.15.3.16 getTileOptionsSubstring()

```

std::string WindTurbine::getTileOptionsSubstring (
    void ) [virtual]

```

Helper method to assemble and return tile options substring.

## Returns

Tile options substring.

Reimplemented from [TileImprovement](#).

```

835 {
836     //          32 char x 17 line console "-----\n";
837     std::string options_substring = "CAPACITY: ";
838     options_substring += std::to_string(this->capacity_kW);
839     options_substring += " kW (level ";
840     options_substring += std::to_string(this->upgrade_level);
841     options_substring += ") \n";
842
843     options_substring += "PRODUCTION: ";
844     options_substring += std::to_string(this->production_MWh);
845     options_substring += " MWh\n";
846
847     options_substring += "DISPATCHABLE: ";
848     options_substring += std::to_string(this->dispatchable_MWh);
849     options_substring += " MWh\n";
850
851     options_substring += "HEALTH: ";
852     options_substring += std::to_string(this->health);
853     options_substring += "/100";
854
855     if (this->health <= 0) {
856         options_substring += " ** BROKEN! **\n";
857     }
858
859     else {
860         options_substring += "\n";
861     }
862
863     options_substring += " \n";
864     options_substring += " **** WIND TURBINE OPTIONS **** \n";
865     options_substring += " \n";
866
867     if (this->is_broken) {
868         options_substring += " [R]: REPAIR (";
869         options_substring += std::to_string(WIND_TURBINE_BUILD_COST);
870         options_substring += " K)\n";
871     }
872
873     else {
874         options_substring += " [E]: OPEN PRODUCTION MENU \n";
875     }
876
877     options_substring += " [U]: OPEN UPGRADE MENU \n";
878     options_substring += "HOLD [P]: SCRAP (";
879     options_substring += std::to_string(SCRAP_COST);
880     options_substring += " K)";
881
882     return options_substring;
883 } /* getTileOptionsSubstring() */

```

#### 4.15.3.17 processEvent()

```

void WindTurbine::processEvent (
    void ) [virtual]

```

Method to process [WindTurbine](#). To be called once per event.

Reimplemented from [TileImprovement](#).

```

995 {
996     TileImprovement :: processEvent ();
997
998     if (this->event_ptr->type == sf::Event::KeyPressed) {
999         this->__handleKeyPressEvents();
1000     }
1001
1002     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
1003         this->__handleMouseButtonEvents();
1004     }
1005
1006     return;
1007 } /* processEvent() */

```

#### 4.15.3.18 processMessage()

```
void WindTurbine::processMessage (
    void ) [virtual]
```

Method to process [WindTurbine](#). To be called once per message.

Reimplemented from [TileImprovement](#).

```
1022 {
1023     TileImprovement :: processMessage();
1024
1025     //...
1026
1027     return;
1028 } /* processMessage() */
```

#### 4.15.3.19 setIsSelected()

```
void WindTurbine::setIsSelected (
    bool is_selected ) [virtual]
```

Method to set the is selected attribute.

##### Parameters

<i>is_selected</i>	The value to set the is selected attribute to.
--------------------	--

Reimplemented from [TileImprovement](#).

```
900 {
901     TileImprovement :: setIsSelected(is_selected);
902
903     if (this->is_running and this->is_selected) {
904         this->assets_manager_ptr->getSound("wind turbine running")->play();
905     }
906
907     return;
908 } /* setIsSelected() */
```

#### 4.15.3.20 update()

```
void WindTurbine::update (
    void ) [virtual]
```

Method to trigger production and dispatchable updates.

Reimplemented from [TileImprovement](#).

```
970 {
971     this->__computeProduction();
972     this->__computeProductionCosts();
973     this->__computeDispatch();
974
975     if (this->is_selected) {
976         this->__sendTileStateRequest();
977     }
978
979     return;
980 } /* update() */
```

## 4.15.4 Member Data Documentation

### 4.15.4.1 capacity\_factor\_vec

```
std::vector<double> WindTurbine::capacity_factor_vec
```

A vector of daily capacity factors for the current month.

### 4.15.4.2 capacity\_kW

```
int WindTurbine::capacity_kW
```

The rated production capacity [kW] of the solar PV array.

### 4.15.4.3 dispatch\_MWh

```
int WindTurbine::dispatch_MWh
```

The current dispatch [MWh] of the solar PV array.

### 4.15.4.4 dispatch\_vec\_MWh

```
std::vector<double> WindTurbine::dispatch_vec_MWh
```

A vector of daily dispatch [MWh] for the current month.

### 4.15.4.5 dispatchable\_MWh

```
int WindTurbine::dispatchable_MWh
```

The amount of production that is directly dispatchable to the grid (i.e. production correlated with demand).

#### 4.15.4.6 max\_daily\_production\_MWh

```
double WindTurbine::max_daily_production_MWh
```

The maximum daily production [MWh] of the solar PV array.

#### 4.15.4.7 production\_MWh

```
int WindTurbine::production_MWh
```

The current production [MWh] of the solar PV array.

#### 4.15.4.8 production\_vec\_MWh

```
std::vector<double> WindTurbine::production_vec_MWh
```

A vector of daily production [MWh] for the current month.

#### 4.15.4.9 rotor\_drotation

```
double WindTurbine::rotor_drotation
```

The rotation rate of the rotor.

The documentation for this class was generated from the following files:

- header/[WindTurbine.h](#)
- source/[WindTurbine.cpp](#)





## Chapter 5

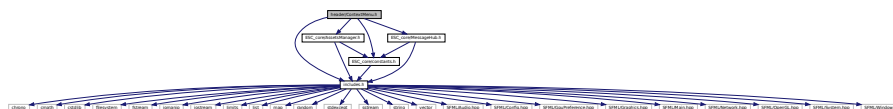
# File Documentation

### 5.1 header/ContextMenu.h File Reference

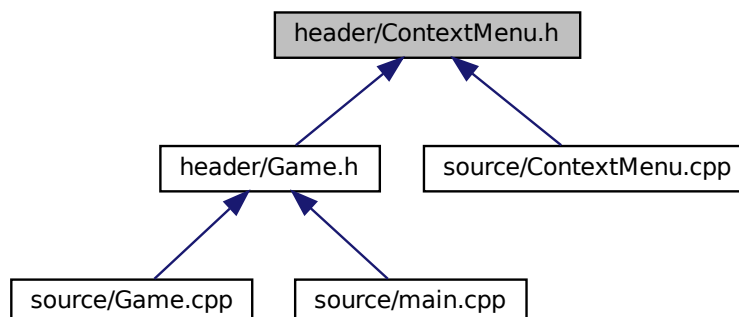
Header file for the [ContextMenu](#) class.

```
#include "ESC_core/constants.h"
#include "ESC_core/includes.h"
#include "ESC_core/AssetsManager.h"
#include "ESC_core/MessageHub.h"
```

Include dependency graph for ContextMenu.h:



This graph shows which files directly or indirectly include this file:



## Classes

- class [ContextMenu](#)

*A class which defines a context menu for the game.*

## Enumerations

- enum [ConsoleState](#) {  
[NONE\\_STATE](#) , [READY](#) , [MENU](#) , [TILE](#) ,  
[N\\_CONSOLE\\_STATES](#) }

*An enumeration of the different console screen states.*

### 5.1.1 Detailed Description

Header file for the [ContextMenu](#) class.

### 5.1.2 Enumeration Type Documentation

#### 5.1.2.1 ConsoleState

enum [ConsoleState](#)

An enumeration of the different console screen states.

##### Enumerator

NONE_STATE	None state (for initialization)
READY	Ready (default) state.
MENU	<a href="#">Game</a> menu state.
TILE	Tile context state.
N_CONSOLE_STATES	A simple hack to get the number of console screen states.

```

68         {
69     NONE\_STATE,
70     READY,
71     MENU,
72     TILE,
73     N\_CONSOLE\_STATES
74 };

```

## 5.2 header/DieselGenerator.h File Reference

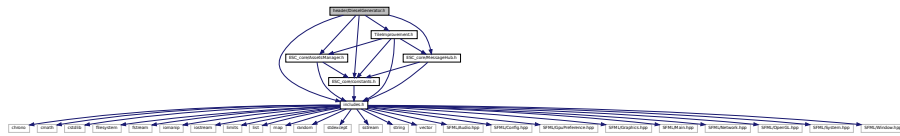
Header file for the [DieselGenerator](#) class.

```

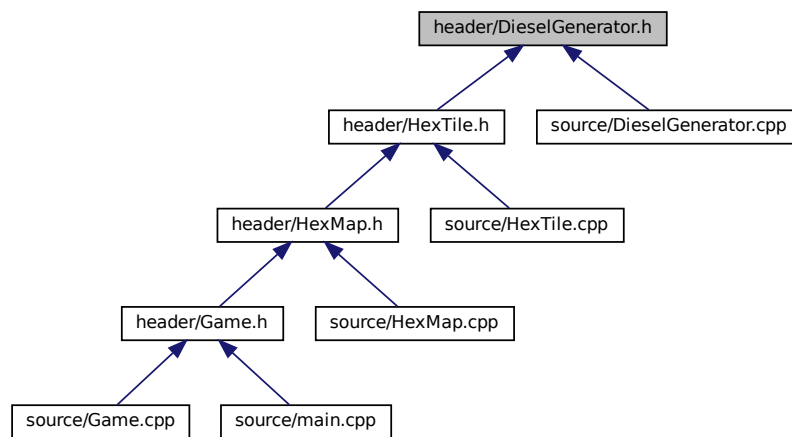
#include "ESC_core/constants.h"
#include "ESC_core/includes.h"
#include "ESC_core/AssetsManager.h"

```

```
#include "ESC_core/MessageHub.h"
#include "TileImprovement.h"
Include dependency graph for DieselGenerator.h:
```



This graph shows which files directly or indirectly include this file:



## Classes

- class [DieselGenerator](#)  
A settlement class (child class of [TileImprovement](#)).

### 5.2.1 Detailed Description

Header file for the [DieselGenerator](#) class.

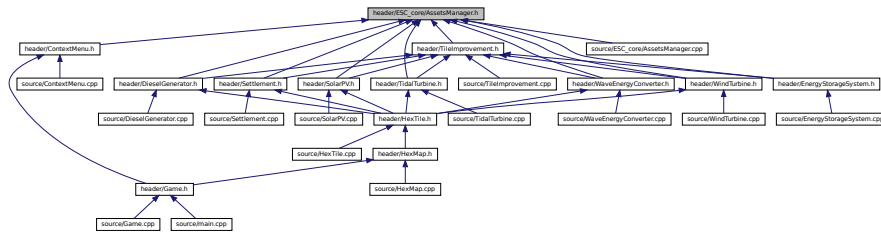
## 5.3 header/EnergyStorageSystem.h File Reference

Header file for the [EnergyStorageSystem](#) class.

```
#include "ESC_core/constants.h"
#include "ESC_core/includes.h"
#include "ESC_core/AssetsManager.h"
#include "ESC_core/MessageHub.h"
```



This graph shows which files directly or indirectly include this file:



## Classes

- class [AssetsManager](#)  
A class which manages visual and sound assets.

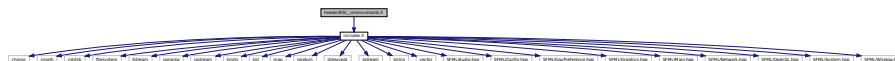
### 5.4.1 Detailed Description

Header file for the [AssetsManager](#) class.

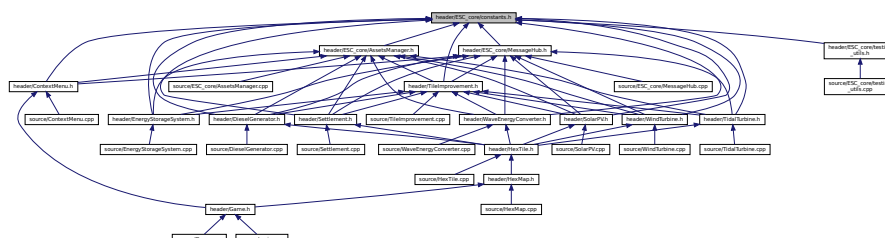
## 5.5 header/ESC\_core/constants.h File Reference

Header file for various constants.

```
#include "includes.h"
Include dependency graph for constants.h:
```



This graph shows which files directly or indirectly include this file:



## Functions

- `const sf::Color FOREST_GREEN` (34, 139, 34)  
*The base colour of a forest tile.*
- `const sf::Color LAKE_BLUE` (0, 102, 204)  
*The base colour of a lake (water) tile.*
- `const sf::Color MOUNTAINS_GREY` (97, 110, 113)  
*The base colour of a mountains tile.*
- `const sf::Color OCEAN_BLUE` (0, 51, 102)  
*The base colour of an ocean (water) tile.*
- `const sf::Color PLAINS_YELLOW` (245, 222, 133)  
*The base colour of a plains tile.*
- `const sf::Color RESOURCE_CHIP_GREY` (175, 175, 175, 250)  
*The base colour of the resource chip (backing).*
- `const sf::Color MENU_FRAME_GREY` (185, 187, 182)  
*The base colour of the context menu frame.*
- `const sf::Color MONOCHROME_SCREEN_BACKGROUND` (40, 40, 40)  
*The base colour of old monochrome screens.*
- `const sf::Color VISUAL_SCREEN_FRAME_GREY` (151, 151, 143)  
*The base colour of the framing of the visual screen.*
- `const sf::Color MONOCHROME_TEXT_GREEN` (0, 255, 102)  
*The base colour of old monochrome text (green).*
- `const sf::Color MONOCHROME_TEXT_AMBER` (255, 176, 0)  
*The base colour of old monochrome text (amber).*
- `const sf::Color MONOCHROME_TEXT_RED` (255, 44, 0)  
*The base colour of old monochrome text (red).*

## Variables

- `const double FLOAT_TOLERANCE` = 1e-6  
*Tolerance for floating point equality tests.*
- `const unsigned long long int SECONDS_PER_YEAR` = 31537970
- `const unsigned long long int SECONDS_PER_MONTH` = 2628164
- `const int FRAMES_PER_SECOND` = 60  
*Target frames per second.*
- `const double SECONDS_PER_FRAME` = 1.0 / 60  
*Target seconds per frame (just reciprocal of target frames per second).*
- `const int GAME_WIDTH` = 1200  
*Width of the game space.*
- `const int GAME_HEIGHT` = 800  
*Height of the game space.*
- `const std::vector< double > TILE_TYPE_CUMULATIVE_PROBABILITIES`  
*Cumulative probabilities for each tile type (to support procedural generation).*
- `const std::vector< double > TILE_RESOURCE_CUMULATIVE_PROBABILITIES`  
*Cumulative probabilities for each tile resource (to support procedural generation).*
- `const std::string TILE_SELECTED_CHANNEL` = "TILE SELECTED CHANNEL"  
*A message channel for tile selection messages.*
- `const std::string NO_TILE_SELECTED_CHANNEL` = "NO TILE SELECTED CHANNEL"  
*A message channel for no tile selected messages.*
- `const std::string TILE_STATE_CHANNEL` = "TILE STATE CHANNEL"

- A message channel for tile state messages.*
- const std::string `HEX_MAP_CHANNEL` = "HEX MAP CHANNEL"
- A message channel for hex map messages.*
- const std::string `SETTLEMENT_CHANNEL` = "SETTLEMENT CHANNEL"
- A message channel for the settlement.*
- const int `CLEAR_FOREST_COST` = 40
- The cost of clearing a forest tile.*
- const int `CLEAR_MOUNTAINS_COST` = 250
- The cost of clearing a mountains tile.*
- const int `CLEAR_PLAINS_COST` = 20
- The cost of clearing a plains tile.*
- const int `DIESEL_GENERATOR_BUILD_COST` = 100
- The cost of building (or upgrading) a diesel generator in 100 kW increments.*
- const int `WIND_TURBINE_BUILD_COST` = 400
- The cost of building (or upgrading) a wind turbine in 100 kW increments.*
- const double `WIND_TURBINE_WATER_BUILD_MULTIPLIER` = 1.25
- The additional cost of building on water.*
- const int `SOLAR_PV_BUILD_COST` = 300
- The cost of building (or upgrading) a solar PV array in 100 kW increments.*
- const double `SOLAR_PV_WATER_BUILD_MULTIPLIER` = 1.5
- The additional cost of building on water.*
- const int `TIDAL_TURBINE_BUILD_COST` = 600
- The cost of building (or upgrading) a tidal turbine in 100 kW increments.*
- const int `WAVE_ENERGY_CONVERTER_BUILD_COST` = 800
- The cost of building (or upgrading) a wave energy converter in 100 kW increments.*
- const int `ENERGY_STORAGE_SYSTEM_BUILD_COST` = 160
- The cost of adding energy storage in 200 kWh increments.*
- const int `SCRAP_COST` = 50
- The cost of scrapping a tile improvement (other than settlement).*
- const int `MAX_UPGRADE_LEVELS` = 5
- The maximum upgrade level of any tile improvement.*
- const int `MAX_STORAGE_LEVELS` = 5
- The maximum storage level of any tile improvement.*
- const int `STARTING_CREDITS` = 800
- The starting balance of credits.*
- const double `CREDITS_PER_MWH_SERVED` = 1
- The number of credits (x1000) earned.*
- const int `EMISSIONS_LIFETIME_LIMIT_TONNES` = 1200
- The lifetime limit on CO2-equivalent emissions (1 tonne CO2e ~ = 667 L diesel).*
- const int `RESOURCE_ASSESSMENT_COST` = 20
- The cost of doing a resource assessment.*
- const int `BUILD_SETTLEMENT_COST` = 250
- The cost of building a settlement.*
- const int `STARTING_POPULATION` = 100
- The starting population of a settlement.*
- const double `POPULATION_MONTHLY_GROWTH_RATE` = 1.02
- The monthly population growth rate.*
- const double `LITRES_DIESEL_PER_MWH_PRODUCTION` = 375
- The litres of diesel consumed in producing 1 MWh (assumes higher heating value and constant thermal efficiency of ~0.25).*
- const double `COST_PER_LITRE_DIESEL` = 1.75

- The cost of a litre of diesel.*

  - const double `KG_CO2E_PER_LITRE_DIESEL` = 3.1596
- The CO2-equivalent mass of emissions that result from burning one litre of diesel fuel.*

  - const double `DIESEL_OP_MAINT_COST_PER_MWH_PRODUCTION` = 50
- The operation and maintenace cost of running a diesel generator (assumed 0.05 credits per kWh produced).*

  - const double `SOLAR_OP_MAINT_COST_PER_MWH_PRODUCTION` = 10
- The operation and maintenance cost of running a solar PV array (assumed 0.01 credits per kWh produced).*

  - const double `TIDAL_OP_MAINT_COST_PER_MWH_PRODUCTION` = 50
- The operation and maintenance cost of running a tidal turbine (assumed 0.05 credits per kWh produced).*

  - const double `WAVE_OP_MAINT_COST_PER_MWH_PRODUCTION` = 50
- The operation and maintenance cost of running a wave energy converter (assumed 0.05 credits per kWh produced).*

  - const double `WIND_OP_MAINT_COST_PER_MWH_PRODUCTION` = 50
- The operation and maintenance cost of running a wind turbine (assumed 0.05 credits per kWh produced).*

  - const std::vector< double > `MEAN_DAILY_DEMAND_RATIOS`

*The mean daily demand ratio for each month, where demand ratio is demand [MWh] divided by maximum daily demand [MWh]. Maximum daily demand is simply (24)(max load [kW]) / 1000.*
- const std::vector< double > `STDEV_DAILY_DEMAND_RATIOS`

*The standard deviation in daily demand ratio for each month, where demand ratio is demand [MWh] divided by maximum daily demand [MWh]. Maximum daily demand is simply (24)(max load [kW]) / 1000.*
- const double `MAXIMUM_DAILY_DEMAND_PER_CAPITA` = 0.0475

*The maximum daily demand [MWh] (at any point in the year) per capita.*
- const std::vector< double > `MEAN_DAILY_SOLAR_CAPACITY_FACTORS`

*The mean daily solar capacity factors for each month, where capacity factor is daily production [MWh] divided by maximum daily production [MWh]. Maximum daily production is simply (24)(power capacity [kW]) / 1000.*
- const std::vector< double > `STDEV_DAILY_SOLAR_CAPACITY_FACTORS`

*The standard deviation in daily solar capacity factors for each month, where capacity factor is daily production [MWh] divided by maximum daily production [MWh]. Maximum daily production is simply (24)(power capacity [kW]) / 1000.*
- const double `DAILY_TIDAL_CAPACITY_FACTOR` = 0.225

*The daily tidal capacity factor, where capacity factor is daily production [MWh] divided by maximum daily production [MWh]. Maximum daily production is simply (24)(power capacity [kW]) / 1000. The tides are not a random process (usually semi-diurnal, mostly driven by orbits of moon and sun).*
- const std::vector< double > `MEAN_DAILY_WAVE_CAPACITY_FACTORS`

*The mean daily wave capacity factors for each month, where capacity factor is daily production [MWh] divided by maximum daily production [MWh]. Maximum daily production is simply (24)(power capacity [kW]) / 1000.*
- const std::vector< double > `STDEV_DAILY_WAVE_CAPACITY_FACTORS`

*The standard deviation in daily wave capacity factors for each month, where capacity factor is daily production [MWh] divided by maximum daily production [MWh]. Maximum daily production is simply (24)(power capacity [kW]) / 1000.*
- const std::vector< double > `MEAN_DAILY_WIND_CAPACITY_FACTORS`

*The mean daily wind capacity factors for each month, where capacity factor is daily production [MWh] divided by maximum daily production [MWh]. Maximum daily production is simply (24)(power capacity [kW]) / 1000.*
- const std::vector< double > `STDEV_DAILY_WIND_CAPACITY_FACTORS`

*The standard deviation in daily wind capacity factors for each month, where capacity factor is daily production [MWh] divided by maximum daily production [MWh]. Maximum daily production is simply (24)(power capacity [kW]) / 1000.*
- const std::string `GAME_CHANNEL` = "GAME CHANNEL"

*A message channel for game messages.*
- const std::string `GAME_STATE_CHANNEL` = "GAME STATE CHANNEL"

*A message channel for game state messages.*

### 5.5.1 Detailed Description

Header file for various constants.



## 5.5.2 Function Documentation

### 5.5.2.1 FOREST\_GREEN()

```
const sf::Color FOREST_GREEN (
    34 ,
    139 ,
    34 )
```

The base colour of a forest tile.

### 5.5.2.2 LAKE\_BLUE()

```
const sf::Color LAKE_BLUE (
    0 ,
    102 ,
    204 )
```

The base colour of a lake (water) tile.

### 5.5.2.3 MENU\_FRAME\_GREY()

```
const sf::Color MENU_FRAME_GREY (
    185 ,
    187 ,
    182 )
```

The base colour of the context menu frame.

### 5.5.2.4 MONOCHROME\_SCREEN\_BACKGROUND()

```
const sf::Color MONOCHROME_SCREEN_BACKGROUND (
    40 ,
    40 ,
    40 )
```

The base colour of old monochrome screens.

#### 5.5.2.5 MONOCHROME\_TEXT\_AMBER()

```
const sf::Color MONOCHROME_TEXT_AMBER (
    255 ,
    176 ,
    0 )
```

The base colour of old monochrome text (amber).

#### 5.5.2.6 MONOCHROME\_TEXT\_GREEN()

```
const sf::Color MONOCHROME_TEXT_GREEN (
    0 ,
    255 ,
    102 )
```

The base colour of old monochrome text (green).

#### 5.5.2.7 MONOCHROME\_TEXT\_RED()

```
const sf::Color MONOCHROME_TEXT_RED (
    255 ,
    44 ,
    0 )
```

The base colour of old monochrome text (red).

#### 5.5.2.8 MOUNTAINS\_GREY()

```
const sf::Color MOUNTAINS_GREY (
    97 ,
    110 ,
    113 )
```

The base colour of a mountains tile.

#### 5.5.2.9 OCEAN\_BLUE()

```
const sf::Color OCEAN_BLUE (
    0 ,
    51 ,
    102 )
```

The base colour of an ocean (water) tile.

#### 5.5.2.10 PLAINS\_YELLOW()

```
const sf::Color PLAINS_YELLOW (
    245 ,
    222 ,
    133 )
```

The base colour of a plains tile.

#### 5.5.2.11 RESOURCE\_CHIP\_GREY()

```
const sf::Color RESOURCE_CHIP_GREY (
    175 ,
    175 ,
    175 ,
    250 )
```

The base colour of the resource chip (backing).

#### 5.5.2.12 VISUAL\_SCREEN\_FRAME\_GREY()

```
const sf::Color VISUAL_SCREEN_FRAME_GREY (
    151 ,
    151 ,
    143 )
```

The base colour of the framing of the visual screen.

### 5.5.3 Variable Documentation

#### 5.5.3.1 BUILD\_SETTLEMENT\_COST

```
const int BUILD_SETTLEMENT_COST = 250
```

The cost of building a settlement.

#### 5.5.3.2 CLEAR\_FOREST\_COST

```
const int CLEAR_FOREST_COST = 40
```

The cost of clearing a forest tile.

#### 5.5.3.3 CLEAR\_MOUNTAINS\_COST

```
const int CLEAR_MOUNTAINS_COST = 250
```

The cost of clearing a mountains tile.

#### 5.5.3.4 CLEAR\_PLAINS\_COST

```
const int CLEAR_PLAINS_COST = 20
```

The cost of clearing a plains tile.

#### 5.5.3.5 COST\_PER\_LITRE\_DIESEL

```
const double COST_PER_LITRE_DIESEL = 1.75
```

The cost of a litre of diesel.

#### 5.5.3.6 CREDITS\_PER\_MWH\_SERVED

```
const double CREDITS_PER_MWH_SERVED = 1
```

The number of credits (x1000) earned.

#### 5.5.3.7 DAILY\_TIDAL\_CAPACITY\_FACTOR

```
const double DAILY_TIDAL_CAPACITY_FACTOR = 0.225
```

The daily tidal capacity factor, where capacity factor is daily production [MWh] divided by maximum daily production [MWh]. Maximum daily production is simply  $(24)(\text{power capacity [kW]}) / 1000$ . The tides are not a random process (usually semi-diurnal, mostly driven by orbits of moon and sun).

#### 5.5.3.8 DIESEL\_GENERATOR\_BUILD\_COST

```
const int DIESEL_GENERATOR_BUILD_COST = 100
```

The cost of building (or upgrading) a diesel generator in 100 kW increments.

#### 5.5.3.9 DIESEL\_OP\_MAINT\_COST\_PER\_MWH\_PRODUCTION

```
const double DIESEL_OP_MAINT_COST_PER_MWH_PRODUCTION = 50
```

The operation and maintenace cost of running a diesel generator (assumed 0.05 credits per kWh produced).

#### 5.5.3.10 EMISSIONS\_LIFETIME\_LIMIT\_TONNES

```
const int EMISSIONS_LIFETIME_LIMIT_TONNES = 1200
```

The lifetime limit on CO2-equivalent emissions (1 tonne CO2e  $\sim$  667 L diesel).

#### 5.5.3.11 ENERGY\_STORAGE\_SYSTEM\_BUILD\_COST

```
const int ENERGY_STORAGE_SYSTEM_BUILD_COST = 160
```

The cost of adding energy storage in 200 kWh increments.

#### 5.5.3.12 FLOAT\_TOLERANCE

```
const double FLOAT_TOLERANCE = 1e-6
```

Tolerance for floating point equality tests.

#### 5.5.3.13 FRAMES\_PER\_SECOND

```
const int FRAMES_PER_SECOND = 60
```

Target frames per second.

#### 5.5.3.14 GAME\_CHANNEL

```
const std::string GAME_CHANNEL = "GAME CHANNEL"
```

A message channel for game messages.

#### 5.5.3.15 GAME\_HEIGHT

```
const int GAME_HEIGHT = 800
```

Height of the game space.

#### 5.5.3.16 GAME\_STATE\_CHANNEL

```
const std::string GAME_STATE_CHANNEL = "GAME STATE CHANNEL"
```

A message channel for game state messages.

#### 5.5.3.17 GAME\_WIDTH

```
const int GAME_WIDTH = 1200
```

Width of the game space.

#### 5.5.3.18 HEX\_MAP\_CHANNEL

```
const std::string HEX_MAP_CHANNEL = "HEX MAP CHANNEL"
```

A message channel for hex map messages.

#### 5.5.3.19 KG\_CO2E\_PER\_LITRE\_DIESEL

```
const double KG_CO2E_PER_LITRE_DIESEL = 3.1596
```

The CO<sub>2</sub>-equivalent mass of emissions that result from burning one litre of diesel fuel.

#### 5.5.3.20 LITRES\_DIESEL\_PER\_MWH\_PRODUCTION

```
const double LITRES_DIESEL_PER_MWH_PRODUCTION = 375
```

The litres of diesel consumed in producing 1 MWh (assumes higher heating value and constant thermal efficiency of ~0.25).

#### 5.5.3.21 MAX\_STORAGE\_LEVELS

```
const int MAX_STORAGE_LEVELS = 5
```

The maximum storage level of any tile improvement.

#### 5.5.3.22 MAX\_UPGRADE\_LEVELS

```
const int MAX_UPGRADE_LEVELS = 5
```

The maximum upgrade level of any tile improvement.

#### 5.5.3.23 MAXIMUM\_DAILY\_DEMAND\_PER\_CAPITA

```
const double MAXIMUM_DAILY_DEMAND_PER_CAPITA = 0.0475
```

The maximum daily demand [MWh] (at any point in the year) per capita.

#### 5.5.3.24 MEAN\_DAILY\_DEMAND\_RATIOS

```
const std::vector<double> MEAN_DAILY_DEMAND_RATIOS
```

**Initial value:**

```
= {  
    0.702, 0.704, 0.652,  
    0.546, 0.445, 0.362,  
    0.261, 0.261, 0.379,  
    0.518, 0.622, 0.716  
}
```

The mean daily demand ratio for each month, where demand ratio is demand [MWh] divided by maximum daily demand [MWh]. Maximum daily demand is simply (24)(max load [kW]) / 1000.

#### 5.5.3.25 MEAN\_DAILY\_SOLAR\_CAPACITY\_FACTORS

```
const std::vector<double> MEAN_DAILY_SOLAR_CAPACITY_FACTORS
```

**Initial value:**

```
= {  
    0.029, 0.061, 0.117,  
    0.183, 0.228, 0.233,  
    0.219, 0.185, 0.139,  
    0.081, 0.040, 0.021  
}
```

The mean daily solar capacity factors for each month, where capacity factor is daily production [MWh] divided by maximum daily production [MWh]. Maximum daily production is simply (24)(power capacity [kW]) / 1000.

#### 5.5.3.26 MEAN\_DAILY\_WAVE\_CAPACITY\_FACTORS

```
const std::vector<double> MEAN_DAILY_WAVE_CAPACITY_FACTORS
```

**Initial value:**

```
= {  
    0.742, 0.694, 0.618,  
    0.467, 0.366, 0.292,  
    0.280, 0.293, 0.374,  
    0.424, 0.662, 0.600  
}
```

The mean daily wave capacity factors for each month, where capacity factor is daily production [MWh] divided by maximum daily production [MWh]. Maximum daily production is simply (24)(power capacity [kW]) / 1000.

#### 5.5.3.27 MEAN\_DAILY\_WIND\_CAPACITY\_FACTORS

```
const std::vector<double> MEAN_DAILY_WIND_CAPACITY_FACTORS
```

**Initial value:**

```
= {  
    0.591, 0.594, 0.627,  
    0.629, 0.579, 0.537,  
    0.442, 0.507, 0.587,  
    0.618, 0.611, 0.580  
}
```

The mean daily wind capacity factors for each month, where capacity factor is daily production [MWh] divided by maximum daily production [MWh]. Maximum daily production is simply (24)(power capacity [kW]) / 1000.

#### 5.5.3.28 NO\_TILE\_SELECTED\_CHANNEL

```
const std::string NO_TILE_SELECTED_CHANNEL = "NO TILE SELECTED CHANNEL"
```

A message channel for no tile selected messages.

#### 5.5.3.29 POPULATION\_MONTHLY\_GROWTH\_RATE

```
const double POPULATION_MONTHLY_GROWTH_RATE = 1.02
```

The monthly population growth rate.

#### 5.5.3.30 RESOURCE\_ASSESSMENT\_COST

```
const int RESOURCE_ASSESSMENT_COST = 20
```

The cost of doing a resource assessment.



#### 5.5.3.31 SCRAP\_COST

```
const int SCRAP_COST = 50
```

The cost of scrapping a tile improvement (other than settlement).

#### 5.5.3.32 SECONDS\_PER\_FRAME

```
const double SECONDS_PER_FRAME = 1.0 / 60
```

Target seconds per frame (just reciprocal of target frames per second).

#### 5.5.3.33 SECONDS\_PER\_MONTH

```
const unsigned long long int SECONDS_PER_MONTH = 2628164
```

#### 5.5.3.34 SECONDS\_PER\_YEAR

```
const unsigned long long int SECONDS_PER_YEAR = 31537970
```

#### 5.5.3.35 SETTLEMENT\_CHANNEL

```
const std::string SETTLEMENT_CHANNEL = "SETTLEMENT CHANNEL"
```

A message channel for the settlement.

#### 5.5.3.36 SOLAR\_OP\_MAINT\_COST\_PER\_MWH\_PRODUCTION

```
const double SOLAR_OP_MAINT_COST_PER_MWH_PRODUCTION = 10
```

The operation and maintenance cost of running a solar PV array (assumed 0.01 credits per kWh produced).

#### 5.5.3.37 SOLAR\_PV\_BUILD\_COST

```
const int SOLAR_PV_BUILD_COST = 300
```

The cost of building (or upgrading) a solar PV array in 100 kW increments.

#### 5.5.3.38 SOLAR\_PV\_WATER\_BUILD\_MULTIPLIER

```
const double SOLAR_PV_WATER_BUILD_MULTIPLIER = 1.5
```

The additional cost of building on water.

#### 5.5.3.39 STARTING\_CREDITS

```
const int STARTING_CREDITS = 800
```

The starting balance of credits.

#### 5.5.3.40 STARTING\_POPULATION

```
const int STARTING_POPULATION = 100
```

The starting population of a settlement.

#### 5.5.3.41 STDEV\_DAILY\_DEMAND\_RATIOS

```
const std::vector<double> STDEV_DAILY_DEMAND_RATIOS
```

**Initial value:**

```
= {  
    0.069, 0.074, 0.072,  
    0.072, 0.063, 0.060,  
    0.012, 0.031, 0.040,  
    0.049, 0.063, 0.053  
}
```

The standard deviation in daily demand ratio for each month, where demand ratio is demand [MWh] divided by maximum daily demand [MWh]. Maximum daily demand is simply  $(24)(\text{max load [kW]}) / 1000$ .

#### 5.5.3.42 STDEV\_DAILY\_SOLAR\_CAPACITY\_FACTORS

```
const std::vector<double> STDEV_DAILY_SOLAR_CAPACITY_FACTORS
```

**Initial value:**

```
= {  
    0.013, 0.024, 0.043,  
    0.049, 0.072, 0.072,  
    0.076, 0.065, 0.048,  
    0.026, 0.018, 0.009  
}
```

The standard deviation in daily solar capacity factors for each month, where capacity factor is daily production [MWh] divided by maximum daily production [MWh]. Maximum daily production is simply (24)(power capacity [kW]) / 1000.

#### 5.5.3.43 STDEV\_DAILY\_WAVE\_CAPACITY\_FACTORS

```
const std::vector<double> STDEV_DAILY_WAVE_CAPACITY_FACTORS
```

**Initial value:**

```
= {  
    0.146, 0.135, 0.163,  
    0.145, 0.158, 0.106,  
    0.086, 0.058, 0.145,  
    0.171, 0.184, 0.309  
}
```

The standard deviation in daily wave capacity factors for each month, where capacity factor is daily production [MWh] divided by maximum daily production [MWh]. Maximum daily production is simply (24)(power capacity [kW]) / 1000.

#### 5.5.3.44 STDEV\_DAILY\_WIND\_CAPACITY\_FACTORS

```
const std::vector<double> STDEV_DAILY_WIND_CAPACITY_FACTORS
```

**Initial value:**

```
= {  
    0.147, 0.142, 0.198,  
    0.154, 0.162, 0.202,  
    0.180, 0.217, 0.198,  
    0.168, 0.141, 0.168  
}
```

The standard deviation in daily wind capacity factors for each month, where capacity factor is daily production [MWh] divided by maximum daily production [MWh]. Maximum daily production is simply (24)(power capacity [kW]) / 1000.

#### 5.5.3.45 TIDAL\_OP\_MAINT\_COST\_PER\_MWH\_PRODUCTION

```
const double TIDAL_OP_MAINT_COST_PER_MWH_PRODUCTION = 50
```

The operation and maintenance cost of running a tidal turbine (assumed 0.05 credits per kWh produced).

#### 5.5.3.46 TIDAL\_TURBINE\_BUILD\_COST

```
const int TIDAL_TURBINE_BUILD_COST = 600
```

The cost of building (or upgrading) a tidal turbine in 100 kW increments.

#### 5.5.3.47 TILE\_RESOURCE\_CUMULATIVE\_PROBABILITIES

```
const std::vector<double> TILE_RESOURCE_CUMULATIVE_PROBABILITIES
```

**Initial value:**

```
= {  
    0.10,  
    0.30,  
    0.70,  
    0.90,  
    1.00  
}
```

Cumulative probabilities for each tile resource (to support procedural generation).

#### 5.5.3.48 TILE\_SELECTED\_CHANNEL

```
const std::string TILE_SELECTED_CHANNEL = "TILE SELECTED CHANNEL"
```

A message channel for tile selection messages.

#### 5.5.3.49 TILE\_STATE\_CHANNEL

```
const std::string TILE_STATE_CHANNEL = "TILE STATE CHANNEL"
```

A message channel for tile state messages.

#### 5.5.3.50 TILE\_TYPE\_CUMULATIVE\_PROBABILITIES

```
const std::vector<double> TILE_TYPE_CUMULATIVE_PROBABILITIES
```

**Initial value:**

```
= {  
    0.25,  
    0.50,  
    0.75,  
    1.00  
}
```

Cumulative probabilities for each tile type (to support procedural generation).

#### 5.5.3.51 WAVE\_ENERGY\_CONVERTER\_BUILD\_COST

```
const int WAVE_ENERGY_CONVERTER_BUILD_COST = 800
```

The cost of building (or upgrading) a wave energy converter in 100 kW increments.

#### 5.5.3.52 WAVE\_OP\_MAINT\_COST\_PER\_MWH\_PRODUCTION

```
const double WAVE_OP_MAINT_COST_PER_MWH_PRODUCTION = 50
```

The operation and maintenance cost of running a wave energy converter (assumed 0.05 credits per kWh produced).

#### 5.5.3.53 WIND\_OP\_MAINT\_COST\_PER\_MWH\_PRODUCTION

```
const double WIND_OP_MAINT_COST_PER_MWH_PRODUCTION = 50
```

The operation and maintenance cost of running a wind turbine (assumed 0.05 credits per kWh produced).

#### 5.5.3.54 WIND\_TURBINE\_BUILD\_COST

```
const int WIND_TURBINE_BUILD_COST = 400
```

The cost of building (or upgrading) a wind turbine in 100 kW increments.

#### 5.5.3.55 WIND\_TURBINE\_WATER\_BUILD\_MULTIPLIER

```
const double WIND_TURBINE_WATER_BUILD_MULTIPLIER = 1.25
```

The additional cost of building on water.

## 5.6 header/ESC\_core/doxygen\_cite.h File Reference

Header file which simply cites the doxygen tool.

### 5.6.1 Detailed Description

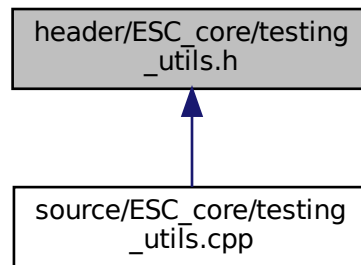
Header file which simply cites the doxygen tool.

Ref: [van Heesch. \[2023\]](#)





This graph shows which files directly or indirectly include this file:



## Functions

- void [printGreen](#) (std::string)  
*A function that sends green text to std::cout.*
- void [printGold](#) (std::string)  
*A function that sends gold text to std::cout.*
- void [printRed](#) (std::string)  
*A function that sends red text to std::cout.*
- void [testFloatEquals](#) (double, double, std::string, int)  
*Tests for the equality of two floating point numbers  $x$  and  $y$  (to within `FLOAT_TOLERANCE`).*
- void [testGreaterThan](#) (double, double, std::string, int)  
*Tests if  $x > y$ .*
- void [testGreaterThanOrEqualTo](#) (double, double, std::string, int)  
*Tests if  $x \geq y$ .*
- void [testLessThan](#) (double, double, std::string, int)  
*Tests if  $x < y$ .*
- void [testLessThanOrEqualTo](#) (double, double, std::string, int)  
*Tests if  $x \leq y$ .*
- void [testTruth](#) (bool, std::string, int)  
*Tests if the given statement is true.*
- void [expectedErrorNotDetected](#) (std::string, int)  
*A utility function to print out a meaningful error message whenever an expected error fails to be thrown/caught/detected.*

### 5.9.1 Detailed Description

Header file for various testing utilities.

This is a library of utility functions used throughout the various test suites.

### 5.9.2 Function Documentation



### 5.9.2.1 expectedErrorNotDetected()

```
void expectedErrorNotDetected (
    std::string file,
    int line )
```

A utility function to print out a meaningful error message whenever an expected error fails to be thrown/caught/detected.

#### Parameters

<i>file</i>	The file in which the test is applied (you should be able to just pass in "__FILE__").
<i>line</i>	The line of the file in which the test is applied (you should be able to just pass in "__LINE__").

```
462 {
463     std::string error_str = "\n ERROR   failed to throw expected error prior to line ";
464     error_str += std::to_string(line);
465     error_str += " of ";
466     error_str += file;
467
468     #ifdef _WIN32
469         std::cout << error_str << std::endl;
470     #endif
471
472     throw std::runtime_error(error_str);
473     return;
474 } /* expectedErrorNotDetected() */
```

### 5.9.2.2 printGold()

```
void printGold (
    std::string input_str )
```

A function that sends gold text to std::cout.

#### Parameters

<i>input_str</i>	The text of the string to be sent to std::cout.
------------------	---

```
114 {
115     std::cout << "\x1B[33m" << input_str << "\033[0m";
116     return;
117 } /* printGold() */
```

### 5.9.2.3 printGreen()

```
void printGreen (
    std::string input_str )
```

A function that sends green text to std::cout.

#### Parameters

<i>input_str</i>	The text of the string to be sent to std::cout.
------------------	---

```

94 {
95     std::cout << "\xB[32m" << input_str << "\033[0m";
96     return;
97 } /* printGreen() */

```

#### 5.9.2.4 printRed()

```

void printRed (
    std::string input_str )

```

A function that sends red text to std::cout.

##### Parameters

<i>input_str</i>	The text of the string to be sent to std::cout.
------------------	---

```

134 {
135     std::cout << "\xB[31m" << input_str << "\033[0m";
136     return;
137 } /* printRed() */

```

#### 5.9.2.5 testFloatEquals()

```

void testFloatEquals (
    double x,
    double y,
    std::string file,
    int line )

```

Tests for the equality of two floating point numbers *x* and *y* (to within `FLOAT_TOLERANCE`).

##### Parameters

<i>x</i>	The first of two numbers to test.
<i>y</i>	The second of two numbers to test.
<i>file</i>	The file in which the test is applied (you should be able to just pass in " <code>__FILE__</code> ").
<i>line</i>	The line of the file in which the test is applied (you should be able to just pass in " <code>__LINE__</code> ").

```

168 {
169     if (fabs(x - y) <= FLOAT_TOLERANCE) {
170         return;
171     }
172
173     std::string error_str = "ERROR: testFloatEquals():\t in ";
174     error_str += file;
175     error_str += "\tline ";
176     error_str += std::to_string(line);
177     error_str += ":\t\n";
178     error_str += std::to_string(x);
179     error_str += " and ";
180     error_str += std::to_string(y);
181     error_str += " are not equal to within +/- ";
182     error_str += std::to_string(FLOAT_TOLERANCE);
183     error_str += "\n";
184
185     #ifdef _WIN32
186         std::cout << error_str << std::endl;
187     #endif

```

```

188
189     throw std::runtime_error(error_str);
190     return;
191 } /* testFloatEquals() */

```

### 5.9.2.6 testGreaterThan()

```

void testGreaterThan (
    double x,
    double y,
    std::string file,
    int line )

```

Tests if  $x > y$ .

#### Parameters

<i>x</i>	The first of two numbers to test.
<i>y</i>	The second of two numbers to test.
<i>file</i>	The file in which the test is applied (you should be able to just pass in "__FILE__").
<i>line</i>	The line of the file in which the test is applied (you should be able to just pass in "__LINE__").

```

221 {
222     if (x > y) {
223         return;
224     }
225
226     std::string error_str = "ERROR: testGreaterThan():\t in ";
227     error_str += file;
228     error_str += "\tline ";
229     error_str += std::to_string(line);
230     error_str += ":\t\n";
231     error_str += std::to_string(x);
232     error_str += " is not greater than ";
233     error_str += std::to_string(y);
234     error_str += "\n";
235
236     #ifdef _WIN32
237         std::cout << error_str << std::endl;
238     #endif
239
240     throw std::runtime_error(error_str);
241     return;
242 } /* testGreaterThan() */

```

### 5.9.2.7 testGreaterThanOrEqualTo()

```

void testGreaterThanOrEqualTo (
    double x,
    double y,
    std::string file,
    int line )

```

Tests if  $x \geq y$ .

#### Parameters

<i>x</i>	The first of two numbers to test.
----------	-----------------------------------

## Parameters

<i>y</i>	The second of two numbers to test.
<i>file</i>	The file in which the test is applied (you should be able to just pass in "__FILE__").
<i>line</i>	The line of the file in which the test is applied (you should be able to just pass in "__LINE__").

```

272 {
273     if (x >= y) {
274         return;
275     }
276
277     std::string error_str = "ERROR: testGreaterThanOrEqualTo():\t in ";
278     error_str += file;
279     error_str += "\tline ";
280     error_str += std::to_string(line);
281     error_str += ":\t\n";
282     error_str += std::to_string(x);
283     error_str += " is not greater than or equal to ";
284     error_str += std::to_string(y);
285     error_str += "\n";
286
287     #ifdef _WIN32
288         std::cout << error_str << std::endl;
289     #endif
290
291     throw std::runtime_error(error_str);
292     return;
293 } /* testGreaterThanOrEqualTo() */

```

## 5.9.2.8 testLessThan()

```

void testLessThan (
    double x,
    double y,
    std::string file,
    int line )

```

Tests if  $x < y$ .

## Parameters

<i>x</i>	The first of two numbers to test.
<i>y</i>	The second of two numbers to test.
<i>file</i>	The file in which the test is applied (you should be able to just pass in "__FILE__").
<i>line</i>	The line of the file in which the test is applied (you should be able to just pass in "__LINE__").

```

323 {
324     if (x < y) {
325         return;
326     }
327
328     std::string error_str = "ERROR: testLessThan():\t in ";
329     error_str += file;
330     error_str += "\tline ";
331     error_str += std::to_string(line);
332     error_str += ":\t\n";
333     error_str += std::to_string(x);
334     error_str += " is not less than ";
335     error_str += std::to_string(y);
336     error_str += "\n";
337
338     #ifdef _WIN32
339         std::cout << error_str << std::endl;
340     #endif
341
342     throw std::runtime_error(error_str);
343     return;

```

```
344 }    /* testLessThan() */
```

### 5.9.2.9 testLessThanOrEqualTo()

```
void testLessThanOrEqualTo (
    double x,
    double y,
    std::string file,
    int line )
```

Tests if  $x \leq y$ .

#### Parameters

<i>x</i>	The first of two numbers to test.
<i>y</i>	The second of two numbers to test.
<i>file</i>	The file in which the test is applied (you should be able to just pass in "__FILE__").
<i>line</i>	The line of the file in which the test is applied (you should be able to just pass in "__LINE__").

```
374 {
375     if (x <= y) {
376         return;
377     }
378
379     std::string error_str = "ERROR: testLessThanOrEqualTo():\t in ";
380     error_str += file;
381     error_str += "\tline ";
382     error_str += std::to_string(line);
383     error_str += ":\t\n";
384     error_str += std::to_string(x);
385     error_str += " is not less than or equal to ";
386     error_str += std::to_string(y);
387     error_str += "\n";
388
389     #ifdef _WIN32
390         std::cout << error_str << std::endl;
391     #endif
392
393     throw std::runtime_error(error_str);
394     return;
395 }    /* testLessThanOrEqualTo() */
```

### 5.9.2.10 testTruth()

```
void testTruth (
    bool statement,
    std::string file,
    int line )
```

Tests if the given statement is true.

#### Parameters

<i>statement</i>	The statement whose truth is to be tested ("1 == 0", for example).
<i>file</i>	The file in which the test is applied (you should be able to just pass in "__FILE__").
<i>line</i>	The line of the file in which the test is applied (you should be able to just pass in "__LINE__").

```

422 {
423     if (statement) {
424         return;
425     }
426
427     std::string error_str = "ERROR: testTruth():\t in ";
428     error_str += file;
429     error_str += "\tline ";
430     error_str += std::to_string(line);
431     error_str += ":\t\n";
432     error_str += "Given statement is not true";
433
434     #ifdef _WIN32
435         std::cout << error_str << std::endl;
436     #endif
437
438     throw std::runtime_error(error_str);
439     return;
440 } /* testTruth() */

```

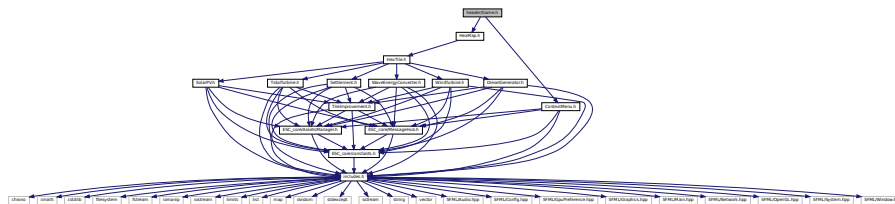
## 5.10 header/Game.h File Reference

```

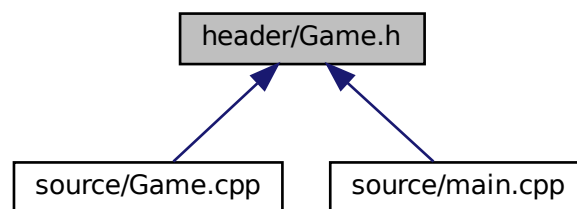
#include "HexMap.h"
#include "ContextMenu.h"

```

Include dependency graph for Game.h:



This graph shows which files directly or indirectly include this file:



## Classes

- class [Game](#)

*A class which acts as the central class for the game, by containing all other classes and implementing the game loop.*

## Enumerations

- enum `GamePhase` {  
`BUILD_SETTLEMENT`, `SYSTEM_MANAGEMENT`, `LOSS_EMISSIONS`, `LOSS_DEMAND`,  
`LOSS_CREDITS`, `VICTORY`, `N_GAME_PHASES` }

*An enumeration of the various game phases.*

### 5.10.1 Enumeration Type Documentation

#### 5.10.1.1 GamePhase

```
enum GamePhase
```

An enumeration of the various game phases.

## Enumerator

BUILD_SETTLEMENT	The settlement building phase.
SYSTEM_MANAGEMENT	The system management phase (main phase of play).
LOSS_EMISSIONS	A loss due to excessive emissions.
LOSS_DEMAND	A loss due to failing to meet the demand.
LOSS_CREDITS	A loss due to running out of credits.
VICTORY	A victory (12 consecutive months of zero emissions).
N_GAME_PHASES	A simple hack to get the number of elements in GamePhase.

```

66         {
67         BUILD_SETTLEMENT,
68         SYSTEM_MANAGEMENT,
69         LOSS_EMISSIONS,
70         LOSS_DEMAND,
71         LOSS_CREDITS,
72         VICTORY,
73         N_GAME_PHASES
74     }; /* GamePhase */

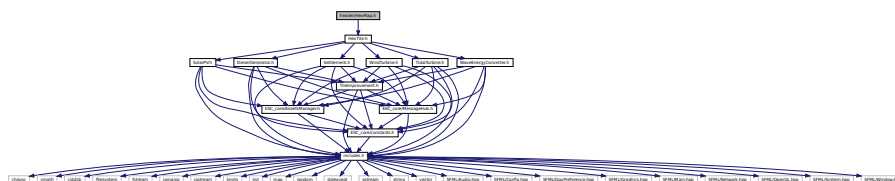
```

## 5.11 header/HexMap.h File Reference

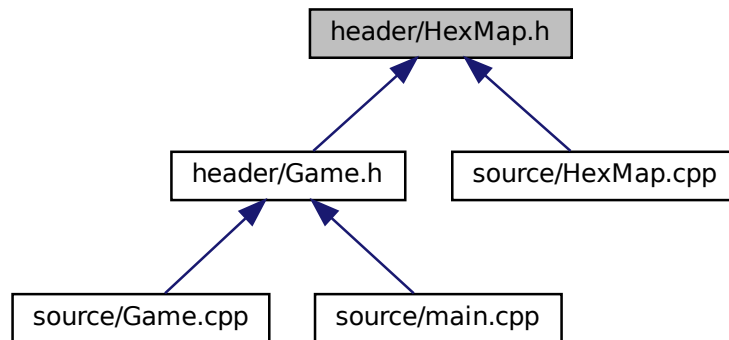
Header file for the [HexMap](#) class.

```
#include "HexTile.h"
```

Include dependency graph for HexMap.h:



This graph shows which files directly or indirectly include this file:



## Classes

- class [HexMap](#)

*A class which defines a hex map of hex tiles.*

### 5.11.1 Detailed Description

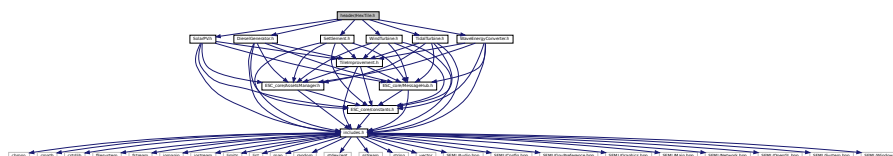
Header file for the [HexMap](#) class.

## 5.12 header/HexTile.h File Reference

Header file for the [Game](#) class.

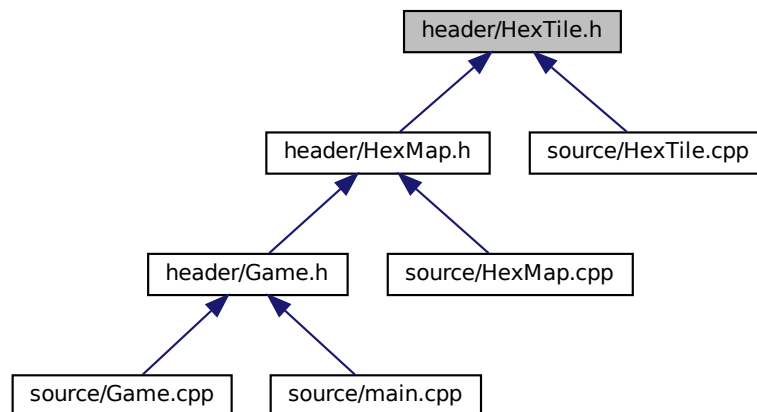
```
#include "DieselGenerator.h"
#include "Settlement.h"
#include "SolarPV.h"
#include "TidalTurbine.h"
#include "WaveEnergyConverter.h"
#include "WindTurbine.h"
```

Include dependency graph for HexTile.h:





This graph shows which files directly or indirectly include this file:



## Classes

- class [HexTile](#)  
A class which defines a hex tile of the hex map.

## Enumerations

- enum [TileType](#) {  
NONE\_TYPE , FOREST , LAKE , MOUNTAINS ,  
OCEAN , PLAINS , N\_TILE\_TYPES }  
An enumeration of the different tile types.
- enum [TileResource](#) {  
POOR , BELOW\_AVERAGE , AVERAGE , ABOVE\_AVERAGE ,  
GOOD , N\_TILE\_RESOURCES }  
An enumeration of the different tile resource values.

### 5.12.1 Detailed Description

Header file for the [Game](#) class.

Header file for the [HexTile](#) class.

### 5.12.2 Enumeration Type Documentation

#### 5.12.2.1 TileResource

enum [TileResource](#)

An enumeration of the different tile resource values.

## Enumerator

POOR	A poor resource value.
BELOW_AVERAGE	A below average resource value.
AVERAGE	An average resource value.
ABOVE_AVERAGE	An above average resource value.
GOOD	A good resource value.
N_TILE_RESOURCES	A simple hack to get the number of elements in TileResource.

```

88         {
89     POOR,
90     BELOW_AVERAGE,
91     AVERAGE,
92     ABOVE_AVERAGE,
93     GOOD,
94     N_TILE_RESOURCES
95 }; /* TileResource */

```

## 5.12.2.2 TileType

```
enum TileType
```

An enumeration of the different tile types.

## Enumerator

NONE_TYPE	A dummy tile (for initialization).
FOREST	A forest tile.
LAKE	A lake tile.
MOUNTAINS	A mountains tile.
OCEAN	An ocean tile.
PLAINS	A plains tile.
N_TILE_TYPES	A simple hack to get the number of elements in TileType.

```

71         {
72     NONE_TYPE,
73     FOREST,
74     LAKE,
75     MOUNTAINS,
76     OCEAN,
77     PLAINS,
78     N_TILE_TYPES
79 }; /* TileType */

```

## 5.13 header/Settlement.h File Reference

Header file for the [Settlement](#) class.

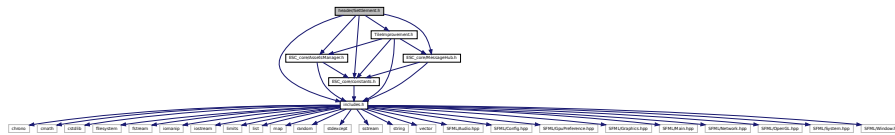
```

#include "ESC_core/constants.h"
#include "ESC_core/includes.h"
#include "ESC_core/AssetsManager.h"
#include "ESC_core/MessageHub.h"

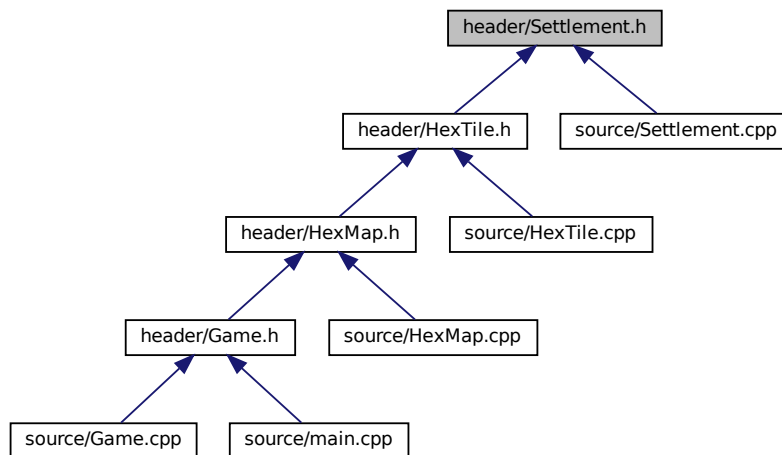
```

```
#include "TileImprovement.h"
```

Include dependency graph for Settlement.h:



This graph shows which files directly or indirectly include this file:



## Classes

- class [Settlement](#)  
A settlement class (child class of [TileImprovement](#)).

### 5.13.1 Detailed Description

Header file for the [Settlement](#) class.

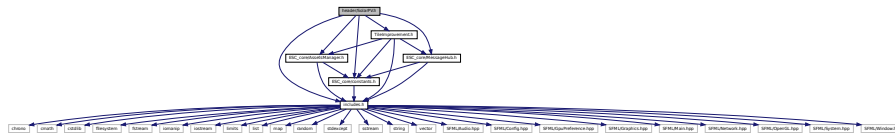
## 5.14 header/SolarPV.h File Reference

Header file for the [SolarPV](#) class.

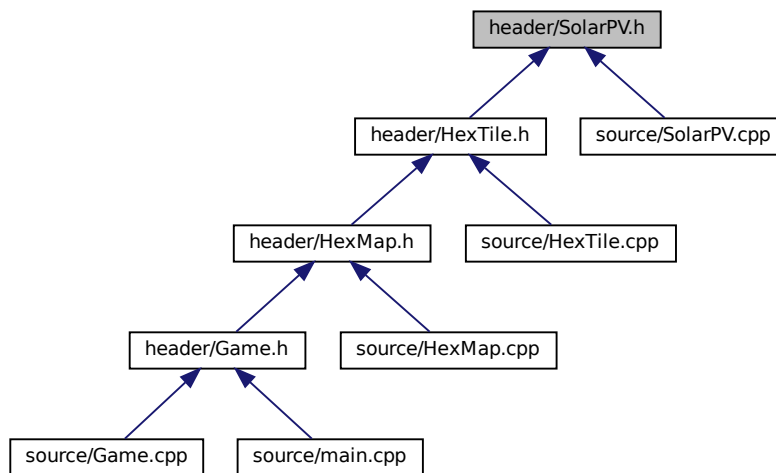
```
#include "ESC_core/constants.h"
#include "ESC_core/includes.h"
#include "ESC_core/AssetsManager.h"
#include "ESC_core/MessageHub.h"
```

```
#include "TileImprovement.h"
```

Include dependency graph for SolarPV.h:



This graph shows which files directly or indirectly include this file:



## Classes

- class [SolarPV](#)  
A settlement class (child class of [TileImprovement](#)).

### 5.14.1 Detailed Description

Header file for the [SolarPV](#) class.

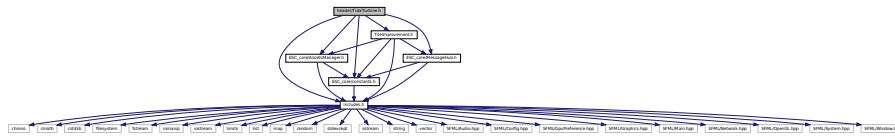
## 5.15 header/TidalTurbine.h File Reference

Header file for the [TidalTurbine](#) class.

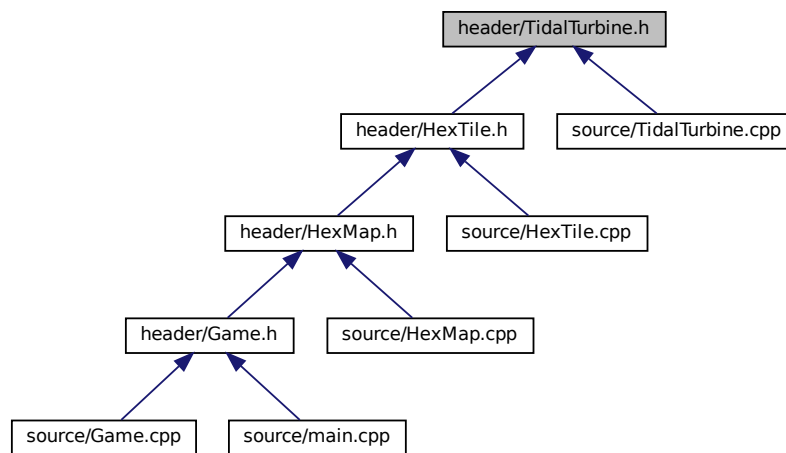
```
#include "ESC_core/constants.h"
#include "ESC_core/includes.h"
#include "ESC_core/AssetsManager.h"
#include "ESC_core/MessageHub.h"
```

```
#include "TileImprovement.h"
```

Include dependency graph for TidalTurbine.h:



This graph shows which files directly or indirectly include this file:



## Classes

- class TidalTurbine

A settlement class (child class of *TileImprovement*).

### 5.15.1 Detailed Description

Header file for the `TidalTurbine` class.

## 5.16 header/TileImprovement.h File Reference

Header file for the `TileImprovement` class.

```
#include "ESC_core/constants.h"
#include "ESC_core/includes.h"
#include "ESC_core/AssetsManager.h"
```



## Enumerator

SETTLEMENT	A settlement.
DIESEL_GENERATOR	A diesel generator.
SOLAR_PV	A solar PV array.
WIND_TURBINE	A wind turbine.
TIDAL_TURBINE	A tidal turbine.
WAVE_ENERGY_CONVERTER	A wave energy converter.
ENERGY_STORAGE_SYSTEM	An energy storage system.
N_TILE_IMPROVEMENT_TYPES	A simple hack to get the number of elements in TileImprovementType.

```

68         {
69     SETTLEMENT,
70     DIESEL_GENERATOR,
71     SOLAR_PV,
72     WIND_TURBINE,
73     TIDAL_TURBINE,
74     WAVE_ENERGY_CONVERTER,
75     ENERGY_STORAGE_SYSTEM,
76     N_TILE_IMPROVEMENT_TYPES
77 }; /* TileImprovementType */

```

## 5.17 header/WaveEnergyConverter.h File Reference

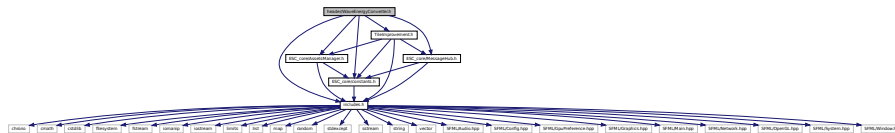
Header file for the [WaveEnergyConverter](#) class.

```

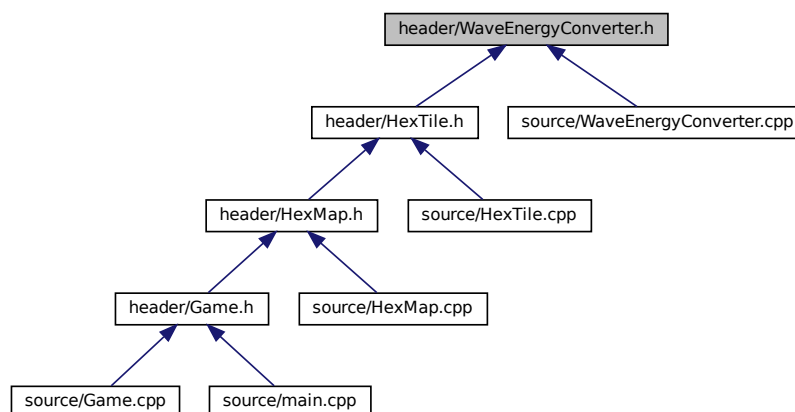
#include "ESC_core/constants.h"
#include "ESC_core/includes.h"
#include "ESC_core/AssetsManager.h"
#include "ESC_core/MessageHub.h"
#include "TileImprovement.h"

```

Include dependency graph for WaveEnergyConverter.h:



This graph shows which files directly or indirectly include this file:



## Classes

- class [WaveEnergyConverter](#)  
A settlement class (child class of [TileImprovement](#)).

### 5.17.1 Detailed Description

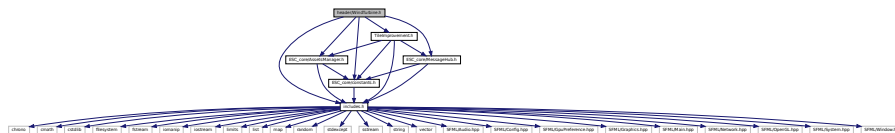
Header file for the [WaveEnergyConverter](#) class.

## 5.18 header/WindTurbine.h File Reference

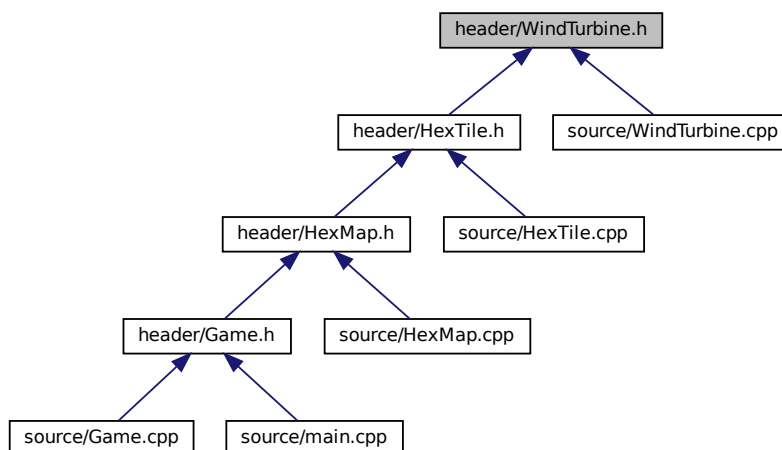
Header file for the [WindTurbine](#) class.

```
#include "ESC_core/constants.h"
#include "ESC_core/includes.h"
#include "ESC_core/AssetsManager.h"
#include "ESC_core/MessageHub.h"
#include "TileImprovement.h"
```

Include dependency graph for WindTurbine.h:



This graph shows which files directly or indirectly include this file:



## Classes

- class [WindTurbine](#)  
A settlement class (child class of [TileImprovement](#)).



### 5.18.1 Detailed Description

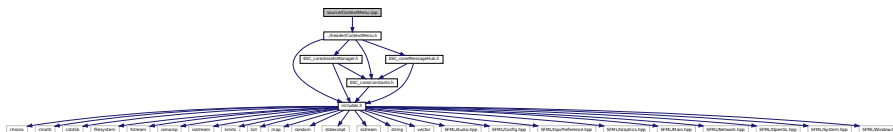
Header file for the `WindTurbine` class.

## 5.19 source/ContextMenu.cpp File Reference

Implementation file for the `ContextMenu` class.

```
#include "../header/ContextMenu.h"
```

Include dependency graph for ContextMenu.cpp:



### 5.19.1 Detailed Description

Implementation file for the `ContextMenu` class.

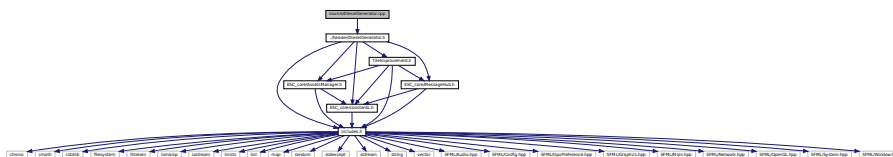
A class which defines a context menu for the game.

## 5.20 source/DieselGenerator.cpp File Reference

Implementation file for the DieselGenerator class.

```
#include "../header/DieselGenerator.h"
```

Include dependency graph for DieselGenerator.cpp:



### 5.20.1 Detailed Description

Implementation file for the [DieselGenerator](#) class.

A base class for the tile improvement hierarchy.





## 5.24.2 Function Documentation

### 5.24.2.1 expectedErrorNotDetected()

```
void expectedErrorNotDetected (
    std::string file,
    int line )
```

A utility function to print out a meaningful error message whenever an expected error fails to be thrown/caught/detected.

#### Parameters

<i>file</i>	The file in which the test is applied (you should be able to just pass in "__FILE__").
<i>line</i>	The line of the file in which the test is applied (you should be able to just pass in "__LINE__").

```
462 {
463     std::string error_str = "\n ERROR   failed to throw expected error prior to line ";
464     error_str += std::to_string(line);
465     error_str += " of ";
466     error_str += file;
467
468     #ifdef _WIN32
469         std::cout << error_str << std::endl;
470     #endif
471
472     throw std::runtime_error(error_str);
473     return;
474 } /* expectedErrorNotDetected() */
```

### 5.24.2.2 printGold()

```
void printGold (
    std::string input_str )
```

A function that sends gold text to std::cout.

#### Parameters

<i>input_str</i>	The text of the string to be sent to std::cout.
------------------	---

```
114 {
115     std::cout << "\x1B[33m" << input_str << "\033[0m";
116     return;
117 } /* printGold() */
```

### 5.24.2.3 printGreen()

```
void printGreen (
    std::string input_str )
```

A function that sends green text to std::cout.

## Parameters

<i>input_str</i>	The text of the string to be sent to <code>std::cout</code> .
------------------	---

```

94 {
95     std::cout << "\x1B[32m" << input_str << "\033[0m";
96     return;
97 } /* printGreen() */

```

## 5.24.2.4 printRed()

```

void printRed (
    std::string input_str )

```

A function that sends red text to `std::cout`.

## Parameters

<i>input_str</i>	The text of the string to be sent to <code>std::cout</code> .
------------------	---

```

134 {
135     std::cout << "\x1B[31m" << input_str << "\033[0m";
136     return;
137 } /* printRed() */

```

## 5.24.2.5 testFloatEquals()

```

void testFloatEquals (
    double x,
    double y,
    std::string file,
    int line )

```

Tests for the equality of two floating point numbers *x* and *y* (to within `FLOAT_TOLERANCE`).

## Parameters

<i>x</i>	The first of two numbers to test.
<i>y</i>	The second of two numbers to test.
<i>file</i>	The file in which the test is applied (you should be able to just pass in " <code>__FILE__</code> ").
<i>line</i>	The line of the file in which the test is applied (you should be able to just pass in " <code>__LINE__</code> ").

```

168 {
169     if (fabs(x - y) <= FLOAT_TOLERANCE) {
170         return;
171     }
172
173     std::string error_str = "ERROR: testFloatEquals():\t in ";
174     error_str += file;
175     error_str += "\tline ";
176     error_str += std::to_string(line);
177     error_str += ":\t\n";
178     error_str += std::to_string(x);
179     error_str += " and ";
180     error_str += std::to_string(y);
181     error_str += " are not equal to within +/- ";

```

```

182     error_str += std::to_string(FLOAT_TOLERANCE);
183     error_str += "\n";
184
185     #ifdef _WIN32
186         std::cout << error_str << std::endl;
187     #endif
188
189     throw std::runtime_error(error_str);
190     return;
191 } /* testFloatEquals() */

```

#### 5.24.2.6 testGreaterThan()

```

void testGreaterThan (
    double x,
    double y,
    std::string file,
    int line )

```

Tests if  $x > y$ .

##### Parameters

<i>x</i>	The first of two numbers to test.
<i>y</i>	The second of two numbers to test.
<i>file</i>	The file in which the test is applied (you should be able to just pass in "__FILE__").
<i>line</i>	The line of the file in which the test is applied (you should be able to just pass in "__LINE__").

```

221 {
222     if (x > y) {
223         return;
224     }
225
226     std::string error_str = "ERROR: testGreaterThan():\t in ";
227     error_str += file;
228     error_str += "\tline ";
229     error_str += std::to_string(line);
230     error_str += ":\t\n";
231     error_str += std::to_string(x);
232     error_str += " is not greater than ";
233     error_str += std::to_string(y);
234     error_str += "\n";
235
236     #ifdef _WIN32
237         std::cout << error_str << std::endl;
238     #endif
239
240     throw std::runtime_error(error_str);
241     return;
242 } /* testGreaterThan() */

```

#### 5.24.2.7 testGreaterThanOrEqualTo()

```

void testGreaterThanOrEqualTo (
    double x,
    double y,
    std::string file,
    int line )

```

Tests if  $x \geq y$ .

## Parameters

<i>x</i>	The first of two numbers to test.
<i>y</i>	The second of two numbers to test.
<i>file</i>	The file in which the test is applied (you should be able to just pass in "__FILE__").
<i>line</i>	The line of the file in which the test is applied (you should be able to just pass in "__LINE__").

```

272 {
273     if (x >= y) {
274         return;
275     }
276
277     std::string error_str = "ERROR: testGreaterThanOrEqualTo():\t in ";
278     error_str += file;
279     error_str += "\tline ";
280     error_str += std::to_string(line);
281     error_str += ":\t\n";
282     error_str += std::to_string(x);
283     error_str += " is not greater than or equal to ";
284     error_str += std::to_string(y);
285     error_str += "\n";
286
287     #ifdef _WIN32
288         std::cout << error_str << std::endl;
289     #endif
290
291     throw std::runtime_error(error_str);
292     return;
293 } /* testGreaterThanOrEqualTo() */

```

## 5.24.2.8 testLessThan()

```

void testLessThan (
    double x,
    double y,
    std::string file,
    int line )

```

Tests if  $x < y$ .

## Parameters

<i>x</i>	The first of two numbers to test.
<i>y</i>	The second of two numbers to test.
<i>file</i>	The file in which the test is applied (you should be able to just pass in "__FILE__").
<i>line</i>	The line of the file in which the test is applied (you should be able to just pass in "__LINE__").

```

323 {
324     if (x < y) {
325         return;
326     }
327
328     std::string error_str = "ERROR: testLessThan():\t in ";
329     error_str += file;
330     error_str += "\tline ";
331     error_str += std::to_string(line);
332     error_str += ":\t\n";
333     error_str += std::to_string(x);
334     error_str += " is not less than ";
335     error_str += std::to_string(y);
336     error_str += "\n";
337
338     #ifdef _WIN32
339         std::cout << error_str << std::endl;
340     #endif
341
342     throw std::runtime_error(error_str);

```

```

343     return;
344 } /* testLessThan() */

```

#### 5.24.2.9 testLessThanOrEqualTo()

```

void testLessThanOrEqualTo (
    double x,
    double y,
    std::string file,
    int line )

```

Tests if  $x \leq y$ .

##### Parameters

<i>x</i>	The first of two numbers to test.
<i>y</i>	The second of two numbers to test.
<i>file</i>	The file in which the test is applied (you should be able to just pass in "__FILE__").
<i>line</i>	The line of the file in which the test is applied (you should be able to just pass in "__LINE__").

```

374 {
375     if (x <= y) {
376         return;
377     }
378
379     std::string error_str = "ERROR: testLessThanOrEqualTo():\t in ";
380     error_str += file;
381     error_str += "\tline ";
382     error_str += std::to_string(line);
383     error_str += ":\t\n";
384     error_str += std::to_string(x);
385     error_str += " is not less than or equal to ";
386     error_str += std::to_string(y);
387     error_str += "\n";
388
389     #ifdef _WIN32
390         std::cout << error_str << std::endl;
391     #endif
392
393     throw std::runtime_error(error_str);
394     return;
395 } /* testLessThanOrEqualTo() */

```

#### 5.24.2.10 testTruth()

```

void testTruth (
    bool statement,
    std::string file,
    int line )

```

Tests if the given statement is true.

##### Parameters

<i>statement</i>	The statement whose truth is to be tested ("1 == 0", for example).
<i>file</i>	The file in which the test is applied (you should be able to just pass in "__FILE__").
<i>line</i>	The line of the file in which the test is applied (you should be able to just pass in "__LINE__").



```

422 {
423     if (statement) {
424         return;
425     }
426
427     std::string error_str = "ERROR: testTruth():\t in ";
428     error_str += file;
429     error_str += "\tline ";
430     error_str += std::to_string(line);
431     error_str += ":\t\t\n";
432     error_str += "Given statement is not true";
433
434     #ifdef _WIN32
435         std::cout << error_str << std::endl;
436     #endif
437
438     throw std::runtime_error(error_str);
439     return;
440 } /* testTruth() */

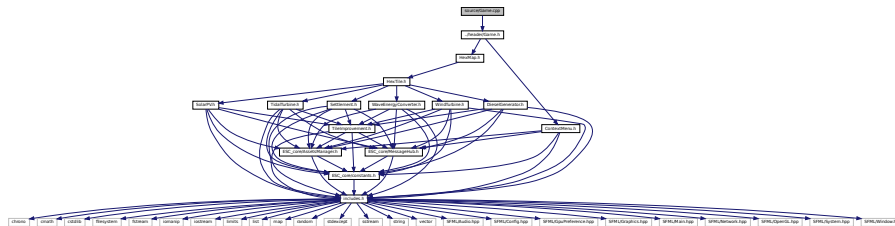
```

## 5.25 source/Game.cpp File Reference

Implementation file for the `Game` class.

```
#include "../header/Game.h"
```

Include dependency graph for Game.cpp:



### 5.25.1 Detailed Description

Implementation file for the `Game` class.

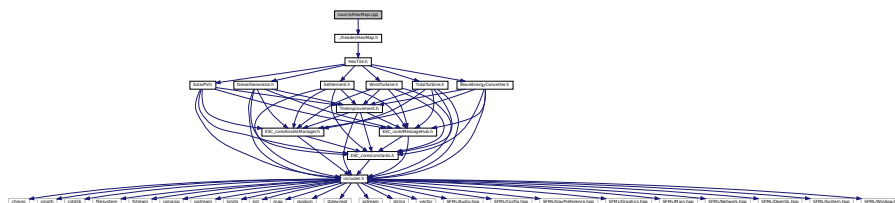
A class which defines a tile of a hex map.

## 5.26 source/HexMap.cpp File Reference

Implementation file for the [HexMap](#) class.

```
#include "../header/HexMap.h"
```

Include dependency graph for HexMap.cpp:





## 5.28.1 Detailed Description

Implementation file for `main()` for Road To Zero.

## 5.28.2 Function Documentation

### 5.28.2.1 `constructRenderWindow()`

```
sf::RenderWindow * constructRenderWindow (
    void )
```

Helper function to construct render window.

#### Returns

Pointer to the render window.

```
339 {
340     sf::RenderWindow* render_window_ptr = new sf::RenderWindow(
341         sf::VideoMode(GAME_WIDTH, GAME_HEIGHT),
342         "Road To Zero"
343     );
344
345     return render_window_ptr;
346 } /* constructRenderWindow() */
```

### 5.28.2.2 `loadAssets()`

```
void loadAssets (
    AssetsManager * assets_manager_ptr )
```

Helper function to load game assets.

#### Parameters

<code>assets_manager_ptr</code>	Pointer to the assets manager.
---------------------------------	--------------------------------

```
66 {
67     // 1. load font assets
68     assets_manager_ptr->loadFont("assets/fonts/DroidSansMono.ttf", "DroidSansMono");
69     assets_manager_ptr->loadFont("assets/fonts/Glass_TTY_VT220.ttf", "Glass_TTY_VT220");
70
71     // 2. load tile sheets
72     assets_manager_ptr->loadTexture(
73         "assets/tile_sheets/pine_tree_64x64_1_CC-BY.png",
74         "pine_tree_64x64_1"
75     );
76
77     assets_manager_ptr->loadTexture(
78         "assets/tile_sheets/wheat_64x64_1_CC-BY.png",
79         "wheat_64x64_1"
80     );
81
82     assets_manager_ptr->loadTexture(
83         "assets/tile_sheets/mountain_64x64_1_CC-BY.png",
84         "mountain_64x64_1"
```

```
85     "mountain_64x64_1"
86 );
87
88 assets_manager_ptr->loadTexture(
89     "assets/tile_sheets/water_waves_64x64_1_CC-BY.png",
90     "water_waves_64x64_1"
91 );
92
93 assets_manager_ptr->loadTexture(
94     "assets/tile_sheets/water_shimmer_64x64_1_CC-BY.png",
95     "water_shimmer_64x64_1"
96 );
97
98 assets_manager_ptr->loadTexture(
99     "assets/tile_sheets/brick_house_64x64_1_CC-BY.png",
100    "brick_house_64x64_1"
101 );
102
103 assets_manager_ptr->loadTexture(
104     "assets/tile_sheets/magnifying_glass_64x64_1_CC-BY.png",
105     "magnifying_glass_64x64_1"
106 );
107
108 assets_manager_ptr->loadTexture(
109     "assets/tile_sheets/exp2_0_CC0.png",
110     "tile clear explosion"
111 );
112
113 assets_manager_ptr->loadTexture(
114     "assets/tile_sheets/emissions_8x8_1_CC-BY.png",
115     "emissions"
116 );
117
118 assets_manager_ptr->loadTexture(
119     "assets/tile_sheets/diesel_generator_64x64_2_CC-BY.png",
120     "diesel generator"
121 );
122
123 assets_manager_ptr->loadTexture(
124     "assets/tile_sheets/solar_PV_64x64_1_CC-BY.png",
125     "solar PV array"
126 );
127
128 assets_manager_ptr->loadTexture(
129     "assets/tile_sheets/wind_turbine_64x64_2_CC-BY.png",
130     "wind turbine"
131 );
132
133 assets_manager_ptr->loadTexture(
134     "assets/tile_sheets/energy_storage_system_64x64_1_CC-BY.png",
135     "energy storage system"
136 );
137
138 assets_manager_ptr->loadTexture(
139     "assets/tile_sheets/tidal_turbine_64x64_2_CC-BY.png",
140     "tidal turbine"
141 );
142
143 assets_manager_ptr->loadTexture(
144     "assets/tile_sheets/wave_energy_converter_64x64_2_CC-BY.png",
145     "wave energy converter"
146 );
147
148 assets_manager_ptr->loadTexture(
149     "assets/tile_sheets/upgrade_arrow_16x16_1_CC-BY.png",
150     "upgrade arrow"
151 );
152
153 assets_manager_ptr->loadTexture(
154     "assets/tile_sheets/upgrade_plus_16x16_1_CC-BY.png",
155     "upgrade plus"
156 );
157
158 assets_manager_ptr->loadTexture(
159     "assets/tile_sheets/energy_storage_16x16_1_CC-BY.png",
160     "storage level"
161 );
162
163 assets_manager_ptr->loadTexture(
164     "assets/tile_sheets/coin_16x16_1_CC-BY.png",
165     "coin"
166 );
167
168
169 // 3. load sounds
170 assets_manager_ptr->loadSound(
171     "assets/audio/samples/mixkit-magical-coin-win-1936_MixkitFree.ogg",
```

```
172     "coin ring"
173 );
174
175 assets_manager_ptr->loadSound(
176     "assets/audio/samples/mixkit-positive-notification-951_MixkitFree.ogg",
177     "positive notification"
178 );
179
180 assets_manager_ptr->loadSound(
181     "assets/audio/samples/mixkit-sci-fi-click-900_MixkitFree.ogg",
182     "sci-fi click"
183 );
184
185 assets_manager_ptr->loadSound(
186     "assets/audio/samples/mixkit-apartment-buzzer-bell-press-932_MixkitFree.ogg",
187     "insufficient credits"
188 );
189
190 assets_manager_ptr->loadSound(
191     "assets/audio/samples/mixkit-data-scanner-2487_MixkitFree.ogg",
192     "resource assessment"
193 );
194
195 assets_manager_ptr->loadSound(
196     "assets/audio/samples/mixkit-interface-click-1126_MixkitFree.ogg",
197     "console string print"
198 );
199
200 assets_manager_ptr->loadSound(
201     "assets/audio/samples/mixkit-video-game-retro-click-237_MixkitFree.ogg",
202     "resource overlay toggle on"
203 );
204
205 assets_manager_ptr->loadSound(
206     "assets/audio/samples/mixkit-video-game-retro-click-237_REVERSED_MixkitFree.ogg",
207     "resource overlay toggle off"
208 );
209
210 assets_manager_ptr->loadSound(
211     "assets/audio/samples/mixkit-explosion-with-rocks-debris-1703_MixkitFree.ogg",
212     "clear mountains tile"
213 );
214
215 assets_manager_ptr->loadSound(
216     "assets/audio/samples/mixkit-arcade-game-explosion-2759_MixkitFree.ogg",
217     "clear non-mountains tile"
218 );
219
220 assets_manager_ptr->loadSound(
221     "assets/audio/samples/mixkit-electronic-retro-block-hit-2185_MixkitFree.ogg",
222     "place improvement"
223 );
224
225 assets_manager_ptr->loadSound(
226     "assets/audio/samples/mixkit-video-game-lock-2851_REVERSED_MixkitFree.ogg",
227     "build menu open"
228 );
229
230 assets_manager_ptr->loadSound(
231     "assets/audio/samples/mixkit-video-game-lock-2851_MixkitFree.ogg",
232     "build menu close"
233 );
234
235 assets_manager_ptr->loadSound(
236     "assets/audio/samples/mixkit-jump-into-the-water-1180_MixkitFree.ogg",
237     "splash"
238 );
239
240 assets_manager_ptr->loadSound(
241     "assets/audio/samples/505316__nuncaconoci__diesel_CC0.ogg",
242     "diesel running"
243 );
244
245 assets_manager_ptr->loadSound(
246     "assets/audio/samples/33460__pempi__320d_2_CC-BY.ogg",
247     "diesel start"
248 );
249
250 assets_manager_ptr->loadSound(
251     "assets/audio/samples/132724__andy_gardner__wind-turbine-blades_CC-BY.ogg",
252     "wind turbine running"
253 );
254
255 assets_manager_ptr->loadSound(
256     "assets/audio/samples/58416__darren1979__oceanwaves_CC-SAMPLING.ogg",
257     "ocean waves"
258 );
```

```

259
260     assets_manager_ptr->loadSound(
261         "assets/audio/samples/369927__mephisto_egmont__water-flowing-in-tubes_CC-BY.ogg",
262         "water flow"
263     );
264
265     assets_manager_ptr->loadSound(
266         "assets/audio/samples/647663__jotraing__electric-train-motor-idle-loop-new-generation-rollingstock_CC0.ogg",
267         "solar hum"
268     );
269
270     assets_manager_ptr->loadSound(
271         "assets/audio/samples/mixkit-epic-futuristic-movie-accent-2913_MixkitFree.ogg",
272         "game title screen"
273     );
274
275     assets_manager_ptr->loadSound(
276         "assets/audio/samples/mixkit-calm-park-with-people-and-children_MixkitFree.ogg",
277         "people and children"
278     );
279
280     assets_manager_ptr->loadSound(
281         "assets/audio/samples/mixkit-magical-coin-win-1936_MixkitFree.ogg",
282         "upgrade"
283     );
284
285     assets_manager_ptr->loadSound(
286         "assets/audio/samples/mixkit-cool-interface-click-tone-2568_MixkitFree.ogg",
287         "interface click"
288     );
289
290     assets_manager_ptr->loadSound(
291         "assets/audio/samples/mixkit-factory-metal-hard-hit-2980_MixkitFree.ogg",
292         "breakdown"
293     );
294
295     assets_manager_ptr->loadSound(
296         "assets/audio/samples/mixkit-fantasy-game-success-notification-270_MixkitFree.ogg",
297         "victory"
298     );
299
300     assets_manager_ptr->loadSound(
301         "assets/audio/samples/mixkit-player-losing-or-failing-2042_MixkitFree.ogg",
302         "loss"
303     );
304
305
306     // 4. load tracks
307     assets_manager_ptr->loadTrack(
308         "assets/audio/tracks/TreeStarMoon_Dobranoc_CC0.ogg",
309         "Tree Star Moon - Dobranoc"
310     );
311
312     assets_manager_ptr->loadTrack(
313         "assets/audio/tracks/TreeStarMoon_Lighthouse_CC0.ogg",
314         "Tree Star Moon - Lighthouse"
315     );
316
317     assets_manager_ptr->loadTrack(
318         "assets/audio/tracks/TreeStarMoon_SkyFarm_CC0.ogg",
319         "Tree Star Moon - Sky Farm"
320     );
321
322     return;
323 } /* loadAssets() */

```

### 5.28.2.3 main()

```

int main (
    int argc,
    char ** argv )
{
    // 1. load assets
    AssetsManager assets_manager;
    loadAssets(&assets_manager);

    // 2. construct render window
    sf::RenderWindow* render_window_ptr = constructRenderWindow();

```

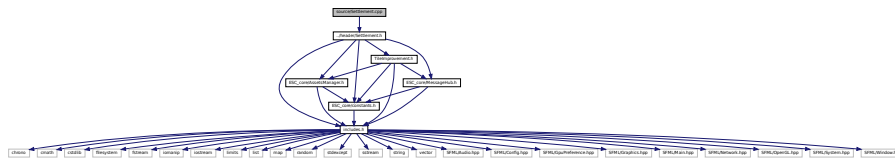
```
362
363 // 3. start game loop
364 bool quit_game = false;
365 assets_manager.playTrack();
366
367 while (not quit_game) {
368     Game game(render_window_ptr, &assets_manager);
369     quit_game = game.run();
370 }
371
372 // 4. clean up
373 render_window_ptr->close();
374 delete render_window_ptr;
375
376 return 0;
377 } /* main() */
```

## 5.29 source/Settlement.cpp File Reference

Implementation file for the **Settlement** class.

```
#include "../header/Settlement.h"
```

Include dependency graph for Settlement.cpp:



### 5.29.1 Detailed Description

Implementation file for the **Settlement** class.

A base class for the tile improvement hierarchy.

### 5.30 source/SolarPV.cpp File Reference

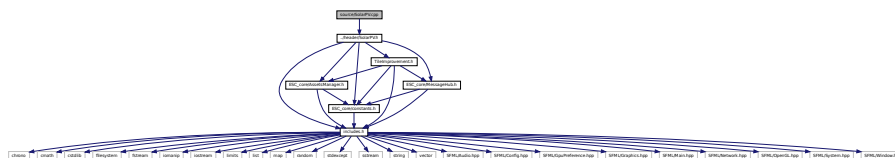
Implementation file for the **SolarPV** class.

```
#include "../header/SolarPV.h"
```

```

// Include dependency graph for SolarPV.cpp:

```





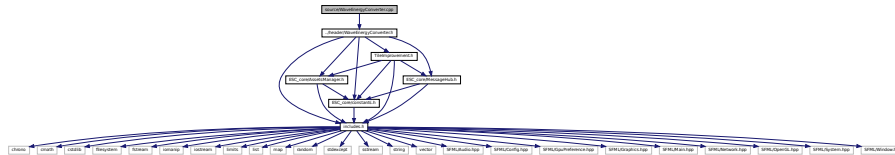


## 5.33 source/WaveEnergyConverter.cpp File Reference

Implementation file for the [WaveEnergyConverter](#) class.

```
#include "../header/WaveEnergyConverter.h"
```

Include dependency graph for WaveEnergyConverter.cpp:



### 5.33.1 Detailed Description

Implementation file for the [WaveEnergyConverter](#) class.

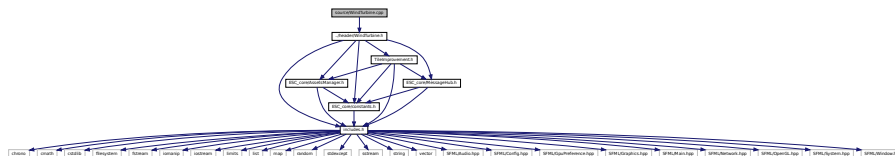
A base class for the tile improvement hierarchy.

## 5.34 source/WindTurbine.cpp File Reference

Implementation file for the [WindTurbine](#) class.

```
#include "../header/WindTurbine.h"
```

Include dependency graph for WindTurbine.cpp:



### 5.34.1 Detailed Description

Implementation file for the [WindTurbine](#) class.

A base class for the tile improvement hierarchy.



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