Road To Zero - The Microgrid Management Game

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Chapter 1

Hierarchical Index

1.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Chapter 2

Class Index

2.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 3

File Index

3.1 File List

Here is a list of all files with brief descriptions:

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

path_2_sound	A path (either relative or absolute) to the sound file.
sound_key	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
694     //  2. clear textures
695     std::map<std::string, sf::Texture*>::iterator texture_iter;
696     for (
697         texture_iter = this->texture_map.begin();
698         texture_iter != this->texture_map.end();
699         texture_iter++
700     ) {
701         delete texture_iter->second;
702
703         std::cout « "Texture " « texture_iter->first « " deleted from texture map" «
704             std::endl;
705     }
706     this->texture_map.clear();
707
708
709     //  3. clear sound buffers
710     std::map<std::string, sf::SoundBuffer*>::iterator soundbuffer_iter;
711     for (
712         soundbuffer_iter = this->soundbuffer_map.begin();
713         soundbuffer_iter != this->soundbuffer_map.end();
714         soundbuffer_iter++
715     ) {
716         delete soundbuffer_iter->second;
717
718         std::cout « "SoundBuffer " « soundbuffer_iter->first «
719             " deleted from soundbuffer map" « std::endl;
720     }
721     this->soundbuffer_map.clear();
722
723
724     //  4. clear sounds
725     std::map<std::string, sf::Sound*>::iterator sound_iter;
726     for (
727         sound_iter = this->sound_map.begin();
728         sound_iter != this->sound_map.end();
729         sound_iter++
730     ) {
731         sound_iter->second->stop();
732         delete sound_iter->second;
733
734         std::cout « "Sound " « sound_iter->first « " deleted from sound map" «
735             std::endl;
736     }
737     this->sound_map.clear();
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

font_key	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

sound_key	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

sound_key	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

texture_key	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

path_2_font	A path (either relative or absolute) to the font file.
font_key	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

path_2_sound	A path (either relative or absolute) to the sound file.
sound_key	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

path_2_texture	A path (either relative or absolute) to the texture file.
texture_key	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 
245     //  2. load from file, throw error on fail
246     sf::Texture* texture_ptr = new sf::Texture();
247 
248     if (not texture_ptr->loadFromFile(path_2_texture)) {
249         std::string error_str = "ERROR  AssetsManager::loadTexture()  could not load ";
250         error_str += "texture at ";
251         error_str += path_2_texture;
252 
253         this->clear();
254 
255         #ifdef _WIN32
256             std::cout « error_str « std::endl;
```

```
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

path_2_track	A path (either relative or absolute) to the track file.
track_key	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:

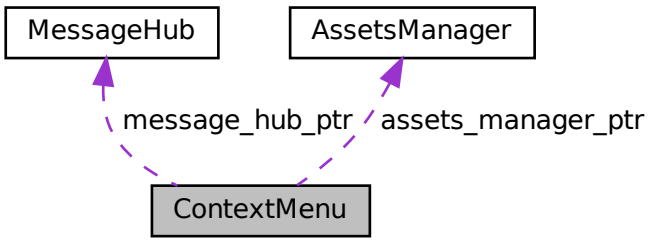
- header/ESC_core/AssetsManager.h
- source/ESC_core/AssetsManager.cpp

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

event_ptr	Pointer to the event class.
render_window_ptr	Pointer to the render window.
assets_manager_ptr	Pointer to the assets manager.
message_hub_ptr	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(MONOCHROME_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(MONOCHROME_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
701         case (sf::Keyboard::Q): {
702             if (this->console_state == ConsoleState :: MENU) {
703                 this->__sendQuitGameMessage();
704             }
705         }
706
707
708         case (sf::Keyboard::R): {
709             if (this->console_state == ConsoleState :: MENU) {
710                 this->__sendRestartGameMessage();
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
747         case (sf::Mouse::Right): {
748             //...
749
750             break;
751         }
752
753
754         default: {
755             // do nothing!
756
757             break;
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

console_state	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               += "[R]:  RESTART                      \n";
529             this->console_string               += "                                  \n";
530             this->console_string               += "[TAB]:  TOGGLE RESOURCE OVERLAY \n";
```

```
531             this->console_string                += "[T]:  TUTORIAL                  \n";
532             this->console_string                += "                               \n";
533             this->console_string                += "                               \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 
547         case (ConsoleState :: TILE): {
548             // take console string from tile state message
549 
550             break;
551         }
552 
553 
554         default: {
555             //           32 char x 17 line console "--------------------------------\n";
556             this->console_string                 = "  **** RTZ 64 CONTEXT V12 ****  \n";
557             this->console_string                += "                                \n";
558             this->console_string                += "64K RAM SYSTEM  38911 BYTES FREE\n";
559             this->console_string                += "                                \n";
560             this->console_string                += "[TAB]:  TOGGLE RESOURCE OVERLAY \n";
561             this->console_string                += "                                \n";
562             this->console_string                += "[ESC]:          MENU            \n";
563             this->console_string                += "[LEFT CLICK]:  TILE INFO/OPTIONS\n";
564             this->console_string                += "[RIGHT CLICK]: CLEAR SELECTION  \n";
565             this->console_string                += "                               \n";
566             this->console_string                += "[ENTER]:  END TURN              \n";
567             this->console_string                += "                               \n";
568             this->console_string                += "READY.                          ";
569 
570             break;
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.setFillColor(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.setFillColor(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 
412     //  4. right framing
413     this->console_screen_frame_right.setPointCount(n_points);
414 
415     this->console_screen_frame_right.setPoint(
416         0,
417         sf::Vector2f(
418             this->position_x - 50,
419             this->position_y + GAME_HEIGHT - 50
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:

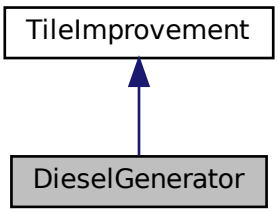
- header/ContextMenu.h
- source/ContextMenu.cpp

4.3 DieselGenerator Class Reference

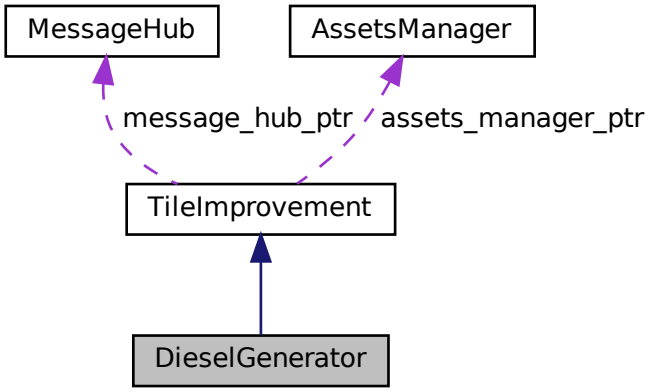
A settlement class (child class of TileImprovement).

```
#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 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 chimney animation).

Private Member Functions

- void __setUpTileImprovementSpriteAnimated (void)

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

4.3.1 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

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

```
279   :
280 TileImprovement(
281     position_x,
282     position_y,
283     tile_resource,
284     event_ptr,
285     render_window_ptr,
286     assets_manager_ptr,
287     message_hub_ptr
288 )
289 {
290     //  1. set attributes
291 
292     //  1.1. private
293     //...
294 
295     //  1.2. public
296     this->tile_improvement_type = TileImprovementType :: DIESEL_GENERATOR;
297 
298     this->is_running = false;
299 
300     this->health = 100;
301 
302     this->capacity_kW = 100;
303     this->upgrade_level = 1;
304 
305     this->production_MWh = 0;
306     this->max_production_MWh = 72;
307 
308     this->smoke_da = 1e-8 * SECONDS_PER_FRAME;
309     this->smoke_dx = 5 * SECONDS_PER_FRAME;
310     this->smoke_dy = -10 * SECONDS_PER_FRAME;
311     this->smoke_prob = 8 * SECONDS_PER_FRAME;
312 
313     this->smoke_sprite_list = {};
314 
315     this->tile_improvement_string = "DIESEL GEN";
316 
317     this->__setUpTileImprovementSpriteAnimated();
318 
319     std::cout « "DieselGenerator constructed at " « this « std::endl;
320 
321     return;
322 }   /* DieselGenerator() */
```

4.3.2.2 ~DieselGenerator()

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

Destructor for the DieselGenerator class.

```
551 {
552     std::cout « "DieselGenerator at " « this « " destroyed" « std::endl;
553 
554     return;
555 }   /* ~DieselGenerator() */
```

4.3.3 Member Function Documentation

4.3.3.1 __handleKeyPressEvents()

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

Helper method to handle key press events.

```
161 {
162     if (this->just_built) {
163         return;
164     }
165 
166 
167     switch (this->event_ptr->key.code) {
168         case (sf::Keyboard::U): {
169             this->__upgrade();
170 
171             break;
172         }
173 
174 
175         default: {
176             // do nothing!
177 
178             break;
179         }
180     }
181 
182 
183     return;
184 }   /* __handleKeyPressEvents() */
```

4.3.3.2 __handleMouseButtonEvents()

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

Helper method to handle mouse button events.

```
199 {
200     if (this->just_built) {
201         return;
202     }
203 
204     switch (this->event_ptr->mouseButton.button) {
205         case (sf::Mouse::Left): {
206             //...
207 
208             break;
209         }
210 
211 
212         case (sf::Mouse::Right): {
213             //...
214 
215             break;
216         }
217 
218 
219         default: {
220             // do nothing!
221 
222             break;
223         }
224     }
225 
226     return;
227 }   /* __handleMouseButtonEvents() */
```

4.3.3.3 __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() */
```

4.3.3.4 __upgrade()

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

Helper method to upgrade the diesel generator.

```
114 {
115     if (this->credits < DIESEL_GENERATOR_BUILD_COST) {
116         std::cout « "Cannot upgrade diesel generator: insufficient credits (need "
117             « DIESEL_GENERATOR_BUILD_COST « " K)" « std::endl;
118
119         this->__sendInsufficientCreditsMessage();
120         return;
121     }
122
123     if (this->upgrade_level >= MAX_UPGRADE_LEVELS) {
124         return;
125     }
126
127     this->is_running = false;
128
129     this->health = 100;
130
131     this->capacity_kW += 100;
132     this->upgrade_level++;
133
134     this->production_MWh = 0;
135     this->max_production_MWh += 72;
136
137     this->just_upgraded = true;
138
139     this->assets_manager_ptr->getSound("upgrade")->play();
140
141     this->__sendCreditsSpentMessage(DIESEL_GENERATOR_BUILD_COST);
142     this->__sendTileStateRequest();
143     this->__sendGameStateRequest();
144
145     return;
146 }   /* __upgrade() */
```

4.3.3.5 advanceTurn()

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

Method to handle turn advance.

Reimplemented from TileImprovement.

```
390 {
391     //...
392
393     std::cout « "Turn advance message received by " « this « std::endl;
394     return;
395 }   /* advanceTurn() */
```

4.3.3.6 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.

```
459 {
460     //  1. if just built, call base method and return
461     if (this->just_built) {
462         TileImprovement :: draw();
463
464         return;
465     }
466
467     //  2. handle upgrade effects
468     if (this->just_upgraded) {
469         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
470             this->tile_improvement_sprite_animated[i].setColor(
471                 sf::Color(
472                     255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
473                     255,
474                     255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
475                     255
476                 )
477             );
478
479             this->tile_improvement_sprite_animated[i].setScale(
480                 sf::Vector2f(
481                     1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
482                     1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2)
483                 )
484             );
485         }
486
487         this->upgrade_frame++;
488     }
489
490     if (this->upgrade_frame >= 2 * FRAMES_PER_SECOND) {
491         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
492             this->tile_improvement_sprite_animated[i].setColor(
493                 sf::Color(255,255,255,255)
494             );
495
496             this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1,1));
497         }
498
499         this->just_upgraded = false;
500         this->upgrade_frame = 0;
501     }
502
503
504     //  3. draw first element of animated sprite
505     this->render_window_ptr->draw(this->tile_improvement_sprite_animated[0]);
506
507
508     //  4. draw second element of animated sprite
```

```
509     if (this->is_running) {
510         //...
511     }
512 
513     else {
514         //...
515     }
516 
517     this->render_window_ptr->draw(this->tile_improvement_sprite_animated[1]);
518 
519 
520     //  5. draw smoke effects
521     if (this->is_running) {
522         //...
523     }
524 
525 
526     //  6. draw production menu
527     if (this->production_menu_open) {
528         this->render_window_ptr->draw(this->production_menu_backing);
529         this->render_window_ptr->draw(this->production_menu_backing_text);
530 
531         //...
532     }
533 
534     this->frame++;
535     return;
536 }   /* draw() */
```

4.3.3.7 getTileOptionsSubstring()

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

Helper method to assemble and return tile options substring.

Returns

Tile options substring.

Reimplemented from TileImprovement.

```
339 {
340     int upgrade_cost = DIESEL_GENERATOR_BUILD_COST;
341 
342     //                  32 char x 17 line console "--------------------------------\n";
343     std::string options_substring                = "CAPACITY:    ";
344     options_substring                           += std::to_string(this->capacity_kW);
345     options_substring                           += " kW (level ";
346     options_substring                           += std::to_string(this->upgrade_level);
347     options_substring                           += ")\n";
348 
349     options_substring                           += "PRODUCTION:  ";
350     options_substring                           += std::to_string(this->production_MWh);
351     options_substring                           += " MWh (MAX ";
352     options_substring                           += std::to_string(this->max_production_MWh);
353     options_substring                           += ")\n";
354 
355     options_substring                           += "HEALTH:      ";
356     options_substring                           += std::to_string(this->health);
357     options_substring                           += "/100\n";
358 
359     options_substring                           += "                                \n";
360     options_substring                           += "  **** DIESEL GEN OPTIONS ****  \n";
361     options_substring                           += "                                \n";
362     options_substring                           += "     [E]:  OPEN PRODUCTION MENU \n";
363 
364     if (this->upgrade_level < MAX_UPGRADE_LEVELS) {
365         options_substring                           += "     [U]:  + 100 kW (";
366         options_substring                           += std::to_string(upgrade_cost);
367         options_substring                           +=" K)\n";
368     }
369 
370     options_substring                           += "HOLD [P]:  SCRAP (";
371     options_substring                           += std::to_string(SCRAP_COST);
372     options_substring                           += " K)";
373 
374     return options_substring;
375 }   /* getTileOptionsSubstring() */
```

4.3.3.8 processEvent()

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

Method to process DieselGenerator. To be called once per event.

Reimplemented from TileImprovement.

```
410 {
411     TileImprovement :: processEvent();
412 
413     if (this->event_ptr->type == sf::Event::KeyPressed) {
414         this->__handleKeyPressEvents();
415     }
416 
417     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
418         this->__handleMouseButtonEvents();
419     }
420 
421     return;
422 }   /* processEvent() */
```

4.3.3.9 processMessage()

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

Method to process DieselGenerator. To be called once per message.

Reimplemented from TileImprovement.

```
437 {
438     TileImprovement :: processMessage();
439 
440     //...
441 
442     return;
443 }   /* processMessage() */
```

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 max_production_MWh

```
int DieselGenerator::max_production_MWh
```

The maximum production [MWh] for this turn.

4.3.4.3 production_MWh

```
int DieselGenerator::production_MWh
```

The current production [MWh] of the diesel generator.

4.3.4.4 smoke_da

```
double DieselGenerator::smoke_da
```

The per frame delta in smoke particle alpha value.

4.3.4.5 smoke_dx

```
double DieselGenerator::smoke_dx
```

The per frame delta in smoke particle x position.

4.3.4.6 smoke_dy

```
double DieselGenerator::smoke_dy
```

The per frame delta in smoke particle y position.

4.3.4.7 smoke_prob

```
double DieselGenerator::smoke_prob
```

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

4.3.4.8 smoke_sprite_list

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

A list of smoke sprite (for chimney animation).

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

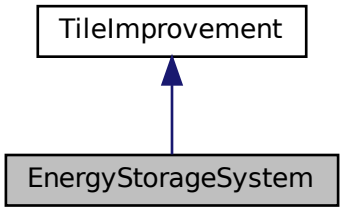
- header/DieselGenerator.h
- source/DieselGenerator.cpp

4.4 EnergyStorageSystem Class Reference

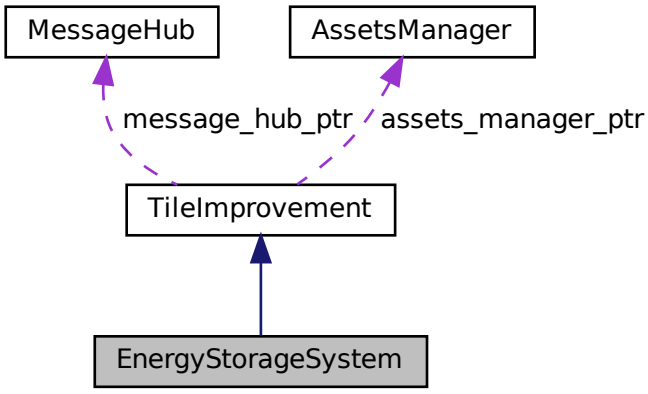
A settlement class (child class of TileImprovement).

`#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

position_x	The x position of the tile.
position_y	The y position of the tile.
event_ptr	Pointer to the event class.
render_window_ptr	Pointer to the render window.
assets_manager_ptr	Pointer to the assets manager.
message_hub_ptr	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             break;
191         }
192 
193 
194         default: {
195             // do nothing!
196 
197             break;
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 
230         case (sf::Mouse::Right): {
231             //...
232 
233             break;
234         }
235 
236 
237         default: {
238             // do nothing!
239 
240             break;
241         }
242     }
243 
244     return;
245 }   /* __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(MONOCHROME_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
475     //  2. draw static sprite
476     this->render_window_ptr->draw(this->tile_improvement_sprite_static);
477
478
479     //  3. draw production menu
480     if (this->production_menu_open) {
481         this->render_window_ptr->draw(this->production_menu_backing);
482         this->render_window_ptr->draw(this->production_menu_backing_text);
483
484         //...
485     }
486
487     this->frame++;
488     return;
489 }   /* 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                           += "                                \n";
387     options_substring                           += "**** ENERGY STORAGE OPTIONS ****\n";
388     options_substring                           += "                                \n";
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

is_selected	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:

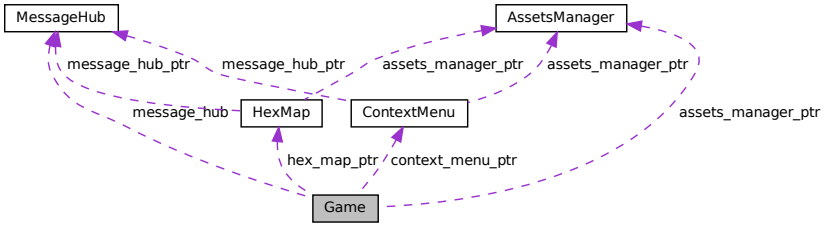
- header/EnergyStorageSystem.h
- source/EnergyStorageSystem.cpp

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.
- 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 turn = 0

  The current game turn.
- 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 __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 __insufficientCreditsAlarm (void)

  Helper method to sound and display and insufficient credits alarm.
- 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.

```
843 {
844     //  1. set attributes
845 
846     //  1.1. private
847     this->render_window_ptr = render_window_ptr;
848 
849     this->assets_manager_ptr = assets_manager_ptr;
850 
```

```
851     //  1.2. public
852     this->game_phase = GamePhase :: BUILD_SETTLEMENT;
853
854     this->quit_game = false;
855     this->game_loop_broken = false;
856     this->show_frame_clock_overlay = false;
857
858     this->frame = 0;
859     this->time_since_start_s = 0;
860
861     double seconds_since_epoch = time(NULL);
862     double years_since_epoch = seconds_since_epoch / SECONDS_PER_YEAR;
863
864     this->year = 1970 + (int)years_since_epoch;
865     this->month = (years_since_epoch - (int)years_since_epoch) * 12 + 1;
866     while (this->month > 12) {
867         this->month -= 12;
868     }
869
870     this->population = 0;
871     this->credits = STARTING_CREDITS;
872     this->demand_MWh = 0;
873     this->cumulative_emissions_tonnes = 0;
874
875     this->hex_map_ptr = new HexMap(
876         6,
877         &(this->event),
878         this->render_window_ptr,
879         this->assets_manager_ptr,
880         &(this->message_hub)
881     );
882
883     this->context_menu_ptr = new ContextMenu(
884         &(this->event),
885         this->render_window_ptr,
886         this->assets_manager_ptr,
887         &(this->message_hub)
888     );
889
890     //  2. add message channel(s)
891     this->message_hub.addChannel(GAME_CHANNEL);
892     this->message_hub.addChannel(GAME_STATE_CHANNEL);
893
894     std::cout « "Game constructed at " « this « std::endl;
895
896     return;
897 }   /* Game() */
```

4.5.2.2 ~Game()

```
Game::~Game (
            void  )
```

Destructor for the Game class.

```
981 {
982     //  1. clean up attributes
983     delete this->hex_map_ptr;
984     delete this->context_menu_ptr;
985
986     std::cout « "Game at " « this « " destroyed" « std::endl;
987
988     return;
989 }   /* ~Game() */
```

4.5.3 Member Function Documentation

4.5.3.1 __advanceTurn()

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

Helper method to advance turn.

```
113 {
114     //  1. advance turn
115     this->turn++;
116 
117     //  2. advance month/year
118     this->month++;
119     if (this->month > 12) {
120         this->year++;
121         this->month = 1;
122     }
123 
124     //  3. update population
125     if (this->turn == 1) {
126         this->population = STARTING_POPULATION;
127     }
128 
129     else {
130         this->population = ceil(this->population * POPULATION_MONTHLY_GROWTH_RATE);
131     }
132 
133     //  4. update demand
134     this->__computeCurrentDemand();
135 
136     //  5. send turn advance message
137     this->__sendTurnAdvanceMessage();
138 
139 }   /* __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     //...
96 
97     return;
98 }   /* __checkTerminatingConditions() */
```

4.5.3.3 __computeCurrentDemand()

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

Helper method to compute current energy demand.

```
154 {
155     unsigned seed = std::chrono::system_clock::now().time_since_epoch().count();
156     std::default_random_engine generator(seed);
157 
158     std::normal_distribution<double> normal_dist(
159         MEAN_DAILY_DEMAND_RATIOS[this->month - 1],
160         STDEV_DAILY_DEMAND_RATIOS[this->month - 1]
161     );
162 
163     double monthly_demand_ratio = 0;
164 
165     for (int i = 0; i < 30; i++) {
166         monthly_demand_ratio += normal_dist(generator);
167     }
168 
169     this->demand_MWh =
170         monthly_demand_ratio * MAXIMUM_DAILY_DEMAND_PER_CAPITA * this->population;
171 
172     return;
173 }   /* __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.

```
810 {
811     this->__drawHUD();
812 
813     if (this->show_frame_clock_overlay) {
814         this->__drawFrameClockOverlay();
815     }
816 
817     return;
818 }   /* draw() */
```

4.5.3.5 __drawFrameClockOverlay()

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

Helper method to draw frame clock overlay.

```
636 {
637     std::string frame_clock_string = "FRAME: ";
638     frame_clock_string += std::to_string(this->frame);
639     frame_clock_string += "\nTIME SINCE START [s]: ";
640     frame_clock_string += std::to_string(this->time_since_start_s);
641 
642     sf::Text frame_clock_text(
643         frame_clock_string,
644         *(this->assets_manager_ptr->getFont("DroidSansMono")),
645         16
646     );
647 
648     sf::RectangleShape frame_clock_backing(
649         sf::Vector2f(
650             1.02 * frame_clock_text.getLocalBounds().width,
651             1.20 * frame_clock_text.getLocalBounds().height
652         )
653     );
654     frame_clock_backing.setFillColor(sf::Color(0, 0, 0, 255));
655 
656     this->render_window_ptr->draw(frame_clock_backing);
657     this->render_window_ptr->draw(frame_clock_text);
658 
659     return;
660 }   /* __drawFrameClockOverlay() */
```

4.5.3.6 __drawHUD()

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

Helper method to heads-up display (HUD).

```
675 {
676     //  1. first line (top)
677     std::string HUD_string = "YEAR: ";
678     HUD_string += std::to_string(this->year);
679 
680     HUD_string += "    MONTH: ";
681     HUD_string += std::to_string(this->month);
682 
683     HUD_string += "    POPULATION: ";
684     HUD_string += std::to_string(this->population);
685 
686     HUD_string += "    CREDITS: ";
```

```
687     HUD_string += std::to_string(this->credits);
688     HUD_string += " K";
689 
690     HUD_string += "    CURRENT DEMAND: ";
691     HUD_string += std::to_string(this->demand_MWh);
692     HUD_string += " MWh";
693 
694     sf::Text HUD_text(
695         HUD_string,
696         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
697         16
698     );
699 
700     HUD_text.setPosition(
701         (800 - HUD_text.getLocalBounds().width) / 2,
702         8
703     );
704 
705     HUD_text.setFillColor(MONOCHROME_TEXT_GREEN);
706 
707     this->render_window_ptr->draw(HUD_text);
708 
709 
710     //  2. second line (top)
711     HUD_string = "CUMULATIVE EMISSIONS: ";
712     HUD_string += std::to_string(this->cumulative_emissions_tonnes);
713     HUD_string += " tonnes (CO2e)";
714 
715     HUD_string += "    LIFETIME LIMIT: ";
716     HUD_string += std::to_string(EMISSIONS_LIFETIME_LIMIT_TONNES);
717     HUD_string += " tonnes (CO2e)";
718 
719     HUD_text.setString(HUD_string);
720 
721     HUD_text.setPosition(
722         (800 - HUD_text.getLocalBounds().width) / 2,
723         35
724     );
725 
726     this->render_window_ptr->draw(HUD_text);
727 
728 
729     //  3. third line (bottom)
730     HUD_string = "GAME PHASE: ";
731 
732     switch (this->game_phase) {
733         case (GamePhase :: BUILD_SETTLEMENT): {
734             HUD_string += "BUILD SETTLEMENT";
735 
736             break;
737         }
738 
739 
740         case (GamePhase :: SYSTEM_MANAGEMENT): {
741             HUD_string += "SYSTEM MANAGEMENT";
742 
743             break;
744         }
745 
746 
747         case (GamePhase :: LOSS_EMISSIONS): {
748             HUD_string += "LOSS (EMISSIONS)";
749 
750             break;
751         }
752 
753 
754         case (GamePhase :: LOSS_DEMAND): {
755             HUD_string += "LOSS (DEMAND)";
756 
757             break;
758         }
759 
760 
761         case (GamePhase :: LOSS_CREDITS): {
762             HUD_string += "LOSS (CREDITS)";
763 
764             break;
765         }
766 
767 
768         case (GamePhase :: VICTORY): {
769             HUD_string += "VICTORY";
770 
771             break;
772         }
773 
```

```
774
775         default: {
776             HUD_string += "???";
777
778             break;
779         }
780     }
781
782     HUD_string += "    TURN: ";
783     HUD_string += std::to_string(this->turn);
784
785     HUD_text.setString(HUD_string);
786
787     HUD_text.setPosition(
788         (800 - HUD_text.getLocalBounds().width) / 2,
789         GAME_HEIGHT - 35
790     );
791
792     this->render_window_ptr->draw(HUD_text);
793
794     return;
795 }   /* __drawHUD() */
```

4.5.3.7 __handleKeyPressEvents()

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

Helper method to handle key press events.

```
188 {
189     switch (this->event.key.code) {
190         case (sf::Keyboard::Enter): {
191             if (this->game_phase == GamePhase :: SYSTEM_MANAGEMENT) {
192                 this->__checkTerminatingConditions();
193                 if (this->game_phase == GamePhase :: SYSTEM_MANAGEMENT) {
194                     this->__advanceTurn();
195                 }
196             }
197
198             break;
199         }
200
201
202         case (sf::Keyboard::Tilde): {
203             this->__toggleFrameClockOverlay();
204
205             break;
206         }
207
208
209         case (sf::Keyboard::Tab): {
210             this->hex_map_ptr->toggleResourceOverlay();
211
212             break;
213         }
214
215
216         default: {
217             // do nothing!
218
219             break;
220         }
221     }
222
223     return;
224 }   /* __handleKeyPressEvents() */
```

4.5.3.8 __handleMouseButtonEvents()

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

Helper method to handle mouse button events.

```
239 {
240     switch (this->event.mouseButton.button) {
241         case (sf::Mouse::Left): {
242             //...
243 
244             break;
245         }
246 
247 
248         case (sf::Mouse::Right): {
249             //...
250 
251             break;
252         }
253 
254 
255         default: {
256             // do nothing!
257 
258             break;
259         }
260     }
261 
262     return;
263 }   /* __handleMouseButtonEvents() */
```

4.5.3.9 __insufficientCreditsAlarm()

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

Helper method to sound and display and insufficient credits alarm.

```
529 {
530     //  1. sound buzzer
531     this->assets_manager_ptr->getSound("insufficient credits")->play();
532 
533     //  2. construct alarm text and backing rectangle
534     sf::Text insufficient_credits_text(
535         "INSUFFICIENT CREDITS",
536         (*(this->assets_manager_ptr->getFont("DroidSansMono"))),
537         32
538     );
539 
540     insufficient_credits_text.setOrigin(
541         insufficient_credits_text.getLocalBounds().width / 2,
542         insufficient_credits_text.getLocalBounds().height / 2
543     );
544 
545     insufficient_credits_text.setPosition(400, GAME_HEIGHT / 2);
546 
547     sf::RectangleShape backing_rectangle(
548         sf::Vector2f(
549             1.1 * insufficient_credits_text.getLocalBounds().width,
550             1.5 * insufficient_credits_text.getLocalBounds().height
551         )
552     );
553 
554     backing_rectangle.setFillColor(RESOURCE_CHIP_GREY);
555 
556     backing_rectangle.setOrigin(
557         backing_rectangle.getLocalBounds().width / 2,
558         backing_rectangle.getLocalBounds().height / 2
559     );
560 
561     backing_rectangle.setPosition(400, (GAME_HEIGHT / 2) + 8);
562 
563     //  3. display loop (blocking ~3 seconds)
564     bool red_flag = true;
565     int alarm_frame = 0;
```

```
566     double time_since_alarm_s = 0;
567
568     sf::Clock alarm_clock;
569
570     while (alarm_frame < 2.5 * FRAMES_PER_SECOND) {
571
572
573         time_since_alarm_s = alarm_clock.getElapsedTime().asSeconds();
574
575         if (time_since_alarm_s >= (alarm_frame + 1) * SECONDS_PER_FRAME) {
576             while (this->render_window_ptr->pollEvent(this->event)) {
577                 // do nothing!
578             }
579
580             this->render_window_ptr->clear();
581
582             this->hex_map_ptr->draw();
583             this->context_menu_ptr->draw();
584             this->__draw();
585
586             if (alarm_frame % (FRAMES_PER_SECOND / 3) == 0) {
587                 if (red_flag) {
588                     red_flag = false;
589                 }
590
591                 else {
592                     red_flag = true;
593                 }
594             }
595
596             if (red_flag) {
597                 insufficient_credits_text.setFillColor(MONOCHROME_TEXT_RED);
598             }
599
600             else {
601                 insufficient_credits_text.setFillColor(sf::Color(255, 255, 255));
602             }
603
604             this->render_window_ptr->draw(backing_rectangle);
605             this->render_window_ptr->draw(insufficient_credits_text);
606
607             this->render_window_ptr->display();
608
609             alarm_frame++;
610             this->frame++;
611         }
612
613         // check track status, move to next if stopped
614         if (this->assets_manager_ptr->getTrackStatus() == sf::SoundSource::Stopped) {
615             this->assets_manager_ptr->nextTrack();
616             this->assets_manager_ptr->playTrack();
617         }
618     }
619
620     return;
621 }   /* __insufficientCreditsAlarm( */
```

4.5.3.10 __processEvent()

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

Helper method to process Game. To be called once per event.

```
279 {
280     if (this->event.type == sf::Event::Closed) {
281         this->quit_game = true;
282         this->game_loop_broken = true;
283     }
284
285     if (this->event.type == sf::Event::KeyPressed) {
286         this->__handleKeyPressEvents();
287     }
288
289     if (this->event.type == sf::Event::MouseButtonPressed) {
290         this->__handleMouseButtonEvents();
291     }
292
293     return;
294 }   /* __processEvent() */
```

4.5.3.11 __processMessage()

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

Helper method to process Game. To be called once per message.

```
417 {
418     if (not this->message_hub.isEmpty(GAME_CHANNEL)) {
419         Message game_channel_message = this->message_hub.receiveMessage(GAME_CHANNEL);
420 
421         if (game_channel_message.subject == "quit game") {
422             this->quit_game = true;
423             this->game_loop_broken = true;
424 
425             std::cout « "Quit game message received by " « this « std::endl;
426             this->message_hub.popMessage(GAME_CHANNEL);
427         }
428 
429         if (game_channel_message.subject == "restart game") {
430             this->game_loop_broken = true;
431 
432             std::cout « "Restart game message received by " « this « std::endl;
433             this->message_hub.popMessage(GAME_CHANNEL);
434         }
435 
436         if (game_channel_message.subject == "state request") {
437             std::cout « "Game state request message received by " « this « std::endl;
438 
439             this->__sendGameStateMessage();
440             this->message_hub.popMessage(GAME_CHANNEL);
441         }
442 
443         if (game_channel_message.subject == "credits spent") {
444             this->credits -= game_channel_message.int_payload["credits spent"];
445 
446             std::cout « "Credits spent message (" «
447                 game_channel_message.int_payload["credits spent"] « ") received by "
448                 « this « std::endl;
449 
450             std::cout « "Current credits (Game): " « this->credits « " K" «
451                 std::endl;
452 
453             this->message_hub.popMessage(GAME_CHANNEL);
454         }
455 
456         if (game_channel_message.subject == "insufficient credits") {
457             std::cout « "Insufficient credits message received by " « this «
458                 std::endl;
459 
460             this->__insufficientCreditsAlarm();
461 
462             this->message_hub.popMessage(GAME_CHANNEL);
463         }
464 
465         if (game_channel_message.subject == "update game phase") {
466             std::cout « "Update game phase message received by " « this « std::endl;
467 
468             if (
469                 game_channel_message.string_payload["game phase"] == "system management"
470             ) {
471                 this->game_phase = GamePhase :: SYSTEM_MANAGEMENT;
472                 this->__advanceTurn();
473             }
474 
475             else if (
476                 game_channel_message.string_payload["game phase"] == "loss emissions"
477             ) {
478                 this->game_phase = GamePhase :: LOSS_EMISSIONS;
479             }
480 
481             else if (
482                 game_channel_message.string_payload["game phase"] == "loss demand"
483             ) {
484                 this->game_phase = GamePhase :: LOSS_DEMAND;
485             }
486 
487             else if (
488                 game_channel_message.string_payload["game phase"] == "loss credits"
489             ) {
490                 this->game_phase = GamePhase :: LOSS_CREDITS;
491             }
492 
493             else if (
494                 game_channel_message.string_payload["game phase"] == "victory"
```

```
495             ) {
496                 this->game_phase = GamePhase :: VICTORY;
497             }
498 
499             this->message_hub.popMessage(GAME_CHANNEL);
500         }
501     }
502 
503     if (not this->message_hub.isEmpty(GAME_STATE_CHANNEL)) {
504         Message game_state_message =
505             this->message_hub.receiveMessage(GAME_STATE_CHANNEL);
506 
507         if (game_state_message.subject == "turn advance") {
508             std::cout « "Turn advance message received by " « this « std::endl;
509             this->message_hub.popMessage(GAME_STATE_CHANNEL);
510         }
511     }
512 
513     return;
514 }   /* __processMessage() */
```

4.5.3.12 __sendGameStateMessage()

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

Helper method to format and send a game state message.

```
309 {
310     Message game_state_message;
311 
312     game_state_message.channel = GAME_STATE_CHANNEL;
313     game_state_message.subject = "game state";
314 
315     game_state_message.int_payload["year"] = this->year;
316     game_state_message.int_payload["month"] = this->month;
317     game_state_message.int_payload["population"] = this->population;
318     game_state_message.int_payload["credits"] = this->credits;
319     game_state_message.int_payload["demand_MWh"] = this->demand_MWh;
320     game_state_message.int_payload["cumulative_emissions_tonnes"] =
321         this->cumulative_emissions_tonnes;
322 
323     switch (this->game_phase) {
324         case (GamePhase :: BUILD_SETTLEMENT): {
325             game_state_message.string_payload["game phase"] = "build settlement";
326 
327             break;
328         }
329 
330 
331         case (GamePhase :: SYSTEM_MANAGEMENT): {
332             game_state_message.string_payload["game phase"] = "system management";
333 
334             break;
335         }
336 
337 
338         case (GamePhase :: LOSS_EMISSIONS): {
339             game_state_message.string_payload["game phase"] = "loss emissions";
340 
341             break;
342         }
343 
344 
345         case (GamePhase :: LOSS_DEMAND): {
346             game_state_message.string_payload["game phase"] = "loss demand";
347 
348             break;
349         }
350 
351 
352         case (GamePhase :: LOSS_CREDITS): {
353             game_state_message.string_payload["game phase"] = "loss credits";
354 
355             break;
356         }
357 
358 
359         case (GamePhase :: VICTORY): {
```

```
360             game_state_message.string_payload["game phase"] = "victory";
361
362             break;
363         }
364
365
366         default: {
367             // do nothing!
368
369             break;
370         }
371     }
372
373     this->message_hub.sendMessage(game_state_message);
374
375     std::cout « "Game state message sent by " « this « std::endl;
376     return;
377 }   /* __sendGameStateMessage() */
```

4.5.3.13 __sendTurnAdvanceMessage()

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

Helper method to format and send a turn advance message.

```
392 {
393     Message turn_advance_message;
394
395     turn_advance_message.channel = GAME_STATE_CHANNEL;
396     turn_advance_message.subject = "turn advance";
397
398     this->message_hub.sendMessage(turn_advance_message);
399
400     std::cout « "Turn advance message sent by " « this « std::endl;
401     return;
402 }   /* __sendTurnAdvanceMessage() */
```

4.5.3.14 __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() */
```

4.5.3.15 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).

```
915 {
916     //  1. play brand animation
917     //...
918 
919     //  2. show splash screen
920     //...
921 
922     //  3. start game loop
923     while (not this->game_loop_broken) {
924         this->time_since_start_s = this->clock.getElapsedTime().asSeconds();
925 
926         if (this->time_since_start_s >= (this->frame + 1) * SECONDS_PER_FRAME) {
927             //  6.1. process events
928             while (this->render_window_ptr->pollEvent(this->event)) {
929                 this->hex_map_ptr->processEvent();
930                 this->context_menu_ptr->processEvent();
931                 this->__processEvent();
932             }
933 
934 
935             //  6.2. process messages
936             while (this->message_hub.hasTraffic()) {
937                 this->hex_map_ptr->processMessage();
938                 this->context_menu_ptr->processMessage();
939                 this->__processMessage();
940             }
941 
942 
943             //  6.3. draw frame
944             this->render_window_ptr->clear();
945 
946             this->hex_map_ptr->draw();
947             this->context_menu_ptr->draw();
948             this->__draw();
949 
950             this->render_window_ptr->display();
951 
952 
953             //  6.4. increment frame
954             this->frame++;
955         }
956 
957         // check track status, move to next if stopped
958         if (this->assets_manager_ptr->getTrackStatus() == sf::SoundSource::Stopped) {
959             this->assets_manager_ptr->nextTrack();
960             this->assets_manager_ptr->playTrack();
961         }
962 
963     }
964 
965     return this->quit_game;
966 }   /* 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 clock

```
sf::Clock Game::clock
```

The game clock.

4.5.4.3 context_menu_ptr

```
ContextMenu* Game::context_menu_ptr
```

Pointer to the context menu.

4.5.4.4 credits

```
int Game::credits
```

Current balance of credits.

4.5.4.5 cumulative_emissions_tonnes

```
int Game::cumulative_emissions_tonnes
```

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

4.5.4.6 demand_MWh

```
int Game::demand_MWh
```

Current energy demand [MWh].

4.5.4.7 event

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

The game events class.

4.5.4.8 frame

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

The current frame of the game.

4.5.4.9 game_loop_broken

```
bool Game::game_loop_broken
```

Boolean indicating whether or not the game loop is broken.

4.5.4.10 game_phase

```
GamePhase Game::game_phase
```

The current phase of the game.

4.5.4.11 hex_map_ptr

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

Pointer to the hex map (defines game world).

4.5.4.12 message_hub

```
MessageHub Game::message_hub
```

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

4.5.4.13 month

```
int Game::month
```

Current game month.

4.5.4.14 population

```
int Game::population
```

Current population.

4.5.4.15 quit_game

```
bool Game::quit_game
```

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

4.5.4.16 render_window_ptr

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

A pointer to the render window.

4.5.4.17 show_frame_clock_overlay

```
bool Game::show_frame_clock_overlay
```

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

4.5.4.18 time_since_start_s

```
double Game::time_since_start_s
```

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

4.5.4.19 turn

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

The current game turn.

4.5.4.20 year

```
int Game::year
```

Current game year.

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

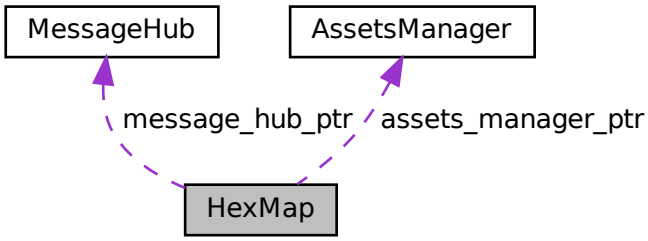
- header/Game.h
- source/Game.cpp

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

n_layers	The number of layers in the HexMap.
event_ptr	Pointer to the event class.
render_window_ptr	Pointer to the render window.
assets_manager_ptr	Pointer to the assets manager.
message_hub_ptr	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

Pointer	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
319             else {
320                 list_iter++;
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

hex_ptr	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

hex_ptr	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

n_elements	The number of elements in the generated noise vector.
n_components	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

potential_x	The potential x position of the tile.
potential_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 
966         default: {
967             // do nothing!
968 
969             break;
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 
1007         case (sf::Mouse::Right): {
1008             if (this->tile_selected) {
1009                 this->tile_selected = false;
1010                 this->__sendNoTileSelectedMessage();
1011             }
1012 
1013             break;
1014         }
1015 
1016 
1017         default: {
1018             // do nothing!
1019 
1020             break;
1021         }
1022     }
1023 
1024     return;
1025 }   /* __handleMouseButtonEvents() */
```

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(MONOCHROME_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(MONOCHROME_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:

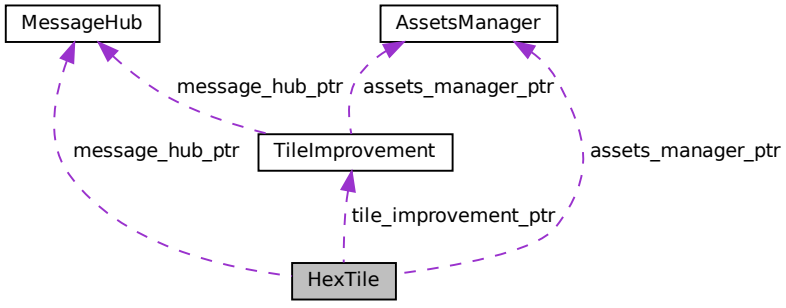
- header/HexMap.h
- source/HexMap.cpp

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 postion 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

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

```
2309 {
2310     //  1. set attributes
2311
2312     //  1.1. private
2313     this->event_ptr = event_ptr;
2314     this->render_window_ptr = render_window_ptr;
2315
2316     this->assets_manager_ptr = assets_manager_ptr;
2317     this->message_hub_ptr = message_hub_ptr;
2318
2319     //  1.2. public
2320     this->show_node = false;
2321     this->show_resource = false;
2322     this->resource_assessed = false;
2323     this->resource_assessment = false;
2324     this->is_selected = false;
2325     this->draw_explosion = false;
2326
2327     this->decoration_cleared = false;
2328     this->has_improvement = false;
2329     this->tile_improvement_ptr = NULL;
2330
2331     this->build_menu_open = false;
2332
2333     this->explosion_frame = 0;
2334
2335     this->frame = 0;
2336     this->credits = 0;
2337
2338     this->scrap_improvement_frame = 0;
2339
```

```
2340     this->position_x = position_x;
2341     this->position_y = position_y;
2342
2343     this->major_radius = 32;
2344     this->minor_radius = (sqrt(3) / 2) * this->major_radius;
2345
2346     this->game_phase = "build settlement";
2347
2348     //  2. set up and position drawable attributes
2349     this->__setUpNodeSprite();
2350     this->__setUpTileSprite();
2351     this->__setUpSelectOutlineSprite();
2352     this->__setUpResourceChipSprite();
2353     this->__setResourceText();
2354     this->__setUpMagnifyingGlassSprite();
2355     this->__setUpTileExplosionReel();
2356
2357     //  3. set tile type and resource (default to none type and average)
2358     this->setTileType(TileType :: NONE_TYPE);
2359     this->setTileResource(TileResource :: AVERAGE);
2360
2361     std::cout « "HexTile constructed at " « this « std::endl;
2362
2363     return;
2364 }   /* HexTile() */
```

4.7.2.2 ~HexTile()

```
HexTile::~HexTile (
            void  )
```

Destructor for the HexTile class.

```
2932 {
2933     if (this->tile_improvement_ptr != NULL) {
2934         delete this->tile_improvement_ptr;
2935     }
2936
2937     std::cout « "HexTile at " « this « " destroyed" « std::endl;
2938
2939     return;
2940 }   /* ~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.

```
1410 {
1411     int build_cost = DIESEL_GENERATOR_BUILD_COST;
1412
1413     if (this->credits < build_cost) {
1414         std::cout « "Cannot build diesel generator: insufficient credits (need "
1415             « build_cost « " K)" « std::endl;
1416
1417         this->__sendInsufficientCreditsMessage();
1418         return;
1419     }
1420
1421     this->tile_improvement_ptr = new DieselGenerator(
1422         this->position_x,
1423         this->position_y,
1424         this->tile_resource,
```

```
1425         this->event_ptr,
1426         this->render_window_ptr,
1427         this->assets_manager_ptr,
1428         this->message_hub_ptr
1429     );
1430
1431     this->has_improvement = true;
1432     this->__closeBuildMenu();
1433
1434     this->__sendCreditsSpentMessage(build_cost);
1435     this->__sendTileStateMessage();
1436     this->__sendGameStateRequest();
1437
1438     return;
1439 }   /* __buildDieselGenerator() */
```

4.7.3.2 __buildEnergyStorage()

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

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

```
1658 {
1659     /*
1660     int build_cost = ENERGY_STORAGE_SYSTEM_BUILD_COST;
1661
1662     if (this->credits < build_cost) {
1663         std::cout « "Cannot build energy storage system: insufficient credits (need "
1664             « build_cost « " K)" « std::endl;
1665
1666         this->__sendInsufficientCreditsMessage();
1667         return;
1668     }
1669
1670     this->tile_improvement_ptr = new EnergyStorageSystem(
1671         this->position_x,
1672         this->position_y,
1673         this->event_ptr,
1674         this->render_window_ptr,
1675         this->assets_manager_ptr,
1676         this->message_hub_ptr
1677     );
1678
1679     this->has_improvement = true;
1680     this->__closeBuildMenu();
1681
1682     this->__sendCreditsSpentMessage(build_cost);
1683     this->__sendTileStateMessage();
1684     this->__sendGameStateRequest();
1685     */
1686     return;
1687 }   /* __buildEnergyStorage() */
```

4.7.3.3 __buildSettlement()

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

Helper method to build a settlement on this tile.

```
1363 {
1364     if (this->credits < BUILD_SETTLEMENT_COST) {
1365         std::cout « "Cannot build settlement: insufficient credits (need "
1366             « BUILD_SETTLEMENT_COST « " K)" « std::endl;
1367
1368         this->__sendInsufficientCreditsMessage();
1369         return;
1370     }
1371
1372     this->__clearDecoration();
```

```
1373
1374     this->tile_improvement_ptr = new Settlement(
1375         this->position_x,
1376         this->position_y,
1377         this->tile_resource,
1378         this->event_ptr,
1379         this->render_window_ptr,
1380         this->assets_manager_ptr,
1381         this->message_hub_ptr
1382     );
1383
1384     this->has_improvement = true;
1385
1386     this->assess();
1387     this->__sendAssessNeighboursMessage();
1388
1389     this->__sendUpdateGamePhaseMessage("system management");
1390     this->__sendCreditsSpentMessage(BUILD_SETTLEMENT_COST);
1391     this->__sendTileStateMessage();
1392     this->__sendGameStateRequest();
1393
1394     return;
1395 }   /* __buildSettlement() */
```

4.7.3.4 __buildSolarPV()

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

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

```
1454 {
1455     int build_cost = SOLAR_PV_BUILD_COST;
1456
1457     if (this->tile_type == TileType :: LAKE) {
1458         build_cost *= SOLAR_PV_WATER_BUILD_MULTIPLIER;
1459     }
1460
1461     if (this->credits < build_cost) {
1462         std::cout « "Cannot build solar PV array: insufficient credits (need "
1463             « build_cost « " K)" « std::endl;
1464
1465         this->__sendInsufficientCreditsMessage();
1466         return;
1467     }
1468
1469     this->tile_improvement_ptr = new SolarPV(
1470         this->position_x,
1471         this->position_y,
1472         this->tile_resource,
1473         this->event_ptr,
1474         this->render_window_ptr,
1475         this->assets_manager_ptr,
1476         this->message_hub_ptr
1477     );
1478
1479     this->has_improvement = true;
1480     this->__closeBuildMenu();
1481
1482     if (this->tile_type == TileType :: LAKE) {
1483         this->decoration_cleared = true;
1484         this->assets_manager_ptr->getSound("splash")->play();
1485     }
1486
1487     this->__sendCreditsSpentMessage(build_cost);
1488     this->__sendTileStateMessage();
1489     this->__sendGameStateRequest();
1490
1491     return;
1492 }   /* __buildSolarPV() */
```

4.7.3.5 __buildTidalTurbine()

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

Helper method to build a tidal turbine on this tile.

```
1566 {
1567     int build_cost = TIDAL_TURBINE_BUILD_COST;
1568
1569     if (this->credits < build_cost) {
1570         std::cout « "Cannot build tidal turbine: insufficient credits (need "
1571             « build_cost « " K)" « std::endl;
1572
1573         this->__sendInsufficientCreditsMessage();
1574         return;
1575     }
1576
1577     this->tile_improvement_ptr = new TidalTurbine(
1578         this->position_x,
1579         this->position_y,
1580         this->tile_resource,
1581         this->event_ptr,
1582         this->render_window_ptr,
1583         this->assets_manager_ptr,
1584         this->message_hub_ptr
1585     );
1586
1587     this->has_improvement = true;
1588     this->decoration_cleared = true;
1589     this->assets_manager_ptr->getSound("splash")->play();
1590     this->__closeBuildMenu();
1591
1592     this->__sendCreditsSpentMessage(build_cost);
1593     this->__sendTileStateMessage();
1594     this->__sendGameStateRequest();
1595
1596     return;
1597 }   /* __buildTidalTurbine() */
```

4.7.3.6 __buildWaveEnergyConverter()

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

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

```
1612 {
1613     int build_cost = WAVE_ENERGY_CONVERTER_BUILD_COST;
1614
1615     if (this->credits < build_cost) {
1616         std::cout « "Cannot build wave energy converter: insufficient credits (need "
1617             « build_cost « " K)" « std::endl;
1618
1619         this->__sendInsufficientCreditsMessage();
1620         return;
1621     }
1622
1623     this->tile_improvement_ptr = new WaveEnergyConverter(
1624         this->position_x,
1625         this->position_y,
1626         this->tile_resource,
1627         this->event_ptr,
1628         this->render_window_ptr,
1629         this->assets_manager_ptr,
1630         this->message_hub_ptr
1631     );
1632
1633     this->has_improvement = true;
1634     this->decoration_cleared = true;
1635     this->assets_manager_ptr->getSound("splash")->play();
1636     this->__closeBuildMenu();
1637
1638     this->__sendCreditsSpentMessage(build_cost);
1639     this->__sendTileStateMessage();
1640     this->__sendGameStateRequest();
1641
1642     return;
1643 }   /* __buildWaveEnergyConverter() */
```

4.7.3.7 __buildWindTurbine()

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

Helper method to build a wind turbine on this tile.

```
1507 {
1508     int build_cost = WIND_TURBINE_BUILD_COST;
1509
1510     if (
1511         (this->tile_type == TileType :: LAKE) or
1512         (this->tile_type == TileType :: OCEAN)
1513     ) {
1514         build_cost *= WIND_TURBINE_WATER_BUILD_MULTIPLIER;
1515     }
1516
1517     if (this->credits < build_cost) {
1518         std::cout « "Cannot build wind turbine: insufficient credits (need "
1519             « build_cost « " K)" « std::endl;
1520
1521         this->__sendInsufficientCreditsMessage();
1522         return;
1523     }
1524
1525     this->tile_improvement_ptr = new WindTurbine(
1526         this->position_x,
1527         this->position_y,
1528         this->tile_resource,
1529         this->event_ptr,
1530         this->render_window_ptr,
1531         this->assets_manager_ptr,
1532         this->message_hub_ptr
1533     );
1534
1535     this->has_improvement = true;
1536     this->__closeBuildMenu();
1537
1538     if (
1539         (this->tile_type == TileType :: LAKE) or
1540         (this->tile_type == TileType :: OCEAN)
1541     ) {
1542         this->decoration_cleared = true;
1543         this->assets_manager_ptr->getSound("splash")->play();
1544     }
1545
1546     this->__sendCreditsSpentMessage(build_cost);
1547     this->__sendTileStateMessage();
1548     this->__sendGameStateRequest();
1549
1550     return;
1551 }   /* __buildWindTurbine() */
```

4.7.3.8 __clearDecoration()

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

Helper method to clear tile decoration.

```
791 {
792     this->decoration_cleared = true;
793     this->draw_explosion = true;
794
795     switch (this->tile_type) {
796         case (TileType :: FOREST): {
797             this->assets_manager_ptr->getSound("clear non-mountains tile")->play();
798
799             break;
800         }
801
802
803         case (TileType :: MOUNTAINS): {
804             this->assets_manager_ptr->getSound("clear mountains tile")->play();
805
806             break;
807         }
```

```
808
809
810         case (TileType :: PLAINS): {
811             this->assets_manager_ptr->getSound("clear non-mountains tile")->play();
812
813             break;
814         }
815
816
817         default: {
818             // do nothing!
819
820             break;
821         }
822     }
823
824     return;
825 }   /* __clearDecoration() */
```

4.7.3.9 __closeBuildMenu()

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

Helper method to close the tile improvement build menu.

```
1338 {
1339     if (not this->build_menu_open) {
1340         return;
1341     }
1342
1343     this->build_menu_open = false;
1344     this->assets_manager_ptr->getSound("build menu close")->play();
1345
1346     return;
1347 }   /* __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.

```
1804 {
1805     std::string coords_substring = "TILE COORDS:  (";
1806     coords_substring += std::to_string(int(this->position_x - 400));
1807     coords_substring += ", ";
1808     coords_substring += std::to_string(int(this->position_y - 400));
1809     coords_substring += ")\n";
1810
1811     return coords_substring;
1812 }   /* __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.

```
1963 {
1964     std::string improvement_substring = "TILE IMPROVEMENT:  ";
1965 
1966     if (this->has_improvement) {
1967         improvement_substring += this->tile_improvement_ptr->tile_improvement_string;
1968         improvement_substring += "\n";
1969     }
1970 
1971     else {
1972         improvement_substring += "NONE\n";
1973     }
1974 
1975     return improvement_substring;
1976 }   /* __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.

```
1993 {
1994     //                   32 char x 17 line console "--------------------------------\n";
1995     std::string options_substring                = "     **** TILE OPTIONS ****     \n";
1996     options_substring                           += "                                \n";
1997 
1998     if (this->game_phase == "build settlement") {
1999         if (
2000             (this->tile_type != TileType :: OCEAN) and
2001             (this->tile_type != TileType :: LAKE)
2002         ) {
2003             options_substring += "[B]:  BUILD SETTLEMENT (";
2004             options_substring += std::to_string(BUILD_SETTLEMENT_COST);
2005             options_substring += " K)\n";
2006         }
2007     }
2008 
2009 
2010     else if (this->game_phase == "system management") {
2011         if (this->has_improvement) {
2012             options_substring.clear();
2013             options_substring = this->tile_improvement_ptr->getTileOptionsSubstring();
2014         }
2015 
2016 
2017         else if (not this->resource_assessed) {
2018             options_substring += "[A]:  ASSESS RESOURCE (";
2019             options_substring += std::to_string(RESOURCE_ASSESSMENT_COST);
2020             options_substring += " K)\n";
2021         }
2022 
2023 
2024         else if (
2025             (not this->decoration_cleared) and
2026             (this->tile_type != TileType :: OCEAN) and
```

```
2027             (this->tile_type != TileType :: LAKE)
2028         ) {
2029             options_substring += "[C]:  CLEAR TILE (";
2030 
2031             switch (this->tile_type) {
2032                 case (TileType :: FOREST): {
2033                     options_substring += std::to_string(CLEAR_FOREST_COST);
2034 
2035                     break;
2036                 }
2037 
2038 
2039                 case (TileType :: MOUNTAINS): {
2040                     options_substring += std::to_string(CLEAR_MOUNTAINS_COST);
2041 
2042                     break;
2043                 }
2044 
2045 
2046                 case (TileType :: PLAINS): {
2047                     options_substring += std::to_string(CLEAR_PLAINS_COST);
2048 
2049                     break;
2050                 }
2051 
2052 
2053                 default: {
2054                     //do nothing!
2055 
2056                     break;
2057                 }
2058             }
2059 
2060             options_substring += " K)\n";
2061         }
2062 
2063 
2064         else if (
2065             (this->decoration_cleared) or
2066             (this->tile_type == TileType :: OCEAN) or
2067             (this->tile_type == TileType :: LAKE)
2068         ) {
2069             options_substring += "[B]: OPEN BUILD MENU\n";
2070         }
2071     }
2072 
2073 
2074     else if (this->game_phase == "victory") {
2075         options_substring                       += "       **** VICTORY ****        \n";
2076     }
2077 
2078 
2079     else {
2080         options_substring                       += "        **** LOSS ****          \n";
2081     }
2082 
2083     return options_substring;
2084 }   /* __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.

```
1893 {
1894     std::string resource_substring = "TILE RESOURCE:     ";
1895 
1896     if (this->resource_assessed) {
1897         switch (this->tile_resource) {
1898             case (TileResource :: POOR): {
```

```
1899                 resource_substring += "POOR\n";
1900
1901                 break;
1902             }
1903
1904
1905             case (TileResource ::BELOW_AVERAGE): {
1906                 resource_substring += "BELOW AVERAGE\n";
1907
1908                 break;
1909             }
1910
1911
1912             case (TileResource :: AVERAGE): {
1913                 resource_substring += "AVERAGE\n";
1914
1915                 break;
1916             }
1917
1918
1919             case (TileResource :: ABOVE_AVERAGE): {
1920                 resource_substring += "ABOVE AVERAGE\n";
1921
1922                 break;
1923             }
1924
1925
1926             case (TileResource :: GOOD): {
1927                 resource_substring += "GOOD\n";
1928
1929                 break;
1930             }
1931
1932
1933             default: {
1934                 resource_substring += "???\n";
1935
1936                 break;
1937             }
1938         }
1939     }
1940
1941     else {
1942         resource_substring += "???\n";
1943     }
1944
1945     return resource_substring;
1946 }   /* __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.

```
1829 {
1830     std::string type_substring = "TILE TYPE:         ";
1831
1832     switch (this->tile_type) {
1833         case (TileType :: FOREST): {
1834             type_substring += "FOREST\n";
1835
1836             break;
1837         }
1838
1839
1840         case (TileType :: LAKE): {
1841             type_substring += "LAKE\n";
1842
1843             break;
1844         }
```

```
1845
1846
1847         case (TileType :: MOUNTAINS): {
1848             type_substring += "MOUNTAINS\n";
1849
1850             break;
1851         }
1852
1853
1854         case (TileType :: OCEAN): {
1855             type_substring += "OCEAN\n";
1856
1857             break;
1858         }
1859
1860
1861         case (TileType :: PLAINS): {
1862             type_substring += "PLAINS\n";
1863
1864             break;
1865         }
1866
1867
1868         default: {
1869             type_substring += "???\n";
1870
1871             break;
1872         }
1873     }
1874
1875     return type_substring;
1876 }   /* __getTileTypeSubstring() */
```

4.7.3.15 __handleKeyPressEvents()

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

Helper method to handle key press events.

```
874 {
875     if (not this->is_selected) {
876         return;
877     }
878
879
880     if (this->event_ptr->key.code == sf::Keyboard::Escape) {
881         this->__setIsSelected(false);
882     }
883
884
885     if (this->build_menu_open) {
886         switch (this->tile_type) {
887             case (TileType :: FOREST): {
888                 switch (this->event_ptr->key.code) {
889                     case (sf::Keyboard::D): {
890                         this->__buildDieselGenerator();
891
892                         break;
893                     }
894
895
896                     case (sf::Keyboard::S): {
897                         this->__buildSolarPV();
898
899                         break;
900                     }
901
902
903                     case (sf::Keyboard::W): {
904                         this->__buildWindTurbine();
905
906                         break;
907                     }
908
909
910                     case (sf::Keyboard::E): {
911                         this->__buildEnergyStorage();
912
```

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

```
1000
1001                        break;
1002                    }
1003
1004
1005                    case (sf::Keyboard::T): {
1006                        this->__buildTidalTurbine();
1007
1008                        break;
1009                    }
1010
1011
1012                    case (sf::Keyboard::A): {
1013                        this->__buildWaveEnergyConverter();
1014
1015                        break;
1016                    }
1017
1018
1019                    default: {
1020                        // do nothing!
1021
1022                        break;
1023                    }
1024                }
1025
1026                break;
1027            }
1028
1029
1030            case (TileType :: PLAINS): {
1031                switch (this->event_ptr->key.code) {
1032                    case (sf::Keyboard::D): {
1033                        this->__buildDieselGenerator();
1034
1035                        break;
1036                    }
1037
1038
1039                    case (sf::Keyboard::S): {
1040                        this->__buildSolarPV();
1041
1042                        break;
1043                    }
1044
1045
1046                    case (sf::Keyboard::W): {
1047                        this->__buildWindTurbine();
1048
1049                        break;
1050                    }
1051
1052
1053                    case (sf::Keyboard::E): {
1054                        this->__buildEnergyStorage();
1055
1056                        break;
1057                    }
1058
1059
1060                    default: {
1061                        // do nothing!
1062
1063                        break;
1064                    }
1065                }
1066
1067                break;
1068            }
1069
1070
1071            default: {
1072                //do nothing!
1073
1074                break;
1075            }
1076        }
1077    }
1078
1079
1080    if (this->game_phase == "build settlement") {
1081        if (
1082            (this->tile_type != TileType :: OCEAN) and
1083            (this->tile_type != TileType :: LAKE)
1084        ) {
1085            if (this->event_ptr->key.code == sf::Keyboard::B) {
1086                this->__buildSettlement();
```

```
1087             }
1088         }
1089     }
1090
1091
1092     else if (this->game_phase == "system management") {
1093         if (this->has_improvement) {
1094             if (this->tile_improvement_ptr->tile_improvement_type != TileImprovementType :: SETTLEMENT)
     {
1095                 if (this->event_ptr->key.code == sf::Keyboard::P) {
1096                     this->__scrapImprovement();
1097                 }
1098             }
1099
1100             /*
1101              * All other inputs will be caught and handled by
1102              *   this->tile_improvement_ptr->processEvent()
1103              */
1104         }
1105
1106
1107         else if (not this->resource_assessed) {
1108             if (this->event_ptr->key.code == sf::Keyboard::A) {
1109                 if (this->credits < RESOURCE_ASSESSMENT_COST) {
1110                     std::cout << "Cannot assess resource: insufficient credits (need "
1111                         << RESOURCE_ASSESSMENT_COST << " K)" << std::endl;
1112
1113                     this->__sendInsufficientCreditsMessage();
1114                 }
1115
1116                 else {
1117                     this->assess();
1118                     this->__sendCreditsSpentMessage(RESOURCE_ASSESSMENT_COST);
1119                     this->__sendTileStateMessage();
1120                     this->__sendGameStateRequest();
1121                 }
1122             }
1123         }
1124
1125
1126         else if (
1127             (not this->decoration_cleared) and
1128             (this->tile_type != TileType :: OCEAN) and
1129             (this->tile_type != TileType :: LAKE)
1130         ) {
1131             if (this->event_ptr->key.code == sf::Keyboard::C) {
1132                 int clear_cost = 0;
1133
1134                 switch (this->tile_type) {
1135                     case (TileType :: FOREST): {
1136                         clear_cost = CLEAR_FOREST_COST;
1137
1138                         break;
1139                     }
1140
1141
1142                     case (TileType :: MOUNTAINS): {
1143                         clear_cost = CLEAR_MOUNTAINS_COST;
1144
1145                         break;
1146                     }
1147
1148
1149                     case (TileType :: PLAINS): {
1150                         clear_cost = CLEAR_PLAINS_COST;
1151
1152                         break;
1153                     }
1154
1155
1156                     default: {
1157                         // do nothing!
1158
1159                         break;
1160                     }
1161                 }
1162
1163                 if (this->credits < clear_cost) {
1164                     std::cout << "Cannot clear tile: insufficient credits (need "
1165                         << clear_cost << " K)" << std::endl;
1166
1167                     this->__sendInsufficientCreditsMessage();
1168                 }
1169
1170                 else {
1171                     this->__clearDecoration();
1172                     this->__sendCreditsSpentMessage(clear_cost);
```

```
1173                     this->__sendTileStateMessage();
1174                     this->__sendGameStateRequest();
1175                 }
1176             }
1177         }
1178
1179
1180         else if (
1181             (this->decoration_cleared) or
1182             (this->tile_type == TileType :: OCEAN) or
1183             (this->tile_type == TileType :: LAKE)
1184         ) {
1185             if (this->event_ptr->key.code == sf::Keyboard::B) {
1186                 this->__openBuildMenu();
1187             }
1188         }
1189     }
1190
1191     return;
1192 }   /* __handleKeyPressEvents() */
```

4.7.3.16 __handleKeyReleaseEvents()

```
void HexTile::__handleKeyReleaseEvents (
              void  )  [private]
1198 {
1199     if (not this->is_selected) {
1200         return;
1201     }
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
1235         default: {
1236             // do nothing!
1237
1238             break;
1239         }
1240     }
1241
1242     /*
1243     if (this->event_ptr->key.code == sf::Keyboard::P) {
1244
1245     }
1246     */
1247
1248     return;
1249 }   /* __handleKeyReleaseEvents() */
```

4.7.3.17 __handleMouseButtonEvents()

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

Helper method to handle mouse button events.

```
1262 {
1263     switch (this->event_ptr->mouseButton.button) {
1264         case (sf::Mouse::Left): {
1265             if (this->__isClicked()) {
1266                 std::cout « "Tile (" « this->position_x « ", " «
1267                     this->position_y « ") was selected" « std::endl;
1268 
1269                 this->__setIsSelected(true);
1270 
1271                 this->__sendTileSelectedMessage();
1272                 this->__sendTileStateMessage();
1273                 this->__sendGameStateRequest();
1274             }
1275 
1276             else {
1277                 this->__setIsSelected(false);
1278             }
1279 
1280             break;
1281         }
1282 
1283 
1284         case (sf::Mouse::Right): {
1285             this->__setIsSelected(false);
1286 
1287             break;
1288         }
1289 
1290 
1291         default: {
1292             // do nothing!
1293 
1294             break;
1295         }
1296     }
1297 
1298     return;
1299 }   /* __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.

```
842 {
843     sf::Vector2i mouse_position = sf::Mouse::getPosition(*render_window_ptr);
844 
845     double mouse_x = mouse_position.x;
846     double mouse_y = mouse_position.y;
847 
848     double distance = sqrt(
849         pow(this->position_x - mouse_x, 2) +
850         pow(this->position_y - mouse_y, 2)
851     );
852 
853     if (distance < this->minor_radius) {
854         return true;
855     }
856     else {
857         return false;
858     }
859 }   /* __isClicked() */
```

4.7.3.19 __openBuildMenu()

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

Helper method to open the tile improvement build menu.

```
1314 {
1315     if (this->build_menu_open) {
1316         return;
1317     }
1318
1319     this->build_menu_open = true;
1320     this->assets_manager_ptr->getSound("build menu open")->play();
1321
1322     return;
1323 }   /* __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.

```
1703 {
1704     //  1. implement key hold confirmation
1705     if (this->scrap_improvement_frame <= FRAMES_PER_SECOND) {
1706         double colour_scalar =
1707             1 - ((double)(this->scrap_improvement_frame) / (FRAMES_PER_SECOND));
1708
1709         if (
1710             this->tile_improvement_ptr->tile_improvement_sprite_static.getTexture() != NULL
1711         ) {
1712             this->tile_improvement_ptr->tile_improvement_sprite_static.setColor(
1713                 sf::Color(255, 255 * colour_scalar, 255 * colour_scalar, 255)
1714             );
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
1733     //  2. carry out scrapping
1734     else {
1735         this->draw_explosion = true;
1736         this->assets_manager_ptr->getSound("clear non-mountains tile")->play();
1737
1738         if (this->tile_improvement_ptr->production_menu_open) {
1739             this->tile_improvement_ptr->production_menu_open = false;
1740             this->assets_manager_ptr->getSound("build menu close")->play();
1741         }
1742
1743         delete this->tile_improvement_ptr;
1744         this->tile_improvement_ptr = NULL;
1745
1746         this->has_improvement = false;
1747
1748         this->scrap_improvement_frame = 0;
1749
1750         if (
1751             (this->tile_type == TileType :: LAKE) or
1752             (this->tile_type == TileType :: OCEAN)
```

```
1753         ) {
1754             this->decoration_cleared = false;
1755         }
1756 
1757         this->__sendCreditsSpentMessage(SCRAP_COST);
1758         this->__sendTileStateMessage();
1759         this->__sendGameStateRequest();
1760     }
1761 
1762     return;
1763 }   /* __scrapImprovement() */
```

4.7.3.21 __sendAssessNeighboursMessage()

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

Helper method to format and send assess neighbours message.

```
2140 {
2141     Message assess_neighbours_message;
2142 
2143     assess_neighbours_message.channel = HEX_MAP_CHANNEL;
2144     assess_neighbours_message.subject = "assess neighbours";
2145 
2146     this->message_hub_ptr->sendMessage(assess_neighbours_message);
2147 
2148     std::cout << "Assess neighbours message sent by " << this << std::endl;
2149 
2150     return;
2151 }   /* __sendAssessNeighboursMessage() */
```

4.7.3.22 __sendCreditsSpentMessage()

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

Helper method to format and send a credits spent message.

Parameters

credits_spent	The number of credits that were spent.

```
2223 {
2224     Message credits_spent_message;
2225 
2226     credits_spent_message.channel = GAME_CHANNEL;
2227     credits_spent_message.subject = "credits spent";
2228 
2229     credits_spent_message.int_payload["credits spent"] = credits_spent;
2230 
2231     this->message_hub_ptr->sendMessage(credits_spent_message);
2232 
2233     std::cout << "Credits spent (" << credits_spent << ") message sent by " << this
2234         << std::endl;
2235     return;
2236 }   /* __sendCreditsSpentMessage() */
```

4.7.3.23 __sendGameStateRequest()

```
void HexTile::__sendGameStateRequest (
```

```
            void  )  [private]
```

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

```
2166 {
2167     Message game_state_request;
2168
2169     game_state_request.channel = GAME_CHANNEL;
2170     game_state_request.subject = "state request";
2171
2172     this->message_hub_ptr->sendMessage(game_state_request);
2173
2174     std::cout « "Game state request message sent by " « this « std::endl;
2175     return;
2176 }   /* __sendGameStateRequest() */
```

4.7.3.24 __sendInsufficientCreditsMessage()

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

Helper method to format and send an insufficient credits message.

```
2251 {
2252     Message insufficient_credits_message;
2253
2254     insufficient_credits_message.channel = GAME_CHANNEL;
2255     insufficient_credits_message.subject = "insufficient credits";
2256
2257     this->message_hub_ptr->sendMessage(insufficient_credits_message);
2258
2259     std::cout « "Insufficient credits message sent by " « this « std::endl;
2260
2261     return;
2262 }   /* __sendInsufficientCreditsMessage() */
```

4.7.3.25 __sendTileSelectedMessage()

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

Helper method to format and send message on tile selection.

```
1778 {
1779     Message tile_selected_message;
1780
1781     tile_selected_message.channel = TILE_SELECTED_CHANNEL;
1782     tile_selected_message.subject = "tile selected";
1783
1784     this->message_hub_ptr->sendMessage(tile_selected_message);
1785
1786     return;
1787 }   /* __sendTileSelectedMessage() */
```

4.7.3.26 __sendTileStateMessage()

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

Helper method to format and send tile state message.

```
2099 {
2100     Message tile_state_message;
2101 
2102     tile_state_message.channel = TILE_STATE_CHANNEL;
2103     tile_state_message.subject = "tile state";
2104 
2105 
2106     //                  32 char x 17 line console "--------------------------------\n";
2107     std::string console_string                  = "      **** TILE INFO ****       \n";
2108 
2109     console_string                             += this->__getTileCoordsSubstring();
2110     console_string                             += "                                \n";
2111 
2112     console_string                             += this->__getTileTypeSubstring();
2113     console_string                             += this->__getTileResourceSubstring();
2114     console_string                             += this->__getTileImprovementSubstring();
2115     console_string                             += "                                \n";
2116 
2117     console_string                             += this->__getTileOptionsSubstring();
2118 
2119     tile_state_message.string_payload["console string"] = console_string;
2120 
2121     this->message_hub_ptr->sendMessage(tile_state_message);
2122 
2123     std::cout << "Tile state message sent by " << this << std::endl;
2124     return;
2125 }   /* __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

game_phase	The updated game phase.

```
2193 {
2194     Message update_game_phase_message;
2195 
2196     update_game_phase_message.channel = GAME_CHANNEL;
2197     update_game_phase_message.subject = "update game phase";
2198 
2199     update_game_phase_message.string_payload["game phase"] = game_phase;
2200 
2201     this->message_hub_ptr->sendMessage(update_game_phase_message);
2202 
2203     std::cout << "Update game phase message sent by " << this << std::endl;
2204 
2205     return;
2206 }   /* __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

is_selected	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     }
770 
771     if ((not is_selected) and this->build_menu_open) {
772         this->__closeBuildMenu();
773     }
774 
775     return;
776 }   /* __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(MONOCHROME_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(MONOCHROME_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
702         case (TileType :: LAKE): {
703             this->__setUpSolarPVBuildOption(true);
704             this->__setUpWindTurbineBuildOption(true);
705
706             break;
707         }
708
709
710         case (TileType :: MOUNTAINS): {
711             this->__setUpDieselGeneratorBuildOption();
712             this->__setUpSolarPVBuildOption();
713             this->__setUpWindTurbineBuildOption();
714             //this->__setUpEnergyStorageSystemBuildOption();
715
716             break;
717         }
718
719
```

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

4.7.3.31 __setUpBuildOption()

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

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

Parameters

texture_key	The key for the appropriate illustration asset for the build option.
option_string	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(MONOCHROME_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\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\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

is_lake	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     //                                  "----------------\n"
532     std::string solar_PV_string         = " SOLAR PV ARRAY \n";
533     solar_PV_string                    += "                \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     //                                  "----------------\n"
573     std::string tidal_turbine_string    = " TIDAL TURBINE  \n";
574     tidal_turbine_string               += "                \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\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\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

is_lake	If being built on a lake tile.
is_ocean	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.

```
2685 {
2686     this->resource_assessed = true;
2687     this->resource_assessment = true;
2688 
2689     this->assets_manager_ptr->getSound("resource assessment")->play();
2690 
2691     this->__setResourceText();
2692     this->__sendTileStateMessage();
2693 
2694     return;
2695 }   /* assess() */
```

4.7.3.45 decorateTile()

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

Method to decorate tile.

```
2563 {
2564     switch (this->tile_type) {
2565         case (TileType :: FOREST): {
2566             this->tile_decoration_sprite.setTexture(
2567                 *(this->assets_manager_ptr->getTexture("pine_tree_64x64_1"))
2568             );
2569 
2570             break;
2571         }
2572 
2573         case (TileType :: LAKE): {
2574             this->tile_decoration_sprite.setTexture(
2575                 *(this->assets_manager_ptr->getTexture("water_shimmer_64x64_1"))
2576             );
2577 
2578             break;
2579         }
2580 
2581         case (TileType :: MOUNTAINS): {
2582             this->tile_decoration_sprite.setTexture(
2583                 *(this->assets_manager_ptr->getTexture("mountain_64x64_1"))
2584             );
2585 
2586             break;
2587         }
2588 
2589         case (TileType :: OCEAN): {
2590             this->tile_decoration_sprite.setTexture(
2591                 *(this->assets_manager_ptr->getTexture("water_waves_64x64_1"))
2592             );
2593 
2594             break;
2595         }
2596 
2597         case (TileType :: PLAINS): {
2598             this->tile_decoration_sprite.setTexture(
2599                 *(this->assets_manager_ptr->getTexture("wheat_64x64_1"))
2600             );
2601 
2602             break;
2603         }
2604 
2605         default: {
2606             // do nothing!
2607 
2608             break;
2609         }
2610     }
2611 
2612 
2613     if (this->tile_type == TileType :: OCEAN or this->tile_type == TileType :: LAKE) {
2614         this->tile_decoration_sprite.setOrigin(
2615             this->tile_decoration_sprite.getLocalBounds().width / 2,
2616             this->tile_decoration_sprite.getLocalBounds().height / 2
2617         );
2618 
2619         this->tile_decoration_sprite.setPosition(
2620             this->position_x,
2621             this->position_y
2622         );
2623 
2624         if ((double)rand() / RAND_MAX > 0.5) {
2625             this->tile_decoration_sprite.setScale(sf::Vector2f(-1, 1));
2626         }
2627     }
2628 
2629     else {
2630         this->tile_decoration_sprite.setOrigin(
2631             this->tile_decoration_sprite.getLocalBounds().width / 2,
2632             this->tile_decoration_sprite.getLocalBounds().height
2633         );
2634 
2635         this->tile_decoration_sprite.setPosition(
2636             this->position_x,
2637             this->position_y + 12
2638         );
2639 
2640         if ((double)rand() / RAND_MAX > 0.5) {
```

```
2641             this->tile_decoration_sprite.setScale(sf::Vector2f(-1, 1));
2642         }
2643     }
2644
2645     return;
2646 }   /* 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.

```
2826 {
2827     //  1. draw hex
2828     this->render_window_ptr->draw(this->tile_sprite);
2829
2830     //  2. draw node
2831     if (this->show_node) {
2832         this->render_window_ptr->draw(this->node_sprite);
2833     }
2834
2835     //  3. draw tile decoration
2836     if (not this->decoration_cleared) {
2837         this->render_window_ptr->draw(this->tile_decoration_sprite);
2838     }
2839
2840     //  4. draw selection outline
2841     if (this->is_selected) {
2842         sf::Color outline_colour = this->select_outline_sprite.getOutlineColor();
2843
2844         outline_colour.a =
2845             255 * pow(cos((M_PI * this->frame) / FRAMES_PER_SECOND), 2);
2846
2847         this->select_outline_sprite.setOutlineColor(outline_colour);
2848
2849         this->render_window_ptr->draw(this->select_outline_sprite);
2850     }
2851
2852     //  5. draw tile improvement
2853     if (this->has_improvement) {
2854         if (not this->tile_improvement_ptr->just_built) {
2855             this->tile_improvement_ptr->draw();
2856         }
2857     }
2858
2859     //  6. draw resource
2860     if (this->show_resource) {
2861         this->render_window_ptr->draw(this->resource_chip_sprite);
2862         this->render_window_ptr->draw(this->resource_text);
2863     }
2864
2865     //  7. draw resource assessment notification
2866     if (this->resource_assessment) {
2867         int alpha = this->magnifying_glass_sprite.getColor().a;
2868
2869         alpha -= 0.05 * FRAMES_PER_SECOND;
2870         if (alpha < 0) {
2871             alpha = 0;
2872             this->resource_assessment = false;
2873         }
2874
2875         this->magnifying_glass_sprite.setColor(
2876             sf::Color(255, 255, 255, alpha)
2877         );
2878
2879         this->render_window_ptr->draw(this->magnifying_glass_sprite);
2880     }
2881
2882     //  8. draw explosion, then settlement placement
2883     if (this->draw_explosion) {
2884         this->render_window_ptr->draw(this->explosion_sprite_reel[this->explosion_frame]);
2885
2886         if (this->frame % (FRAMES_PER_SECOND / 20) == 0) {
2887             this->explosion_frame++;
2888         }
2889
2890         if (this->explosion_frame >= this->explosion_sprite_reel.size()) {
```

```
2891             this->draw_explosion = false;
2892             this->explosion_frame = 0;
2893         }
2894     }
2895
2896     else if (this->has_improvement) {
2897         if (this->tile_improvement_ptr->just_built) {
2898             this->tile_improvement_ptr->draw();
2899         }
2900     }
2901
2902     //  9. build menu
2903     if (this->build_menu_open) {
2904         this->render_window_ptr->draw(this->build_menu_backing);
2905         this->render_window_ptr->draw(this->build_menu_backing_text);
2906
2907         for (size_t i = 0; i < this->build_menu_options_vec.size(); i++) {
2908             for (size_t j = 0; j < this->build_menu_options_vec[i].size(); j++) {
2909                 this->render_window_ptr->draw(this->build_menu_options_vec[i][j]);
2910             }
2911             this->render_window_ptr->draw(this->build_menu_options_text_vec[i]);
2912         }
2913     }
2914
2915     this->frame++;
2916     return;
2917 }   /* draw() */
```

4.7.3.47 processEvent()

```
void HexTile::processEvent (
             void  )
```

Method to process HexTile. To be called once per event.

```
2710 {
2711     //  1. process TileImprovement events
2712     if (
2713         this->is_selected and
2714         this->tile_improvement_ptr != NULL
2715     ) {
2716         this->tile_improvement_ptr->processEvent();
2717     }
2718
2719     //  2. process HexTile events
2720     if (this->event_ptr->type == sf::Event::KeyPressed) {
2721         this->__handleKeyPressEvents();
2722     }
2723
2724     if (this->event_ptr->type == sf::Event::KeyReleased) {
2725         this->__handleKeyReleaseEvents();
2726     }
2727
2728     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
2729         this->__handleMouseButtonEvents();
2730     }
2731
2732     return;
2733 }   /* processEvent() */
```

4.7.3.48 processMessage()

```
void HexTile::processMessage (
             void  )
```

Method to process HexTile. To be called once per message.

```
2748 {
2749     //  1. process TileImprovement messages
2750     if (
2751         this->is_selected and
```

```
2752         this->tile_improvement_ptr != NULL
2753     ) {
2754         this->tile_improvement_ptr->processMessage();
2755     }
2756
2757     //  2. process HexTile messages
2758     if (this->is_selected) {
2759         if (not this->message_hub_ptr->isEmpty(GAME_STATE_CHANNEL)) {
2760             Message game_state_message = this->message_hub_ptr->receiveMessage(
2761                 GAME_STATE_CHANNEL
2762             );
2763
2764             if (game_state_message.subject == "game state") {
2765                 this->credits = game_state_message.int_payload["credits"];
2766                 this->game_phase = game_state_message.string_payload["game phase"];
2767
2768                 if (this->tile_improvement_ptr != NULL) {
2769                     this->tile_improvement_ptr->credits = this->credits;
2770                     this->tile_improvement_ptr->game_phase = this->game_phase;
2771                     this->tile_improvement_ptr->month =
2772                         game_state_message.int_payload["month"];
2773                     this->tile_improvement_ptr->demand_MWh =
2774                         game_state_message.int_payload["demand_MWh"];
2775
2776                     this->tile_improvement_ptr->update();
2777                 }
2778
2779                 std::cout « "Game state message received by " « this « std::endl;
2780                 this->__sendTileStateMessage();
2781                 this->message_hub_ptr->popMessage(GAME_STATE_CHANNEL);
2782             }
2783
2784             else if (
2785                 this->has_improvement and
2786                 game_state_message.subject == "turn advance"
2787             ) {
2788                 this->tile_improvement_ptr->advanceTurn();
2789             }
2790         }
2791
2792         if (not this->message_hub_ptr->isEmpty(TILE_STATE_CHANNEL)) {
2793             Message tile_state_message = this->message_hub_ptr->receiveMessage(
2794                 TILE_STATE_CHANNEL
2795             );
2796
2797             if (tile_state_message.subject == "state request") {
2798                 this->__sendTileStateMessage();
2799
2800                 std::cout « "Tile state request received by " « this « std::endl;
2801                 this->message_hub_ptr->popMessage(TILE_STATE_CHANNEL);
2802             }
2803         }
2804
2805         std::cout « "Current credits (HexTile): " « this->credits « " K" «
2806             std::endl;
2807     }
2808
2809     return;
2810 }   /* processMessage() */
```

4.7.3.49 setTileResource() [1/2]

```
void HexTile::setTileResource (
            double input_value )
```

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

Parameters

input_value	A numerical input in the closed interval [0, 1].

```
2512 {
2513     //  1. check input
2514     if (input_value < 0 or input_value > 1) {
2515         std::string error_str = "ERROR  HexTile::setTileResource()  given input value is ";
```

```
2516         error_str += "not in the closed interval [0, 1]";
2517
2518         #ifdef _WIN32
2519             std::cout « error_str « std::endl;
2520         #endif  /* _WIN32 */
2521
2522         throw std::runtime_error(error_str);
2523     }
2524
2525     //  2. convert input value to tile resource
2526     TileResource tile_resource;
2527
2528     if (input_value <= TILE_RESOURCE_CUMULATIVE_PROBABILITIES[0]) {
2529         tile_resource = TileResource :: POOR;
2530     }
2531     else if (input_value <= TILE_RESOURCE_CUMULATIVE_PROBABILITIES[1]) {
2532         tile_resource = TileResource :: BELOW_AVERAGE;
2533     }
2534     else if (input_value <= TILE_RESOURCE_CUMULATIVE_PROBABILITIES[2]) {
2535         tile_resource = TileResource :: AVERAGE;
2536     }
2537     else if (input_value <= TILE_RESOURCE_CUMULATIVE_PROBABILITIES[3]) {
2538         tile_resource = TileResource :: ABOVE_AVERAGE;
2539     }
2540     else {
2541         tile_resource = TileResource :: GOOD;
2542     }
2543
2544     //  3. call alternate method
2545     this->setTileResource(tile_resource);
2546
2547     return;
2548 }   /* 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

tile_resource	The resource (TileResource) value to attribute to the tile.

```
2490 {
2491     this->tile_resource = tile_resource;
2492     this->__setResourceText();
2493
2494     return;
2495 }   /* 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

input_value	A numerical input in the closed interval [0, 1].

```
2440 {
2441     //  1. check input
2442     if (input_value < 0 or input_value > 1) {
2443         std::string error_str = "ERROR  HexTile::setTileType()  given input value is ";
2444         error_str += "not in the closed interval [0, 1]";
2445 
2446         #ifdef _WIN32
2447             std::cout << error_str << std::endl;
2448         #endif  /* _WIN32 */
2449 
2450         throw std::runtime_error(error_str);
2451     }
2452 
2453     //  2. convert input value to tile type
2454     TileType tile_type;
2455 
2456     if (input_value <= TILE_TYPE_CUMULATIVE_PROBABILITIES[0]) {
2457         tile_type = TileType :: LAKE;
2458     }
2459     else if (input_value <= TILE_TYPE_CUMULATIVE_PROBABILITIES[1]) {
2460         tile_type = TileType :: PLAINS;
2461     }
2462     else if (input_value <= TILE_TYPE_CUMULATIVE_PROBABILITIES[2]) {
2463         tile_type = TileType :: FOREST;
2464     }
2465     else {
2466         tile_type = TileType :: MOUNTAINS;
2467     }
2468 
2469     //  3. call alternate method
2470     this->setTileType(tile_type);
2471 
2472     return;
2473 }   /* 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

tile_type	The type (TileType) to set the tile to.

```
2379 {
2380     this->tile_type = tile_type;
2381 
2382     switch (this->tile_type) {
2383         case (TileType :: FOREST): {
2384             this->tile_sprite.setFillColor(FOREST_GREEN);
2385 
2386             break;
2387         }
2388 
2389         case (TileType :: LAKE): {
2390             this->tile_sprite.setFillColor(LAKE_BLUE);
2391 
2392             break;
2393         }
2394 
2395         case (TileType :: MOUNTAINS): {
2396             this->tile_sprite.setFillColor(MOUNTAINS_GREY);
2397 
2398             break;
2399         }
2400 
2401         case (TileType :: OCEAN): {
2402             this->tile_sprite.setFillColor(OCEAN_BLUE);
2403 
2404             break;
2405         }
2406 
2407         case (TileType :: PLAINS): {
```

```
2408             this->tile_sprite.setFillColor(PLAINS_YELLOW);
2409
2410             break;
2411         }
2412
2413         default: {
2414             // do nothing!
2415
2416             break;
2417         }
2418     }
2419
2420     this->__setUpBuildMenu();
2421
2422     return;
2423 }   /* setTileType(TileType) */
```

4.7.3.53 toggleResourceOverlay()

```
void HexTile::toggleResourceOverlay (
              void  )
```

Method to toggle the tile resource overlay.

```
2661 {
2662     if (this->show_resource) {
2663         this->show_resource = false;
2664     }
2665     else {
2666         this->show_resource = true;
2667     }
2668
2669     return;
2670 }   /* 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.
- std::map< std::string, bool > bool_payload = {}

  A boolean payload.
- std::map< std::string, int > int_payload = {}

  A vector payload.
- std::map< std::string, double > double_payload = {}

  A vector 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 vector payload.

4.8.2.4 int_payload

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

A vector payload.

4.8.2.5 string_payload

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

A string payload.

4.8.2.6 subject

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

A string describing the message subject.

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 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 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.

```
425 {
426     this->clear();
427
428     std::cout « "MessageHub at " « this « " destroyed" « std::endl;
429
430     return;
431 }   /* ~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

channel	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.

```
405 {
406 
407     this->clearMessages();
408     this->message_map.clear();
409 
410     return;
411 }   /* clear() */
```

4.9.3.3 clearMessages()

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

Method to clear messages from the MessageHub.

```
379 {
380     std::map<std::string, std::list<Message>::iterator map_iter;
381     for (
382         map_iter = this->message_map.begin();
383         map_iter != this->message_map.end();
384         map_iter++
385     ) {
386         map_iter->second.clear();
387     }
388 
389     return;
390 }   /* 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 isEmpty()

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

Method to check if channel is empty.

Parameters

channel	The key for the message channel being checked.

Returns

A boolean indicating whether the channel is empty or not.

```
244 {
245     //  1. check if channel is in map (if not, throw error)
246     if (this->message_map.count(channel) <= 0) {
247         std::string error_str = "ERROR  MessageHub::isEmpty()  channel ";
248         error_str += channel;
249         error_str += " is not in message map";
250
251         #ifdef _WIN32
252             std::cout « error_str « std::endl;
253         #endif  /* _WIN32 */
254
255         throw std::runtime_error(error_str);
256     }
257
258     if (this->message_map[channel].empty()) {
259         return true;
260     }
261     else {
262         return false;
263     }
264 }   /* isEmpty() */
```

4.9.3.6 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

channel	The key for the message channel being popped.

```
333 {
334     //  1. check if channel is in map (if not, throw error)
335     if (this->message_map.count(channel) <= 0) {
336         std::string error_str = "ERROR  MessageHub::receiveMessage()  channel ";
337         error_str += channel;
338         error_str += " is not in message map";
339 
340         #ifdef _WIN32
341             std::cout << error_str << std::endl;
342         #endif  /* _WIN32 */
343 
344         throw std::runtime_error(error_str);
345     }
346 
347     //  2. check if channel is empty (if so, throw error)
348     if (this->message_map[channel].empty()) {
349         std::string error_str = "ERROR  MessageHub::receiveMessage()  channel ";
350         error_str += channel;
351         error_str += " is empty";
352 
353         #ifdef _WIN32
354             std::cout << error_str << std::endl;
355         #endif  /* _WIN32 */
356 
357         throw std::runtime_error(error_str);
358     }
359 
360     //  3. pop message
361     this->message_map[channel].pop_front();
362 
363     return;
364 }   /* popMessage() */
```

4.9.3.7 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

channel	The key for the message channel being received from.

Returns

The first message in the given channel.

```
284 {
285     //  1. check if channel is in map (if not, throw error)
286     if (this->message_map.count(channel) <= 0) {
287         std::string error_str = "ERROR  MessageHub::receiveMessage()  channel ";
288         error_str += channel;
289         error_str += " is not in message map";
290 
291         #ifdef _WIN32
292             std::cout << error_str << std::endl;
293         #endif  /* _WIN32 */
294 
```

```
295         throw std::runtime_error(error_str);
296     }
297
298     //  2. check if channel is empty (if so, throw error)
299     if (this->message_map[channel].empty()) {
300         std::string error_str = "ERROR  MessageHub::receiveMessage()  channel ";
301         error_str += channel;
302         error_str += " is empty";
303
304         #ifdef _WIN32
305             std::cout << error_str << std::endl;
306         #endif  /* _WIN32 */
307
308         throw std::runtime_error(error_str);
309     }
310
311     //  3. receive message
312     Message message = this->message_map[channel].front();
313
314     return message;
315 }   /* receiveMessage() */
```

4.9.3.8 removeChannel()

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

Method to remove channel from message map.

Parameters

channel	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() */
```

4.9.3.9 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

message	The message to be sent.

```
205 {
206     //  1. check if channel is in map (if not, throw error)
207     std::string channel = message.channel;
208 
209     if (this->message_map.count(channel) <= 0) {
210         std::string error_str = "ERROR  MessageHub::sendMessage()  channel ";
211         error_str += channel;
212         error_str += " is not in message map";
213 
214         #ifdef _WIN32
215             std::cout « error_str « std::endl;
216         #endif  /* _WIN32 */
217 
218         throw std::runtime_error(error_str);
219     }
220 
221     //  2. send message to message map
222     this->message_map[channel].push_back(message);
223 
224     return;
225 }   /* 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:

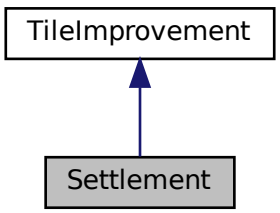
- header/ESC_core/MessageHub.h
- source/ESC_core/MessageHub.cpp

4.10 Settlement Class Reference

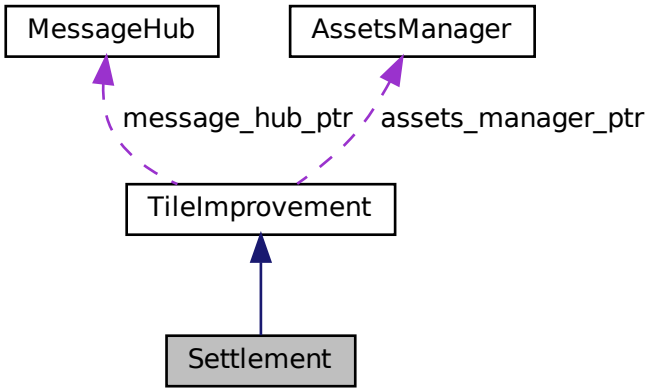
A settlement class (child class of TileImprovement).

`#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

- 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).

Private Member Functions

- void __setUpTileImprovementSpriteStatic (void)

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

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

```
213   :
214 TileImprovement(
215     position_x,
216     position_y,
217     tile_resource,
218     event_ptr,
```

```
219     render_window_ptr,
220     assets_manager_ptr,
221     message_hub_ptr
222 )
223 {
224     //  1. set attributes
225 
226     //  1.1. private
227     //...
228 
229     //  1.2. public
230     this->tile_improvement_type = TileImprovementType :: SETTLEMENT;
231 
232     this->smoke_da = SECONDS_PER_FRAME / 4;
233     this->smoke_dx = 5 * SECONDS_PER_FRAME;
234     this->smoke_dy = -10 * SECONDS_PER_FRAME;
235     this->smoke_prob = 3 * SECONDS_PER_FRAME;
236 
237     this->smoke_sprite_list = {};
238 
239     this->tile_improvement_string = "SETTLEMENT";
240 
241     this->__setUpTileImprovementSpriteStatic();
242 
243     std::cout « "Settlement constructed at " « this « std::endl;
244 
245     return;
246 }   /* Settlement() */
```

4.10.2.2 ~Settlement()

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

Destructor for the Settlement class.

```
445 {
446     std::cout « "Settlement at " « this « " destroyed" « std::endl;
447 
448     return;
449 }   /* ~Settlement() */
```

4.10.3 Member Function Documentation

4.10.3.1 __handleKeyPressEvents()

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

Helper method to handle key press events.

```
103 {
104     if (this->just_built) {
105         return;
106     }
107 
108     switch (this->event_ptr->key.code) {
109         //...
110 
111 
112         default: {
113             // do nothing!
114 
115             break;
116         }
117     }
118 
119     return;
120 }   /* __handleKeyPressEvents() */
```

4.10.3.2 __handleMouseButtonEvents()

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

Helper method to handle mouse button events.

```
135 {
136     if (this->just_built) {
137         return;
138     }
139 
140     switch (this->event_ptr->mouseButton.button) {
141         case (sf::Mouse::Left): {
142             //...
143 
144             break;
145         }
146 
147 
148         case (sf::Mouse::Right): {
149             //...
150 
151             break;
152         }
153 
154 
155         default: {
156             // do nothing!
157 
158             break;
159         }
160     }
161 
162     return;
163 }   /* __handleMouseButtonEvents() */
```

4.10.3.3 __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() */
```

4.10.3.4 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.

```
364 {
365     //  1. if just built, call base method and return
366     if (this->just_built) {
367         TileImprovement :: draw();
368 
369         return;
370     }
371 
372     //  2. draw static sprite and chimney smoke effects
373     this->render_window_ptr->draw(this->tile_improvement_sprite_static);
374 
375     std::list<sf::Sprite>::iterator iter = this->smoke_sprite_list.begin();
376 
377     double alpha = 255;
378 
379     while (iter != this->smoke_sprite_list.end()) {
380         this->render_window_ptr->draw(*iter);
381 
382         alpha = (*iter).getColor().a;
383 
384         alpha -= this->smoke_da;
385 
386         if (alpha <= 0) {
387             iter = this->smoke_sprite_list.erase(iter);
388             continue;
389         }
390 
391         (*iter).setColor(sf::Color(255, 255, 255, alpha));
392 
393         (*iter).move(
394             this->smoke_dx + 2 * (((double)rand() / RAND_MAX) - 1) / FRAMES_PER_SECOND,
395             this->smoke_dy
396         );
397 
398         (*iter).rotate(((double)rand() / RAND_MAX));
399 
400         iter++;
401     }
402 
403 
404     if ((double)rand() / RAND_MAX < smoke_prob) {
405         this->smoke_sprite_list.push_back(
406             sf::Sprite(*(this->assets_manager_ptr->getTexture("emissions")))
407         );
408 
409         this->smoke_sprite_list.back().setOrigin(
410             this->smoke_sprite_list.back().getLocalBounds().width / 2,
411             this->smoke_sprite_list.back().getLocalBounds().height / 2
412         );
413 
414         this->smoke_sprite_list.back().setPosition(
415             this->position_x + 9 + 4 * ((double)rand() / RAND_MAX) - 2,
416             this->position_y - 33
417         );
418     }
419 
420     //  3. draw production menu
421     if (this->production_menu_open) {
422         this->render_window_ptr->draw(this->production_menu_backing);
423         this->render_window_ptr->draw(this->production_menu_backing_text);
424 
425         //...
426     }
427 
428     this->frame++;
429     return;
430 }   /* draw() */
```

4.10.3.5 getTileOptionsSubstring()

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

Helper method to assemble and return tile options substring.

Returns

Tile options substring.

Reimplemented from TileImprovement.

```
288 {
289     //                  32 char x 17 line console "--------------------------------\n";
290     std::string options_substring                = "  **** SETTLEMENT OPTIONS ****  \n";
291     options_substring                           += "                                \n";
292     options_substring                           += "                                \n";
293     options_substring                           += "                                \n";
294     options_substring                           += "                                \n";
295     options_substring                           += "                                \n";
296     options_substring                           += "                                \n";
297     options_substring                           += "                                \n";
298 
299     return options_substring;
300 }   /* getTileOptionsSubstring() */
```

4.10.3.6 processEvent()

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

Method to process Settlement. To be called once per event.

Reimplemented from TileImprovement.

```
315 {
316     TileImprovement :: processEvent();
317 
318     if (this->event_ptr->type == sf::Event::KeyPressed) {
319         this->__handleKeyPressEvents();
320     }
321 
322     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
323         this->__handleMouseButtonEvents();
324     }
325 
326     return;
327 }   /* processEvent() */
```

4.10.3.7 processMessage()

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

Method to process Settlement. To be called once per message.

Reimplemented from TileImprovement.

```
342 {
343     TileImprovement :: processMessage();
344 
345     //...
346 
347     return;
348 }   /* processMessage() */
```

4.10.3.8 setIsSelected()

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

Method to set the is selected attribute.

Parameters

is_selected	The value to set the is selected attribute to.

Reimplemented from TileImprovement.

```
263 {
264     TileImprovement :: setIsSelected(is_selected);
265 
266     if (this->is_selected) {
267         this->assets_manager_ptr->getSound("people and children")->play();
268     }
269 
270     return;
271 }   /* setIsSelected() */
```

4.10.4 Member Data Documentation

4.10.4.1 smoke_da

```
double Settlement::smoke_da
```

The per frame delta in smoke particle alpha value.

4.10.4.2 smoke_dx

```
double Settlement::smoke_dx
```

The per frame delta in smoke particle x position.

4.10.4.3 smoke_dy

```
double Settlement::smoke_dy
```

The per frame delta in smoke particle y position.

4.10.4.4 smoke_prob

```
double Settlement::smoke_prob
```

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

4.10.4.5 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:

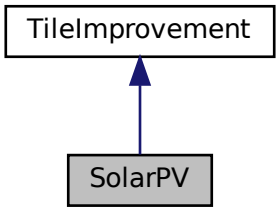
- header/Settlement.h
- source/Settlement.cpp

4.11 SolarPV Class Reference

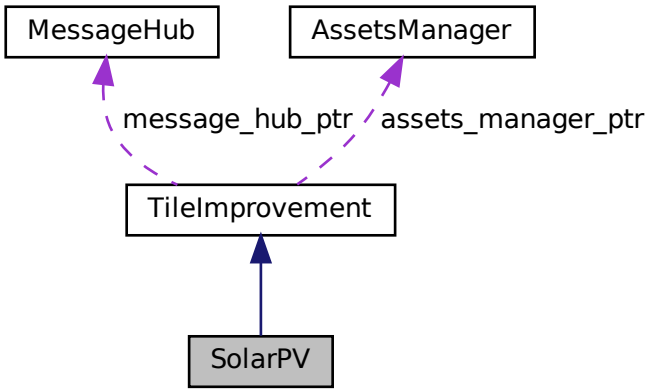
A settlement class (child class of TileImprovement).

```
#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 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 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 monthly_capacity_factor

  The current monthly capacity factor.

Private Member Functions

- void __setUpTileImprovementSpriteStatic (void)

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

  Helper method to upgrade power capacity.
- void __updateProduction (void)

  Helper method to update current production.
- void __computeDispatchable (void)

  Helper method to compute current dispatchable.
- 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.

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

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

```
470   :
471 TileImprovement(
472     position_x,
473     position_y,
474     tile_resource,
475     event_ptr,
476     render_window_ptr,
477     assets_manager_ptr,
478     message_hub_ptr
479 )
480 {
481     //  1. set attributes
482
483     //  1.1. private
484     //...
485
486     //  1.2. public
487     this->tile_improvement_type = TileImprovementType :: SOLAR_PV;
488
489     this->is_running = false;
490
491     this->health = 100;
492
493     this->capacity_kW = 100;
494     this->upgrade_level = 1;
495     this->storage_level = 0;
496
497     this->production_MWh = 0;
498     this->dispatchable_MWh = 0;
499
500     this->max_daily_production_MWh = (double)(24 * this->capacity_kW) / 1000;
501     this->monthly_capacity_factor = 0;
502
503     this->tile_improvement_string = "SOLAR PV ARRAY";
504
505     this->__setUpTileImprovementSpriteStatic();
506
507     this->__updateProduction();
508     this->__computeDispatchable();
509
510     std::cout « "SolarPV constructed at " « this « std::endl;
511
512     return;
513 }   /* SolarPV() */
```

4.11.2.2 ~SolarPV()

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

Destructor for the SolarPV class.

```
753 {
754     std::cout « "SolarPV at " « this « " destroyed" « std::endl;
755
756     return;
757 }   /* ~SolarPV() */
```

4.11.3 Member Function Documentation

4.11.3.1 __computeDispatchable()

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

Helper method to compute current dispatchable.

```
190 {
191     if (this->production_MWh < 0.15 * this->demand_MWh) {
192         this->dispatchable_MWh = this->production_MWh;
193     }
194 
195     else {
196         //...
197     }
198 
199     return;
200 }   /* __computeDispatchable() */
```

4.11.3.2 __drawUpgradeOptions()

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

Helper method to set up and draw upgrade options.

```
323 {
324     //  1. draw power capacity upgrade sprite
325     sf::Vector2f initial_position = this->tile_improvement_sprite_static.getPosition();
326     this->tile_improvement_sprite_static.setPosition(400 - 100, 400 - 32);
327 
328     sf::Color initial_colour = this->tile_improvement_sprite_static.getColor();
329     this->tile_improvement_sprite_static.setColor(sf::Color(255, 255, 255, 255));
330 
331     sf::Vector2f initial_scale = this->tile_improvement_sprite_static.getScale();
332     this->tile_improvement_sprite_static.setScale(sf::Vector2f(1, 1));
333 
334     this->render_window_ptr->draw(this->tile_improvement_sprite_static);
335 
336     this->tile_improvement_sprite_static.setPosition(initial_position);
337     this->tile_improvement_sprite_static.setColor(initial_colour);
338     this->tile_improvement_sprite_static.setScale(initial_scale);
339 
340     this->render_window_ptr->draw(this->upgrade_arrow_sprite);
341 
342 
343     //  2. draw power capacity upgrade text
344     //                  16 char line = "                \n"
345     std::string power_upgrade_string = "POWER CAPACITY  \n";
346     power_upgrade_string            += "                \n";
347 
348     power_upgrade_string            += "CAPACITY:  ";
349     power_upgrade_string            += std::to_string(this->capacity_kW);
350     power_upgrade_string            += " kW\n";
351 
352     power_upgrade_string            += "LEVEL:     ";
353     power_upgrade_string            += std::to_string(this->upgrade_level);
354     power_upgrade_string            += "\n\n";
355 
356     if (this->upgrade_level < MAX_UPGRADE_LEVELS) {
357         power_upgrade_string        += "[W]: + 100 kW (";
358         power_upgrade_string        +=  std::to_string(SOLAR_PV_BUILD_COST);
359         power_upgrade_string        += " K)\n";
360     }
361 
362     else {
363         power_upgrade_string        += " * MAX LEVEL *  \n";
364     }
365 
366     sf::Text power_upgrade_text = sf::Text(
367         power_upgrade_string,
368         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
369         16
370     );
371 
372     power_upgrade_text.setOrigin(power_upgrade_text.getLocalBounds().width / 2, 0);
373     power_upgrade_text.setPosition(400 - 100, 400 - 32 + 16);
374     power_upgrade_text.setFillColor(MONOCHROME_TEXT_GREEN);
375 
376     this->render_window_ptr->draw(power_upgrade_text);
377 
378 
379     //  3. draw energy capacity (storage) upgrade sprite
380     this->render_window_ptr->draw(this->storage_upgrade_sprite);
381     this->render_window_ptr->draw(this->upgrade_plus_sprite);
382 
```

```
383
384     //  4. draw energy capacity (storage) upgrade text
385     //                    16 char line = "                \n"
386     std::string energy_upgrade_string = "ENERGY CAPACITY \n";
387     energy_upgrade_string            += "                \n";
388
389     energy_upgrade_string            += "CAPACITY:  ";
390     energy_upgrade_string            += std::to_string(this->storage_level * 200);
391     energy_upgrade_string            += " kWh\n";
392
393     energy_upgrade_string            += "LEVEL:     ";
394     energy_upgrade_string            += std::to_string(this->storage_level);
395     energy_upgrade_string            += "\n\n";
396
397     if (this->storage_level < MAX_STORAGE_LEVELS) {
398         energy_upgrade_string        += "[D]: + 200 kWh (";
399         energy_upgrade_string        +=  std::to_string(ENERGY_STORAGE_SYSTEM_BUILD_COST);
400         energy_upgrade_string        += " K)\n";
401     }
402
403     else {
404         energy_upgrade_string += " * MAX LEVEL *  \n";
405     }
406
407     sf::Text energy_upgrade_text = sf::Text(
408         energy_upgrade_string,
409         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
410         16
411     );
412
413     energy_upgrade_text.setOrigin(energy_upgrade_text.getLocalBounds().width / 2, 0);
414     energy_upgrade_text.setPosition(400 + 100, 400 - 32 + 16);
415     energy_upgrade_text.setFillColor(MONOCHROME_TEXT_GREEN);
416
417     this->render_window_ptr->draw(energy_upgrade_text);
418
419     return;
420 }   /* __drawUpgradeOptions() */
```

4.11.3.3 __handleKeyPressEvents()

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

Helper method to handle key press events.

```
215 {
216     if (this->just_built) {
217         return;
218     }
219
220     switch (this->event_ptr->key.code) {
221         case (sf::Keyboard::U): {
222             this->__openUpgradeMenu();
223
224             break;
225         }
226
227
228         case (sf::Keyboard::W): {
229             if (this->production_menu_open) {
230                 //...
231             }
232
233             else if (this->upgrade_menu_open) {
234                 this->__upgradePowerCapacity();
235             }
236
237             break;
238         }
239
240
241         case (sf::Keyboard::S): {
242             //...
243
244             break;
245         }
246
247
```

```
248         case (sf::Keyboard::D): {
249             if (this->upgrade_menu_open) {
250                 this->__upgradeStorageCapacity();
251             }
252 
253             break;
254         }
255 
256 
257         default: {
258             // do nothing!
259 
260             break;
261         }
262     }
263 
264     return;
265 }   /* __handleKeyPressEvents() */
```

4.11.3.4 __handleMouseButtonEvents()

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

Helper method to handle mouse button events.

```
280 {
281     if (this->just_built) {
282         return;
283     }
284 
285     switch (this->event_ptr->mouseButton.button) {
286         case (sf::Mouse::Left): {
287             //...
288 
289             break;
290         }
291 
292 
293         case (sf::Mouse::Right): {
294             //...
295 
296             break;
297         }
298 
299 
300         default: {
301             // do nothing!
302 
303             break;
304         }
305     }
306 
307     return;
308 }   /* __handleMouseButtonEvents() */
```

4.11.3.5 __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() */
```

4.11.3.6 __updateProduction()

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

Helper method to update current production.

```
150 {
151     unsigned seed = std::chrono::system_clock::now().time_since_epoch().count();
152     std::default_random_engine generator(seed);
153
154     double mean =
155         this->tile_resource_scalar * MEAN_DAILY_SOLAR_CAPACITY_FACTORS[this->month - 1];
156
157     double stdev = STDEV_DAILY_SOLAR_CAPACITY_FACTORS[this->month - 1];
158
159     if (this->tile_resource_scalar > 1) {
160         stdev /= this->tile_resource_scalar;
161     }
162
163     std::normal_distribution<double> normal_dist(mean, stdev);
164
165     this->monthly_capacity_factor = 0;
166
167     for (int i = 0; i < 30; i++) {
168         this->monthly_capacity_factor += normal_dist(generator);
169     }
170
171     this->production_MWh =
172         round(this->monthly_capacity_factor * this->max_daily_production_MWh);
173
174     return;
175 }   /* __updateProduction() */
```

4.11.3.7 __upgradePowerCapacity()

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

Helper method to upgrade power capacity.

```
103 {
104     if (this->credits < SOLAR_PV_BUILD_COST) {
105         std::cout « "Cannot upgrade solar PV: insufficient credits (need "
106             « SOLAR_PV_BUILD_COST « " K)" « std::endl;
107
108         this->__sendInsufficientCreditsMessage();
109         return;
110     }
111
112     if (this->upgrade_level >= MAX_UPGRADE_LEVELS) {
113         return;
114     }
115
116     this->health = 100;
117
118     this->capacity_kW += 100;
```

```
119     this->upgrade_level++;
120
121     this->max_daily_production_MWh = (double)(24 * this->capacity_kW) / 1000;
122
123     this->production_MWh =
124         this->monthly_capacity_factor * this->max_daily_production_MWh;
125
126     this->just_upgraded = true;
127
128     this->assets_manager_ptr->getSound("upgrade")->play();
129
130     this->__sendCreditsSpentMessage(SOLAR_PV_BUILD_COST);
131     this->__sendTileStateRequest();
132     this->__sendGameStateRequest();
133
134     return;
135 }   /* __upgradePowerCapacity() */
```

4.11.3.8 advanceTurn()

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

Method to handle turn advance.

Reimplemented from TileImprovement.

```
575 {
576     //  1. update
577     this->update();
578
579     //...
580
581     std::cout « "Turn advance message received by " « this « std::endl;
582     this->__sendGameStateRequest();
583     return;
584 }   /* advanceTurn() */
```

4.11.3.9 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.

```
668 {
669     //  1. if just built, call base method and return
670     if (this->just_built) {
671         TileImprovement :: draw();
672
673         return;
674     }
675
676
677     //  2. handle upgrade effects
678     if (this->just_upgraded) {
679         this->tile_improvement_sprite_static.setColor(
680             sf::Color(
681                 255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
682                 255,
683                 255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
684                 255
685             )
686         );
687
688         this->tile_improvement_sprite_static.setScale(
689             sf::Vector2f(
```

```
690                 1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
691                 1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2)
692             )
693         );
694 
695         this->upgrade_frame++;
696     }
697 
698     if (this->upgrade_frame >= 2 * FRAMES_PER_SECOND) {
699         this->tile_improvement_sprite_static.setColor(
700             sf::Color(255,255,255,255)
701         );
702 
703         this->tile_improvement_sprite_static.setScale(sf::Vector2f(1,1));
704 
705         this->just_upgraded = false;
706         this->upgrade_frame = 0;
707     }
708 
709 
710     //  3. draw static sprite
711     this->render_window_ptr->draw(this->tile_improvement_sprite_static);
712 
713 
714     //  4. draw storage upgrades
715     for (size_t i = 0; i < this->storage_upgrade_sprite_vec.size(); i++) {
716         this->render_window_ptr->draw(this->storage_upgrade_sprite_vec[i]);
717     }
718 
719 
720     //  5. draw production menu
721     if (this->production_menu_open) {
722         this->render_window_ptr->draw(this->production_menu_backing);
723         this->render_window_ptr->draw(this->production_menu_backing_text);
724 
725         //...
726     }
727 
728     //  6. draw upgrade menu
729     if (this->upgrade_menu_open) {
730         this->render_window_ptr->draw(this->upgrade_menu_backing);
731         this->render_window_ptr->draw(this->upgrade_menu_backing_text);
732 
733         this->__drawUpgradeOptions();
734     }
735 
736     this->frame++;
737     return;
738 }   /* draw() */
```

4.11.3.10 getTileOptionsSubstring()

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

Helper method to assemble and return tile options substring.

Returns

Tile options substring.

Reimplemented from TileImprovement.

```
530 {
531     //                  32 char x 17 line console "--------------------------------\n";
532     std::string options_substring                = "CAPACITY:      ";
533     options_substring                           += std::to_string(this->capacity_kW);
534     options_substring                           += " kW (level ";
535     options_substring                           += std::to_string(this->upgrade_level);
536     options_substring                           += ")\n";
537 
538     options_substring                           += "PRODUCTION:    ";
539     options_substring                           += std::to_string(this->production_MWh);
540     options_substring                           += " MWh\n";
541 
```

```
542     options_substring                           += "DISPATCHABLE:  ";
543     options_substring                           += std::to_string(this->dispatchable_MWh);
544     options_substring                           += " MWh\n";
545
546     options_substring                           += "HEALTH:        ";
547     options_substring                           += std::to_string(this->health);
548     options_substring                           += "/100\n";
549
550     options_substring                           += "                                \n";
551     options_substring                           += "   **** SOLAR PV OPTIONS ****   \n";
552     options_substring                           += "                                \n";
553     options_substring                           += "     [E]:  OPEN PRODUCTION MENU \n";
554     options_substring                           += "     [U]:  OPEN UPGRADE MENU    \n";
555     options_substring                           += "HOLD [P]:  SCRAP (";
556     options_substring                           += std::to_string(SCRAP_COST);
557     options_substring                           += " K)";
558
559     return options_substring;
560 }   /* getTileOptionsSubstring() */
```

4.11.3.11 processEvent()

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

Method to process SolarPV. To be called once per event.

Reimplemented from TileImprovement.

```
619 {
620     TileImprovement :: processEvent();
621
622     if (this->event_ptr->type == sf::Event::KeyPressed) {
623         this->__handleKeyPressEvents();
624     }
625
626     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
627         this->__handleMouseButtonEvents();
628     }
629
630     return;
631 }   /* processEvent() */
```

4.11.3.12 processMessage()

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

Method to process SolarPV. To be called once per message.

Reimplemented from TileImprovement.

```
646 {
647     TileImprovement :: processMessage();
648
649     //...
650
651     return;
652 }   /* processMessage() */
```

4.11.3.13 update()

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

Method to trigger production and dispatchable updates.

Reimplemented from TileImprovement.

```
599 {
600     this->__updateProduction();
601     this->__computeDispatchable();
602
603     return;
604 }   /* update() */
```

4.11.4 Member Data Documentation

4.11.4.1 capacity_kW

```
int SolarPV::capacity_kW
```

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

4.11.4.2 dispatchable_MWh

```
int SolarPV::dispatchable_MWh
```

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

4.11.4.3 max_daily_production_MWh

```
double SolarPV::max_daily_production_MWh
```

The maximum daily production [MWh] of the solar PV array.

4.11.4.4 monthly_capacity_factor

```
double SolarPV::monthly_capacity_factor
```

The current monthly capacity factor.

4.11.4.5 production_MWh

```
int SolarPV::production_MWh
```

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

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

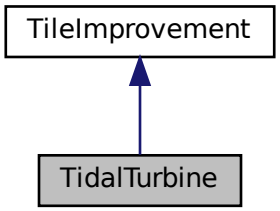
- header/SolarPV.h
- source/SolarPV.cpp

4.12 TidalTurbine Class Reference

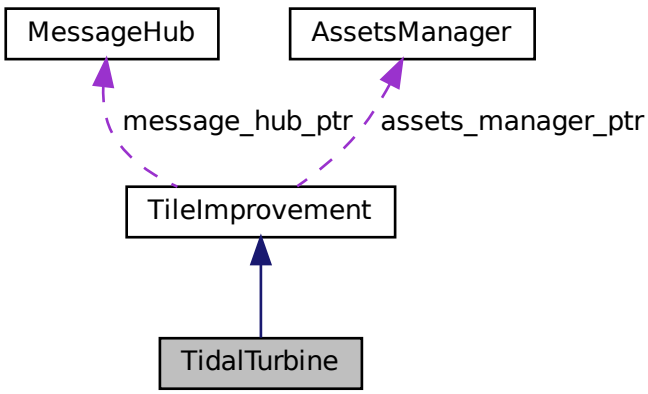
A settlement class (child class of TileImprovement).

```
#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 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 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 monthly_capacity_factor

  The current monthly capacity factor.

Private Member Functions

- void __setUpTileImprovementSpriteAnimated (void)

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

  Helper method to upgrade power capacity.
- void __updateProduction (void)

  Helper method to update current production.
- void __computeDispatchable (void)

  Helper method to compute current dispatchable.
- 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.

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

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

```
461   :
462 TileImprovement(
463     position_x,
464     position_y,
465     tile_resource,
466     event_ptr,
467     render_window_ptr,
468     assets_manager_ptr,
469     message_hub_ptr
470 )
471 {
472     //  1. set attributes
473
474     //  1.1. private
475     //...
476
477     //  1.2. public
478     this->tile_improvement_type = TileImprovementType :: TIDAL_TURBINE;
479
480     this->is_running = false;
481
482     this->health = 100;
483
```

```
484     this->capacity_kW = 100;
485     this->upgrade_level = 1;
486     this->storage_level = 0;
487 
488     this->dispatchable_MWh = 0;
489 
490     this->max_daily_production_MWh = (double)(24 * this->capacity_kW) / 1000;
491 
492     this->monthly_capacity_factor =
493         30 * this->tile_resource_scalar * DAILY_TIDAL_CAPACITY_FACTOR;
494 
495     this->production_MWh =
496         round(this->monthly_capacity_factor * this->max_daily_production_MWh);
497 
498     this->tile_improvement_string = "TIDAL TURBINE";
499 
500     this->__setUpTileImprovementSpriteAnimated();
501 
502     std::cout << "TidalTurbine constructed at " << this << std::endl;
503 
504     return;
505 }   /* TidalTurbine() */
```

4.12.2.2 ~TidalTurbine()

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

Destructor for the TidalTurbine class.

```
762 {
763     std::cout << "TidalTurbine at " << this << " destroyed" << std::endl;
764 
765     return;
766 }   /* ~TidalTurbine() */
```

4.12.3 Member Function Documentation

4.12.3.1 __computeDispatchable()

```
void TidalTurbine::__computeDispatchable (
            void  )  [private]
```

Helper method to compute current dispatchable.

```
179 {
180     if (this->production_MWh < 0.15 * this->demand_MWh) {
181         this->dispatchable_MWh = this->production_MWh;
182     }
183 
184     else {
185         //...
186     }
187 
188     return;
189 }   /* __computeDispatchable() */
```

4.12.3.2 __drawUpgradeOptions()

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

Helper method to set up and draw upgrade options.

```
312 {
313     //  1. draw power capacity upgrade sprite
314     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
315         sf::Vector2f initial_position = this->tile_improvement_sprite_animated[i].getPosition();
316         this->tile_improvement_sprite_animated[i].setPosition(400 - 100, 400 - 32 - 8);
317 
318         sf::Color initial_colour = this->tile_improvement_sprite_animated[i].getColor();
319         this->tile_improvement_sprite_animated[i].setColor(sf::Color(255, 255, 255, 255));
320 
321         sf::Vector2f initial_scale = this->tile_improvement_sprite_animated[i].getScale();
322         this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1, 1));
323 
324         this->render_window_ptr->draw(this->tile_improvement_sprite_animated[i]);
325 
326         this->tile_improvement_sprite_animated[i].setPosition(initial_position);
327         this->tile_improvement_sprite_animated[i].setColor(initial_colour);
328         this->tile_improvement_sprite_animated[i].setScale(initial_scale);
329     }
330 
331     this->render_window_ptr->draw(this->upgrade_arrow_sprite);
332 
333 
334     //  2. draw power capacity upgrade text
335     //                  16 char line = "                \n"
336     std::string power_upgrade_string = "POWER CAPACITY  \n";
337     power_upgrade_string            += "                \n";
338 
339     power_upgrade_string            += "CAPACITY:  ";
340     power_upgrade_string            += std::to_string(this->capacity_kW);
341     power_upgrade_string            += " kW\n";
342 
343     power_upgrade_string            += "LEVEL:     ";
344     power_upgrade_string            += std::to_string(this->upgrade_level);
345     power_upgrade_string            += "\n\n";
346 
347     if (this->upgrade_level < MAX_UPGRADE_LEVELS) {
348         power_upgrade_string        += "[W]: + 100 kW (";
349         power_upgrade_string        +=  std::to_string(TIDAL_TURBINE_BUILD_COST);
350         power_upgrade_string        += " K)\n";
351     }
352 
353     else {
354         power_upgrade_string        += " * MAX LEVEL *  \n";
355     }
356 
357     sf::Text power_upgrade_text = sf::Text(
358         power_upgrade_string,
359         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
360         16
361     );
362 
363     power_upgrade_text.setOrigin(power_upgrade_text.getLocalBounds().width / 2, 0);
364     power_upgrade_text.setPosition(400 - 100, 400 - 32 + 16);
365     power_upgrade_text.setFillColor(MONOCHROME_TEXT_GREEN);
366 
367     this->render_window_ptr->draw(power_upgrade_text);
368 
369 
370     //  3. draw energy capacity (storage) upgrade sprite
371     this->render_window_ptr->draw(this->storage_upgrade_sprite);
372     this->render_window_ptr->draw(this->upgrade_plus_sprite);
373 
374 
375     //  4. draw energy capacity (storage) upgrade text
376     //                   16 char line = "                \n"
377     std::string energy_upgrade_string = "ENERGY CAPACITY \n";
378     energy_upgrade_string            += "                \n";
379 
380     energy_upgrade_string            += "CAPACITY:  ";
381     energy_upgrade_string            += std::to_string(this->storage_level * 200);
382     energy_upgrade_string            += " kWh\n";
383 
384     energy_upgrade_string            += "LEVEL:     ";
385     energy_upgrade_string            += std::to_string(this->storage_level);
386     energy_upgrade_string            += "\n\n";
387 
388     if (this->storage_level < MAX_STORAGE_LEVELS) {
389         energy_upgrade_string        += "[D]: + 200 kWh (";
```

```
390         energy_upgrade_string        +=  std::to_string(ENERGY_STORAGE_SYSTEM_BUILD_COST);
391         energy_upgrade_string        += " K)\n";
392     }
393
394     else {
395         energy_upgrade_string += " * MAX LEVEL *  \n";
396     }
397
398     sf::Text energy_upgrade_text = sf::Text(
399         energy_upgrade_string,
400         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
401         16
402     );
403
404     energy_upgrade_text.setOrigin(energy_upgrade_text.getLocalBounds().width / 2, 0);
405     energy_upgrade_text.setPosition(400 + 100, 400 - 32 + 16);
406     energy_upgrade_text.setFillColor(MONOCHROME_TEXT_GREEN);
407
408     this->render_window_ptr->draw(energy_upgrade_text);
409
410     return;
411 }   /* __drawUpgradeOptions() */
```

4.12.3.3 __handleKeyPressEvents()

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

Helper method to handle key press events.

```
204 {
205     if (this->just_built) {
206         return;
207     }
208
209     switch (this->event_ptr->key.code) {
210         case (sf::Keyboard::U): {
211             this->__openUpgradeMenu();
212
213             break;
214         }
215
216
217         case (sf::Keyboard::W): {
218             if (this->production_menu_open) {
219                 //...
220             }
221
222             else if (this->upgrade_menu_open) {
223                 this->__upgradePowerCapacity();
224             }
225
226             break;
227         }
228
229
230         case (sf::Keyboard::S): {
231             //...
232
233             break;
234         }
235
236
237         case (sf::Keyboard::D): {
238             if (this->upgrade_menu_open) {
239                 this->__upgradeStorageCapacity();
240             }
241
242             break;
243         }
244
245
246         default: {
247             // do nothing!
248
249             break;
250         }
251     }
252
253     return;
254 }   /* __handleKeyPressEvents() */
```

4.12.3.4 __handleMouseButtonEvents()

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

Helper method to handle mouse button events.

```
269 {
270     if (this->just_built) {
271         return;
272     }
273 
274     switch (this->event_ptr->mouseButton.button) {
275         case (sf::Mouse::Left): {
276             //...
277 
278             break;
279         }
280 
281 
282         case (sf::Mouse::Right): {
283             //...
284 
285             break;
286         }
287 
288 
289         default: {
290             // do nothing!
291 
292             break;
293         }
294     }
295 
296     return;
297 }   /* __handleMouseButtonEvents() */
```

4.12.3.5 __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() */
```

4.12.3.6 __updateProduction()

```
void TidalTurbine::__updateProduction (
            void  )  [private]
```

Helper method to update current production.

```
161 {
162     //...
163
164     return;
165 }   /* __updateProduction() */
```

4.12.3.7 __upgradePowerCapacity()

```
void TidalTurbine::__upgradePowerCapacity (
            void  )  [private]
```

Helper method to upgrade power capacity.

```
114 {
115     if (this->credits < TIDAL_TURBINE_BUILD_COST) {
116         std::cout « "Cannot upgrade tidal turbine: insufficient credits (need "
117             « TIDAL_TURBINE_BUILD_COST « " K)" « std::endl;
118
119         this->__sendInsufficientCreditsMessage();
120         return;
121     }
122
123     if (this->upgrade_level >= MAX_UPGRADE_LEVELS) {
124         return;
125     }
126
127     this->health = 100;
128
129     this->capacity_kW += 100;
130     this->upgrade_level++;
131
132     this->max_daily_production_MWh = (double)(24 * this->capacity_kW) / 1000;
133
134     this->production_MWh =
135         round(this->monthly_capacity_factor * this->max_daily_production_MWh);
136
137     this->just_upgraded = true;
138
139     this->assets_manager_ptr->getSound("upgrade")->play();
140
141     this->__sendCreditsSpentMessage(TIDAL_TURBINE_BUILD_COST);
142     this->__sendTileStateRequest();
143     this->__sendGameStateRequest();
144
145     return;
146 }   /* __upgradePowerCapacity() */
```

4.12.3.8 advanceTurn()

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

Method to handle turn advance.

Reimplemented from TileImprovement.

```
567 {
568     //  1. update
569     this->update();
570
571     //...
572
573     std::cout « "Turn advance message received by " « this « std::endl;
574     this->__sendGameStateRequest();
575     return;
576 }   /* advanceTurn() */
```

4.12.3.9 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.

```
660 {
661     //  1. if just built, call base method and return
662     if (this->just_built) {
663         TileImprovement :: draw();
664 
665         return;
666     }
667 
668 
669     //  2. handle upgrade effects
670     if (this->just_upgraded) {
671         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
672             this->tile_improvement_sprite_animated[i].setColor(
673                 sf::Color(
674                     255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
675                     255,
676                     255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
677                     255
678                 )
679             );
680 
681             this->tile_improvement_sprite_animated[i].setScale(
682                 sf::Vector2f(
683                     1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
684                     1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2)
685                 )
686             );
687         }
688 
689         this->upgrade_frame++;
690     }
691 
692     if (this->upgrade_frame >= 2 * FRAMES_PER_SECOND) {
693         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
694             this->tile_improvement_sprite_animated[i].setColor(
695                 sf::Color(255,255,255,255)
696             );
697 
698             this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1,1));
699         }
700 
701         this->just_upgraded = false;
702         this->upgrade_frame = 0;
703     }
704 
705 
706     //  3. draw first element of animated sprite
707     this->render_window_ptr->draw(this->tile_improvement_sprite_animated[0]);
708 
709 
710     //  4. draw second element of animated sprite
711     if (this->is_running) {
712         //...
713     }
714 
715     else {
716         //...
717     }
718 
719     this->render_window_ptr->draw(this->tile_improvement_sprite_animated[1]);
720 
721 
722     //  5. draw storage upgrades
723     for (size_t i = 0; i < this->storage_upgrade_sprite_vec.size(); i++) {
724         this->render_window_ptr->draw(this->storage_upgrade_sprite_vec[i]);
725     }
726 
727 
728     //  6. draw production menu
729     if (this->production_menu_open) {
730         this->render_window_ptr->draw(this->production_menu_backing);
731         this->render_window_ptr->draw(this->production_menu_backing_text);
732 
733         //...
734     }
```

```
735
736
737     //  7. draw upgrade menu
738     if (this->upgrade_menu_open) {
739         this->render_window_ptr->draw(this->upgrade_menu_backing);
740         this->render_window_ptr->draw(this->upgrade_menu_backing_text);
741
742         this->__drawUpgradeOptions();
743     }
744
745     this->frame++;
746     return;
747 }   /* draw() */
```

4.12.3.10 getTileOptionsSubstring()

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

Helper method to assemble and return tile options substring.

Returns

Tile options substring.

Reimplemented from TileImprovement.

```
522 {
523     //                  32 char x 17 line console "--------------------------------\n";
524     std::string options_substring                = "CAPACITY:      ";
525     options_substring                           += std::to_string(this->capacity_kW);
526     options_substring                           += " kW (level ";
527     options_substring                           += std::to_string(this->upgrade_level);
528     options_substring                           += ")\n";
529
530     options_substring                           += "PRODUCTION:    ";
531     options_substring                           += std::to_string(this->production_MWh);
532     options_substring                           += " MWh\n";
533
534     options_substring                           += "DISPATCHABLE:  ";
535     options_substring                           += std::to_string(this->dispatchable_MWh);
536     options_substring                           += " MWh\n";
537
538     options_substring                           += "HEALTH:        ";
539     options_substring                           += std::to_string(this->health);
540     options_substring                           += "/100\n";
541
542     options_substring                           += "                                \n";
543     options_substring                           += "**** TIDAL TURBINE OPTIONS **** \n";
544     options_substring                           += "                                \n";
545     options_substring                           += "     [E]:  OPEN PRODUCTION MENU \n";
546     options_substring                           += "     [U]:  OPEN UPGRADE MENU    \n";
547     options_substring                           += "HOLD [P]:  SCRAP (";
548     options_substring                           += std::to_string(SCRAP_COST);
549     options_substring                           += " K)";
550
551     return options_substring;
552 }   /* getTileOptionsSubstring() */
```

4.12.3.11 processEvent()

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

Method to process TidalTurbine. To be called once per event.

Reimplemented from TileImprovement.

```
611 {
612     TileImprovement :: processEvent();
613 
614     if (this->event_ptr->type == sf::Event::KeyPressed) {
615         this->__handleKeyPressEvents();
616     }
617 
618     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
619         this->__handleMouseButtonEvents();
620     }
621 
622     return;
623 }   /* processEvent() */
```

4.12.3.12 processMessage()

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

Method to process TidalTurbine. To be called once per message.

Reimplemented from TileImprovement.

```
638 {
639     TileImprovement :: processMessage();
640 
641     //...
642 
643     return;
644 }   /* processMessage() */
```

4.12.3.13 update()

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

Method to trigger production and dispatchable updates.

Reimplemented from TileImprovement.

```
591 {
592     this->__updateProduction();
593     this->__computeDispatchable();
594 
595     return;
596 }   /* update() */
```

4.12.4 Member Data Documentation

4.12.4.1 capacity_kW

```
int TidalTurbine::capacity_kW
```

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

4.12.4.2 dispatchable_MWh

```
int TidalTurbine::dispatchable_MWh
```

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

4.12.4.3 max_daily_production_MWh

```
double TidalTurbine::max_daily_production_MWh
```

The maximum daily production [MWh] of the solar PV array.

4.12.4.4 monthly_capacity_factor

```
double TidalTurbine::monthly_capacity_factor
```

The current monthly capacity factor.

4.12.4.5 production_MWh

```
int TidalTurbine::production_MWh
```

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

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

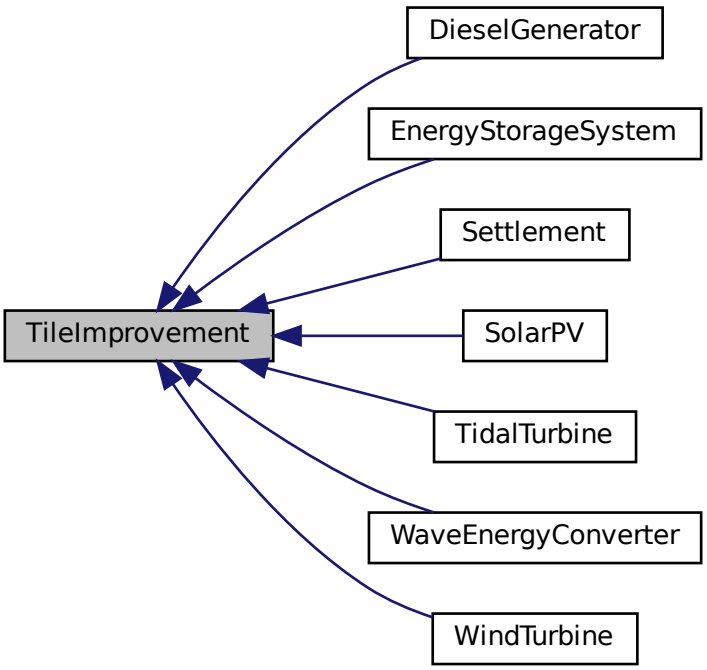
- header/TidalTurbine.h
- source/TidalTurbine.cpp

4.13 TileImprovement Class Reference

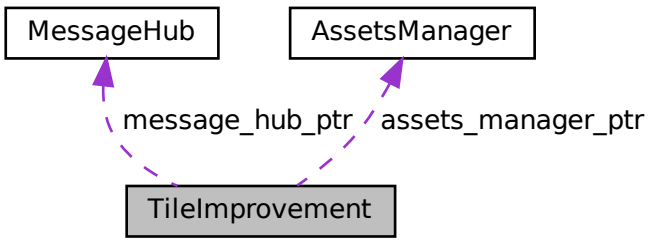
A base class for the tile improvement hierarchy.

`#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.
- 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_level

  The level of storage installed alongside the tile improvement.

- 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::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.

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 __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 __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.

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

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

```
569 {
570     //  1. set attributes
571 
572     //  1.1. protected
573     this->event_ptr = event_ptr;
574     this->render_window_ptr = render_window_ptr;
575 
576     this->assets_manager_ptr = assets_manager_ptr;
577     this->message_hub_ptr = message_hub_ptr;
578 
579     //  1.2. public
580     this->is_selected = true;
581     this->just_built = true;
582     this->production_menu_open = false;
583     this->upgrade_menu_open = false;
584 
585     this->just_upgraded = false;
586     this->upgrade_frame = 0;
587 
588     this->frame = 0;
589     this->credits = 0;
590     this->month = 1;
591     this->demand_MWh = 0;
592 
593     this->tile_resource = tile_resource;
594 
595     switch (this->tile_resource) {
596         case (0): {
597             this->tile_resource_scalar = 0.8;
598 
599             break;
600         }
601 
602 
603         case (1): {
604             this->tile_resource_scalar = 0.9;
605 
606             break;
607         }
608 
609 
610         case (2): {
611             this->tile_resource_scalar = 1;
612 
613             break;
614         }
615 
616 
617         case (3): {
618             this->tile_resource_scalar = 1.1;
619 
620             break;
621         }
622 
623 
624         case (4): {
625             this->tile_resource_scalar = 1.2;
626 
627             break;
628         }
629 
630 
631         default: {
632             this->tile_resource_scalar = 1;
633         }
634     }
635 
636     this->position_x = position_x;
637     this->position_y = position_y;
638 
639     this->game_phase = "build settlement";
```

```
640
641     this->__setUpProductionMenu();
642     this->__setUpUpgradeMenu();
643
644     std::cout « "TileImprovement constructed at " « this « std::endl;
645
646     return;
647 }   /* TileImprovement() */
```

4.13.2.2 ~TileImprovement()

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

Destructor for the TileImprovement class.

```
865 {
866     std::cout « "TileImprovement at " « this « " destroyed" « std::endl;
867
868     return;
869 }   /* ~TileImprovement() */
```

4.13.3 Member Function Documentation

4.13.3.1 __closeProductionMenu()

```
void TileImprovement::__closeProductionMenu (
            void  )  [protected]
```

Helper method to close the production menu.

```
350 {
351     if (not this->production_menu_open) {
352         return;
353     }
354
355     this->production_menu_open = false;
356     this->assets_manager_ptr->getSound("build menu close")->play();
357
358     return;
359 }   /* __closeProductionMenu() */
```

4.13.3.2 __closeUpgradeMenu()

```
void TileImprovement::__closeUpgradeMenu (
            void  )  [protected]
```

Helper method to close the build menu.

```
402 {
403     if (not this->upgrade_menu_open) {
404         return;
405     }
406
407     this->upgrade_menu_open = false;
408     this->assets_manager_ptr->getSound("build menu close")->play();
409
410     return;
411 }   /* __closeUpgradeMenu() */
```

4.13.3.3 __handleKeyPressEvents()

```
void TileImprovement::__handleKeyPressEvents (
            void  )  [protected]
```

Helper method to handle key press events.

```
235 {
236     if (this->tile_improvement_type == TileImprovementType :: SETTLEMENT) {
237         return;
238     }
239 
240     if (this->just_built) {
241         return;
242     }
243 
244     switch (this->event_ptr->key.code) {
245         case (sf::Keyboard::E): {
246             this->__openProductionMenu();
247 
248             break;
249         }
250 
251 
252         default: {
253             // do nothing!
254 
255             break;
256         }
257     }
258 
259     return;
260 }   /* __handleKeyPressEvents() */
```

4.13.3.4 __handleMouseButtonEvents()

```
void TileImprovement::__handleMouseButtonEvents (
            void  )  [protected]
```

Helper method to handle mouse button events.

```
275 {
276     if (this->tile_improvement_type == TileImprovementType :: SETTLEMENT) {
277         return;
278     }
279 
280     if (this->just_built) {
281         return;
282     }
283 
284     switch (this->event_ptr->mouseButton.button) {
285         case (sf::Mouse::Left): {
286             //...
287 
288             break;
289         }
290 
291 
292         case (sf::Mouse::Right): {
293             //...
294 
295             break;
296         }
297 
298 
299         default: {
300             // do nothing!
301 
302             break;
303         }
304     }
305 
306     return;
307 }   /* __handleMouseButtonEvents() */
```

4.13.3.5 __openProductionMenu()

```
void TileImprovement::__openProductionMenu (
            void  )  [protected]
```

Helper method to open the production menu.

```
322 {
323     if (this->production_menu_open) {
324         return;
325     }
326
327     if (this->upgrade_menu_open) {
328         this->__closeUpgradeMenu();
329     }
330
331     this->production_menu_open = true;
332     this->assets_manager_ptr->getSound("build menu open")->play();
333
334     return;
335 }   /* __openProductionMenu() */
```

4.13.3.6 __openUpgradeMenu()

```
void TileImprovement::__openUpgradeMenu (
            void  )  [protected]
```

Helper method to open the upgrade menu.

```
374 {
375     if (this->upgrade_menu_open) {
376         return;
377     }
378
379     if (this->production_menu_open) {
380         this->__closeProductionMenu();
381     }
382
383     this->upgrade_menu_open = true;
384     this->assets_manager_ptr->getSound("build menu open")->play();
385
386     return;
387 }   /* __openUpgradeMenu() */
```

4.13.3.7 __sendCreditsSpentMessage()

```
void TileImprovement::__sendCreditsSpentMessage (
            int credits_spent )  [protected]
```

Helper method to format and send a credits spent message.

Parameters

credits_spent	The number of credits that were spent.

```
479 {
480     Message credits_spent_message;
481
482     credits_spent_message.channel = GAME_CHANNEL;
483     credits_spent_message.subject = "credits spent";
484
485     credits_spent_message.int_payload["credits spent"] = credits_spent;
486
```

```
487     this->message_hub_ptr->sendMessage(credits_spent_message);
488
489     std::cout « "Credits spent (" « credits_spent « ") message sent by " « this
490         « std::endl;
491     return;
492 }   /* __sendCreditsSpentMessage() */
```

4.13.3.8 __sendGameStateRequest()

```
void TileImprovement::__sendGameStateRequest (
            void  )  [protected]
```

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

```
452 {
453     Message game_state_request;
454
455     game_state_request.channel = GAME_CHANNEL;
456     game_state_request.subject = "state request";
457
458     this->message_hub_ptr->sendMessage(game_state_request);
459
460     std::cout « "Game state request message sent by " « this « std::endl;
461     return;
462 }   /* __sendGameStateRequest() */
```

4.13.3.9 __sendInsufficientCreditsMessage()

```
void TileImprovement::__sendInsufficientCreditsMessage (
            void  )  [protected]
```

Helper method to format and send an insufficient credits message.

```
507 {
508     Message insufficient_credits_message;
509
510     insufficient_credits_message.channel = GAME_CHANNEL;
511     insufficient_credits_message.subject = "insufficient credits";
512
513     this->message_hub_ptr->sendMessage(insufficient_credits_message);
514
515     std::cout « "Insufficient credits message sent by " « this « std::endl;
516
517     return;
518 }   /* __sendInsufficientCreditsMessage() */
```

4.13.3.10 __sendTileStateRequest()

```
void TileImprovement::__sendTileStateRequest (
            void  )  [protected]
```

Helper method to format and send a request for the parent HexTile to send a tile state message.

```
427 {
428     Message tile_state_request;
429
430     tile_state_request.channel = TILE_STATE_CHANNEL;
431     tile_state_request.subject = "state request";
432
433     this->message_hub_ptr->sendMessage(tile_state_request);
434
435     std::cout « "Tile state request sent by " « this « std::endl;
436     return;
437 }   /* __sendTileStateRequest() */
```

4.13.3.11 __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(MONOCHROME_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(MONOCHROME_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() */
```

4.13.3.12 __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
162     return;
163 }   /* __setUpUpgradeMenu() */
```

4.13.3.13 __upgradeStorageCapacity()

```
void TileImprovement::__upgradeStorageCapacity (
            void  )  [protected]
```

Helper method to upgrade storage capacity.

```
178 {
179     if (this->credits < ENERGY_STORAGE_SYSTEM_BUILD_COST) {
180         std::cout « "Cannot add energy storage: insufficient credits (need "
181             « ENERGY_STORAGE_SYSTEM_BUILD_COST « " K)" « std::endl;
182
183         this->__sendInsufficientCreditsMessage();
184         return;
185     }
186
187     if (this->storage_level >= MAX_STORAGE_LEVELS) {
188         return;
189     }
190
191     this->health = 100;
192
193     this->storage_level++;
194
195     this->storage_upgrade_sprite_vec.push_back(
196         sf::Sprite(
197             *(this->assets_manager_ptr->getTexture("storage level"))
198         )
199     );
200
201     this->storage_upgrade_sprite_vec.back().setOrigin(
202         this->storage_upgrade_sprite_vec.back().getLocalBounds().width / 2,
203         this->storage_upgrade_sprite_vec.back().getLocalBounds().height
204     );
205
206     this->storage_upgrade_sprite_vec.back().setPosition(
207         this->position_x + 18,
208         this->position_y + 25 - 7 * this->storage_upgrade_sprite_vec.size()
209     );
210
211     this->just_upgraded = true;
212
213     this->assets_manager_ptr->getSound("upgrade")->play();
214
215     this->__sendCreditsSpentMessage(ENERGY_STORAGE_SYSTEM_BUILD_COST);
216     this->__sendTileStateRequest();
217     this->__sendGameStateRequest();
218
219     return;
220 }   /* __upgradeStorageCapacity() */
```

4.13.3.14 advanceTurn()

```
virtual void TileImprovement::advanceTurn (
            void  )  [inline], [virtual]
```

Reimplemented in WindTurbine, WaveEnergyConverter, TidalTurbine, SolarPV, and DieselGenerator.

```
175 {return;}
```

4.13.3.15 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.

```
736 {
737     if (this->tile_improvement_sprite_static.getTexture() != NULL) {
738         int alpha = this->tile_improvement_sprite_static.getColor().a;
739 
740         alpha += 0.08 * FRAMES_PER_SECOND;
741 
742         this->tile_improvement_sprite_static.setColor(
743             sf::Color(255, 255, 255, alpha)
744         );
745 
746         this->tile_improvement_sprite_static.move(0, 50 * SECONDS_PER_FRAME);
747 
748         if (
749             (alpha >= 255) or
750             (this->tile_improvement_sprite_static.getPosition().y >= this->position_y + 12)
751         ) {
752             this->tile_improvement_sprite_static.setColor(
753                 sf::Color(255, 255, 255, 255)
754             );
755 
756             this->tile_improvement_sprite_static.setPosition(
757                 this->position_x,
758                 this->position_y + 12
759             );
760 
761             this->just_built = false;
762             this->assets_manager_ptr->getSound("place improvement")->play();
763         }
764 
765         this->render_window_ptr->draw(this->tile_improvement_sprite_static);
766     }
767 
768 
769     else {
770         int alpha = 0;
771 
772         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
773             alpha = this->tile_improvement_sprite_animated[i].getColor().a;
774 
775             alpha += 0.08 * FRAMES_PER_SECOND;
776 
777             this->tile_improvement_sprite_animated[i].setColor(
778                 sf::Color(255, 255, 255, alpha)
779             );
780 
781             this->tile_improvement_sprite_animated[i].move(0, 50 * SECONDS_PER_FRAME);
782 
783             if (
784                 (alpha >= 255) or
785                 (this->tile_improvement_sprite_animated[i].getPosition().y >= this->position_y + 12)
786             ) {
787                 this->tile_improvement_sprite_animated[i].setColor(
788                     sf::Color(255, 255, 255, 255)
789                 );
790 
791                 this->tile_improvement_sprite_animated[i].setPosition(
```

```
792                     this->position_x,
793                     this->position_y + 12
794                 );
795             }
796
797             this->render_window_ptr->draw(this->tile_improvement_sprite_animated[i]);
798         }
799
800         if (
801             (alpha >= 255) or
802             (this->tile_improvement_sprite_animated[0].getPosition().y >= this->position_y + 12)
803         ) {
804             this->just_built = false;
805             this->assets_manager_ptr->getSound("place improvement")->play();
806
807             switch (this->tile_improvement_type) {
808                 case (TileImprovementType :: WIND_TURBINE): {
809                     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
810                         this->tile_improvement_sprite_animated[i].setOrigin(32, 32);
811                         this->tile_improvement_sprite_animated[i].move(0, -32);
812                     }
813
814                     break;
815                 }
816
817
818                 case (TileImprovementType :: TIDAL_TURBINE): {
819                     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
820                         this->tile_improvement_sprite_animated[i].setOrigin(32, 45);
821                         this->tile_improvement_sprite_animated[i].move(0, -19);
822                     }
823
824                     break;
825                 }
826
827
828                 case (TileImprovementType :: WAVE_ENERGY_CONVERTER): {
829                     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
830                         this->tile_improvement_sprite_animated[i].setOrigin(32, 32);
831                         this->tile_improvement_sprite_animated[i].move(0, -32);
832                     }
833
834                     break;
835                 }
836
837
838                 default: {
839                     // do nothing!
840
841                     break;
842                 }
843             }
844         }
845     }
846
847
848     this->frame++;
849     return;
850 }   /* draw() */
```

4.13.3.16 getTileOptionsSubstring()

```
virtual std::string TileImprovement::getTileOptionsSubstring (
            void  )  [inline], [virtual]
```

Reimplemented in WindTurbine, WaveEnergyConverter, TidalTurbine, SolarPV, Settlement, EnergyStorageSystem, and DieselGenerator.

```
179 {return "";}
```

4.13.3.17 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.

```
691 {
692     if (this->event_ptr->type == sf::Event::KeyPressed) {
693         this->__handleKeyPressEvents();
694     }
695 
696     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
697         this->__handleMouseButtonEvents();
698     }
699 
700     return;
701 }   /* processEvent() */
```

4.13.3.18 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.

```
716 {
717     //...
718 
719     return;
720 }   /* processMessage() */
```

4.13.3.19 setIsSelected()

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

Method to set the is selected attribute.

Parameters

is_selected	The value to set the is selected attribute to.

Reimplemented in Settlement, and EnergyStorageSystem.

```
664 {
665     this->is_selected = is_selected;
666 
667     if ((not is_selected) and this->production_menu_open) {
668         this->__closeProductionMenu();
669     }
670 
671     if ((not is_selected) and this->upgrade_menu_open) {
```

```
672         this->__closeUpgradeMenu();
673     }
674
675     return;
676 }   /* setIsSelected() */
```

4.13.3.20 update()

```
virtual void TileImprovement::update (
             void  )  [inline], [virtual]
```

Reimplemented in WindTurbine, WaveEnergyConverter, TidalTurbine, and SolarPV.

```
177 {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 event_ptr

```
sf::Event* TileImprovement::event_ptr  [protected]
```

A pointer to the event class.

4.13.4.5 frame

```
unsigned long long int TileImprovement::frame
```

The current frame of this object.

4.13.4.6 game_phase

```
std::string TileImprovement::game_phase
```

The current phase of the game.

4.13.4.7 health

```
int TileImprovement::health
```

The health of the improvement.

4.13.4.8 is_running

```
bool TileImprovement::is_running
```

A boolean which indicates whether or not the improvement is running.

4.13.4.9 is_selected

```
bool TileImprovement::is_selected
```

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

4.13.4.10 just_built

```
bool TileImprovement::just_built
```

A boolean which indicates that the improvement was just built.

4.13.4.11 just_upgraded

```
bool TileImprovement::just_upgraded
```

A boolean which indicates that the improvement was just upgraded.

4.13.4.12 message_hub_ptr

```
MessageHub* TileImprovement::message_hub_ptr  [protected]
```

A pointer to the message hub.

4.13.4.13 month

```
int TileImprovement::month
```

The current month of play.

4.13.4.14 position_x

```
double TileImprovement::position_x
```

The x position of the tile improvement.

4.13.4.15 position_y

```
double TileImprovement::position_y
```

The y position of the tile improvement.

4.13.4.16 production_menu_backing

```
sf::RectangleShape TileImprovement::production_menu_backing
```

A backing for the production menu.

4.13.4.17 production_menu_backing_text

```
sf::Text TileImprovement::production_menu_backing_text
```

Text for the production menu backing.

4.13.4.18 production_menu_open

```
bool TileImprovement::production_menu_open
```

A boolean which indicates whether or not the production menu is open.

4.13.4.19 render_window_ptr

```
sf::RenderWindow* TileImprovement::render_window_ptr  [protected]
```

A pointer to the render window.

4.13.4.20 storage_level

```
int TileImprovement::storage_level
```

The level of storage installed alongside the tile improvement.

4.13.4.21 storage_upgrade_sprite

```
sf::Sprite TileImprovement::storage_upgrade_sprite
```

A sprite for illustrating storage (in upgrade menu).

4.13.4.22 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).

4.13.4.23 tile_improvement_sprite_animated

```
std::vector<sf::Sprite> TileImprovement::tile_improvement_sprite_animated
```

An animated sprite, for the ContextMenu visual screen.

4.13.4.24 tile_improvement_sprite_static

```
sf::Sprite TileImprovement::tile_improvement_sprite_static
```

A static sprite, for decorating the tile.

4.13.4.25 tile_improvement_string

```
std::string TileImprovement::tile_improvement_string
```

A string representation of the tile improvement type.

4.13.4.26 tile_improvement_type

```
TileImprovementType TileImprovement::tile_improvement_type
```

The type of the tile improvement.

4.13.4.27 tile_resource

```
int TileImprovement::tile_resource
```

The renewable resource quality of the tile.

4.13.4.28 tile_resource_scalar

```
double TileImprovement::tile_resource_scalar
```

A scalar associated with the renewable resource quality.

4.13.4.29 upgrade_arrow_sprite

```
sf::Sprite TileImprovement::upgrade_arrow_sprite
```

An upgrade arrow sprite.

4.13.4.30 upgrade_frame

```
int TileImprovement::upgrade_frame
```

The frame of the upgrade animation.

4.13.4.31 upgrade_level

```
int TileImprovement::upgrade_level
```

The upgrade level of the improvement.

4.13.4.32 upgrade_menu_backing

```
sf::RectangleShape TileImprovement::upgrade_menu_backing
```

A backing for the upgrade menu.

4.13.4.33 upgrade_menu_backing_text

```
sf::Text TileImprovement::upgrade_menu_backing_text
```

Text for the upgrade menu backing.

4.13.4.34 upgrade_menu_open

```
bool TileImprovement::upgrade_menu_open
```

A boolean which indicates whether or not the build menu is open.

4.13.4.35 upgrade_plus_sprite

```
sf::Sprite TileImprovement::upgrade_plus_sprite
```

An upgrade plus sprite.

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

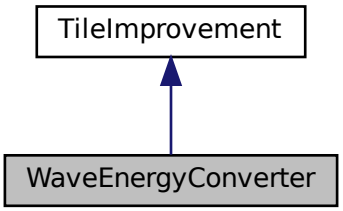
- header/TileImprovement.h
- source/TileImprovement.cpp

4.14 WaveEnergyConverter Class Reference

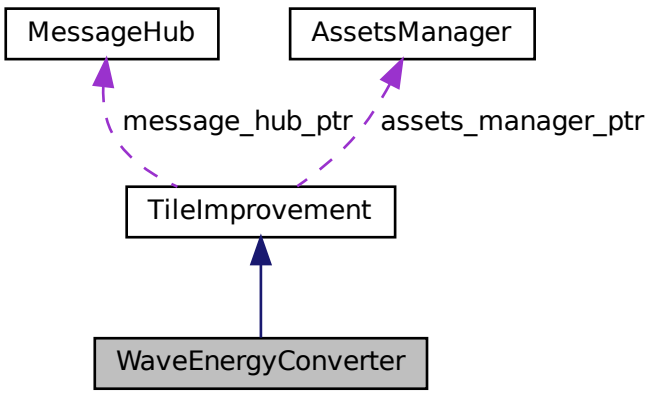
A settlement class (child class of TileImprovement).

```
#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 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 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 monthly_capacity_factor

  The current monthly capacity factor.

Private Member Functions

- void __setUpTileImprovementSpriteAnimated (void)

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

  Helper method to upgrade power capacity.
- void __updateProduction (void)

  Helper method to update current production.
- void __computeDispatchable (void)

  Helper method to compute current dispatchable.
- 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.

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

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

```
482   :
483 TileImprovement(
484     position_x,
485     position_y,
486     tile_resource,
487     event_ptr,
488     render_window_ptr,
489     assets_manager_ptr,
490     message_hub_ptr
491 )
492 {
493     //  1. set attributes
494
495     //  1.1. private
496     //...
497
498     //  1.2. public
499     this->tile_improvement_type = TileImprovementType :: WAVE_ENERGY_CONVERTER;
500
501     this->is_running = false;
502
503     this->health = 100;
504
```

```
505     this->capacity_kW = 100;
506     this->upgrade_level = 1;
507     this->storage_level = 0;
508
509     this->production_MWh = 0;
510     this->dispatchable_MWh = 0;
511
512     this->max_daily_production_MWh = (double)(24 * this->capacity_kW) / 1000;
513     this->monthly_capacity_factor = 0;
514
515     this->tile_improvement_string = "WAVE ENERGY";
516
517     this->__setUpTileImprovementSpriteAnimated();
518     this->__updateProduction();
519
520     std::cout « "WaveEnergyConverter constructed at " « this « std::endl;
521
522     return;
523 }   /* WaveEnergyConverter() */
```

4.14.2.2 ~WaveEnergyConverter()

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

Destructor for the WaveEnergyConverter class.

```
780 {
781     std::cout « "WaveEnergyConverter at " « this « " destroyed" « std::endl;
782
783     return;
784 }   /* ~WaveEnergyConverter() */
```

4.14.3 Member Function Documentation

4.14.3.1 __computeDispatchable()

```
void WaveEnergyConverter::__computeDispatchable (
            void  )  [private]
```

Helper method to compute current dispatchable.

```
201 {
202     if (this->production_MWh < 0.15 * this->demand_MWh) {
203         this->dispatchable_MWh = this->production_MWh;
204     }
205
206     else {
207         //...
208     }
209
210     return;
211 }   /* __computeDispatchable() */
```

4.14.3.2 __drawUpgradeOptions()

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

Helper method to set up and draw upgrade options.

```
333 {
334     //  1. draw power capacity upgrade sprite
335     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
336         sf::Vector2f initial_position = this->tile_improvement_sprite_animated[i].getPosition();
337         this->tile_improvement_sprite_animated[i].setPosition(400 - 100, 400 - 32 - 20);
338 
339         sf::Color initial_colour = this->tile_improvement_sprite_animated[i].getColor();
340         this->tile_improvement_sprite_animated[i].setColor(sf::Color(255, 255, 255, 255));
341 
342         sf::Vector2f initial_scale = this->tile_improvement_sprite_animated[i].getScale();
343         this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1, 1));
344 
345         this->render_window_ptr->draw(this->tile_improvement_sprite_animated[i]);
346 
347         this->tile_improvement_sprite_animated[i].setPosition(initial_position);
348         this->tile_improvement_sprite_animated[i].setColor(initial_colour);
349         this->tile_improvement_sprite_animated[i].setScale(initial_scale);
350     }
351 
352     this->render_window_ptr->draw(this->upgrade_arrow_sprite);
353 
354 
355     //  2. draw power capacity upgrade text
356     //                  16 char line = "                \n"
357     std::string power_upgrade_string = "POWER CAPACITY  \n";
358     power_upgrade_string            += "                \n";
359 
360     power_upgrade_string            += "CAPACITY:  ";
361     power_upgrade_string            += std::to_string(this->capacity_kW);
362     power_upgrade_string            += " kW\n";
363 
364     power_upgrade_string            += "LEVEL:     ";
365     power_upgrade_string            += std::to_string(this->upgrade_level);
366     power_upgrade_string            += "\n\n";
367 
368     if (this->upgrade_level < MAX_UPGRADE_LEVELS) {
369         power_upgrade_string        += "[W]: + 100 kW (";
370         power_upgrade_string        +=  std::to_string(WAVE_ENERGY_CONVERTER_BUILD_COST);
371         power_upgrade_string        += " K)\n";
372     }
373 
374     else {
375         power_upgrade_string        += " * MAX LEVEL *  \n";
376     }
377 
378     sf::Text power_upgrade_text = sf::Text(
379         power_upgrade_string,
380         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
381         16
382     );
383 
384     power_upgrade_text.setOrigin(power_upgrade_text.getLocalBounds().width / 2, 0);
385     power_upgrade_text.setPosition(400 - 100, 400 - 32 + 16);
386     power_upgrade_text.setFillColor(MONOCHROME_TEXT_GREEN);
387 
388     this->render_window_ptr->draw(power_upgrade_text);
389 
390 
391     //  3. draw energy capacity (storage) upgrade sprite
392     this->render_window_ptr->draw(this->storage_upgrade_sprite);
393     this->render_window_ptr->draw(this->upgrade_plus_sprite);
394 
395 
396     //  4. draw energy capacity (storage) upgrade text
397     //                   16 char line = "                \n"
398     std::string energy_upgrade_string = "ENERGY CAPACITY \n";
399     energy_upgrade_string            += "                \n";
400 
401     energy_upgrade_string            += "CAPACITY:  ";
402     energy_upgrade_string            += std::to_string(this->storage_level * 200);
403     energy_upgrade_string            += " kWh\n";
404 
405     energy_upgrade_string            += "LEVEL:     ";
406     energy_upgrade_string            += std::to_string(this->storage_level);
407     energy_upgrade_string            += "\n\n";
408 
409     if (this->storage_level < MAX_STORAGE_LEVELS) {
410         energy_upgrade_string        += "[D]: + 200 kWh (";
```

```
411         energy_upgrade_string        +=  std::to_string(ENERGY_STORAGE_SYSTEM_BUILD_COST);
412         energy_upgrade_string        += " K)\n";
413     }
414
415     else {
416         energy_upgrade_string += " * MAX LEVEL *  \n";
417     }
418
419     sf::Text energy_upgrade_text = sf::Text(
420         energy_upgrade_string,
421         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
422         16
423     );
424
425     energy_upgrade_text.setOrigin(energy_upgrade_text.getLocalBounds().width / 2, 0);
426     energy_upgrade_text.setPosition(400 + 100, 400 - 32 + 16);
427     energy_upgrade_text.setFillColor(MONOCHROME_TEXT_GREEN);
428
429     this->render_window_ptr->draw(energy_upgrade_text);
430
431     return;
432 }   /* __drawUpgradeOptions() */
```

4.14.3.3 __handleKeyPressEvents()

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

Helper method to handle key press events.

```
226 {
227     if (this->just_built) {
228         return;
229     }
230
231     switch (this->event_ptr->key.code) {
232         case (sf::Keyboard::U): {
233             this->__openUpgradeMenu();
234
235             break;
236         }
237
238
239         case (sf::Keyboard::W): {
240             if (this->production_menu_open) {
241                 //...
242             }
243
244             else if (this->upgrade_menu_open) {
245                 this->__upgradePowerCapacity();
246             }
247
248             break;
249         }
250
251
252         case (sf::Keyboard::S): {
253             //...
254
255             break;
256         }
257
258
259         case (sf::Keyboard::D): {
260             if (this->upgrade_menu_open) {
261                 this->__upgradeStorageCapacity();
262             }
263
264             break;
265         }
266
267
268         default: {
269             // do nothing!
270
271             break;
272         }
273     }
274
275     return;
276 }   /* __handleKeyPressEvents() */
```

4.14.3.4 __handleMouseButtonEvents()

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

Helper method to handle mouse button events.

```
291 {
292     if (this->just_built) {
293         return;
294     }
295     switch (this->event_ptr->mouseButton.button) {
296         case (sf::Mouse::Left): {
297             //...
298 
299             break;
300         }
301 
302 
303         case (sf::Mouse::Right): {
304             //...
305 
306             break;
307         }
308 
309 
310         default: {
311             // do nothing!
312 
313             break;
314         }
315     }
316 
317     return;
318 }   /* __handleMouseButtonEvents() */
```

4.14.3.5 __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() */
```

4.14.3.6 __updateProduction()

```
void WaveEnergyConverter::__updateProduction (
            void  )  [private]
```

Helper method to update current production.

```
161 {
162     unsigned seed = std::chrono::system_clock::now().time_since_epoch().count();
163     std::default_random_engine generator(seed);
164 
165     double mean =
166         this->tile_resource_scalar * MEAN_DAILY_WAVE_CAPACITY_FACTORS[this->month - 1];
167 
168     double stdev = STDEV_DAILY_WAVE_CAPACITY_FACTORS[this->month - 1];
169 
170     if (this->tile_resource_scalar > 1) {
171         stdev /= this->tile_resource_scalar;
172     }
173 
174     std::normal_distribution<double> normal_dist(mean, stdev);
175 
176     this->monthly_capacity_factor = 0;
177 
178     for (int i = 0; i < 30; i++) {
179         this->monthly_capacity_factor += normal_dist(generator);
180     }
181 
182     this->production_MWh =
183         round(this->monthly_capacity_factor * this->max_daily_production_MWh);
184 
185     return;
186 }   /* __updateProduction() */
```

4.14.3.7 __upgradePowerCapacity()

```
void WaveEnergyConverter::__upgradePowerCapacity (
            void  )  [private]
```

Helper method to upgrade power capacity.

```
114 {
115     if (this->credits < WAVE_ENERGY_CONVERTER_BUILD_COST) {
116         std::cout << "Cannot upgrade wave energy converter: insufficient credits (need "
117             << WAVE_ENERGY_CONVERTER_BUILD_COST << " K)" << std::endl;
118 
119         this->__sendInsufficientCreditsMessage();
120         return;
121     }
122 
123     if (this->upgrade_level >= MAX_UPGRADE_LEVELS) {
124         return;
125     }
126 
127     this->health = 100;
128 
129     this->capacity_kW += 100;
130     this->upgrade_level++;
131 
132     this->max_daily_production_MWh = (double)(24 * this->capacity_kW) / 1000;
133 
134     this->production_MWh =
135         this->monthly_capacity_factor * this->max_daily_production_MWh;
136 
137     this->just_upgraded = true;
138 
139     this->assets_manager_ptr->getSound("upgrade")->play();
140 
141     this->__sendCreditsSpentMessage(WAVE_ENERGY_CONVERTER_BUILD_COST);
142     this->__sendTileStateRequest();
143     this->__sendGameStateRequest();
144 
145     return;
146 }   /* __upgradePowerCapacity() */
```

4.14.3.8 advanceTurn()

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

Method to handle turn advance.

Reimplemented from TileImprovement.

```
585 {
586     //  1. update
587     this->update();
588 
589     //...
590 
591     std::cout « "Turn advance message received by " « this « std::endl;
592     this->__sendGameStateRequest();
593     return;
594 }   /* advanceTurn() */
```

4.14.3.9 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.

```
678 {
679     //  1. if just built, call base method and return
680     if (this->just_built) {
681         TileImprovement :: draw();
682 
683         return;
684     }
685 
686 
687     //  2. handle upgrade effects
688     if (this->just_upgraded) {
689         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
690             this->tile_improvement_sprite_animated[i].setColor(
691                 sf::Color(
692                     255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
693                     255,
694                     255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
695                     255
696                 )
697             );
698 
699             this->tile_improvement_sprite_animated[i].setScale(
700                 sf::Vector2f(
701                     1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
702                     1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2)
703                 )
704             );
705         }
706 
707         this->upgrade_frame++;
708     }
709 
710     if (this->upgrade_frame >= 2 * FRAMES_PER_SECOND) {
711         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
712             this->tile_improvement_sprite_animated[i].setColor(
713                 sf::Color(255,255,255,255)
714             );
715 
716             this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1,1));
717         }
718 
719         this->just_upgraded = false;
720         this->upgrade_frame = 0;
721     }
722 
723 
```

```
724     //  3. draw first element of animated sprite
725     this->render_window_ptr->draw(this->tile_improvement_sprite_animated[0]);
726
727
728     //  4. draw second element of animated sprite
729     if (this->is_running) {
730         //...
731     }
732
733     else {
734         //...
735     }
736
737     this->render_window_ptr->draw(this->tile_improvement_sprite_animated[1]);
738
739
740     //  5. draw storage upgrades
741     for (size_t i = 0; i < this->storage_upgrade_sprite_vec.size(); i++) {
742         this->render_window_ptr->draw(this->storage_upgrade_sprite_vec[i]);
743     }
744
745
746     //  6. draw production menu
747     if (this->production_menu_open) {
748         this->render_window_ptr->draw(this->production_menu_backing);
749         this->render_window_ptr->draw(this->production_menu_backing_text);
750
751         //...
752     }
753
754
755     //  7. draw upgrade menu
756     if (this->upgrade_menu_open) {
757         this->render_window_ptr->draw(this->upgrade_menu_backing);
758         this->render_window_ptr->draw(this->upgrade_menu_backing_text);
759
760         this->__drawUpgradeOptions();
761     }
762
763     this->frame++;
764     return;
765 }   /* draw() */
```

4.14.3.10 getTileOptionsSubstring()

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

Helper method to assemble and return tile options substring.

Returns

Tile options substring.

Reimplemented from TileImprovement.

```
540 {
541     //                  32 char x 17 line console "--------------------------------\n";
542     std::string options_substring                = "CAPACITY:      ";
543     options_substring                           += std::to_string(this->capacity_kW);
544     options_substring                           += " kW (level ";
545     options_substring                           += std::to_string(this->upgrade_level);
546     options_substring                           += ")\n";
547
548     options_substring                           += "PRODUCTION:    ";
549     options_substring                           += std::to_string(this->production_MWh);
550     options_substring                           += " MWh\n";
551
552     options_substring                           += "DISPATCHABLE:  ";
553     options_substring                           += std::to_string(this->dispatchable_MWh);
554     options_substring                           += " MWh\n";
555
556     options_substring                           += "HEALTH:        ";
557     options_substring                           += std::to_string(this->health);
558     options_substring                           += "/100\n";
```

```
559
560     options_substring                           += "                                \n";
561     options_substring                           += " **** WAVE ENERGY OPTIONS ****  \n";
562     options_substring                           += "                                \n";
563     options_substring                           += "      [E]:  OPEN PRODUCTION MENU \n";
564     options_substring                           += "      [U]:  OPEN UPGRADE MENU    \n";
565     options_substring                           += "HOLD [P]:  SCRAP (";
566     options_substring                           += std::to_string(SCRAP_COST);
567     options_substring                           += " K)";
568
569     return options_substring;
570 }   /* getTileOptionsSubstring() */
```

4.14.3.11 processEvent()

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

Method to process WaveEnergyConverter. To be called once per event.

Reimplemented from TileImprovement.

```
629 {
630     TileImprovement :: processEvent();
631
632     if (this->event_ptr->type == sf::Event::KeyPressed) {
633         this->__handleKeyPressEvents();
634     }
635
636     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
637         this->__handleMouseButtonEvents();
638     }
639
640     return;
641 }   /* processEvent() */
```

4.14.3.12 processMessage()

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

Method to process WaveEnergyConverter. To be called once per message.

Reimplemented from TileImprovement.

```
656 {
657     TileImprovement :: processMessage();
658
659     //...
660
661     return;
662 }   /* processMessage() */
```

4.14.3.13 update()

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

Method to trigger production and dispatchable updates.

Reimplemented from TileImprovement.

```
609 {
610     this->__updateProduction();
611     this->__computeDispatchable();
612
613     return;
614 }   /* update() */
```

4.14.4 Member Data Documentation

4.14.4.1 capacity_kW

```
int WaveEnergyConverter::capacity_kW
```

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

4.14.4.2 dispatchable_MWh

```
int WaveEnergyConverter::dispatchable_MWh
```

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

4.14.4.3 max_daily_production_MWh

```
double WaveEnergyConverter::max_daily_production_MWh
```

The maximum daily production [MWh] of the solar PV array.

4.14.4.4 monthly_capacity_factor

```
double WaveEnergyConverter::monthly_capacity_factor
```

The current monthly capacity factor.

4.14.4.5 production_MWh

```
int WaveEnergyConverter::production_MWh
```

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

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

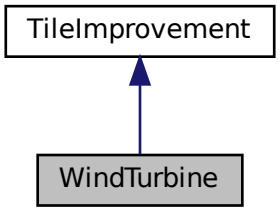
- header/WaveEnergyConverter.h
- source/WaveEnergyConverter.cpp

4.15 WindTurbine Class Reference

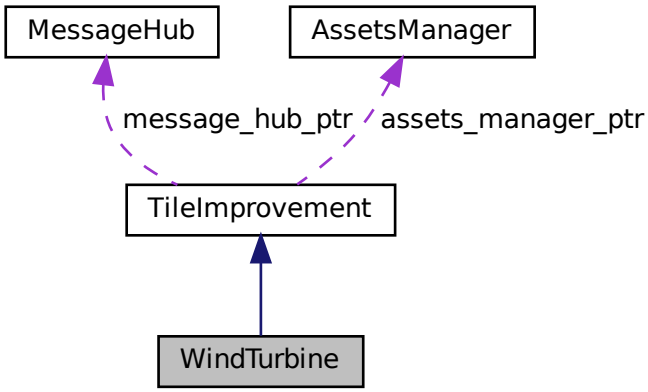
A settlement class (child class of TileImprovement).

`#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 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 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 monthly_capacity_factor

  The current monthly capacity factor.

Private Member Functions

- void __setUpTileImprovementSpriteAnimated (void)

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

  Helper method to upgrade the power capacity.
- void __updateProduction (void)

  Helper method to update current production.
- void __computeDispatchable (void)

  Helper method to compute current dispatchable.
- 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.

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

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

```
483   :
484 TileImprovement(
485     position_x,
486     position_y,
487     tile_resource,
488     event_ptr,
489     render_window_ptr,
490     assets_manager_ptr,
491     message_hub_ptr
492 )
493 {
494     //  1. set attributes
495
496     //  1.1. private
497     //...
498
499     //  1.2. public
500     this->tile_improvement_type = TileImprovementType :: WIND_TURBINE;
501
502     this->is_running = false;
503
504     this->health = 100;
505
506     this->capacity_kW = 100;
507     this->upgrade_level = 1;
508     this->storage_level = 0;
509
510     this->production_MWh = 0;
511     this->dispatchable_MWh = 0;
512
513     this->max_daily_production_MWh = (double)(24 * this->capacity_kW) / 1000;
514     this->monthly_capacity_factor = 0;
515
516     this->tile_improvement_string = "WIND TURBINE";
517
518     this->__setUpTileImprovementSpriteAnimated();
519     this->__updateProduction();
```

```
520
521     std::cout « "WindTurbine constructed at " « this « std::endl;
522
523     return;
524 }   /* WindTurbine() */
```

4.15.2.2 ~WindTurbine()

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

Destructor for the WindTurbine class.

```
781 {
782     std::cout « "WindTurbine at " « this « " destroyed" « std::endl;
783
784     return;
785 }   /* ~WindTurbine() */
```

4.15.3 Member Function Documentation

4.15.3.1 __computeDispatchable()

```
void WindTurbine::__computeDispatchable (
            void  )  [private]
```

Helper method to compute current dispatchable.

```
201 {
202     if (this->production_MWh < 0.15 * this->demand_MWh) {
203         this->dispatchable_MWh = this->production_MWh;
204     }
205
206     else {
207         //...
208     }
209
210     return;
211 }   /* __computeDispatchable() */
```

4.15.3.2 __drawUpgradeOptions()

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

Helper method to set up and draw upgrade options.

```
334 {
335     //  1. draw power capacity upgrade sprite
336     for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
337         sf::Vector2f initial_position = this->tile_improvement_sprite_animated[i].getPosition();
338         this->tile_improvement_sprite_animated[i].setPosition(400 - 100, 400 - 56);
339
340         sf::Color initial_colour = this->tile_improvement_sprite_animated[i].getColor();
341         this->tile_improvement_sprite_animated[i].setColor(sf::Color(255, 255, 255, 255));
342
343         sf::Vector2f initial_scale = this->tile_improvement_sprite_animated[i].getScale();
344         this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1, 1));
345
```

```
346         this->render_window_ptr->draw(this->tile_improvement_sprite_animated[i]);
347
348         this->tile_improvement_sprite_animated[i].setPosition(initial_position);
349         this->tile_improvement_sprite_animated[i].setColor(initial_colour);
350         this->tile_improvement_sprite_animated[i].setScale(initial_scale);
351     }
352
353     this->render_window_ptr->draw(this->upgrade_arrow_sprite);
354
355
356     //  2. draw power capacity upgrade text
357     //                  16 char line = "                \n"
358     std::string power_upgrade_string = "POWER CAPACITY  \n";
359     power_upgrade_string            += "                \n";
360
361     power_upgrade_string            += "CAPACITY:  ";
362     power_upgrade_string            += std::to_string(this->capacity_kW);
363     power_upgrade_string            += " kW\n";
364
365     power_upgrade_string            += "LEVEL:     ";
366     power_upgrade_string            += std::to_string(this->upgrade_level);
367     power_upgrade_string            += "\n\n";
368
369     if (this->upgrade_level < MAX_UPGRADE_LEVELS) {
370         power_upgrade_string        += "[W]: + 100 kW (";
371         power_upgrade_string        +=  std::to_string(WIND_TURBINE_BUILD_COST);
372         power_upgrade_string        += " K)\n";
373     }
374
375     else {
376         power_upgrade_string        += " * MAX LEVEL *  \n";
377     }
378
379     sf::Text power_upgrade_text = sf::Text(
380         power_upgrade_string,
381         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
382         16
383     );
384
385     power_upgrade_text.setOrigin(power_upgrade_text.getLocalBounds().width / 2, 0);
386     power_upgrade_text.setPosition(400 - 100, 400 - 32 + 16);
387     power_upgrade_text.setFillColor(MONOCHROME_TEXT_GREEN);
388
389     this->render_window_ptr->draw(power_upgrade_text);
390
391
392     //  3. draw energy capacity (storage) upgrade sprite
393     this->render_window_ptr->draw(this->storage_upgrade_sprite);
394     this->render_window_ptr->draw(this->upgrade_plus_sprite);
395
396
397     //  4. draw energy capacity (storage) upgrade text
398     //                   16 char line = "                \n"
399     std::string energy_upgrade_string = "ENERGY CAPACITY \n";
400     energy_upgrade_string            += "                \n";
401
402     energy_upgrade_string            += "CAPACITY:  ";
403     energy_upgrade_string            += std::to_string(this->storage_level * 200);
404     energy_upgrade_string            += " kWh\n";
405
406     energy_upgrade_string            += "LEVEL:     ";
407     energy_upgrade_string            += std::to_string(this->storage_level);
408     energy_upgrade_string            += "\n\n";
409
410     if (this->storage_level < MAX_STORAGE_LEVELS) {
411         energy_upgrade_string        += "[D]: + 200 kWh (";
412         energy_upgrade_string        +=  std::to_string(ENERGY_STORAGE_SYSTEM_BUILD_COST);
413         energy_upgrade_string        += " K)\n";
414     }
415
416     else {
417         energy_upgrade_string += " * MAX LEVEL *  \n";
418     }
419
420     sf::Text energy_upgrade_text = sf::Text(
421         energy_upgrade_string,
422         *(this->assets_manager_ptr->getFont("Glass_TTY_VT220")),
423         16
424     );
425
426     energy_upgrade_text.setOrigin(energy_upgrade_text.getLocalBounds().width / 2, 0);
427     energy_upgrade_text.setPosition(400 + 100, 400 - 32 + 16);
428     energy_upgrade_text.setFillColor(MONOCHROME_TEXT_GREEN);
429
430     this->render_window_ptr->draw(energy_upgrade_text);
431
432     return;
```

```
433 }   /* __drawUpgradeOptions() */
```

4.15.3.3 __handleKeyPressEvents()

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

Helper method to handle key press events.

```
226 {
227     if (this->just_built) {
228         return;
229     }
230 
231     switch (this->event_ptr->key.code) {
232         case (sf::Keyboard::U): {
233             this->__openUpgradeMenu();
234 
235             break;
236         }
237 
238 
239         case (sf::Keyboard::W): {
240             if (this->production_menu_open) {
241                 //...
242             }
243 
244             else if (this->upgrade_menu_open) {
245                 this->__upgradePowerCapacity();
246             }
247 
248             break;
249         }
250 
251 
252         case (sf::Keyboard::S): {
253             //...
254 
255             break;
256         }
257 
258 
259         case (sf::Keyboard::D): {
260             if (this->upgrade_menu_open) {
261                 this->__upgradeStorageCapacity();
262             }
263 
264             break;
265         }
266 
267 
268         default: {
269             // do nothing!
270 
271             break;
272         }
273     }
274 
275     return;
276 }   /* __handleKeyPressEvents() */
```

4.15.3.4 __handleMouseButtonEvents()

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

Helper method to handle mouse button events.

```
291 {
292     if (this->just_built) {
293         return;
```

```
294     }
295
296     switch (this->event_ptr->mouseButton.button) {
297         case (sf::Mouse::Left): {
298             //...
299
300             break;
301         }
302
303
304         case (sf::Mouse::Right): {
305             //...
306
307             break;
308         }
309
310
311         default: {
312             // do nothing!
313
314             break;
315         }
316     }
317
318     return;
319 }   /* __handleMouseButtonEvents() */
```

4.15.3.5 __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() */
```

4.15.3.6 __updateProduction()

```
void WindTurbine::__updateProduction (
            void  )  [private]
```

Helper method to update current production.

```
161 {
162     unsigned seed = std::chrono::system_clock::now().time_since_epoch().count();
163     std::default_random_engine generator(seed);
164 
165     double mean =
166         this->tile_resource_scalar * MEAN_DAILY_WIND_CAPACITY_FACTORS[this->month - 1];
167 
168     double stdev = STDEV_DAILY_WIND_CAPACITY_FACTORS[this->month - 1];
169 
170     if (this->tile_resource_scalar > 1) {
171         stdev /= this->tile_resource_scalar;
172     }
173 
174     std::normal_distribution<double> normal_dist(mean, stdev);
175 
176     this->monthly_capacity_factor = 0;
177 
178     for (int i = 0; i < 30; i++) {
179         this->monthly_capacity_factor += normal_dist(generator);
180     }
181 
182     this->production_MWh =
183         round(this->monthly_capacity_factor * this->max_daily_production_MWh);
184 
185     return;
186 }   /* __updateProduction() */
```

4.15.3.7 __upgradePowerCapacity()

```
void WindTurbine::__upgradePowerCapacity (
            void  )  [private]
```

Helper method to upgrade the power capacity.

```
114 {
115     if (this->credits < WIND_TURBINE_BUILD_COST) {
116         std::cout << "Cannot upgrade wind turbine: insufficient credits (need "
117             << WIND_TURBINE_BUILD_COST << " K)" << std::endl;
118 
119         this->__sendInsufficientCreditsMessage();
120         return;
121     }
122 
123     if (this->upgrade_level >= MAX_UPGRADE_LEVELS) {
124         return;
125     }
126 
127     this->health = 100;
128 
129     this->capacity_kW += 100;
130     this->upgrade_level++;
131 
132     this->max_daily_production_MWh = (double)(24 * this->capacity_kW) / 1000;
133 
134     this->production_MWh =
135         this->monthly_capacity_factor * this->max_daily_production_MWh;
136 
137     this->just_upgraded = true;
138 
139     this->assets_manager_ptr->getSound("upgrade")->play();
140 
141     this->__sendCreditsSpentMessage(WIND_TURBINE_BUILD_COST);
142     this->__sendTileStateRequest();
143     this->__sendGameStateRequest();
144 
145     return;
146 }   /* __upgradePowerCapacity() */
```

4.15.3.8 advanceTurn()

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

Method to handle turn advance.

Reimplemented from TileImprovement.

```
586 {
587     //  1. update
588     this->update();
589 
590     //...
591 
592     std::cout « "Turn advance message received by " « this « std::endl;
593     this->__sendGameStateRequest();
594     return;
595 }   /* advanceTurn() */
```

4.15.3.9 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.

```
679 {
680     //  1. if just built, call base method and return
681     if (this->just_built) {
682         TileImprovement :: draw();
683 
684         return;
685     }
686 
687 
688     //  2. handle upgrade effects
689     if (this->just_upgraded) {
690         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
691             this->tile_improvement_sprite_animated[i].setColor(
692                 sf::Color(
693                     255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
694                     255,
695                     255 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
696                     255
697                 )
698             );
699 
700             this->tile_improvement_sprite_animated[i].setScale(
701                 sf::Vector2f(
702                     1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2),
703                     1 + 0.2 * pow(cos((M_PI * this->upgrade_frame) / FRAMES_PER_SECOND), 2)
704                 )
705             );
706         }
707 
708         this->upgrade_frame++;
709     }
710 
711     if (this->upgrade_frame >= 2 * FRAMES_PER_SECOND) {
712         for (size_t i = 0; i < this->tile_improvement_sprite_animated.size(); i++) {
713             this->tile_improvement_sprite_animated[i].setColor(
714                 sf::Color(255,255,255,255)
715             );
716 
717             this->tile_improvement_sprite_animated[i].setScale(sf::Vector2f(1,1));
718         }
719 
720         this->just_upgraded = false;
721         this->upgrade_frame = 0;
722     }
723 
724 
```

```
725     //  3. draw first element of animated sprite
726     this->render_window_ptr->draw(this->tile_improvement_sprite_animated[0]);
727
728
729     //  4. draw second element of animated sprite
730     if (this->is_running) {
731         //...
732     }
733
734     else {
735         //...
736     }
737
738     this->render_window_ptr->draw(this->tile_improvement_sprite_animated[1]);
739
740
741     //  5. draw storage upgrades
742     for (size_t i = 0; i < this->storage_upgrade_sprite_vec.size(); i++) {
743         this->render_window_ptr->draw(this->storage_upgrade_sprite_vec[i]);
744     }
745
746
747     //  6. draw production menu
748     if (this->production_menu_open) {
749         this->render_window_ptr->draw(this->production_menu_backing);
750         this->render_window_ptr->draw(this->production_menu_backing_text);
751
752         //...
753     }
754
755
756     //  7. draw upgrade menu
757     if (this->upgrade_menu_open) {
758         this->render_window_ptr->draw(this->upgrade_menu_backing);
759         this->render_window_ptr->draw(this->upgrade_menu_backing_text);
760
761         this->__drawUpgradeOptions();
762     }
763
764     this->frame++;
765     return;
766 }   /* draw() */
```

4.15.3.10 getTileOptionsSubstring()

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

Helper method to assemble and return tile options substring.

Returns

Tile options substring.

Reimplemented from TileImprovement.

```
541 {
542     //                  32 char x 17 line console "--------------------------------\n";
543     std::string options_substring                = "CAPACITY:      ";
544     options_substring                           += std::to_string(this->capacity_kW);
545     options_substring                           += " kW (level ";
546     options_substring                           += std::to_string(this->upgrade_level);
547     options_substring                           += ")\n";
548
549     options_substring                           += "PRODUCTION:    ";
550     options_substring                           += std::to_string(this->production_MWh);
551     options_substring                           += " MWh\n";
552
553     options_substring                           += "DISPATCHABLE:  ";
554     options_substring                           += std::to_string(this->dispatchable_MWh);
555     options_substring                           += " MWh\n";
556
557     options_substring                           += "HEALTH:        ";
558     options_substring                           += std::to_string(this->health);
559     options_substring                           += "/100\n";
```

```
560
561     options_substring                           += "                                \n";
562     options_substring                           += " **** WIND TURBINE OPTIONS **** \n";
563     options_substring                           += "                                \n";
564     options_substring                           += "     [E]:  OPEN PRODUCTION MENU \n";
565     options_substring                           += "     [U]:  OPEN UPGRADE MENU    \n";
566     options_substring                           += "HOLD [P]:  SCRAP (";
567     options_substring                           += std::to_string(SCRAP_COST);
568     options_substring                           += " K)";
569
570     return options_substring;
571 }   /* getTileOptionsSubstring() */
```

4.15.3.11 processEvent()

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

Method to process WindTurbine. To be called once per event.

Reimplemented from TileImprovement.

```
630 {
631     TileImprovement :: processEvent();
632
633     if (this->event_ptr->type == sf::Event::KeyPressed) {
634         this->__handleKeyPressEvents();
635     }
636
637     if (this->event_ptr->type == sf::Event::MouseButtonPressed) {
638         this->__handleMouseButtonEvents();
639     }
640
641     return;
642 }   /* processEvent() */
```

4.15.3.12 processMessage()

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

Method to process WindTurbine. To be called once per message.

Reimplemented from TileImprovement.

```
657 {
658     TileImprovement :: processMessage();
659
660     //...
661
662     return;
663 }   /* processMessage() */
```

4.15.3.13 update()

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

Method to trigger production and dispatchable updates.

Reimplemented from TileImprovement.

```
610 {
611     this->__updateProduction();
612     this->__computeDispatchable();
613
614     return;
615 }   /* update() */
```

4.15.4 Member Data Documentation

4.15.4.1 capacity_kW

```
int WindTurbine::capacity_kW
```

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

4.15.4.2 dispatchable_MWh

```
int WindTurbine::dispatchable_MWh
```

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

4.15.4.3 max_daily_production_MWh

```
double WindTurbine::max_daily_production_MWh
```

The maximum daily production [MWh] of the solar PV array.

4.15.4.4 monthly_capacity_factor

```
double WindTurbine::monthly_capacity_factor
```

The current monthly capacity factor.

4.15.4.5 production_MWh

```
int WindTurbine::production_MWh
```

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

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

- header/WindTurbine.h
- source/WindTurbine.cpp

Chapter 5

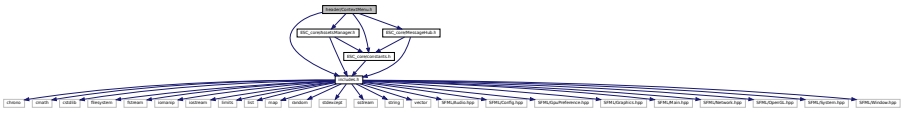
File Documentation

5.1 header/ContextMenu.h File Reference

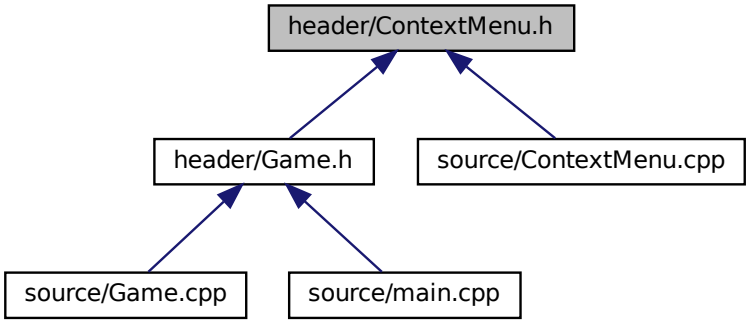
Header file for the ContextMenu class.

```
#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	Game 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 };
```

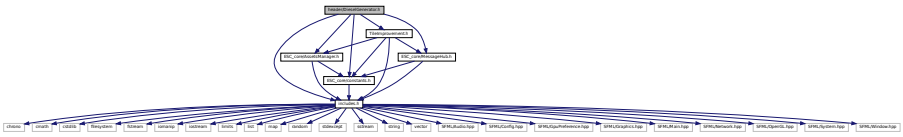
5.2 header/DieselGenerator.h File Reference

Header file for the DieselGenerator class.

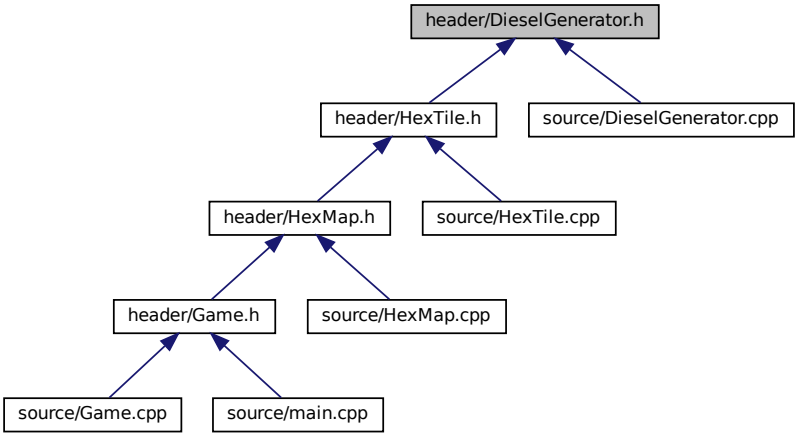
```
#include "ESC_core/constants.h"
#include "ESC_core/includes.h"
#include "ESC_core/AssetsManager.h"
```

```
#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

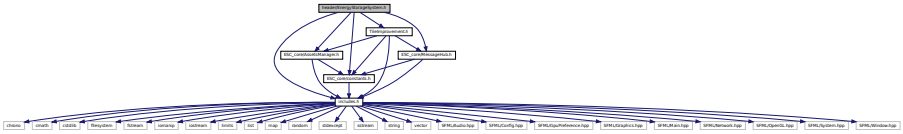
Header file for the DieselGenerator class.

5.3 header/EnergyStorageSystem.h File Reference

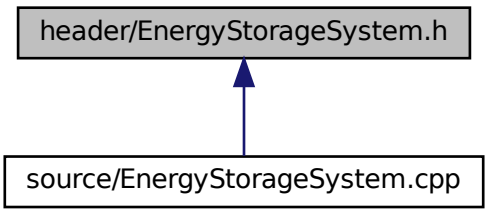
Header file for the EnergyStorageSystem class.

```
#include "ESC_core/constants.h"
#include "ESC_core/includes.h"
#include "ESC_core/AssetsManager.h"
#include "ESC_core/MessageHub.h"
```

```
#include "TileImprovement.h"
```
Include dependency graph for EnergyStorageSystem.h:



This graph shows which files directly or indirectly include this file:



Classes

- class EnergyStorageSystem

  A settlement class (child class of TileImprovement).

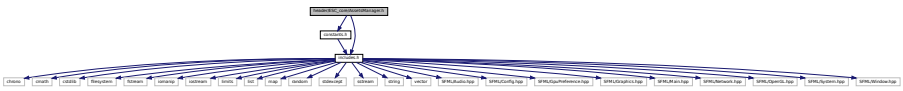
5.3.1 Detailed Description

Header file for the EnergyStorageSystem class.

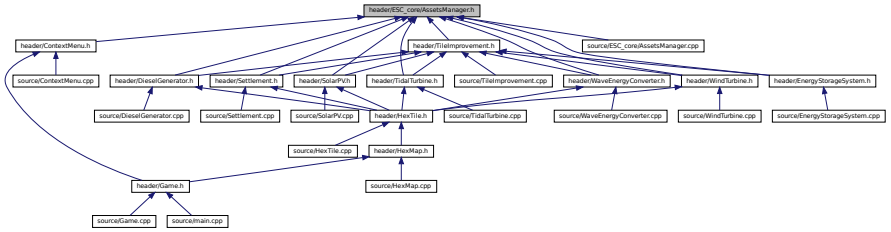
5.4 header/ESC_core/AssetsManager.h File Reference

Header file for the AssetsManager class.

```
#include "constants.h"
#include "includes.h"
```
Include dependency graph for AssetsManager.h:



This graph shows which files directly or indirectly include this file:



Classes

- class AssetsManager

  A class which manages visual and sound assets.

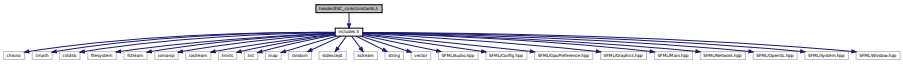
5.4.1 Detailed Description

Header file for the AssetsManager class.

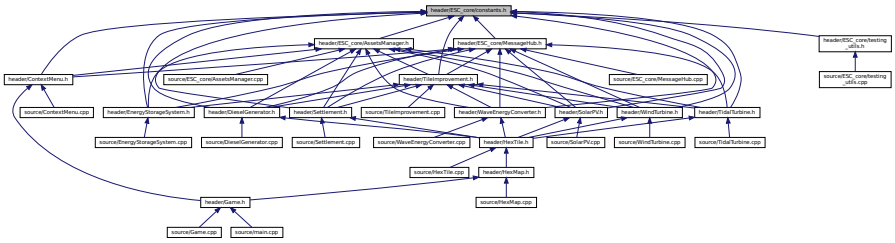
5.5 header/ESC_core/constants.h File Reference

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 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 ugrading) 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 = 999999
- const double CREDITS_PER_MWH_SERVED = 1.25

  The number of credits earned.
- const int EMISSIONS_LIFETIME_LIMIT_TONNES = 1500

  The CO2-equivalent mass of emissions that would result from burning 1,000,000 L of diesel fuel.
- 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 = 1.005

  The monthly population growth rate.
- const double CO2E_KG_PER_LITRE_DIESEL = 3.1596

  The CO2-equivalent mass of emissions that result from burning one litre of diesel fuel.
- 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 = 0.2175

  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, and are not very sensitive to season.

- 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 CO2E_KG_PER_LITRE_DIESEL

```
const double CO2E_KG_PER_LITRE_DIESEL = 3.1596
```

The CO2-equivalent mass of emissions that result from burning one litre of diesel fuel.

5.5.3.6 CREDITS_PER_MWH_SERVED

```
const double CREDITS_PER_MWH_SERVED = 1.25
```

The number of credits earned.

5.5.3.7 DAILY_TIDAL_CAPACITY_FACTOR

```
const double DAILY_TIDAL_CAPACITY_FACTOR = 0.2175
```

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, and are not very sensitive to season.

5.5.3.8 DIESEL_GENERATOR_BUILD_COST

```
const int DIESEL_GENERATOR_BUILD_COST = 100
```

The cost of building (or ugrading) a diesel generator in 100 kW increments.

5.5.3.9 EMISSIONS_LIFETIME_LIMIT_TONNES

```
const int EMISSIONS_LIFETIME_LIMIT_TONNES = 1500
```

The CO2-equivalent mass of emissions that would result from burning 1,000,000 L of diesel fuel.

5.5.3.10 ENERGY_STORAGE_SYSTEM_BUILD_COST

```
const int ENERGY_STORAGE_SYSTEM_BUILD_COST = 160
```

The cost of adding energy storage in 200 kWh increments.

5.5.3.11 FLOAT_TOLERANCE

```
const double FLOAT_TOLERANCE = 1e-6
```

Tolerance for floating point equality tests.

5.5.3.12 FRAMES_PER_SECOND

```
const int FRAMES_PER_SECOND = 60
```

Target frames per second.

5.5.3.13 GAME_CHANNEL

```
const std::string GAME_CHANNEL = "GAME CHANNEL"
```

A message channel for game messages.

5.5.3.14 GAME_HEIGHT

```
const int GAME_HEIGHT = 800
```

Height of the game space.

5.5.3.15 GAME_STATE_CHANNEL

```
const std::string GAME_STATE_CHANNEL = "GAME STATE CHANNEL"
```

A message channel for game state messages.

5.5.3.16 GAME_WIDTH

```
const int GAME_WIDTH = 1200
```

Width of the game space.

5.5.3.17 HEX_MAP_CHANNEL

```
const std::string HEX_MAP_CHANNEL = "HEX MAP CHANNEL"
```

A message channel for hex map messages.

5.5.3.18 MAX_STORAGE_LEVELS

```
const int MAX_STORAGE_LEVELS = 5
```

The maximum storage level of any tile improvement.

5.5.3.19 MAX_UPGRADE_LEVELS

```
const int MAX_UPGRADE_LEVELS = 5
```

The maximum upgrade level of any tile improvement.

5.5.3.20 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.

5.5.3.21 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.

5.5.3.22 MEAN_DAILY_SOLAR_CAPACITY_FACTORS

```
const std::vector<double> MEAN_DAILY_SOLAR_CAPACITY_FACTORS
```

Initial value:

```
= {
    0.022, 0.046, 0.088,
    0.138, 0.171, 0.175,
    0.164, 0.139, 0.104,
    0.061, 0.030, 0.016
}
```

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.

5.5.3.23 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.

5.5.3.24 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.

5.5.3.25 NO_TILE_SELECTED_CHANNEL

```
const std::string NO_TILE_SELECTED_CHANNEL = "NO TILE SELECTED CHANNEL"
```

A message channel for no tile selected messages.

5.5.3.26 POPULATION_MONTHLY_GROWTH_RATE

```
const double POPULATION_MONTHLY_GROWTH_RATE = 1.005
```

The monthly population growth rate.

5.5.3.27 RESOURCE_ASSESSMENT_COST

```
const int RESOURCE_ASSESSMENT_COST = 20
```

The cost of doing a resource assessment.

5.5.3.28 SCRAP_COST

```
const int SCRAP_COST = 50
```

The cost of scrapping a tile improvement (other than settlement).

5.5.3.29 SECONDS_PER_FRAME

```
const double SECONDS_PER_FRAME = 1.0 / 60
```

Target seconds per frame (just reciprocal of target frames per second).

5.5.3.30 SECONDS_PER_MONTH

```
const unsigned long long int SECONDS_PER_MONTH = 2628164
```

5.5.3.31 SECONDS_PER_YEAR

```
const unsigned long long int SECONDS_PER_YEAR = 31537970
```

5.5.3.32 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.

5.5.3.33 SOLAR_PV_WATER_BUILD_MULTIPLIER

```
const double SOLAR_PV_WATER_BUILD_MULTIPLIER = 1.5
```

The additional cost of building on water.

5.5.3.34 STARTING_CREDITS

```
const int STARTING_CREDITS = 999999
```

5.5.3.35 STARTING_POPULATION

```
const int STARTING_POPULATION = 100
```

The starting population of a settlement.

5.5.3.36 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)(max load [kW]) / 1000.

5.5.3.37 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.

5.5.3.38 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.

5.5.3.39 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.

5.5.3.40 TIDAL_TURBINE_BUILD_COST

```
const int TIDAL_TURBINE_BUILD_COST = 600
```

The cost of building (or upgrading) a tidal turbine in 100 kW increments.

5.5.3.41 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).

5.5.3.42 TILE_SELECTED_CHANNEL

```
const std::string TILE_SELECTED_CHANNEL = "TILE SELECTED CHANNEL"
```

A message channel for tile selection messages.

5.5.3.43 TILE_STATE_CHANNEL

```
const std::string TILE_STATE_CHANNEL = "TILE STATE CHANNEL"
```

A message channel for tile state messages.

5.5.3.44 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).

5.5.3.45 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.

5.5.3.46 WIND_TURBINE_BUILD_COST

```
const int WIND_TURBINE_BUILD_COST = 400
```

The cost of building (or upgrading) a wind turbine in 100 kW increments.

5.5.3.47 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]

5.7 header/ESC_core/includes.h File Reference

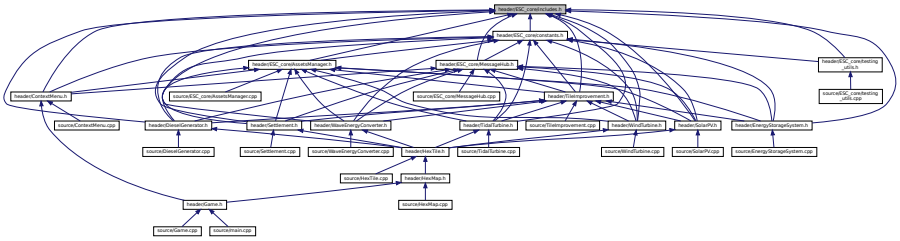
Header file for various includes.

```
#include <chrono>
#include <cmath>
#include <cstdlib>
#include <filesystem>
#include <fstream>
#include <iomanip>
#include <iostream>
#include <limits>
#include <list>
#include <map>
#include <random>
#include <stdexcept>
#include <sstream>
#include <string>
#include <vector>
#include <SFML/Audio.hpp>
#include <SFML/Config.hpp>
#include <SFML/GpuPreference.hpp>
#include <SFML/Graphics.hpp>
#include <SFML/Main.hpp>
```

```
#include <SFML/Network.hpp>
#include <SFML/OpenGL.hpp>
#include <SFML/System.hpp>
#include <SFML/Window.hpp>
```

Include dependency graph for includes.h:

This graph shows which files directly or indirectly include this file:



5.7.1 Detailed Description

Header file for various includes.

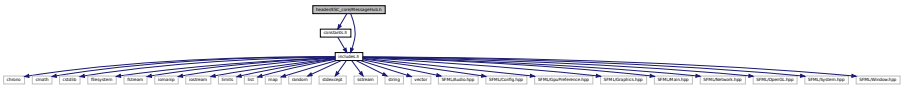
Ref: Gomila [2023]

5.8 header/ESC_core/MessageHub.h File Reference

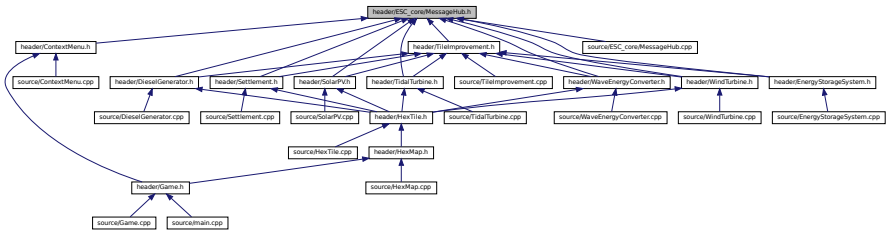
Header file for the MessageHub class.

```
#include "constants.h"
#include "includes.h"
```

Include dependency graph for MessageHub.h:



This graph shows which files directly or indirectly include this file:



Classes

- struct Message

  A structure which defines a standard message format.
- class MessageHub

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

5.8.1 Detailed Description

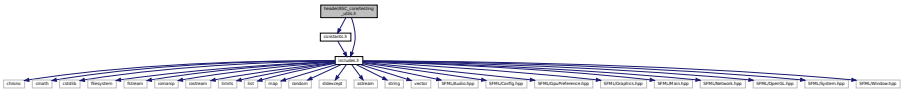
Header file for the MessageHub class.

5.9 header/ESC_core/testing_utils.h File Reference

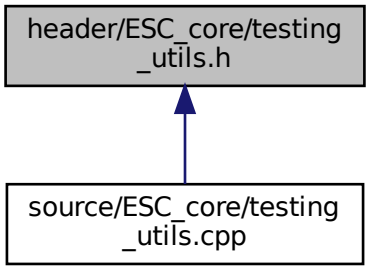
Header file for various testing utilities.

```
#include "constants.h"
#include "includes.h"
```

Include dependency graph for testing_utils.h:



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 >= y.
- void testLessThan (double, double, std::string, int)

  Tests if x < y.
- void testLessThanOrEqualTo (double, double, std::string, int)

  Tests if x <= 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

file	The file in which the test is applied (you should be able to just pass in "__FILE__").
line	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

input_str	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

input_str	The text of the string to be sent to std::cout.

```
94 {
95     std::cout « "\x1B[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

input_str	The text of the string to be sent to std::cout.

```
134 {
135     std::cout « "\x1B[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

x	The first of two numbers to test.
y	The second of two numbers to test.
file	The file in which the test is applied (you should be able to just pass in "__FILE__").
line	The line of the file in which the test is applied (you should be able to just pass in "__LINE__").

```
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

x	The first of two numbers to test.
y	The second of two numbers to test.
file	The file in which the test is applied (you should be able to just pass in "__FILE__").
line	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 >= y.

Parameters

x	The first of two numbers to test.
y	The second of two numbers to test.
file	The file in which the test is applied (you should be able to just pass in "__FILE__").
line	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

x	The first of two numbers to test.
y	The second of two numbers to test.
file	The file in which the test is applied (you should be able to just pass in "__FILE__").
line	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 <= y.

Parameters

x	The first of two numbers to test.
y	The second of two numbers to test.
file	The file in which the test is applied (you should be able to just pass in "__FILE__").
line	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

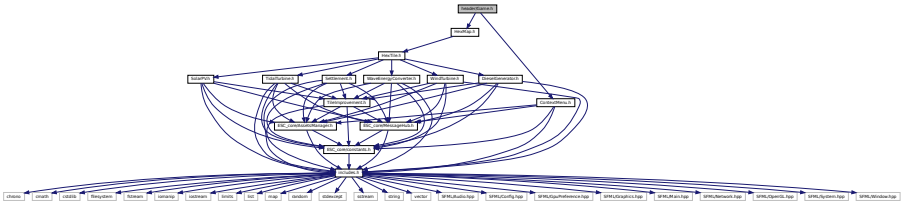
statement	The statement whose truth is to be tested ("1 == 0", for example).
file	The file in which the test is applied (you should be able to just pass in "__FILE__").
line	The line of the file in which the test is applied (you should be able to just pass in "__LINE__").

```
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() */
```

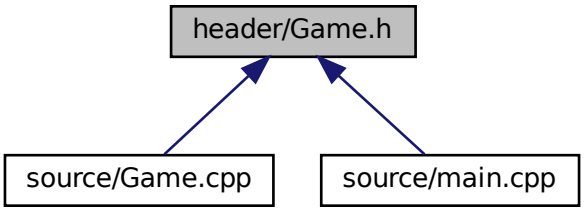
5.10 header/Game.h File Reference

```
#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

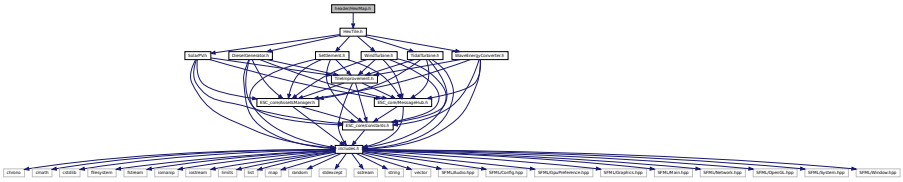
BUILD_SETTLEMENT	The settlement building phase.
SYSTEM_MANAGEMENT	The system management phase (main phase of play).
LOSS_EMISSIONS	A loss due to excessive emissions.
LOSS_DEMAND	A loss due to failing to meet the demand.
LOSS_CREDITS	A loss due to running out of credits.
VICTORY	A victory (12 consecutive 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 */
```

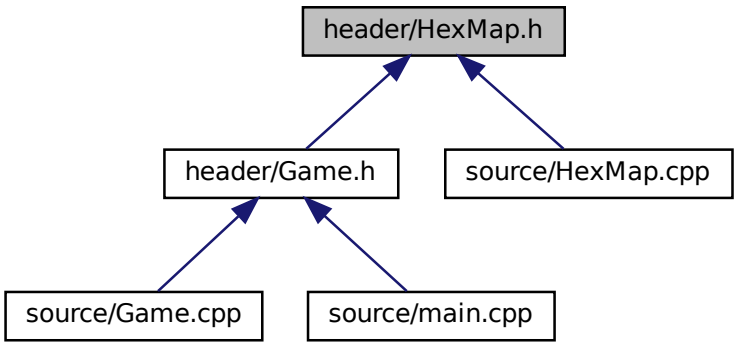
5.11 header/HexMap.h File Reference

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

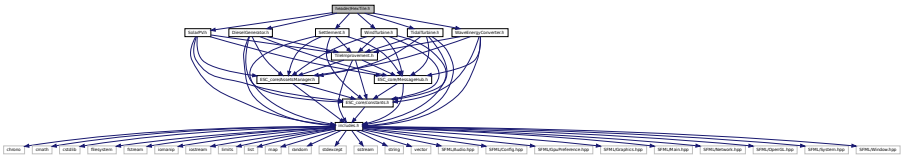
Header file for the HexMap class.

5.12 header/HexTile.h File Reference

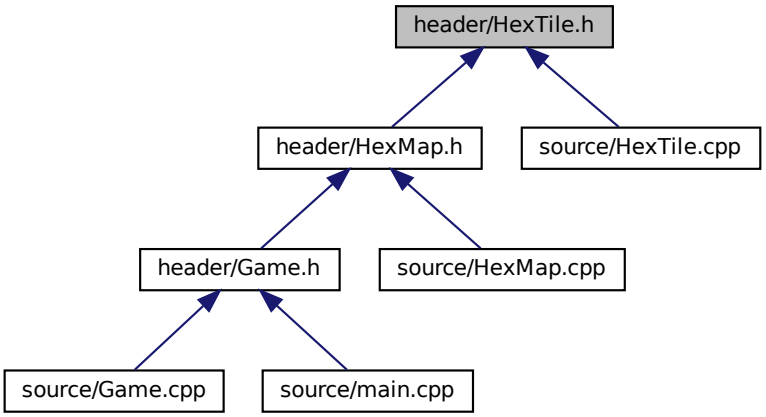
Header file for the Game class.

```
#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.

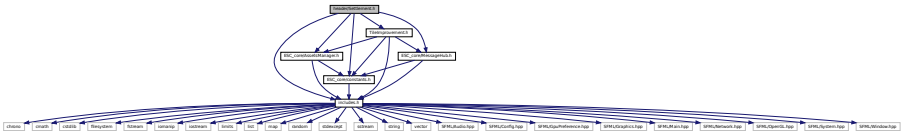
```
71              {
72     NONE_TYPE,
73     FOREST,
74     LAKE,
75     MOUNTAINS,
76     OCEAN,
77     PLAINS,
78     N_TILE_TYPES
79 }; /* TileType */
```

5.13 header/Settlement.h File Reference

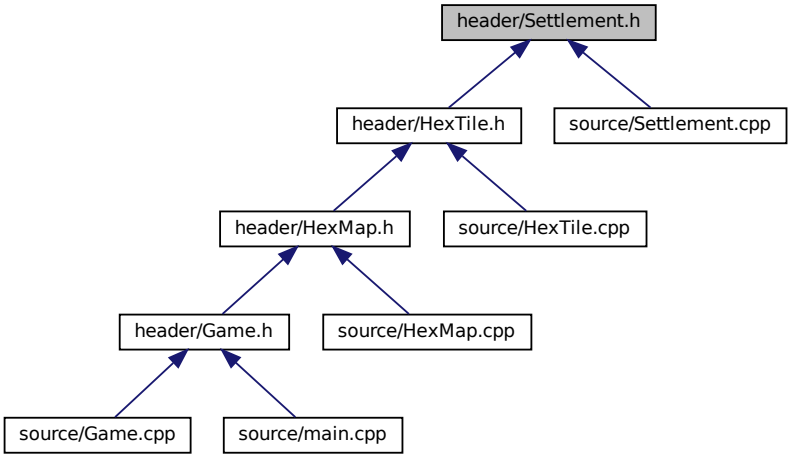
Header file for the Settlement class.

```
#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

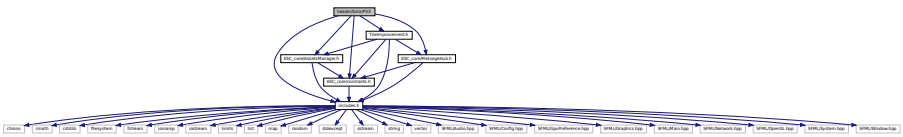
Header file for the Settlement class.

5.14 header/SolarPV.h File Reference

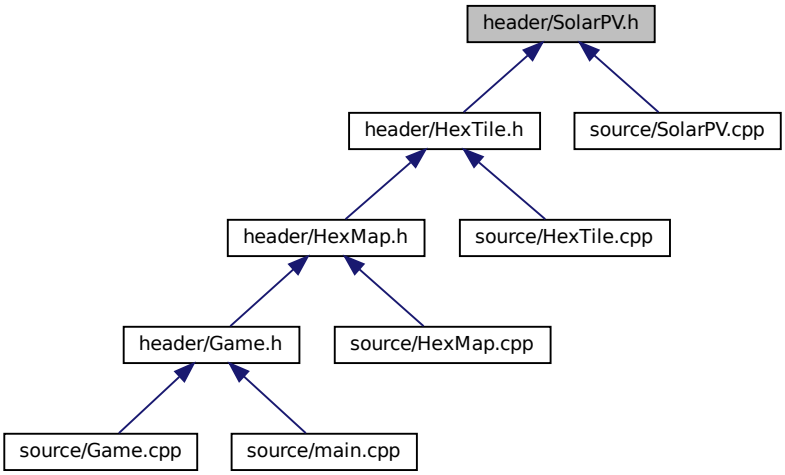
Header file for the SolarPV class.

```
#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

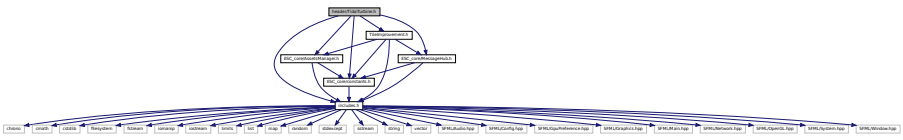
Header file for the SolarPV class.

5.15 header/TidalTurbine.h File Reference

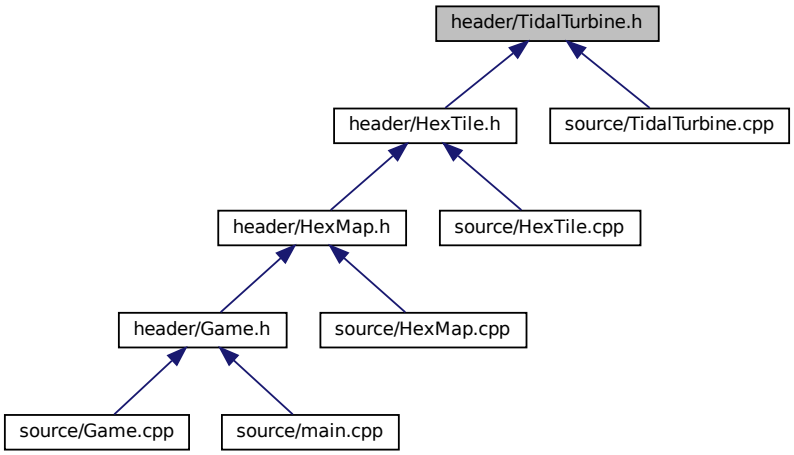
Header file for the TidalTurbine class.

```
#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

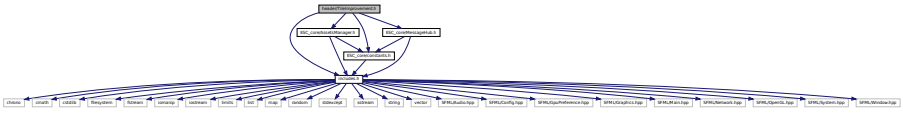
Header file for the TidalTurbine class.

5.16 header/TileImprovement.h File Reference

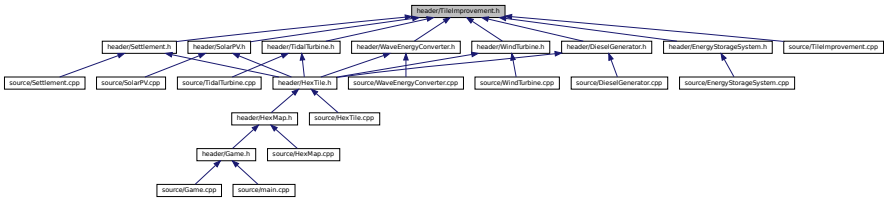
Header file for the TileImprovement class.

```
#include "ESC_core/constants.h"
#include "ESC_core/includes.h"
#include "ESC_core/AssetsManager.h"
#include "ESC_core/MessageHub.h"
```

Include dependency graph for TileImprovement.h:



This graph shows which files directly or indirectly include this file:



Classes

- class TileImprovement

  A base class for the tile improvement hierarchy.

Enumerations

- enum TileImprovementType {
  SETTLEMENT , DIESEL_GENERATOR , SOLAR_PV , WIND_TURBINE ,
  TIDAL_TURBINE , WAVE_ENERGY_CONVERTER , ENERGY_STORAGE_SYSTEM , N_TILE_IMPROVEMENT_TYPES
  }

  An enumeration of the different tile improvement types.

5.16.1 Detailed Description

Header file for the TileImprovement class.

5.16.2 Enumeration Type Documentation

5.16.2.1 TileImprovementType

```
enum TileImprovementType
```

An enumeration of the different tile improvement types.

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 */
```

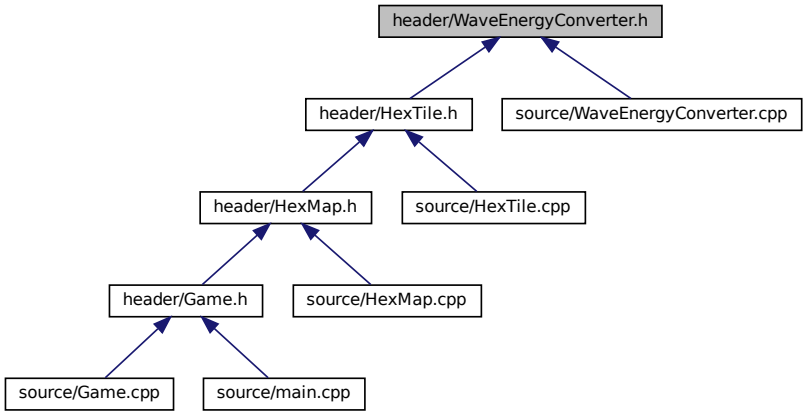
5.17 header/WaveEnergyConverter.h File Reference

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

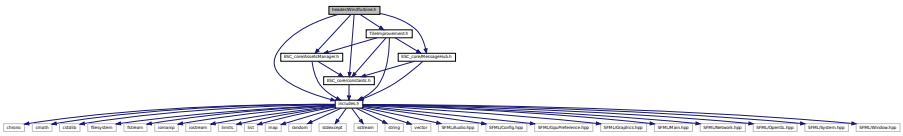
Header file for the WaveEnergyConverter class.

5.18 header/WindTurbine.h File Reference

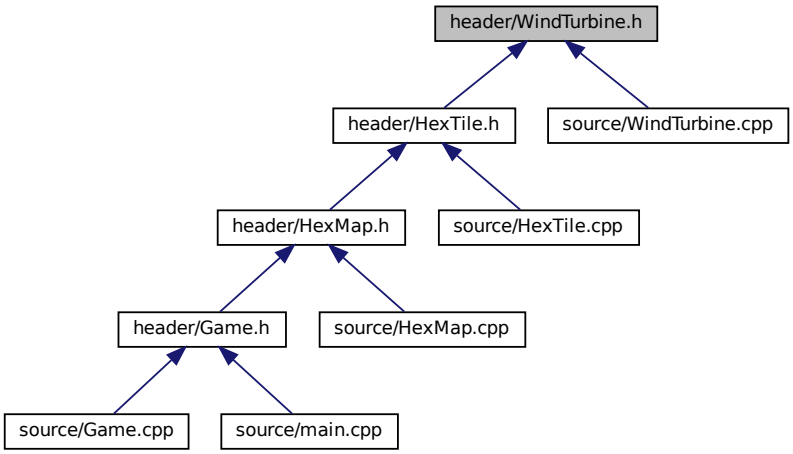
Header file for the WindTurbine class.

```
#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).

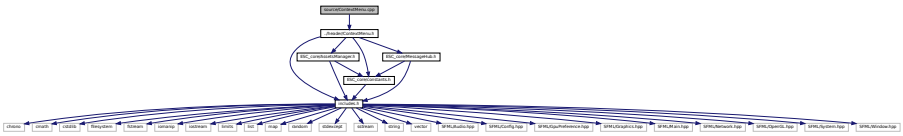
5.18.1 Detailed Description

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

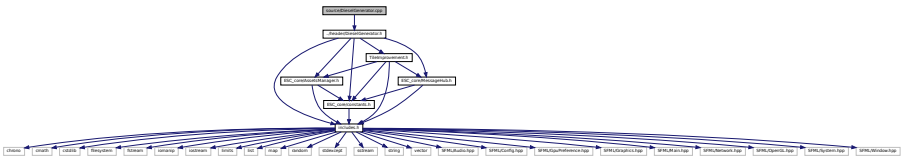
Implementation file for the ContextMenu class.

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

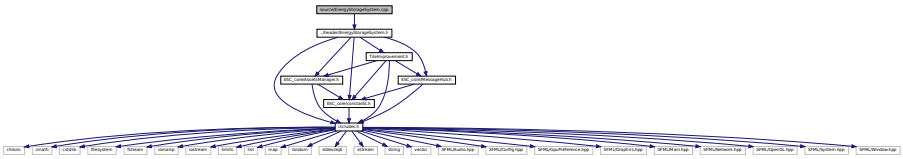
Implementation file for the DieselGenerator class.

A base class for the tile improvement hierarchy.

5.21 source/EnergyStorageSystem.cpp File Reference

Implementation file for the EnergyStorageSystem class.

```
#include "../header/EnergyStorageSystem.h"
```
Include dependency graph for EnergyStorageSystem.cpp:



5.21.1 Detailed Description

Implementation file for the EnergyStorageSystem class.

A base class for the tile improvement hierarchy.

5.22 source/ESC_core/AssetsManager.cpp File Reference

Implementation file for the AssetsManager class.

```
#include "../../header/ESC_core/AssetsManager.h"
```
Include dependency graph for AssetsManager.cpp:

5.22.1 Detailed Description

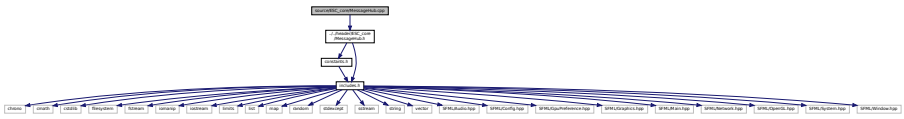
Implementation file for the AssetsManager class.

A class which manages visual and sound assets.

5.23 source/ESC_core/MessageHub.cpp File Reference

Implementation file for the MessageHub class.

```
#include "../../header/ESC_core/MessageHub.h"
```
Include dependency graph for MessageHub.cpp:



5.23.1 Detailed Description

Implementation file for the MessageHub class.

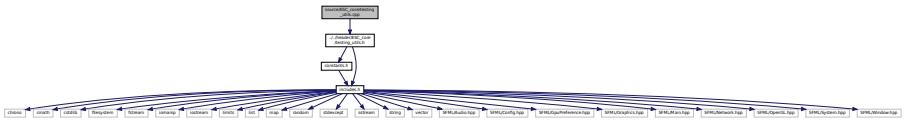
A class which acts as a central hub for inter-object message traffic.

5.24 source/ESC_core/testing_utils.cpp File Reference

Implementation file for various testing utilities.

```
#include "../../header/ESC_core/testing_utils.h"
```

Include dependency graph for testing_utils.cpp:



Functions

- void printGreen (std::string input_str)

  A function that sends green text to std::cout.
- void printGold (std::string input_str)

  A function that sends gold text to std::cout.
- void printRed (std::string input_str)

  A function that sends red text to std::cout.
- 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).
- void testGreaterThan (double x, double y, std::string file, int line)

  Tests if x > y.
- void testGreaterThanOrEqualTo (double x, double y, std::string file, int line)

  Tests if x >= y.
- void testLessThan (double x, double y, std::string file, int line)

  Tests if x < y.
- void testLessThanOrEqualTo (double x, double y, std::string file, int line)

  Tests if x <= y.
- void testTruth (bool statement, std::string file, int line)

  Tests if the given statement is true.
- 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.

5.24.1 Detailed Description

Implementation file for various testing utilities.

This is a library of utility functions used throughout the various test suites.

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

file	The file in which the test is applied (you should be able to just pass in "__FILE__").
line	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

input_str	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

input_str	The text of the string to be sent to std::cout.

```
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

input_str	The text of the string to be sent to std::cout.

```
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

x	The first of two numbers to test.
y	The second of two numbers to test.
file	The file in which the test is applied (you should be able to just pass in "__FILE__").
line	The line of the file in which the test is applied (you should be able to just pass in "__LINE__").

```
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

x	The first of two numbers to test.
y	The second of two numbers to test.
file	The file in which the test is applied (you should be able to just pass in "__FILE__").
line	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 >= y.

Parameters

x	The first of two numbers to test.
y	The second of two numbers to test.
file	The file in which the test is applied (you should be able to just pass in "__FILE__").
line	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

x	The first of two numbers to test.
y	The second of two numbers to test.
file	The file in which the test is applied (you should be able to just pass in "__FILE__").
line	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 <= y.

Parameters

x	The first of two numbers to test.
y	The second of two numbers to test.
file	The file in which the test is applied (you should be able to just pass in "__FILE__").
line	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

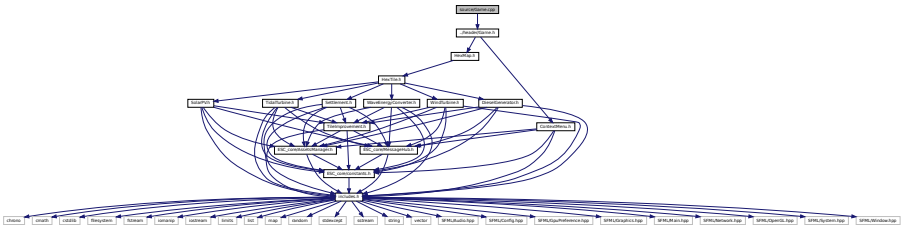
statement	The statement whose truth is to be tested ("1 == 0", for example).
file	The file in which the test is applied (you should be able to just pass in "__FILE__").
line	The line of the file in which the test is applied (you should be able to just pass in "__LINE__").

```
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() */
```

5.25 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

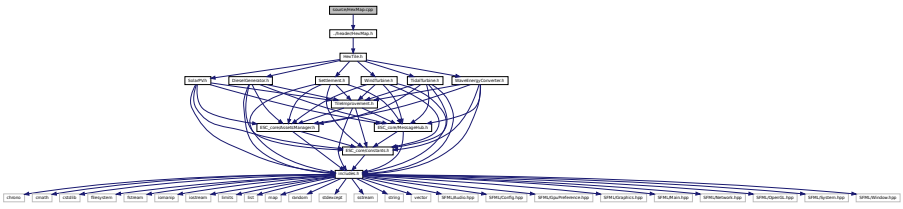
Implementation file for the Game class.

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:



5.26.1 Detailed Description

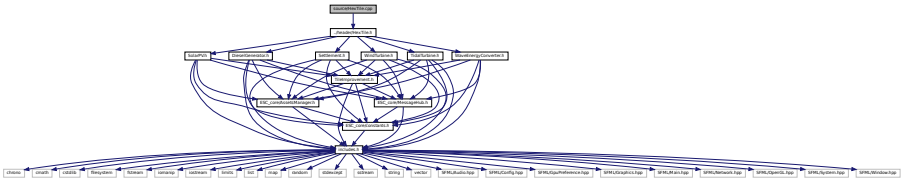
Implementation file for the HexMap class.

A class which defines a hex map of hex tiles.

5.27 source/HexTile.cpp File Reference

Implementation file for the HexTile class.

```
#include "../header/HexTile.h"
```
Include dependency graph for HexTile.cpp:



5.27.1 Detailed Description

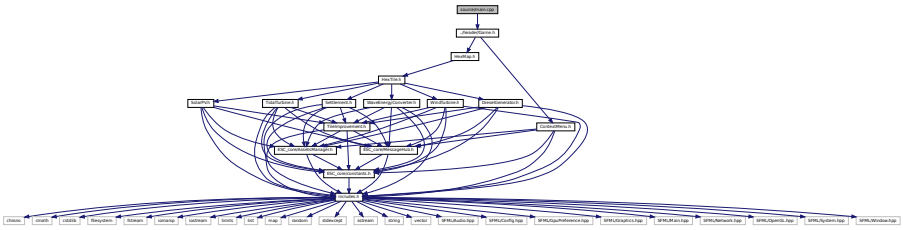
Implementation file for the HexTile class.

A class which defines a tile of a hex map.

5.28 source/main.cpp File Reference

Implementation file for main() for Road To Zero.

```
#include "../header/Game.h"
```
Include dependency graph for main.cpp:



Functions

- void loadAssets (AssetsManager *assets_manager_ptr)

  Helper function to load game assets.
- sf::RenderWindow * constructRenderWindow (void)

  Helper function to construct render window.
- int main (int argc, char **argv)

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.

```
314 {
315     sf::RenderWindow* render_window_ptr = new sf::RenderWindow(
316         sf::VideoMode(GAME_WIDTH, GAME_HEIGHT),
317         "Road To Zero"
318     );
319
320     return render_window_ptr;
321 }   /* constructRenderWindow() */
```

5.28.2.2 loadAssets()

```
void loadAssets (
            AssetsManager * assets_manager_ptr )
```

Helper function to load game assets.

Parameters

assets_manager_ptr	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
72     //  2. load tile sheets
73     assets_manager_ptr->loadTexture(
74         "assets/tile_sheets/pine_tree_64x64_1_CC-BY.png",
75         "pine_tree_64x64_1"
76     );
77
78     assets_manager_ptr->loadTexture(
79         "assets/tile_sheets/wheat_64x64_1_CC-BY.png",
80         "wheat_64x64_1"
81     );
82
83     assets_manager_ptr->loadTexture(
84         "assets/tile_sheets/mountain_64x64_1_CC-BY.png",
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
164     //  3. load sounds
165     assets_manager_ptr->loadSound(
166         "assets/audio/samples/mixkit-magical-coin-win-1936_MixkitFree.ogg",
167         "coin ring"
168     );
169
170     assets_manager_ptr->loadSound(
171         "assets/audio/samples/mixkit-positive-notification-951_MixkitFree.ogg",
172         "positive notification"
173     );
174
175     assets_manager_ptr->loadSound(
176         "assets/audio/samples/mixkit-sci-fi-click-900_MixkitFree.ogg",
177         "sci-fi click"
178     );
179
180     assets_manager_ptr->loadSound(
181         "assets/audio/samples/mixkit-apartment-buzzer-bell-press-932_MixkitFree.ogg",
```

```
182         "insufficient credits"
183     );
184
185     assets_manager_ptr->loadSound(
186         "assets/audio/samples/mixkit-data-scanner-2487_MixkitFree.ogg",
187         "resource assessment"
188     );
189
190     assets_manager_ptr->loadSound(
191         "assets/audio/samples/mixkit-interface-click-1126_MixkitFree.ogg",
192         "console string print"
193     );
194
195     assets_manager_ptr->loadSound(
196         "assets/audio/samples/mixkit-video-game-retro-click-237_MixkitFree.ogg",
197         "resource overlay toggle on"
198     );
199
200     assets_manager_ptr->loadSound(
201         "assets/audio/samples/mixkit-video-game-retro-click-237_REVERSED_MixkitFree.ogg",
202         "resource overlay toggle off"
203     );
204
205     assets_manager_ptr->loadSound(
206         "assets/audio/samples/mixkit-explosion-with-rocks-debris-1703_MixkitFree.ogg",
207         "clear mountains tile"
208     );
209
210     assets_manager_ptr->loadSound(
211         "assets/audio/samples/mixkit-arcade-game-explosion-2759_MixkitFree.ogg",
212         "clear non-mountains tile"
213     );
214
215     assets_manager_ptr->loadSound(
216         "assets/audio/samples/mixkit-electronic-retro-block-hit-2185_MixkitFree.ogg",
217         "place improvement"
218     );
219
220     assets_manager_ptr->loadSound(
221         "assets/audio/samples/mixkit-video-game-lock-2851_REVERSED_MixkitFree.ogg",
222         "build menu open"
223     );
224
225     assets_manager_ptr->loadSound(
226         "assets/audio/samples/mixkit-video-game-lock-2851_MixkitFree.ogg",
227         "build menu close"
228     );
229
230     assets_manager_ptr->loadSound(
231         "assets/audio/samples/mixkit-jump-into-the-water-1180_MixkitFree.ogg",
232         "splash"
233     );
234
235     assets_manager_ptr->loadSound(
236         "assets/audio/samples/505316__nuncaconoci__diesel_CC0.ogg",
237         "diesel running"
238     );
239
240     assets_manager_ptr->loadSound(
241         "assets/audio/samples/33460__pempi__320d_2_CC-BY.ogg",
242         "diesel start"
243     );
244
245     assets_manager_ptr->loadSound(
246         "assets/audio/samples/132724__andy_gardner__wind-turbine-blades_CC-BY.ogg",
247         "wind turbine running"
248     );
249
250     assets_manager_ptr->loadSound(
251         "assets/audio/samples/58416__darren1979__oceanwaves_CC-SAMPLING.ogg",
252         "ocean waves"
253     );
254
255     assets_manager_ptr->loadSound(
256         "assets/audio/samples/369927__mephisto_egmont__water-flowing-in-tubes_CC-BY.ogg",
257         "water flow"
258     );
259
260     assets_manager_ptr->loadSound(
261
    "assets/audio/samples/647663__jotraing__electric-train-motor-idle-loop-new-generation-rollingstock_CC0.ogg",
262         "energy storage system"
263     );
264
265     assets_manager_ptr->loadSound(
266         "assets/audio/samples/mixkit-epic-futuristic-movie-accent-2913_MixkitFree.ogg",
267         "game title screen"
```

```
268     );
269
270     assets_manager_ptr->loadSound(
271         "assets/audio/samples/mixkit-calm-park-with-people-and-children_MixkitFree.ogg",
272         "people and children"
273     );
274
275     assets_manager_ptr->loadSound(
276         "assets/audio/samples/mixkit-magical-coin-win-1936_MixkitFree.ogg",
277         "upgrade"
278     );
279
280
281     //  4. load tracks
282     assets_manager_ptr->loadTrack(
283         "assets/audio/tracks/TreeStarMoon_Dobranoc_CC0.ogg",
284         "Tree Star Moon - Dobranoc"
285     );
286
287     assets_manager_ptr->loadTrack(
288         "assets/audio/tracks/TreeStarMoon_Lighthouse_CC0.ogg",
289         "Tree Star Moon - Lighthouse"
290     );
291
292     assets_manager_ptr->loadTrack(
293         "assets/audio/tracks/TreeStarMoon_SkyFarm_CC0.ogg",
294         "Tree Star Moon - Sky Farm"
295     );
296
297     return;
298 }   /* loadAssets() */
```

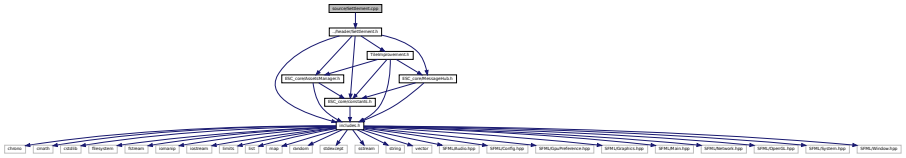
5.28.2.3 main()

```
int main (
              int argc,
              char ** argv )
330 {
331     //  1. load assets
332     AssetsManager assets_manager;
333     loadAssets(&assets_manager);
334
335     //  2. construct render window
336     sf::RenderWindow* render_window_ptr = constructRenderWindow();
337
338     //  3. start game loop
339     bool quit_game = false;
340     assets_manager.playTrack();
341
342     while (not quit_game) {
343         Game game(render_window_ptr, &assets_manager);
344         quit_game = game.run();
345     }
346
347     //  4. clean up
348     render_window_ptr->close();
349     delete render_window_ptr;
350
351     return 0;
352 }   /* 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

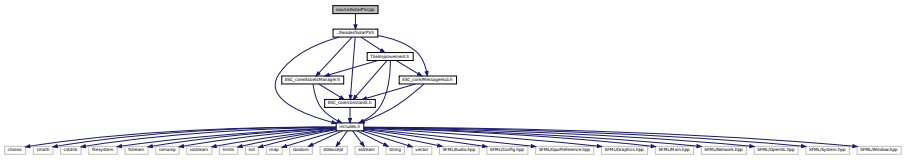
Implementation file for the Settlement class.

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:



5.30.1 Detailed Description

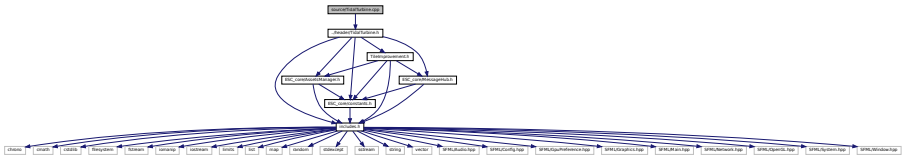
Implementation file for the SolarPV class.

A base class for the tile improvement hierarchy.

5.31 source/TidalTurbine.cpp File Reference

Implementation file for the TidalTurbine class.

`#include "../header/TidalTurbine.h"`
Include dependency graph for TidalTurbine.cpp:



5.31.1 Detailed Description

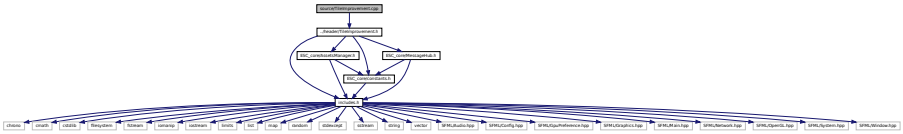
Implementation file for the TidalTurbine class.

A base class for the tile improvement hierarchy.

5.32 source/TileImprovement.cpp File Reference

Implementation file for the TileImprovement class.

```
#include "../header/TileImprovement.h"
```
Include dependency graph for TileImprovement.cpp:



5.32.1 Detailed Description

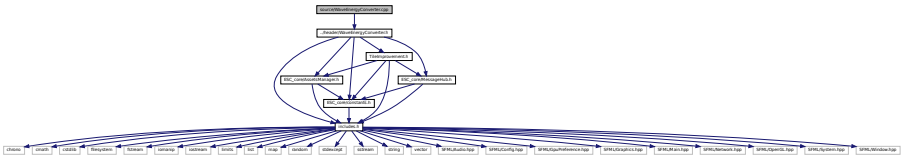
Implementation file for the TileImprovement class.

A base class for the tile improvement hierarchy.

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

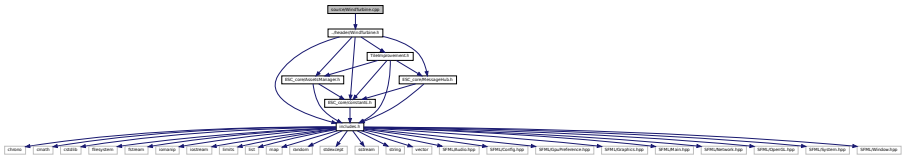
Implementation file for the WaveEnergyConverter class.

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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