**beta II**

**Plan of the week of 21th of December**

**Plan of the rest of the course:**

* Spend the coming holidays and maybe an extra week to finish the grid integration.
* Spend the coming holidays and maybe an extra week to build a new game based on the level presented in the first beta plan.
* Spend the time beyond this point polishing the game (better UI, proper tutorial, playing experience, sounds, etc …).

**Goal of the week(s):**

Have a presentable and playable beta by Friday the 8th January. The beta II should contain the following game mechanism:

1. Tower defence aspect of the game.
2. Grid integration with the possibility of placing two pumps, placing one pump and one wind turbine transformer each anywhere on the map.
3. Placement of wind turbine based on the terrain height and distance to nearest transformer.
4. Placement of links between the different elements manually.
5. Customization of wind turbines for powertrain (from a finite number of choice) and blade size (from a finite number of choices).
6. Introduce the maintenance mechanic with respect to the choice of power train and the normal maintenance cycle for wind turbines.

**Chapters and levels to be created for the beta II:**

The playable game (beta) at the end of the week (on the 8th January) shall contain several chapters and levels. This game is structured slightly differently. There are four chapters that are introduced within this version of the game. The first chapter consists of three levels which are dedicated to the learning of the tower defence concept.:

1. The first chapter “A tower defence game” is limited with respect to the possible mechanics. In this chapter, only the pumps can be added. Several wind turbines (3 basic wind turbines) are already placed on the map. When the player places pumps, he also has to connect it with the wind turbine of his choice. Every other mechanism in the game is frozen and should not affect the gameplay (including the power losses and height which should not be displayed within the information panel). The chapter is composed of the following levels:
2. Level 1: A simple map is to be used with just no turns in the river. Place the wind turbines randomly on the map.
3. Level 2: A slightly more complex map with one turn in the river.
4. Level 3: A “complex-er” map where there is a U in the river where the player has to place his pump otherwise he cannot win this level.
5. The second chapter “Heights and losses”. This chapter is once again limited along the lines of the heights and losses. This time these two mechanics are introduced. The player must once again place the links between the turbines and the pumps but there are no transformers possibilities on the map. The aim of this chapter is to teach the player about heights and power losses without the need for grid integration. The player is able to place pumps which he learnt in the previous chapter.
   1. Level 1: In this level, only the heights are activated. The player should therefore look for the highest spots. The map should be made such that the highest spots are required to win this level. The map should be just a long line (easier to tune). The 100 heights should be on different sides of the map. The player should have enough money for three turbines (basic) and should need to place these three turbines onto three patches of 90 or 100 to win the game.
   2. Level 2: In this level, the power loss is also activated. The wind turbine transformer should be placed far enough from the pump transformer. The player will have to understand the power loss between the pumps and their transformer, and the power loss between the wind turbines and their transformer.
   3. Level 3: This is just a more complicated version of the second level, challenging the player with pump placement based on where the pump transformer is already placed.
6. The third chapter “The life of a transformer” is again limited in game mechanics. This is the chapter introducing the player to the grid integration. In this part, the player has to place all components (pumps, transformers, wind turbines and the links between these elements) but cannot yet customize the wind turbines.
   1. Level 1: In the first level, the player only has to place the transformers, the pumps and the wind turbines are already set. The aim here is to teach the player where the optimum location for the positioning of the transformer. This also teaches the player about the different losses depending on the links that are being used between the different elements within the game.
   2. Level 2: In the second level, the player can place all four types of objects plus the links. The map should contain a remotely located high position to force the player to place his wind turbine at a certain distance
   3. Level 3: A map similar to the previous level with remotely located high tiles and a harder level.
7. The fourth chapter “Custom made maintenance” is the final chapter of this game to be presented at the end of the course. It should introduce the player to the customization of the wind turbines and the maintenance along with the rest of all the other mechanics that were presented before.
   1. Level 1: In the first level, the player can only place one customization turbine. He can also place the transformers and the pump.
   2. Level 2: The player has a free game, relatively simple. The waves should be designed in such a way that they force the player to rush the placement of small turbine with a high maintenance cost.
   3. Level 3: Harder version of the level 2.

**Bugs to fix from previous version:**

* Clicking within the right panel clicks also on the background. It is therefore not always possible to use the customization panel.
* The fact that it is not possible to build wind turbines after playing the first game (new bug discovered on the 19TH December version).
* The sell button does not disappear when clicking on terrain.
* The panel that appears when pressing the pause button does not deactivate the game. It is therefore possible to place turbines in pause behind the grey panel.

**Main tasks in order of importance:**

1. Introduction of pumps and transformers
2. Appropriate power distribution in the pumps, pump transformer and wind turbine transformer and introduction of the power loss between these elements.
3. Addition of links within the game and their rules.
4. Cost introduction for all components of the game (additional to the previously made wind turbines).
5. Visualization
   * Visualisation of the power through the cable
   * Visualisation of the power in the wind turbine
   * Visualisation of the power in the wind turbine transformer
   * Visualisation of the power in the pump transformer
   * Visualisation of the power in the pump (requires maximum pump power)
6. Wind turbine deterioration.
7. Wind turbine repair.
8. Customization of the wind turbines (blade and wind turbine).
9. Terrain placement not randomized

**Details of the tasks**

1. Introduction of pumps and transformers: There should be four main buttons somewhere at the top of the UI: one for the creation of pumps, one for the creation of wind turbine transformers, one for the creation of pump transformers and one for wind turbines. The pumps and transformers should also be provided with a sell button similar to the wind turbine sell function. The details of the sell button are provided later on in this report.
2. Appropriate power distribution in the pumps, pump transformer and wind turbine transformer. The power loss is different between the different connections. This is an important aspect of the game.

The equation for the power loss is equal to:

The main difference between the different connections is the value of K. The value of P is the power at the beginning of the link. For a wind turbine – wind turbine transformer link, that is the value of power at the wind turbine. For a wind turbine transformer – pump transformer, that is the power in the wind turbine transformer and so on. Note that to calculate the power at the end of a link, the power is given as:

* + For the connection between the wind turbines and the wind turbine transformer, the following value of K can be used:
  + For the connection between the wind turbine transformer and the pump transformer, the following value of K can be used:
  + For the connection between the pump transformer and the pumps, the following value of K can be used:

The power is divided between the pumps and the wind turbines. This works in the following ways:

* The power in the wind turbine transformer is added from all the power of the wind turbines including the losses. The power in a wind turbine transformer is then given as:
* The power in the pump transformer is equal to the power in the wind turbine transformer minus the losses due to the distance between the transformers. It is therefore given as:
* The power in the pump is equally divided from the power that is present in the pump transformer minus the losses incurred due to each of the pump’s distance to the transformer. The power per pump is therefore given as:

1. The player also has to place link between the pumps, transformers, and the wind turbines. The player should be able to create links based on an initial elements and a final element. The player can however not choose the type of link that he is installing. For example, the player should be able to create a link between a pump and a wind turbine. This newly created link would however not be efficient and have a large power loss. The aim here is to teach the player about the use of transformers and of grid integration. It should therefore prevent the player to place any wind turbines connection to the pump when the link is too long and therefore use the transformers which induce a lot less power losses.

Some rules have to be introduced on how to split the power between the different links included within the game:

* + When several links are connected to a wind turbine, towards a pump, the power coming from the wind turbine is divided by the number of connections emerging from the wind turbine regardless of any exterior factors.
  + If the power at a pump is larger than the maximum possible power, then the extra power is just wasted. It is not redistributed to any other pumps.

1. Cost introduction for all components of the game (additional to the previously made wind turbines).
   * A transformer (regardless of which) costs 25 TC.
   * A pump cost 25TC.
   * There are no construction costs based on terrain for transformers or pumps.
   * The costs of selling a transformer costs 20 TC.
   * The costs of selling a pump costs 10 TC.
2. Visualization of the different elements within the game:
   * For all visualization, the visualization should only be readable normally at the normal zoom of the camera. That is, when zooming out, the text/line/else should not scale up but should remain the same as the original. This would avoid a cluttered space when at maximum de-zoom possibility.
   * Visualisation of the power through the cables – cable types. The different cables should have different visualization to display the difference between long distance cables which are used between transformers and short distance cables which are used between transformers and pumps or wind turbines. This visualization should be done through the use of different colours. These colours should be dependent on the value of K for each of the cables. For example, red cables could portray low K values while green cables could portray higher values of K.
   * Visualisation of the power through the cables – power loss. The power loss is due to the distance between cables as mentioned within the point 3 – power distribution. The power losses can be obtained from that section. The power losses should be visualised within the game through a thickness gradient from large to small between due to the distance between the wind turbines and their transformer, the transformers, and the pumps and their transformer.
   * Visualisation of the power in the wind turbine. The output power of the wind turbine should be placed on the upper left of a wind turbine as a number in kW.
   * Visualisation of the power within the turbine transformer. The power within the transformer should be placed on the upper left of the wind turbine transformer as a number in kW.
   * Visualisation of the power in the pump transformer. The power within the pump transformer should be placed on the upper left of the pump transformer as a number in kW.
   * Visualisation of the power in the pump. The pump having a maximum power acceptable, the visualisation should be shown as a pie or a number in percentage on the upper left of the pump. This percentage is calculated from the maximum power of the pump of 125 kW.
3. Maintenance introduction. Wind turbine should deteriorate progressively within the game. This should be shown through a vertical life bar similar to the life bar that is present on top of the bubbles. This life bar should only be visible upon clicking onto the wind turbine or when the wind turbine is below 10% health. The life of a wind turbine deteriorates at the rate of 100% per 1.5 minute of in game time. Once a wind turbine has its 0% health, the wind turbine stops producing power for the next 15 seconds. These 15 seconds correspond to the repair time. After the 15 seconds, the wind turbine recovers its 100% health and the cycle continues. To visualise the repair, the health bar (former green bar) should turn orange and increase during a repair. This will help a player know how long there is left to repair his wind turbine.
4. Fast-repair of wind turbines. Wind turbine should be quickly repairable. For this a button ‘Quick Maintenance’ should be present next to the button sell upon clicking on a wind turbine. This quick repair can only be done once the wind turbine has its health below 10%. When the turbine is still alive (between 10% and 0%), the repair stops the turbine for a duration of 5 seconds during which the repair is performed. When the turbine is already not functioning and has entered normal mandatory free repair, the repair leads to a reduced repair time of 5 seconds. It costs 25 TC to quicken the repair of a wind turbine.
5. Customisation of the wind turbine. This customisation is based upon two parameters: the wind turbine blade length – the power train. The customisation of a wind turbine costs additional money on top of the base costs but will always produce more power than the base default wind turbine. Three options are given for the wind turbine length: small (10 TC, +20kW), medium (20TC, +30kW), large (40TC, +40kW). For the power train there are two options: direct power train and indirect power train. The direct power train is a power train that leads to +20kW and an increase in health of 15 seconds and costs 100 TC. The indirect power train is a power train that leads to +20kW and a decrease of health of 15 seconds. It costs 25 TC.
6. Terrain placement not randomized but designed per level.

**Sounds needed (for Rick):**

* Attack of the pumps
* Wind turbine rotating
* Wind turbine breaking
* Background music
* Menu music
* Earned money from bubbles dying
* Bubbles escaping
* Creation of a customized wind turbine
* Construction of a turbine/transformer/pump
* Win/loss

**Additional constraints – numbers:**

* The maximum power that a pump can have is 125 kW. This would lead the pump to do 6 of damage per hit. After 125kW, the pump is saturated.

**About the tutorials (chapter wise):**

The tutorial should be split in different parts. These should be distributed over the different chapters which each introduce the large new game mechanics. The details are provided within this section:

**Notes:**

* If we were to make different difficulties, maybe consider removing the sell button for wind turbines for the hard mode. (real mode versus learning mode)
* For the trivia scoring, could one apply this: Trivia: given after the first level. Does not restrict access to the second level. If answered appropriately, the player points are doubled. If answered correctly only after level 2, the player is awarded only additional 50% points. And so on ….
* Could we introduce a mechanic that limits the location where the pumps can be placed? For example, they can only be placed within the range of a certain tile. This could help in the learning and teaching process.
* It was proposed by one reviewer to add the damage done to the bubble on the side (as a number) instead of just lowering the health bar. This way, it is possible to directly understand the increase or decrease in damage due to the positioning of wind turbines or else within the game. It would be a better way of feedback for the players.

**Missing parts of the game (not in their order of importance):**

* Sounds and animations.
* Grid integration.
* Maintenance mechanic.
* Trivia (insert that in the form of chapter and level).
* Hover, click and drag.
* Polished UI. (one task would be to make the descriptive text larger and more visible throughout the right panel)
* Leader board and more extensive score.
* Appropriate visualisation for every hidden mechanic.
* A city at the end.
* Level and wave design.
* Possibility of two difficulty level (game versus real life) – would require a lot of changes and would not apply to all levels (not the first ones for example).