**beta**

**Plan of the week of 14th of December**

**Goal of the week:**

Have a presentable and playable beta by Friday the 18th December. The beta 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. Customization of wind turbines for powertrain (from a finite number of choice) and blade size (from a finite number of choices).
5. (Optional) Introduce the maintenance mechanic with respect to the choice of power train and the normal maintenance cycle for wind turbines.

**Levels to be created for the beta**

The playable game (beta) at the end of the week (on the 18th December) shall contain several levels:

1. Level 1: Introduction to the tower defence concept. A simple map is to be used with just two turns in the river. In that version of the game, only the pumps can be added. The pump transformers are placed in a convenient place near to which the player can place the pumps. The wind turbine transformers are also already placed near to a set of two wind turbines located on a hill on the edge of the map. The two transformers are already connected, so are the wind turbines.
2. Level 2: This level builds up on level 1. In this level the player can now place the pump transformer. Note that the power losses are included within this part of the game already. For the rest, it is a similar game. A change of map would introduce some challenge and interest in the player but is not absolutely necessary at this point.
3. Level 3: This level builds up on level 2. In this level the player can now place additionally to previous elements, the wind turbine transformer. Note that the power losses are included within this part of the game already. For the rest, it is a similar game. A change of map would introduce some challenge and interest in the player but is not absolutely necessary at this point.
4. Level 4: For this level the player can only place wind turbines. Only one type of wind turbine is allowed. The wind turbine mechanic both include the power loss and the height aspects so the player needs to place appropriately with respect to both elements. Note that the wind turbine transformer should already be placed. This should help the player understand approximately the power loss and height mechanics.
5. Level 5: For this level, the maintenance concept is introduced into the game. The player can play normally with the elements introduced before on a new map with the maintenance added to the wind turbines. The game should start with nothing on the map.
6. Level 6: For this level, the player should be introduced to turbine customization for the blade choice only. This is done on a new map with all the previously introduced aspects of the game.
7. Level 7: For this level, the player should be introduced to the second part of the turbine customization, that is, the size of the powertrain being used. The player should be able to learn the relation between the turbine blade size and the power train size through a series of possible combination. Note that the powertrain introduces differences with respect to the maintenance making the game ever so strategic on which turbine to use when depending on costs.
8. Level 8: This level should be a free to play level with randomly generated terrain where the player can test his skills without having the possibility of a leader board.

**Main constraints:**

**Main tasks in order of importance:**

1. Start/End game
2. Wind/Lose states
3. Introduction of pumps and transformers
4. Appropriate power distribution in the pumps, pump transformer and wind turbine transformer and introduction of the power loss between these elements.
5. Cost introduction for all components of the game (additional to the previously made wind turbines).
6. 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)
7. Wind turbine deterioration.
8. Wind turbine repair.
9. Customization of the wind turbines (blade and wind turbine).
10. Terrain placement not randomized

**Details of the tasks**

1. Start/End game:
   * The game should know when to end (win or lose states).
   * At the beginning of a game, the player should be told which level he is playing on (1 to 4).
   * At the end of a game, the player should see a display of the words: Win or Lose.
   * At the end of a game, the player should be able to see his score (remaining TC).
   * At the end of a game, the player should be able to restart the level, go to the next level (regardless of win or lose – if he loses due to unforeseen bugs, we want to allow him to go further for testing purposes), go to the previous level.
2. Win/Lose states:
   * The player loses the game once 5 bubbles have gone through to the city.
   * The player wins once all the bubbles have gone through the river and less than 5 have gotten to the city.
3. 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. Pumps and transformers are free to buy. 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.
4. 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. 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 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

**Additional constraints – numbers:**

* Because there is only one transformer for each role, the cables between the pumps, wind turbines and transformers should be made automatically upon the positioning of any of these elements. There is no need for the player to be able to place these cables yet. This might come in a later version of the game where multiple wind turbine or pump transformers might be introduced within the game.
* 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.