Energy Market

Complement Slides

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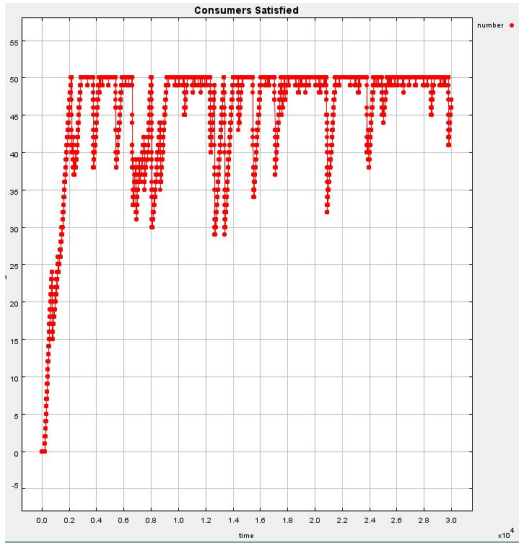
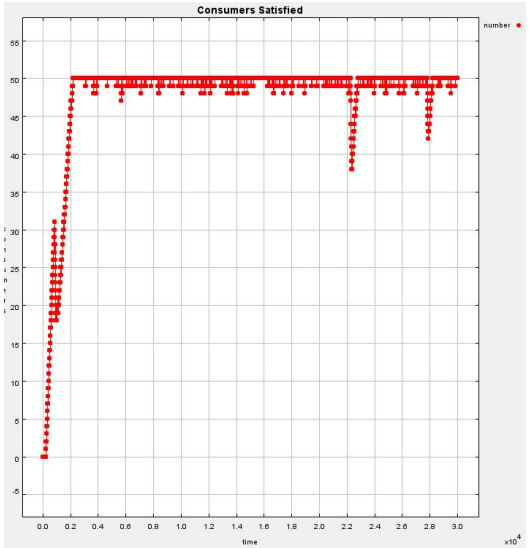
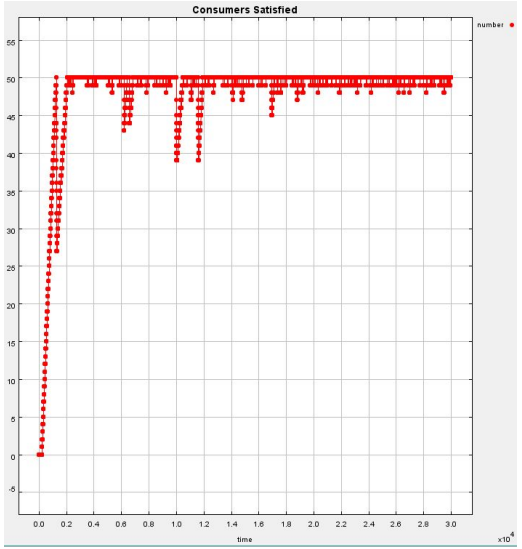
Detailed Execution Examples - testing limits of energy consumed

For this experiment we varied the percentage of total energy consumed against the total energy produced (100% left, 75% center, 50% right).

Simulations were run with 50 consumers, 5 brokers, 30 producers and for 30000 ticks.



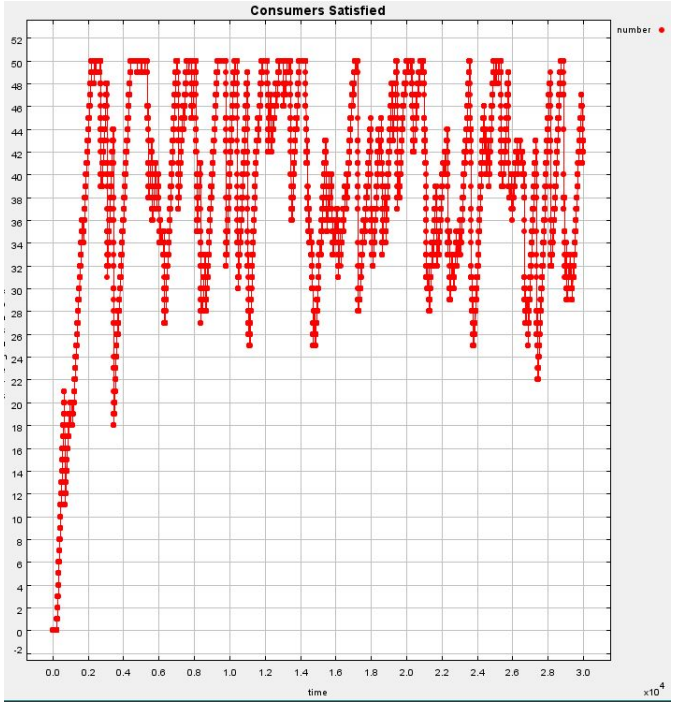




Detailed Execution Examples - testing limits of energy produced/consumed

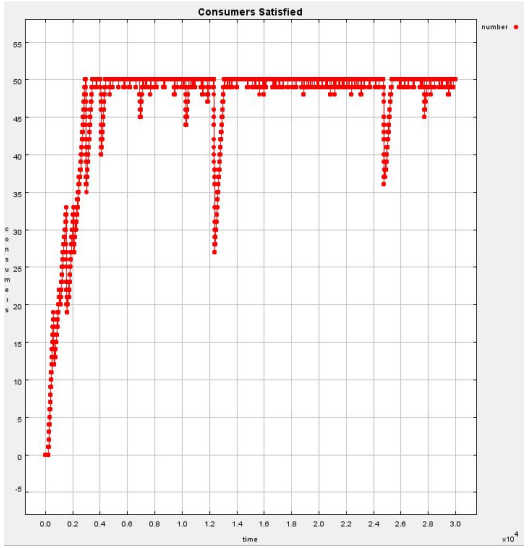
Conclusions - the higher the percentage of energy consumed (versus the total energy generated) the harder it is for brokers to manage the consumers and the producers in order to satisfy everyone.

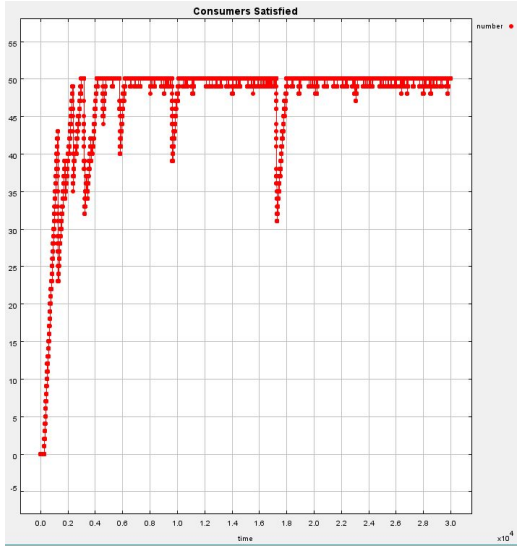
Interestingly, when the total energy consumed is higher than the total energy produced (figure on the right, consumed = produced * 1.25), there are still some moments where all customers are satisfied. This is due to the brokers ability to buy energy and stocking it, enabling them to satisfy all consumers for short periods of time. However, we can see that this is much more unstable and does lead to several consumers being persistently unsatisfied.

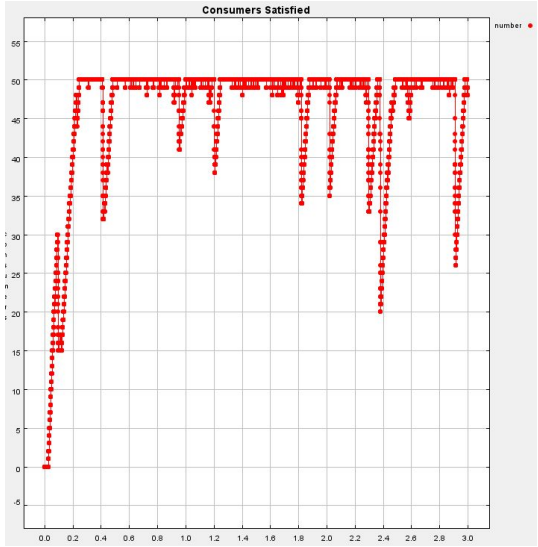


Detailed Execution Examples - limiting the number of producers

For the following experiment we tried manipulating the number of producers (5 left, 30 center, 50 right) to check what happens when brokers might not have a producer to supply them with energy and how that translates to the number of consumers satisfied.





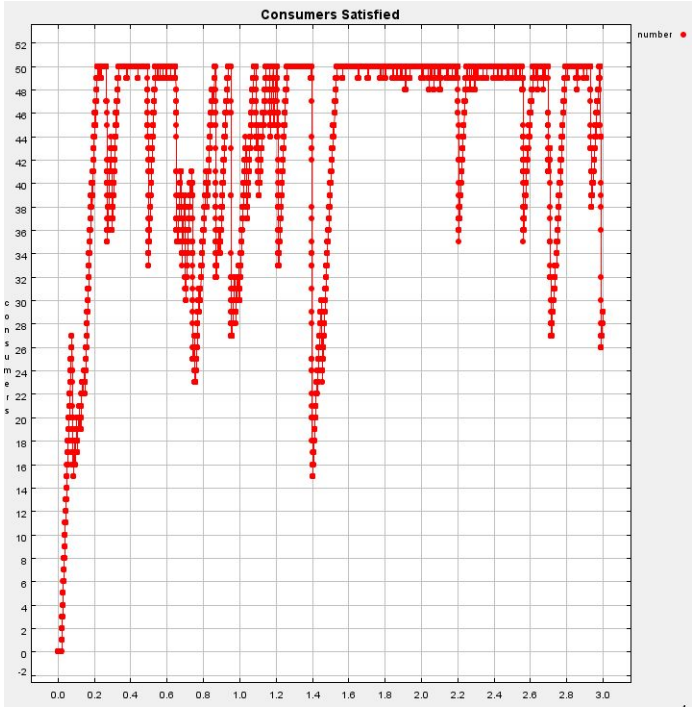


Detailed Execution Examples - limiting the number of producers

Conclusions - although we were expecting that fewer producers would lead to more instability, as it leads to a more coarse granularity of energy traded, there doesn't seem to be any influence on the number of satisfied Consumers.

We think this happened because more producers lead to a higher number of messages being exchanged, leading to an increased overhead when deciding contracts.

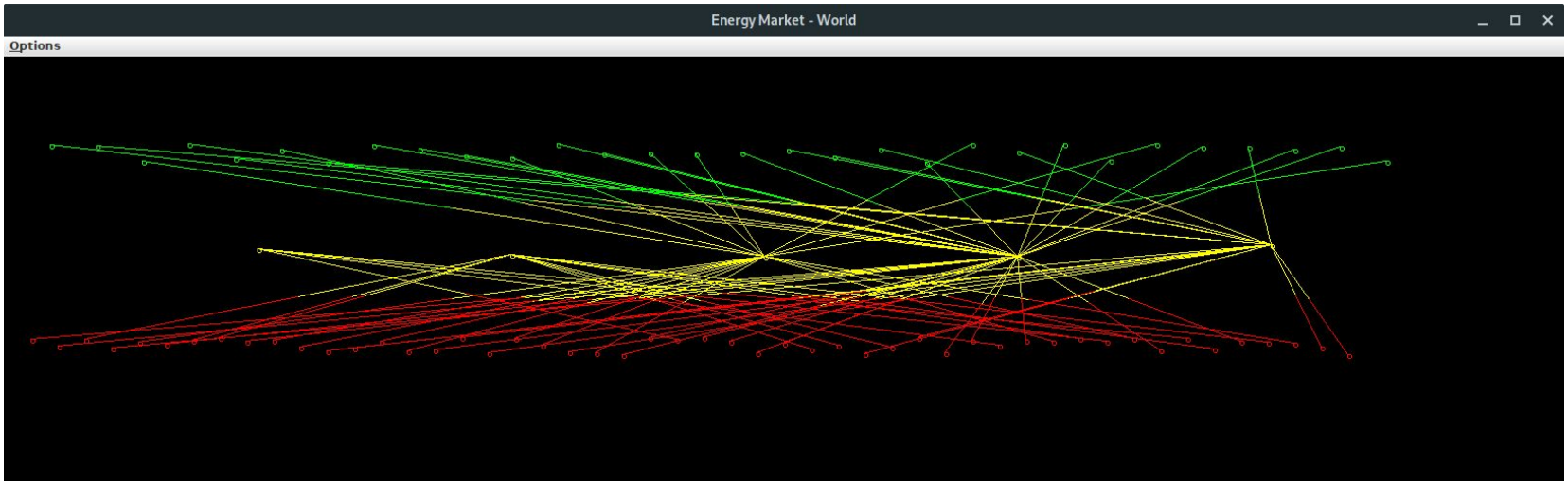
When setting the number of producers to 3 (less than the 5 brokers of the used settings), the number of satisfied consumers grows unstable. And any value below 3 will lead to more instability, as most Brokers will fail to acquire any Producer.



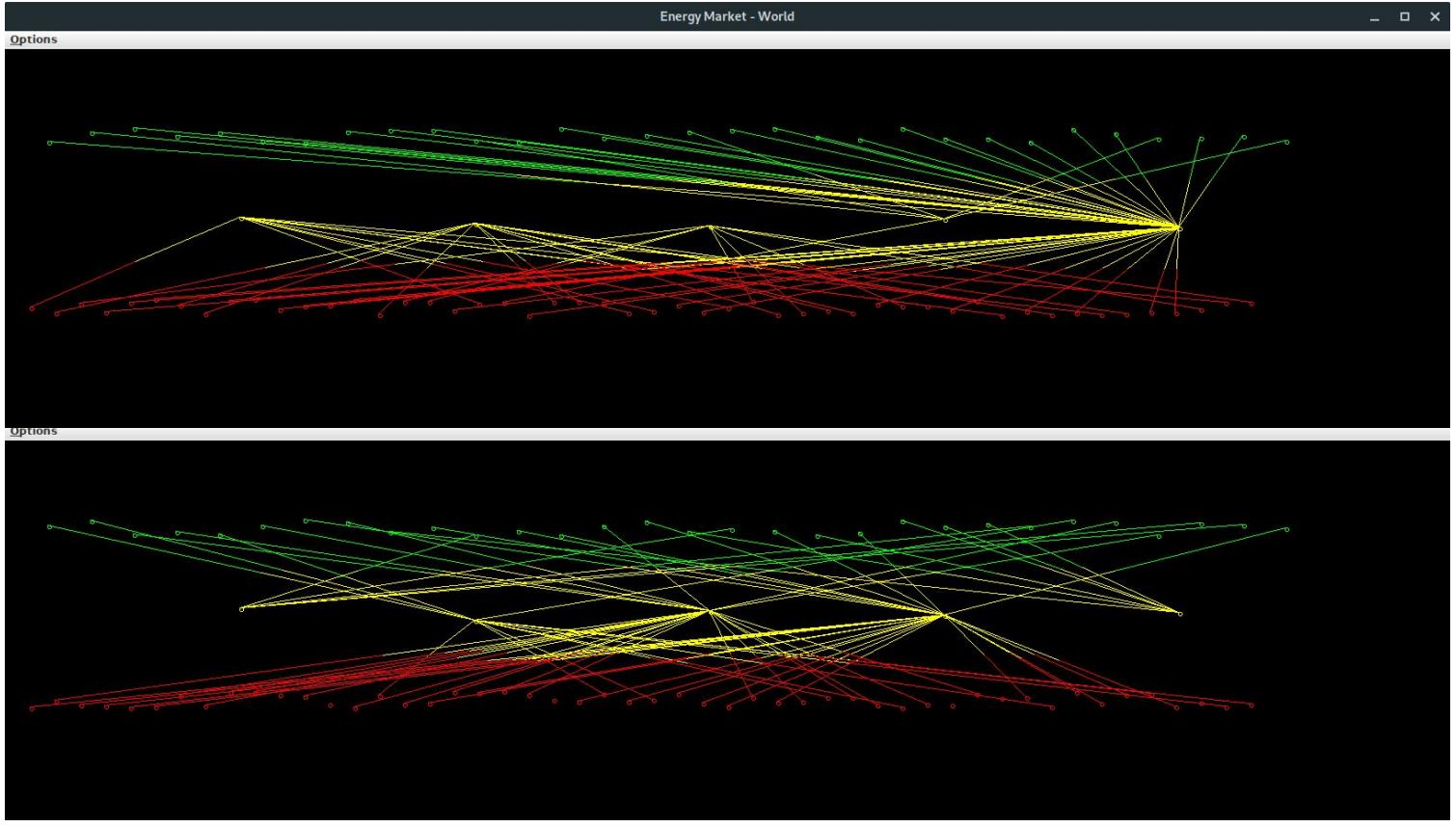
(The configurations were set to 50 consumers and 5 brokers)

Detailed Execution Examples - Type of Consumers

For the following experiment we tried manipulating the type of consumers (normal consumers - current page, lazy consumers - top next page, ecological consumers - bottom next page) to check how markets behave with different types of consumers.



Detailed Execution Examples - Type of Consumers



Detailed Execution Examples - Type of Consumers

Conclusions - As expected, in the **first scenario** there is a moderately even distribution across Consumer-Broker contracts, as each Consumer aims for the cheapest fare, but settles for a more expensive one if the cheaper Brokers are already taken.

The **second scenario** shows an almost perfectly even distribution of Consumers across the different Brokers, as each connects to the Broker that is physically closest to it. This does lead to increased cost for Consumers as they disregard price when choosing a contract.

The **third scenario** leads to a worse distribution of Consumers among Brokers, as all Consumers aim to sign contracts with the same Brokers due to their renewable energy quota. Due to this increased competition, some Consumers have a harder time finding any suitable Broker.

Implemented Classes

Energy Market Launcher - main class that launches the market and handles the market steps.

Wallet - a custom class to keep track of each agent's energy and money, as well as its transactions.

Transaction - a custom representation of movement of money/energy from an agent to another.

Base Contract - class representing the basic information regarding contracts.

Energy Contract Proposal - represents a contract proposal, therefore containing essential information for the contract signing. If the contract goes forward, the proposal is used to sign a definitive contract.

Energy Contract - class that represents a definitive deal between two parties, which is then updated at each time step to enforce its fulfillment.