Business Models for an Aggregator

Application to the situation on Gotland

Author: Quentin Lambert
quentinl@kth.se
Degree programme: CTFYS

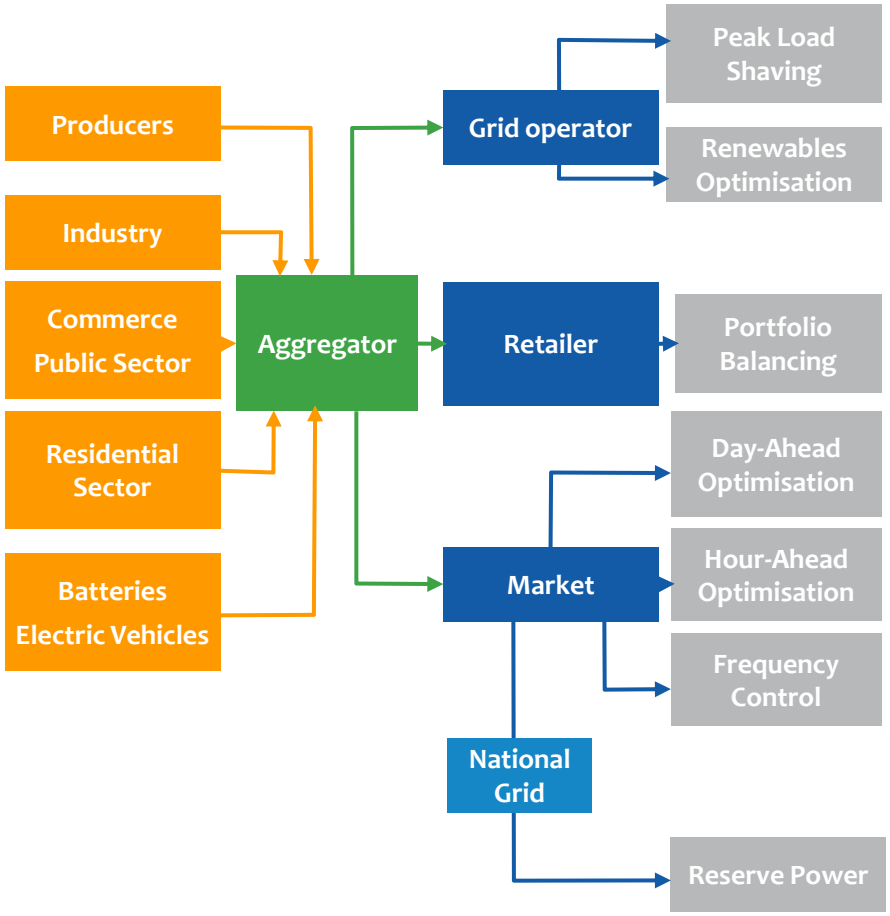
Supervisor: Claes Sandels
claes.sandels@ics.kth.se

Increased intermittent Electricity Production implies new Challenges for current Power Systems

- The expansion of renewable electricity production to meet environmental goals puts electricity grids and power producers in a difficult situation.
- The electric system is such that production and consumption must be equal at every single instant: a cloud above a solar panel or the lack of wind create a deficit in power production that has to be compensated.
- The traditional approach, which considers demand as not flexible, has lead to the environmental paradox where increased shares of renewables imply higher greenhouse gases' emissions, since more fossil energy is needed as back-up when wind and solar farms are not producing.
- **A change of paradigm is needed!** Intermittent production requires flexible consumption to really become sustainable.
- However, individual consumers would hardly have any impact on the global demand curve. It is only through a coordinated steering of vast amounts and types of consumers spread over an entire region that demand response can be effective. Thus the need for ***Aggregators.***

- ***What is exactly an Aggregator?***
  - An Aggregator is an entity that offers technical or economic services to electricity actors based on its capacity to manage *demand response.*
- ***Why this study?***
  - The idea of getting more flexibility in the consumption habits of end-consumers is not new and several small-scale trials have been carried out.
  - However, it is only the recent developments of IT technologies and the increasing share of renewables that triggered research on *smart grids.*
  - This new concept, which includes Aggregators, promises technical and economic advantages: smarter use of current grids, better energy efficiency and beneficial environmental side-effects.
- ***Why Gotland?***
  - The Swedish island presents very interesting characteristics: it is a limited area that can be considered as a replica for the Scandinavian market.
  - Gotland has also the specificity to have a high share of wind power, corresponding to the situation that is forecast in Sweden in 2020.
- ***What was the aim of the study?***
  - **The goal was to determine whether an Aggregator would be a sustainable alternative for Gotland, both environmentally and economically.**

Aggregators are an innovative Solution to increase the Share of Renewables in the Electricity Mix



* The first part of the study analyses and gives an overview of the business opportunities for aggregator.
* As shown on the figure on the left, an aggregator can:
  * **Gather several consumption sources** (orange boxes)
  * **Offer the power flexibility to different electricity market actors** (blue boxes)
  * **Provide adjustable technical and economic services** (grey boxes)

* Based on Gotland's characteristics, the most interesting business case to study from a technical viewpoint was the ***optimisation of wind power consumption by adapting private households' heat load.***
  * In order to perform reasonable simulations, **temperature and consumption boundaries** were set to keep end-consumers warm at home and happy with their electricity bills.

Aggregators will enhance electric Networks' Efficiency provided that necessary Conditions are met

* The second part of the study consisted in evaluating how efficiently an Aggregator would adapt consumption curve to wind power production.
* The figure on the right presents a typical day when wind production exceeds the demand at night and becomes minimal when demand is highest.
  * The action of the Aggregator is to reschedule electric heating so as to increase consumption at night and limit the demand when wind production is low.
* The analyses on Gotland put in evidence the following benefits:
  * **Environmental:** increased wind power integration and a more even demand curve significantly lower CO_2 emissions.
  * **Technical:** a better use of local wind generation, reduces the needs for expensive grid upgrades and risks for outages are reduced.
  * **Economic:** a better planning of heat load can reduce electricity bills for customers while retailers limit their risk to face unpredicted demand variations.
* All in all, a**n Aggregator would clearly contribute to a more sustainable energy system and solve the problems caused by increased renewable energies… if only it were profitable!**

* Key parameters for an economic success for an Aggregator are:
  * **Significant share of intermittent renewable generation,** at times exceeding consumption.
  * Recurrent **high prices and volatility** on the electricity exchange.
  * **Large and varied customer base** ranging from private homes to big industries.
  * Interesting alternative to expensive electricity grid upgrades.
* Further research on Aggregators and their potential is advised to analyse:
  * Interactions between aggregators and other market actors.
  * Impact of unpredictable phenomena (*e.g.* wind) on the profitability.
  * The attitude of final consumers towards active demand.

* **But the best way to get answers is… to develop real-scale pilot projects!**