e-harbours electric

Newsletter e-harbours #3, November 2012

The economic value of flexibility

Photo: Colourbox

The e-harbours expert group on Smart Energy Networks has produced an extensive analysis of the business cases that can make a Smart Grid profitable. In this article we present a summary of the findings.

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Read the full story on page 4

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From Show Cases to Business Cases

"Yes, the e-harbours team does have a good story to tell. And yes, it's getting better all the time. "

Read the full editorial on page 2

Highlights

See some website highlights from eharbours.eu on page 3

The Interreg IVB North Sea Region Programme
Investing in the future by working together for a sustainable and competitive region

Hochschule für Angewandte Wissenschaften Hamburg
Hamburg University of Applied Sciences

pure ENERGY CENTRE

City of Amsterdam

Malmö stad

vito vision on technology

ROBERT GORDON UNIVERSITY·ABERDEEN

Port of Antwerp

ZNSTD

Editorial:

"From Show Cases to Business Cases"

Yes, the e-harbours team does have a good story to tell. And yes, it's getting better all the time. As our Show Cases develop and the research progresses, we can see the story attracts more and more people and businesses as well.

In the Antwerp and Hamburg harbour huge amounts of flexibility are identified. And it seems worthwhile to exploit it. Using your own local, green energy to optimize your energy contracts and to save money. It's already there in our Show Cases. Now our projects' aim is to show this can be done on a much larger scale. From Show Cases to Business Cases. The market will adopt our ideas only on a basis of a sound business case, considering all aspects.

The e-harbours document 'Strategies and Business Cases for Smart Energy Networks' is a mayor milestone in addressing this topic for large scale implementation. It will be of great help to boost renewables in an industrial environment in the North Sea Region.

Jan Schreuder
Project manager
e-harbours

E-harbours newsletter.

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www.eharbours.eu

Website stories from eharbours.eu

"Improving the balance of the grid is vital for the implementation of renewables"

The Shetlands don't have a connection to the national electricity grid, and up till now, we have to generate our own electricity locally. That puts constraints on the grid, and makes it difficult to incorporate renewables like wind energy.

Read the full interview with Elizabeth Johnson of Pure Energy Centre, the Shetland here:

http://eharbours.eu/uncategorized/improving-the-balance-of-the-grid-is-vital-for-the-implementation-of-renewables

E-harbours: from North Sea to Mediterranean

At the European exchange conference Green Mobility in Catania, Sicily, Green IT Amsterdam showcased results of eharbours. Hugo Niesing, e-harbours team member & consultant at Resourcefully, presented the findings of e-harbours on smart grids. The conference resulted in two TV reports, available on our website:

http://eharbours.eu/uncategorized/e-harbours-from-north-sea-to-mediterranean

Vito presents e-harbours at EERA conference in Milano

The 'Joint Program' of the EERA on Smart Grids took place in Milano, Italy, and was an excellent opportunity for Maarten Hommelberg from Vito to present the
e-harbours project.

http://eharbours.eu/uncategorized/smart-grids-discussed-at-flanders-smart-hub

Showcase A2: Hamburg, Germany. University of Applied Sciences (HAW Hamburg)

Business Cases for Smart Grids: The economic value of flexibility

Photo: Colourbox

The e-harbours expert group on Smart Energy Networks has produced an extensive analysis of the business cases that can make a Smart Grid profitable. In this article we present a summary of the findings.

The expert group uses a broad definition of Smart Grids, encompassing both local and nation-wide systems: "Smart energy networks are intelligent and flexible solutions that may combine demand side integration, local generation of (renewable) energy and energy storage on different levels." This definition includes so-called Virtual Power Plants, where several dispersed consumers (and producers) are integrated, but also refers to energy solutions that are implemented locally at a single facility and behave smartly within the energy grid.

The electricity grid must be kept in balance at all times. This task gets more challenging when intermittent renewable sources like wind and solar power must be accommodated, as these sources cannot be regulated. Flexibility, both on the production side and in the demand for electricity, can help balancing the grid, and therefore represents an economic value. The value of flexibility is the driver for the business cases in this report. That value can make Smart Grids profitable.

Two determinants of flexibility

The expert group singles out two basic determinants to characterize the flexibility of single devices or entire properties: the amount of shiftable load, and the flexibility over time. The shiftable load measures the total amount of electric power that can be shifted on or off at a given moment compared to the baseline load. This usually varies over the course of the day or the week. Typical amounts in commercial and industrial properties, that may justify economic exploitation, reach from tens of kW to tens of MW. Flexibility over time describes how long a certain amount of load can be switched without negatively affecting the process or application the device is used for. Typical time spans for shiftable loads reach from several minutes to several hours, in some cases even weeks.

In many cases, these two determinants are interdependent, meaning that a big load is shiftable over a rather short time, or that a small amount of load may be shifted over a longer time. The greater the amount of shiftable load and its flexibility over time, the more business cases become available and the higher the potential benefits from employing a smart energy network.

Exploiting flexibility
The expert group identified different possibilities to exploit flexibility. They stated: "One group of business cases builds on the fact that the price of electricity (and/or for using the electricity grid) may vary with the changing supply and demand over time. By exploiting flexibility, consumers may thus reduce their electricity costs and producers can maximize their revenues. In another group of business cases, flexibility is made available to grid operators who utilize it to directly support the electricity grid on different levels."

Business Cases
The expert group distinguishes six different business cases for Smart Grids:

1. Contract optimization
- Reduce grid utilization costs
Consumers of electricity pay not only a price per kWh, but also a fee for grid usage, based on both total consumption and maximum load. Systematically reducing maximum load by shaving off load peaks thus leads to savings. Additionally, in some countries, consumers are rewarded for "atypical grid usage", i.e. their demand is highest during the off-peak hours.
- Profit from flexible energy tariffs
In several countries, prices per kWh vary depending on the time of the day – the simplest model differentiates between peak hours (e.g. 07:00 – 22.00) and off-peak hours. In order to reduce energy costs, flexible loads are shifted to off-peak periods. Similarly, in some countries time-dependent tariffs for the feed-in of own production are common, making it more profitable to deliver to the grid at peak hours.

2. Trade on the wholesale market
Energy exchange markets operate market platforms for trading energy and energy-related products such as electricity. Participants can use the different markets to buy and sell electricity on short and long terms, but have to pay an entrance fee. Profitable, when you can form a group of producers and consumers, and trade collectively.

3. Balancing group settlement
In the electricity sector, balancing responsible parties (BRP's) are active. They assist grid operators to guarantee the balance between supply and demand.


Photo: Jo Scmaltz

Producers and consumers who are able to shift loads can help the BRP with keeping the grid balanced in its portfolio, which has an economic value.

4. Offer reserve capacity
Reserve capacity (positive and negative) is needed to stabilize the grid frequency at 50Hz. Transmission grid operators (TSO's) buy certain amounts of reserve capacity on special market platforms. In principle, also consumers can offer reserve capacity on these markets. For example, a chemical plant can start a production line when demand is dropping below expected values, and get paid for that service. However, strict regulations apply for this business case.

5. Local system management
A group of producers and consumers can collectively reschedule their power usage and local production, for local system management purposes. Via local system management the distributing company (DSO) can defer investments in reinforcement of the distribution grid. In fact there is a general benefit in the form of a shift in system peak demand and it helps solving specific local network congestion issues.

6. Large scale grid stabilization services
Large-scale producers and consumers connected to the high voltage grid can help stabilize the transmission system. This can be done by either providing reactive power or by congestion management. Reactive power is usually provided by large central power plants on request of the TSO. Flexibility offered by a VPP may locally contribute to voltage control but the development of adapted strategies might be

needed. With congestion management is meant that TSO`s are able to negotiate contracts with significant electricity consumers to be able to switch them off when grid load exceeds limit.

Profit and risk
Which of these business models is the most profitable? That depends on the local situation, the characteristics of producers/consumers, but also on the national framework (e.g. regulation and practices that apply in a national electricity system).

Load shifting can affect local processes, and asks for careful planning. For some processes, the potential (financial) damage may be too high compared to the expected revenues. Moreover, revenues can be uncertain in the long run. Energy markets are volatile and difficult to predict. Also, national regulations regarding renewable energy, energy efficiency and climate protection have been changing constantly in all European countries in the last decade. All these factors have a big impact on the different business cases, and make the decision to invest in Smart Energy Networks more complicated.

Combining different business cases
A general conclusion: to maximize profits and minimize payback time for investments in Smart Energy Networks, one should seek to combine several business cases. For example, by shifting certain loads to off-peak periods, a facility can shave its day-time load peaks to reduce grid utilization costs, and at the same time buy electricity directly from the spot market to benefit from lower off-peak prices. However, as more business cases are implemented and more markets are served, the planning and optimization process gets much more complex: It has to be calculated for each time unit what combination of marketing options would yield optimal profits.

Download the full report Strategies and Business Cases for Smart Energy Networks (including figures on different business cases in four countries from the North Sea Region) from e-harbours.eu/downloads

Aberdeen, United Kingdom. Robert Gordon University.

Identifying the potential

At Robert Gordon University in Aberdeen the e-harbours team has widened the range of its activities. RGU is involved in the Scalloway showcase, where the energy system of local harbours is metered and analyzed. While PURE is collecting and processing data on the Scalloway Port, RGU does the same in Fraserburgh. The team is currently contacting other ports from the North and North East of Scotland to include them in the showcase.

RGU studies the methodological aspects of all e-harbours showcases. In the end, this will prove to be crucial in identifying the potential of the solutions worked out in different showcases. The team now works on a benchmarking methodology to compare a variety of electric (harbour) vehicles against a range of criteria (energy efficiency, cost, CO2 mitigation, market potential, etc).

An important new strand of work is developing on energy labeling. An example: can we devise a label that tells the consumer how much energy is hidden in the fish produce they buy? RGU is now doing the background research on both the labelling architecture and the energy modelling. A promising new venture.

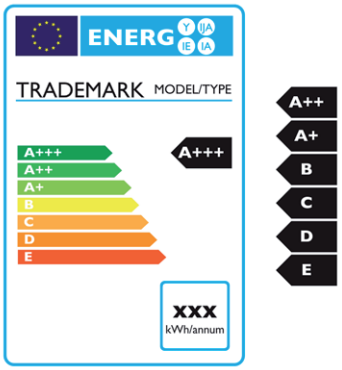

Photo: Colourbox

Showcase A1: Antwerp, Belgium. VITO and Port of Antwerp.

AMORAS: Sludge processing driven by wind power?

In the Antwerp showcase of e-harbours, the researchers of Vito devoted a lot of attention to one of the biggest facilities in the port, the sludge processing plant AMORAS. The gains that can be realized by introducing a wind turbine and a Smart Grid on this location are significant.

The Port of Antwerp is located on the banks of the river 'de Schelde', about 70 kilometers from the North Sea. The river is continuously deposing sediments, that have to be dredged to keep the water deep enough for sea going vessels. Every year, more than a million tons of dredged material has to be processed. Antwerp recently built a state-of-the-art facility to filter and dewater the sludge, called AMORAS. The goal is to limit the amount of material that has to be dumped, and to re-use as much of the sludge as possible.

AMORAS collects the sludge in a huge buffer: the 'underwater cell'. The sludge is dredged again with an electric cutter, sieved and desanded, then pumped through pipelines to a second buffer: the thickening pools. From the second buffer the sludge is pumped to the mechanical dewatering installations for final processing and storage.

The screening by Vito made immediately clear that the AMORAS facility has a huge potential for the exploitation of flexibility. The installations employ a load of several Megawatts. Both locations have huge buffers, which can store sludge for weeks, and a considerable overcapacity in the pumping installations. "AMORAS can quite easily activate their flexibility by shifting the times they move material from one basin to another," says the new showcase leader at Vito, Fred Kuijper. The researchers made a simplified model of the installations, and simulated the situation where a wind turbine is in operation on the location. The simulations show, that AMORAS could operate

AMORAS: Antwerp Port Authority

the pumping installation almost completely on wind energy. When the facility uses its flexibility in an optimal way, almost 80% of the wind energy can be used locally. This results in an overall energy cost reduction of almost 20%.

The researchers state, that the flexibility of AMORAS is big compared to the other companies screened in the Port of Antwerp. Due to the fact that the buffers can store sludge over a timescale of days to even weeks, the facility is extremely well suited for local wind balancing. But the organization of the process has to be adapted to make this balancing possible. Nowadays, the pumping installations are operated only during traditional office hours. To make full use of the potential flexibility, staff should be hired for the night and the weekend. Further study will have to be carried out to investigate the business case under practical conditions. The Vito team is confident that the huge potential benefits of exploiting the flexibility at AMORAS can be realized.

For more information on the AMORAs project, see the website (in Dutch and English): http://www.amoras.be/

Showcase B1: Zaanstad, Netherlands. City of Zaanstad.

Electric cars: Cleaner Transport and a Smart Energy Solution

Smart energy systems focus on the flexibility that can be found in the consumption and production of energy. This flexibility has an economic value. A smart energy system makes flexibility into a commodity, which raises money and lowers the energy bill.

The Zaanstad showcase employs the flexibility that can be found in its fleet of 16 electric cars. Monetizing that flexibility improves the business case for electric transport and the renewable energy sources. The challenge is, to exploit the flexibility without impeding the users of the electric fleet in any way. Moreover: facilitating the users of e-cars and thus assisting the energy transition.

The batteries in Zaanstad's e-cars play a dominant role in balancing the demand for energy in the our system. Its' nickname REload IT refers to the main components of the smart energy system Renewable Energy (RE) and Information Technology (IT). REloadIT is keeping track of many different variables. The status of the batteries, reservations made by users, production of our PV-systems and a wind turbine are linked to the system. Information on the current weather conditions and wind and sun predictions are taken from the Internet, as well as fluctuating prices of electricity (APX). All this information is processed by a state-of-the-art software application, developed by Zaanstad's contractor EnergyGo.

At the very beginning, the main focus was the optimization of the decisions on energy management. The goal was to adapt the charging process to the availability of electricity from our own renewable sources. Did we really need to charge the cars at peak hours, or could this be postponed to off-peak, relying on the weather forecast? Is it better to sell the energy or to use it to charge the cars? The algorithms were meant to improve the financial and CO2-index of the system. In the meantime, Zaanstad is experiencing the real value of being a prosumer. Two important partners in the electricity system, our DSO Alliander and our Energy Service Provider Greenchoice assist Zaanstad to further develop its business case, for example by experimenting with different tariff structures. This way, both the electric cars, and the investments in renewable energy get more profitable. From an energy point of view, the car became just a moving battery to help optimizing the Municipalities energy prosumers' profile.

But while developing the smart system specs, the need was felt more and more to facilitate the end user: a driver of an electric car is not interested in energy management; he just wants a reliable car. Tom Groot of the Zaanstad Climate Program made a survey to analyze the preferences of the users. "The users like the smooth drive, the

silence of the cars," Tom said. But there is critique as well. "Range anxiety remains an important issue for users of electric cars. You must be sure that you reach your destination in time." In principle, this should be no problem. The range of a fully charged current e-car is approximately 150 kilometers. The average trip of the Zaanstad employees amounts to 30 kilometers. "The anxiety is based more on emotion, than on facts," Tom remarked. Nevertheless, users want to be sure the car they get assigned is completely charged. Tom Groot: "Zaanstad and EnergyGo described the need of an interface to communicate with the end-user in an easy to understand IT-environment. Now the reservation system has a similar graphical style as our other application. Everybody can log on to make reservations for a car, and have a look at the status and the charging level of that car. It's as user-friendly as it gets. The availability and reliability of the e-car will prove to be a key factor in the smart system. "

Another stakeholder is Zaanstad's fleet manager. He needs different information. To reduce costs, he is aiming for as few e-cars as possible. Can we optimize the occupancy rate and go back to 15, or even 12 cars? The smart system will support that sort of decisions.

A new topic is raised over the last few weeks, inspired by the Antwerp and Hamburg stories: can we expand our smart grid, adding other functions, besides the e-cars? What if other energy-consuming weather-related processes are included in the system? Take for example the pumps of the sewer system. When the reservoirs reach a certain level, now the pumps are automatically switched on. This automated action can be replaced by a more intelligent system, relying on the weather prediction of REloadIT. The moment the pumps are starting could be shifted, adding another source of flexibility to the system. The system underlying RELoadIT can be expanded almost at will. As the shiftable load increases, so do the potential profits of trading on the energy markets.

"But first things first," Tom states. "To increase energy awareness, we are going to show the amount of CO2 we save by driving electric. And how much energy we get from our own PV-panels and wind turbine. Nothing beats the feeling to drive a car powered by energy you generated yourself. It makes you feel free and independent.".

Showcase A2: Hamburg, Germany. University of Applied Sciences (HAW Hamburg)

The Smart Energy Network Roadshow

Who is already making money with smart grids, and how will things develop in the future? In order to get to know market players, their business cases and expectations, the Hamburg team of e-harbours is going on a "Roadshow" through the German North Sea Region and beyond. Interviews are conducted with smart grid operators, business consultants and researchers.

Some points that are addressed:
- What are today's markets and business cases for smart energy networks?
- Energy markets are changing quickly - how will business cases develop in the wake of the transition to renewables?
- Companies have complex requirements and priorities - what do attractive solutions look like in this context?
- e-harbours has found potentials for flexible energy solutions in harbour areas – do they suit the business models of existing providers?
- How can public entities profit from flexibility within their infrastructure?
- What are the regulatory barriers for implementation, and how should policies on national and European level be modified?

Participants in the Roadshow are also invited to a local stakeholder meeting in January, where companies, market players and policymakers will explore how profitable smart energy networks can be built in Hamburg and beyond.

Showcase B2: Amsterdam, Netherlands. City of Amsterdam.

Electric sightseeing boats need more compact batteries

The Municipality of Amsterdam foresees a future in which only electric boats sail the canals and waterways of the city. Nowadays, electric boating accounts for less than 10 percent of water traffic in town, but the share is rising. The Municipality employs different tactics to stimulate further growth, for example by giving discount through environmental licenses for electric boats: owners only have to pay half of the mooring-money. The city also has provided a recharging infrastructure for pleasure boats.

The Amsterdam showcase of e-harbours focuses on the combination of electric boating with renewable energy and Smart Grids. Boats can carry a relatively large battery pack, which provides chances for the storage and return delivery of energy. A Smart Grid could use the storage capacity of an electric fleet to lower total energy costs by retrieving the stored electricity at peak times. The Amsterdam showcase has developed an approach to test this innovative idea.

The idea is to realize a Smart Marina in a bend of the Amstel river. This marina will feature 160 mooring places for ships, a swimming pool, restaurants and other leisure facilities. The complex produces electricity with a large PV-system on the roof. Part of the produced energy is stored in the batteries of 30 electric rental boats that are moored in the marina. This electricity can be retrieved at night, when the restaurants are in full operation.

The Municipality wants to issue a tender for the design and construction of this Marina. But unexpected juridical problems have delayed the process. At the moment no licenses for rental boats can be issued. This severely affects the business case of the Marina, since the fleet of rental boats is a cornerstone of the concept. However, the delay has not diminished the political and

Amsterdam Queens-Day Koen Muurling / Flickr

administrative backing for the plan. The tender will hopefully be issued coming January.

In the meantime the Municipality is investigating other possibilities to stimulate electric boating in the city waters. An important target are the professional roundtrip-boats. Around 200 of these boats – mainly powered by conventional diesel engines - show sightseeing tourists the most beautiful spots along the Amsterdam canals and waterways. The diesel engines of the boats cause a lot of noise and air pollution, that hinders both the tourists and the inhabitants of the city center.

The business case for conversion of roundtrip boats to electric motors is complicated. These boats are used very intensively, they usually run for 16 hours every day non-stop. The battery

pack needed for such long workdays is huge. Full recharging of these large-scale batteries can take up to 10 hours, which limits the number of roundtrips the boat can make during the day.

Part of the roundtrip fleet (about 40 boats) already features electric motors. These are used mainly for charter trips through the canals. Around 5% of the (mainly corporate) customers that charter these boats ask specifically for electric propulsion. Because they want 'green' boats, but also because the electric boats are nice and quiet compared to regular diesel boats.

The Amsterdam municipality is investigating how the business case for electric roundtrip boating can be turned around. The usability of the battery pack clearly is one of the crucial factors: there is an urgent need for more compact batteries that can be recharged fast.

Showcase B3: Malmö, Sweden. City of Malmö.

Living in the House of the Future

The eight new Urban Villas that E.ON is building in the Western Harbour in Malmö are just about to be finished. The outdoor environment is being put in place, the five electric charging points for the electric cars are installed, the windmill and photovoltaic systems are in place on the roof and inside the final testing and support of the technical equipment is being carried out.

The E.ON project aims at demonstrating new ways to generate and use electricity though interaction with the customer. The interest in the project even before it is finished has proven to be great. Groups of journalists from all over Europe has already visited the houses.

Are you ready to move in? As a tenant in the E.ON house you will take part in an experiment where you will be able to evaluate and test the latest equipment. You will be able to produce your own energy and via the ipad and smartphone you can monitor, adjust and follow your energy usage.

To meet the external requests and to be able to show the different solutions, E.ON plans to keep one apartment as showroom. This enables visualization of the technical solutions and gives you an insight in the individual perspective of what future living can be like.

e-harbours electric

The e-harbours project: Towards clean and energy innovative harbours in the North Sea region

The objectives of e-harbours
The challenge is to create a more sustainable energy model in harbour regions on the basis of innovative intelligent energy networks (smart grids). e-harbours focuses 3 objectives:

- Increase the production and use of renewable energy in harbour cities. Harbour cities have extensive industrial areas with a great potential for development of sustainable energies; from wind, solar PV, tide, waves and the reuse of industrial waste, heat or cooling available
- Increase the use of energy smart grids. Attuning demand and supply of energy by flexible demand management, instantaneous load shedding (both directions), energy labelling, intelligent storage
- Increase the use of electric transport, a perfect partner to connect to large scale renewable energies and leading to a more healthy environment in the harbour regions

Who are the e-harbour partners?
The lead partner of the e-harbours project is the municipality of Zaanstad in the Netherlands. The other partners are:

Municipality of Amsterdam, NL
Port of Antwerp, BE
City of Malmö, SE
Hamburg University of Applied Sciences, DE
Pure Energy Centre, UK
Robert Gordon University, UK
VITO, BE

The project is financially supported by the Interreg North Sea Region program.

More on e-harbours

- Lead Beneficiary and contact:
  Municipality of Zaanstad
  Jan Schreuder
  Tel: 0031 (0)629027834
  j.schreuder@zaanstad.nl
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