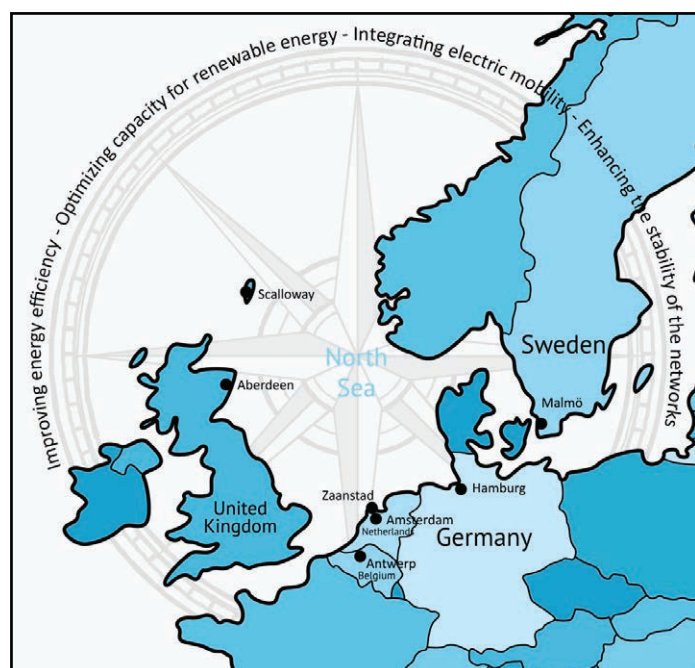


Newsletter e-harbours #6, February 2014

The e-harbours journey has reached it's goal



Based on Colourbox

The seven locations who have joined on the journey.

Large industrial cities and harbour areas, with a dense variety of production and consumption processes, are a perfect testing ground for smart energy concepts.

The aim of e-harbours is to explore the possibilities for large-scale implementation of smart energy networks, specifically through four pillars of energy optimisation: Renewable energy, Energy efficiency, Electric mobility and stability for the energy networks. Now we are happy to present the project findings after our three and a half years of work.

Read the full story on page 4

"What's next?"

It is a fact of life: life goes on. But now the North Sea Region Programme project e-harbours is coming to an end. With an attractive Point of Arrival document and an stylish website as a framework for further implementation of the e-harbours concept on smart energy solutions. The energy debate is becoming more and more visible for the average EU-citizen.

Read the full editorial on page 2

Showcase results

In this final issue of the e-harbours newsletter we display the results from the different showcases in the project.

Read the full story from the showcases on page 6 and forward



What can your organisation learn from e-harbours?

Page 15

Editorial:

"What's next?"

It is a fact of life: life goes on. But now the North Sea Region Programme project e-harbours is coming to an end. With an attractive Point of Arrival document and an stylish website as a framework for further implementation of the e-harbours concept on smart energy solutions.

The energy debate is becoming more and more visible for the average EU-citizen. Newspapers and blogs report on the energy sector struggling with expensive fossil back-up-systems, an excess supply of subsidised green energy and energy prices both dropping and rising at the same time. In its lifetime of 42 months the project sure was challenged to meet the contract's obligations in rapidly changing circumstances.

We all can feel that Europe started recovering from the financial crisis. We noticed an increasing need to save on expenses, including our energy bill. But at the same time budget cuts and policy rethinking of partners put pressure on keeping the focus on the project. We saw interventions in the energy market, by regulations in different EU member states. Most of them supporting the energy transition, but challenging our team to produce relevant output.

We saw the emerging use of cheap shale gas, not only influencing the global transport routes and the position of some harbours, but changing the energy prices as well. A challenge for the introduction of a greener energy concept in those harbours.

Mid 2009 the first ideas on the project were launched. Quite impressive to notice we are still able to add some flavour to today's debate on smart energy concepts, if you come to think of it. From day one we have been working on our legacy. Our main message will live for another five years on the web: the need for smart energy solutions is undisputed. And local cooperation sure is smart. From now on, that is a fact of life too....

Jan
Schreuder
Project
manager
e-harbours



E-harbours newsletter.

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

Legal and finance specialist Gerrit Buist comments on the findings of e-harbours:

‘Harbours are ideal locations for the energy transition’

“What I particularly like about e-harbours is that teams from different countries, with different mentalities, have started looking for ways to change the energy system bottom up.” Gerrit Buist knows the energy business from the inside. He worked as an entrepreneur and as a legal and financial specialist for different companies and initiatives in the international energy business, and then became one of the founders of the Center for Energy at the University of Amsterdam. Mr. Buist will chair the second day of the final conference of the project in Zaanstad. What does he think of the e-harbours findings?

Gerrit Buist: “I am amazed at the reaction of some harbour companies on the research of the e-harbours teams. As if they don’t want to think about energy costs. It seems as if energy costs are exogenous, something you cannot influence yourself. To that type of managers I would like to say: Beware, you can influence what you pay for energy and if you don’t it will cost you dearly!

“Many people think energy is a topic for engineers only. Well, it has been. Like so many technologies. I can remember that the radio was a very complicated machine, full of switches and buttons that you had to manipulate just right to be able to listen to a station. Now there is a radio in your smartphone, very easy to use... Likewise, at the start of electrification you had to build very large power stations that could supply everyone with energy. Now we can do that much better, in a decentralized way, with local production for local consumers. As e-harbours remarks: technically we are able to do that, the only thing we have to do is make good arrangements. Reaching agreement between producers and consumers is the core of the innovation.”

Legal barriers?

“Harbours are the ideal locations for the energy transition, working as they are all day with logistic systems. Energy is nothing else than logistics, the very precise tuning of supply to demand, so harbours are by nature well suited for that sort of job.”

But they are hindered by legal barriers, as the final document of e-harbours states.



Legal and finance specialist Gerrit Buist

Gerrit Buist: “Legal barriers? Power relations, you mean. Technical innovation always encounters objections from the companies that rule the market, the incumbents. They will begin to say that innovation in their market is impossible. When it appears possible after all, they will say: it is dangerous! Do not use an unknown brand of telephone! It can explode in your hands! In the end, the ruling companies will accept some change, but on their terms, of course. This is exactly what we see now in the energy sector.”

A second effort

So where will the change come from?

Gerrit Buist: “Money is the main driver. You do not want to pay too much for energy, especially not when your profile doesn’t fit with that of your supplier. You want green and local energy. Sometimes you want to use power and sometimes you want to be a supplier. Another important driver is independence. People do not want to become dependent on companies they don’t like nor trust. You have to be realistic. E-harbours wants to realize a lot. I agree with the Point of Arrival document: not all solutions will function in all harbours. What I hope is that the stakeholders in the harbours, when they read this report, decide to make a second effort in the direction of local smart networks. I would be disappointed, if that development did not come off the ground.”

The top 10 findings of e-harbours



The e-harbours team in Scalloway harbour

The aim of e-harbours is to explore the possibilities for large-scale implementation of smart energy networks, specifically through four pillars of energy optimisation: Renewable energy, Energy efficiency, Electric mobility and stability for the energy networks. Now we are happy to present the project findings after our three and a half years of work.

1. Costs form a key driver. Our case studies show that (local) uptake of renewable resources, combined with the exploitation of flexibility, can result in an energy cost reduction of around 15%. In some instances, this cost reduction can be realised with limited investments, resulting in profitable business cases. Local green energy can be profitable in both large and small harbours. For e-mobility applications electrical storage potentially can bring even higher rewards.

2. For large harbours, finding flexibility is the key. Flexibility is needed to profit from local green production. Our energy audits have demonstrated a large amount of flexible electric loads available at large industrial users. Their exploitation could reduce total electricity costs in the order of 5-15%.

3. The potential to find flexibility and deliver smart energy varies. We expected to find a lot of exploitable flexibility in cold stores, for example, but in fact we found more flexibility in large industrial production facilities (such as chemical plants).

4. E-mobility is a key element of a future smart system concept. Electric cars, boats and vessels, Heavy Goods Vehicles, cranes and reefers offer great potential

as part of smart energy systems. Our showcases have shown this at a small scale. The challenge is to scale up and get these pilots into the mainstream. Vehicle technology is improving but the high cost of e-mobility and battery load cycle limitations remain barriers that have to be overcome.

5. The theory (and technology) works but the business cases do not. There are profitable business cases for smart energy, but they are not exploited yet. We encountered a lack of awareness of the economic value of flexibility, and of its potential. Also, organisations are reluctant to modify their 'core business', even when they are aware of the potential benefits of exploiting flexibility.

6. Existing regulatory and fiscal regimes are not helpful. Present tariff structures in the energy sector do not reward the exploitation of flexibility. In countries like The Netherlands, there is a trend towards higher taxes on energy tariffs at the expense of variable base pricing, reducing the difference between on peak and off peak energy. This dampens the potential to find costs savings and undermines the economic value of any flexibility within the system. Concerning the exploitation of flexibility, there is no such thing as best practice that can be exchanged internationally. Markets, tariffs, fiscal and regulatory regimes vary too much between countries. What works in Sweden might not work in Germany. The present definition of private networks needs to be reconsidered. Energy regulation should encourage opportunities to develop 'private energy areas'.

7. One size does not fit all. While a lot of flexibility can be found in large harbours, the small harbours in the region tell a different story. These ports, with only a handful of significant energy consumers in a limited range of industries, can provide little or no usable flexibility. However there are significant opportunities for raising energy efficiency and awareness. Many of these small harbours are situated in - often remote - regions where there is great potential for renewable energy, like on the Shetlands and Orkney islands.

8. Regenerating harbour areas provides opportunities. The City of Malmö puts smart energy at the heart of its efforts to regenerate the Western and Northern

harbours. That is the way to do it. Embedding smart energy in regeneration and new development provides better opportunities than retrofitting, finding business cases in existing harbour operations.

9. Despite the challenges, our message is getting across. We experienced a gradual rising of awareness among e-harbours industrial partners and other stakeholders on topics like renewable energy and smart energy systems. They are interested in energy saving and – in particular - cost reduction as long as it does not impact on their core business.

10. ...And occasionally you uncover something exciting. Who had thought reefers (refrigerated containers) can be an important source of flexibility? Another example: we carried out some work to develop an energy label for fish. In doing this work, we generated some fascinating data on the vast differences in the energy embedded in catching, processing and distributing different species of fish. This will lead to new research.

Key recommendations for policy makers

A. We strongly support the shift we perceive in European energy policy, from subsidizing renewable energy resources, towards exploiting smart energy concepts. Help find solutions which provide a clear return on investment and align with the long-term investment strategies of industry, investors and developers.

B. Encourage the development of “private network energy” concepts, enabling ‘pro-sumers’ to exchange

energy. This will support local communities in their energy transition.

C. Reward flexibility in the system. Flexibility is not exploitable in the current energy market, partly because of an increasing unbalance between base price and levies on energy. Taxes, distribution and transport fees, subsidies, and other ‘contributions’ form an increasing part of the overall energy price and are no incentive for smart behaviour. Redesign the system of incentives and penalties in line with smart energy concepts.

What next?

We are ready for the next step in the development of smart energy systems; during the last years many pilot projects in this field have shown that technology is not an obstacle anymore, both residential developers and industrial companies are ready for further implementation. By implementing a few policy changes as recommended, we think the next step towards a more sustainable energy supply can be made.

Then the next generation of pilot-projects could focus on (virtual) taxing, fair pricing of network costs, balancing, and encouragement of reserve capacity. Working towards the same goal: *Green energy and energy management as a starting point, fossil resources as a backup resource.*

e-harbours
electric

The e-harbours journey

At eharbours.eu you may read the full story on e-harbours from our Point of Departure to our Point of Arrival. Download the “The e-harbours Journey”



Showcase: Zaanstad, Netherlands. City of Zaanstad.

Zaanstad: local cooperation sure is smart



In the municipality of Zaanstad 2 case studies have been performed: ReloadIT and Hoogtij

Case study: ReloadIT

Case study “REloadIT” implies the development of a smart grid system: an ICT-platform and a real smart grid based on a configuration of a car park of electric vehicles, and renewable resources, i.e. solar panels and wind turbines. The second part of the case study implies an analysis on the viability of potential business cases. Within REloadIT consortium examined whether the benefits of renewable energy production could be matched with flexible energy consumption.

The smart grid application has been developed and deployed by the Dutch company EnergyGO. It comprises two major functions: the car reservation system, and the demand side management system. The algorithm of the DMS is based on optimization of the reservations of the cars, the weather forecasts, and the load management system of the battery charger.

Innovative energy contract

Inspired by the energy specialists of the e-harbours team, the idea emerged to start an energy procurement based on new smart energy elements: balancing,

flexibility, apx market, esco-experiences, and local (green) energy production.

Building upon the knowledge of the energy market gained in the e-harbours project, the Municipality of Zaanstad has recently negotiated a new energy contract with distributor GreenChoice. Zaanstad has been working on its own Smart Grid by charging the batteries of its electric cars (project ReloadIT) and consumes energy from their own windturbines and PV-systems. These aspects inspired Zaanstad to impose a different role on the supplier. The energy distributor is supposed to act as a proactive partner that shares their specialized knowledge on energy matters that is beneficial to the goals of the municipality.

Findings ReloadIT case study

- A cost reduction of 10% by trading on the APX market is feasible.
- A cost reduction of 20% is feasible by trading on the APX market, combined with a wind turbine on the local estate.
- Electric cars seem to be the ultimate source of flexibility (15-30%). NOTE: Although physical limitations of

batteries reduce the life cycle of the batteries, caused by the number of charge- discharge algorithms.

- Financial gains seem to be a main driver by avoiding taxes and networks costs.
- Present energy tariff i.e. the taxes versus net energy prices hamper exploitation of flexibility.
- The present definition of private network avoids exploitation of renewable sources of energy other than on the local estate. Regional up scaling is thereby hampered.
- Different organizational procedures or governance is needed to realize local owned smart grids based on renewable energy systems.
- "It takes a lot of effort to change existing operational processes and habits..."
- Public Private Partnerships (PPP) can be a complicating solution for this type of projects.

Power to heat (in a residential and industrial area)

Another spin off at the Municipality of Zaanstad was the cooperation with different stakeholders on the development of a "smart and open energy system". This system aims to reuse residual industrial heat for housing, hospitals, swimming pools etc. The basis idea is to introduce balancing capacity/flexibility with the heating system. Hoogtij and Hemmes peninsula are nice examples of act smart from the start.

Feasibility study Hemmes peninsula

The Hemmes peninsula is a residential area, yet to be developed. It comprises the construction of 80 dwellings, to be combined with 6 authentic "Zaanse" windmills. The study comprises an analysis of the energy balance and the economic feasibility of the project. The configuration examined consists of 6 wind mills, 80 all electric dwellings, each having an electric car, solar panels, and heat pump.

Conclusions on the feasibility study:

The yield of this configuration is adequate to cover the energy demand for the whole peninsula.

There is not a business case as: The present legislation does not allow the establishment of a private electric network, a network that could be used to locally balance electricity, thus avoiding transport and energy taxes. The business case depends on subsidies, which are subject to policy, thus not guaranteed for a period of 20 years.

Case study: HoogTij

Case study HoogTij is an example of the development of a smart energy network within an industrial area, a nice example of "how to get smart from the start". The study comprises a technical and economical assessment of a feasible configuration of a large building, a possible heat production system, and renewable energy resources. This study should result in viable business cases. Next to this assessment, the organizational and legislative aspects were examined.

The question was: How can we develop new industrial areas and integrate energy matters right from the start? The development of industrial area HoogTij implied integration of renewable energy sources from the start, yet it was struggling with the viability of potential business cases. Moreover, a network for production of heat and cold is part of the energy infrastructure.

Several concepts for renewable energy production were examined. However, exploiting the flexibility in a smart energy network was not yet considered.

The showcase HoogTij proposes a smart energy network, which includes the following main components:

- Three or four wind turbines
- A district heat/cold network with heat pumps
- Buildings connected to the heat/cold network
- Active and passive heat storage, to provide flexibility in the production of heat.

Findings on the case study Hoogtij

- The economic benefits are so significant, that a heat network combined with a smart grid can provide a profitable business case i.e. 8 to 23%.
- The business case could be more profitable in case the wind turbine is placed on the private estate and the energy can be traded directly (private and smart grid scenarios). The added value of the flexibility turned out to be an additional cost saving of up to 5%.
- The present definition of private network avoids exploitation of renewable sources of energy other than on the local estate. Regional up scaling is thereby hampered.
- Due to Dutch law the placement of wind turbines on shore have been limited or even stopped.
- Present energy tariffs i.e. the amount of taxes versus net energy prices hamper exploitation of flexibility.



Read the full showcase description at eharbours.eu

Showcase: Malmö, Sweden. City of Malmö.

Smart homes & harbour development in Malmö

In City of Malmö, Sweden, two case studies have been performed. The first one examines a smart energy system on household level, the second one a new industrial area in the Northern Harbour.



Smart Homes in Malmö with renewable production and flexible consumption. Photo E.ON

Case study: Smart Homes

Eight new apartments have been erected in the Western Harbour in Malmö, Sweden. The energy company E.ON will demonstrate new ways to generate and use energy through interaction with its customers in the houses called Hållbarheten (Sustainability). The initiative, supported by City of Malmö, does meet all three corner stones of the e-harbours project; smart grids, electric mobility and renewable energy. The eight houses are equipped with different solutions testing new

techniques and 100 measuring points to monitor the results. All houses are equipped with smart grids where also price adjusting solutions are tested for steering of electric cars charging, freezers and laundry machines. The house is also equipped with solar collectors, photovoltaics and it's own wind mill. Five electric cars, one electric vespa and 7 electric bicycles are included in the house for the use of the residents. For the evaluation of the showcase E.ON and residents of the house have been interviewed and data collected. Flexibility in energy consumption have been found from dish washers, tumble dryers, washing machines and electric vehicles charging, in total 44 000 kWh per year.

Findings

If we would upscale the Smart Homes to all newly built apartments in the City of Malmö the total annual load shifting would be 63 MWh per year in 2030. Most of the technical solutions for a Smart Home are today on the open market, but not all of them, for example vehicle to grid-solutions. However E.ON have packaged some of the solutions from the Smart Homes in to a package that could be installed in newly built apartments for a smaller cost. In total however, the flexibility in household energy consumption is quite small



Case study: Northern Harbour

The Northern Harbour in Malmö is the new industrial harbour area for industries and energy production. The Northern Harbour includes both large energy consumers and the most vital energy production

facilities in the city. The scope of the case study was to find excess heat and renewable heat for the district heating grid.

We have mapped energy flow, waste and transport in the Northern Harbour. Interviews with energy actors, six energy producers and consumers in the Northern Harbour were conducted.

Findings

- More excess heat from industries are available.
- More heat could be produced renewable, for example via wood burners replacing compressed natural gas CHP plant.
- SYSAV could store heat locally from day to night when needed

Showcase: Amsterdam, Netherlands. City of Amsterdam.

Searching for flexibility provided by electric boats in Amsterdam

Case study: Electric boats

The Amsterdam canal boats are number 1 tourist attraction in the Netherlands (over 3 million visitors a year). Given the large scale of boating, approximately 250 boats for commercial use (canal cruise boats and rental boats) and 14.000 small leisure boats (owned by citizens), the transfer to electric boating could contribute to the air quality in Amsterdam and to flexibility of energy use (smart grids) on the long run. The Amsterdam canal boats could potentially be an interesting energy buffer, consuming the energy during low demand hours or when local renewables are in excess. The scope of this case study was to estimate the potential of flexibility provided by electric boats.

The strategy was to combine theory based on reports by Waterrecreatie Advies and TNO (Centre for Applied Scientific Research), with input based on interviews with an electric boating company, Greenjoy, an aggregator company — which is authorized to trade on the wholesale market on behalf of a pool of customers — and an association for electric boating “Vereniging Electrisch Varen Nederland”.

The case study shows that the batteries of the electric boats offer a great potential for flexibility, and could be exploited as part of a smart grid application. Local optimisation can be implemented without changing Dutch laws, however integrating wind energy can only be exploited in case the turbine is located at the local estate, and regarded as part of a private grid.

The cluster application has an even higher potential, being part of a grid balancing business case. However, we assumed, for the sake for the analysis, that clustering consumers and producers dispersed over the region would be an option. This is not yet the case yet, this option would be very important to enable exploiting balancing group settlement.



Canal cruises in Amsterdam. Photo Colourbox

Technical issues

Based on the interview with our stakeholders we conclude that technical issues are not the show stopper of using electric boats as part of a smart grid. The electric boats are all equipped with an adequate ICT infrastructure that has enough functionality to support the implementation of a smart grid application (remote monitoring and control: real time remotely charging and discharging batteries). Chargers should be upgraded to higher charging currents, and for exploiting balancing group settlement be replaced by charge-discharge devices.

Contribution cost saving on energy bill due to exploitation of flexibility.

Contribution cost saving on energy bill due to exploitation of flexibility.

Economic issues

The analyses of the different scenario's show that there are viable business cases, using both local and cluster optimisation. However the big question remains whether the gain is high enough to cover possible extra investments.

Read the full description at eharbours.eu

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

Smart energy solutions examined in Hamburg



Looking for smart energy solutions in the harbour area of Hamburg. Photo Colourbox

The e-harbours Hamburg showcase focuses on the application of smart energy solutions in large-scale industrial, commercial and infrastructural properties in a typical harbour environment.

The solutions that are taken into consideration cover a wide range: Local load shifting mechanisms, integration of local consumption and/or production devices into a virtual power plant, combined generation to cover power and heat demand, and options for energy storage in the form of electricity, heat or cold. Although technical possibilities are assessed within each case study, the economic viability of smart energy solutions lies at the centre of attention, following the question: What makes a smart grid profitable? The target is therefore not to build technically viable demonstrators, but to introduce and assess smart energy solutions in today's market-based environment and in accordance to companies' expectations regarding return on investment, operational security etc. Please note that due to non-disclosure agreements with all cooperating companies, no company names can be stated here, and no precise figures can be provided.

Case study 1: Chemical production plant

The company operates a medium-to-large production plant in the Hamburg Harbour, where it produces a broad range of semi-finished goods from raw materials. The plant is operating continuously, but production is organized manually in batches. Production steps vary according to the specific products. What makes the situation very interesting from a Smart Energy point

of view is that the company recently installed a large CHP (combined heat and power) plant that now covers a large part of the company's thermal and electric energy demand.

What have we done

In two extended on-site visits, the flexibility potentials of consumers were analyzed.

Results

The most interesting potentials lie in the flexible operation of the CHP plant in order to provide reserve capacity. At minimal investment costs, revenues can be expected that are equal to several percent of annual electricity costs. However, the CHP alone does not reach the minimum amount of 5 MW of flexible load that is the threshold for direct market entry on the reserve capacity market in Germany. In order to benefit, the company would have to rely on a reserve capacity pool operator, who would in turn charge for his services. This is where the "power-to-heat" option comes into play: Revenues can be almost tripled, and the increased amount of flexible load allows a direct participation on the reserve capacity market. Additional investments are required, but would amortize in about two years.

Case study 2: Container Terminal

Second case study within the Hamburg showcase is a container terminal in the port of Hamburg. It is the most modern of several terminals in Hamburg. With a yearly cargo capacity of 2-3 mio TEUs, it is also a rather large

terminal. The terminal's loading infrastructure (container and storage bridges) are completely electrified, and are largely controlled automatically, i.e. without a human operator steering the crane. The terminal operator is traditionally very engaged in increasing efficiency and reducing ecologic impacts of its facilities. Also, the company is considering several options for on-site production of electricity. Concerning grid infrastructure, none of the terminals in Hamburg is facing physical load constraints. However, peak-load related costs for grid utilization are quite substantial. In addition, the German grid code foresees further reductions in grid utilization costs if the load curve of a consumer is largely stable over the year. Together, this makes quite a strong case for load shifting operations. Another aspect that is also relevant in the case of some container terminals is a peak/off-peak tariff, where off-peak prices per kWh are slightly lower than during peak times.

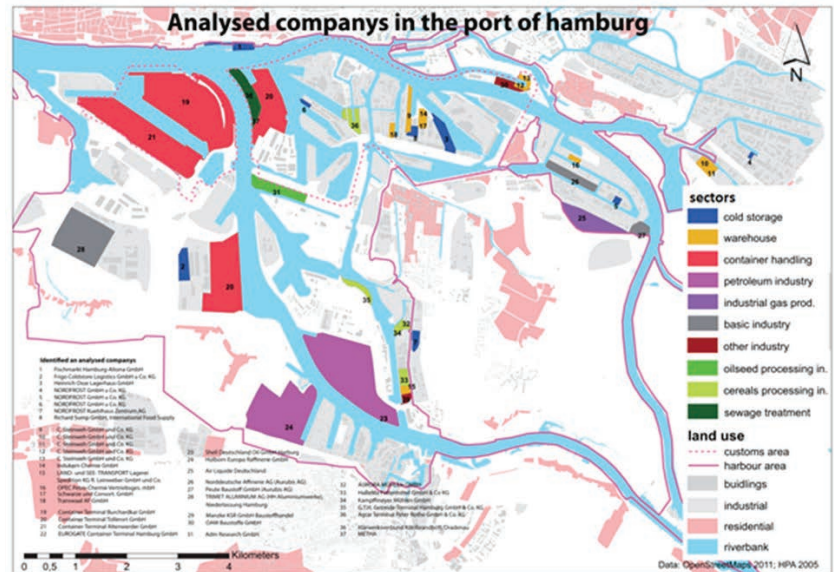
What we have done

Regarding the loads caused by different consumers on the terminal, only rough estimations were available, since they are not currently measured and logged for single parts of the terminal or even separate consumers. Therefore, it was decided to install measurement equipment at the terminal.

Currently, data is collected on 30 measurement points: Measurements extend over a few months in order to capture effects by seasonal changes in terminal turnover and ambient temperature.

Findings

The most interesting application in the Hamburg terminal would be to even out the load curve of the entire terminal in order to reach reductions in grid utilization costs. Also, a reefer-based load management system can be used to profit from a peak/off-peak tariff. Possible savings would amount to several percent of the terminal's total electricity costs, which is a significant amount in absolute terms. Necessary investments would amortize after far less than a year. However, realization of this business case is subject to two conditions: Firstly, the shiftable load represented by reefers must be large enough to even out the load profile for the whole year – which is a very close call.



Hamburg port area. Source HAW/Sumbi

Case study 3: Cold storage warehouses

Refrigerated warehouses for storing frozen or cooled food are found at most commercial harbours around the world. In most cases, they are cooled by vapor-compression refrigeration using electric compressors. Temperature within the warehouse is set according to the products stored, and controlled automatically by thermostats. Compressors also run automatically depending on the demand for coolant in the refrigeration system. If cold storage warehouses are used for load shifting operations, the refrigeration system and thus the power consumption could be controlled in order to reach a certain increase or decrease in total load. Due to the good insulation of cold storage warehouses and the large mass of cargo stored, temperatures within the warehouse will only rise slowly if compressor operation is interrupted.

Findings

It resulted that the warehouse operators could save around 7% on total energy costs using the business case of contract optimization, equivalent to a low 5-figure sum in the analyzed cases. Savings are mainly realized through reductions in grid fees that are available to customers that consume most energy during off-grid times. It has to be noted, however, that one of the assessed warehouses already made use of this business case in the assessed period using a basic timer mechanism – in this case, additional savings through an optimized control are much smaller.

Read the full description online at eharbours.eu

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

Five case studies on flexibility in the Port of Antwerp

The goal of the Antwerp showcase is to facilitate the generation and application of renewable energy in harbour regions. The first aim of our research in the Antwerp harbour is to identify industries that can provide a flexible demand for energy. In close cooperation with the Antwerp Port Authority, VITO selected different companies that operate cooling and freezing facilities, a facility for dewatering and recycling of sludge, and a chemical plant. For each facility the flexibility was quantified, and potential business cases were assessed.



Amoras is one of the participating companies in the harbour of Antwerp

Case study: Amoras

The Port of Antwerp is located about 70 km from the North Sea on the river Scheldt. In order to keep the Port of Antwerp competitive, continuous dredging of the river and in the docks is needed, in order to give ships with more draught access to the Port of Antwerp. In the docks on the right bank, this results every year in more than 1.000.000 m³ (\pm 500.000 tons dry matter) of dredged material which has to be processed. AMORAS is the name of a facility which was recently built as a sustainable solution for the dewatering of sludge.

Quantification of the flexibility

AMORAS has two different locations in the Port of Antwerp: quay 536 in the docks and the 'Bietenveld'. At quay 536 the sludge is accepted in a first buffer: the underwater cell. The sludge is dredged again with an electric cutter and on land a coarse sieving and de-sanding takes place before the sludge is pumped to the second location. At the 'Bietenveld', the sludge arrives in a second big buffer: the thickening pools. From the second buffer the sludge is pumped in to the mechanical dewatering installations for final processing and storage.

A first technical screening showed the AMORAS facility has a huge potential for the exploitation of flexibility. Both locations have huge buffers, which can store sludge for days up until weeks. The pump installation, which is responsible for the transport of the sludge from the first location to the second, has a capacity which is significantly higher than the capacity of the mechanical dewatering installation. The combination of large buffers and overcapacity are perfect ingredients for the presence of flexibility.

Findings

Amoras has a huge flexibility in "time", "power" and "energy" and is well suited for local wind balancing. Present operational constraints must be investigated in order to achieve a valid business case. Due to the large buffers and due to the large overcapacity of the pump installation, simulations showed that it is possible to operate the pump installation completely on wind energy. Without optimization, 60% of the produced wind energy can be used in locally.

In case the flexibility is used in an optimal way, almost 80% of the wind energy can be consumed locally. This results in an overall energy cost reduction of almost 20%.

Case study: Borealis

Borealis is a world player in the production of chemicals and innovative plastics. The Borealis facility in the Port of Antwerp (production site Kallo) produces polypropylene pellets. For the e-harbours project, it is very interesting to have a company as Borealis in its portfolio because it represents a typical “process industry” facility, known for its large energy consumption and very constant energy demand.



A search for flexibility in a company like Borealis shows that it is possible to find flexibility in the process industry. Based on the extremely constant power consumption profile, it was expected that the flexibility within Borealis was limited. However, the present flexibility is significantly higher than expected. At this moment, there is no business case: the flexibility is huge in absolute quantities (confidential information) and can be used to reduce the energy costs, but the gains are limited compared to the total energy consumption of the entire plant.

Case study: Luiknatie

Luiknatie offers services ranging from maritime logistics, handling and storage of various goods to traditional land logistics offering customers complete solutions for import and export. One of the activities of Luiknatie is temperature controlled storage. Luiknatie has a cold store facility in the Antwerp harbour for cooling and for deep-frozen products. It has a quite broad portfolio of products for deep freezing, including chemical products which are not temperature critical. Simulations show that in combination with a wind turbine the theoretical cost reduction could be 12%, mainly due to a 35% reduction of the energy bought during the expensive day tariff and a significant reduction of the peak power consumption.

**Case study Norbert Dentressangle**

Norbert Dentressangle is an international company with a base in Antwerp from where they offer customers a broad range of handling and logistic services to maritime related cargo flows moving through the port of Antwerp. Norbert Dentressangle can provide activities as freight management and transport, warehousing and distribution, terminal operations, short sea and deep sea shipping, stuffing and stripping of containers and all related administration. One of the divisions is the Fresh division, focusing on storage and distribution of temperature controlled perishable products. A new 162.000m³ temperature controlled storage facility was built in 2008, for cooling and for deep-frozen products. The simulations show that combined with wind energy, the maximum power of the refrigeration unit can be used efficiently in order to buffer and exploit cheap wind energy. A yearly cost reduction of 15% is feasible.

**Case study: Sea Invest**

SEA-invest is one of the world's largest terminal operators for dry bulk, fruit and liquid bulk and is active in 25 ports worldwide. SEA-invest Fruit and Food Division mainly focuses in Antwerp on storage and riping of exotic fruits (e.g. bananas, pineapples, etc.). Generally, cold stores are known for their flexibility but typically temperature margins are wider in cold stores for freezing compared to cooling. The constraints set by the company are so tight that insufficient flexibility is available to create a valid business case. For that reason, the remaining flexibility was considered too low and didn't justify further analysis.



All descriptions, findings and recommendations are available online at the e-harbours website. Find the full showcase descriptions online with findings and recommendations: eharbours.eu

Showcase: Scalloway, United Kingdom. Pure Energy Centre.

Smart energy usage in Scalloway Harbour

Scalloway is an important fishing harbour situated on the west side of the Shetland Islands. The relatively small size and the large variety of activities within the harbour area make this site a unique and interesting show case for the uptake of smart grid and renewable energy solutions in a harbour area.

Fishing harbours such as Scalloway have considerable environmental impacts with high CO₂ emissions, water usage and fish waste. The energy demand is high due to the refrigeration and fish processing plants contained within the harbour area, along with transportation, heating systems, net cleaning and shore power for marine vessels whilst in the harbour.



Scalloway Harbour, the Shetland Islands

The aim of the show case is to improve the harbour sustainability, improving efficiency and facilitate the possibility for the intervention of renewables, smart grids and virtual power plants in the area.

What we have done

In collaboration with the harbour authority and the local organisations, Pure Energy Centre® has developed a set of criteria to be used for an effective monitoring of the energy consumption of the Harbour. At the same time, the large potential of renewables energy available in Scalloway has been investigated, with the objective to assess the potential benefits in terms of economic value and CO₂ emissions. The outcomes of the energy monitoring strategy will allow the harbour community to analyse their energy consumption and behaviour, leading to the development of new and effective energy management strategies to reduce their energy costs and become more competitive, locally, regionally, nationally and internationally.

The below summarises what we have done:

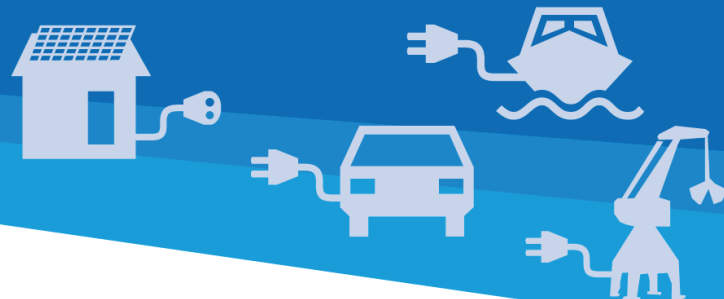
- Development of Universal Energy Analysis Strategy
- Site Analysis and Monitoring
- Assessment of Renewable Energy
- Development of Analysis Tools
- Energy Efficiency Recommendation for Scalloway Harbour

Findings

The application of the strategy showed that the use of a smart grid can potentially provide benefits for Scalloway harbour and could be applied to other European small to medium harbours. It was found that the Distribution Network Operator (DNO) should be fully involved in the implementation of a smart grid solution. In Shetland plans are currently being implemented by the DNO to establish a smart grid through the North Isles New Energy Solutions (NINES) project. It is hoped that once this has been setup, the benefits that smart grids can bring will be implemented in Scalloway harbour. Historically in the Shetland it has always been a great challenge maintaining and managing grid stability, and the inclusion of increasing quantities of renewable energy systems has made it even more difficult. In fact, it is now extremely difficult to connect a renewable production system to the grid. This provides a compelling argument for the implementation of smart grid technologies in the Shetland Islands.

By applying the Energy Efficiency Recommendations, the harbour could save £33,000 per year from a capital investment of £340,000. This means there would be a 10 year payback period and by following these recommendations, harbour stakeholders have the potential to become more profitable, and create more jobs and wealth for the local community.

Read full description online at eharbours.eu



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

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- Supported by: EU Interreg IVB North Sea Regions –Programme
- Priority: 3: Improving the Accessibility of Places in the North Sea Region
- Area of Intervention: 3.3: To promote the development of efficient and effective logistics solutions
- Duration: September 2010 - February 2014
- Website: www.eharbours.eu