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WP 3.7 Application of Smart Energy Networks

Organisational and Legislative Analysis
Summary results of showcase REloadIT at Zaanstad

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1 Introduction

Smart energy networks are intelligent and flexible solutions which combine flexible energy consumption, local generation of (renewable) energy and energy storage on different levels. In any smart energy network, the presence of both technical/economical and organisational/legislative conditions is crucial.

The e-harbours report 3.5 focuses on the *technical and economical aspects* of smart energy solutions. The scope of WP3.5 is the translation of the 6 universal business cases (e-harbours report WP3.4) on the level of every showcase. It gives an overview of the potential for the exploitation within the existing local (national) rules and regulations.

This e-harbours report 3.7 focuses on the *organizational and legislative aspects* of smart energy solutions. A list of barriers has already been composed (deliverable 3.3).
This report 3.7 addresses the analysis on a local level, and gives an overview of barriers which hamper the exploitation of smart energy systems.

1.1 Description showcase

The municipality Zaanstad has ambitious goals to become climate neutral in 2020. Local renewable energy production, as well as clean mobility is stimulated. Within the REloadIT project a smart grid system has been developed tested to examine whether the benefits of renewable energy production can be matched with flexible energy consumption. To accomplish this goal, three core activity areas have been defined: 1) energy reduction 2) introduction of renewable energy production and 3) innovation. Project REloadIT is an example of goals 2 and 3.
Renewable energy generation by photovoltaic and wind, energy storage, electric driving, balancing energy and the role of the electricity network are aspects of energy transition that are not common practice for the municipality. This document covers the study on the organisational and operational impact of the introduction of a smart grid system: that is the development and implementation of a smart energy system based combining renewable energy production and flexible energy usage by electric cars. The ICT-system comprises two main components: a car reservation system for electric cars, and a smart energy algorithm which controls the smart charging of electric cars.
The main objectives to be addressed were:

1. To optimise the usage of renewable local energy to be consumed by the electric cars of Zaanstad by developing a smart grid system (development of software, and integration with present hardware).
2. Demonstration of the capability of the smart grid application under practical conditions: i.e. the reliability of the ICT-system, and availability of electric cars, and the operational aspects.
3. Study on possible business cases (scope 3.5) and focus on organisational and legislative aspects.

1.2 The strategy/approach

This report reflects on the organizational and legislative aspects of the showcases, conclusions and lessons learned. We make a distinction between Zaanstad-internal and smart grid specific matters. The next project phases were followed:

- Determine the objectives of the municipality (to be documented in the project plan);
- Organising a startup of a REloadIT user group consisting of personnel from various departments of the municipality, partners of e-harbours, car park owner and operator;
- Writing a REloadIT project plan (planning in time, roles, finances etc.), reviewed and approved by the ReloadIT
- Writing the functional and system requirements of the REloadIT SmartGrid;
- Subcontracting and development of the software application;
- Commissioning of the system ;
- Exchange experience with the user group. Further developing and improving the system.
- Study on barriers of the possible business cases (see report 3.5) but focus on organisational and legislative aspects that hamper the introduction of smart systems.

In chapter 2 the different project phases (summarised in 4 phases) are elaborated.

1.3 Scope of the e-harbours showcase in Zaanstad.

Current situation charging infrastructure
The new City Hall was completed and the infrastructure for charging the cars has already been operational. There are solar panels installed on the municipal bicycle building and there are solar panels on other buildings.

Contracts
The contracts of the energy supplier until now played a minor role in the possibility to reduce energy costs. Zaanstad is anticipating future sustainable development with the procurement of new energy contracts for the municipal organization. There are several questions and barriers which REloadIT encountered in the realization of this project.

Preconditions
Important precondition starting the REloadIT development is that the current operational ICT-systems within the Zaanstad municipality should not be affected by the implementation of REloadIT. The charging stations were not capable to be used as dis-charging systems, which could be a future functionality in case storage of energy and feed into the grid should be an option.

Questions to be answered & challenges encountered by the introduction of the smart system:

- How to involve end users: examine aspects on behaviour, how is good behaviour (planning & realization energy question) rewarded?
- What did we learn, what is needed to overcome the technical and organisational hurdles, how to accept and embed the knowledge gained into the hearts and minds of the personnel (and in the management system)?
- Different parties are involved; this increases the complexity of the project organisation how to manage this?

- How to manage the changed perception of costs and or investments during the running time of an experimental contract?

<u>REloadIT deliverables</u>

1) Work Plan REloadIT (Dutch)
2) System Specification (functional & technical) REloadIT
3) Design document (July 2011)
4) Financial planning REloadIT (Oct 2011)
5) Software application REloadIT
6) Smart grid application REloadIT
7) Web application (user interface) REloadIT
8) Internal presentations between August 2011 and April 2013
9) Project meeting agenda's & minutes
10) Minutes stakeholder meetings.
11) Questionnaire electric transport Zaanstad

2 SUMMARY RESULTS

2.1 SHOWCASE RELOADIT

2.1.1 Introduction

The municipality of Zaanstad aims to be climate neutral in 2020. Local renewable energy production, as well as clean mobility is stimulated. Within the REloadIT project a smart grid system has been developed and tested to examine whether the benefits of renewable energy production can be matched with flexible energy consumption. The following paragraphs depict the process of the development of the smart system, the organisational aspects focused on organisational and legislative barriers...

2.1.2 Investigation results

A) REloadIT start-up phase

During the start-up phase of REloadIT the project-team was established. The REloadIT project partners included: the municipal car park operator (Q-Park), the charging equipment company (IMTECH), the responsible for the electric cars within the municipality (Zaanstad), the project leader electric transport (Zaanstad) the regional DSO (Alliander), the University from Amsterdam (UvA) and the project leader from Zaanstad. In this phase the partners where getting acquainted with the concepts of a smart grid. The technical specialists were in the lead, guided by the REloadIT project leader and supported by Vito.

Deliverables: Project work plan and a functional specification of REloadIT.

Barriers encountered:

1) Getting some of the regional partners committed to the project was difficult.
2) Especially the commercial partners, persuading them to invest time and efforts in such experiment without having a short term commercial benefit.
3) Nobody truly responsible for energy-related matters: it was (very) difficult during both start-up and lifetime of the project, to keep our won organisation involved municipality of the added value of (smart) energy management

B) The REloadIT system design phase

During the period August to November 2011, the REloadIT system was defined. This included the system functional and technical specifications, and specification of the development path (including testing, evaluation and adding improvements). The project team realised a project plan, including a project finance scheme. As Smart Energy Systems are new at Zaanstad, they consulted the e-harbours partners VITO, who supported Zaanstad during this phase.
Deliverable: System specification REloadIT.

Barriers encountered:

1) Cooperation within the municipality: the department responsible for IT within the municipality was requested to collaborate, but this was hard, given the pressure of operational issues and the nature of an innovative Smart Energy experiment. It could not fit in the present ICT-infrastructure within the time frame of e-harbours.

2) The commitment of partners was not always obvious; it was not always possible to get the promised contributions from some partners (in spite of frequently requesting). No sanctions lead to less commitment of partners.
3) It was quite difficult to gather information of the equipment: concerning the solar systems, and the car charging equipment.
4) During the period of further tuning the design REloadIT system objectives written into the functional technical specifications document the subcontracting procurement was also initiated
5) Within the organisation of the parking (too) many stakeholders are involved. They are partially responsible for the operations. Not clear where/whom to ask your questions.

C) The REloadIT system development and implementation phase

Introduction

The municipality had difficulties to assess the investments involved to develop such a system. A tendering process was initiated, by approaching four companies to submit a tender. An internal debate about the tendering procedure took quite some extra time and proved to be a serious barrier for the REloadIT project realisation. The selection process resulted in the selection of the best offer on value for money. EnergyGO was selected not only because they submitted the best offer, but also because they were prepared to invest in the development of the REloadIT system.

REloadIT system implementation

During the technical development phase of REloadIT (March-October 2012) the project team worked on the technical options. The Zaanstad authorities, the electric car park manager, the technology provider, and other stakeholders all contributed to the system design.

The involvement of the operational departments (Services and ICT) was not well established in this phase. During the development of the technical and functional specifications the ICT department unfortunately was not involved. Technical and organisational issues were foreseen by the ICT-department. The project e-harbours decided to go on to the next stage, in order to proceed and meet the demands of the international planning.

Internal inventory on car usage

A questionnaire regarding electric vehicle utilisation was executed, providing an inventory with opinions and desired functionality to optimise electric car utilisation. This proved to be important input for the developers of the REloadIT system. The outcome of the questionnaire also emphasises that there are barriers to overcome to improve the utilisation of electric vehicles. Employers still prefer a fossil based car above an electric car due to: unfamiliarity of automation driving and uncertainty if the battery is sufficient loaded for their planned travel.

Barriers encountered:

1. Employers are not yet familiar with the peculiarities of electric cars. More instructions are necessary about the operation of an electric car.
2. Subcontracting ICT-scope was a new aspect for the Zaanstad team.
3. Estimating costs and efforts for this type of ICT-project is difficult.
4. The continuous involvement of the stakeholders (especially internal departments) is necessary, but a challenging process. This turned out to be the mayor barrier. Internal cooperation with too many stakeholders .

2.1.5 Legislative and contractual barriers (smart grid related)

During the REloadIT project it became clear that the current energy legislation, regarding regulations of tariffs, taxes and requirements for owning and using the grid, is not optimal to promote the introduction of smart grids. This is illustrated by the following arguments.

The existing energy tariff structure is based on the conventional energy supply and transportation. There is no incentive to use renewable energy production directly for energy demand. Flexibility in capacity tariffs regarding this situation -sustainable production and local demand energy management- is not yet available.
Energy tax legislation is not appropriate to anticipate on innovative developments, such as more local decentralized renewable energy production and the increase of (de)charging of electric vehicles. REloadIT indicates that the revenue for the produced solar electricity strongly depends on existing energy contract for energy consumption of the building on which roof the panels is installed. The revenues differs if the contract is based on large (for instance, in case of centralised procurement) or small consumers. When the own produced solar energy is consumed on another location nearby (own smart grid) the consumer pays energy tax for its own produced renewable energy. Several stakeholders asked the national government to adjust energy policy to encounter this issue.

REloadIT has to make clear agreements about ownerships and usages of the charging points, electric vehicles, public space (), energy-infrastructure, renewable energy units have to be made. Juridical responsibilities have to be appointed in an early stage of the project if possible.

During the service contracting phases of the parking lot, not yet all learnings/ins and outs of REloadIT were available. This led to a current situation in which the flexibility of the project can't fully be used for cost reduction. It is recommended to beware of consequences of agreements to be made. This means that during contracting phase specific attention has to be paid to:

- How to value the balancing of energy supply and demand.
- New responsibilities have to be defined and agreed upon. For instance regarding performance of installations, software applications, customers' satisfaction about reservation and use of electric cars etc.

Energy contract
Another spinoff of the REloadIT project is the latest energy contract rewarded by GreenChoice to the municipality Zaanstad. During the REloadIT trajectory the existing energy contract ended. Inspired by the energy specialists in the e-harbours team, the idea emerged to start an energy procurement based on new smart energy elements in it: balancing, flexibility, apx, esco-experiences and own (green) production. Core of the innovation is to include energy saving requirements as an incentive for the supplier.
Lessons learned and recommendations of the accomplishment of the energy contract are published in a small document titled *Local Procurement of Renewable Energy - Cooperation between the Municipality of Zaanstad and the energy provider.*

2.1.4 Spin off REloadIT

Innovation award 2013
REloadIT is one of the first operational systems where renewable energy generation and local consumption are locally optimised. This resulted in more clean energy concerted into 'work' with a minimal impact on the electricity grid. This is one of the reasons that REloadIT has been rewarded the with the Alliander Innovation award 2013, our regional DSO.

Reuse of ReloadIT
The system was presented to the project team (December 2012). The idea emerged to consider whether the energy and electric vehicle management tool could be applied broader in the municipality.
A smart municipality wide transport strategy support could increase the added value of REloadIT. This is still in the planning, but at present the real-time testing of REloadIT is ongoing and this phase will be finalised October 2013. An evaluation will be executed and provide knowledge regarding the future application and development of REloadIT technology.

3 Conclusions

The REloadIT project shows that technological issues are not the real challenge. The REloadIT project demonstrated that a technical ICT-infrastructure is an essential element for the realisation of a sustainable energy supply in the future.
The real challenges are related to communication, finances and organisation**.** Finances regarding energy, taxation, energy-network issues is a field for specialists.
Organisational issues when executing innovation in an operational environment with multiple stakeholders brought other barriers.
During the startup-, development-, implementation- and testing phases may barriers were identified. This is however a natural process of innovative project activities which are developed in large organisations with a large variety of (inter-)processes and procedures.
Zaanstad related aspects:

- This project created internal support for electric mobility and renewable energy, and could inspire regional partners.
- Within the municipality a greater support for smart energy systems has been created, the term 'SmartGrid' has been established;
- Internal collaboration within the municipality can be difficult. The REloadIT activities increased the work load
- Two consecutive project leaders left the project, this hampered the continuity, created a knowledge gap of new PL. Fred: adviseer om voortaan een externe ICT-expert aan te wijzen...
- Change management in large organisations is an important issue to address, create good expectation management by open communication and early involvement of personnel.
- The REloadIT project created a knowledge base in Zaanstad, which could be reused for other projects.

Smart grid related aspects

- Present legislation (national) not yet fit for upscaling smart energy systems ; private nets are forbidden.
- For the sake of demonstration: Virtual cases (based on scenario's EnergyGO report) were defined to obtain a feasible and representative business cases;

4 Lessons learned

4.1 Organisational issues

Organisational – lessons learned (Zaanstad specific)

- In 2010 energy management was an underrated topic in the Municipality, were little knowledge was available.
- The staff originally appointed to this tasks had no experience leading ICT related projects nor with smart grid applications. This was worsened by the fact that various staff changes occurred during the definition and development phase of REloadIT.
- Specific external/internal expertise is needed to lead and develop a smart grid application.
- Continuous internal communication is essential from concept to implementation of an application. Pay attention to accessibility of crucial information at an early stage of the project and arrange easy access to information.
- Take into account it takes a lot of effort to change existing operational processes and habits. Example: The involvement of the ICT department
- Different organisational procedures or governance is needed to realise local owned smart grids based on renewable. Public Private Partnerships (PPP) can be a complicating solution for this type of projects.

Organisational – recommendations (Zaanstad specific)

- Elaborate (and embed into the management system) organisational guidelines to established local owned smart grids based on integration of renewable energy. Requirements of organisations, skills, expertise, finances and capacity;
    - Make a check list of crucial information and requirements and an overview of the responsible persons within organisations to get access towards this information; Characteristic of a smart grid demonstration project is that different organisations are involved. Which persons have the right competence and authority to make the needed decisions;
- Define ownership, maintenance and operations divided between different organisations/departments of Zaanstad or subcontracted activities.
- Arrange regional and national networks to start exchanging best practices;
- How to better involve/embed the ICT department in future projects it is suggested to define preconditions concerning ICT-security aspects, and internal ICT-standards.

4.2 Legislative issues (Smart grid specific)

Legislative – lessons learned

- Present national energy regulations and energy contracts are not suited for the introduction of smart grids;
- Interest of the national government regarding legislation and revenues by taxes partly conflict with upscaling ReloadIT finding
- Energy taxes are not supportive to increase the REloadIT business case.
- In general investments costs are high.

4.3 Ideas for further investigation

Networking, embedding and exploiting REloadIT
Future of REloadIT in a regional and national context. The REloadIT system is actually in a testing and evaluation phase, but the municipalities, ministries, provinces and commercial organisations show interest.

1. The great Metropole region of Amsterdam expressed their interest to participate in further extension of REloadIT.
2. A delegation of Rome visited Zaanstad to learn from the REloadIT achievements, the Ministry of Transport and Infrastructure, Directorate General Rijkswaterstaat visited Zaanstad to get acquainted with REloadIT technology and functionality.
3. The launching of REloadIT in the municipality the 1st of March 2013 attracted attention of 120 attendees, companies, municipalities outside Zaanstad, and energy agencies.
4. Various follow up initiatives have been initiated at national and European level. REloadIT is taken up as a Good Practice in the EU funded GreenITNet project (www.GreenITNet.org).
5. Actually the last year of the REloadIT project is ongoing, and the concretisation of the broad scope of this technology is in full development. This will be assessed during the coming half year and prominent present during the final e-harbours event planned in February 2014.

New innovative initiatives
1. The next SmartGrid generation will possibly optimise the adaptation of the present charging stations (remote load and higher charging currents of the batteries),
2. Introduction of a more accurate method of "car energy usage" forecasting.
3. Zaanstad has various proposals submitted targeting further project development, in EU context (FP7, Optimus, IEE ProSmart) and at national scale.

5 References

1) Website of REloadIT: www.reloadit.nl
2) Available presentations and brochures, refer to e-harbours website: http://eharbours.eu/showcases/showcase-zaanstad
3) Questionnaire about the use of electric cars
4) Note/report conclusions questionnaire
5) Note/report test of users electric cars within the REloadIT project
6) Report Lars Botman *Onderzoeksverslag Evaluatie vervoermanagementplan (only in Dutch)*

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WP 3.7 Application of Smart Energy Networks

Organisational and Legislative Analysis
Summary results of showcase "Search for flexibility provided by electric boats in Amsterdam"

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The Interreg IVB North Sea Region Programme
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1 Introduction

Smart energy networks are intelligent and flexible solutions which combine flexible energy consumption, local generation of (renewable) energy and energy storage on different levels. In any smart energy network, the presence of both technical/economical and organisational/legislative conditions is crucial.

The e-harbours report 3.5 focuses on the *technical and economical aspects* of smart energy solutions. The scope of WP3.5 is the translation of the 6 universal business cases (e-harbours report WP3.4) on the level of every showcase. It gives an overview of the potential for the exploitation within the existing local (national) rules and regulations.

This e-harbours report 3.7 focuses on the *organizational and legislative aspects* of smart energy solutions. A long list of general barriers has already been composed (deliverable 3.3).
This report 3.7 addresses the analysis on a local level, and gives an overview of barriers which hamper the exploitation of smart energy systems, and suggestions to improve this situation.

1.1 Description case study

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 an rental boats) and 14.000 small leisure boats (owned by citizens of Amsterdam) 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. We investigated the flexibility that electric boats in Amsterdam could provide.

1.2 The strategy/approach

(See also 3.5)

Consulting stakeholders and literature study
The strategy/approach was to combine theory from reports by Waterrecreatie advies and TNO (Centre for Applied Scientific Research) with input from interviews with a boating company, an aggregator and a association for electric boating, Vereniging Electrisch Varen Nederland". (http://www.ev-nl.nl/).

We interviewed a company in the field of electric boating, Greenjoy and an "aggregator", a commercial party which is authorized to trade on the wholesale market on behalf of a pool of customers. This in order to find out whether companies are interested in the smart grid concept, what the theoretical potential of flexibility is in technical and economical terms (3.5) and what the possible organisational and legislative implications are.

We also studied documents. First a policy document of the Water authority of Amsterdam ("Nota Varen in Amsterdam") in which emission- targets for boats are formulated for the coming years. This in order to estimate the coming developments in electric boating. We also got information about the current state of electric canal cruising and the consequences for business operations from two investigations (conducted by interviewing the branch), completed by Waterrecreatie Advies and TNO.

Assumptions

1) In order to become part of the wholesale market we assumed a virtual cluster of boats located on different locations in the Netherlands.
2) Second assumption is that the cluster may be considered as one legal entity which is responsible an accountable on behalf of the total fleet of boats or the participating fleet owners. This entity could be one company or an association representing the cluster. Keep in mind that the tax tariffs for users >10000 are significantly lower.
3) We also assume that the wind turbines are regarded as part of the legal entity i.e. part of private network. Under the present circumstances in the Netherlands this is not accepted. For the calculations we implemented a smart charging scenario optimising the best financial gains.

1.3 Scope of the e-harbours schowcase "Search for flexibility provided by electric boats in Amsterdam"

(See also 3.5)

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 showcase is to estimate the potential of flexibility provided by electric boats in Amsterdam if all boats become electric (3.5) and the organisational and legislative implications (this document).

2 SUMMARY RESULTS

2.1.1 Introduction

We investigated cases on "local" and cluster level. "Local" means: exploiting the business cases for a small fleet of boats at one geographical location using one grid connection. A cluster level means: a so called virtual power plant of more boats on more than one geographical location.

2.1.2 Investigation results

Local level:

At local level (Greenjoy) there do not seem to be organisational aspects that hamper introduction of smart grid concepts. However, the storage capacity of a single boat/battery is too low to be sufficient for exploiting the flexibility. The advantage is that is only one authority is responsible for the operation of the boats, and one distributor. Greenjoy has developed an ICT infrastructure which, on a hardware level, is capable to meet almost all functions of a SG. Each boat contains a local computer and is equipped with communication facilities (gps, gprs) to enable remote monitoring and potentially also remote control. The ICT application is fully internet/web based and enables customers to log in and make a reservation and schedule the use of a boat at a certain time, day of the week and location. The ICT infrastructure is potentially ready for remote control functions, like setting the SoC set point of the charger of the boat (thus not yet implemented). We may conclude that the ICT infrastructure of Greenjoy enables a smart grid network, cluster of electric boats or any electricity user (and/or sources). Thus the concept of virtual power plant.

Cluster level
Clustering more boats within a company, and/or clustering more electric boat companies requires coordination.

1. Electricity distribution level: are the distributors willing to cooperate to form a virtual power plant and exchange flexibility between customers?
2. Privacy/security level: who operates the ICT infrastructure and is responsible? What about the protection against the insight of the electricity usage of each company?
3. ICT infrastructure: it requires some form of standardisation on communicating with the central broker.

Possible solution within the scope of the Netherlands is to cooperate with aggregator companies like Anode or Powerhouse, which could facilitate the smart grid functions and issues as mentioned above.

2.1.3 Conclusions

Organisational
As long as there is only one authority/organiser and one electricity provider involved, this application can easily being transferred to other municipalities. However, we have to deal with a lot of stakeholders, with conflicting interests (competitors) and operating from on different locations.

Legislative
1) The fleet of boats needs to be considered as a virtual power plant, present legislation regards every connection-point (or charging location) as a separate connection, not part of one “legal entity”
2) Integration of wind turbines or solar panels requires a private net, which is not admitted within the present legislation

3 Overall conclusions

3.1 Summary of the individual results

See 2.1.3

3.2 General Overall Conclusions and recommendations

See 2.1.3

4 Lessons learned

4.1 Organisational issues

See 2.1.3

4.2 Legislative issues

See 2.1.3

4.3 Ideas for further investigation

Investigate legislative options for associations in order to unite companies to organise a cluster.

5 References

[1] Minutes meeting Greenjoy, 26 August 2013
[2] Meeting with Powerhouse, 3 October 2013
[3] Report Waterrecreatie Advies, “rondvaart en recreatievaart in Amsterdam”, 1 November 2012
[4] Report Waterrecreatie Advies, “Elektrisch varen in de Amsterdamse Rondvaart”, 4 September 2013
[5] Presentation TNO (Centre for Applied Scientific Research), “Schone aandrijving voor de Amsterdamse rondvaart”, 9 September 2013
[6] Waternet (Water Authority Amsterdam), “Nota Varen in Amsterdam 2.0”, September 2013

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WP 3.7 Application of Smart Energy Networks

Organisational and Legislative Analysis
Summary results of showcases at the Hamburg harbour

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Hamburg, November 2013

1 Introduction

Smart energy networks are intelligent and flexible solutions which combine flexible energy consumption, local generation of (renewable) energy and energy storage on different levels. In any smart energy network, the presence of both technical/economical and organisational/legislative conditions is crucial.

This e-harbours report 3.7 focuses on the *organizational and legislative aspects* of smart energy solutions. A long list of general barriers has already been composed (deliverable 3.3).
The report 3.7 addresses the analysis on a local basis (country/city/harbour), where the smart energy solutions are hampered.

The e-harbours report 3.5 focuses on the *technical and economical aspects* of smart energy solutions. The scope of WP3.5 is the translation of the 6 universal business cases (e-harbours report WP3.4) on the level of every showcase. It gives an overview of the potential for the exploitation within the existing local (national) rules and regulations.

1.1 Description show case

The e-harbours Hamburg showcases focus 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 showcase, the economic viability of smart energy solutions lies at the center 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.

1.2 The strategy/approach

Although the e-harbours Hamburg lead question was "What makes a Smart Grid profitable?", it became clear that organisational and legislative aspects are at least as important in this context than economic or technical factors: Especially in the energy sector, it is the market framework that determines which business case is viable at all, how large the revenues are and what administrative costs occur.

Ongoing exchange with local stakeholders

Throughout the project, the close contact to the local partners involved in the showcase was a main source of input regarding legislative and organizational aspects. In a recursive process, stakeholders were involved and could provide input during the various stages of the showcase.

During the selection and determination of the showcase's three case studies (see above), organisational and legislative aspects regarding the *status quo* of energy supply were discussed with the respective partners.

In the next step, where individual smart energy solutions were discussed, developed and assessed with each showcase partner, legislative and organizational aspects were again at the center of attention: The developed business cases had to be checked regarding their legislative practicality, and implementation within the partner organizations was discussed regarding internal challenges and requirements.

Interviews with key knowledge carriers on national level

Probably more than in some other countries within the NSR, legislative aspects of the Hamburg showcase are determined by laws and regulations on a national level: The German energy sector is unbundled to a great extent – while this means that markets are open to various actors, it also means that very strong and extensive regulations are in place that are meant to ensure an even playing field.

As some of the business cases assessed within the e-harbours Showcase are very complex and specialized (like the provision of reserve capacity), there are only few competent actors in Germany that are commercially active and experienced in the sector.
To source this knowledge for the project, three stakeholder interviews were conducted with representatives from active market players and a research expert in the field of Demand Side Management and Smart Energy Networks.
The interviews were covering stakeholders' profiles and interests, relevance of smart girds and virtual power plants, potential in harbour areas, development of the national energy market and the further process of pan-european market integration, as well as non-technical bottlenecks, technical requirements and benefits identified in the e-harbours Hamburg case studies.

Barrier analysis

The interview results were combined with findings and observations from the showcases as well as with literature information in order to produce the "Report on non-technical barriers for smart energy solutions" [EHAR2013a], which is available at the e-harbours homepage.

Roundtable workshop and continued exchange with local stakeholders

The findings and messages of this report were taken as a basis for a Roundtable workshop organized in Hamburg, which was attended by more than 35 representatives from various sectors, as well as the key stakeholders within the Showcase.
After this event, implementation of the case studies was pursued further, concretizing and working on the identified key barriers on the legislative and organizational level.

1.3 Scope of the e-harbours showcase in Hamburg

The e-harbours Hamburg showcases focus 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 showcase, the economic viability of smart energy solutions lies at the center 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.

Extended scope

Arguably more significantly than in other countries within the EU or NSR, the German energy sector is influenced by the transition to renewable energies on a national level, which is a declared political goal and is being accelerated by various regulations and incentives. These already broadly affect the business cases and market options for smart energy solutions. In the future, the further path of the so-called "energy shift" will have an even greater influence, as the share of energy from intermittent renewable sources will increase steadily, and with it the need to atune energy demand to a changing supply on a national or supranational level.

Therefore, the extended scope of the project in Hamburg is to identify existing barriers on an energy market level, and derive recommendations and strategies to overcome these problems.

2 SUMMARY RESULTS

Within the Hamburg showcases, energy-market related aspects and findings can be grouped in two categories:

1. Conditions that limit the range of applicable smart energy solutions by not permitting a valid business case
2. Conditions that influence the remaining smart energy solution(s) and the respective business cases.

The first category will be discussed separately in the following chapter, as the findings usually apply to more than one case study in the Hamburg showcase. The second category will be presented in the subsequent chapters for each showcase

2.1 General energy-market related aspects

A general bottom line of the expert interviews and dialogues with key stakeholders was that the options for actually exploiting and marketing flexibility are quite limited. Moreover, demand for flexibility-related products is still modest. This reduces the numbers of business cases generally available for smart energy solutions. While this seems to be an economic problem at first sight, we have to keep in mind that energy markets are extremely regulated. Therefore, probably the largest influence of legislative aspects in the e-harbours Hamburg showcase is taking place indirectly via energy market regulations.
In the following, several issues are introduced – for a more detailed assessment, compare the **Report on non-technical barriers for smart energy solutions** [EHAR2013a] available on the e-harbours website.

Barriers to successful market participation:

- **No clear framework for smart meters and flexible energy tariffs**: Energy suppliers are reluctant to offer more flexible or even real-time tariffs. One reason is that clear regulations and legal frameworks are still missing. At the same time, due to generally low price levels and price spreads on the wholesale markets, energy suppliers are not really ambitious to develop innovative tariff models.

- **Unbundled energy sector:** Regulations require that power transmission, distribution, generation and sales have to be undertaken by independent market actors. While this unbundled structure was created to intensify competition and to prevent the formation of monopoles, it does hamper the implementation of several smart energy business cases. The provision of reserve capacity, for example, is agreed upon between a flexible consumer/producer and the transmission system operator (TSO). However, contractual agreements are also needed with the energy supplier, who usually is the balance responsible party in case of a small-to medium consumer/producer, and also the distribution system operator, in whose physical domain the consumer/producer is located. At the moment, there is a lack of contractual standards and clearing procedures for this, which makes the implementation of this business case very cumbersome in relation to possible revenues. Also aggregators of flexible potentials (like reserve capacity pool operators) face these administrative barriers, which reduces the remuneration which they can offer to flexible consumers.

- Also regarding a **participation in the reserve capacity markets**, it has been noted by experts that the necessary prequalification process is difficult to pass for flexible consumers, since regulations in these markets are traditionally tailored towards generation capacities like power plants. This increases risk and costs of the respective business case, and experts interviewed recommend a simplification of access conditions markets in order to strengthen business models aimed at these markets.

- **Development of the energy market and its regulations is quite unpredictable**. Frequent shifts in political priorities and the increasing influence of EU regulations and verdicts increase uncertainty. Especially exemptions or reductions for industrial consumers regarding grid fees and renewable energy levies are under review from various sides. Business cases building on these mechanisms therefore face a very limited reliability, which makes implementation less likely.

Concurrent incentives and regulations:

- Especially for the business case of providing **reserve capacity**, several policy decisions have put **potential revenues under pressure**: With the so-called “Ordinance for switchable loads” (Verordnung über abschaltbare Lasten) and the “grid reserve” (Netzreserve), new mechanisms have been created that allow TSOs direct access to large-scale load or generation capacities. These capacities are also procured by tendering processes, however, access to these tenders is only feasible for very large consumers or producers. These measures were created to ensure system stability in case of critical events. However, they also have the effect of reducing positive and negative price spikes in the reserve capacity and spot markets, thus weakening potential profits of business cases aimed at these markets.

- The current **privileges for renewable energies** produced under the feed-in tariff also hampers the demand for flexibility: Currently, if renewable energy cannot be fed in due to grid constraints, generation is stopped, but operators of generation capacities get paid the full amount that would have been fed in. Therefore, there is no incentive to use local flexible consumers in order to absorb excessive renewable production. This greatly limits the potentials for universal business case 5 (local system management), or probable business cases that bring together flexible consumers and RE producers.
  Also, feed-in priorities for renewable energies tend to lower mid-day price peaks. While this generally lowers energy costs for consumers, it negatively affects the business cases of contract optimization and spot market procurement.

- **Grid usage fees** are to some extent related to the stableness of a consumer's load profile. Load shifting measures that serve other business cases than the reduction grid usage fees may cause a higher volatility of the consumer's load profile – for example, the activation of additional loads for the provision of reserve capacity – and thus increase grid usage fees. This effect may reduce or even A solution would be to subtract load variations that are effected on purpose to ensure grid stability from the calculation of grid usage fees.

2.2 Chemical production company

2.2.1 Introduction

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. Due to a non-disclosure agreement, the full name and precise data on the company may not be published.
The plant is operating continuously, but production is organized manually in batches. Production steps vary according to the specific products.

The techno-economic analysis (see deliverable 3.5) identified a recently installed combined heat and power plant (CHP) as the main source of flexibility available here.
Economic potentials are substantial and already merit exploitation, e.g. via a reserve capacity pool. With an additional electrical heat production system installed, flexibility would be greatly increased and financial benefits would be almost doubled. The investments needed for an electrical heating system are rather modest compared to the revenues.

The company has decided to actively assess the realization of the business case suggested by the e-harbours team and is already in contact with a professional provider of such a smart energy solution.

2.2.2 Investigation results

Legislative – energy market structure / regulations

While the business case of reserve capacity provision is feasible and profitable, there are **certain regulatory culprits** that have to be observed, and which may complicate or slow down implementation:

Flexible, or **power-driven operation of CHP plants is currently not encouraged**. Even though CHPs would be very suitable to balance fluctuating levels of supply and demand in the grid due to their potential flexibility, still most plants are designed to operate heat-driven.
The first reason for this: In Germany, there is a **granted premium for power produced in CHP plants**. It means that the operator of a CHP receives a premium on top of his direct revenues from selling the power. It is granted for a limited amount of power only – precisely the amount that the CHP produces during 30.000 h of full operation (for a 1 MW CHP it would be paid for the first 30.000 MWh)[1].
The owner of a newly constructed CHP therefore tends to operate the CHP on full power for the first years in order to reach the 30.000h of full production as soon as possible in order to get a quick amortization on his investment.
This, in turn, makes a flexible, power-driven operation of the CHP less attractive – if the CHP only runs at 75% of power on average, it may take about a year longer until the full CHP premium is received.

The second reason is a **lack of revenues and incentives**: Flexible operation in most cases requires a certain over-dimensioning of the CHP and/or an option to store heat if heat production exceeds current demand. This involves additional investment costs – and extra benefits through flexible operation are hard to calculate for companies. Especially since price spreads on the spot markets have diminished (see chapter 2.1), revenues from spot-market optimized operation are quite low.
For biomass CHPs, there is a premium for "flexible design" available that is paid to the owner for each additional KW of installed capacity which exceeds the expected base load of the CHP. To receive the premium, the CHP must not run on full power throughout the year. This system has proven quite effective in order to make biogas CHP production flexible, but is currently not available for fossil-fired CHPs.

The third main issue is that the **provision of reserve capacity is quite complex** on the regulative side (compare the e-harbours report on Strategies and business cases for Smart Energy Networks, [EHAR2012]):
Market access to the reserve capacity market in Germany requires a minimum size of 5MW of shiftable load, and foresees a strict prequalification process. It has been noted by experts that this process is difficult to pass for flexible consumers, since regulations in these markets are traditionally tailored towards generation capacities like power plants. This increases risk and costs of the respective business case, and experts interviewed recommend a simplification of access conditions markets in order to strengthen business models aimed at these markets.
There are some service providers and reserve capacity pool operators active in the market that take care of most administrative tasks and can also incorporate loads smaller than 5 MW. They keep part of the revenues in turn, but are still able to offer an attractive remuneration to the client.

However, as it became clear in the interviews with those players, they also face administrative hurdles and problems:
Various contractual agreements are necessary, which are formally quite clear, but not in their actual realization. The clearing process between consumer, pool operator, energy supplier and distribution grid operator is not yet standardized. Depending on the goodwill of especially the energy supplier (who is usually the balancing responsible party), clearing can be obstructed to a point where it gets unattractive for the consumer/pool operator.
Some pool operators therefore demand the creation of a new market role of "Demand Response Aggregators" with clear-cut products and processes.

[1] The premium depends on the total size of the CHP: From 250 kW to 2 MW, it is 2.4 ct./kWh; over 2 MW it is still 1.8 ct./kWh.

Legislative – other fields

Apart from energy sector regulations, there were no specific legislative aspects identified that play a role for the implementation of smart energy solutions in this case.

Organisational – within the organisation

At the beginning of the cooperation, the e-harbours team was surprised about the **small amount of detailed information** the company itself has about its own power consumption characteristics. Sub-groups of electrical consumers are not measured, and for e.g. hydrogen or process water consumption there was not even an overall profile available.
Also, due to the historical subsequent extensions of the company's premises and installations, there is no comprehensive inventory of dispersed electric devices, let alone a central control

It became visible that in implementing a smart energy solution, **various persons / departments within the organization are involved**. Initial talks began with representatives in the area of process optimization. While this was good to get a clear view of the company's business and processes, these persons did not have a clear "energy perspective". With the installation of an energy manager within the company during the time of the cooperation, this perspective was added.
Following the assessment of business cases and concrete options for smart energy solutions, it became clear that implementation would require a certain financial investment – in this phase, which is still ongoing at present, higher-level executives had to be involved and made familiar with the concept.
All in all, this cascade of addressing different persons within the organisation was necessary, but very time-consuming.

The slow progress of cooperation in this case was partly due to a **very high workload** of company representatives. The energy manager and his colleagues are already bearing a large workload concerning various energy-related subjects. Implementing the business case requires substantial preparations on technical, economic, regulative and legal aspects. Also, possible investments have to be cleared by high-level executives and the controlling department. Even though there is certainly a high interest, it is not a top priority: Since production is going on unaffected also without the intervention, there is **little sense of urgency** to change anything.

Organisational – external

Limited sustainable agenda: The company is not currently dealing with final customers, and also does not attract a large public attention. It certainly does strive for innovative changes regarding energy and resource efficiency, but it can be speculated that these initiatives are mainly cost-driven. The company operating the Hamburg factory is part of a larger international consortium, but as of now has not been publishing own sustainability reports. Therefore, corporate social responsibility and a "green" image are probably not driving decisions as much as in other larger industrial companies.

In the cooperation with external partners, and also in the context of e-harbours, the company is quite **restrictive concerning data forwarding**. While this is not a general problem concerning the implementation of the business case together with an external service provider, it may slow down the setting up of the business model.

2.2.3 Conclusions

While a valid business case could be identified in the case of the chemical company, it's implementation is still hindered mainly by 2 factors.

1. The administrative barriers regarding access to the reserve capacity market, which require great expertise and a certain experience in the field. The partner company does not have this expertise. It is necessary to obtain a dependable legal assessment in order to prepare implementation. This will be done together with the company until the end of the project. This should also clarify how a realization together with an external service provider could be designed in terms of investment and running costs, risks, responsibilities revenues etc.
2. Internal bottlenecks regarding staff capacities: Energy manager and related departments already carry a large workload. As far as investments are concerned, management, finances and controlling also have to be involved. Together with a low sense of urgency, implementation is not brought forward as decidedly as possible.

2.3 Container Terminal

2.3.1 Introduction

Second element of 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, they are considering several options for on-site production of electricity.

Main source of flexibility found at the terminal are refrigerated containers, or reefers. They are used in the global transport chain for storing chilled or frozen food. Each of these so-called "reefers" has an electrical on-board cooling unit.
Due to their good insulation, their cooling system could be switched off for several hours without compromising the inside temperature boundaries. Several 100 to over 1000 reefer units are stored at the terminal at any moment, so a load management system based on reefers could be used to shift considerable amounts of load over several hours.

2.3.2 Investigation results

Legislative – energy market structure / regulations

The business case for a reefer-based load management system is mainly due to the grid fee regulations in Germany: Large consumers are exempt from a large part of grid usage fees if they achieve to stabilize their load profile over the year to meet certain requirements (compare 3.5 report). This is intended as an aid for energy-intensive industries in order to reduce specific energy costs.
While it is an economically attractive option in the present case, there are two pitfalls involved:

Firstly, the regulation to exempt large consumers from grid fees and to levy the avoided fees on the rest of the energy consumers represents a problematic practice from a legal point of view. This is why the EU is closely examining these reductions and may intervene, **rendering the business case somewhat unreliable**.
Secondly, the scheme represents **a sub-optimization** from a systemic point of view: Due to the rising share of fluctuating renewable resources in the energy grid, constant load profiles of large consumers are not as desirable as in the era of conventional large power plants. It would be much more beneficial for the energy system if companies had an incentive to adapt their load profile to e.g. a day-ahead energy production forecast.

Apart from the a. m. application, other options are imaginable to exploit the high flexibility provided by the reefers, but don't present a viable business case. The energy market aspects that are responsible for this are discussed in chapter 2.1.

Legislative – other fields

Neither the reefers nor the cargo transported within them is property of the terminal operator. Reefers are usually owned or leased by shipping lines or cargo transport companies. For the handling of containers, **strict contractual agreements** exist between shipping lines and terminal operators. In the case of reefers, it lies within the responsibility of the terminal operator to ensure a reliable energy supply, so that temperature is kept within the permitted boundaries at all times. Cargo temperature is logged, and if it is found that temperature boundaries were exceeded due to power interruptions at the terminal, the terminal operator is held liable. Since a reefer's content may be worth over 1 million EUR, the damage caused by one spoiled reefer would likely exceed yearly profits from a reefer-based load management system.
It therefore has to be cleared that load-shifting based on reefers is a. generally permitted by the contract between reefer/cargo owner and the terminal and b. if an insurance scheme is needed and available to cover potential liabilities caused by the load management system.

Organisational – within the organisation

Generally, the organisation is quite **open to innovative approaches** regarding energy and sustainability. It positions itself as a leading innovator in the field of greener cargo handling.
Good working relations were established with the sustainability manager and the energy manager, who have far-reaching competences within the company. There is an intrinsic motivation to promote the implementation of smart energy solutions beyond short-term cost savings, although this aspect does naturally play a role when assessing different options.

As it was the case with the chemical company, it was astonishing that the terminal operator only had **limited insight of power consumption** profiles within the terminal (see also 3.5 report). This made primary data collection necessary – which, on the other hand, provided good insights for the terminal operator

Practical parts of the showcase realization, like the installation of measurement equipment, were **more time-consuming than expected**: Since large parts of the terminal grid are high voltage systems, installations had to be carried out by a certified external service provider. Also, measures had to be taken to ensure uninterrupted operation of all involved devices.

A drawback for the implementation was that the terminal is not yet equipped with a reefer management system, unlike other terminals in the NSR. This considerably increases necessary investment and thus also internal barriers and caveats towards implementation.

Organisational – external

To the knowledge of the e-harbours team, a reefer-based load management system would be a worldwide pioneer project that requires substantial R&D efforts. While it is technically feasible (compare 3.5 report), the complexity of the systems that have to be combined (terminal energy management, logistic container management, reefer monitoring and control system) requires the active involvement of at least some of the systems' designers. The respective parties may in turn profit from such a development partnership, but the coordinative and administrative challenges exceed the terminal operator's capacities.
A practicable way to face this would be in a R&D project with the involvement of one or more scientific partners, system manufacturers and potential users like terminals or shipping lines. HAW is currently assessing such options together with e-harbours partner VITO from Belgium.

2.3.3 Conclusions

The terminal case study did yield one interesting business case, whose legislative foundation is clear-cut, but somewhat problematic: The respective regulation might not persist due to legal concerns from the EU. Also, it's producing a sub-optimization on a systemic point of view by levelling out the load profile, regardless of changing energy supply on grid level.
Regarding other legislative aspects, there are some contract and liability issues to cover towards the actual owners of the reefers and their cargo.

On the organizational level, partnership was evolving well with a clear momentum from a sustainability point of view. However, the complex nature of the terminal made technical steps towards implementation tedious at times.

The largest challenge on organizational level may lie in the creation of a R&D partnership of different actors capable of combining the different technical systems involved. To this end, a spin-off project is assessed together with e-harbours partner VITO.

2.4 Cold storage warehouses

2.4.1 Introduction

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Within the e-harbours showcase, three cold storage warehouses in the harbor were investigated regarding their potentials for smart energy solutions.
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.

2.4.2 Investigation results

Legislative – energy market structure / regulations

The economic potentials identified for the three warehouses stem from a combination of several business cases (compare 3.5 report).
The first business case is quite straightforward from a legislative point of view:

Contract optimization, with a focus on off-grid tariff optimization, peak load reduction, and also the realization of what is called "atypical grid utilization" in Germany – which leads to the highest amount of savings. It is a substantial discount on grid fees granted to a customer that has his periods of highest demand during certain pre-defined off-peak periods. "Atypical grid utilization" has to be granted by the distribution grid operator on the basis of publically available criteria. This process is well described and transparent.
Peak load reduction does not even require a formal procedure to take effect, since peak load is determined automatically – as well as peak and off-peak price components, if the customer has such a contract.

Spot market energy procurement is the second largest potential source of revenues after contract optimization. Spot market access is legally possible for all larger consumers, and mechanisms are also well established. It does cause a certain administrative overhead, e.g. for acquiring the market access and clearing the transactions, but service providers are in the market who take care of these steps for a commission.

While the two business cases described so far do not face large regulatory barriers concerning implementation, there are consequences of energy market structures concerning the attractiveness and profitability of these options, e.g. through a reduced spread in peak/off-peak tariffs – this is discussed on a general basis in chapter 2.1.

The third business case is **reserve capacity provision**: As none of the warehouses comes close to the minimum offer size of 5 MW, this would have to be done via a pool operator. For legislative implications, see chapter 2.1.

Legislative – other fields

For load shifting operations, similar aspects have to be observed as in the reefer case study: Temperature boundaries have to be observed under all circumstances in order to avoid liability claims by customers or lessees of cooling space. Also, sanitary inspections do check for temperature deviations.
Even when temperature boundaries are adhered to, it was commented by experts that frequent shifts in temperature could cause microcrystalline variations in the stored frozen goods, which may negatively affect quality.
However, these points seem manageable, as two of the investigated warehouses are already actively managing loads on a certain level.

Organisational – within the organisation

The main part of the investigation was carried out by an external consultant who has vast experiences in energetically optimizing cold storage warehouses. Owners were very cooperative and allowed insight into measurement data, and invited the researchers for on-site visits.

They are in the majority well informed about energy issues and the mechanisms of electricity markets. In the visited warehouses, however, savings were either considered too small to justify a closer examination, or investment costs for retrofitting the necessary central control mechanisms was considered too expensive. One warehouse already undertook certain load shifting measures via an external service provider, so they did not want to start parallel activities but rather updated their service provider with the additional information that e-harbours provided.

Notably, one company subsequently equipped another cold storage house outside of Hamburg which under construction at the time with control infrastructure and is now doing extensive load shifting at that property.
This was due to lower additional investment costs at the newly built property, together with a higher insulation standard that allows greater flexibility and thus higher revenues.

Organisational – external

No external organisational aspects of relevance were identified in the case study.

2.4.3 Conclusions

Legislative foundations for the business cases applicable for the cold storages are clear-cut and do not present significant barriers to implementation. However, market structures do indirectly affect the profitability of business cases, thus making revenues not attractive enough for implementation. On the organizational level, companies were competent and principally eager to implement measures, given that revenues justify the additional overheads.

A clear message is that a focus should be put on properties that are just being newly built or retrofitted, where additional costs and overheads are reduced.

3 Overall conclusions

3.1 Summary results and recommendations

3.1.1 Legislative – energy market structure / regulations

Energy sector legislation is an issue in all case studies, however with varying relevance. The complex business case of reserve capacity provision for the chemical plant is subject to many legislative barriers, like the prequalification procedure and the lack of standardized clearing processes between involved market actors.

For the other two case studies, energy sector legislation has to be observed in order to be granted the targeted reductions in grid fees, or to be able to trade on the spot market. Here it is less a question of market entry barriers, but of indirect effects of market design and regulation on possible revenues.

Here, the results presented in chapter 2.1 come into play: Markets for flexibility products are not yet well established – for example, flexible consumers can hardly access time-of-use tariffs. On the

existing markets, like the reserve capacity market, competition is quite high due to a large number of fossil plants that are still operating, but facing lower energy sales on the normal market due to subsidized RE production.

Recommendations in this sector include:

- further facilitate market access and processes within reserve capacity markets
- develop clear market roles for flexibility/demand response aggregators
- create incentives for flexible operation of consumers and distributed producers, and revise other incentives that counteract the principle of flexible operation
- make sure that energy legislation development is as reliable and foreseeable as possible (unlike in the case of grid fee exemption for large customers)

3.1.2 Legislative – other fields

In other legal and regulatory areas outside the energy sector, barriers are depending on the sector a potentially flexible consumer is active in. For both refrigerated containers and cold storage warehouses, liability questions could be an issue.
At least in the assessed cases, there were no relevant legal barriers to constructing and operating the smart energy solution itself – this may be because all studied solutions would be implemented locally on the premise of one company. The picture might change if several actors would have been directly involved, or the interests of other stakeholders.

Recommendations and lessons learned in this context therefore only comprise:

- clear beforehand if third parties or their assets are tangled by the implementation
- take appropriate safeguards against consequences of a mal-functioning of the smart energy system: Either optimize operational security to a point where failure is extremely unlikely, or extend insurance schemes to include such risks

3.1.3 Organisational – within the organization

Organizational aspects within the respective companies have been found to play a significant role in all assessed cases.

An issue that was brought up by interviewed experts and could also be noticed in some of the showcases, is related to the internal structure of larger companies: Many smart energy solutions require interventions in the production process of a company. Possible benefits by these solutions, in contrary, occur in the domain of energy procurement, which is often located in the general procurement department. Therefore, production department executives often do not get a direct advantage out of the implementation of smart energy solutions. Moreover, they have to take extra efforts and, to a certain extent, the risk of negative influences on production.

Another important barrier may be the high workload that many company representatives are bearing. Especially energy managers are facing continuously changing regulations and market

conditions which leave little room for innovative approaches that do not necessarily address an existing problem.

Management or business administration executives may not have the technical background, but usually are more open to cost-reducing innovations. Usually they have the authority to designate internal resources towards implementation. As soon as investments are involved, the decision to implement has to be taken by the management anyhow, and is subject to controlling processes etc.

The significance of a sustainable agenda as a driver for smart energy solutions varies between companies. For some, it is already a good motive to explore innovative solutions, others may not even be interested to put themselves into a public focus. A general finding from the expert interviews was that companies may find it difficult to communicate the environmental benefits of smart energy solutions due to their indirect effects and limited visibility compared to e.g. electric vehicles or RE installations.

Recommendations and lessons learned in this context:

- address management executives as soon as possible, as they have the authority to bring implementation forward
- underline the ability to react quicker to changing market conditions as a strategic advantage of smart energy solutions
- present “green” image effects as an extra added value, but don’t rely on it as main driver for implementation

3.1.4 Organisational – external

External organisational issues were not found to be major barriers in the assessed case studies. Once again, this might be due to the fact that none of the business cases requires an elaborate partnership between different actors.
Only in the cases where there may be external service providers involved (e.g. reserve capacity pool operators), it remains to be seen if cooperation is as unproblematic as depicted by the respective providers on the market.

Recommendations and lessons learned in this context are few:

3.2 Ideas for further investigation

During the project lifetime of e-harbours, the basic challenge of stabilizing an energy system based on renewable energies has moved much more into the focus of public debate in Germany – accelerated by the Government decision of 2011 to phase out nuclear power and make the "energy transition" a priority policy goal. In the face with rising prices for end consumers and stagnating prices and discounts on fees for large consumers, it is also discussed who should bear the costs of the energy transition.
In this context, the foundations of a reformed market design are currently being developed.
From a smart energy point of view, it is important to define and communicate the requirements of intelligent solutions towards a reformed energy market. Research topics may include:

- standardized flexibility products
- new market roles for flexibility/demand response aggregators
- possible requirements to provide flexible potentials together with the development of new RE capacities
- new approaches to create a market between flexible consumers and producers of RE, who would be responsible that their production can be accommodated in the grid

Also on the implementation level, some topics appear:

As stated in chapter 2.3, the concept of a reefer-based load management system is appealing – technical viability is assured, and there is a high level of transferability both towards other container terminals and towards on-ship use. Yet, it requires some substantial R&D efforts. This could be done in an either completely private consortium, or in the context of an ICT-oriented public-private project.
The concept of offering reserve capacity by using a CHP together with power-to-heat technology has been discussed in chapter 2.2. It would be interesting to evaluate how an owner-operator model could look like in which an external provider is taking over investment, construction and operation of the power-to-heat add-on, thus reducing risk and overheads for the company itself.

5 References

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e-harbours

WP 3.7 Application of Smart Energy Networks

Organisational and Legislative Analysis
Summary results of showcase City of Malmo

Author(s) : City of Malmö
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The Interreg IVB North Sea Region Programme
Investing in the future by working together for a sustainable and competitive region

1 Introduction

Smart energy networks are intelligent and flexible solutions which combine flexible energy consumption, local generation of (renewable) energy and energy storage on different levels. In any smart energy network, the presence of both technical/economical and organisational/legislative conditions is crucial.

The e-harbours report 3.5 focuses on the *technical and economical aspects* of smart energy solutions. The scope of WP3.5 is the translation of the 6 universal business cases (e-harbours report WP3.4) on the level of every cas e study. It gives an overview of the potential for the exploitation within the existing local (national) rules and regulations.

This e-harbours report 3.7 focuses on the *organizational and legislative aspects* of smart energy solutions. A long list of general barriers has already been composed (deliverable 3.3).
This report 3.7 addresses the analysis on a local level, and gives an overview of barriers which hamper the exploitation of smart energy systems.

1.1 Description case study

The Northern harbour is the node for energy production for City of Malmö and the region of Skåne. EON and Sysav are the large producers of electricity, heat and biogas, which is distributed to the harbour and the city net for district heating, electricity and gas. The harbour area is 230 ha and now locates about 85 companies and is undergoing an expansion of another 450 ha.

The challenge for the City of Malmö and the region as a whole is that there is a lack of electricity production while there is an excess of heat, and that the energy mix is mainly based on conventional energy carriers. But, there exists a big potential in better matching production and demand, reusing excess heat and making capacity available for electricity production, as well as increasing the share of renewables of the energy mix.

The scope of this case is to show how collaboration between companies in the Northern harbour and the City of Malmö can generate increased reuse of excess energy, capacity for electricity production and a greener district heating. The method is based on investigations and collaboration between the City of Malmö and companies in the Northern harbour, such as E.ON (energy producer and owner of the district heating grid), SYSAV (energy producer of district heat and electricity) and Norcarb (industry and producer of excess heat).

1.2 The strategy/approach

In order to distinguish the organisational and legislative barriers, the following steps have been taken.

Identification of the organisational and legislative barriers of the Northern Harbour has been done with the following steps:

1. Interviews with EON, SYSAV and Norcarb
2. Interviews with stakeholders in the Northern Harbour area, such as Cementa AB, Finnlines, OKQ8, Stena Recycling AB, VA Syd etc.
3. Desktop research, on internet and telephone with institutions such as Energimarknadsinspektionen, Svensk Energi etc.

1.3 Scope of the e-harbours case study in the Northern Harbour.

The deliverables of this case study are:

- The report ”Studie om industriell samverkan i Norra hamnen” (EN: Study on industrial collaboration in the Northern harbour), City of Malmö, Sweden, published by City of Malmö.
- The report “Utveckling av industrisamverkan i Norra hamnen, Malmö - sammanställning av arbete, data och resultat under 2012” (EN: Development of industrial collaboration in the Northern Harbour, Malmö – compilation of work, data and results 2012)”, published by the City of Malmö.

2 SUMMARY RESULTS

2.1 Northern harbour

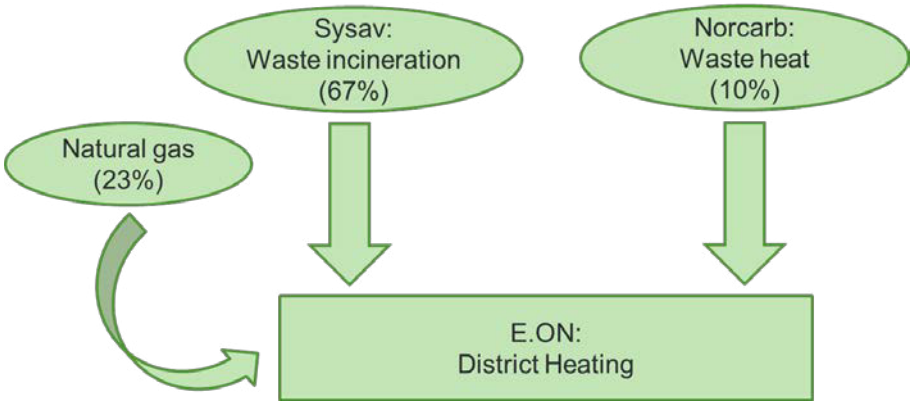
2.1.1 Introduction

The Northern harbour is the node for energy production for City of Malmö and the region of Skåne. EON, Sysav are the large energy producers of electricity, heat and biogas, which distributed to the harbour and the city net for district heating, electricity and gas. The harbour area is 230 ha and now locates about 85 companies and is undergoing an expansion of another 45 ha.

The challenge for the City of Malmö and the region as a whole, is that there’s a lack of electricity production while there’s an excess of heat. But, there exists a big potential in matching production and demand, reusing excess heat and making capacity available for electricity production.

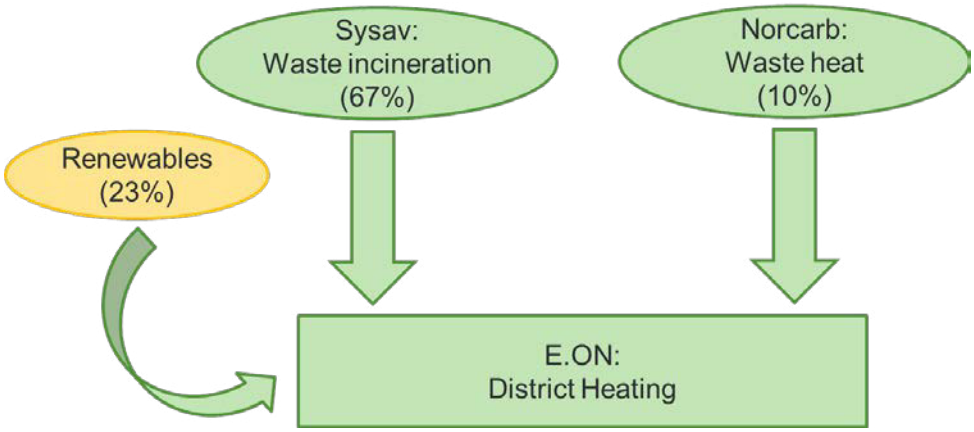
The case study Northern Harbour will show how capacity for electricity production can be made available through collaboration between companies in the Northern harbour and the City. This is supposed to be done through cooperation between E.ON (owner of the district heating grid), SYSAV (produces heat from waste incineration) and Norcarb (produces excess heat from oil incineration).

The first step in this cooperation is illustrated in the picture below.



The excess heat from Sysav and Norcarbs plants are transferred into E.ONs district heating grid. Sysavs part is 67%, Norcarbs part is 10% and the remaining part (23%) consist of natural gas from Öresundsverket.

The next step in this cooperation is illustrated in the picture below:



The part of natural gas is supposed to be switched to renewable energy sources. This part is supposed to come from wood-based incineration.

A part from this, it will also be investigated how the heat generation from SYSAV and Norcarb can be made even more efficient. For example, SYSAV wants to invest in an accumulation tank to save heat during the day and use it during the night.

2.1.2 Investigation results

Legislative barriers

Legislative barriers in the present context of the Northern Harbour are related to that EON has geographical monopoly on both the district heating grid *and* the delivery of district heating in Malmö. This means that even if an industry produces large amount of heat and wants to transfer it to the grid, E.ON has the right to deny this.

However, this monopoly also makes it possible to achieve the target of 23% renewables in the district heating grid. Without this monopoly, it would be impossible to control the amount of renewables since any fossil fuel based incineration could transfer their heat to the grid.

Organisational barriers

The organisational barriers are the result of the legislative barriers since E.ON's monopoly affects the relationship between the heat producers and the grid owner. Hence, this section refers to the one above.

3 Overall conclusions

3.2 General Overall Conclusions and recommendations

- Legislative barriers are related to the monopoly of the district heating grid.
- Organisational barriers are the result of the legislative barriers.

4 Lessons learned

4.1 Organisational issues

See below.

4.2 Legislative issues

The case study (1.1) made in the Northern Harbour in Malmö will be possible to implement in other countries as long as there is a district heating grid available. However, barriers could occur if there is any monopoly on the grid.

4.3 Ideas for further investigation

Develop the efficiency of SYSAVS waste incineration and Norcarbs excess heat production.

5 References

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e-harbours

WP 3.7 Application of Smart Energy Networks

Organisational and Legislative Analysis
Summary results of showcase at City of Malmö

Author(s) : City of Malmö,
Release date : 2013-09-30 (draft)

Photo: Your location

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1 Introduction

Smart energy networks are intelligent and flexible solutions which combine flexible energy consumption, local generation of (renewable) energy and energy storage on different levels. In any smart energy network, the presence of both technical/economical and organisational/legislative conditions is crucial.

The e-harbours report 3.5 focuses on the *technical and economical aspects* of smart energy solutions. The scope of WP3.5 is the translation of the 6 universal business cases (e-harbours report WP3.4) on the level of every showcase. It gives an overview of the potential for the exploitation within the existing local (national) rules and regulations.

This e-harbours report 3.7 focuses on the *organizational and legislative aspects* of smart energy solutions. A long list of general barriers has already been composed (deliverable 3.3).
This report 3.7 addresses the analysis on a local level, and gives an overview of barriers which hamper the exploitation of smart energy systems.

1.1 Description show case

Smart homes consist of seven smartly designed rental apartments in the residence area Western Harbour in Malmö, owned and managed by the energy company E.ON.

Different energy systems for electricity, heating and hot water are tested in the apartments: district heating, air/water-heat pump, gas and solar collectors. A hundred measuring points are installed in each apartment and residents can follow and monitor the energy use via an app on a tablet or smart phone.

Part of the energy is produced locally: solar collectors produce heating and hotwater, PVCs and windmill produce electricity. The grid electricity has a fully variable price connected to the Nord pool spot intraday market.

Each apartment also has a vehicle included in the contract. In total there are five electric cars, one gas driven car, one electric vespa, seven electric bikes.

Smart homes focus on the user perspective:

- Visualisation – all energy use is measured and visualized
- Monitoring – all energy use can be monitored by the user
- Price model – the price model should be easy to understand.

1.2 The strategy/approach

In order to distinguish the organisational and legislative barriers, the following steps have been taken.

Identification of the organisational and legislative barriers of Smart homes has been done with the following steps:

1. Interviews with the energy company EON, which is the construction company and also the property owner of Smart homes.
2. Interviews with stakeholders such as residents of Smart homes

3. Desktop research, on internet and telephone with institutions such as Energimarknadsinspektionen, Svensk Energi

1.3 Scope of the e-harbours showcase at/in Smart homes.

The deliverables of this show case are:

Smart system for with 100 control points for energy use and temperature in each apartment.
Software consisting of an app for monitoring and steering energy use.

2 SUMMARY RESULTS

2.1 Case study Smart Homes

2.1.1 Introduction

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Smart homes focus on the user perspective:

- Visualisation – all energy use is measured and visualized
- Monitoring – all energy use can be monitored by the user
- Price model – the price model should be easy to understand.

2.1.2 Investigation results

Organisational barriers

Organisational barriers in the present context of Smart homes are related to complexity of the Smart homes business model. The business model of Smart homes is based on a holistic energy system, combining various different energy media – district heating, gas, air to water heat pump, electricity from the grid, as well as locally produced energy from sun and wind. Developing and running a system with this level of complexity requires a close cooperation between the many different energy supply systems. The barrier consist in that the grid owners for electricity (EON Elnät) and gas (EON Gas) have a geographical monopoly, and with the monopoly comes the responsibility to offer the same possibilities for all energy suppliers and that the grid owner cannot favour one electricity/gas

supplier before another. This limits their ability to participate in such joint interventions as a holistic energy system requires. This causes organisational barriers for the energy company EON.

Organisational barriers within a possible cluster would be same as in the present context,. A cluster could be new Smart Homes apartments, the construction companies, property managers, such as the EON-company, the municipality, such as the City of Malmö .

Legislative barriers
Legislative barriers in the present context of Smart homes is related to the regulations on pricing of energy. Smart homes is partly supplied with locally produced renewable energy. The business model is to sell the excess energy from those renewable sources to the grid. However, this only generates a saving on the annual electricity bill (due to the fact that you only get paid about half the price for one own produced kWh compared to what you have to pay for one) and not an actual profit.

Legislative barriers within a possible cluster, such as the EU level, is also related to pricing. Smart homes are using a variable electricity rate. Such pricing is applicable on a deregulated electricity market. In the EU, only ten countries have a deregulated electricity market. The EU-legislation is going towards deregulation, but in the meantime, until the this has been fully implemented it may constitute a barrier for the business case of Smart homes.

3 Overall conclusions

3.2 General Overall Conclusions and recommendations

Organisational barriers are related to the complexity of the business model and the limitations of some of the EON companies to cooperate in a holistic energy system model.
Legislative barriers are related to the limitations to make a business of selling locally produced renewable energy to the net and the use of variable prices.
The business model of Smart homes will be possible to implement in countries with a deregulated market.

4 Lessons learned

4.1 Organisational issues

Running an energy system for a building with this level of complexity requires a common business model that all the energy suppliers involved can agree upon.

4.2 Legislative issues

Legislation can be a barrier, but it can also favour the development of this kind of projects.
Influencing decision makers will be an important part of the process of implementing sustainable living in harbour cities.

4.3 Ideas for further investigation

Development of a model or platform for cooperation on an organisational level for the creation of smart energy systems for buildings.

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WP 3.7 Application of Smart Energy Networks

Organisational and Legislative Analysis
Summary results of Energy Management in the Fraserburgh area

Alan Owen, Leontine Kansongue, Ebun Akinsete, Simon Burnett and Andy Grinnall

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1.1 Introduction

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This e-harbours report 3.7 focuses on the *organizational and legislative aspects* of smart energy solutions. A long list of general barriers has already been composed (deliverable 3.3).
This report 3.7 addresses the analysis on a local basis (country/city/harbour), where the smart energy solutions are hampered.

It gives an overview of barriers which hamper the exploitation of the other universal business cases

This document summarizes the results for each of the showcases in the Fraserburgh area.

1.2 The strategy in showcase:

The strategy adopted within the Fraserburgh area centres around local energy system management (universal business case 5).

The first showcase explores the management of the system by feeding in renewable energy sources into the grid to supplement supply and use/ implementation of heat recovery system (from refrigerators) for space heating. This is supported by a feasibility study on the viability of a wind turbine is in progress as well as monitoring energy usage.

The second showcase expands the view of local energy systems to consider embedded energy flows within local produce. It conducts a life cycle analysis of fish produce from the Fraserburgh area, and examines the potential energy reductions that could be made by encouraging more responsible consumer behaviour through the use of an energy product label.

Identification of organisational barriers within the present context

- Cost of Investment

Identification of organisational barriers within a possible cluster (incl specific member state issues)

n/a

Identification of legislative barriers within the contract

- Planning regulations affecting application for wind turbine installation

Identification of legislative barriers within a possible cluster (incl specific member state issues)

n/a

1.3 Scope of the of the energy management exercise

The core aim of the energy management exercise in Fraserburgh was to examine the workings of the energy systems in the area; exploring the generation, use and flow of energy within this system. Thereby providing a basis for strands of activity which seek to address the sustainability of this energy system; either by grid management or life cycle analysis of embedded energy. The core areas of activity covered include:

- Modelling energy use with the aim of establishing the potential for promoting greater use of renewables, smart grids and virtual power plants, electric vehicles and measures to improve energy efficiency

- Viability of production and use of renewable energy in harbour cities from wind, solar PV, tide, waves and the reuse of industrial waste, heat or cooling available

- Attuning demand and supply of energy by flexible demand management, load shedding, energy labelling, intelligent storage

- Developing an energy labelling scheme for fish for use by domestic consumers

Researchers from RGU's Institute for Innovation, Design & Sustainability (IDEAS) and Institute for Management, Governance and Society Research (IMaGeS) worked in collaboration with the Fraserburgh Harbour Commissioners Office, local businesses, retailers, and industry bodies in order to conduct the above listed activities.

2 SUMMARY RESULTS

2.1 Monitoring energy usage and meteorological variables

2.1.1 Introduction

Aim:
The aim of this project was to monitor the energy usage and meteorological variables in small to medium sized harbour area with the intention of promoting the use of renewable energy to improve efficiency and encourage a more sustainable environment.

Objectives:

- Identify different types of energy usage.
- Identify available renewable energy resources.
- Monitor the use of energy and the availability of sources of renewable energy.
- To estimate the contributions of other system parameters using models developed from available data.
- Test model on data from another harbour
- Increase the production and use of renewable energy in harbour cities from wind, solar PV, tide, waves and the reuse of industrial waste, heat or cooling available
- Develop an analytical model that can be used to predict energy use in any small or medium harbour from limited data inputs
- Develop a measurement and data analysis strategy allowing small to medium sized harbours to prioritize their investment in renewable energy and smart grid systems
- Identify areas where improved metering or monitoring can improve or cut down energy usage

This showcase looked at two areas: first, the monitoring of energy usage for businesses operating around the harbour with the view of finding ways to cut down consumption and secondly, meteorological measurement to assess viability of a future wind turbine to supplement supply therefore leading to reduction in carbon emission.

During the first stage of the work, various meetings were held to identify the types of energy used by different stakeholders. This was then followed up by installation of instrumentations kits such as current monitoring tool. With the data gathered, strategies are being developed for use by harbour authorities and commercial businesses in the harbour area to reduce their carbon dioxide emissions, energy use and energy bills. These strategies will give information of the cost of implementing each measure and the savings that would be made once this is in place. The second part of the work involved the installation of a weather station to monitor meteorology availability with the ultimate aim of installing a wind turbine in future.

The study envisaged energy usage and the challenges faced by the industries within Fraserburgh harbour area to identify gaps and set recommendations that will help reduce energy bills and carbon emission therefore providing stakeholders with strategies for increasing their sustainability.

2.1.2 Investigation summary

The research done was based on two different aspects:

- Monitoring of energy usage
- Meteorological measurement

The monitoring energy usage stage involved a pre-study of the businesses to identify the different types of energy used, the equipment/machinery utilised and a field study of the business plant rooms to identify best energy monitoring equipment required to measure the power consumption of buildings and machinery. Utility bills were also gathered to assist in analysing the overall power consumption of the factories/businesses. Instrumentation tools such as pico-current monitoring kits and power quality analyser were used to measure the power consumed. These equipment were installed in various plant rooms to automatically record and download the energy used every 10min. The main objective of this was to help identify periods of high consumption to better understand the energy usage and find means to reduce this.

The second part of the work involved installing a weather station to monitor meteorological data. A mast was installed outside the harbour area with the aim of measuring the wind speed from two anemometers: one being 10meters and the other 20meters high. Davis weatherlink software was also installed to link davis weather station to a computer direct to a network set up in the harbour office. This allowed all logged weather data to be stored, viewed and analysed in considerable detail. The installed weatherlink software records data such as wind speed, temperature, wind direction, dew point and humidity. The recorded data were used for analyses to determine future viability of a wind turbine.

Available information

The information provided within this study is based on:

- Desktop study
- Interview notes with stakeholders
- Primary and secondary data collection from equipment such as data loggers(Pico current monitoring kits and Power quality analyzer; Davis weather station)
- Fieldwork notes
- Publications
- Electricity meters readings and utility bills

2.1.3 Conclusions

The scope of the work done till date shows a constant power consumption profile by most businesses and flexibility at this stage is quite difficult to define but not impossible.

There is a potential of reducing the energy usage if renewable energy is fed into the grid system and measures are taken to make use of the heat recovered for space heating especially during the winter. Result at this stage might not be accurate, but there is a huge potential of reducing the amounts of energy used per KWh, therefore a reduction in utility bills as well as carbon dioxide emission.

It was identified during the study that most businesses make use of peak and off peak period meters where appropriate to cut down their energy bills but none of them considered the use of heat dissipated by refrigeration systems to warm their offices and this is wasted. The use of the dissipated heat to keep offices warm could save a lot of KWh of energy.

Another aspect of the study revealed that most businesses keen on reducing their expenditure on energy without recognising that the integration of renewable energy in their supply will accrue them lots of benefits.

Finally current government has the ambition to move towards a more sustainable environment thus commending the use of renewables to promote a friendlier environment.

2.2 Energy Label for Fish Products

2.2.1 Introduction

Aim:

To model the amount of energy consumed at different stages of the fish production process, with the view to developing and eco-label for fish products

Objectives:

- Energy modelling of the 'supply chain' for fish landed in Peterhead and /or Fraserburgh fish markets (energy consumed in catching, landing, logistical transportation, processing, packaging, etc) from sea to supermarket via different supply chains (local, national , international)
- Survey and focus group research on the information management aspects of the labelling system, the labelling architecture and how consumers read and respond to the labels
- Survey and focus group research on the consumer decision making process
- Identification and recruitment of a retail partner
- Development of appropriate energy labelling scheme for fish products landed in NE of Scotland, and information web portal for domestic consumers

This showcase involved research into the design of an energy label for fish that have been caught, processed, transported and sold using in the Fraserburgh area. The work which was a collaboration between two of the University's research institutes, the Institute for Innovation, Design & Sustainability (IDEAS) and the Institute for Management, Governance and Society Research (IMaGeS), incorporated energy life cycle analysis techniques as well as research into the design and use of food labels to explore the viability of an eco-label for fish products which displays the amount of energy used in catching, processing and transporting the product.

The development of eco-labels has arisen for a variety of reasons, relating to a number of environmental themes such as sustainability of resources (forests, water, and animals - including fish) greenhouse gases, environmental pollution, food and crop issues such as organic, food miles, and out of season provision. Trends such as 'green consumerism' highlight the fact that buyers are becoming increasingly conscious of the ethical credentials businesses they patronise; with sustainability and environmental impact of products featuring as a criteria for purchase (Young *et al,* 2010). It is expected that having a clearly visible label with information on the 'energy cost' of a product not only helps consumers make an informed decision but encourages more sustainable behaviour. With consumer spend as a driving force behaviour change among businesses can also be encouraged. Thus more businesses will be motivated to seek energy efficiencies within their supply chain so as to reduce the embedded energy in their products.

The showcase examines the flow of energy within the local system, and bridges the gap between the businesses (as the key energy users in the focus areas) and their consumers, with the overarching aim of reducing energy use within the system as a whole. While a number of labels which display information on CO2 emissions and ethical fishing practices currently exist, there are none which specifically address energy use in fish production.

2.2.2 Investigation summary.

The investigation presented two parallel strands of research:

- The production and use of eco-labels (led by IMaGeS)
- The life cycle assessment of energy use in fish production (led by IDEAS)

The core objectives of the first strand of research focusing on the label itself were to:

- present an overview of eco-labelling
- give examples of how labels are currently used
- present a standardisation regime applicable to the creation of eco-labels
- outline and illustrate possible label designs that may be appropriate for the fish energy label

The second strand of the investigation was focused on compiling the data required to populate the label. The main objectives of this strand were to:

- Identify possible methods of life cycle analysis
- Identify appropriate case study species
- Chart outline supply chain for selected species
- model the energy consumed along the 'supply chain' for fish landed in the Fraserburgh area
- Identify key issues relating to the study

Available information

Information utilised within the investigation was sourced from:

- Primary data from interviews with fishermen, local businesses, professional industry bodies
- Primary data from energy monitoring equipment
- Historic energy consumption from utility bills
- Fieldwork notes
- Existing literature
- Governmental and Nongovernmental Reports
- National and International Standards

2.2.3 Conclusions

There is an opportunity here to address a gap in the scope covered by eco-labels currently in use. The current EU energy label covers the energy performance of electronic goods, and even with the likes John Lewis recently launching a trial of a life cycle based products for their most popular household appliances (Smithers, 2013), there is still no such equivalent for fish products.

The most widely used eco-label for the fish industry which is issued by the Marine Stewardship Council assesses the production chain of custody standard and does not consider the energy input into the production process. This shortcoming was highlighted in a report by the Department for Environment, Food and Rural Affairs which stated that most environmental labelling schemes for food products were 'practice-based', thereby focusing on ethical issues in relation to the food production process; however there was a dearth of labels which adopted an 'outcomes-based' approach that would provide *"greater technical credibility to the label and enable consumers to better understand product-specific environmental impacts"* (Defra, 2010).

Flexibility in terms of energy savings offer an added financial incentive as cost savings. More organisations are considering the energy efficiency of their supply chain, with companies such as Unilever recording 10% reductions in their environmental footprint in 2 years, which in turn has translated into $250 in cost savings (Jerschefske, 2012).

Current views by the government suggest that labelling should be considered as part of a suite of government initiatives to address energy use and behaviour change. It is suggested that energy labelling efforts be coordinated and integrated into industrial schemes and governmental regulations both at national and international levels (Defra, 2010; FCRN, 2011).

3 Overall conclusions

Analyses of energy usage in Fraserburgh harbour focused on various businesses such as fish factories, ice factory and main harbour offices as a whole which included market around the harbour and all other branches operating under the auspices of the harbour. For most of these businesses, instrumentation kits were installed on their premises for energy measurement.

The study showed that further reduction in energy usage is attainable if renewables such as wind energy is used and heat recovery mechanisms are implemented. However means of motivating and incentivising lower energy usage still requires further investigation. The use of an energy label has been proposed by the government as a viable option which should be considered in conjunction with a suite of government initiatives.

4 Lessons learned

4.1 Organisational issues

With regards to the energy label, there has been no direct experience of organisational issues yet, so it is difficult to quantify any lessons learned. Howerver research revealed other organisations such as Tescos had been forced to abandon similar CO2 labelling schemes in the past due to challenges arising from defining the scope of the analysis as well as reliability of teh data collected.

Instrumentations used for energy monitoring system must comply with bristish standards according to IET regulations (e.g. BS 6739:2009 Code of practice for instrumentation in process control systems: installation design and practice). Organisations investing in wind industry require manufacturers and supliers serving the wind industry to meet certain standards such as: Global certificates in ISO 14001 and OHSAS 18001 and ISO 9001 standard; a proven corporate commitment to global sustainability that has been recognised by environmental certificates from major organisations.

4.2 Legislative issues

Most legislative issues in relation to the energy lable may be mitigated by ensuring that the label complies with existing ISO standards such as ISO 14025 for the Type III declarations based on LCA data (Burnett and Grinnall, 2012).

4.3 Ideas for further investigation

- Consumer testing of the energy label
- Energy label for other products
- LCA considering the entire life cycle (through to use and disposal)
- Further study should consider the viability of marine energy(waves and tides)
- Consideration of waste recycle for bioenergy

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e-harbours

WP 3.7 Application of Smart Energy Networks

Organisational and Legislative Analysis
Summary results of showcase Zaanstad, case study HoogTij

Author(s) : Paul Bakkum
Release date : October 18th 2013

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See also Workplan wp3: on the internal e-harbours web site.

1.1 Description case study

The municipality Zaanstad has a firm environmental ambition: to become climate neutral in 2020. To accomplish this aim three core activity areas are defined: 1) energy reduction 2) renewable energy production and 3) innovation.
This document summarizes the results for the HoogTij case study at Zaanstad (the Netherlands). This case study is of importance concerning the latter two core areas: renewable energy production is supported and promoted through this innovative applied smart grid within the case study.

The aim of case study HoogTij was to seek for new ways to increase the sustainability of the area and to assess the potential for a smart grid. Several concepts for renewable energy production where already investigated for HoogTij. However, exploiting the flexibility in a smart energy network was not yet considered. The case of the industrial development HoogTij is a good example for a possible application of smart grid technology. Flexibility that is present in the system of the heat network can be exploited in a smart grid and can be profitable.

1.2 The strategy/approach

Case study HoogTij has taken a quite practical approach, as the translation of the added value of a Smart Grid towards comprehensive results for the municipality required clarification, communication and concretisation at the project start.
Renewable energy generation by photovoltaic and wind, energy storage, electric driving, balancing energy and the role of the electricity network in these aspects of energy transition are not common good for the municipality.
The e-harbours teams and the members of the municipality Zaanstad, together with a graduate student from the TU Eindhoven have developed jointly this project, having the Zaanstad energy ambitions in mind, while gathering knowledge of the strategic value of a smart energy system. In all project phases organisational, legislative, communicative (with the stakeholders) issues arose. This report reflects on the organizational and legislative aspects of the Case study.

<u>A step wise strategy is followed, reflected in this report and consisting of different project phases:</u>

I. Determination of municipality objectives and sub-objectives;

II. Defining partners of the case study HoogTij (internal municipality departments, partners in e-harbours, and a student from the TU Eindhoven);
III. Commitment on the principals of the case study HoogTij by the stakholders (developer OHW and the shareholders RON and BNG GO);
IV. Gathering the information, necessary for the case study HoogTij, such as the functional and technical requirements;
V. Reporting the results of the case study HoogTij;
VI. Sharing the results of the case study HoogTij with the partners and stakeholders.

The text in chapter 2.1.2 describes the different project phases including a small section on barriers encountered and lessons learned, to be partly included in chapter 3.

1.3 Scope of the e-harbours Case study Hoogtij.

The scope of HoogTij comprises the search for a viable business case using smart grid technologies, for the industrial site HoogTij.

In 2002 the municipality Zaanstad and some developers started with the development of the industrial site HoogTij, which is part of the harbour area of Amsterdam. To achieve this ambition, we have chosen for several technical and organisational arrangements. One of the technical arrangements was to use a heating and cooling network. Nuon Warmte started to exploit this network, but due to the economical recession, the issuing of plots of land slowed down. Consequence was that there was little demand of energy, and NUON Warmte decided to stop the exploitation of the network. This resulted in a dialog between the municipality of Zaanstad, OHW and NUON Warmte about the conditions on which Nuon Warmte could quit with the project. This was in 2011 and an agreement was settled. OHW and the municipality Zaanstad took over the network, upgraded it and started to supply heat and cold. The intentions were not to exploitate the network, but to keep it running for the time being and find a substitute for Nuon Warmte.

Within the case study the opportunities for exploiting a smart grid were analysed and judged on their value for the development of a sustainable industrial site. Important point for the project is that several applications where studied in the past, but never in the context of a smart grid. A graduate student from the TU Eindhoven has analysed the possibilities for a smart grid on the industrial site HoogTij.

The aim of the master theses was to consider whether the application of a smart system could enhance the integration of renewable energy, and could lead to a viable business case.

HoogTij deliverables :

July 2012, meeting with the stakeholder, present with the study proposal.
September 2012, kickoff meeting
September – December 2012, various meetings with specialists and partners (Vito, Cofely, Liander) (minutes available)
January 2013 first proposal energy concept HoogTij, Simulation of a smart grid application (S. Lubach, Januar 23th, 2013)
January / February 2013, meeting with the stakeholders, present with the energy concept HoogTij
March 2013, meeting with stakeholders, specialists and market players.

2 SUMMARY RESULTS

2.1 CASE STUDY HOOGTIJ

2.1.1 Introduction

Case study HoogTij includes the application of a smart grid on the industrial site HoogTij. The results of this study (with reference to document 3.5 [WP 3.5 Application of Smart Energy Networks Technical and Economic Anallyses Summary results of showcase Zaanstad, show case HoogTij]) are satisfying and promising: the use of a smart grid is profitable and more profit can be achieved if some arrangements are made between different stakeholders.

As earlier mentioned, the intention is to develop HoogTij as a sustainable industrial site. Due to the economical recession, the development was less prosperous as predicted, which led to negative financial consequences for one of the shareholders. The intentions to develop a sustainable industrial site where abandoned and stakeholders didn't want to 'bother' the companies on HoogTij with these initiatives.

The municipality Zaanstad is convinced a smartgrid on HoogTij could be profitable and started the case study to proof shareholders sustainable energy is profitable.

Different activities have been deployed in Zaanstad during the last years. These activities were all focused on drawing attention to sustainable energy. In addition to that, the lessons learned from the HoogTij case study are contributing to the objective 'Zaanstad to become climate-neutral by 2020'. More sustainable energy within the municipality borders are ways to success.

2.1.2 Investigation results

A) HoogTij start-up phase

During start-up phase of HoogTij the goal and means of the project were definite. HoogTij is for several reasons interesting, because:

- it is a new industrial site, with several sustainability goals;
- at the start-up of the project, several measures were taken to achieve the objectives. An example is the lack of gas connections for central heating and the use of a sustainable district heating and cooling network instead.

Barriers encountered and Lessons Learned in this phase:

Not many barriers where encountered during this phase.

B) The case study HoogTij case study

During the period September 2012 to February 2013 the study took place. The study was subdivided into a literature and practical part. During the practical part several specialists and participants were approached, like Liander (DSO), Cofely (Technology provider), Vito (knowledge institute) and the Rijksgebouwendienst (end user).

Barriers encountered and Lessons Learned in this phase:

The collaboration with the stakeholders was sometimes a bit difficult. This had to do with the critical situation in which the development was: due to the recession the issuing plots of land was slowing. During every meeting with the stakeholder(s) there were some reservations about the study and the

results and the study was not regarded as an opportunity for the development, but as a threat. So during every meeting the stakeholder had to be convinced.

C) The results of the case study HoogTij
With the case study HoogTij the benefit and the economic viability of using a smart grid in combination with a district heating system in the development of an industrial site was demonstrated.

Barriers encountered and Lessons Learned in this phase:
A barrier is the contribution and the legislation issues regarding taxes, which has to be paid for the energy transport. The profits could be higher in case a private network is allowed, reducing the grid fees of the distributor. More financial profit can be gained when more partners or participants will be part of the smart grid.

Another barrier was that the County Counsel has declared a ban on new wind turbines on land. This has undermined the introduction of renewable energy on industrial sites.

Detention centre HoogTij
During the case study the public competition for a new detention centre on HoogTij was ongoing. In the summer of 2013 the wining contractor has been announced. The constructor has designed a self-sufficient detention centre by using renewable energy generated photovoltaic and wind energy, almost similar as the case study. So the market has seen the benefit by using renewable energy, however a smart grid hasn't been implemented.

2.1.3 Conclusions

The HoogTij case study addressed some technological issues, but these are easy to overcome. The real challenges are dealing with communication, finances and organisation.
The case study shows that a smart grid on a larger scale can be interesting for the development of a sustainable industrial site. Not all te stakeholders recognize a smart grid as a way to reduce the energy costs. The constructor of the detention centre on HoogTij has recognised the opportunities making use of a smart grid.
There will be also a possibility to use this energy in the surroundings of the detention centre, by extending the network.

The most striking conclusions:

- Due to national law, the benefit of a smart grid using renewable wind energy limits the amount of profit; Example: A private network with a renewable energy source can provide a higher benefit, because one can avoid energy taxes. Legislation makes it very difficult to actually make use of this potential saving.
- A project can only be successful by involving the regional partners from the start, and finding a consensus in the ambition to develop a sustainable system.
- National law limits the possibility to realise a smart grid on a bigger scale, since taxes and grid usage costs are charged when the public grid is used.

4 Lessons learned

4.1 Organisational issues

Organisational – lessons learned

- Specific expertise and close cooperation is needed to develop a smart grid. This can be achieved by studying the showcase, determine the stakeholders and convince them about the use and benefit of a smart grid.
- Continues communication is essential (with various members of the project team and the stakeholders). Involvement from the beginning i.e. from concept, design to realisation is required.
- Take advantage of the accessible expertise and use this expertise for spinoff on other areas: in the municipality Zaanstad this is done by realisation of an innovative energy contract and contributions to a municipality wide sustainable mobility plan.
- Take into account that it takes time to change existing operational processes and habits.

Organisational - recommendations

-

4.2 Legislative issues

Legislative – lessons learned

- Current national energy regulations and energy contracts are not suited for the introduction of smart grids;
- Interests of the national and county government regarding legislation and revenues by taxes partly conflict with the large role out of clean mobility and local renewable energy supply.
- Energy taxation schedules should be changed to anticipate on future increase of local renewable energy production combined.
- There are many requirements to be fulfilled to realise an own grid.

Legislative - recommendations

- More extensive projects and communication about the energy taxation, network costs and other boundary conditions hampering the energy transition are required;
- New and or adjusted legislation and taxes rules are needed to promote the integration of local owned smart grids based on renewables;
- Tailor made energy contracts needed taking into account real value of predictable renewable energy production and consumption patterns.

4.3 Ideas for further investigation

To embed the approach and lessons learned from this project, enhance the awareness of the municipality, province and region, in order to fully exploit the potential of smart energy concepts.

e-harbours electric

e-harbours

WP 3.7 Application of Smart Energy Networks

Organisational and Legislative Analysis
Summary results of the Antwerp showcase

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The Interreg IVB North Sea Region Programme
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1 Introduction

Smart energy networks are intelligent and flexible solutions which combine flexible energy consumption, local generation of (renewable) energy and energy storage on different levels. In any smart energy network, the presence of both technical/economical and organisational/legislative conditions is crucial.

The e-harbours report 3.5 focuses on the *technical and economic aspects* of smart energy solutions. The scope of WP3.5 is the translation of the 6 universal business cases (e-harbours report WP3.4) on the level of every case study. It gives an overview of the potential for the exploitation within the existing local (national) rules and regulations.

This e-harbours report 3.7 focuses on the *organizational and legislative aspects* of smart energy solutions. A long list of general barriers has already been composed (deliverable 3.3).
This report 3.7 addresses the analysis on a local level, and gives an overview of barriers which hamper the exploitation of smart energy systems.

1.1 Short description of the Antwerp show case

1.1.1 General introduction

The port of Antwerp is one of the biggest mainports of Europe

Over the centuries, the Antwerp port area grew to exactly 13,057 hectares, or about 20,000 football fields. In this area, the Port Authority gives land, warehouses, covering and quays in concession to private enterprises to develop their commercial activities.

No less than 150,000 people contribute to the success story of the Port of Antwerp every day. This includes lorry drivers, ship's agents and customs official. The majority of people works for private enterprises in and around the port area, but there are also indispensable links such as the Antwerp Port Authority and different government departments.

The Antwerp Port Authority plays an important role in the day-to-day operation of the port. Its 1,650 employees ensure the port functions. The Port Authority manages and maintains the docks, the bridges, locks, quay walls and grounds. It is also responsible for the safety of shipping in the docks, bridges and locks. The Port Authority provides tugs and cranes, carries out dredging work and promotes the port in Belgium and abroad.

About 900 private enterprises are active on the so-called superstructure, the terminals for instance. This refers to big (petro)chemical industry complexes, container terminals and big transit warehouses, but also small-scale ships agencies. These companies not only load and unload vessels, but also store goods, process them and transport them further into Europe, for instance. A lot of companies also plot out the most efficient route – and method for products.

Photo 1: Aereal view on a part of the chemical cluster within the Antwerp port area

Photo 2: Areal view on a few docks within the port of Antwerp

1.1.2 The Antwerp port authority and E-harbours

With a view to the future the Antwerp Port Authority is working on sustainable development and innovation of the port. An integrated energy policy of the Antwerp Port Authority aims at a sustainable economic development, maximum energy efficiency and great care for the environment.

To convert this policy into specific results, the Port Authority has launched several initiatives and projects regarding the security of energy supply, energy saving through innovation and making maximum use of renewable energy. E-harbours is one of those initiatives. Within E-harbours, the Antwerp port authority investigates the potentials of smart energy networks within a complex industrial and very competitive environment.

1.2 Approach of the Antwerp show case

In the Antwerp port area, 5 industrial companies were approached in order to investigate in detail the potential of smart energy networks for their specific situation. This was done through an intensive demand-response audit, carried out by VITO (Flemish Institute for Technological Research). In the audit, following aspects of flexibility were investigated:

- Magnitude of flexibility (how many kW of flexibility is present);
- Duration of flexibility (how many minutes or hours of flexibility is present);
- Economic valuation of the flexibility.

In 4 out of the 5 cases, the implementation of smart energy networks was found to be technically and financially attractive.

These 4 case studies were:

1. Luiknatie: storage of frozen products at a temperature of at least -18°C. Flexibility was found by varying the temperature of the warehouse between -18°C and -25°C. Nearby this warehouse, a wind turbine is planned with a direct electricity delivery towards this warehouse. The combination of both (inflexible) renewable energy production and flexible energy demand can lead to a win-win situation.

2. Norbert Dentressangle: same case study as described above. Storage of frozen products at a temperature of at least -18°C.

3. Borealis: chemical production plant within the port area: Flexibility was found in the prolypropylene section were a substantial amount of energy (several MW's) was identified during a short period of time (less than one hour)

4. Amoras: installation for processing of waste sludge from the docks in the port of Antwerp. The pumping installations of Amoras (several MW) turned out to be very flexible, as there

are a lot of possibilities of intermediate storage of the sludge in the process. Several MW's of flexibility during long periods of time were identified.

In each of the case studies, the future interaction with distributed renewable energy generation was thoroughly investigated. All those companies will host one or more large wind turbines on their site in the coming years. The potential for smart interaction between renewable energy production and smart energy demand is thus very high for all of these companies.

The detailed results of the case studies can be found in more detail in the e-harbours report 3.5.

2 Organisational and legislative context within the port of Antwerp

2.1 Introduction

The above examples show that in the industrial processes within the port of Antwerp, flexibility is present. Next step in the path towards smart energy networks is the realisation of the added value of flexibility within these industrial processes. However, the path towards implementation also needs to take into account the organisational and legislative context within the port of Antwerp specific and the Flanders region and Belgium more broadly speaken.

In this chapter we give an overview of the different (often non-technical) elements which influence the decisions of these companies whether or not to proceed with the implementation of smart energy networks.

2.2 Barrier analysis

The figures below show a graphical analysis of the different barriers which have been identified in the different case studies. Following barriers were identified:

- **Acceptance by stakeholders:** Are the different stakeholders in the case studies ready and willing to go ahead with a smart grids approach?
- **Regulatory framework:** Is the regulatory framework facilitating or rather hampering the case study?
- **Technical feasibility:** Is the technical feasibility of the smart grid project assured?
- **Organisational framework:** Is the organisation ready for implementation of a smart grid project?
- **Economic pricing model:** Are the expected benefits high enough for the organisation to implement the smart grid approach? Higher perceived risk should lead to higher potential benefits.
- **Absence of conflicting interests:** Do all stakeholders have the same or similar interests?

The figures show a qualitative expert judgement, rather than a quantitative approach. Nevertheless, the figures give a good indication of the potential barriers within the different business cases.

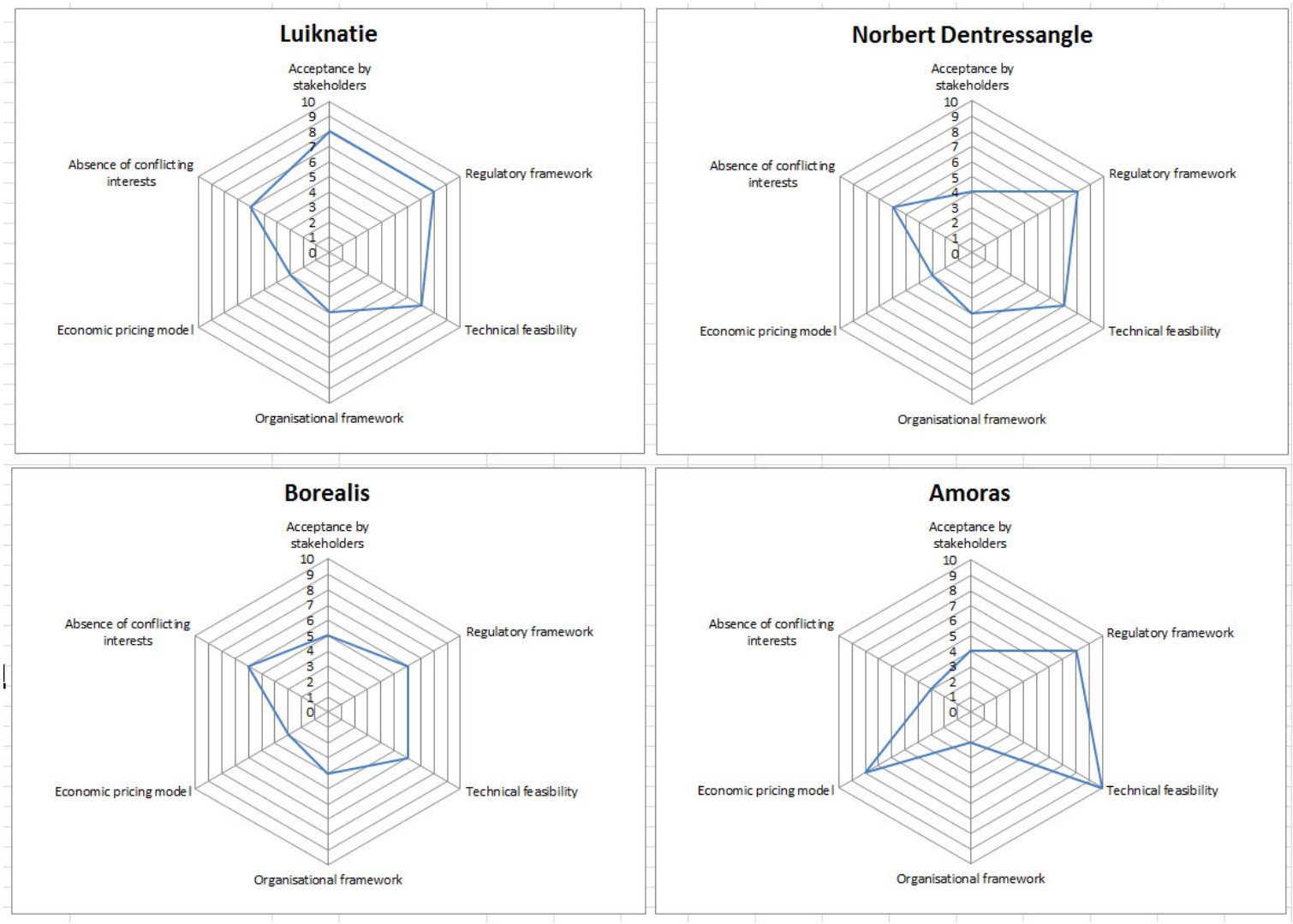


Figure 1: High level barrier analysis for the individual business cases.

Following figure shows an overall impression of the barrier analyses for the different case studies. Following general conclusions can be deducted:

- Only one of the four business cases has a very clear, substantial economic financial return (Amoras). In the other business cases, the potential financial gains are perceived to be rather low in combination with the perceived risk of the business case. Perceived risk and expected workload, in combination with rather low expected financial benefits, are in most cases a real barrier for implementation
- There seem to be quite a lot of barriers with regard to the organisational framework. Small organisations often do not have the resources to actively participate in smart grid projects, in larger organisations there are often split views between different departments.
- For the individual business cases that were studied, no important barriers with regard to the regulatory framework were identified. Further in the document we will explain that regulatory framework can be a real barrier for smart grids projects in a more geographical context.

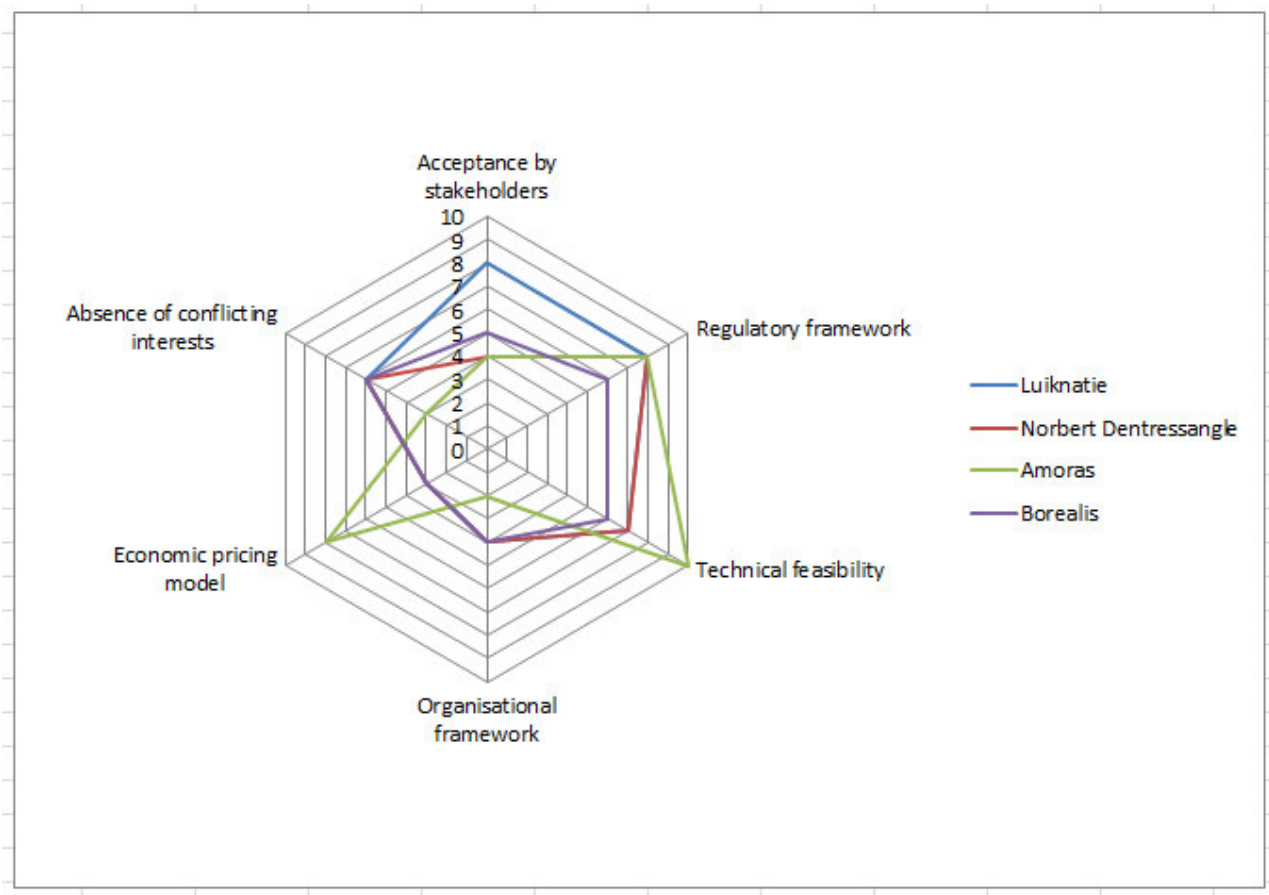


Figure 2: High level barrier analysis for all the business cases.

2.3 Expert meeting

In order to correctly identify all the non-technical elements (barriers) for implementation of smart energy networks, the e-harbours project team organised a meeting of an expert panel to discuss all aspects of the case studies. The expert group consisted of following companies:

- Grid operators
  - Distribution grid operator Eandis
  - Transmission grid operator Elia
- Aggregators
  - Represented by the company Restore
- Industrial companies
  - Represented by the port of Antwerp
- Research institutes
  - VITO

Photo 3: Meeting of the expert group

This expert group discussed the non-technical barriers, based on a specific zone within the Antwerp port area. Figure 3 shows this zone. Within this relative small area of 3 km x 3 km all opportunities and challenges of smart energy networks come together.

The figure shows that in this specific area a lot of electricity is consumed by chemical industries, container terminals, warehouses with deep freezing, etc.

On the other hand, at this moment already a lot of electricity production units inject their produced electricity into the grid. Moreover, in the near future, additional generation capacity of renewable energy (wind mills) will be installed. The port of Antwerp will install in this zone more than 30 MW of wind energy (+10 wind mills of 3 MWe each).

All this electricity generation and demand has to pass a specific high voltage cabine (150 kV → 36 kV and 15 kV). This specific high voltage cabine has no or very little spare capacity.

This situation illustrates the potential of smart energy networks:

- Transmission and distribution network capacity is limited in this area.
- Adding renewable energy generation capacity to this transmission and distribution network capacity is difficult, given the traditional way of thinking about and calculation of network capacity by the grid operators. Taking a broader approach and integrating demand side management into the picture would solve most if not all capacity constraints, thus facilitating the introduction of renewables into the grid system.
- The flexibility of the smaller industrial consumers could be aggregated into a broader profile, which could be very interesting for energy aggregators. This could lead to more interesting and flexible prices for the smaller industrial consumers
- Large industrial consumers can offer their flexibility towards the transmission grid operator in order to assist in secondary or tertiary reserve capacities.
- ….

On the other hand, this illustrates the many challenges of smart energy networks. We will elaborate on these challenges in the next paragraphs.

Figure 3: Industrial zone within the port of Antwerp

2.4 Contractual barriers for smart networks in the port of Antwerp

Within the example as shown in Figure 1, we identified following contractual barriers:

A. Company nr. 8 (deep freezing company) has an obvious potential for smart networks, as described in the detailed case study for Luiknatie and Norbert Dentressangle. These companies however, have a relatively small capacity for demand side management (typically a few 100 kW's). At this moment, these companies encounter two types of contractual barriers:
   - Energy suppliers offer no tariff structure available which gives adequate incentives for these companies to implement demand side management. Deep freezing companies typically work by a day and night tariff scheme. These tariff schemes should be further detailed (f.i. on an hourly basis) in order to exploit the full potential of the available flexibility.
   - Aggregators typically desire a flexibility window of at least 200 kW. This is quite high for these companies.

B. Company nr. 5 and nr. 7 have long-term injection contracts signed with third parties. Breaking into these contracts is far from obvious.

C. Transmission and distribution system operators need to respect all reserved capacity on the grid, although in practice some of these capacities are never used. Imposing flexibility in current contracts is not allowed.

D. Company nr. 9 will build 8 wind turbines via a project company. In order to obtain the necessary financing, the financial institutions demand long term delivery contracts with reputable energy suppliers. Adding flexibility in these contracts is far from obvious, given the extra amount of uncertainty this induces.

The above examples show that existing contracts often hamper the realisation of smart grids. The examples also show that at this moment smart energy networks is often not considered enough during contract negotiations between contracting parties. Smart energy networks require a broader view on the future of electricity supply and demand, were collaboration between all actors becomes essential.

2.5 Acceptance barriers for smart networks

Within the example as shown in Figure 1, we identified following acceptance barriers:

A. Companies nr. 2 and 6 manage their energy portfolio on a company group level. These companies are thus not interested to think about a smart grid approach in a geographical with grid constraints as a driver. Investment decisions are not taken on a local level, but rather from an international group level perspective.

B. None of the parties agrees on an independent co-ordinator who takes the initiative.

C. Some of the technical directors within some companies are unwilling to promote smart grid projects within their own organisation, as perceived possible profits are not in line with required efforts to realise the project. The risks in the business case often prevail over the possible (modest) financial benefits.

D. Getting the timing of different industrial parties right, is extremely difficult.

2.6 Regulatory barriers for smart networks in the port of Antwerp

Within the example as shown in Figure 1, we identified following regulatory barriers:

A. Companies nr. 1, 5, 7 and 9 cannot install direct lines towards some industrial consumers in the area, as private distribution networks are not allowed. This prevents integration of renewables into the load profile of interested companies.

B. Distribution and transmission system operators are obliged to respect reserved (but mostly not fully realised) capacity. This lead to difficulties for integration of renewables on the distribution or transmission grids.

2.7 Overall conclusions

The above paragraphs show that non-technical considerations are quite important in the realisation trajectory towards smart energy networks implementation. Many potential industrial companies with technical potentials in smart energy networks currently perceive the non-technical barriers and risks to be too high in relation to the potential financial gains.

There is a great need for clear, sound business cases with appropriate risk identification and risk management.

3 The importance of smart grids for the port of Antwerp and other European seaports

3.1 Advantages for the port of Antwerp

Smart networks have an added value for the port of Antwerp on following domains:

A. Temporary solution for the lack of net capacity on the distribution or transmission net.

In order to realise the full potential of renewable energy production in the port area (wind solar), the existing distribution grid (15 kV) needs to be reinforced. Adding renewable energy to the existing grid, leads to potential stability issues on this grid.

A solution for this issue would be to curtail the windturbines by means of an active signal from the DSO. A better alternative to curtailing would be to exploit the full potential of demand side management within the industrial cluster in the port. During periods of potential net instability, the flexibility within the industrial companies should first be addressed, rather than curtailing of the renewable energy production capacity.

B. Added value for companies and investors

Energy cost for industrial companies in the port are is very high and will continue to stay high in coming years. In the coming years, business cases with respect to smart energy will offer the companies within the port area the potential to reduce overall energy costs.

Possible business cases for industrial companies in port areas are:

- Optimalisation of energy contracts by means of peak shaving through new ICT-tools
- Optimalisation of energy contracts by means of flexible energy tariffs on an hourly or even 15-minutes basis.
- Reduced energy cost through improved access to the wholesale market for electricity (directly or through aggregating companies)
- Reduced energy costs because of balancing services that can be offered to the market.
- Reduced energy costs because of reserve capacities that can be offered to grid operators.

These business cases are discussed in detail in the report e-harbours WP 3.4.

Energy cost and the way to valorize flexibility could prove to become an extra investment parameter for choosing the port of Antwerp in the coming years.

3.2 Role for the Antwerp port authority

The responsibilities within the Port Authority are very diverse. The Port Authority manages and maintains the docks, bridges, locks, quay walls and land. It is also responsible for the efficient passage and safety of the shipping traffic in the Antwerp port area. It provides tugs and cranes, carries out dredging work and promotes the port in Belgium and abroad.

To boost the competitiveness of the Port of Antwerp, the Antwerp Port Authority was established as an independent, municipally-owned company in 1997. Before this it was managed by the Mayor and Aldermen and the local council of the city of Antwerp.

In its current legal format, the Port Authority has its own decision-making powers and a human resources policy separate from the city. And the Port Authority also has the power to reach joint ventures with other companies or government departments. In this way it can flexibly meet a rapidly evolving maritime market.

The Antwerp Port Authority has a long history of successfully facilitating industrial companies and create the conditions for these industrial companies to operate competitively.

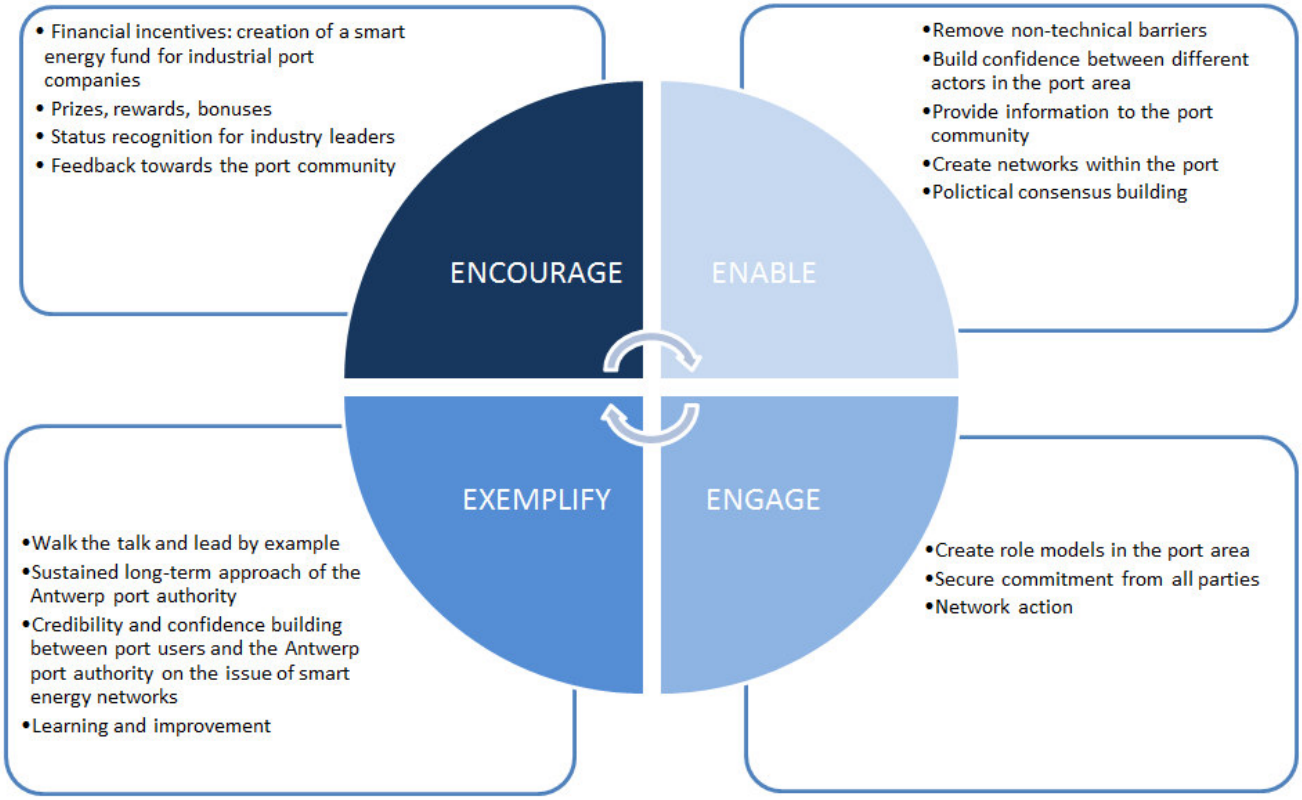
Given this long history of facilitating industrial companies, the Antwerp port authority will in coming years also try to facilitate the introduction of smart energy networks in the port area. The port authority will help to realise real-life cases in the industrial port context, in order to provide competitive advantages for port users.

The Antwerp port authority is ideally placed to work on the non-technical barriers of smart grids, by:

- Influencing policy makers to create the right conditions for investments in smart grids;
- Bringing together industrial companies and grid operators in order to monetize the saved costs for delayed or even avoided grid enforcement and make sure that at least part of these saved costs are beneficial for the companies who provide the flexibility;
- Organising knowledge sharing initiatives with regard to smart energy networks;
- Actively identify and support business cases with regard to smart energy networks in the port area;
- Providing where necessary the necessary contractual guarantees. As the Antwerp port authority by nature is a company with a very long term view regarding the development of the port area, it is ideally placed to facilitate or enhance contractual stability.

In order to realise this new role with regard to smart energy network the Antwerp port authority will work with the 4E model for behavioural change: ***Enable, Engage, Exemplify*** and ***Encourage***.

The figure below shows the different terrains of action where the Antwerp Port Authority can create added value on the issue of smart energy networks. The idea is that the Antwerp Port Authority will act as a catalyst on the issue of smart energy networks in the coming years.


• Financial incentives: creation of a smart energy fund for industrial port companies
• Prizes, rewards, bonuses
• Status recognition for industry leaders
• Feedback towards the port community
ENCOURAGE
ENABLE
•Remove non-technical barriers
•Build confidence between different actors in the port area
•Provide information to the port community
•Create networks within the port
•Polictical consensus building
EXEMPLIFY
ENGAGE
•Walk the talk and lead by example
•Sustained long-term approach of the Antwerp port authority
•Credibility and confidence building between port users and the Antwerp port authority on the issue of smart energy networks
•Learning and improvement
•Create role models in the port area
•Secure commitment from all parties
•Network action

***