Energising Local Capacities: Seven Pathways Towards Resource Efficiency

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Energising Local Capacities

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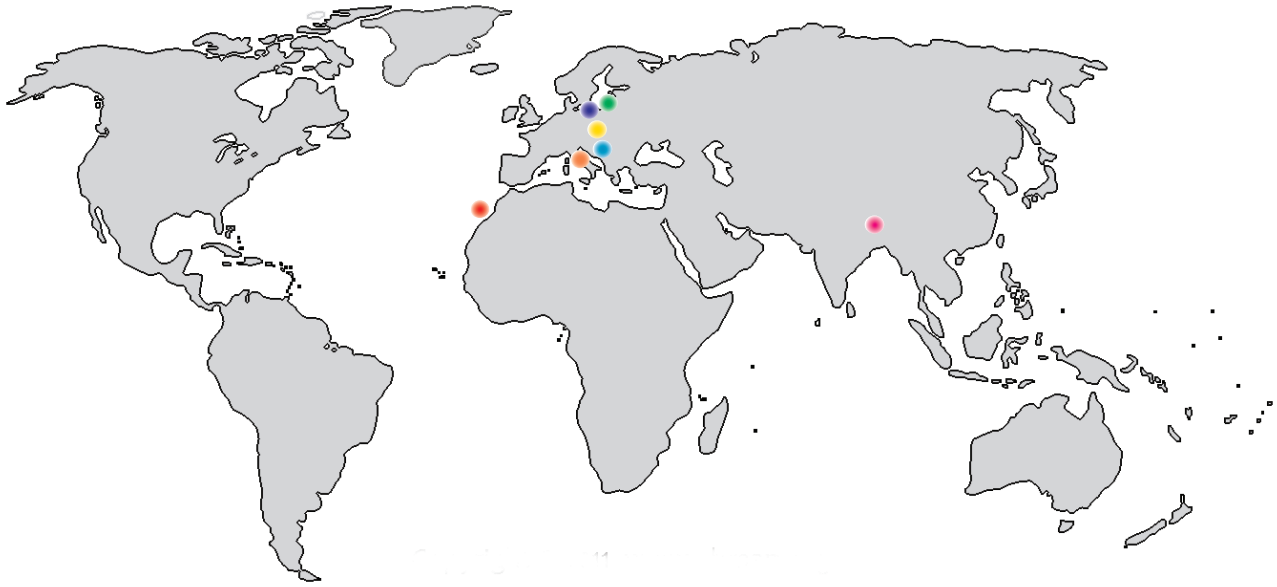

SED 2012 Project Locations

Gran Canaria, Spain · Firenze, Italy · Zabrze, Poland · Klaipėda, Lithuania

Balatonalmádi, Hungary · Gdynia, Poland · Kurseong, India

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Introducing Strategic Environmental Development

Over the past few decades a number of phenomena have occurred bringing a new set of challenges to the attention of humankind. The world is changing, demanding us to reassess our idea of development. Natural disasters combined with financial crises, poverty, massive consumption and resource scarcity are posing a great challenge to society. Today we are not only dealing with climate change, but also with a shift in institutional priorities around the world.

This year is the 40th anniversary of the Stockholm Conference during which the concept of sustainability as a development goal for humankind was introduced. Sustainability requires a new way of thinking about the world's resources and the development of new relationships between different actors in society.

This shift towards sustainability and the new systemic perspective that it brings, is a common task not only for governments and local communities, but also for private companies, universities and individuals. Everyone has a responsibility in this process of change.

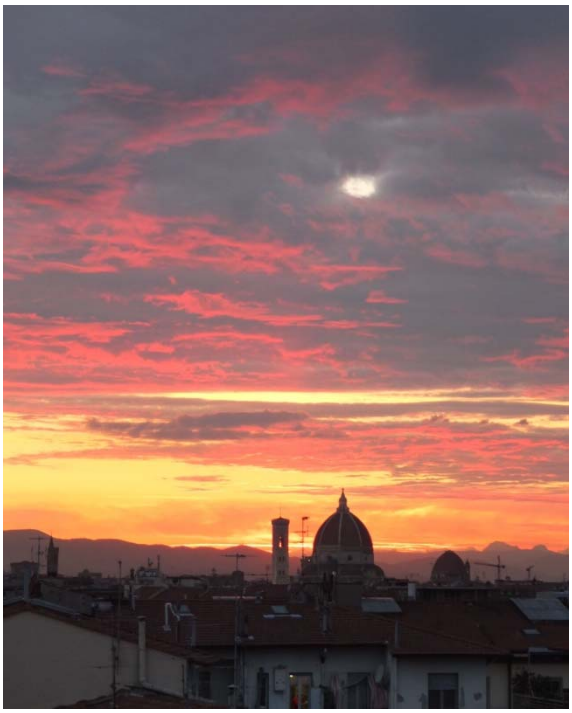
Within this context, one of the greatest challenges is to manage the world's existing resources in a sustainable way. If we are to meet this challenge, it is imperative that new structures and systems are developed. By adopting new technologies, using resources in more efficient ways and reducing energy consumption and waste production, societies can continue their journey along the pathway of sustainable development.

The Strategic Environmental Development (SED) course is a learning experience aiming at finding a balance between real-life complexities and theoretical knowledge.

The projects presented in this publication approach sustainability and resource efficiency from a local perspective.

Working at the local level presents a number of challenges but also offers a number of unique opportunities. While international and national agreements and policies are crucial, achieving sustainability will ultimately require significant action at the local level.

By incorporating local insights and involving local stakeholders, creative and context specific solutions can be developed which not only contribute to wider societal goals but also increase the capacities and resilience of the local communities themselves. In this sense, the collective aim of our projects is to contribute to the development of local capacities in the different working areas. It is hoped that through these collaborations the seeds of sustainability that have been planted can continue to grow and flourish.



This report describes the process and results of seven projects carried out by IIIEE students, supervised by staff from the institute. The seven projects took place in six different countries and were primarily concerned with the development of local capacities to achieve sustainable development.

The team in Gran Canaria was assisting the environmental consultancy firm Sumamos in a project on sustainable refurbishment of buildings. The key task of the team was to analyse current organisational and technical barriers to refurbishment of apartment-hotel complexes.

The team in Italy investigated the possibilities for further development of biogas production and usage in the Firenze area.

The team in Poland who worked in Zabrze cooperated with the Municipality of Zabrze and the municipal waste company MOSiR in drafting a pre-feasibility study on the implementation of a biogas system in Zabrze.

The team in Klaipeda identified energy security options for a cluster of companies operating in Klaipeda port.

The team in Hungary worked with the Municipality of Balatonalmádi to develop their internal capacity to design an energy strategy for the city.

The other team who worked in Poland participated in the third phase of the EU project InnoHeat and was hosted by the district heating company OPEC in Gdynia. The specific task was to create a manual that could be used in the analysis of management in district heating companies in general.

Last but not least, the team in India contributed to the second phase of the Kurseong Integrated Water Management project in cooperation with the Swedish International Development Cooperation Agency.

The Seven Teams

Gran Canaria, Spain

Åke Thidell, Anna Vehviläinen, Beatriz Medina Warmburg, Sebastian Lema, Signe D. Nielsen, Patricia Jimenez, Kai Ulrik

Sebastian Lema is from Colombia and has a background in business administration and economics,

Signe Damgaard Nielsen is from Denmark, and she has a background in corporate social responsibility and service management,

Anna Vehviläinen comes from Finland with a background in accounting and business administration,

Kai Ulrik is from Australia and has a background in environmental sciences and corporate carbon accounting,

together with their supervisor Åke Thidell – professor and researcher at IIIEE- constitutes Team Gran Canaria.

Firenze, Italy

Gregory Eve, Håkan Rodhe, María Paula Llosa, Mathilde Andersson, Emmy Carlsson, Peter Lindeblad

Mathilde Andersson from France has a background in environmental engineering,

Emmy Carlsson is from Sweden and has a degree in environmental studies,

María Paula Llosa is from Argentina and has a background in environmental law,

Peter Lindeblad from Sweden has a background in business administration and IT,

with the help of Gregory Eve, on-site facilitator and Håkan Rodhe, director of IIIEE educational activities.

Zabrze, Poland

Živilė Poderienė, Randy Remigius, Johanna Generosi, Erika Machacek

Erika Machacek from Austria has a degree in economics,

Johanna Generosi is from Italy and has an academic background in physics,

Živilė Poderienė is from Lithuania and has a background in environmental engineering and,

Randy Remigius, from Indonesia has a background in business administration;

supervisors in Zabrze were Mikael Backman and Lars Hansson – Associate Professors at IIIEE.

Klaipėda, Lithuania

Brit Samborsky, Fredrik Lingvall, Nurzat Myrsalieva, Min A Lee, Andrius Plepys

Brit Samborsky is Canadian and has a background in mechanical engineering and energy management,

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Min A Lee is South Korean and has an academic background in accounting,

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Balatonalmádi, Hungary

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Rachel Armstead, from Wales, UK has an academic background in anthropology and sociology,

Cherisse Braithwaite is from Trinidad & Tobago and has a background in environmental science and sociology,

Ana Marton comes from Romania with a background in biology,

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and Philip Peck, Associate Professor at IIIEE.

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Jeffrey McKinnon from Canada, with an academic background in business administration,

Sigríður Droplaug Jónsdóttir is from Iceland, having a degree in environmental science,

Vasil Zlatev comes from Bulgaria with an educational background in economics and psychology,

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Kurseong, India

Lara Hale, Nicholas Arsenault, Yoko Morimoto, Prasad Khedkar, Murat Mirata

Nicholas Arsenault from Canada holds degrees in environment and resource studies and Spanish and Latin American Studies,

Lara Hale from USA has an academic background in environmental studies and biology,

Prasad Khedkar comes from India with an educational background in biotechnology, environmental sciences and urban planning,

Yoko Morimoto is from Japan with a degree in geoscience,

with the help of Dr. Murat Mirata, member of IIIEE Academy.

Sun on the Horizon: Sustainable Revival of outdated Apartment Hotels on Gran Canaria

Who, how and why should apartment hotel complexes with multiple ownership structures invest in sustainable refurbishments?

By Anna Vehviläinen, Kai Ulrik, Sebastian Lema & Signe Damgaard Nielsen

Introduction:

Gran Canaria, one of the seven islands of the Canary island archipelago, has a rich tradition as a winter getaway for Northern European tourists. With the attraction of warm temperatures, long beaches and numerous accommodation options, Gran Canaria provides an ideal option to escape the European winter. Mass tourism spanning from the 1960s has had a unique impact in the south of Gran Canaria, namely Maspalomas. The tourism industry has provided local employment within hospitality and construction sectors, accounting for ~80% of the gross income of Gran Canaria [1]. However, public spaces and private apartment hotels of Maspalomas have gradually become dilapidated and outdated. Many apartment hotel blocks have received little renovation in their lifetime and no longer cater to the needs of the actual tourist.

Maspalomas Apartment Hotel complexes

These outdated accommodation complexes form the basis of this report. Such complexes have become run-down "eye-sores" which decrease the general aesthetics of the area, deterring tourists and reducing occupancy rates. With reduced occupancy, owners of such apartment hotel complexes have experienced revenue loss, and in turn have lost interest and incentives to invest in refurbishing the property.

The aim of this project is to provide an initial action plan to Sumamos, an environmental consulting firm in Gran Canaria, specialising in sustainable refurbishment. The project methodology involves three stages; preliminary research, onsite data collection (including site visits of three complexes, interviewing relevant actors and participating in a collaborative workshop), followed by a final report. Key objectives were to analyse the current issues relating to organisational and technical aspects of outdated apartment hotel complexes, and provide recommendations for addressing these issues. The final report attempts to answer the focus question 'how can private, small scale, apartment hotel owners act collectively to facilitate sustainable refurbishments in Maspalomas, and meet the needs of current and future tourism market?' by focusing on how apartment hotel complexes could invest in retrofits with sustainability in mind.

Background

Mass Tourism & Gran Canaria

The 1950s saw the emergence and rapid growth of Mediterranean coastal resorts, which have been mirrored in numerous destinations both within the Mediterranean region and internationally [2]. In the case of Gran Canaria, mass tourism exploded in the late 1960s, gaining the reputation as the "best winter destination in Europe" [I]. The 1970s saw an influx to the warmer southern parts of the island, namely Maspalomas, which was previously uninhabited [I]. This growth increased exponentially until the late 1990s transforming the economy, socio-political structures and physical environments of the region [2].

During the major period of popularity and growth in Maspalomas, architectural design of apartment hotel complexes followed a generic model and construction had no consideration for the local environment. As tourism increased with popularity in the region, more accommodation complexes were constructed with minimal urban planning requirements or restrictions.

Maspalomas Beach and Lighthouse

The Butler framework provides a tourist area life cycle analysis, which describes the growth and decline of resort towns which have come into existence due to mass tourism [3]. The framework identifies different "generations of mass-tourism". The first generation refers to the time of industrial revolution, typically grand Victorian architecture. Second generation resorts typically have a short life cycle of 30 years, caused by the rapid development, increased competition and intensive concentration in one area leading to "tourism monoculture". The third generation refers to the destinations built in developing countries around the 1980's with strict regulations and high planning powers [4]. Maspalomas is a prime example of a tourist destination with numerous second generation apartment hotel complexes, many of which are 40 years old and are in dire need for renovation.

Environmental & Social Impacts from Mass Tourism

Mass tourism has numerous positive and negative social and environmental aspects on tourist destinations, such as Gran Canaria. Tourism is responsible for 5% of the global CO_2 emissions, with air travel considered as the main tourism contributor to global warming (responsible for 40% of the total carbon emissions caused by the sector) [5]. Generally, apartment hotels have high energy consumption, commonly contributing the second largest operational expense. The major sources of energy expenditure in an apartment hotel include space heating, hot water generation, cooling and lighting [6]. Whilst heating demand is low on Gran Canaria, many second generation properties in Maspalomas can enhance their operational efficiency via sustainable renovations. Such sustainable renovations options will be addressed in the following chapters.

Whilst tourism provides island destinations with positive aspects such as economic development, several negative aspects impact island ecosystems which require

specific environmental management. Such negative aspects include: coastal degradation due to lack of zoning, increased traffic, changing cultural patterns and pressure on natural resources. Gran Canaria experiences a permanent water shortage, with several energy intensive desalination plants operating on the island. As stated in Table 1, sustainable tourism is of key importance in protecting the local environment; particularly in regards to local transport, construction, hotel services (waste, water, energy) and air travel. Whilst Gran Canaria has developed in a non-sustainable manner, there is an opportunity to shift to more sustainable practices in future planning and developments.

Sustainable (Potential future plans)	**Non-Sustainable (Maspalomas)**
General concepts: - Slow & controlled development - Long term	General concepts: - Rapid & uncontrolled development - Short term
Development strategies: - Plan, then develop - Local developers - Locals employed	Development strategies: - Develop, no planning - Outside developers - Increase capacity
Tourist behaviour: - Learning about local environment - Repeat visits	Tourist behaviour: - No interaction about local environment - Unlikely to return

Table 1: Typical features of tourism [7]

Gran Canaria Tourist Demographics: Shifting Demands

Maspalomas has experienced thirty years of substantial growth, reaching 10 million visitors a year. The location has been established as a favourite tourist destination during the European peak winter period [I]. However, with falling travel costs, similar beach holiday destinations have been emerging along the equatorial band as far as the Indian Ocean and Caribbean [2]. Table 2 illustrates numerous competitors to Gran Canaria during the winter peak period, which is a potential threat to Gran Canaria tourism.

International	**Regional**
Barbados	Mallorca
Cape Verde	Tenerife
Marsa Alam	Crete
Maldives	Cyprus
Phuket	Malta

Table 2: Vacation destinations for winter period [8]

As illustrated in Table 3, the most common tourists in Maspalomas over the winter period are British, German and Scandinavians. From this Northern European perspective, the Canary Islands and Egypt provide the closest and most popular holiday destinations. A representative of Kuoni, one of the largest tourist operators on the island, explained that Egypt has been suffering political instability since 2010. As a result the Canary Islands have received a considerable influx of tourists as an alternative to Egypt [II]. Demand for accommodation is outweighing current supply within the Maspalomas accommodation, with tourists forced to stay at lower quality apartment hotels. In an interview with Mr. Cáceres, professor of urban planning [I], he claimed that this current tourism boom would continue for another 4 to 5 years, providing incentive for private owners to invest in hotel accommodation.

Tourist Origin	**January 2011**
Germany	72 790
Norway	41 810
Sweden	41 310
United Kingdom	38 590
Finland	21 520
Denmark	19 090

Table 3: Most common tourist to Gran Canaria [9]

Traditionally, most accommodation in Maspalomas takes the form of self-

sufficient apartment hotel complexes. However, the most common accommodation currently offered by Swedish travel agencies are three to five star hotels with all-inclusive packages. With evolving tourist demands, Maspalomas apartment hotels need to adapt to stay competitive. The two major target groups are families and seniors. Families are attracted to Maspalomas due to the all-inclusive packages and convienence. The seniors market is the largest and wealthiest tourism segment, which is attracted to Maspalomas due to the weather and beaches [10]. A Danish survey performed by Apollo showed that 25% of senior tourist (over 65 years old) view social responsibility in general tourism activities as "important" [11], whereas five years ago this figure was "non-existent".

Maspalomas: Multiple Ownership Structure of Apartment Hotels

Whilst Gran Canaria is still experiencing high volumes of tourists, there is a real need to address the outdated and obsolete tourism hotspots around the south of the island, especially Maspalomas' public spaces and run-down tourism accommodation complexes. Whilst public spaces rely heavily on government and municipal involvement in order to upgrade (and are outside of the scope of this paper), apartment hotel complexes for tourists are a key area of importance. As found in Table 4, Maspalomas encompasses 220 hotels, resorts and apartment complexes, making it the most saturated tourist location on the island.

Gran Canaria	Accommodation #
Maspalomas	220
Puerto de Mogán	85
Las Palmas	44
Artenara	38

Table 4: Tourist accommodation locations [9]

In order for Maspalomas to remain an attractive tourism location, these private apartment hotel complexes require significant renovations. Potential enhancements include improvements in internal infrastructure such as energy and water systems, as well as internal retrofits including appliances, insulation and lighting. These renovations have the opportunity to introduce sustainable aspects to existing complexes, decreasing both operational costs for owners and environmental impacts of tourists on a local scale.

Recently apartment hotel complexes have invested in "facelifts", such as painting exteriors to improve the complex's appearance; this is a short-term solution. Many of these complexes now require more comprehensive renovations in order to stay in the market. Whilst the construction sector and tour operators suggest that complexes should be renovated every 12 to 15 years, many have not received a renovation in 30 years. The classification of accommodation on Gran Canaria is also outdated, with different grading systems for apartments (key ratings) and hotels/resorts (star ratings). To avoid confusion, most travel agencies and tour operators have created their own grading system [III].

The unique challenge faced in Maspalomas is that apartment hotel complexes have a complicated ownership structure, involving numerous private owners within one property. Typically, many of these owners invested in Maspalomas during the construction boom of the 1970's and are now seniors. Owners have varying financial situations for reinvestment in renovations, leading to the deterioration of the apartment hotel complex.

International Case Studies of Eco-Refurbishment of Apartment Hotels

Previous international experiences have been utilised as benchmarks to evaluate potential improvements in the out-dated hotel facilities in Maspalomas. Two study cases have been identified; the first is Saint Nikola in Bulgaria which is an apartment hotel complex similar to those found in Maspalomas. The second hotel is Palma de Mallorca, due to similarities with Gran Canaria as a mass tourist destination.

Complex Saint Nikola, Sliven, Bulgaria:

This 3 star apartment hotel complex has four buildings with 20 double and 8 single rooms. The complex was recently renovated by the owner. The total project cost was EUR 419 853, of this EUR 190 336 was provided by the Bulgarian Energy Efficiency Fund [12]. Table 5 indicates the economic and environmental savings with a payback period of 4.4 years.

Implemented energy saving measures:
Thermal insulation of walls and roof
Installation of solar panels for domestic hot water
New boiler on natural gas
Estimated savings:
Electricity: ~49 200 kWh/y
Thermal energy: ~578 300 kWh/y
Cost savings: ~95 400 EUR/y (a result of fuel switch and estimated savings)

Table 5: Economic and environmental savings [12]

Case of Palma de Mallorca:

Palma de Mallorca is a part of a larger project for the HES (Hotel Energy Solution) e-toolkit developed by UNWTO (United Nations World Tourism Organization). The project was designed to facilitate the use of renewable energies and energy efficient systems for small and medium sized hotels [13]. Table 6 shows the payback period for several sustainable initiatives implemented by 23 (four and five star) hotels that participated in the project.

Energy Improvements	**Initial invest EUR**	**Savings per year EUR**	**Pay-back years**
Change electricity company conditions	6 777	5 312	1.31
Isolation improvement	264	1 327	0.2
Lighting regulation	12	1 467	0.01
Improving of boilers	345	1 773	0.19
Change source of energy	18 000	8 937	2.01
Solar energy use for hot water	124 000	19 304	6.42
TOTAL	149 398	38 120	3.92

Table 6: Energy savings and investments [13]

Findings

This study builds on three different apartment hotel complexes as cases for Maspalomas. The complexes were selected by Sumamos based on the current condition of the apartment hotels; all cases represent the common problem of becoming obsolete due to lack of refurbishment. In addition, several complexes in Maspalomas are also facing challenges with multiple ownership structures. In relation to data gathering; three apartment hotel site visits with interviews were made, along with four additional interviews through individual meetings.

Case Study 1: Koka

Koka is an apartment hotel located in Playa del Ingles, Maspalomas, it currently has a three “key” rating (a rating system traditionally applied to apartment hotels). It was built in 1976 and consists of 300 apartments spread over four buildings. One third of the rooms are used for tourist purposes which operate in a self-catering manner, the remaining two thirds are in

private use. Each of the apartment owners is individually responsible for the room's renovation, where refurbishment of the complexes common area, such as the electricity infrastructure, must be agreed upon by all owners [IV, V].

The clientele in the summer time consists mostly of young Spanish and British tourists, whereas in the winter time it serves mostly elderly couples. The complex is also very popular among homosexual tourists due to its close location to the party scene in Playa del Ingles [IV, V].

Poolside at Koka

Environmental/technical:

Koka is entirely dependent upon the electricity grid for energy supply. In the beginning of 2012 the hotel was threatened to be shut down due to its outdated and unsafe electricity infrastructure. The administrative party was forced to negotiate with the central island government in order to upgrade infrastructure to meet the minimum requirements. These improvements have led to plans of installing individual electricity meters for each apartment; such meters can significantly improve an occupant's energy consumption by providing a direct illustration of monthly energy usage and influencing behaviour. Currently, zero apartments have key card systems installed to turn off the lamps and electrical appliances. The lighting in the rooms is currently outdated with incandescent lights; such lights are also used in the pool area along with compact fluorescents [IV, V].

Renewable energy sources are not applied at Koka. The outdoor pool is not heated and the centralised hot water system is heated by light oil. There has been minimal pressure to implement a renewable solution such as solar thermal on the rooftop, even though solar potential is particularly high on the property. The major issues with the rooftop solar photovoltaic installations are discussed further in this chapter. Koka's internal water infrastructure supplying the apartments is also outdated. There are no water efficiency initiatives such as double flush toilets or water saving devices installed. Water is also used for the upkeep of gardens and lawns, watering systems are installed in garden beds [IV, V].

Organisational:

Almost all of the apartments at Koka are owned by separate owners. This causes several challenges when it comes to common decision making. All actions have to be supported by every owner of the resort and as there are approximately 300 owners agreements and willingness to change is a barrier. This complicated ownership structure impacts the ability to agree upon refurbishment issues, which typically require larger scale investments. Many of the owners do not want to risk the financial burden of the future investments, even with a return on investment of less than five years. This hesitance to reinvest has a great deal to do with the owner structure, where most of the current owners are elderly people who do not have long term plans for the property [IV, V].

An example of the problematic situation in multiple owners is the potential for solar PV installations. All owners would have to agree on the installation decision, and then the owners of the top story apartments (who also own the roof space) would have to agree to the installations. Due to these kinds of challenges with refurbishment decisions, Koka has mainly focused on superficial improvements and investments in smaller scale changes. For example, the improvements of common spaces of the complex with sculptures and fountains. [IV, V].

Case Study 2: Las Walkirias

Las Walkirias was built in 1988 and it is also located in Playa del Ingles. The apartment hotel complex has 48 rooms, of which 16 are in private use [VI, VII].

The clientele consists of tourists who stay for longer terms, ranging from two weeks to two months. Homosexual guests are also a major target group for the hotel due to local nightlife. In the winter peak period the hotel accommodates mostly German and Scandinavian tourists, whereas in the summer most guests are from Spain [VI, VII].

Environmental/technical:

Las Walkirias does not have a central Heating, Ventilation and Air Conditioning system (HVAC), nor do they provide any form of air conditioning for tourists. This minimizes the hotel energy consumption. The rooms are lit with compact fluorescent lamps and the outdoor area with halogen flood-lights. The room lighting is controlled by a key card system that shuts them off when leaving the room, however all appliances are left on. Internal blinds are always pulled on vacant rooms to reduce heating the room [VI, VII].

Las Walkirias has installed a solar thermal system on the rooftop of the property in order to heat the swimming pool and some of the domestic water. The system includes a closed loop solar hot water with 34 hot water units on the roof and two accumulation tanks in the basement. The rest of the heating for domestic water is supported by a diesel boiler. According to the hotel management, the current hot water system is not working at optimal rate due to unknown reasons, and will be serviced after peak season [VI, VII].

Las Walkirias rooftop is utilised for solar thermal panels to heat the pool below.

Organisational:

Las Walkirias' provides apartment rooms for both tourist purposes and private use, for independent owners 32 rooms are provided for tourist accommodation and are owned in its majority by three separate stakeholders, whom make up a "society".

The administrator of Las Walkirias is the person in charge of promoting the rental of the apartments, although he also manages other complexes and his policy is only to

operate with a maximum of three owners in order to avoid the problems of multiple ownership structures. The administrator has changed the reliance on tour operators from 90% five years ago to 70% today. Hence, 30% of the apartments are available for individual online bookings by independent tourists. This means that the revenue flows straight to the hotel administrator, instead of circulating via the tour operators, which enables faster access to capital. [VI, VII].

Case Study 3: El Cardonal

El Cardonal is a bungalow apartment complex in the Sonnenland district of Maspalomas. The two star apartment hotel hosts mostly families and elderly couples who look for more peaceful surroundings than Playa del Ingles. In the summer season the guests are mainly Spanish and in winter time Northern Europeans. The apartment hotel complex was constructed in 1987 and it consists of 53 bungalows [VII].

Environmental/technical:

El Cardonal is fully reliant on external electricity, the outdoor pool is not heated and zero renewable energy sources are applied. The bungalows are not heated, ventilated nor air conditioned; which reduces the energy demand of the complex. However, energy efficiency could be improved if the rooms employed a key card system for individual room energy saving. Nevertheless, when the rooms are vacant the appliances are switched off and the blinders pulled. Compact fluorescent lights have been installed in the rooms, as well as outdoors where halogen flood lamps are used [VII].

El Cardonal is attentive to the water usage on the property; the bathrooms have information sheets about the water saving programme in the hotel and requests for minimising the washing of towels and linen. The water system in each room is decentralised, utilising an inefficient 1500W systems in each bungalow. The yard is planted with lawn and drought resistant plants that are watered manually four times a week. There is a large opportunity for reducing water consumption and saving on water costs by investigating grey water and water capture options [VII].

Organisational:

El Cardonal has a single owner and employs six people full time. Due to the one decision maker the potential refurbishment decisions can be made without long waiting periods. This is important in the bungalow structure, as they require more maintenance compared to “attached” hotel apartment complexes, in terms of materials and the structure of building. The bungalow complex is independent from any tour operators and has been satisfied with the occupancy rates through individual internet bookings [VII].

Interviews & Further Data Collection

During an interview with municipal architects, an important programme for hotel refurbishments and constructions in Maspalomas area was discussed. Instead of building new resorts, the municipality is encouraging the current actors related to the apartment hotels to make changes towards a greener Maspalomas. The programme establishes an incentive for the owners to relocate from their current location in a dense tourist area, to a less dense location in the same region. This is designed to increasing the green public areas. As a reward, new allowances for hotel beds in the east and west end of Maspalomas are offered in correlation with the established

new green public spaces. However, the problem that has arisen is that the offered land for new construction is owned by a single person and the pricing of the land area is relatively high. This has reduced the willingness of the property owners to actually implement the programme [VIII].

The municipal urban architects presented the situation of the high rate of obsolete apartment hotels in the whole area. This data was confirmed also in the discussions with two of the largest tour operators on Gran Canaria [II, IX]. It was brought up by both tour operators; Kuoni and Thomas Cook, that several resorts are in desperate need of refurbishment in order to meet the quality requirements of the tour operators. They are very aware of the technical and physical situation of the complexes, however are reluctant to take a leading role to encourage the apartment hotels to revive.

The operators typically only provide funding and loans to the most attractive resorts and apartment hotels, yet they require several actions from even the small scale complexes when it comes to refurbishment. For example, the operators require specific swimming pool temperatures of all complexes, when they are aware of the law that enforces pools to be heated only by renewable energy. Tour operators have a balance of power as they provide tourists to Maspalomas apartment hotels, therefore they have the ability to force requirements upon apartment hotels in order to retain contracts with the tour operators. Whilst the complex owners are typically small investors and often incapable in making big investments, the tour operators' have the ability to contribute to assisting such small scale apartment hotels in refurbishment [II, VI, VII, IX].

The Gran Canaria Tourist Board representative Mrs. Cáceres [X] indicated the significance of the potential tour operators' involvement in the refurbishment projects as they hold such a powerful position. The Tourist Board is working closely with the apartment hotels by helping in the renovation processes. The tourism board provides architectural project advice for apartment hotels that want to renovate, along with quality project services and promote government credits for refurbishments [X].

Workshops & Analysis

Data gathering culminated in a full day workshop involving 35 participants, including representatives from three complexes along with several additional relevant actors. Based on the main conclusion and findings of the workshops, the following chapter outlines several recommendations related to apartment hotel challenges in Maspalomas. These suggestions involve the remodelling of the apartment hotel infrastructure in Maspalomas in three following areas: organizational structure, funding sources and environmental improvements.

Organisational Structure

In contrast to the international case studies of sustainable hotel refurbishment reviewed during the preparation phase, the case of Gran Canaria is unique. Maspalomas presents a highly fragmented ownership structure which, in some cases, reaches 300 owners for the same complex. This makes it difficult for management and decision making in the sense that if any of the owners object to the potential improvements, they cannot be carried out.

In this sense, a potential solution would be to extend the change in ownership struc-

ture planned in the Santa Monica hotel, Playa del Ingles, which is about to change from a privately owned property with multiple owners, to a structure with an allocation of shares; as exists in a private company. This provides two main advantages; first that decisions should not be approved unanimously by the owners but by majority, and second this business model can attract external investors (such as tour operators) who can buy shares and become co-owners of the complex. Additionally, this allows the property to be used as a guarantee of investment, and also promotes an active participation of external investors (such as tour operators) in the internal management of the apartment hotel.

Another requirement highlighted by tour operators is investment in remodelling of the apartment hotels to avoid the combined use of a complex for tourism and residential activities. The current regulation in force allows up to 50% of residential use in the apartment hotel, but based on the workshop discussions, it would be preferable that those complexes were exclusively used for tourist activities. Additionally, residential housing requires certain infrastructure such as parks, schools and community areas, not available in Maspalomas.

Finally, the stakeholders involved in the tourist exploitation of apartment hotels request stricter control by local authorities on those owners who rent their apartments on an informal basis. This is known as "black renting", where owners do not meet minimal accommodation requirements and evade the payment of taxes by tourist activities [I].

Funding sources

According to the views of owners and managers of the complex, one of the major constraints to carrying out the renovations and install eco-efficiency improvements is the lack of financial resources. Although there have been public funds to promote these renovations, the complicated requirements to access to these resources have limited its adoption. Additionally, the current economic situation of Spain has also affected the owners of the apartment hotels; hence the investment of private savings for refurbishment is not considered a priority.

During workshop discussion regarding funding, three potential financing alternatives were identified:

- Create a private fund with resources and contributions of the different stakeholders involved in the tourist operation of the apartment hotels. Considering that the obsolescence of the buildings not only affects the owners, but also to tour operators, local authorities, and apartment hotel managers who have developed a business around tourism in Maspalomas.
- Introduce fiscal incentives to retain part of the investments made in remodelling of tax returns. Similar to the Swedish model of incentives known as ROT, which provides different levels of tax relief in order to promote refurbishments of properties and job creation.
- Obtain resources from tour operators, whom could be involved as co-owners of the apartments; improving the management of apartment hotels and use the property as a warranty on the resources invested.
- Engage an energy service company providing energy efficient and renewable energy initiatives. This third party

would fund the initial renovations and perform maintenance on the installation. In return, the third party would capture the return on investment savings until the installation is paid back.

Another source of indirect funding can be obtained through the sale of allowances for new beds. Since 2002 there has been a moratorium that does not allow the approval of new hotel beds on the island. However, a law on "urgent measures for urban planning" allows for up to 100% of new beds, when refurbishment of obsolete apartment hotels occurs. These beds could be used in the remodelling of the existing building or can be sold in a "bed market" for new buildings. Unfortunately, this law has not been materialized as yet.

Environmental improvements

According to the general impressions gained during the workshops, Gran Canaria has great potential for the introduction of renewable energy sources such as PV, wind turbines and geothermal energy. Unfortunately the lack of public incentives and the elimination of feed-in tariff have limited its development. However, it is possible to implement some of these technologies in the vast majority of apartment hotels, as long as the payback period meets the needs of investors.

Investments in solar or geothermal energy installations for water heating have a payback period of five to seven years. Therefore, if those investments are made by the operators, a long-term lease contract is required to recoup these investments.

Additionally, during the apartment hotel site visits, multiple energy efficient recommendations were identified, such as:

- Use key cards that turn off lights and electrical appliances when the guests leave the room.
- Replace conventional light bulbs with fluorescent or LED lamps.
- Install automatic lighting systems in common areas with movement sensors.
- Provide staff training to the employees to identify and promote potential energy saving.
- Install low-energy appliances.

In regards to reducing water consumption, the main findings are related to collecting rain water and pursuing grey water for irrigation purposes, along with the installation of double flush toilet systems.

Conclusions: Roadmap for success

This project provides recommendations for how apartment hotel complexes can invest in sustainable renovations. Suggestions have been addressed in three parts; the first issue addresses who should be responsible for investing in apartment hotel refurbishments. It is suggested that a combination of different stakeholders are involved in the exploitation of the apartment hotels, such as owners, operator of the complexes and tour operators. The second issue discusses why these actors should invest in complex refurbishment. The vast majority of stakeholders that have invested in resources in developing the current business structure of Maspalomas have allowed for the tourist exploitation. Therefore, the obsolescence of private complexes and market exit of tourists would affect the investments of all stakeholders involved. The third issue provides recommendations on how the complexes can successfully act on sustainable refurbishments. It has been identified that Gran Canaria has a great

potential for renewable energy sources, however its adoption by hoteliers has been limited by lack of public incentives.

This report provides the basis for the secondary phase of the project to be pursued by Sumamos. It is suggested that the next actions could involve conducting a pilot project with one of the complexes involved in workshop, and exploring in detail the ongoing case of apartment hotel Santa Monica in Maspalomas, with ownership structure change and refurbishment planning.

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List of people interviewed

[I] Eduardo Cáceres, Catedrático de Urbanismo, ULPGC, April 16, 2012

[II] Roger Jarkell, Apollo/Kuoni, Senior contract manager, April 13, 2012

[III] Travel Agent, Pers. Comm. (Lund Resebyrå), March, 2012.

[IV] Carlos Castell, Koka, Administrator for society members and tourist use, April 17, 2012

[V] Mauricio Crevero, Koka, President of owners, April 17, 2012

[VI] José Zaffiro, Las Walkirias, Hotel manager, April 16, 2012

[VII] Ramiro Zaffiro, Las Walkirias/El Cardonal, Administrator, April 16, 2012

[VIII] Enrique Blanco, Arquitecto Jefe del ayuntamiento de San, April 17, 2012

[IX] Patrik Marklund, Thomas Cook Northern Europe, Product Manager & Head of Mediacenter, Telephone interview March 26, 2012

[X] Vanessa Cáceres, Patronato de Turismo, Arquitecta jefe, April 18, 2012

Biogas in Firenze

Towards a shared vision

By: Mathilde Andersson, Emmy Carlsson, Paula Llosa & Peter Lindeblad

Introduction

Firenze, the capital city of the Italian region of Tuscany, is a very popular tourist destination, attracting 12 million visitors each year. In 1982, UNESCO declared the city of Firenze a World Heritage Site, due to its artistic and architectural heritage. With 370 000 inhabitants in the city and 1.5 million people in its metropolitan area, it is the most populous area in the region.

Cities like Firenze face major challenges attributable to concentrated and urbanised areas. For instance, there is a growing shortage of available land for landfilling in the area around Firenze as in many areas throughout Europe and the organic fraction of municipal solid waste been landfilled has to be progressively reduced within the European Community.

Figure 1: Map of Italy

Also, areas relying on energy imports like natural gas have a huge dependency on foreign suppliers and are therefore subject to energy security issues and to vulnerability to political instability.

Furthermore, there are economic and environmental challenges associated with wastewater treatment, sludge management and municipal solid waste collection and treatment. Biogas has a great potential to contribute to solving a number of these issues, while producing renewable and sustainable energy.

In this report we will go into details about the possibilities and drivers for biogas production and usage, and also the risks and constraints that might follow. It is structured into three main blocks: first an overview of biogas is provided in order to fill any knowledge gap; second, a case study of Sweden is provided to help understanding the elements of a successful biogas development; and finally, an on-site consultancy mission is depicted and the final recommendations are delivered. The aim of the report is to provide insight into what is recommended in order to explore the potential of biogas production.

The Essence of Biogas

Biogas is a mix of CO_2 and methane produced during the breakdown of organic matter by specific bacteria in the absence of oxygen. The digestion of organic matter is a controlled process taking place in digesters, which can be fed with a variety of organic materials, or *substrate*, e.g. wastewater sludge, manure, organic waste from households or food industries, organic matter in existing landfill and agricultural waste. Each type of substrate is characterised by its nutrient content, its composition of wet/dry content, referred to as total solid or TS, its digestibility and its potential methane yield as illustrated in the table below.

Substrate	% TS	m3/ton TS	% methane
Waste water sludge	5	300	65
Organic food waste	33	618	63
Slaughter industry waste	16	575	63
Cow manure	9	244	65

Table 1: Examples of substrates and their yields

Biogas Production Process

Substrates can be mixed and co-digested. *Co-digestion* – simultaneous fermentation of a variety of substrates, such as sludge and organic waste - diversifies sourcing, enhances biogas production, stabilizes the digestion process and generates a better quality fertiliser. When part of the substrate, food waste has to go through a pre-treatment process that retrieves non-organic matter and transforms it into *slurry*, material that is ready to be digested.

The digestion process is to be controlled and monitored so that essential parameters such as temperature, oxygen levels and pH are maintained at their optimum.

Use of Biogas

Similar to natural gas, biogas can be used for several purposes. Without further refinement, the gas can be used to produce electricity or heating, including the energy needs of the plant itself. In terms of output, 1 Nm^3 of biogas delivers approximately 6 kWh.

Biogas can be cleaned and upgraded to remove impurities, remove carbon dioxide and enhance methane content up to 97%. This biomethane is similar in composition to natural gas. It is renewable and can be used as a vehicle fuel for buses, cars, trucks,

agricultural machines, or injected into the gas grid for use in households or industries. The energy content of biomethane is higher than petrol, 9.7 kWh per Nm^3 compared to 9.1 kWh per liter. On the other hand it has lower energy content of natural gas, which is around 10-11 kWh depending on its origin. Therefore, before injecting biogas into the grid, the biomethane sometimes has to be mixed with Liquefied Petroleum Gas (LPG) in order to raise the energy level.

Moreover the *digestate*, what is left after the digestion process, can be reused as a biofertiliser to return some of the nutrients to agriculture, depending on its composition.

Political and Legal Incentives

The way policies shape the legal framework in which biogas development is taking place acts as a major driver.

At the European level, the EU Directive on Renewable Energy sets a 20% target for the share of renewables in the energy gross final consumption by 2020 [1]. Otherwise, the biodegradable waste share going to landfills has to be reduced by a defined percentage in the coming years according to the European Directive 1999/31/ EC on the landfill of waste [2]. Additionally, the Waste Directive 2008/98/EC aims at improving the use and efficiency of resources [3] and the Sewage Sludge Directive 86/278 seeks to encourage the use of sewage sludge in agriculture [4].

At the Swedish national level, besides the transposition of the Directives, a system for energy taxation (fuels are taxed on their pollutants emission) has been implemented to promote energy efficiency and encourage the development and use of renewable energy resources [5] [6]. Besides, a support system based on electricity certificates was introduced in May 2003 encouraging the production of electricity from biogas.

Subsidies like the Local Investment Programme (LIP), from 1998 to 2002, and the Climate Investment Programme (KLIMP), from 2003 to 2008 [5] [7], also encouraged the development of energy from renewable sources. For instance, the LIP allocated SEK 6.2 billion (EUR 700 million) to over 1800 environmental projects in 161 municipalities between 1998 and 2002 [5] [7], and KLIMP therefore continues with encouraging municipalities to reduce their emissions of greenhouse gases via long-term investments. [5] [8]

Bin for organic waste in Firenze

At the Italian national level, the transposition of the different EU Directives leads to legislative decrees [9] [10]. The most important one is the Legislative Decree Nº 28 of 2011 called "Promozione dell' uso dell' energia da fonti rennovabili", promoting the development of energies from renewable sources through coming incentives. So far the Legislative Decree Nº 79 from 1999 or "Bersani Decree" on *green certificates* (tradeable certificates of energy

production from renewable sources), and *feed-in tariffs* (monetary incentives to feed into electricity grid), is still in place [9] [10] [11]. However it will be replaced in the coming months, generating some uncertainty. Finally, Italy has launched a National Action Renewable Energy Action Plan in June 2010 that sets the national renewable energy policy as well as the targets, support schemes, actions and assessments for the promotion of Renewable Energies [9].

Positive Experience from Skåne

Sweden produces about 1.4 TWh of energy from biogas annually, in some 230 different production sites: wastewater treatment plants, landfills, co-digestion plants, farms, and industrial facilities. Almost half of the production is used for heating, 5% is used for electricity and 36% is upgraded as a vehicle fuel.

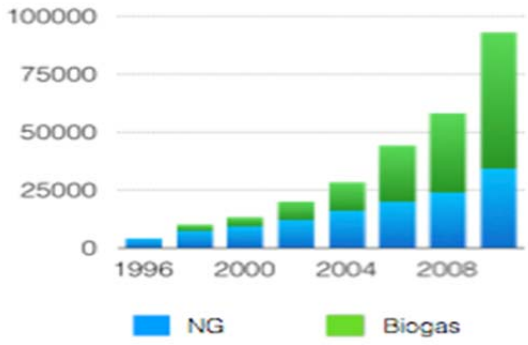

Figure 2: Nm³ usage of fuel gas in Sweden 1996-2010

Since Sweden produces electricity mainly from hydro and nuclear power, the country is benefitting from relatively low electricity prices. So it is in the fuel sector that the potential for biogas is the greatest. Although the fleet of cars, buses and trucks running on natural gas or biogas is still smaller compared to Italy, around 40 000 against 730 000 vehicles, the increase of use of gas for vehicle fuel has been rather tremendous in the last decades, as illustrated in the graph above.

The region of Skåne, the southernmost part of Sweden, has a population of 1.25 million. In this region, the annual production of biogas is over 300 GWh distributed among 40 different production sites. Biogas is produced mainly at landfills and wastewater treatment plants, but there is also three facilities for co-digestion that together generate almost one third of the energy produced. On top of this, but to a much smaller extent, biogas is produced in industry and on farms.

Substrate producer

The market for biogas in Skåne essentially lies in combined heating and power generation (CHP), heating only, and in upgraded biomethane for vehicle fuel, as depicted in the figure below. The lion's share, around 70%, of the upgraded biogas is used in public transportation.

In Sweden only 1% of the total waste is landfilled, 49% is material recycled which includes biological treatment of organic waste, 49% is incinerated for energy recovery and the remaining 1% is classified as hazardous waste and is treated separately.

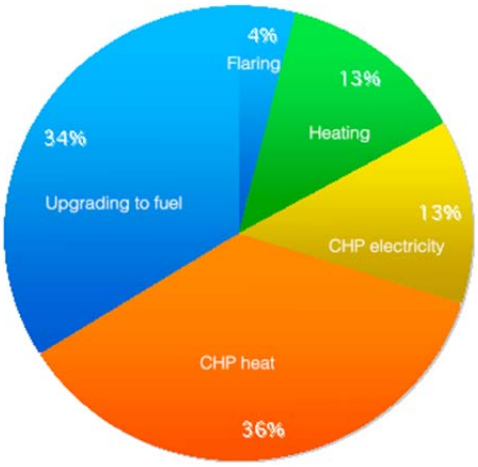

Figure 3: Biogas usage in Skåne, 2010

The Road Map to 2020

In 2010 a number of actors in the biogas sector, including municipalities and public and private organisations, gathered and decided on a common vision for the future development of biogas in Skåne. This vision, and the *road map* to get there, was developed through workshops and network meetings, and the overall target is to produce 3 TWh of biogas energy by 2020, corresponding to 10% of total energy need.

Road Map Targets

Apart from the overall objectives of the vision of biogas in Skåne 2020, the road map also includes specific targets that should be fulfilled by that same year. Among them is that 85% of all biogas should be upgraded to biomethane to be used for fuel while the remaining 15% should be used for electricity and heating. This means that 25% of the total car fleet would run on biomethane and 10% of the heavy traffic on liquefied biogas. Public transport companies should run all vehicles on upgraded biogas.

The road map also lays out that the production of biogas on farms should increase by 2020, as well as the use of biofertilisers. The increased use of biofertilisers will lead to a decreased reliance on chemical fertilisers, which are energy intensive, and this will lead to a decrease of eutrophication by 50%.

There is also a target in the road map that includes ongoing research, in which new applications should be developed and new techniques should be introduced in both the production phase as well as the upgrading and user phases.

On top of this there is also a target concerning public awareness, i.e. the inhabitants in the region should be aware of what biogas is and how it can be used.

Truck delivering manure

Actors and Stakeholders

The actors involved in the road map towards biogas 2020 in Skåne come from a wide range of different sectors, from private companies such as grid operators, harbors and consulting firms to public companies like energy companies, a public transportation company, waste treatment company and wastewater treatment company. There is also a wide range of municipalities and other organisations such as universities, the Regional Council, the County administrative board and the Federation of Swedish Farmers. The stakeholders have different roles in the biogas sector: producing, upgrading, distributing and retailing. Together the organisations created a platform for cooperation and networking: Biogas Syd,

which is in charge of guarding the vision of Biogas 2020 and acts as project coordinators.

Drivers and Risks

Skåne is strongly dependent on energy from fossil sources, especially when it comes to fuel for vehicles. However, in Skåne there are strong political incentives to reduce this dependency as well as promoting public health and better environment. There is also willingness among politicians and other stakeholders to increase resource efficiency, make use of local available resources, address the risks involved and mitigate price volatility on natural gas. Additionally, augmenting biogas production also leads to more local jobs and stronger economic diversification in the region, and it fosters a more secure energy supply.

Swedish targets to reduce landfilling and incineration of organic waste is also a strong driver to encourage the production of biogas in the region.

In order to achieve these goals some important risks and constraints has to be overcome. First, there is a political risk with lack of clear legal and economic incentives and major uncertainties in the future policies that will shape the legal framework in the area. Moreover, there is a very important risk involved in lack or deficiency in collaboration and communication among local actors. To avoid conflicting interests and ensure that all actors work towards a common goal, the definition of a shared vision is necessary.

Furthermore, from the economic point of view risks stem from market uncertainties. Those can be addressed by securing the market before starting any production. Investing in new technologies also includes

Biogas plant in Sweden

a financial risk that multiplying individual investors can limit. Moreover, many projects in Skåne have partly been financed by regional, state or EU projects that spurred the entire sector.

Lastly, public resistance, inertia or lack of awareness should not be underestimated. Indeed, if the public understanding is low there is a higher risk of local resistance which can prevent or delay some projects and jeopardise the set targets.

Conclusions from Skåne

Things learned from the biogas production in Skåne are the following:

- Due to low electricity price it makes sense to upgrade biogas to biomethane in Sweden
- There have been strong political incentives to increase the biogas production
- Biogas production and incineration have expanded in parallel

How can biogas be advanced in Firenze?

Since the same EU directives apply in both Firenze and Skåne, and the regions are a similar in size, we have been using the case of Skåne as a model for how biogas could be

developed in Firenze.

Regarding Italy, oil and natural gas dominate the primary energy supply, which is heavily dependent on energy imports, and there is a low level of fuel diversity [12] as illustrated below in figure below.

Within bioenergy, the share of biogas in Italy is 8% (2009). The total biogas production for 2009 amounted to about 5.2 TWh and 80% of this production was from landfill. Tuscany, where Firenze is situated, had 10 biogas production plants producing biogas out of sewage sludge in 2009. This represents more than 90% of the biogas production for the region [13].

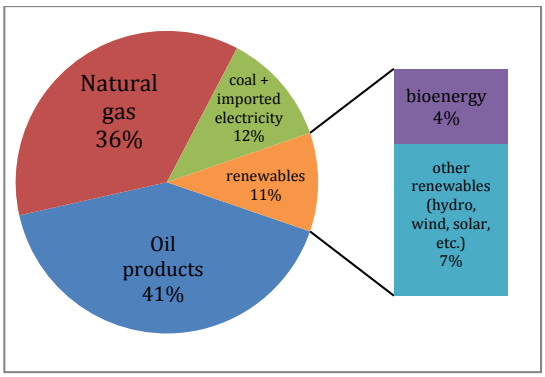

Figure 4: Energy use by source in Italy, 2009

There is a huge potential identified for biogas production from anaerobic digestion of organic waste from municipal solid waste, cattle and pig manure as well as agriculture residues in Italy [13]. However, manure and agriculture waste are available in a very moderate amount in Tuscany, especially in the area around Firenze, therefore it seems that more potential lies in sludge and food waste.

The market opportunities for biogas that have been identified are boosting the transport sector, both for private cars and public transportation, as Italy has over 700 000 vehicles running on natural gas - far ahead of any other European country - and stimulating its integrating into the very well developed natural gas network for industrial and household purposes [13].

In the area in and around Firenze, *Publiacqua*, the local wastewater treatment company, produces 1 000 m^3 biogas/day from sludge in three anaerobic digesters, each of them with a capacity of 4 800 m^3. Only three of the six digesters a in place are used, which highlights an underexploited capacity. So far, the biogas production is used internally to partly cover the energy needs of the plant. Publiacqua has been looking to join forces with *Quadrifoglio*, the waste company, in order to make use of the digesting capacity by adding their treated organic waste, but deplore a lack of support from public entities.

Findings from Firenze

During the week in Firenze, we were given the opportunity to visit and interview a number of actors in the biogas sector: the waste water treatment company Publi-acqua, the waste company Quadrifoglio, the gas distribution company Toscana Energia and the public transportation company ATAF, among others. The interviews conducted provided a holistic overview of the situation upon which we base our recommendations below.

The municipality of Firenze has no waste treatment or wastewater treatment on its own but is a part of a larger system with surrounding municipalities. There is issues with space in Firenze: there is no land to build on which means that they have to outsource all their waste problems to surrounding municipalities. The landfills, as well as the wastewater treatment and waste treatment plants, are located in surrounding municipalities.

Meeting with gas grid operator in Firenze

The most important finding derived from our interviews is the apparent lack of communication and cooperation among the actors in the sector. From a political perspective, there are obstacles that have to be overcome in order to increase collaboration among the actors. No real planning and coordination at the municipal level have been identified in order to implement a framework that would foster action. Support to individual actions that encourage biogas development, such as the case of Publiacqua, is an example to illustrate the need for planning, communication, coordination and decision-making. Indeed, there is a potential and relevant synergy effect between Publiacqua and Quadrifoglio. The proposal is to direct the pre-treated organic fraction of the municipal solid waste collection to the digesters of the wastewater treatment plant, and thereby make better use of the capacity they have installed already. The use of the overcapacity at Publiacqua seems like a quick and logical gain for all parties.

Secondly, as the country is already equipped with a widespread natural gas grid, upgrading technologies represents a major opportunity to utilise renewable gas within an already in-place natural gas market. Indeed, the gas market is well established on the demand side, mainly consisting of electricity generation (45%), the commerce, public and residential sectors (36%) and the industry sector (16%) (data for 2008) [14]. The transport sector is also using natural gas, both the private car fleet and the public transportation companies, such as ATAF in Firenze, having 36% of their buses running on NG. On the supply side there is mainly the sludge and the organic fraction of municipal solid waste, but other supply sources should not be neglected and more closely looked at in order to identify possibilities.

Thirdly, on the legal aspect it has been found that biomethane may be injected into the grid provided that it meets the quality requirements (Decree No 28/2011), that a related quality standard is expected in the near future and that the adoption of the Resolution No 108/06, related to the approved CRDG (Codice di Rete per il servizio di distribuzione gas), obliges the distribution companies to offer neutral and non-discriminatory services to companies and sales to wholesalers [15].

Finally, there is a clear lack of incentives regarding two aspects: incentives to produce biomethane and incentives for households to sort their organic waste. Implementing financial incentives for biomethane producers such as feed-in tariffs does not fall within the purview of the municipality, but is a major drivers for enhancing production at the local level. Since 2009, electricity produced from biogas is subject to a 15 year guaranteed price of EUR 0.18 or 0.28 per kWh, but the feed-in tariffs for biomethane are expected to come in the near future. Regarding waste sorting incentives, so far the citizens of

Firenze are targeted with information campaigns to increase awareness and action, which can be further encouraged. However, there are other incentives such as financial incentives, i.e. waste taxation according to the share of waste sorted, that can be implemented in order to strengthen the organic waste fraction supply as a substrate for biogas production within the province of Firenze.

The technological aspects have not been identified as a major barrier as anaerobic digestion technologies are easily harnessed and are already well developed throughout Italy. Pre-treatment tech-nologies needed to treat the organic fraction coming from the municipal waste are also believed to not be a major barrier in terms of technology.

Filling station for ATAFs buses

Recommendations

Our team believes that Firenze has a clear potential to increase its production and use of biogas. However, the extent of this increase depends on a number of factors, primarily the coming legal framework for renewable energy in Italy. To spur biogas development in Firenze, our team would suggest working step-by-step as explained below in our packages of recommendations.

Base package

The base package of recommendations, which is crucial for all continued work with biogas, contains the following main recommendation: All actors and stake-holders; metropolitan municipalities, public companies, regional authorities, private companies and other relevant stakeholders, like the university, should come together and *formulate a shared and common vision* for the biogas development in Firenze. A shared vision, similar to the one in Skåne, aims at unifying the expectations of all actors, encompassing project managers and the local com-munities where biogas plants are to be developed. This will require collaboration, communication and political will, and the suggested initiator for this work is the regional authorities. The vision shall be developed so that it incentivises all actors, and it shall be documented, reviewed and signed by all parties.

The base packages further includes a strong recommendation to *create or appoint a coordinating organisation*. This organi-sation will be held responsible for :

- Guarding and updating the vision,
- Coordinating projects and plans,
- Investigating possibilities for external financing,
- Closely monitor ongoing legislative development,
- Developing business cases for biogas investments, and
- Initiating and organise campaigns to raise public awareness.

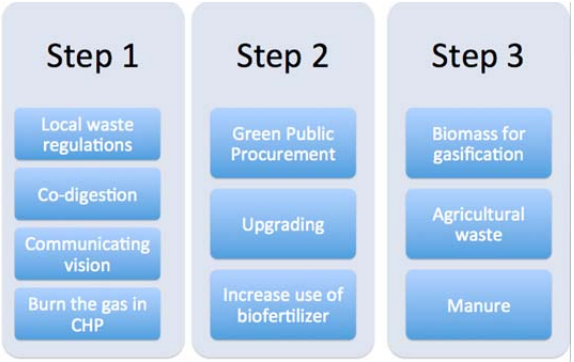

Figure 5: Recommendation packages

Step 1 package

Once the base package is in place, our team strongly recommends proceeding to the first logical step of biogas development in Firenze. Since there are already actors sitting on the resources needed and the barriers are low, this step should be considered a low-hanging fruit.

The main recommendation in this step is to make use of existing resources and *start up a co-digestion plant* run with the sludge from the wastewater treated by Publiacqua and the organic waste collected and treated by Quadrifoglio. Indeed, on the one hand, Publiacqua has an unused capacity of digesters and, on the other hand, Quadrofoglio is planning to produce biogas from the organic waste. If they get support for a joint venture, derived from the base package shared vision, the increase of gas production from a co-digestion plant will constitute a great impetus. In this first step, we recommend that the gas should be used in CHP generation only.

Assuming that the base package is in place, the coordinating organisation should also start *communicating the shared vision* to the political establishment, businesses and the public in order to raise awareness and interest in the renewable energy supply in general and biogas in particular.

A last recommendation in this first step is to *change municipal regulation* to give higher incentives for households to actually source-separate their organic waste, which currently depends on education and awareness raising.

Step 2 package

The next step package of recommendations has strong dependencies on coming Italian legislation on renewable energy. The main idea is to *start upgrading biogas* to biomethane, provided that the incentives in the legislation are conducive to this e.g. feed-in-tariffs. There is a large biomethane market in Italy, both in the CNG car fleet and in household gas use, and if incentives are right it might be economically feasible to start producing it.

In relation to this, Firenze also has a good chance to influence the future market for biomethane in public transportation. By applying *green public procurement* and adding the correct requirements to the bidding process that will lead to the privatisation of public transportation, there is a possibility to secure a market for local production of upgraded biogas.

The final step 2 recommendation is to start working on the market for *biofertilisers*. A satisfactory quality biofertiliser can be given away or even sold to farmers provided that they value this product. Educating and incentivising local farmers to use biofertilisers instead of chemical fertilisers will have several economical and environmental advantages.

Step 3 package

The final step package is more of a collection of ideas for future development of biogas, given that the first two steps are in place. The recommendations involve starting considering enrichment of the mix of organic matters used for biogas

production and to *use of other substrates*, like biomass, agricultural waste and manure, in the biogas production process or, in the case of biomass, even in a gasification process.

Through gasification, organic material is converted to hydrogen at high temperatures. Gasification is planned to cover a substantial part of the biogas production in Skåne, and should also be considered an interesting option in Firenze.

Outcomes

By developing the production and subsequent use of biogas or upgrading to biomethane, our team believes that Firenze will enjoy a number of positive outcomes.

A huge decrease in landfilled waste can therefore be achieved, which is a great financial saving since every tonne of this waste costs EUR 150. By not landfilling they will also make better and more efficient use of the resources at hand. Another important outcome is that the dependency on foreign suppliers of natural gas, and thus energy, will decrease and that vulnerability to the volatility of natural gas prices will be mitigated.

On top of this, we believe that investing in biogas and biomethane can generate local jobs and thereby local tax revenues. It will also be a good way to work proactively to comply with future legislation on renewable energy that is likely to come, judging from existing EU directives in the area.

Naturally, making use of waste and sludge and increasing the use of biofertilisers will eventually have positive environmental effects, which, in combination with energy self-sufficiency, is not only good for the environment but also for the image and the identity of Firenze.

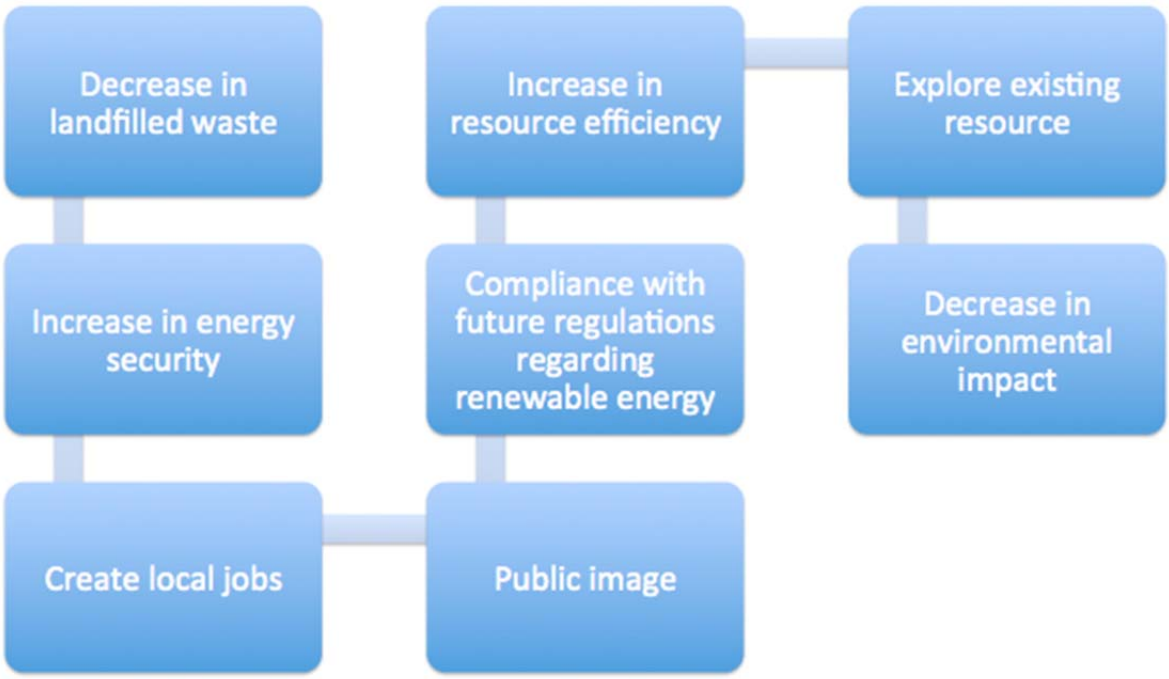

Figure 6: Potential gains

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List of people interviewed

In Skåne

Carl Lillienhöök, CEO, Biogasen Kristianstad, personal interview in Kristianstad on 23/3 2012.

Martin Hallmer, Project Manager, SYSAV Biotech, telephone interview on 26/3 2012.

Liselotte Stålhandske, Business Developer, VA Syd, telephone interview on 27/3 2012.

Caroline Steinwig, Environmental Consultant, BioMil AB, personal interview in Lund on 27/3 2012.

Björn Goffeng, CEO, BioMil AB, personal interview in Lund on 27/3 2012.

Markus Paulsson, Biogas Coach, Lund municipality, personal interview in Lund on 29/3 2012.

Anna Hansson, General Manager, Biogas Syd, telephone interview on 30/3 2012.

Per Löwenham, Business Developer, E.On, telephone interview on 2/4 2012.

In Firenze

Sergio Gatteschi, Chief Executive, Agenzia Fiorentina per l'Energia, personal interview in Firenze on 10/4 2012.

Simone Caffaz, Depuration Processes Manager, Publiacqua, personal interview on 12/04/2012.

Vittorio Ghione, External Relations, Toscana Energia gas grid, personal interview on 12/04/2012.

Massimo Mensuali, Procurement and Contracts Management, ATAF, personal interview on 13/04/2012.

Franco Cristo, Plant manager, Quadrofoglio, personal interview in Firenze on 16/4 2012.

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Pre-feasibility Study on Biogas Production from Organic Waste in Zabrze

By Johanna Generosi, Erika Machacek, Živilė Poderienė & Randy Remigius

Introduction

As environmental issues become more visible in the current world, energy policies, which have a vital role in tackling environmental issues, start to look for alternative energy sources to replace fossil fuel energy. The development of renewable energy industry, as a means to fulfil energy demand, expands as the awareness of environmental issues increases.

Biogas is one of the renewable energy sources that can be very beneficial in some circumstances. Biogas is produced from the decomposition of organic matter. This fact makes biogas even more attractive because not only can it fulfil energy demand in a society but it can also solve waste management issues. In fact, in many countries, such as Sweden for instance, biogas production was first implemented to solve a waste management problem.

The involvement of many stakeholders in the implementation of a biogas system proves to be a challenge in some countries compared to other renewable energy systems. For example, the availability of substrates to be used for the production of biogas depends on how much organic waste is available and how contaminated it is. This implies that unless good waste separation at source and well functioning collection system are implemented, biogas production will not flourish. Also, the legislative framework can present a barrier if its design does not support biogas market development. Furthermore, frequent legislative changes also pose a risk to business investments.

Nevertheless, when a biogas production system brings all stakeholders together to overcoming all barriers the outcome is very beneficial, both economically and environmentally.

In this report we present a pre-feasibility study for the implementation of a biogas system in Zabrze, Poland.

Zabrze

Zabrze, is the twin city of Lund, Sweden. It belongs to the Upper Silesia voivodship or province, which is one of the 16 Polish provinces. It is located in the urban zone of Katowice, one of the biggest cities in Poland. The population in Zabrze is about 186 000. Zabrze, as a former coal mining town used to be referred to as "the most polluted city in Europe". As a consequence, some parts of the urban area are still heavily contaminated, known as brownfields, causing serious environmental problems, such as salinisation of surface waters, waste production, waste storage, mine waste dumps, the residue of mining activity - with danger of causing endogenic fires, change of water relations and damage on surface [1]. Despite the mentioned impacts, brownfields can be revitalised and could

then be a potential source of economic revenue.

Today only one coal mine is still in operation in Zabrze, the others are closed and some of those are used for tourism purposes. Furthermore, authorities of the city of Zabrze are applying to get two Silesian coal mines onto the UNESCO's World Heritage List.

Project Client

The clients of this project are Zabrze Municipality and MOSiR, Miejski Ośrodek Sportu i Rekreacji, a sport and waste management company in Zabrze.

Since the new waste management regulation was introduced in Poland in January 2012 [2], each municipality is in charge of waste collection and reduction of the amount of waste put into landfill. This condition makes biogas production out of household organic waste more attractive since it can generate income from the output products (biogas and bio-fertiliser), and in parallel solve waste problems in Zabrze. Moreover, MOSiR financially supports sport activities with waste management operations (landfill site). This is considered an opportunity to ameliorate waste management in Zabrze and MOSiR sees business potential in extending their business to biogas production.

In order to establish such a system, the municipality has to improve the waste separation system to have non-contaminated organic waste. Moreover, a sufficient amount of organic waste for the right mixture of biogas substrate is important. To understand whether a biogas production system is possible to establish in the city of Zabrze, a pre-feasibility study was requested by the client.

Methodology

A literature review identifying Swedish case studies of biogas systems transferable to the Polish context, preceded the data collection onsite in Zabrze. During the seven days of field study, numerous stakeholders were interviewed to test the reliability of the data and collect further details such as on the volume and type of substrates available.

The following sections provide an overview of the performed investigation process aimed at assessing the possibility to implement a biogas facility in Zabrze.

Biogas Production

In this section technical parts of biogas production process as well as the usage of biogas are covered.

Anaerobic Digestion Process

Biogas is a natural gas produced from the decomposition of organic materials such as animal manure, food waste, and sewage sludge without the presence of oxygen (anaerobic digestion). Biogas produced from this process is a clean renewable energy source.

The anaerobic digestion process mostly takes place inside the biogas reactor (digester) where the organic substrates, in the form of slurry, are digested by the methanogens (methane producing bacteria) and changed into decomposed slurry and biogas. The process has three phases: (1) Hydrolysis, (2) Acidification, and (3) Methane formation [3].

There are several key parameters inside the reactor plant to be controlled during the process to create a good living environment for the bacteria.

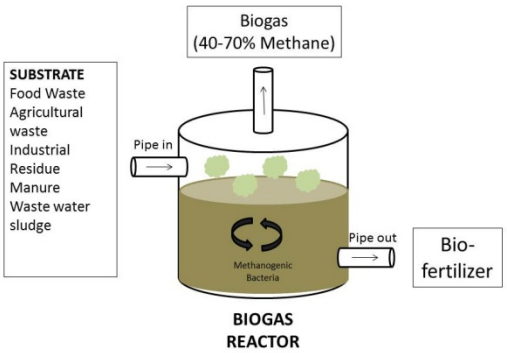

Figure 1. Biogas production process diagram.

These parameters are: (1) substrate temperature, (2) pH level, (3) availability of nutrients, (4) carbon / nitrogen ratio, (5) retention time, (6) solid content, and (7) agitation. Biogas produced from this process contains 40-70% methane [3].

Biogas Use

After production, biogas can be directly used or cleaned and upgraded to obtain a higher value product. To make combustion of biogas more efficient and to avoid damage to the equipment, the impurities in biogas could be removed before further use [3].

The three most common uses of biogas are:

1. Direct combustion. Biogas can be used in direct combustion for heating purposes such as district heating and cooking.

2. Combine heat and power plant (CHP). Biogas can be used as a fuel by power-plants to generate electricity. The excess heat can be used for internal or other heating purposes such as district heating. Furthermore, by producing electricity using biogas, the producer could get a green certificate (depends on country's policy) that gives a financial benefit.

3. Biofuel. Upgraded biogas (in which hydrogen sulphides and carbon dioxide are removed) contains up to 97% methane and can be used as a vehicle fuel for bus, trucks, and private cars as well as for injection to a gas grid.

Biogas in Sweden

Biogas Development in Sweden

Biogas production in Sweden has taken place since the 1940s. During that time, biogas was a by-product from waste water sludge reduction in the process of waste water treatment.

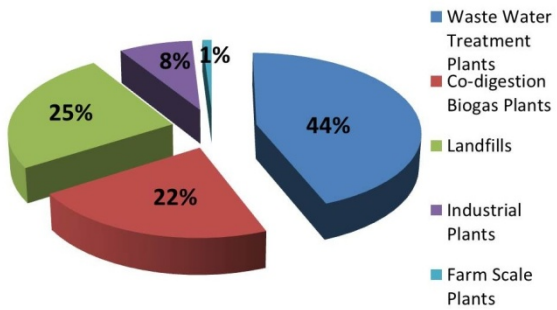

Figure 2. Biogas production plants in Sweden (2008) [4].

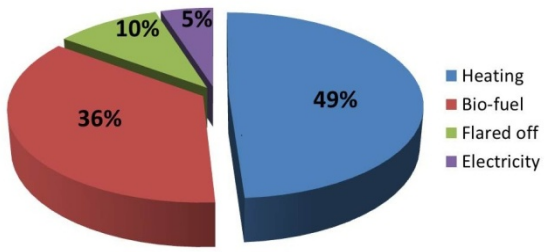

Figure 3. Biogas usage in Sweden (2008)[5].

The 1970's energy crisis triggered the further development of larger scale biogas production in Sweden for commercial purposes. In 2008 Sweden produced 1400 GWh of biogas [5], compared to 428 GWh produced in 2011 in Poland from biogas plants [6].

In Sweden biogas is mostly used for heating purposes (49%) and for upgrading to bio-fuel (36%); very little is used to produce electricity (5%) since electricity is

cheaply available from hydro- and nuclear power sources.The remaining 10% is flared off.

Case Study: Kristianstad Kommun

Kristianstad is a small town in the southern region of Skåne in Sweden with approximately 80 000 inhabitants. It is known in Sweden for its strong biogas production. In 2009, the town produced approximately 68 GWh of biogas [4] and almost all of the energy consumption in Kristianstad is powered by biogas. Approximately 44 GWh of biogas produced in Kristianstad is upgraded to biofuel and the rest is used to generate electricity and heat.

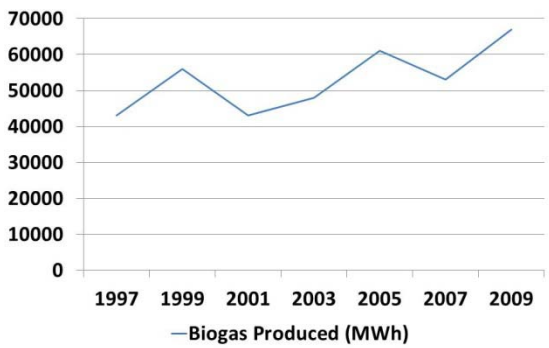

Figure 4. Biogas production in Kristianstad overtime [4]

Biogas in Kristianstad is produced by the wastewater treatment plant, the landfill site, and a co-digestion biogas reactor plant (known as the Karpalund co-digestion plant).

The Karpalund co-digestion reactor plant on its own produces around 42GWh of biogas per year, which is upgraded into biofuel. Substrates used to produce biogas in Karpalund biogas plant are residues from food industry (46%), household food waste (30%), and animal manure (24%) [4].

This case study illustrates the potential for biogas production within a small town.

Figure 5. Biogas plant at the waste water treatment site in Zabrze.

Legal Framework for Biogas Produced from Organic Waste

This section provides an outline on the European legislation related to waste and energy management, which is applicable to biogas production from organic waste. An overview of its transposition into Polish law is then covered.

Directive 2008/98/EC on waste

The Waste Framework Directive lays out the definitions and core concepts regarding waste management, such as the meaning of waste, recycling, and recovery. It defines when waste is considered waste or a valued raw material. The Directive introduces principles regarding basic waste management and the waste management hierarchy which is to be applied to waste legislation and policies of EU Member States.

The Directive sets out two targets: preparation for re-use and recycling of 50% of certain waste materials from households and other similar origins, and 70% preparing for re-use, recycling and other recovery of

construction and demolition waste. It also calls upon Member States to adopt waste management plans and waste prevention programmes [7].

Directive 1999/31/EC on the landfilling of waste

With a view to reducing the environmental threat of greenhouse gas emissions from biodegradable waste put into landfills, this Landfill Directive makes it obligatory for Member States to reduce the amount of landfilled biodegradable waste to 35% of 1995 levels by 2016 [8].

Directive 2000/76/EC on the incineration of waste

This Directive is relevant to the study given that the EU classifies burned carbon from organic waste as climate-neutral. With this stance, incineration of organic might be regarded as a way to achieve landfilling targets [9].

Directive 2009/28/EC on the promotion of the use of energy from renewable sources

This Directive, commonly referred to as RED Directive, sets mandatory targets on a national level for EU member states for the use of energy from renewable energy sources (RES) with the aim to achieve the overall EU 20 per cent target of energy from RES in 2020. The Directive calls upon Member States to adopt National Renewable Energy Action Plans (nREAPs) [10].

Polish Legislative Framework

National Renewable Energy Action Plan (nREAP)

The nREAP has been drawn up and sent to the EU in December 2010 to meet the commitment under Article 4(1) of Directive 2009/28/EC (point 4).

According to Rogulska and Krasuska (2012), the nREAP is based on the Polish Energy Policy 2030 regarding the 15% share of RES to be achieved by 2020. It is divided into different energy sector targets: 8.6% for heat and cooling, 4% power production and 2.9% transport.

National Energy Policy

The National Energy Policy, addressing the entire energy sector, provides targets for renewable energy until 2030 [11].It introduces a 15% target of RES in final energy consumption by 2020 and 20% in 2030 with the 15% target reflecting the objective set out in the EU RED Directive. Further, the Energy Policy stipulates a 10% target for biofuels in transportation by 2020, along with the implementation of second generation biofuels [11].

The Energy Policy promotes the continuation of renewable energy certificates of origin, or green certificates, and tax relief for energy generated from RES [11].

Energy Law Act

The 1997 Energy Law Act [12] defines state energy policy development, underlying principles and terms of supply of fuels and energy (including heat) and operation of energy enterprises. It also designates the institutions in charge of fuel and energy economy, e.g. the Energy Regulatory Office (URE).

The Act has been adjusted several times to support renewable energy and cogeneration with the latest version entering into force in October 2011, replacing the Energy Law [13] and introducing the provisions of the Act of 19 August 2011 [14,15]. These provisions define agricultural biogas as fuel

gas derived from: (1) agricultural raw materials, (2) by-products of agriculture, (3) liquid or solid animal manure, (4) by-products or residues from the processing of agricultural products, and (5) forest biomass and a methane fermentation process [14]. This definition excludes organic food waste and thereby restricts the exploration of the full economic potential of this type of biogas because it is not being applicable for grid injection.

The Act requests electricity generators and suppliers to reach definite quota of green certificates/certificates of origin. Alternatively, the companies can pay fees. If neither of the two options are selected, the Energy Regulatory Office requests a penalty payment.

Selling electricity on the market or offering it to an electricity supplier at the previous year's market price is an option for electricity producers [12].

As of December 2011, the installed capacity of licensed biogas plants according to Muras [15] amounted to 0.1 GW. Muras [15] illustrates the development in the production of electricity and certificates of origin in the period 2005 - 2011 and shows a total energy production from Polish biogas plants of 428 GWh in 2011.

National Waste Management Plan 2010

As mentioned earlier, this report focuses on the province (voivodship) of Śląskie, or Upper Silesia. This provinces' waste management plan is being revised at the moment [16].

Polish Act of Waste

Article 16a of the Act [2] is a transposition of the EU landfill Directive 99/31/EC. It introduces mandatory targets for Polish communities regarding the reduction of biodegradable waste to be landfilled which are 75% (by weight) by 2010, 50% by 2013, and 35% by 2020 using base level of year 1995 level (in Poland 4.38 mln t/yr).

Poland is subject to fines of about 40 000 EUR per day for not complying with EU Directives regarding waste management [17].

Support Mechanisms

Renewable energy support measures in Poland are [11]:

- Electricity: green certificates and quota obligation; electricity generated from RES must be purchased
- Heat: purchase obligation for heat from RES
- Transportation biofuels: national indicative targets which are imposed on producers and importers of fuels, designated fleets; possibility of producing liquid biofuels by farmers for own use, excise tax relief for biofuels

Renewable energy	
	all types of renewable energy sources (natural production of electricity)
	agricultural biogas injected into the network (equivalent)
CHP	
	agricultural biogas (any power), and all biogas or biomass (Pel <1 MW)
	non-agricultural biogas, biomass (Pel> = 1 MW)
	All biogas (any power)

Table 1. Different types of certificates [18].

Table 1 outlines the different types of certificates currently in place and Table 2 shows the cost in PLN (Polish Złoty) /MWh in 2012 for energy from RES as per green certificates and from different sources of co-generation.

Both yellow and red certificates are antici-

pated to be phased out at the end of 2012, while the violet certificate is expected to remain in its form until 2018.

PLN/MWh 2012			
202*	< 286.74	distributive electricity generation or CHP - not high performance	
202*	< 286.74	< 128.80	CHP unit - high performance
202*	< 286.74	< 29.30	
202*	< 286.74	< 60.00	
* Chairman of ERO shall publish until 31.03.2012			

Table 2. Revenues from individual units of RES and RES in the CHP, 2012 [18].

The grey column refers to the fixed price of PLN 202 (EUR 48) for conventional energy; PLN 286.74 (EUR 68) is the price cap for green certificates and the prices in the yellow PLN 128.80 (EUR 30), red PLN 29.30 (EUR 7) and the violet PLN 60.00 (EUR 14) section refer to the respective caps.

The annual production of electricity from biogas in Poland amounts to 8 GWh in 2012, which represents 1.8% of the total energy from biogas produced. Electricity from biogas ranks second in terms of revenues to be achieved, following biomass [18].

Stakeholder Analysis

The implementation of a biogas system is complex and implies the involvement of multiple actors, normally not interlinked. On one side, it is crucial to investigate all the accessible sources of raw materials for the digestion process. On the other hand, the demand for the finished product has to be analysed then linked to, and balanced with, the supply.

Organic Waste Survey and Potential

For the purpose of the pre-feasibility study, suitable agricultural, municipal and industrial wastes were considered. Organic waste is here defined as waste material appropriate for anaerobic digestion excluding soil, sand, wood and other similar products.

Waste management follows waste generation and can be divided into two steps: collection of waste and disposal. Each step entails different stakeholders. In the city of Zabrze and neighbouring areas, the main waste producers include farms, industries, citizens, schools, hospital, supermarkets and restaurants.

Collection of waste is performed by private companies. Waste disposal areas include farmland, landfill and composting sites. In Zabrze, the great majority of municipal solid waste (MSW), including organic waste, is disposed in the landfill and only 7% of the waste is source separated and recovered for recycling. The composting site is processing public park waste and food waste from 513 households. It is included in an ongoing pilot project started in 2004 aimed at reducing the amount of organic waste put in landfill and increasing public awareness on source separation and recycling. [19]

In the near future, a refuse-derived fuel facility (RDF) will be set up in Zabrze [20]. Furthermore, a methane extraction facility has been installed on the landfill site and two incineration plants are planned to be constructed in the neighbouring city Ruda and in Dąbrowa Górnicza [20].

Our research was focused on waste streams suitable for anaerobic digestion.

Table 3 shows the types of waste and their sources. Moreover, it indicates the feasibility of including these wastes in the biogas system.

Waste type	Origin	Availability	Comments
Manure (Pig)	Danish Farming Consultants Sp. z o.o.	Partial	On the way to build own biogas plant
Manure (Pig)	Farm of Andrzej Sylwestrzak	Yes	Approximately 40 km from Zabrze
Food waste	Residential	Yes	Pilot project of 513 households, to be extended
Food waste	School	Yes	Too small amount to be considered
Grass clipping	Public parks	Yes	Seasonal fluctuations, risk of including unwanted elements, e.g. soil, branches, roots
WWTP Sludge	Zabrzańskie Przedsiębiorstwo Wodociągów i Kanalizacji Sp. z o.o	No	Already producing biogas
Brewery by-products	Van Pur S.A.	Partial	By-product of fermenting process sold to farmers.

Table 3. List of the investigated sources of organic waste with a potential to be employed in a biogas system [19-23].

According to the survey, the most reliable sources of waste available are the food waste from single family and semi-detached houses in Zabrze and the manure from pig farms in Rzeczyce, Gliwice.

Demand for Biogas

In a biogas plant, the digestion process results in two main products: biogas (with a methane content that ranges between 40% and 70%) and biofertiliser. The latter can be used by farmers on their fields. In our study, the substrate provider (pig farm) would also be the receiver of bio-fertiliser. It is relevant to note that replacing the direct use of manure with a processed biofertiliser avoids health risks (presence of microbes in the excreta), ground water contamination due to excess nutrient presence (eutrophication) and unpleasant odours. It also improves the soil quality due to the higher concentration of nutrients and easier uptake for crops.

The main product of the digestion process can be used in several ways – as already explained in the previous section, "Biogas use".

In our study, three main uses have been considered: direct utilisation of biogas in a co-generation power plant to produce heat and electricity, upgraded to fuel used for private and public transportation, and upgraded for gas grid injection.

After analysing the different views of stakeholders and taking into account national regulations, economic incentives and other relevant socio-political aspects, direct utilisation of biogas was chosen to be the most promising use in Poland today.

Table 4 summarises our findings indicating the arguments in favour and against the three different uses of biogas.

Electricity generation by a diesel engine fuelled by biogas.

Technology	Use	Cost	Efficiency	Drivers	Barriers
Co-generation Heat and Power (CHP)	Sell electricity to the grid	High	Medium	- Economic incentives (green and yellow certificates) - EU and national targets of RES - Independence from world market oil price	- Technology
Biogas upgrading	Vehicle fuel	Very high	High	- Cleaner combustion - Improved air quality - Independence from world market oil price - Stable fuel price	-No economic incentives - Replacement of bus fleet too expensive - Use of biogas does not pay back
Biogas upgrading	Sell gas to the grid	Very high	High	- Energy security - Independence from world market oil price	- Only upgraded biogas produced from agricultural waste can be fed into the gas grid

Table 4. Analysis of the possible uses of biogas, including drivers and barriers in the Polish context today.

Suggested Biogas Plant

As a result of our research, we propose a two-step scenario for the implementation of the biogas system in the Zabrze. Moreover, we include performance recommendations and a vision on how the biogas usage could be extended in the future.

Step 1

The first step consists of the construction of a small-scale biogas plant, with a maximum capacity of 350 kW.

Following the successful above mentioned Swedish experience, we suggest a substrate composed by municipal food waste and pig manure in the ratio 3:7.

According to Ms Agnieszka Duda [19], the actual amount of food waste collected from the 513 villas included in the pilot project in Zabrze is 220 t/yr. By extending the collection scheme to 4000 single-family and semi-detached villas – out of an estimated total of 8000 – approximately 1700 t/yr of food waste could be fed into the biogas digester, together with 4000 t/yr pig manure.

The amount of biogas produced is technology and substrate dependent. Assuming that each tonne of mixed waste (30% food waste and 70% pig manure) has the potential to be converted into 256 Nm^3 of biogas with 60% CH_4 content, and that the system has a continuous activity throughout the year, then 1.4 mln m^3 of biogas could be produced yearly.

Besides the biogas production, a co-generation plant of heat and power (CHP) is suggested. This would allow the production of ~ 2.9 GWh_e/yr, considering 6 kWh/m^3 the calorific value of biogas and 35% the efficiency of the CHP plant. The electricity would be fed into the grid and the yearly revenue would amount to approximately PLN 1.4 mln (EUR 333 000), taking into account the actual price on the market (PLN 489.74 (EUR 117)/MWh, [16]), including the economic incentives (green and yellow certificates).

In parallel, the generated heat could be exploited for heating the digestion tank and the surrounding working place.

Furthermore, in a future scenario where the biogas production is increased, the

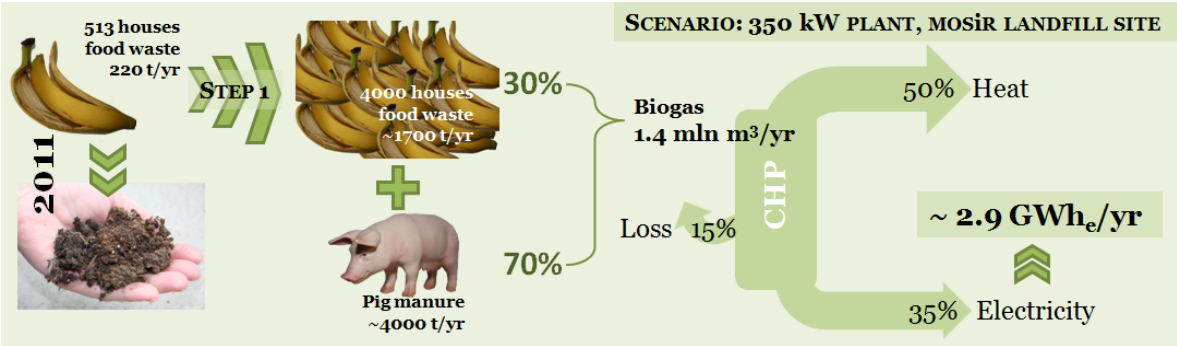

Figure 6. Scheme of the proposed scenario where a 350 kW biogas plant is suggested to be built on MOSiR's landfill site.

excess heat could be used for district heating.

Figure 6 shows a scheme that summarizes the first step of the suggested scenario.

The proposed location of the biogas plant is MOSiR´s landfill site. This place has several advantages compared to other areas, including social acceptance (no additional odour problems), an accepted permit and possible synergies with the on-site equipment (e.g. methane extraction and capture from the landfill).

Step 2

A further step in this scenario implies the expansion of the collection scheme of food waste to the remaining villas, to block houses and public institutions (e.g. schools, elderly houses). In addition to the pig manure, the substrate supply could be extended to other farms, the food industry and supermarkets.

An increase in the supply could lead to the implementation of an additional biogas digester.

Recommendations

Legal Framework

A multitude of regulations influence the development of biogas plants. Depending on their design and adaptability to local socio-economic and political conditions, they can represent non-technical barriers to biogas development [24].

The specification of organic waste as the source for biogas in the biogas definition (see Energy Law Act) is recommended to allow for all the economic potential of this fuel to be harnessed.

There is a need to integrate the work of different ministries, such as that of the Ministry of Economy, in charge of energy issues, and the Ministry of the Environment responsible for waste.

Technology

In this setting, it is crucial to stress the importance of starting with a small-scale biogas plant. Although the technology is well-known and tested, there are many uncertainties that could jeopardise the whole project. The amount and quality of the food waste is one major example.

Moreover, the source separated waste collection system should be improved continuously. Specific attention should be given to hazardous waste in order to avoid contamination of the other wet and dry waste fraction.

Furthermore, even though the planned refuse-derived fuel plant can be seen as a tool

to separate the municipal waste in different fractions, the resulting separated organic waste will always be contaminated and not suitable for anaerobic digestion. Since the plant efficiency will decrease and the bio-fertiliser produced will contain plastic, heavy metals, etc., it is crucial to use exclusively MSW wet fraction exclusively separated at the source.

Economics

There might be a need to review fixed prices for RES as the stipulated renewable energy targets might not be reached with this approach.

To reduce the emphasis that is currently being placed on biomass for the achievement of the nREAP and allow for biogas to play a role, effective support measures need to be put in place.

Conclusion

Beside the pure technical realisation of the biogas plant, the successful implementation and expansion of this project will depend on multiple conditions. Socio-economic and political factors will strongly influence the timeframe during which the realisation will be feasible.

The adaptation of the existing legal framework; to be more exhaustive and facilitate biogas production from organic waste, will be a main pillar in fostering biogas' contribution to the achievement of Polish renewable energy targets. The adaptation of a new definition of biogas to include biogas produced from municipal food waste, the adaptation of existing, and introduction of new economic incentives favouring the biogas upgrade to vehicle fuel or the feed-in to the gas grid, will bring about new opportunities for Zabrze.

Continuing efforts to improve source waste separation and MSW collection will foster the biogas development potential.

Further, the educational endeavours with regards to waste management already being undertaken and targeting Polish citizens at all ages will need to be continued. Public awareness raising through advertisement campaigns, competitions and open days, and education initiatives in schools, is strongly encouraged.

With increasing purchasing power, it is likely that per capita generation of organic waste will rise and will be accompanied by a decrease in organic waste secondary usage such as for private small-scale composting. This development might require new ways of MSW management and waste handling in light of EU Directives banning organic waste from landfilling and current capacity restrictions of incineration facilities along with an increase in penalties Poland faces for non-compliance.

Biogas production from organic waste represents both an opportunity for Poland on its path to achieve the national overall renewable energy target and a chance for energy security and independence in an increasingly complex market which is more and more characterised by unpredictable external events.

Our team.

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Re-imagining Klaipėda Port:

Options and Pathways for Energy Security

By Brit Samborsky, Fredrik Lingvall, Mina Lee & Nurzat Myrsalieva

Introduction to Klaipėda Port

Background on Klaipėda Port

Lithuania sits at the crossroads between East and West, and Klaipėda is the heart of its trade activities. Despite strong re-integration with the West through membership in the European Union and NATO, Russia and the whole eastern bloc remain important trading partners. As the third largest port in the Baltic region, Klaipėda Port is responsible for generating 4.5% of Lithuanian GDP and maintaining trade with 65 countries [1]. The Port provides operating space for various maritime industries including stevedoring, shipbuilding and ship repairing companies. The Port is the dominant feature of Klaipėda city, occupying a strip along its entire coastal area. In stark contrast, one of the country's most beloved natural areas – the Curonian Spit – lies directly across from the city.

The Port has ambitious growth plans. It is dredging the harbour to increase the depth of the shipping lane from 13 m to 14.5 m, and a new container distribution hub is being built to accommodate larger container ships. It also has plans to build a new passenger-cargo terminal and construct a new outer port to handle larger volumes of cargo, liquid and oil products. In recent years the Port has experienced a steady increase in cargo volume due to a new rail shipping line connecting Klaipėda with China via Russia [1].

Klaipėda Port operations with city in background

In addition, there are plans to reunite the local community with the harbour. The vision is to re-develop part of the Port's territory into residential and commercial areas. There are currently at least two such projects in the planning stages. In modern times, the residents of the city have been almost completely cut off by the Port's commercial activities, with no access to the waterfront except at two ferry terminals.

Problem of Energy Security

With regard to the growth plans, a serious threat exists; insecure energy supply will be a challenge to the Port's business goals. Lithuania is heavily reliant on imported energy for heat, electricity and transportation fuels [2]. Price volatility is an accompanying problem due to the variable prices of most fuel sources. Most of the Port's infrastructure was built in response to the Soviet Union's centralised, subsidised energy sector, which historically resulted in

inefficient use of energy [3]. This provided very little motivation to use Lithuania's local energy resources effectively.

In order to address the issue of energy security, six Port companies together with research institutions formed the Baltic Coastal National Renewable Energy Cluster (Cluster). Companies in the Cluster fall into two categories: Port operations and property re-development [5].

The main objective of the Cluster is to join efforts in researching and implementing innovative energy solutions at the Klaipėda Port in order to ensure its continued economic growth and competitiveness in the international arena.

Objectives and Methodology

This report aims to provide members of the Cluster with various options to reduce energy risks in light of the country's current energy structure and policy, and based on the relevant experiences of other seaports in the world. The resultant energy security options are targeted to the Port's two major groups: operating and residential re-development companies.

Research methods include review of selected case studies, on-site observations and interviews with relevant stakeholders at Klaipėda Port.

Lithuanian Energy Strategy

In October 2010 Lithuania adopted the National Energy Independence Strategy to ensure the security, competitiveness and sustainability of its energy sector and to comply with relevant EU energy policies such as EU 2020 strategy and EU Third Energy Package [6,7,8]. The National Energy Independence Strategy outlines long-term goals of the energy sector to be achieved by 2020, 2030 and 2050 respectively. According to this strategy by 2020 the country plans to fully integrate into the European energy system and build energy generation capacity sufficient to satisfy internal demand. In order to achieve the first goal the country plans to complete the construction of two strategic power links with Poland and Sweden, and establish synchronous connection to the European Continental Network. The second goal involves construction of a new nuclear power plant and increasing renewable electricity generation [6].

For the heating sector the country aims to increase energy efficiency by 30 to 40% by 2020 and shift heat production from gas-based to biomass. The share of renewable energy in final consumption is planned to reach 23%, with at least 20% in the electricity sector, 60% in the district heating sector and 10% in the transport sector [6].

To comply with EU Third Energy Package, Lithuania has reorganized its electricity sector by unbundling the ownership structure. In 2012 electricity generation, transmission and distribution have been separated on the basis of ownership to improve efficiency and competitiveness [6].

Energy System of Lithuania

The energy infrastructure in Lithuania can be understood by examining its major supply and consumption areas. For both electricity and heat, there is a high level of dependency on external sources.

Current Infrastructure

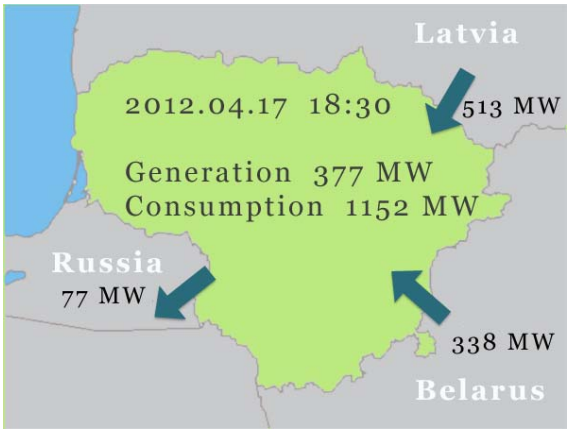
"Currently the Baltic States gas market is dysfunctional" is the assessment from Lithuania's National Control Commission for Prices and Energy [9]. Lithuania is 100% reliant on Russia for its natural gas

supply, which is used primarily for heating, electricity generation and industrial processes. Natural gas accounts for around 70% of Lithuania's primary energy [10].

Oil is imported to Lithuania by tanker ship and sent to the country's single refinery in Mažeikiai, to be upgraded to fuel products and both consumed internally and exported to other countries.

Electricity is generated at six major facilities fuelled mainly by natural gas, fuel oil (although this is being phased out) and hydro power from the Nemunas River [9]. Heat is also produced at three of the power plants, which supplements the heating plants located in most municipalities.

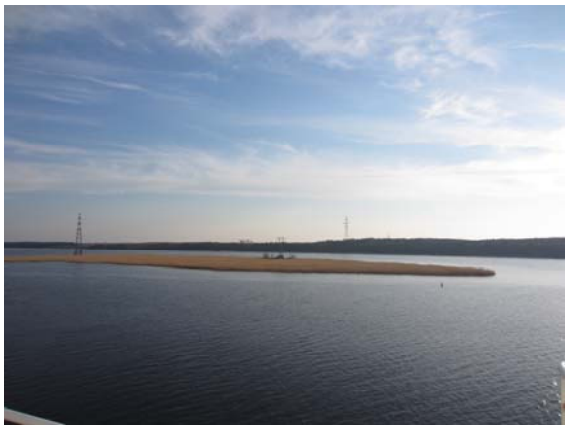
In 2009 the Ignalina nuclear power plant stopped operating as part of EU requirements placed upon Lithuania. This loss of generation meant that Elektrėnai power plant – using a combination of natural gas, heavy fuel oil and bitumen-based fuel – became the country's primary source of power [4]. It does not meet EU environmental guidelines, but older units are being replaced with more efficient gas turbines. Lithuania is now in an energy deficit position, importing electricity from neighbouring countries Latvia and Belarus.



Snapshot of Lithuania's electricity grid: net importer since 2010 [4]

Future Plans

A major part of Lithuania's energy strategy is focused on securing another supply of natural gas. The government has decided to create a liquefied natural gas (LNG) terminal, which will import gas by tanker ships. Lithuania's President Dalia Grybauskaitė stressed the importance of the project recently when she said "we will be able to speak about our energy security, stability, and possibility to implement independent decisions only when having the liquefied natural gas terminal in place" [11]. In March 2012, the location for a floating LNG terminal was announced: an island within Klaipėda Port's territory. The project is expected to take first delivery of gas by end of 2014, with a planned capacity equal to the country's annual consumption.



Location of future floating LNG terminal at the island Kiaulės Nugara, planned for 2014

In March 2012 the government signed a concession agreement with Hitachi Ltd to build a new nuclear reactor facility at Visaginas, to be operational by 2020 to 2022 . Plans are also underway for nuclear power plants in Russia's Kaliningrad to the southwest, and in Belarus just a few kilometres east of the Lithuanian border, which would come into operation sometime earlier than Lithuania's planned facility, undermining the economic case for its

construction. Opinions vary on whether all or any of these nuclear projects will indeed be completed, and a referendum on the Lithuanian plant may occur later in 2012.

Renewable Energy Potential

Currently modest amounts of electricity are produced from renewable sources of energy such as biomass, wind and geothermal. However, Lithuania has significant potential for generation of energy from renewable sources. The following section provides brief overview of possible best options for energy generation from renewable sources in Klaipėda.

Wind

In the electricity sector wind is the most dominant renewable source of energy. 2010 saw a 43% increase in electricity from wind, to account for 3.9% of domestic generation [2]. This has been driven in part by the favourable wind resource in the western part of the country and also by the government's feed-in tariff policy, which has substantially reduced the payback period for wind. The country is already halfway to its target of 500 MW installed capacity by 2020. This rapid development led to a change in the policy as of January 2012. A competitive process was introduced where the bidder accepting the lowest feed-in tariff will be allowed to develop the wind project [12]. While this should result in lower costs to government, it also creates uncertainty for potential investors.

Solar

Solar photovoltaic (PV) electricity is also being installed. Lithuania is not particularly well situated for exploiting solar due to its geographical location and climate conditions, but Klaipėda is in the zone with the best potential. A targeted PV feed-in tariff has made the return on investment attractive to project developers.

PV installed capacity	*Feed-in tariff EUR/kWh (LTL/kWh)*
< 100 kW	0.47 (1.63)
100kw < 1 MW	0.45 (1.56)
> 1 MW	0.44 (1.51)

Figure 1. Lithuanian PV feed-in tariffs [13]

Most solar capacity is available during the six month period from April to September when the country has the most hours of daylight. The national strategy envisions installing 10 MW of solar energy by 2020 with government support of approximately EUR 58 million [13].

Biomass

Biomass still dominates the renewable energy segment, although it is mostly used to produce heat. Much of the supply comes from firewood and wood waste, but also from peat, straw and energy crops. Biomass accounted for 66% of the country's non-imported primary energy supply in 2010, while all other types of renewable fuels accounted for 26% [2]. Approximately one third of Lithuania's territory is covered by forest [12]. The government's target for 2020 is to produce ten times more biomass energy than in 2009 [3].

Geothermal

The western part of Lithuania has the most favourable conditions for utilisation of geothermal energy. Heat can be extracted at shallow depth, where the ground temperature is 15 to 20 °C. Electricity generation would be possible with water at 150 °C, found at depths of 4.3 to 4.5 km [14]. Only one large-scale geothermal project has been completed, but has been unsuccessful due to technical reasons. Small-scale heat pumps have been more successful, with the

current trend of approximately 600 units installed per year. The government does not have a special support scheme for geothermal energy.

Observations at the Port

On-site interviews and observations provided significant new information for the IIIEE research team. In some cases assumptions were confirmed, but often the reality is substantially different than background research might suggest. Several observations made a large impact on the project direction and shaped the recommendations that followed. The most significant of those are highlighted below.

Electricity Market Structure: Uneven Policy Approach

The most common energy-related complaint during interviews in Klaipėda was that prices are too high. This is evident when comparing Lithuania's recent energy prices with indicators such as per capita GDP or annual income, or asking the typical man on the street for his opinion on energy costs. But it is also worth comparing costs in neighbouring markets. In fact, electricity prices for Lithuanian industrial customers are comparable to many other European countries, even considering the loss of the Ignalina nuclear plant at end of 2009.

Several developments have taken place concurrently that make the situation somewhat opaque: unbundling energy markets in accordance with the EU Third Energy Package, closure and clean-up of the nuclear facility, opening of the Baltpool electricity trading exchange. Additionally, legislation is being introduced and revised in areas such as renewable energy, heat sector, natural gas and energy resources. This creates a dynamic environment, but not always with coordinated or effective results.

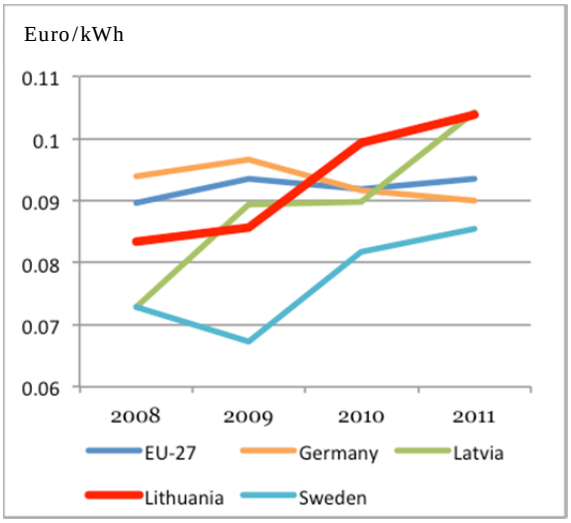


Figure 2: Lithuania electricity price – historical comparison with select EU countries [15]

One of the key findings in Klaipėda was the effect of the regulated power pricing structure. While the overall price is high for consumers, the cost of the energy component is favourable when compared against neighbouring markets. It is the transmission, distribution and other charges that make the prices higher than in the past. This mechanism passes additional costs through to the customers, such as the decommissioning of the nuclear facility, and the new power cables linking to foreign markets. Notably, a charge known as the VIAP (also referred to as Services of General Economic Interest) is applied to all electricity generated in Lithuania [16,17]. The VIAP is intended to provide funds for the various feed-in tariffs, subsidies and incentives. But the unusual aspect is that the fee is applied to those same renewable sources as well, even when the energy is consumed on-site by any party other than the generator.

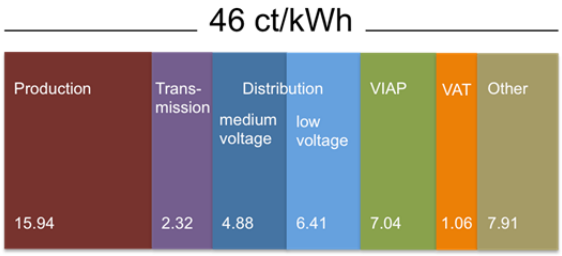


Figure 3: Lithuania electricity price components, average for 2012 (in LTL centas) [16,17]

The present electricity pricing model is discouraging local generation because of high non-energy charges. The result is a low degree of grid decentralisation and disadvantaged economics for local generation projects. This policy aspect is largely beyond the control of the Port's companies, but it is a significant obstacle for any new energy options. A possible solution could be to restructure the electricity charges on the national level, with a higher energy charge and lower delivery and transmission charges. This would provide two important incentives: energy conservation to save on energy charges, and on-site generation to avoid transmission charges. Without this structural reform, the best solution may be for industrial users to entirely fund their own generation projects, so as to minimise their overall costs.

Furthermore in the policy domain, various renewable sources are being offered feed-in tariffs of varying value and duration, which further distorts the market. The recent cases of PV and wind tariffs being set at unusually high rates, with modifications required afterwards, indicates that more attention is required towards unintended outcomes of policies.

Port Authority: Reluctant Leader

Klaipėda Port has one central authority to oversee the territory that is leased on a long-term basis to various operating companies. The Port Authority is the Lithuanian government's representative, with the task of maintaining infrastructure and planning the future of the Port. That infrastructure, however, is limited to the outer 25 m of the harbour land, and basically including the concrete only. Energy supply is left entirely to the operating companies, according to the Port's Infrastructure and Development Director [II].

An opportunity exists for the Port Authority to lead with a vision for the future, and contribute to the national plan for energy independence. At the moment, this does not appear to be a priority. Without strong leadership in the area of energy provision, the Port as a whole will risk losing competitiveness, and losing business to neighbouring ports. The recommendation is therefore that the Port Authority should play an active role in developing a strong energy infrastructure for all its operating companies.

Competing Uses: Port, City, Re-Development

The independent spirit that is so evident among companies likely occurs because of natural rivalries, and also due to competition for the same physical space at the Port. With re-development plans in place, the existing businesses are feeling squeezed by the encroachment on their territory. And of course the citizens of the city wish to live in a safe, clean and quiet environment, with access to the sea. With a long-term vision, in many cases alternatives can be found to find appropriate sites for displaced industry.

Collaboration: Not Fully Engaged

A simple theme surfaced continually during conversations with various Port entities, namely the lack of collaboration.

While this is certainly understood by the various groups, it was still surprising at times for the research team to uncover information about significant new projects that had not been communicated to neighboring businesses and members of the Cluster.

An obvious opportunity exists for companies to work together to provide energy solutions within the Port area, and also for local and national government to take on a partnership role. Some of the energy solutions available within the Port are only financially feasible if several companies work together to develop the projects.

Finally, the companies that are planning to re-develop sections of the Port can also work together or with their industrial neighbors to create the highest quality living and working spaces for their customers. The citizens of Klaipėda, too, can play a role in re-establishing a connection to their waterfront.

Options for Klaipėda Port Companies

Based on the information provided by the Cluster the total annual electricity consumption of 16 major companies in 2011 was 71 GWh [III]. Four of these companies account for 78% of total consumption. This high-use group could benefit most from new energy options.

The Port's companies rely almost entirely on electricity to meet their energy demands. Due to lack of more detailed information on energy consumption the analysis of possible ways to reduce energy risks is limited only to proposing possible options for on-site generation. More thorough investigation of other alternatives has not been pursued.

Case Study: Rotterdam Energy Port

Rotterdam Port aims to become Europe's number one energy port. Rotterdam is building its generation capacity up to 7 000 MW, spread over a number of generating technologies such as coal, biomass, natural gas, heat, steam, wind and solar energy. There is a long-term strategy that aims to achieve reliable, affordable and sustainable energy with Rotterdam Port acting as a hub for arrival, production and distribution of energy. The wide energy mix shall ensure higher energy security. Their port authority has close collaboration with business operating in the port and the City of Rotterdam to encourage new actors to locate their business in the port. The port authority aims to get new business interested in Rotterdam Port and support synergies through cluster formations as well as encourage market competition [18].

Option 1: Energy Mix

Rotterdam Port shows how a wide variety of energy supply from various fuels provides advantages in terms of increased energy security and market competition. Klaipėda Port wants to decrease its dependency on energy from the national grid and imported natural gas. If Klaipėda can emulate Rotterdam in achieving the same kind of energy mix, they can also increase their energy security. The case of Rotterdam Port shows that a situation like this requires high levels of collaboration between port authorities, businesses operating in the port and the city that lies in connection to the port.

Option 2: On-Site Renewable Energy Generation

Rotterdam Energy Port and experiences from other seaports demonstrate that on-

site generation of energy is one of the best ways to secure energy supply. As has been indicated earlier, Klaipėda has great potential for generation of renewable sources of energy such as wind power, solar, geothermal and biomass. On-site generation of such energy can help the Port achieve energy, environmental and economic benefits, but also to demonstrate environmental leadership to the public and improve the image of the Port. It can help the companies reduce energy costs by decreasing susceptibility to conventional fuel price volatility. On-site energy generation is usually defined as having higher power quality due to fewer interconnections in the transmission of electricity and is less likely to have grid-based electricity shortages or blackouts [19].

Based on the analysis of Lithuanian energy policy, support schemes and literature research the most suitable sources of on-site energy generation for the Port are large scale wind farms, large scale PV installations, deep geothermal and biomass.

Option 3: Combined Heat and Power

For Port companies that have substantial and consistent demand for electricity and heat, combined heat and power (CHP) is feasible and viable energy supply option. The main benefit of CHP is simultaneous co-generation of electricity and useful thermal energy from one fuel source. CHP is more efficient than conventional separate heat and centralized power systems because it allows significant cost savings, with efficiency of more than 80% at the point of use by utilizing waste heat from power generation. From an environmental perspective CHP is better than conventional coal-fired power stations as it reduces emissions of CO_2, NOx, SO_2 per unit of energy produced by more than half [20].

CHP can use both fossil and renewable sources of fuel to produce electricity and heat. CHP can offer reliable energy supply on-site due to the possibility of being dispatched when renewable sources are not available or grid-supplied energy is more expensive.

Options for Residential Re-development

Memelio Miestas

Two members of the Cluster, Memelio Miestas and Klaipėdos Laivų Remontas, plan to re-develop part of the Port territory into residential and commercial areas. Memelio Miestas is a real estate investor and property development company. In 2006 it acquired on a long-term lease basis 6.8 hectares of Port territory with the aim of re-developing the area into an attractive residential and commercial area. In 2009 the company announced tenders for architectural design and selected two projects proposed by Lithuanian and Danish architects [21].

Building on Memelio Miestas land to be preserved

Memelio Miestas plans to demolish all but two existing buildings and construct around 20 000 m² of new buildings. For

energy, Memelio Miestas wants to generate on-site renewable energy and make use of EU structural funds for financing.

Construction is expected to coincide with the 2014 to 2020 round of funding, with expectations to receive 50 to 60% support for renewable projects. However as of today Memelio Miestas has not researched the specific options that would best suit the development plan [V].

Klaipėdos Laivų Remontas

Klaipėdos Laivų Remontas is a medium and small tonnage ship repairing company located adjacent to Memelio Miestas. The property contains a number of buildings that have historical value for Klaipėda city and Lithuania. The company has decided to re-locate its ship-repairing elsewhere and re-develop its existing territory into residential and commercial area. The project will include 20% renovated existing buildings and 80% new buildings. The re-development is planned in three phases. The first phase has already started. The second and third phases are longer term projects. Unlike Memelio Miestas, Klaipėdos Laivų Remontas does not have specific renewable energy projects. It has already connected the first phase of the project to the municipal district heating system, and adequate electricity service already exists on-site. However the company is interested in reducing energy costs and ensuring reliable energy supply [IV].

The Memelio Miestas and Klaipėdos Laivų Remontas development projects are located on neighbouring land on both sides of the Danė River. However, it was evident that no communication about their respective plans is occurring between them, based on discussions with their representatives.

Re-development sites along Danė River

Case Study: Western Harbour

Western Harbour (Västra Hamnen) is a district in Malmö, Sweden's third largest city. Until the year 2000, the area was used by the shipbuilding company Kockums for its business operations. Kockums ceased operations in 2001, leaving an area best described as a brownfield. The Swedish government decided to develop a sustainable residential area in the Western Harbour to provide housing for 10 000 people and 20 000 work and study places. Local generation was provided using renewable energy sources. A 2 MW wind turbine generates electricity. 1 400 m² of solar collectors placed on rooftops provide heat. Heat pumps also provide heat utilizing water from an aquifer for heat, and sea water for cooling. Organic waste is used for generating biogas for heating and vehicle fuel. Housing built in the area must meet a maximum limit of 105 kWh per m² electricity use per year [22].

Option 1: On-site Heat Generation

As has been mentioned earlier the western part of Lithuania has the most favourable conditions for utilisation of geothermal energy. Besides being a potentially clean source of energy, main advantages of shallow geothermal include consistency of the

energy source and predictability of operations.

The Swedish experience is instructive in the case of heat pumps. The overall cost of operation is favourable compared to several other heating methods. While the heat market is very much local, the economic case is attractive in Sweden. The main variable cost is electricity used to operate the pumps, while the thermal resource is free.

Heating supply type	Euro cents per kWh heating
Biomass	5.7
Heat pump (SPF=2.5)	6.3
District heating	6.6
Oil	9.1
Direct electricity	9.8

Figure 4. Operating costs for Sweden residential scale heating systems, 2004 [23]

There are more than one million heat pumps operating in Sweden. Multiple family dwellings and commercial buildings comprise up to 15% of the market [24]. Due to the efforts made in research and development, other countries can benefit from the advances made by Swedish industry. The residential developments in Klaipėda Port appear to be well suited to heat pumps.

A second heating option is biomass boilers. Lithuania is recognised to have strong biomass energy potential, with much of the fuel passing through the Port en route to other markets. An opportunity exists to use these biomass sources as well as waste from the Port's wood shipping companies. This strategy has been used successfully in re-development projects elsewhere in the world [25].

Option 2: Energy Efficient Buildings and Solar Energy

One of the main energy security measures available for all buildings is energy efficiency and conservation. All efforts made during design and construction will continue to pay back throughout the buildings' lifespan by reducing the need to provide energy. The keys to success are a motivated construction team and educated occupants.

When efficiency and conservation are taken to their practical limits, heating and cooling needs can be drastically reduced in an environment such as Lithuania. The on-site heating options can be paired with efficient buildings to reduce dependence on natural gas for heating – a stated concern – and offer a more predictable cost of operation.

PV electricity and solar thermal are both options for roof space, although the advantages of each need to be considered before selecting one over the other. The costs of all heating and electricity alternatives should be assessed, and an energy price forecast is an important decision-making tool.

Option 3: Partnering with Neighbours

Residential and office buildings have limited space for on-site energy generation. Each square metre could otherwise be used by occupants with potential for revenue. So the options are more limited than for industry, but collaboration again may provide a solution.

Groups of companies could pool their resources to develop larger-scale energy projects, such as ownership of large wind turbines or solar PV plants. These need not be located directly on the residential lands,

but rather the ownership structure is key to ensuring security of supply and desired prices. Western Harbour provides a model for using off-site renewable wind generation to supply a residential community. Although current legislation levies a charge on energy transferred between companies, some projects may still be financially attractive.

Another energy source for residential developments could come from their neighbouring industry. If groups collaborated, the lower grade waste heat from industrial users could be sold to lower intensity users. Small power plants could also provide energy to several members of the Cluster if they can align their priorities and look beyond their individual borders.

Conclusion

Klaipėda Port is facing a number of challenges to remain competitive in the Baltic region and continue its business growth. Energy security is a crucial element in this challenge, due to high dependence on few suppliers. A stated goal is to find more secure and less expensive energy options. A Cluster of companies exists to pursue solutions for the Port.

Other seaports and developments around the world demonstrate successful steps toward taking control of energy supply. These examples, along with the discussions with local companies have resulted in a set of realistic options that could be pursued at Klaipėda Port.

Opportunities have been identified for Port companies and residential development. The primary options include on-site generation and developing a mix of energy sources. This will diversify supply and enhance energy security. Fuels available to the Port include both conventional and renewable resources.

Energy security is a complex challenge. Collaboration is required to succeed. All stakeholders can individually benefit through collective efforts to meet their energy needs. By re-thinking the concept of who is a competitor and who is a partner, creative solutions may yield new benefits. And by re-imagining the role of the Port, energy security can provide a strong foundation for local industry, Klaipėda and Lithuania.

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Energising the Future of Balatonalmádi

By Rachel Armstead, Cherisse Braithwaite, Ana Marton & Jessika Richter

Our Task

The municipality of Balatonalmádi in Hungary is looking to develop sustainable energy solutions within the city. After examination of the municipality's current activities regarding energy, it became clear that it was not ready for recommendations of advanced technical solutions. Accordingly, the focus of our project shifted towards developing a prerequisite capacity within the municipality, enabling them to generate a clear vision for the city's energy future and to coordinate actions within this vision.

The greatest barriers we faced were access to relevant documents and language. Almost all documents are in Hungarian, requiring extensive translation. Fortunately, we had one member in our group fluent in Hungarian to ensure adequate interpretations.

Background

Balatonalmádi is a small city of approximately 9300 people (as of 2011) located on the north-eastern shore of Lake Balaton in Hungary. Balatonalmádi is one of 179 municipalities situated in the wider Lake Balaton Region and is well connected being just 12 km from the county capital of Veszprém and 120 km from Budapest with motorway and rail connections [1].

The Balaton region is an area of ecological, agricultural and recreational significance as well as outstanding natural beauty. Agricultural land makes up nearly 50% of the region's land use and 80% of this is fruit orchards. The region has a warm temperate climate which is perfect for viticulture and as a result the northern shore has become a well-known wine producing region [2]. The climate also means that a large share of energy is consumed for heating in winter and cooling in summer.

Balatonalmádi Lakefront

The Lake Balaton Region has favourable endowments of solar energy, biomass (in particular organic wastes arising from local forests, reeds, arable lands and horticulture) providing potential for biogas and biodiesel fuel production. The region also has significant geothermal energy sources (although this resource is not in the vicinity of Balatonalmádi itself) [3].

The region is economically reliant on summer tourism and this holds true for Balatonalmádi as well. During the summer season, the city's population triples, putting a strain on local infrastructure. Tour-

ism in the area is tied to the quality of the environment. Thus environmental protection should be a priority for the city [4].

Tourism Statistics

- 17 commercial units (39.1 % hotel, 14.8% pension, 21.9 % holiday home, 2.5% hostels, 21.6 % camping) with 533 rooms, 2080 beds [5].
- 273 private rental accommodation
- 75% of visitors domestic tourists [6]

Other cities and towns in the region were used to benchmark the current practices and policies in Balatonalmádi. The nearby city of Veszprém was studied for its approach and process in developing a comprehensive energy strategy. This example is also useful in that Veszprém is very close to Balatonalmádi (12 km), and could therefore also be a potential partner for collaboration. Cities with best practice examples like Växjö in Sweden were also examined for factors held key to the successful outcomes of their vision and energy strategy.

Our Process

The first step in our methodology was a review of existing municipal strategies and reports relating to energy, sustainability and climate change as well as relevant national and EU policies to assess the current situation. Potential stakeholders with an interest or influence in an energy strategy for the city were identified and researched.

Widely used processes for developing a sustainable energy strategy were then examined and the city's current measures assessed to identify remaining gaps. Based on this, significant gaps further examined included the city's vision, internal capacities, and communication with stakeholders.

Visioning with Scenario Building

To build an energy vision, the widely accepted methods of Bandhold & Lindgren [7] were used for the scenario building component of our study. The scenarios were informed by the concepts within the "Five Capitals" framework developed by Forum for the Future [7]. This was applied to build different scenarios making use of the social, financial, human, natural and manufactured capital of the city. Driving forces were also considered in building the scenarios.

Scenario building is a useful tool in the creation of a '*feed forward*' system for strategy and decision making. While a properly functioning feedback system is useful to assess the outcomes of decisions and strategies currently in place, it is also necessary to compile coherent information about potential futures to choose what vision steers the future decisions of the municipality [8].

In developing the scenarios, it was important to identify the key questions to be answered during the exercise. The current situation map should cover both the stakeholders and key focus areas for analysis. Underlying conditions must be clarified for the scenario analysis as well as for visions and strategies [8].

Energy in Balatonalmádi

The energy situation in Balatonalmádi is fairly representative of the rest of Hungary. Natural gas imported from Russia is the main energy source, followed by gas gener-

ated electricity and wood. As an EU member state Hungary is required to comply with EU directives and targets as well as those set within the National Renewable Energy Action Plan (NREAP), adopted in 2010.

Hungary 2020 Targets [9]

- 13% share of renewables (EU)
- 14.65% share of renewables (NREAP)
- Capping Co_2 emissions at 10% growth from 2005 levels
- 10% energy consumption reduction

The Hungarian National Energy Strategy for 2030 (launched in 2012) focuses on ensuring security of supply, promoting competitiveness and sustainability. To this end it promotes a "Nuclear, Coal, Green" scenario with associated objectives for electricity generation [10].

In Hungary, buildings make up circa 40% of the total energy consumption, of which two-thirds is used for heating and cooling. Energy efficiency is a major challenge for Hungary with 70% of Hungarian homes failing to meet modern technical and thermal requirements, with a similar ratio for public buildings. The high demand for gas to heat in winter presents challenges for supply security [10]. Based on our observations in Balatonalmádi, most private houses lack insulation and there was little evidence of the use of renewable energy technologies such as solar collectors for hot water or photovoltaics. Some energy efficiency measures, such as lighting, windows and door replacements had been completed in some of the municipal buildings.

Hungarians also spend a large amount (20%) of their incomes on energy (as compared to a 6% average in the EU) [11]. Households which struggle with larger than (national) average energy costs are considered energy poor. By this definition, 37-40% of Hungarian households are energy poor [12].

The calculated household expenditure on energy in the nearby city of Veszprém is 19% of total expenditure [13]. Also, in discussions with Balatonalmádi residents, energy expenditure was perceived to be high. Balatonalmádi is heavily influenced by macro drivers as well as local drivers for energy development (see Figure 1). The main driver mentioned in interviews was always funding and this applied within all contexts of energy development discussed.

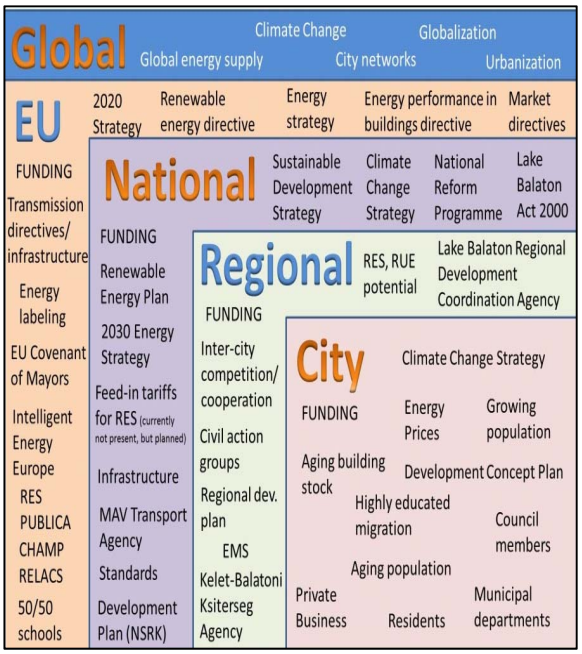

Figure 1 - Drivers for energy development

In Hungary, the main processes for procuring funding are from tenders, feed-in tariffs, and technology leasing. However, current government reforms mean that the first process is limited, the second is cur-

rently unavailable and the last is uncertain due to reform of ownership of municipal buildings (e.g. schools). Clarification from the government about the implementation process is expected in 2013 [14].

The EU has also been an important source of funding for energy projects. Programmes such as those organised by Intelligent Energy - Europe promote energy efficiency and development of renewable energy sources in Hungary.

The Municipal Context

Management of the city's climate and energy activities is coordinated by the local government. The municipality has no official role or department which deals with energy. Due to a very small discretionary budget, the municipality relies on grants.

The municipality has been running environmental programmes since 2003 and since then it has conducted or been involved in a number of studies and projects related to energy and climate change mitigation and adaption (see Figure 2). These have been funded partly by the municipality, but primarily through national tenders and by the EU. The most recent Climate Change Strategy aims to identify the key actions and challenges of climate change adaption and mitigation and is the most comprehensive attempt by the municipality to strategize their energy development.

The municipality has also been involved in some regional initiatives coordinated by the Lake Balaton Development Coordination Agency (LBDCA) in collaboration with municipalities. The LBDCA has developed a regional EMS and a Local Energy Programme for the Balaton Region (RES PUBLICA). This programme has generated a wealth of information regarding the renewable energy potential of the region including a detailed SWOT analysis, a renew-

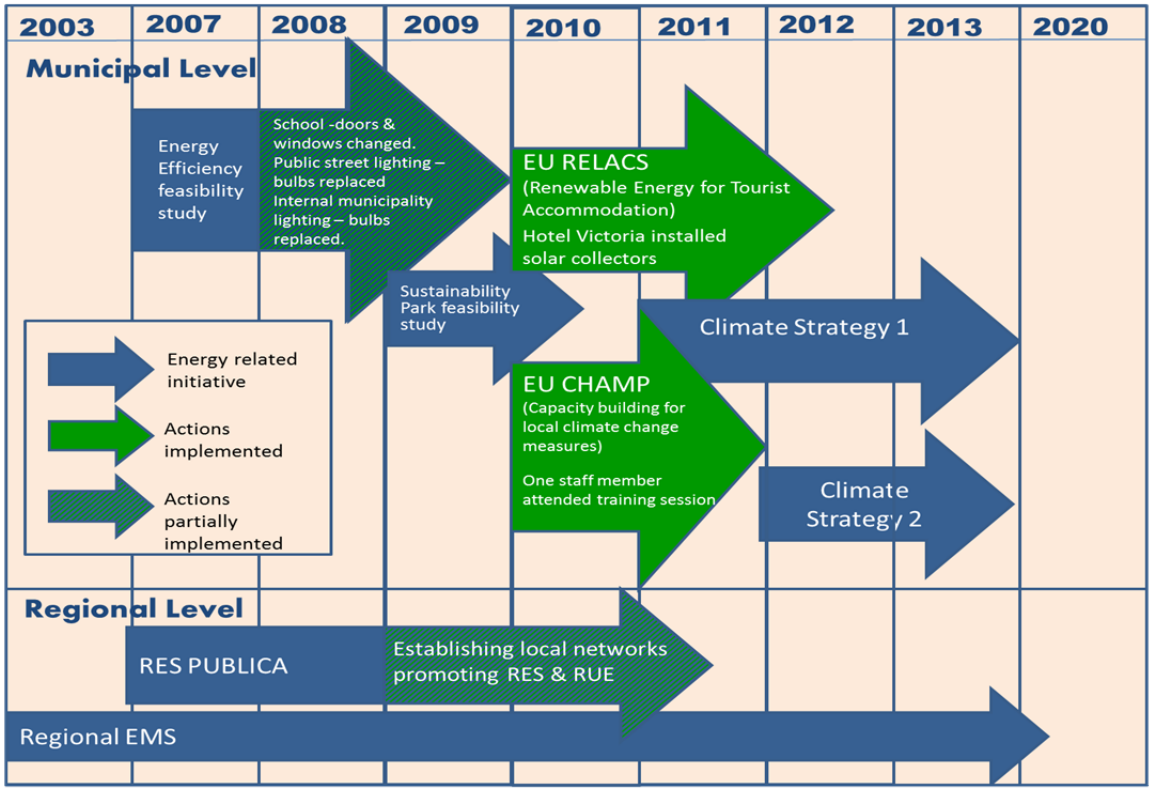

Figure 2 – Timeline of Municipal and Regional Energy Related Initiatives

able energy action plan (for the region) as well as initiating some small projects.

Balatonalmádi has been moderately active in these initiatives but implementation of both Balatonalmádi objectives and the regional renewable energy action plan has been limited. A lack of funding was cited as the main barrier to implementation and the LBDCA noted that it struggles to get municipalities participating actively in projects when no immediate funding is provided, even if projects are beneficial.

As figure 2 illustrates, climate and energy actions have been rather fragmented. This fragmentation was explained in part by the acknowledgment that projects were chosen only by the criteria of available funding rather than assessment of whether the project is in line with any strategy goals or vision. [15]. Thus trends in funding streams have played an important role in shaping municipal decisions. Implementation has been limited. Lack of funding was highlighted repeatedly as the main barrier to action. However, even where implementation has taken place, results have not been measured or communicated. This suggests there are also non-financial barriers to broader dissemination of the strategies.

Evaluation of the City's Approach

This study has evaluated Balatonalmádi's current approach to energy against a set of key elements based on the guidelines for developing a Sustainable Energy Action Plan (SEAP) provided by the Covenant of Mayors (CoM) [16]. The SEAP guidelines are used widely in Europe and are based on international consensus regarding the elements required for a successful municipal climate and energy strategy. The SEAP guidelines are also particularly relevant to the municipality as it has stated in its Climate Strategy that it is considering joining CoM in the future. Thus developing a strategy that already adheres to CoM criteria will assist them in this objective as well as identify a number of critical gaps and opportunities for further elaboration.

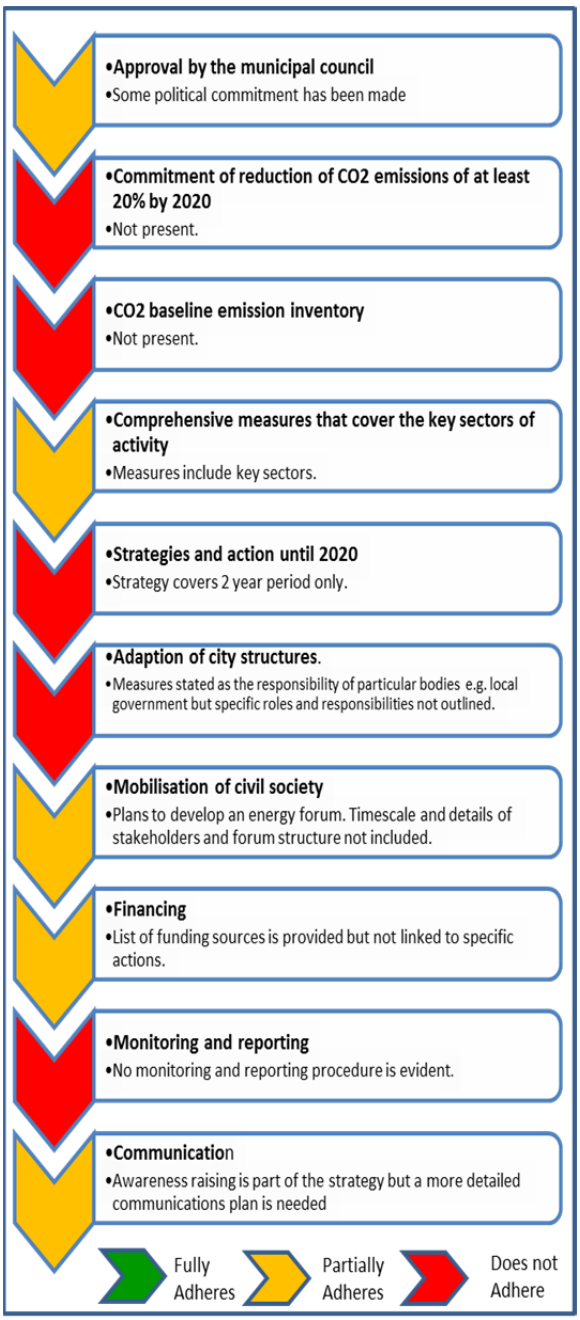

Figure 3 – Evaluation of Balatonalmádi's Climate and Energy Approach Based on the SEAP Guidelines [16]

Assessing Municipal Capacities

In order for a strategy to be successfully implemented it is essential that the necessary capacities are in place within the institution [17]; without these a strategy runs the risk of being simply a piece of paper. To assess municipal capacities, we used the framework based on the key success factors for municipal sustainability projects identified by the Developing Institutional and Social Capacities for Urban Sustainability (DISCUS) Project (shown in Figure 4) [17].

Capacity Indicator	Balatonalmádi
Committed officers	• Few expressed commitment
Political will	• Not visible
Training for sustainable development	• Some evidence – head of environment took part in CHAMP training session
Mainstreaming into working practices	• Staff awareness of municipal energy related projects was low • Relevance of energy to different departments not understood by many
National and international network and activities	• Considering joining Covenant of Mayors and other networks
Province-level support and networks	• Some involvement in LBDCA programmes

Figure 4 – Evaluation of Municipal Capacities Using Indicators Provided by the DISCUS Project [17]

Filling Gaps

As figures 3 and 4 illustrate, there are a number of key elements missing or weak in the existing Climate Strategy and the capacities of the municipality to develop a complementary energy strategy. To address this, we examined the strategy development process itself with a guide published by the US Department of Energy which highlights the necessary steps in strategy development process [18].

Initial Steps of Strategy Process

According to the US model and the SEAP process, one important initial step of any sustainable energy action plan involves the establishment of a vision (see Figure 5, STEP 3). Upon elaborating this vision, a plan to achieve it can be developed. It is also imperative that key stakeholders be continuously engaged during the process, especially during the phase of support building, using effective communication channels [16]. The establishment of a vision and objectives must be shared by relevant stakeholders and they should participate in defining and expressing views on the future vision [7].

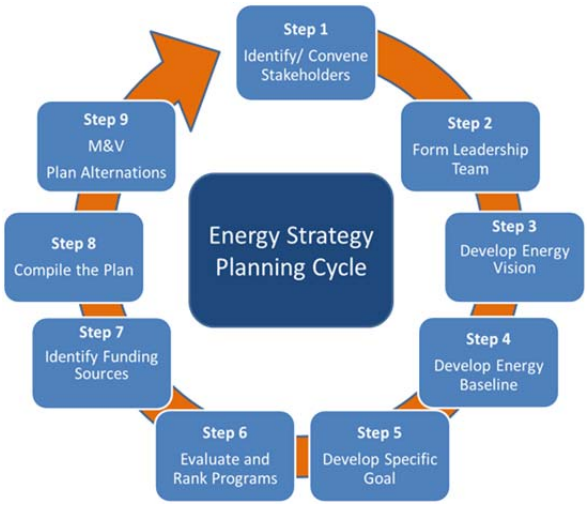

Figure 5 – Steps in energy strategy planning [18]

There appeared to be a low level of stakeholder engagement in current strategy implementation. Therefore, a scenario building exercise was chosen as a meth od of stakeholder engagement in the development of a coherent, integrated energy vision. The exercise also serves the purpose of highlighting any weaknesses within the current strategies e.g. inefficient internal communication. The visions of potential futures were designed around key energy outcomes to stimulate thoughts and ideas of a different Balatonalmádi than found today.

Scenario Building

The scenario exercise was based on the energy systems and possible policy directions within Balatonalmádi and the region. The logic and consistency of the scenarios were based upon two axes of the uncertainty: the source of energy and the geographical scope of the energy strategy. The scenarios were envisioned for 2030, a timeframe aligned with the National Energy plan. Four '*extreme*' scenarios were developed and conceptualised to be easily memorable and understandable by all stakeholders.

Method

The scenario building activity was conducted with municipal staff and external stakeholders. A separate process was conducted at each interview/interaction. The 4 '*extremes*' of the axes were explained and the participants were then asked to plot on the quadrants, shown in Figure 6, where they perceived Balatonalmádi was under the influence of existing strategies and policies. The participants were then asked to plot their desired direction (ideal) of Balatonalmádi in 2030.

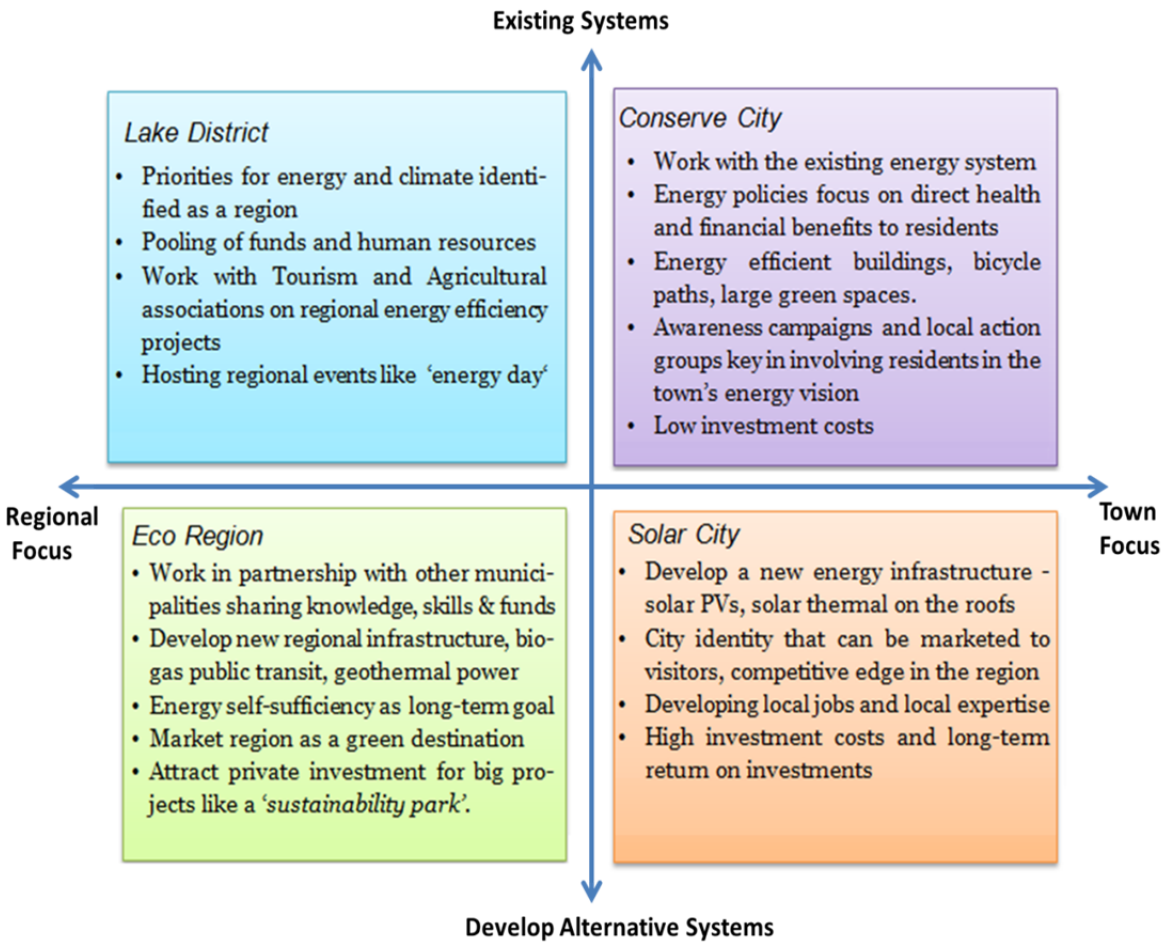

Figure 6 – Four 'extreme' future scenarios

Results of the Exercise

The scenario exercise helped to understand how different interviewees perceive the future of Balatonalmádi. As well as a mapping exercise, the scenario exercise also served to raise awareness about energy issues, highlight the lack of unified vision, and initiate critical thought about ways and means to address long term energy issues.It can be observed that both the municipality and stakeholders have a fairly consistent idea of the direction they see the city going in at present (Figure 7). Most placed their mark within the Conserve City quadrant which was the most conservative vision involving the least change from the present state. This indicates that at present the city is not communicating an ambitious vision of the future with regards to energy.

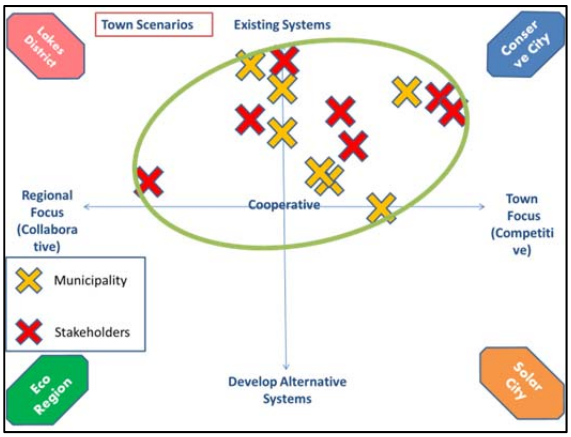

Figure 7 – Where interviewees see current energy

As one can see from Figure 8 people's visions of where they would ideally like to see the city by 2030 show much more variation. The municipality are more conservative in their vision clustering around the central point, while stakeholders are more ambitious. However the most significant point to be drawn from the scenario building results is that both the municipality and external stakeholders would like a change in the direction in the way they perceive Balatonalmádi to be going at present.

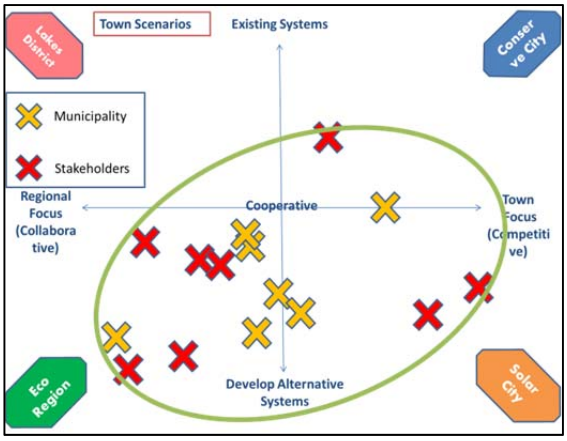

Figure 8 – Where interviewees see the ideal future

There is also some consensus as to the direction of change with a trend towards shifting away from centralised gas dependent energy systems to a more decentralised renewable systems and a desire for Balatonalmádi to work more at a regional level. This desire for change both within the municipality and amongst stakeholders presents a great opportunity for the municipality to develop an ambitious strategy. It indicates that there is strong support and provides evidence of a mandate for action.

Recommendations

Development of a Vision

One of the key recommendations for the municipality of Balatonalmádi is to undertake a diligent and inclusive process to create a guiding vision for the city. The creation of this vision and related objectives is important as it can help steer the decision making of the municipality. The vision must be developed with the input and engagement of all the stakeholders in the city. This active engagement is important for assessing the needs and desires of those

involved in any strategy the municipality pursues, as well as in garnering support for new projects.

Visuals of future scenarios

Further, the vision of the city must be holistic and applicable to all aspects of the city so it can be integrated into other policies and city development strategies. A well-established vision and direction for projects in the city can also provide a much needed competitive edge for local tourism and a sense of local identity and pride.

Access to funding may also be facilitated by actively targeting the efforts of the city towards a specific goal that may encourage investment. Targeting of funding sources will reduce the inefficient use of the municipality's resources. An established vision with a well-structured and implemented strategy will increase access to funding sources as investors respond positively to the certainty in longer term commitment and planning.

Capacity building

One of the key goals of the internal stakeholder interviews was the assessment of the internal capacities within the municipality (Figure 4). Acting upon this assessment, we recommend establishing a climate and energy working group/ task force with established and documented roles and responsibilities within the climate and energy strategy.

If successful implementation of the energy strategy is to be achieved, the working group should involve both internal and external actors as aspects of city development that are affected by the strategy are not all within the municipality e.g. tourism development. Roles and responsibilities should be defined through a proper assessment of all available resources (human, social, financial) and with the established city vision as an overall goal.

Workshop with the municipality

Measurement

If an energy strategy is to be developed with real targets and goals, proper application of measuring and monitoring skills needs to be encouraged. This can be facilitated within the municipality through training and establishment of regular follow-up assessments. The measuring capacity of the municipality can be increased through continual collaborative efforts with interested stakeholders. One suggestion is the active engagement of academic institutions, such as Pannon University in Veszprém, to increase the resources available for active measuring and monitoring within the city.

There is a need for baseline energy data within the city to guide future decisions and initiatives under the energy strategy. Accurate measuring of baseline data and follow-up on progress of projects provides quantitative justification for future investments and allows for better feedback on effectiveness of the strategy. Simple tools for calculating energy consumption and CO2 emissions were provided to the municipality in a separate report.

Communication

One of the key elements of introducing any strategy is the establishment of clear and effective channels of communication between all stakeholders. Internally, the municipality needs to create and communicate clear targets for energy efficiency and greenhouse gas reduction to all relevant departments. In addition, the roles and responsibilities of all employees under the climate and energy strategy need to be well communicated within the municipality to increase accountability and ensure the strategy's implementation.

Genuine stakeholder involvement will contribute to more effective implementation of the climate and energy strategy. It is therefore important to actively communicate progress to all these stakeholders. This follow-up maintains a clear link between the planning, implementation, and progress of a strategy. Establishing clear timeframes for the progress of the strategy encourages accountability for the implementation of the strategy among the responsible parties.

Conveying accurate information efficiently to external stakeholders is also important. The municipality's website was referred to in interviews as the main source of information to external parties. This method of communication needs to be assessed for effectiveness. The website does not appear to be user-friendly, has little information about energy measures and in its current form, does not encourage active participation in the municipality's activities. One example for improvement of the website is to categorise the existing 42 tabs of information into a smaller number of general categories. More detailed information could be included as a sub-category. A climate and energy sub-section should be added to include advice for energy efficiency within the municipality as well as updates on initiatives within the city.

Many of the initiatives that have been undertaken within the city and future projects can be used as demonstrations of energy efficiency and cost savings. This will increase interest from investors as well as better inform and involve residents.

We also recommend the development and improvement of other forms of communication such as public forums. These forums should be actively advertised and used as a method of gathering stakeholder perspectives and involvement.

Conclusion

In summary, we found that the local government in Balatonalmádi faced many challenges in their development of a sustainable energy strategy. There was however a notable tendency within the municipality to focus only on the barriers and overlook the opportunities available, which only served to lower morale. Comparison to nearby towns and cities makes it clear that Balatonalmádi is making less progress with its policies and investments.

While some work had been done in the area of energy, key strategic elements such as specific targets and assignment of roles and tasks, were still lacking. The municipality also lacked the capacity to implement the strategies fully. Often this was related to a lack of funding, but not always.

Taking a reactionary decision-making approach in response to national and regional circumstances, rather than a proactive and directed one, has resulted in the inefficient use of resources (physical, social and human). By adopting the following of funding sources as a development strategy, municipal projects have not made full use of the abundant resources of the region and have not always been aligned with the desires of relevant stakeholders. This has resulted in disconnected attempts at development with no clear city identity or direction being established. Balatonalmádi has struggled to create a competitive identity for its main industry, tourism, however there has been little development in this regard.

Workshop with the municipality

A successful energy strategy for Balatonalmádi will require integration with a wider city development strategy and will therefore necessitate interventions to improve the municipality's ability to direct and implement strategy. The first step in this process was to develop municipal capacity to motivate and involve stakeholders to work together towards a common vision. This does not rely heavily on external funding, but it does require significant effort and capacity from the local government.

Our findings and suggestions were presented in a final workshop to the municipality and in a more detailed version of this report. Activities in the workshop focused on the formation of a municipal energy strategy team, internal and external communication, and, most crucially, the development of a common vision for the sustainable development of Balatonalmádi. Such a vision does not simply predict the future, it makes a future possible.

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Bogdán László – Head of Local Development and Operations Department Balatonalmádi, 11/04/2012

Boros László – City Maintenance/ Operations Balatonalmádi, 11/04/2012

Erdélyi Tamás – resident of Balatonalmádi and project advisor – 16/03/2012

Egerszegi Zita – Environmental Director LBDCA, 13/04/2012

Gál Andrea – Deputy Head of Balaton and Bakony Action Group, 12/04/2012

Gyenes Ákos –Head of Local Tourism Association, 13/04/2012

Hegedűs István – Project Manager of RES PUBLICA, 13/04/2012

Károly Zoltán – Team Leader of City Operations Veszprém, 11/04/2012

Keszey János – Mayor of Balatonalmádi, 14/04/2012Márta Horváthné Labát – Project manager of RELACS, 16/04/2012

Kiss Bernadett – PhD Candidate IIIEE Lund University, 19/03/2012

Dr. Kiszely Pál – Former vice Mayor of Balatonfüred, current Council Member, 11/04/2012

Kovácsné Meilinger Edit- Environmental Advisor Veszprém, 11/04/2012

Dr. Kutics Károly – Finance and Accounting Department Balatonalmádi, 12-16/04/2012

Németh Jánosné – representative of Women for Balaton, 13/04/2012

Némethné Kovács Júlia – Environmental Advisor Balatonalmádi, 12/04/2012

Strupeit Lars – Sustainable Energy Researcher, 29/03/2012.

Szedlák Attila – Mayor of Litér, 13/04/2012

Terbe Zoltán – Deputy Director of Hungarian Renewable Energy Association, 12/04/2012

Toskosz Dimitrisz – Local Business Owner, 16/04/2012

Unk Jánosné Edit – External energy expert/PYLON consultant, 13/04/2012

Viktor Zsuzsanna – Tourism Advisor Balatonalmádi, 16/04/2012

Zana András – Head of Building Department Balatonalmádi, 11/04/2012

District Heating in Gdynia

The road to more efficient management

By Javier Alberto Murdocca, Jeffrey McKinnon, Sigríður Droplaug Jónsdóttir and Vasil Zlatev

Introduction

Heat supply represents one of the most important sectors in the economy of Poland with about 70% of heat demand in cities satisfied by district heating [1]. The economic and political changes in 1990s caused restructuring of the district heating companies. At present the district heating market is highly segregated with more than 3 000 companies operating on national scale [1]. The district heating market is still, however, regulated by a central national authority that sets tariffs for the price of heat energy. The legacy of the past and the new challenges brought in by the transition of Poland to a system of market economy provide ample room for improvements within the district heating sector.

The InnoHeat project addresses these issues. InnoHeat is a project funded through EU's South Baltic Cross-Border Cooperation Programme 2007-2013. The project consists of five phases.

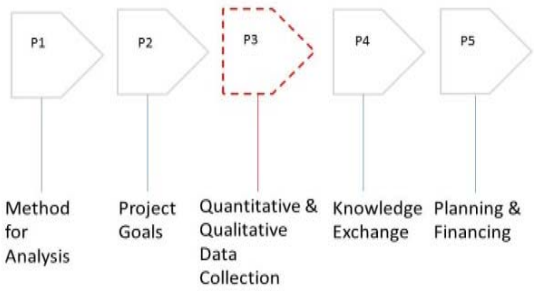

Figure 1 The five phases of the InnoHeat project.

The objective of InnoHeat is to improve district heating systems in the South Baltic Sea Area in terms of efficiency, security, and integration. This goal will be achieved through the development of methods for improvements and comparability between companies, recommendations of technical and management updates, and matching of

investment projects with potential investors. The project consortium includes district heating companies, district heating associations, business organisations, research institutions, and universities from Germany, Lithuania, Poland, and Sweden.

Task at Hand

The assigned project falls in phase 3 of the InnoHeat project – "Quantitative and Qualitative Data Collection" with a focus on gathering qualitative information. The specific task was to create a manual in the form of a questionnaire that could be used to analyse management issues in other district heating companies in the region. The manual was created on the basis of the case study of the district heating company Okręgowe Przedsiębiorstwo Energetyki Cieplnej Sp. z o.o. (OPEC Ltd.), operating in the Gdynia area in Poland.

The Case Study of OPEC

OPEC was established in 1961 and currently supplies 60% of the heat demand of four Pomerania District cities in Poland: Gdynia, Rumia, Sopot, and Wejherowo. Combined these cities have a population of nearly 400 000 people and an area of 208 km² [2].

The region of Pomerania where Gdynia, Rumia, Sopot, and Wejherowo are located.

OPEC is a municipality-owned company with 500 employees at present. OPEC's customers include: housing cooperatives, municipal buildings, businesses, and individual households [2].

OPEC has gone through numerous changes in its history. In the first 30 years of its existence, OPEC was mainly concerned with expansion of the district heating network and improvement of the technical infrastructure. For instance, problems were experienced with the supply of sufficient heat when demand was peaking in the winter. After technical improvements were implemented this issue has since been resolved. Due to economic and political changes in Poland in the 1990s the company had to adapt to the new market conditions.

The 1990s were a time of not only modernising the existing infrastructure, but also of improving customer relations; namely, expanding the company's marketing activities and moving away from the technical focus when it comes to management. OPEC's Financial Department took a more central role as the company was looking for ways to finance necessary infrastructure improvements. Moreover, there was a need for financial planning as expenses and revenues from heat supply had to be balanced. Due to retrofits of residential buildings heat demand from these buildings decreased. For this reason there was need to plan how many more customers had to be secured each year in order to compensate for this decreased demand for heat. In addition, projects concerned with improvement of environmental quality were implemented in 1990s. These projects significantly decreased emissions coming from OPEC's activities.

The beginning of the 21st century saw ever increasing focus on customers, marketing

activities, and quality of services. In 2004 OPEC obtained ISO 9001, ISO 14001, and PN-N 18001 certifications [2]. Moreover, OPEC participated in a number of international projects, including a major renovation World Bank project and multiple EU projects.

To address future challenges, a number of OPEC's employees have gone through additional technical and managerial training in recent years. Emphasis on customer relations and marketing are gaining increasing importance in contrast to a decade ago [3]. The case of OPEC confirmed these findings. As stated previously, the company was primarily occupied with technical improvements at the beginning of its existence, but is moving towards a more customer-oriented approach that reflects the new market challenges. Moreover, the company is going through a process of organisational restructuring simultaneously with implementing a project on thermo-modernisation of nearly 29 km of its district heating network [2]. Another major ongoing project is the construction of a Combined Heat and Power (CHP) plant in Wejherowo.

Thus, as times are changing, OPEC is also adapting to the future. The ultimate long-term goals for the company are: to remain the main provider of heat in its area of operations, maintain close contact with the municipalities involved, expand its services, and connect an ever growing number of customers to the district heating network.

Approach

The task of collecting qualitative management data for the InnoHeat project first required building up fundamental understanding of how district heating works in the targeted area. This understanding has been supported by in-depth primary and secondary data collection.

Coal in Gdynia harbour.

Primary data collection consisted of semi-structured interviews with identified stakeholders and material from the OPEC webpage.

In the pre-phase of the project three interviews were conducted both via phone calls and in person with Mr. Larsson, a project manager at InnoHeat. Also, one Skype interview took place with Mr. Klawiter the Technical Vice-director at OPEC, Mr. Różalski the Technical Director at OPEC and Mrs. Kotowicz a Specialist in International programmes at OPEC.

On-site interviews took place in OPEC's headquarters in Gdynia with the presence of either Mr. Klawiter and/or Mrs. Kotowicz. Representatives from different departments within OPEC i.e. Customer Service Department, Financial Department, Technical Department and Marketing Department were interviewed along with representative from the Supervisory Board and the Chairman of the Board. Six other representatives from various external stakeholders i.e. Housing Associations, municipalities, residential community and heat supplier were interviewed. Five out of twelve interviews needed translation which

Mr. Klawiter and/or Mrs. Kotowicz performed.

Secondary data collection consisted of data collection from research papers, public reports, policy documents and directives from the European Union on district heating.

Less formalised interviews with representative from InnoHeat and IIIEE also were an important part of the learning process surrounding district heating and OPEC.

Competitive District Heating

To be able to better understand the market context in which OPEC operates, Porter's model of five forces [4] was applied to the case study. This provided a platform to closely analyse the company and identify strengths and weaknesses from management point of view.

Figure 2 Porter's five forces [4].

As illustrated above, each force is influenced by several factors, which vary depending on the industry. The following are factors identified to be of importance to OPEC operations:

Barriers to entry

- Time and cost of entry
- Lack of knowledge
- Economies of scale
- Cost advantages

Threat of substitutes

- Substitute performance
- Buyer willingness

Bargaining power of buyers

- Number of customers
- Buying volumes
- Differentiation
- Incentives

Bargaining power of suppliers

- Number of suppliers
- Size of suppliers
- Unique service/product
- Ability to substitute

Rivalry among the exiting players

- Number of competitors
- Exit barriers
- Quality
- Industry concentration
- Diversity of competitors

Based on this model these factors provided a focal point when conducting interviews. When designing questions identified driving forces were kept in mind to understand the management structure of OPEC. Answers to these questions gave important input in creating a tool to analyse management within district heating companies.

Analysis

Important Issues

Based on the interviews performed and the data collected, key issues were identified in relation to current and future development of the company. Important issues for OPEC to consider in the future will be highlighted in the Discussion section. The most important current issues OPEC is facing apply both to internal communication between departments within the company and external communication with its customers. It is important to understand that the fac-

tors highlighted may be common to many district heating companies. Addressing them can help district heating companies adapt to a changing market.

Visit to OPEC's heat supplier Elektrociepłownia Gdyńska.

The importance of internal and external communication was discovered throughout the case study. Internal communication applies to the procedures of how the company shares information between departments. It also helps to better understand the way the company outlines strategies and make decisions. In the case of OPEC, information is shared between related departments like Marketing and Customer Service on a daily basis. Meetings of top management of all departments are held every week to discuss the strategy of the company and incorporate ideas from different viewpoints within the company.

The primary departments responsible for external communication and the relation between OPEC and its customers are the Customer Service and Marketing departments. The interviews revealed that OPEC has an efficient Customer Service Department, which deals with complaints and problems customers experience. External communication is executed in several ways at OPEC such as: e-mail, phone lines, and written correspondence. The most used form of communication is personal interaction when customers pay bills or voice their concerns in person.

Surveys are also conducted to learn customer satisfaction levels, and analyse complaints. However, communication of survey results between departments is sometimes missing. It raises the question of how well OPEC makes use of the information obtained from surveys. However, customers have many means of communication with the company to express their discontent.

The Marketing Department is responsible for targeting future clients with special focus on the bigger ones e.g. Housing Association BAŁTYK. In the case of OPEC most clients approach the company to connect to the network. The Marketing Department cooperates with stakeholders and follows the development of infrastructural projects in the area of OPEC's influence.

The Manual

Given the time constraints and effort to conduct 12 on-site interviews, the purpose of our analysis was to make the qualitative management data collection more structured and simple. The end product of the research conducted was the creation of a manual for analysis of management structures within district heating companies. This manual consists of a series of questions divided into eight categories. These categories were created based on the analysis of the data obtained during interviews. The categories were identified as key issues to investigate to better understand how a district heating company operates. The ultimate goal of the manual is to provide a tool to compare different management structures within district heating companies. By highlighting key differences, an

efficient and effective management structure can be obtained.

Mr. Klawiter demonstrates how pipes are insulated.

The manual has eight categories:

Ownership

This section aims to clarify the ownership of the company and stakeholders involved. The key factor is to identify if the company is publicly or privately owned. Identifying this will help to uncover how decision-making is influenced by public policies and how it affects strategic planning.

Structure

The aim of this section is to have an integral view of the company's departmental structure. Key factors are the number of employees and roles in each department and past and future structural changes. This will help to identify crucial departments within the company, and the company's vision and priorities for its operations.

Regulations

This section seeks insights into the level of control public authorities have on the company's operations. Identifying the presence of tariffs or subsidies will help to understand if the company operates in a strictly market-oriented environment or not. It will also clarify the control the company has over the setting of prices for heat distribution, and if there is any mandate by governmental authorities restricting types of investments.

Market Analysis

The goal of this section is to delineate the company's competitive position in their market. This relative competitive position may then be used to understand how urgently the company must attract new clients. A key factor is to identify competitors on the market and associated prices for competing heat sources to better understand the environment the company operates in.

Customers Relations

The goal of this section is to identify how the company interacts with its customers. The key parameter to examine here is whether the company provides additional services beyond the provision of heat. From a management perspective it is important to analyse the relationship between the products and the end clients. This aids the ability of the company to realise its customer's needs and allows the possibility to adapt to a changing market.

Communication

The purpose of this section is to establish an understanding of the communication structure within the company. The key factor is how information is shared within the company and how it is documented. This will help to identify the channels used to share various types of information that are important to either departments or employees in general.

Decision-Making

The purpose of this section is to establish an understanding of how decisions are made within the company. Key parameters include the creation, evaluation and dissemination of the company's strategy. This will help to identify stakeholders involved in the process of decision-making and how often strategies are reviewed.

Present and past meet – chimney for one of the gas-power boiler plant operated by OPEC mounted on the old.

Suppliers

The goal of this section is to identify the company's suppliers and to understand the relationship between them. The key factor is to understand how heat is supplied to the company and if there is a shared strategy between the heat distributor and the heat supplier should this arrangement exist.

The result of the information obtained from these sections should provide a clear picture of the company's strategic outline and managerial structure. The data collected will be obtained in a form that enables a comparison between different district heating companies. This will highlight strengths and weaknesses between different companies. It will also show how different companies deal with similar problems and everyday tasks. Overall, it will give a broader picture of the district heating industry and highlight opportunities for different management structures and techniques within these companies to become more efficient.

Discussion

Upon completion of the interviews and the manual for use by the InnoHeat project in the collection of qualitative management data, there are several key insights for OPEC to consider as they try to adapt to changing market conditions. This section is designed to discuss these important factors and the manual is intended to identify such issues for further analysis in other district heating companies without the necessity to conduct lengthy interviews.

Upcoming Thermo-modernisation Project

In 2010 OPEC applied for funding from the European Union to modernise approximately 28.3 km of above ground network infrastructure providing heat to cities of Gdynia and Rumia. Most of the investment (95.6%) will be focused in the city of Gdynia while the remaining percentage will focus on the key distribution lines to the neighbouring city of Rumia [2]. This investment will result in a reduction of heat losses in the network and increase efficiency of the system that delivers about 86% of heat demand purchased by OPEC. Specifically, they will be replacing old network pipes that have degraded in quality from weathering and ageing with new pre-insulated pipes.

The direct benefit of this investment will result in fewer supply side disruptions affecting the delivery of heat to their customers. Indirectly the investment will lead to a rise in air quality by reducing the amount of coal burned at source though efficiency gains, improve revenues through continuity of heat supply, and improve soil quality by limiting hot water leakage. This investment is planned over a three-year period, which results in a total expenditure of EUR 14 million of which the European Union will contribute EUR 8 million [2].

Gas boiler.

Restructuring of OPEC

Due to the thermo-modernisation project, OPEC is currently going through the process of restructuring its organisation in order to meet the needs of this investment. OPEC employs approximately 500 employees, with a large number of them working in the technical department. The company will create a new entity staffed almost entirely by people from within the company with the specific task of implementing the thermo-modernisation project.

Gauges on a heat exchanger connect to a small gas boiler operated by OPEC.

The management of OPEC has invested in technology that will require fewer employees to conduct reading of heat meters and monitoring of other technical equipment in the field. This has led to an inflated payroll within an organisation that could operate effectively with 200 fewer employees, in the opinion of top management.

The restructuring is being implemented at an ideal time for OPEC as they have the added advantage of having some of the costs covered through the thermo-modernisation project. This project will be implemented by the excess employees. However, upon completion of the project, the future of the separate entity created by OPEC is still very dependent on how this project develops.

Besides the technical benefits of the thermo-modernisation project, another benefit of training the 200 excess employees for the project is that OPEC could create a new market for themselves in the service sector. This project is intended to extend the competence of OPEC's employee base to be able to market their general maintenance services to the customer based on quality. In the event that this opportunity is not realised the separate entity of the company may be dissolved and the excess personnel

will need to search for employment outside OPEC.

Operating in an environment with strong trade unions has resulted in many discussions between OPEC and the trade unions that has established a close working relationship. OPEC has realised the difficulty of this task but have already begun to think about offering a wide range of assistance for displaced persons including many outplacement services such as aiding in job searches and other training designed to prepare employees for the job market.

Water purifiers in a gas-power boiler plant operated by OPEC.

Future Challenges for OPEC

Shrinking Market

OPEC, like some other district heating companies around Europe, is facing a situation of a shrinking heating market where existing customers have an increasingly lower heat demand. Currently, OPEC has been able to combat this challenge by the addition of new customers. A possible explanation for a shrinking heat market is the recent focus from the EU policy level through the European Directive 2010/31/EU of 19 May 2010 on the energy performance of buildings. The Directive has a focus on municipal buildings, but also private consumers' financial interest in reducing their heating costs through retrofitting their personal dwellings. This represents a significant opportunity for OPEC to diversify their product offerings.

As the demand for heat begins to shrink and buildings become more energy-efficient, OPEC must look for new ways to generate revenue. One such way is to promote itself as a company that connects, installs, maintains and delivers high quality service throughout the product cycle. Currently OPEC is not price competitive in the service market and is narrowly focused on delivering only district heat. Having better departmental cooperation will allow OPEC to realise the opportunity to compete on quality rather than price.

Departmental Cooperation

In addition, OPEC's Marketing and Customer Service Departments are not coordinated in the effort to develop a service market. The Marketing Department has a strong orientation to attracting new clients while the Customer Service Department has a strong orientation to meeting the needs of their existing customers. Closer cooperation between these two departments would allow them to discover what services current customers desire and also market the total package of heating needs to their future customers. Through this coordination they would be able to truly market their product as reliable, safe and convenient for the customers connected to the district-heating grid.

As the economy in Poland continues to develop there will be a market for clients that only want to deal with one company for their entire district heating needs. This clientele will pay for peace of mind knowing that the same company that provides the heat, also maintains their system effective-

ly. When new customers are connected to the grid OPEC has the opportunity to enter into a contractual agreement to service technical equipment through which they supply district heating. Currently, other smaller service companies that do not have the large overhead costs of OPEC, out price them in the market. Since OPEC can not compete on the basis of price, leveraging their size they can compete on the basis of quality of service. Providing expert, around the clock service for a small annual fee provides a more convenient arrangement for customers. For existing customers OPEC has the opportunity to market these services that they currently are unaware of. This arrangement could also provide an opportunity for OPEC to have direct contact with their customers during routine maintenance visits allowing them to provide tips and advice for future efficiency gains.

The principle for this diversification into the service sector is very similar to the business model employed in the automotive industry. Profit margins on the production and sale of the vehicle to a customer are quite thin whereas the profit margins after the sale involving regular maintenance and repairs are much higher, thus it is important to capitalise on maintenance contracts within OPEC.

Energy Situation

OPEC has a difficult situation where the majority of the heat it supplies to customers is provided through a French-owned supplier, almost entirely fuelled by coal using cogeneration. OPEC is essentially locked into this arrangement as the competing methods of providing heat involves a complex relationship with Russian gas producers that charge Poland some of the highest prices in Europe. There are current explorations within Poland to tap into their own gas shale resources but those investments likely will not be realised in next decade.

Due to OPEC's reliance on coal for producing heat, the company is also subject to the volatile fossil-based commodities market. OPEC cannot control the price of coal bought by its supplier and cannot control investments in heat production from biomass due to the fact that investment decisions are made entirely by their supplier. Moreover, OPEC does not have the financial resources to become independent of this relationship.

The Political Environment

A future risk to OPEC concerns the political environment in Poland. Currently OPEC has the cheapest prices for heat production compared to all other alternatives of district heat. Should national policy implement a carbon tax this could change drastically in the future. Continuing to monitor the political environment within Poland remains a key challenge facing OPEC because of the uncertainty involved in politics.

The longest wooden pier in Europe in the city of Sopot.

In addition to this, local or national authorities may also begin to promote renewable

energy through subsidies and other incentives that might result in changing heat and energy production from a centralised system to a more decentralised system. The movement of Polish society towards a system of heat and energy production that resembles a smart grid could become a large challenge to OPEC.

Conclusions

District heating is considered to be an efficient way of heating that could also reduce emissions of greenhouse gases [3]. District heating has existed for a number of years and like any other market, the district heating one is also changing. Some of the reasons for these changes are increased competition from other sources of heating, improved energy performance of buildings that reduces heat demand, and national and international policies and agreements. Often in order to adapt to those challenges, district heating companies have to change the way they manage their business. To do so, district-heating companies must understand their management structure and identify where changes can be introduced to make the companies more efficient and effective.

The manual developed as an end product for the present project aims to aid the understanding of a district heating company's management and compare differences among district heating companies. The manual is intended for use by the district heating companies themselves. The understanding and the comparison of management structures across district heating companies will help these companies make their management more efficient and will also allow them to quickly adapt to changing market conditions.

The team on top of the Sea Tower, Gdynia one of Poland's tallest buildings 125.4 m.

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Integrated Water Management in Kurseong

A PESTLE analysis of the water environment in Kurseong, India

By Nicholas Arsenault, Lara Hale, Prasad Khedkar & Yoko Morimoto

Introduction

This report introduces the work of the Lund University masters student team on water scarcity within the Kurseong Integrated Water Management Project. After introducing Kurseong and the structure of the overall project, we use a PESTLE (Political, Economic, Socio-Cultural, Technological, Legislative, and Environmental) framework for analysing the situation in Kurseong at this phase and setting forth our recommendations. The purpose of this report is to synthesise diverse forms of information gathered from our backgrounds, formal education, other integrated water management projects, and on-site experiences into an interdisciplinary perspective on the current situation and way forward for sustainable water systems in Kurseong.

Background

Kurseong is a sub-division of Darjeeling district situated between Darjeeling and Siliguri in West Bengal, India. The town is located 1 458 m above sea level in the foothills of the Himalaya. It is surrounded by tea gardens and is famous for its boarding schools.

The population of Kurseong as per a 2001 census is 40 067, whereas in 2011 it is estimated to be more than 70 000 [1]. Urbanisation and increasing population are exerting a great amount of stress on water systems and increasing the need for proper waste management.

Figure 1: Location of Darjeeling Sub-Division

Existing reservoirs and water distribution systems in Kurseong constructed during the British rule (60 to 80 years ago) have hardly been upgraded to meet the present demands. Shrinking water resources further increase the gap between demand and supply. At present, water is supplied on alternate days for thirty minutes to an hour – by pipe connections to homes or unofficial access points in public – to the inhabitants of Kurseong during dry season. Businesses and households store as much of this water as possible in order for it to last over the following day. Nonetheless, the majority of households and businesses

in the town are dependent on unofficial private water suppliers or illegal tapping of the system to meet their daily water requirements. Additionally, the quality of both the delivered and purchased water is compromised, and residents are at risk for related health problems.

Mr. Sanjay Prasad, Urban Planner of Kurseong town, formally raised the issue of the deteriorating water supply in 2007. Kurseong Municipality and Artamus, a Sweden-based consulting firm, developed a sustainable water management project for Kurseong in 2009. Soon after, a Sweden-India cooperation was established and funded by Swedish International Development Cooperation Agency (SIDA) in order to support capacity building and work towards infrastructure investments in Kurseong. The partners involved are the Swedish Environmental Research Institute (IVL), the International Institute for Industrial Environmental Economics (IIIEE), rm2rm Group, and Kurseong Municipality.

To solve water problems in Kurseong and ensure sustainable long-term water supply for the inhabitants, the India-Sweden Integrated Water Management Project was initiated in 2008 with a project proposal [1]. The Integrated Water Management Project in Kurseong (2009-2017) is divided into four different phases.

The preliminary phase involving planning and preparatory work was launched from the Project Proposal [1] and was concluded in April 2011. The results of Phase 1 were published in the form of an Observation Report [2]. In 2012, the full-scale project was initiated with the commencement of Phase 2, having an objective to develop a Strategy and an Action Plan presenting measures for sustainable access to potable water in Kurseong. This phase focuses on soft variables and aims at enhancing multi-sector cooperation, capacity building and conflict management in the watershed for the successful implementation of Integrated Water Management (IWM) project. Additionally, this phase will also test the technical feasibility of a pilot project in Kurseong. This work and report contributes an integral part of this phase. Phases 3 and 4 are planned to commence in mid-2013, and the last quarter of 2014 will focus on the hard variables such as procurement of pipes, technologies and building infrastructure. This team's work is a contribution to the early stages of Phase 2 of the Kurseong IWM Project.

Methodology

Our study and contribution to the Kurseong Integrated Water Management project was realised in three distinct steps. The first step of our contribution began on March 14th, 2012, and finished on April 1st when several group members departed for India. The second and on-site step of the project began on April 10th when all group members arrived in Kurseong and concluded on April 19th when we departed. The third step consisted of writing the final report, both for the SED requirements and a more detailed report for the larger Kurseong IWM project. This section will outline the activities that took place during the three steps of this project.

Step 1: Preparatory Phase

The preparatory step of this project took place in the weeks leading up to our departure for India. The purpose of this phase was to familiarise ourselves with the project background, understand integrated water management issues and case studies and prepare for our on-site step. The following activities were carried out during

Step 1:

- Review of reports and observations from Phase 1 of the Kurseong Integrated Water Management Project;
- Review of various case studies and integrated water management projects;
- Initial contact with local and Sweden-based partners;
- Familiarisation with the local cultural, political, environmental and economic contexts;
- Preparation and request for translation of a water survey; and
- Study of local municipal data, maps, and documents.

Step 2: On-site in Kurseong

Step 2 was the on-site portion of this project. We spent a total of nine field days working with local partners and a select group of civil engineering students from the Darjeeling Polytechnic Institute. Along with our project supervisor, Murat Mirata, we spent our days – at times together and at times individually – exploring and learning about broad and specific issues related to water management from a variety of perspectives and disciplines. It must be noted that throughout this step the local students, Mr. Johan Sandberg (IVL – Swedish Partner), Mr. Sanjay Prasad (Municipal Urban Planner), and Mr. Manoj (Municipal Sub Assistant Engineer) were an integral part of much of the conversations, meetings, field visits, interviews and surveys.

The centrepiece of our activities and exploration during this step was the *water profile survey* conducted in households and businesses in Ward 15. Kurseong's Board of Councillors selected this ward to be the future location of a small-scale pilot project because it has a representative population size (of the 1 200 residents), a roughly equal number of males and females, domestic and commercial leases, and ethnically and religiously diverse residents. The objective was to understand the qualitative and quantitative aspects of water usage in this particular ward. This served to create water profile of those living in Ward 15 and an understanding of their relationship with water – and ultimately how their lives are impacted by the current water scarcity.

Figure 2: Location of Ward 15 within Kurseong

With the help of Mr. Henry, Councillor of Ward 15, we were able to meet and interview a representative population from the various communities in the culturally diverse Ward 15, including members of the Nepali, Muslim, Bihari, and Marwari communities. Of particular interest for this project are the women of these communities, as it is women who have the most meaningful and deterministic relationship with water. The four women of the team (two from Lund and two from Darjeeling Polytechnic) added a separate survey addressing women's issues. These female-specific interviews evolved into a narrative

understanding of women's water issues.

Beyond the water profile survey the following activities were carried out during Step 2 of this project:

- Meeting with and collaborating with the local students, Murat Mirata, Johan Sandberg, and local partners;
- Meeting with local stakeholders including the municipal Chairman, local schools, doctors, councillors, shop-owners, and more (please see list of interviewees).
- Visiting and inspecting water infrastructure including mains, reservoirs, and pipelines;
- Visiting Ward 15 whilst the water was turned on and accessible during the morning;
- Conducting a small sample of comparative surveys of upstream Wards 5 and 8; and
- Undergoing water sampling training with the local students at the Pollution Control Board in Siliguri.
- Facilitating a water forum with Ward 15 community members.

Water sampling training

The culmination of the on-site step was a water forum that we hosted with the residents of Ward 15. The purpose of this forum was to share our work, observations, and implications for the project moving forward. Furthermore, it gave community members another opportunity to voice their experiences with water and to express their hopes or reservations for this project. We were also able to convey the message that such a complex problem will not change overnight and that this process has begun, but is far from finished. Finally, it gave us an opportunity to thank the community for welcoming us into their homes and sharing their stories with us.

Step 3: Report Writing

The final step of this project was the preparation and writing of our report for the requirements of the Strategic Environmental Development course. Beyond this, a more detailed report was also written for the partners of the larger project. This expanded report contains further recommendations, reference to case studies, analyses, documentations and information relevant to the future of this project.

PESTLE

PESTLE is a framework for clearly analysing the current state of, and possible futures, for complex systems from six different perspectives: political, economic, socio-cultural, technological, legislative, and environmental. It was originally developed in the late 1960s for use in a business context, but can be utilised for multiple scenarios, including strategic and organisational planning [3]. The team chose this framework because of the interdisciplinary angle and the concise, understandable format of the output. The following section details the outcome of the team's PESTLE analysis

and recommendations.

Political

The functioning of the political system in Kurseong Municipality is relatively recent, with the democratically elected representation forming an operational government just two months ago. There is a councillor to represent each of the twenty wards, and the Board of Councillors is headed by Chairman Sameer Deep Blon. Mr. Sanjay Prasad is the town's urban planner and is a key actor in the reformation of water management. Essential to the dynamics of the current water system is the position of *pipe-fitters* – government employees who link both official and unofficial connections to the piping system and are politically appointed for life.

The Municipal Development Plan [4] is essential for guiding the direction of political action. The current Development Plan was set for 2008 to 2013; and although it includes a segment on water, it is somewhat disconnected from the reality of local water mismanagement. Mr. Sanjay Prasad intends to update the Development Plan for the following five years with more accurate information about a focused vision for water management. But it is important to note that there is an urge among politicians to take immediate, *quick-fix* actions that are politically reactive in the short-term, but interfere with the implementation of a true integrated water management system in the long-run. An example of this is the proposal to pump water up from a neighbouring river, even though there is sufficient water at the sources.

Another aspect affecting water politics in Kurseong is the municipality's relationship with Public Health Engineering (PHE), the West Bengali state department responsible for delivering water to rural areas and to municipal borders and the Darjeeling Gorkha Hill Council (DGHC) sub-division. As often occurs within hierarchal political bodies, there has been non-compatibility between the two levels of government that manifests in difficulties approving water development projects and time delays when repairing damage to the infrastructure. At times the two levels of government blame each other for the lack of progress or action taken on the water system, furthering the complications.

An interesting shift in this relationship is the proposed establishment of the Gorkhaland Territorial Authority (GTA), which would replace the DGHC and act as an autonomous political body, able to retain a certain level of power and financing. It is unknown how (or if) this will affect water management practices in Kurseong.

Political recommendations:

- Establish an independent professional water body to manage the financing, sources, distribution, and development of an integrated water management system. As seen in the Phnom Penh, Cambodia case in Biswas and Tortajada [5].
- The independent body should be mandated by the government, but de-politicised, meaning that it would operate independently and more like a professional entity.
- Integrate solid waste and wastewater management as an integral aspect of an integrated water management system.
- Redefine the pipe-fitter position as a non-political working position, hired through the independent body with outlined responsibilities

and liabilities.

- Create an updated Kurseong development plan that includes a more accurate representation of the current situation and realistic aims for future water development.
- Create strategic partnership and collaborate with PHE to synergise plans for improved monitoring, delivery and quality control.
- Create a broader-scale water action plan with DGHC or GTA.

Economic

The current financial aspects for drinking water are as follows: a small fee included as an unknown portion of the quarterly property tax, fees charged for new (legal or illegal) connections to the piping system, and the market sale of privately sourced water. It is unclear how (if at all) this money is managed within the municipality, and sometimes even payment for a new connection does not yield a connection.

The result is that municipally delivered water is considered *free*, whereas privately bought water has an associated cost – and psychologically, citizens do not connect these two sources of water. For example, when considering how much they could afford to pay each month for clean, reliable water from the municipality, residents do not naturally relate their answers to how much they are already paying each day for private water. Another result is *the tragedy of the commons* insofar as people seek to obtain and hoard water wherever and however they can without consideration for the water supply to other households.

This set-up has economic consequences, as well. A significant amount of money flows to the private sellers, who profit on people's shortage of municipal water. Some of these sellers are obtaining water directly from the municipal pipes known as *pepsi lines* – thus setting their own prices to a commodity that is otherwise without charge. This practice is not clearly illegal under current laws, and given the inadequacy of the municipal system, the government is forced to accept private water as a means of distribution. Further, households and businesses alike face indirect water expenses: fuel for boiling water, time to collect and transport water, and medical treatment for water-related illnesses.

Morning water collection

Thus Kurseong residents are indeed paying for water in a number of dispersed forms – all of which have the potential to be translated into a water tax for safe water delivered to their homes. This is especially important for understanding the wealth divide among households, because in the current system the wealthier families can invest more to obtain and purify water, even though they face fewer water shortages than their downstream neighbours.

Economic recommendations:

- Set a graduated monthly water tax so that (to some extent) the wealthy subsidise water for the poor.
- Illustrate the current cost of water (fuel, municipal fees, private pur-

chase), relative to a new fee structure.

- Collect the funds from the water tax in a water account managed by the independent water body.
- The initial water infrastructure and establishment of an independent water body should be funded through SIDA, Asian Development Bank, state government schemes, and any other relevant investment agencies.
- Identification and application for such funds should be managed through the project's contact at Artamus.

Socio-Cultural

"Water, water everywhere. Not a drop to drink."
- Kurseong Elder quoting the Rime of the Ancient Mariner

Interviews with local residents

There are a variety of socio-cultural stakeholders within Kurseong, including households, schools, small shops, tourism bureaus, and tea gardens to name a few. Schools and tea gardens in particular have the potential to be influential parties throughout the process of a changing water infrastructure, as they are large stakeholders. As some of the tea gardens are seemingly disengaged from the municipality's current initiatives, it is particularly important to engage them. An advantage to future water management is the location, willingness, and expertise of the Darjeeling Polytechnic Institute students and faculty within Kurseong.

It became evident from our interviews in Ward 15 that people feel alienated from the political process (likely due to the former lack of representation). This disconnection manifests in a general lack of awareness concerning water. These gaps in awareness include: the overall water system, reasons for the current scarcity, connections between waste and water, and downstream effects. Already, residents note a better understanding since the appointment of councillors to the wards.

Within households there exists a clear dissatisfaction with the water system. This can be in relation to quality, timing of water availability, consistency in the system's operations, and quantity and quality available. People are concerned about not only the safety of drinking water, but also sanitation overall (due both to health threats and cultural/religious practices) and must use water to cleanse their bodies, clothing, and homes.

Few of the men in the community are aware of the amount of water used for cooking, washing and every day activities at household level. They do, however, recognise the need for a continuous water supply to avoid conflicts with neighbours over water. Many of them have seen the gradual decrease of supply and deteriorating infrastructure in Kurseong and mentioned how water scarcity has negatively impacted their lives.

Women, who are ultimately responsible for water management in the home, report that they are anxious to the extent of

spending sleepless nights worrying about water collection and conservation. Sometimes women fight over access to water from public taps and leaks from exposed pipes. Further, women's positional opportunities within society are compromised by the water situation. Managing water is taking time away from their chores, and this interferes with the possibility of expanding their activities beyond chores.

Local women leaders and interviewers

However, it is important to note that women also help each other, and there is an informal support network for water. Women can borrow water from other households, get help identifying sources of water, and share their worries and challenges with each other.

Socio-cultural recommendations:

- Sponsor an information campaign to improve water awareness that clearly focuses on the water system.
- Create a relationship with KTV (the only local Kurseong news source) to run the information campaign. An example of the discussed forms includes a *water week*, wherein water is reviewed from different angles each day for a week.
- Establish a field-based seminar in which polytechnic students can enroll. The aims of this would be to further connect Kurseong Polytechnic Institute to the water project, better inform students about their local situation, and offer practical engineering experience. Further, this line of education could develop into a local water testing laboratory to improve the municipality's water management capacity.
- Formalise a women's water support group with a representative female leader from each of the wards.
- Elect one or several of these women to represent female community member on the local stakeholder group or the advisory board might be set up within the proposed independent water body.

Technological

Just the initial visual impression of Kurseong's water distribution system is enough to ensure an understanding that it has been very poorly managed – in fact, grossly neglected. The main lines were established during British rule some 65 years ago and have not been renovated since. Instead, a plethora of narrow iron pipes have been joined in parallel with others every time someone new needs a connection until every street edge is spilling over with a conglomeration of (some functional, some not) rusting, bent, and leaking pipes.

There are numerous issues with the piping system besides the chaotic plenitude. Some of the most significant include: placement above ground with easy access to the general public and susceptibility to breakage; abandoned, unused pipes clustered among the functioning ones; leaking during water flow; lines tapped into holes in the mains

to draw extra water, including pepsi lines; heaps of garbage piled on top of eroding pipes; and running the pipes through the open air storm water drain channels.

Current pipe and storm water drain infrastructure

Exacerbating the problems of the distribution system is the fact that the reservoirs are damaged and not used to full capacity. And although they are equipped with filtration systems, none are operational. Another complication for quality is at the delivery point, where because delivery is neither constant nor daily many households store water in 500 to 1000 Litre tanks. The cleanliness of these tanks, mixing of water types, and the storage time both threaten water quality when it is then drawn out.

At the heart of the problem is the lack of any comprehensive technological plan. Not only has this impeded the maintenance of the system, but it has also allowed for unchecked proliferation of both pipes and contamination.

To supplement water from the sources, some households and businesses are collecting rainwater to use for activities of less demanding quality such as cleaning floors and flushing toilets. However, there are not associated technologies for filtering the water to drinking water quality.

Technological recommendations:

- Develop a detailed, holistic technological plan for both distribution within Kurseong and management of the sources and delivery to Kurseong by the proposed independent water body. This should incorporate both aspects of maintenance, repairs, and long-term development. Some fundamental changes would include moving the piping underground and forming a loop, rather than linear branched distribution system.
- Recompose standards for how the system is branched, including appropriate lengths and diameters for piping.
- Execute system-wide repairs of leakage and unofficial connections.
- Include a focus in the plan on encouraging or subsidising rainwater collection and filtration systems and overall increasing the town's rainwater collection capacity.
- Address in the plan how to supply water to public taps such as drinking fountains, toilets, or official access points for those who do not yet have a connection to the municipal distribution system.
- Install water meters at key locations around the town in order to improve usage monitoring capacity.
- Offer education and training to schools and tea gardens on larger-scale rainwater harvesting systems, as they have significant roof capacity.
- Evaluate the possibilities for, and logistics of, extracting unused iron pipes and selling them as scrap iron to help fund the process.

Legislative

It is difficult to analyse a legislative system that is not yet in place. Currently, there are effectively no bylaws and no binding requirements concerning the quality and quantity of water delivered to consumers. There are national standards for water quality, but sub-levels of government lack the capacity to monitor and enforce these standards.

Although PHE is mandated to deliver water to rural areas and to municipal borders, the effectiveness of delivery is compromised by rural demand for water and consequential tapping – a behaviour which has thus far been allowed for the sake of ensuring rural access to water, as per PHE's mandate.

Policing is also an issue within Kurseong, where people are not interfered from tapping municipal lines and extracting extra water, whether for personal use or private sale. Nor are those who do not pay taxes (including the small amount within the property tax) held liable for tax evasion.

Legal recommendations:

- Compose legal documents that outline the legal responsibilities of the independent water body.
- Establish legally-based government support of the independent water body, i.e. it should not be subject to political tides.
- Design and pass water laws and standards for quality and quantity that are clearly linked to the goals set forth in Kurseong's revised development plan.
- All operators, including private water sellers, must be required to comply with the legally established quality standards.

Environmental

Kurseong is nestled among the foothills of the Himalaya and experiences a temperate micro-climate. The area is subject to high levels of rainfall, with precipitation over four months and monsoon weather over an additional two months.

View of Kurseong in the foothills of the Himalaya

Our conversations with the local populations revealed that there are noted changes in climate and precipitation, especially changes in precipitation patterns to more intense rainfall over less time (for example, the monsoon season used to last three months).

Other anthropogenic changes are impacting the environment as well. Deforestation in the catchment is a serious concern for the long-term sustainability of water sources. Non-organic tea gardens practice heavy application of pesticides, which negatively affects water quality downstream in the basin. Both deforestation and tea cultivation promote soil erosion, which interferes with water retention and instigates landslides. Residents who are already dealing with a chaotic water system express concern over how these environmental changes will further affect their access to clean, sufficient water.

Within Kurseong municipality, the lack of municipal solid waste and wastewater management currently imparts grave environmental damage – especially water contamination within, and downstream from, town. Its environmental dynamics and water cycle are thwarted by the lack of any trees, parks, or green belt in the town centre.

Example of current municipal waste management

Environmental recommendations:

- Include municipal solid waste and wastewater management as essential aspects within the overall water plan. These should be integrated into water management as they both impact water quality.
- As recommended in the technological section, encourage and subsidise rainwater collection systems to relieve pressure placed on singular sources.
- Organise regular water quality monitoring, both at the sources and in the municipality. The Pollution Control Board, administered through the West Bengal government, is already an enthusiastic partner and is applying to establish regular testing at two of Kurseong's sources.
- Cooperate with the Forest Department to commence the practise of reforestation in forested areas.
- Work with tea gardens to encourage permaculture practices to increase biodiversity and decrease use of pesticides.
- Establish riparian zone conservation in the water catchment to help buffer water events, improve water quality, reduce erosion, and provide faunal habitat.

Conclusion

From the observations made during the visit and in-depth understanding gained from the interviews conducted we have identified that the water issues in Kurseong are a result of weak governance, inefficient water management, and a failing infrastructure. The newly elected Chairman and the Municipal Board of councillors are committed to bring about changes in the existing system in collaboration with the Indo-Swedish Integrated Water Management project. However, it is evident that the municipality is heavily dependent on this particular project to ensure safe and secure water supply to the local population. The core of our recommendations for the future is to depoliticise the water management system by establishing an independent water body to govern the water system and infrastructure. This independent body should be mandated by the government, but operate independently and more like a professional or private entity. There are many examples throughout the world that could guide this process and transition including the case from Phnom Penh, Cambodia [5]. We also recognised the need to consolidate the common vision for the IWM Project, as it involves various part-

ners having different roles and expertise. The consolidation of these visions should consider the various aspects and recommendations made in this report. Certainly there is an opportunity to manage the water scarcity in Kurseong with stakeholder cooperation and concerted efforts of the project partners. Having said that, we do not believe that the project should move forward solely because there is funding to do so. The livelihoods of an entire community depend on the joint efforts of the project partners and the local stakeholders, and it could be detrimental to this community if the IWM project is not properly carried out. As the project moves forward there should be considerable measures taken to assure that all stakeholders are engaged and have the capacity to sustain a safe and secure water supply for generations to come.

Mr. Sanjay, local and IIIEE students

Disclaimer

This report does not necessarily reflect the opinions of the IWM Kurseong Project.

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List of people interviewed

Mr. Sanjay Prasad, Kurseong Municipality, Urban Planner, 12th April 2012

Mr Manoj Kumar Chhetri, Kurseong Municipality, Sub Assistant Engineer, 12th April 2012

Mr. Sameer Deep Blon, Kurseong Municipality, Chairman, 12th April 2012

Mr. N. K. Sharma, Executive Engineer, Public Health Engineering Department, 13th April 2012

Mr. Raja Banerjee, Makaibari Tea Estate, Owner, 14th April 2012

Mr. Ramesh Subba, Kurseong Municipality, Sanitation Inspector, 16th April 2012

Mr. (Unknown Name), Victoria School, Principal, 16th April 2012

Dr. Angsuman Das. Kurseong Municipality, Health Officer, 16th April 2012

Sister (Unkown Name), Saint Helen's School, Kurseong, 17th April 2012

Mr. A. K. Agarwal, Principal, Bellevue Secondary School, 17th April 2012

Mr. Mahipal Singh, Project Manager, Darjeeling Tea Research Board, 17th April 2012

Key Learning Outcomes

Gran Canaria, Spain

The SED project in Gran Canaria was an incredible journey. We were four students from four different countries, living and working together over an intense one week period. It was a rare and valuable experience. Our group interacted, worked and collaborated with several local stakeholders including academics, municipalities, the tourism board, tour operators, apartment-hotel owners and technical experts who enriched our research and formed the basis for our project. Key practical learning from the project included dealing with translators and business culture in Spain, understanding social and environmental impacts of mass tourism, gaining knowledge of the organisational ownership structures of apartment hotels, and investigating viable sustainable technical solutions for apartment hotel renovations. A memorable and valuable experience!

Firenze, Italy

We enhanced our understanding and skills for building synergies within a group, the members of which have different backgrounds. We developed further flexibility in our working approach to faster adapt to new configurations and we increased our capacity to turn uncertainties into positive outcomes.

One major thing we learned in Italy was that they have a great technical understanding of biogas production and a willingness to develop this field. The real issue is to get political support and get everyone to work together.

Zabrze, Poland

Biogas system development is a very complex procedure involving a multitude of stakeholders and requiring numerous well-functioning processes including good waste source separation, sufficient supply of substrate, efficient logistics, and a production monitoring system. In order to foster the market potential of biogas as a renewable energy source, both a well designed legislative framework and adequate support measures need to be put in place. Certainly, education and public awareness raising are needed to change behaviour amongst all age groups in the population regarding the perception of waste as a resource. This development process is time consuming and in the interim period transition tech-

nologies such as refuse derived fuel plants can be used to bridge the gap towards achieving full biogas potential.

Klaipėda, Lithuania

The SED project in Klaipėda brought many surprises for the team. The preparation phase led us in directions that proved to be more complex then we had imagined. Inevitably, when we arrived on site, some doors closed and other doors opened. Our clients were not exactly who we thought they were and their goals were not always evident. The most challenging aspect was getting the information, sometimes working in three languages at once. The Baltic region was a new destination for us, and the unique culture was entertaining and at times perplexing. An enduring impression for our group was the importance of collaboration in solving the energy security issues faced by Klaipėda Port. We hope that our brief investigation provided an opportunity for the companies we met to begin the process of imagining new solutions to the challenges they face.

Balatonalmádi, Hungary

The SED exercise taught us the importance of having strategically developed goals for the future. We are often taught that having a vision is important when implementing any strategy or management system. Our time in Balatonalmádi gave us all practical insight into how to build such a vision through connecting all stakeholders. Efficient measuring and communication are all important steps in the development process that then builds upon these fundamental steps. A vision does not just predict a future, but it allows a desired future to be created.

Gdynia, Poland

This SED exercise was a great learning experience on many different levels. The learning curve was quite steep for us when it came to the technical aspects of district heating but we left with a solid understanding of the system and how it has developed in Poland. We also gained experience in working in a cross-cultural environment and coordinating work among a diverse set of group members. Perhaps the most important learning we gained out of the SED exercise was interview experience. Asking the right questions is critical to producing a quality final product and communication

through translation is a challenge with which we can now handle with confidence.

Kurseong, India

Engagement in a cross-cultural and hands-on water project has provided us with an in depth understanding of the many complexities, barriers, and solutions involved in Kurseong's water dynamics. In our work with the local community, it has become evident how important their experiences and voices are for identifying and characterising key problems.

Furthermore, we have learned that a short-term solution will not suffice and that multiple long-term solutions will need to be included, but also reach beyond technological fixes. It is evident that a sustainable water supply in Kurseong will require a new model of governance removed from the political realm. In conclusion, we learnt that there is not a natural scarcity of water in Kurseong, but that the lack of water is an artificial phenomenon caused by a failing infrastructure and lack of proper governance.

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International Institute for Industrial Environmental Economics - IIIEE

The International Institute for Industrial Environmental Economics, IIIEE, was established by the Swedish Parliament in 1994. The institute is a part of Lund University and governed by a board appointed by the University and Government.

The IIIEE was founded on the principle that *prevention is better than cure*. The overarching mission of the IIIEE has always been to address global challenges from a perspective of sustainable development. Through innovative research and teaching, the institute drives the advancement and application of knowledge in the fields of policy and strategy for sustainable solutions.

Through its work, the IIIEE aims to motivate and inform society in the development of sustainable consumption and production systems. Research at the institute is directed towards the transformation of technical and management structures, and focuses on the design and application of policy instruments from both a governmental and corporate perspective. The research areas of the institute are numerous and cover among others, the topics of extended producer responsibility, product service systems, supply chain sustainability, energy and energy efficiency, tourism, sustainable urban transitions and information technology. Research areas are cross-cutting and many researchers are active in multiple areas.

As well as being leaders in their research fields the staff are also highly committed and experienced teachers. In fact many have gone through the IIIEE Masters Programme themselves.

The IIIEE bridges the fields of academia and practice through actively collaborating with stakeholders.

It has strong relationships with Swedish and European governments, industry and society. These relationships are leveraged throughout all the programmes that the institute offers. Education at the IIIEE is facilitated through two Masters Programmes: Environmental Management and Policy (EMP) and Environmental Sciences, Policy and Management (MESPOM). The IIIEE also runs educational programmes at the PhD level, as well as undergraduate courses, executive training, and an international web-based, interactive distance-learning course, the Young Masters Programme on Sustainable Development (YMP).

Started in 1995 the EMP Programme is the first IIIEE Masters Programme. The Masters Programme (120 ECTS credits) runs over two years and consists of two blocks: one year distance education using an online platform and one year on-site activities. The programme is shaped to provide a multi-disciplinary education, comprising of economics, law and policy, technology, management and environmental science. Moreover, particular focus is given to preventive environmental strategies, sustainable consumption, cleaner production, energy policy and environmental management.

Students at the IIIEE Master Programmes come from diverse academic backgrounds spanning social science, engineering, law, economics and business. Most students also have several years of professional experience. This rich pool of experience facilitates peer learning which forms an important part of the education programme.

The institute prides itself on providing, a balanced combination of theoretical fundamentals and practical activities. During the on-site half of the course, students take part in a number of study visits within different industries. Students are also given the opportunity to carry out applied projects working with real clients from different companies and municipalities to gain valuable practical experience. This allows for the development of a wide perspective that can be used to approach integrated environmental problems within government and industry.

With global concern over environmental and sustainability issues growing, there comes the need for global solutions. The EMP Masters Programme gathers together people from all over the world making the institute rich in socio-cultural diversity.

This year Batch 17 includes students from 23 countries: Argentina, Australia, Austria, Bulgaria, Canada, Colombia, Denmark, Finland, France, Iceland, India, Indonesia, Italy, Japan, Kyrgyzstan, Lithuania, New Zealand, Romania, South Korea, Sweden,

Trinidad and Tobago, UK, and USA. By bringing together people from all parts of the world, the institute ensures a global perspective and provides a platform for the generation of creative synergies and solutions.

A broad spectrum of opportunities awaits the EMP students after graduation. The programme is designed to be both intense and challenging but is but also immensely rewarding and inspiring at the same time. The knowledge and practical experience gained during the programme ensures that students graduate with a diverse skill set enabling them to excel as professionals in the environmental field. The majority of graduates find careers in industry, research, NGOs, government institutions and consulting.

The tight bonds created during the stay in Lund continue after graduation through the IIIEE Alumni Network, to which all former EMPs are connected. Our active network includes over 500 members from more than 90 countries. The IIIEE Alumni Network serves as a platform for sharing new developments and professional achievements. The institute also hosts an alumni conference, which takes place once every two years offering opportunities to catch up with old friends and make new connections.

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