GBE Factory

Green Blue Energy Factory

FACTORY GUIDE

GBE Business models and best practices in Europe

Supported by INTELLIGENT ENERGY EUROPE

SECOND GENERATION COMMERCIAL AND INDUSTRIAL BUILDINGS:
Renewable energy sources at the service of competitiveness and the environment

GREEN BLUE ENERGY FACTORY

DRAFT GUIDE

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GENERAL FOREWORD

In the last years, environment has become a priority subject for the European Union.

On 16th December 2008 the European Council published the "Climate Energy Measures 20-20-20". These measures are meant to:

- *reduce 20% the emissions of CO^2;*
- *increase 20% the energy saving;*
- *enhance 20% the consumption of energy by RES.*

Also the document "EUROPE 2020: A strategy for smart, sustainable and inclusive growth" states that the fulfillment of these objectives of energy policy would bring a saving of about 60 billion euro for the gas and petrol importations by 2020.

Others improvements in the European energetic markets' integration could produce an increase of 0.6-0.8% of EU GDP. The aim about 20% of consumption by RES could create 600.000 new workplaces that will become one million adding the 20% efficiency target.

This 20-20-20 Strategy is the beginning of a course to rationalize the electrical consumptions and to reduce the CO2 emissions. In 1997, in fact, the European Commission elaborated the "With book" about new policies to increase the percentage of FER's use up to 12% of the total mix energetic amount.

By now this strategy is the first element that makes economy grow.

Often we listen about miraculous "Green Economy"…

"Greening the economy" means mainstreaming practices that use energy efficiently. It also means developing renewable, sustainable sources of energy. In a green economy, renewable energy is easy to access and technology can be powered by these new sources. Setting up entire systems based on new energy sources requires significant time and outlay. But once this infrastructure is in place, a green economy will save money year after year, illustrating why it's a wise and farsighted idea for countries to start the greening process now.

It is well now that a wide range of technologies and methods exist to improve energy efficiency, turn renewables into viable energy sources and reduce emissions. However, ***market conditions prevent them from reaching their full potential****: for this reason is very important the contribution of the European's project. Indeed they allow to promote energy efficiency and encourage the rational use of energy sources, increasing the use of new and renewable energy sources as well as encouraging energy diversification and stimulating energy efficiency and renewables.*

PROJECT FOREWORD

The project GREEN BLUE ENERGY FACTORY promotes the equipment of industrial and commercial buildings with single or combined renewable energy sources, able to provide electricity and heating and cooling for the air conditioning of premises, or/and for the business activities housed within.

GBE FACTORY will represent the transition from fossil fuel warehouses to second generation industrial or commercial buildings. Many of the residential buildings are already equipped with new technologies which allow to have electricity and heating/cooling without the use of fossil fuels. Now the moment has come to extend this trend also in the industrial sectors, starting from the countries of the project's partners (public bodies, organizations and ESCOs from Italy, Germany, Austria, Slovakia and Bulgaria), and aiming at extending the project's effects to the rest of the EU. A GBE Factory can be a single industrial or commercial building working with "zero carbon emissions", or one or more buildings equipped with plants producing renewable energy, which can be distributed to the surrounding companies of the same industrial or commercial area. In this way, abandoned industrial or commercial buildings can become local plants for the production of renewable energy, favouring new business and employment.

In this optic, the project will help companies to identify investment plans integrating renewable energies with their productive activities, with the aim of making direct profit through the existing RES financial support

schemes, and indirect profit through the abatement of electricity and heating/cooling costs as well as through the increase in value of the requalified industrial/commercial sites.

To increase the interest in this field, the project has identified business model and best practices all over Europe. The most advanced ones will be promoted through the dissemination of information. Indeed, the project will support the development of organizations which will make GBE FACTORY their Business Model and will enhance the framework policy and financial conditions.

The forms of intervention will be RES installation in existing, re-qualified or newly built industrial or commercial warehouses, which show also good energy saving features. GBE FACTORY dedicated buildings will pursue the maximization of efficiency and effectiveness of the investments, optimizing the combination of RES technologies and their integration, achieving economies of scale. In this way GBE FACTORIEs can not only be self-sufficient industrial/commercial energy buildings, tending to zero emissions, but also real RES generation plants, that can share renewable electricity and thermal energy with the surrounding industrial or commercial area.

1. EXECUTIVE SUMMARY

To make this work useful for a practical understanding of the advantages of RES use in industrial and commercial warehouses or factories, we have collected existing cases in Europe that we've called "Best practices".

Obviously, different countries mean different BEST PRACTICES since different primary materials suite different geographic areas

On the base of partner's technical skills and of the collected cases, four typologies of GBE FACTORY BUSINESS MODELS which can be replicated all over Europe have been identified, in spite of differences between countries.

This Guide will show, in the easier way possible, different business models matching them with practical examples. Of course existing cases may not have all the elements described as components of the pure business models.

The aim of the project is not only to show how others have integrated RES technologies in their commercial or industrial activity, but also to stimulate the economic and environmental opportunities for an upgrade.

The publication is divided in two sections:

1. *BUSINESS MODELS, where four typologies of business models are described;*
2. *BEST PRACTICES, where we have matched best practices with the business model in order to give a real idea about the possible implementation of such Business Models.*

2. BUSINESS MODELS

2.1. "One by one"

THE GBE FACTORY IS LOCATED INTO THE FIRM SATISFYING THE FIRM'S ENERGY NEEDS

2.1.1. Solar thermal and solar photovoltaic plants

Executive Summary

This simple business model investigates the possibility of achieving sustainable supply of cooling, heat and power for a company or SME through a solar thermal and/or solar photovoltaic plant. According to this Business Models, an ESCO sets up a RES plant, which sells the generated energy to the SME. The RES plant is located in the same building, which

becomes a GBE Factory. Through the GBE factory energy costs will be saved. Surplus energy can be sold to the grid.

Quick Facts

GBE FACTORY MODEL

On the roof or free surfaces of a SME building a solar thermal and/or photovoltaic plant is built. The generated RES energy (heat/cooling/power) is covering partially the local energy demand.

TYPE OF INVESTMENTS

A Solar thermal and/or solar photovoltaic plant provides heat, cooling and power to meet the needs of heating, cooling and power demand of a company/SME.

CUSTOMERS AND TARGET GROUPS

The main target groups are the owners of companies and SMEs with suitable areas for the installation of solar panels, particularly in urban Centers (usually only roofs available). The entrepreneur should have a high needs for air conditioning and heating (e.g. for a shopping mall, large office building, chemical stockage warehouse, agrofood company, etc.) with particularly high energy costs.

RANGE OF THE EXPECTED ECONOMIC INDICATORS (creating and running the GBE FACTORY investment)

EBIT: 54 % (in the 5th year)

EBITDA: 89% (in the 5th year)

ROI: 36.3% (after 25 years)

ROE: 120% (after 25 years)

IRR: 13.5 % (after 25 years)

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1. http://www.solid.at/index.php?option=com_content&task=view&id=50&Itemid=68

2. http://www.biosolesco.org/

Strategic Vision at the base of the investment

The GBE factory covers a substantial part of the energy consumption of the building. The investment cost and energy price for the customer is lower compared to conventional energy system.

The value perceived (by the users)

The company/SME can benefit from an increased independence from fossil fuels, greater security of energy supply and lower energy prices which are based on a performance guarantee contract. In addition, the company can reinforce its corporate image selling a new environment-friendly identity.

Key Activities, Key Partners, Key Resources

THE MAIN KEY ACTIVITIES ARE:

- Inquiry of an operating ESCOs in the field of solar energy
- Energy Audit of the building
- Dimensioning of the system
- Preparation of a business plan
- Contract signing between ESCO and company/SME

KEY PARTNERS GENERALLY ARE: the company/SME owner and the ESCO

KEY RESOURCES FOR FINANCING ARE:

- ESCO
- Company/SME
- Bank institutions or private Investors

Customers and target groups

The main customer is the owner of the company/SME.

The company/SME should have:

- A long-term location solution
- Certain data regarding energy consumption
- An ongoing expensive energy supply
- Obsolete H/C system
- Suitable areas for the collector field

Operation

The solar thermal plant should not be oversized, which would result in a stagnation of the system. Therefore, the design criterion is the summer load of the building. It will produce heating and cooling.

The solar thermal cooling plant (incl. absorption chiller) works more efficiently when it covers the base cooling load of the building (investment compared with the output). The peak of solar radiation and the peak demand of cooling match perfectly and save electricity. Through an intelligent storage management with heat and cold storage, the solar fraction could be increased significantly.

In the fall, spring and winter cooling is not necessary but due to the solar thermal system it is possible to cover a high portion of the required heat (DHW, reheating, etc.) of the building.

The photovoltaic plant is able to provide a significant portion of electricity.

After the commissioning phase the plant runs independently and is controlled via online monitoring.

If there is not 100% RES coverage possible, a centralized or decentralized back up source is necessary.

Cost structure ratios

The main operative costs are electricity (for the operating of pumps and heat rejection of the chiller) and the maintenance of the system, attention should be given to the following points:

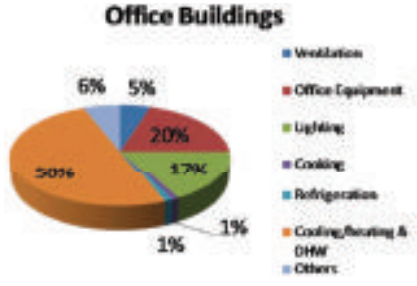
1. Through the selection of different components high attention to quality has to be paid, in order to ensure an error-free and profitable operation.
2. The engineering has to be done by an experienced company.
3. Insurance costs must be considered.

4. Ordinary and extraordinary maintenance costs must be considered.
5. Control and monitoring costs must be considered.
6. Costs of administration and management must be considered.

In the following graph, you can see the price trend of electricity in Europe:

Price trend of European electricity prices €/MWh

As demonstrated in the chart above, electricity had a strong price increase in the last years. This plant saves (through solar cooling) and produces (PV) electricity. The consumption of H/C in an office building is app. 50%.



Energy consumers of an office building

Revenue Stream

REVENUE SOURCES ARE:

From RES energy sales

1. Thermal energy supply (variable income depending on heat production -> climate conditions)
2. Refrigeration energy supply (variable income depending on heat production -> climate conditions)
3. Generated electricity can be feed into the public grid or sold to the SME (variable income depending on climate conditions)

From peak reduction

1. By reducing the thermal (if connected with a district heating grid) and electrical peak demand, the charge for the connection power can be reduced.

From RES incentivizing system

1. RES incentives are recognized by state environment and energy authorities or related organizations (Green certificates or FIT, usually defined in advance for a fixed number of years)
2. Different public grants

From company/SME status

1. In case of an early termination of the performance guarantee contract (the company/SME should sign safety measures . Therefore, for variety of costs (reinstallation of the system, loss of profit, etc.) a deposit of app. 30% of the investment is paid by the

company/SME. This charge will be returned in form of lower energy prices or at a maturity date.

Investment model and financial structure

The main investments are:

- Solar thermal, solar cooling and PV plant
- Additional needed technical parts to feed into the distribution system

Operational main costs should concern:

- Electricity
- The remote controlled supply system
- The maintenance service

The solar thermal, solar cooling and PV plant are owned by the GBE factory, through an energy service company (ESCO).

For the distribution system the company/SME is responsible. The renewable energy must be fed primarily in the distribution system. A minimum energy demand of the SMEs has to be stipulated in the contract. In case of decreasing this minimum energy demand, the company/SME has to pay a penalty for compensating the decreased energy supply. On the other side the ESCO ensures a minimum of energy supply.

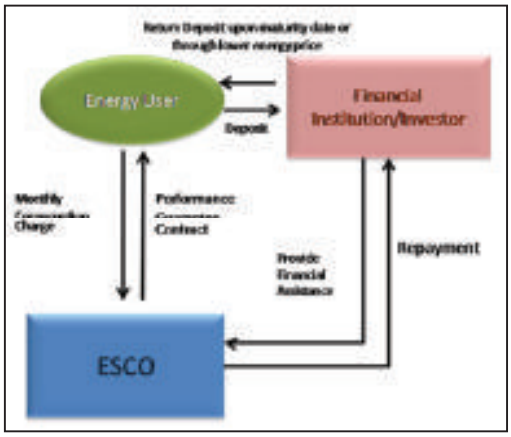
The project is funded by the ESCO, withapp. 30 % deposit from the company/SME.

The investment is carried out by a financial institution or investor through the ESCO.

Equity from the ESCO

The ESCO is responsible for the construction and operation of the plant .

The repayment of the investment is possible through the monthly consumption charge of the SME.



It is desirable that the engineering-, procurement and construction companies have shares of the ESCO (Investors). This should/can achieve better efforts in the planning, construction and operational phase.

ESCO Barriers:

- Size limitation of solar plants
- Low energy price of conventional energy sources
- Public procurement
- Lack of trust in energy savings/supply
- No qualified staff for operation and maintenance (O & M) training
- Late detected malfunctions of solar plant

Business Plan main indicators

From the examination of the main aspects of a business plan applied to this type of GBE FACTORY, one should consider:

1. economic gain;
2. positive SWOT analysis;
3. environmental benefits;
4. safety with advanced technology;
5. legal framework;
6. authorization process;
7. expertise of the people involved;
8. support of key-stakeholders;
9. social benefits;
10. tax framework.

The below mentioned economic indicators are expected:

EBIT: 54 % (in the 5th year)

EBITDA: 89% (in the 5th year)

ROI: 36.3% (after 25 years)

ROE: 120% (after 25 years)

IRR: 13.5 % (after 25 years)

Environmental and economic sustainability

Solar plants (thermal and PV) are one of the most environmentally friendly RES. The installation on roofs prevents the spoiling of valuable ground

areas. This RES system saves or generates valuable energy avoiding the use of fossil fuels (electricity, gas, oil, etc.).

The solar fraction of the total needed energy depends on the base load of the building and available areas for the erection of the solar plant. Because of an intelligent storage management of cold and heat the solar fraction could be increased significantly.

The main sustainability from an economic point of view is a predictable constant energy supply and cost savings for the future.

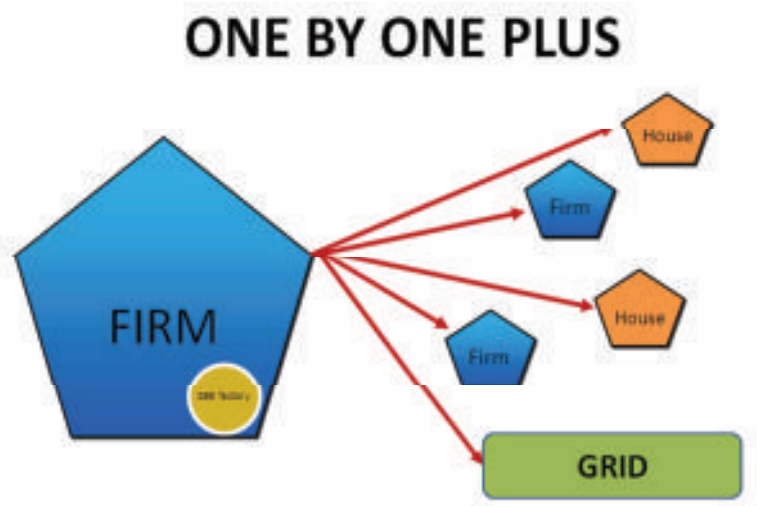
This can be achieved by:

- State-of-the-art design, implementation and maintenance from 1 hand – long life time of the solar plant of app. 25 years
- Financing by experienced partners
- Cost effectiveness by short pay-back time, positive cash flow, stable energy rates, low operating cost; reliable product quality
- Precise invoicing of produced heat (heat meter)
- Guaranteed energy supply and monitoring of savings
- Training program for local partners (O & M)

Furthermore, it is possible for companies/SMEs to stay more competitive through greater independence from energy supply and to have energy cost savings.

To be able to ensure economic sustainability, a long-term performance guarantee of supply contract and a safe financing scheme can be subscribed.

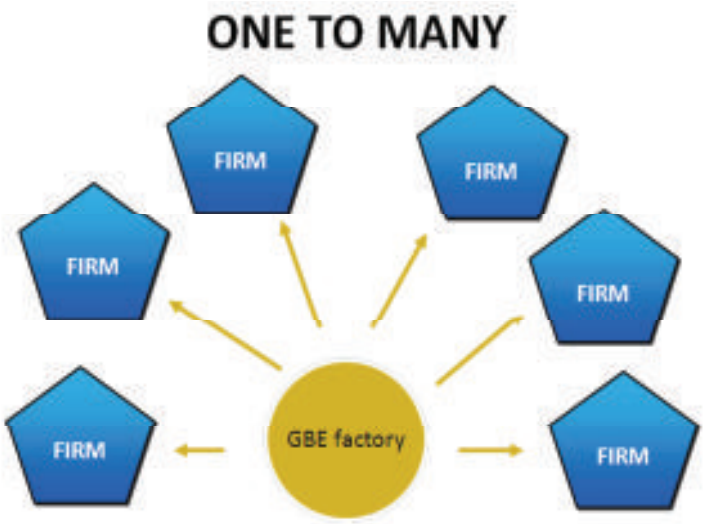
2.2. “One by one plus”



THE GBE FACTORY IS LOCATED INTO THE FIRM SATISFYING THE FIRM ENERGY NEEDS AND SELLING OUT THE SURPLUS

In this particular situation the GBE FIRM not only satisfy its own energy needs but also have an overproduction that could be sold to the grid, if there isn’t any kind of pipe-network.
This model is really interesting because it could be used in particular zone where, for many reasons there isn’t the gas or a distribution network that provide to satisfy local energy and H/C needs.

2.3. "One to many"



A GBE FACTORY IS LOCATED IN AN INDUSTRIAL AREA AND SUPPLIES TO VARIOUS FIRMS HEATING, COOLING AND ELECTRICITY

2.3.1. Biomass power plant with pipe network

Executive Summary

The business model foresees a biomass energy fully completed project cycle utilization for customers in residential, public and industrial sectors. In the industrial sector the proposed business model includes a consortium among users, production, engineering and logistic companies, designers, suppliers, subcontractors and ESCO companies.

Quick Facts

GBE FACTORY MODEL

Industrial buildings are supplied with thermal energy by biomass energy facilities which are built on user's side or in the area near to the customers. The ESCo uses high efficient and quality technologies such as automatic biomass boilers and auxiliary process equipment, wood chippers, specialized tucks for biomass logistic, subcontractors and servicing companies.

TYPE OF INVESTMENTS

Investments in a Biomass power plant (BPP) construction and pipe network to satisfy the complete actual heating and domestic hot water (DHW) need of a group of industrial buildings.

CUSTOMERS AND TARGET GROUPS

The main target customers groups are the owners of the following industrial facilities: SME's, industrial warehouses, Logistic centers, Shopping malls, Greenhouses and Hotels

The main target groups are:

- ESCOs
- Public sector – central, regional and local levels
- Public Housing companies/Associations
- Manufacturers and installers in the biomass industry
- Entrepreneurs
- Energy agencies

- Utilities

Strategic Vision at the base of the investment

BPP construction using renewable energy in the type of wood biomass for heating and DHW supplying of a group of industrial buildings at attractive price and high quality service level, in comparison with the existing conventional solutions for heating and DHW (project base line). Specific objectives of the business model implementation:

- Support the transfer and adoption of technology and/or know-how, the technology upgrading, the development of research facilities and the updating of the facilities;
- Investment in upgrading of production technology and equipment;
- Raise the ability of Small and Medium Enterprises to cope with competitive pressure within European market;
- Improvement the living standards of the employers in industrial buildings;
- Significant decreasing of energy carriers cost for the industrial sectors;
- Sustainable growth establishment;
- Reduction of GHG emission and environmental ecologic impact.

The value perceived (by users)

By virtue of modern investment, a high productivity and value added of the enterprises would be attained, and the owners' factory would become fully

competitive to the EU companies and be capable to ensure sustainable future growth. Providing to the enterprises the opportunity to use high efficiency, environment-friendly products and technologies for the generation of thermal energy, through the utilization of wood biomass at attractive prices. Increasing of productiveness and high level of competitiveness according to EU requirements are also expected. Ecological advantages of the production by using of green energy are achieved.

Key Activities, Key Partners, Key Resources

The main KEY ACTIVITIES for the business model implementation are as follows:

- Biomass collection;
- Production of Chips &Pellets Technological Machines;
- Production of Biomass Boilers and Process Equipment;
- Biomass Fuel Production &Logistic;
- Biomass Information Centers and CHSM;
- Biomass Energy Efficiency Projects Implementation

The main KEY PARTNERS are: owners, commercial banks, funds, subcontractors, independent experts and clusters.

KEY RESOURCES ARE:

- Timber industry;
- State forestry;

- Private forest owner cooperation;
- Municipalities owners of forestry;
- Woodworking enterprises.

Customers and target group

ESCO KEY ACTIVITIES

The main ESCO activities are:

- An energy audit – to establish the potential for saving energy;
- A detailed exploration of the energy sets the base for the projecting, the current consumption of energy and the base scenario for one process, one building or a group of buildings;
- The preparation of a project task;
- Finding a technical solution and a creating a working project;
- Securing the financing of the project;
- Setting up the systems and the realization of complete engineering;
- Full preparation of the site “to the key”;
- Training of the customer’s personnel on the use and maintenance of the appliance;
- Maintenance of the installation for the period of the contract’s validity;
- Monitoring and verification with the purpose of calculating the actual savings compared to the initial energy consumption and the base scenario.

The proposed business model has compliance with National and EU environmental, health and safety standards and norms.

Operation

It is very important during the project implementation in the industry and after its completion to have very good collaboration between the ESCo and the rest business partners such as owners, subcontractors, suppliers, local authorities, installers, service organizations, designers and biomass and logistic companies.

The proposed business model uses clean technology using the wood biomass combustion for thermal energy generation in the industrial sectors. Practically in the many cases the project includes replacement of the exciting light fuel oil and diesel fuel consumption for heating and domestic hot water with ecologically, cheaply and accessibly wood biomass fuel.

The implemented supply system for heating and domestic hot water has to be completely controlled. In the beginning of the project an energy audit, business plan including risks and sensitivity analyses and SWOT analyses have to be prepared.

In defining the project results, the annual quantity of thermal energy used for heating per consumer is calculated. A balance of the wood biomass quantities is made and the quantity of thermal energy produced by the boilers is defined. The influence of boilers efficiency on the wood biomass combustion process is considered. The electricity consumption for the

boiler's own needs and operational and maintenance costs is not taken into account.

The ESCO should do monitoring and verification of the expected results and control of the investment and project schedule and in some cases to change deferent parameters with purpose to achieve very good performance.

Cost structure ratios

The main operational and maintenance costs are due to the wood biomass production and its logistic, servicing of the energy facilities salary cost of the operational personnel and electricity cost for boiler plant own needs.

The costs structure has the following characteristics:

1. The planned cost for wood biomass based on mid-long term supply contracts including biomass logistic, in order to manage and control biomass supply chain.
2. Professional agreements with designers, subcontractors and suppliers for the different stages of the project implementation.
3. The costs for acquiring long-term tangible assets.
4. Costs for system and equipment insurance.
5. Maintenance costs (plant and network).
6. Costs for electricity for own needs.
7. Safety costs.
8. Costs for purchasing spare parts.
9. Monitoring and verification costs.

10. Transportation costs, office maintenance cost and accounting servicing costs.
11. The cost for training and outfit for the operational personnel.
12. Service staff salaries cost.

The allocation annual operation and maintenance cost for the exemplar biomass power plant is shown below.

Revenue Stream

The project revenues include the following sources:

1. Thermal energy sold to the customers:
    - Income from selling of thermal energy. It is depend of the thermal energy consumption.
    - Fixed price for thermal energy and effective and controlled O&M Costs.

2. Selling of GHG emissions reductions:

Income from selling of CO2 emissions. It is depend on the quantities of the saved conventional fuels and methods for calculation of the reduced emissions.

Investment model and financial structure

The following investment and financial models are used:

1. Energy Performance Contracting (EPC).

It is a contract scheme between three partners:

- ESCO;
- the Customer;

- Financial Institution - Bank.

The Customer is obliged to pay the project costs as typically, it borrows from a third party, which most often is a bank or a leasing company and due to the energy savings guaranteed by the ESCo., repays the cost of the borrowed capital. The ESCo undertakes a responsibility for ensuring a minimum energy savings achieving and if a certain minimum turns out to be exceeded by the Customer, and then the former compensates the latter for the surplus margin effect. In case the opposite happens, i.e., the Customer reaches extra economies in comparison with the initially stipulated, and then it pays to the ESCo the sum of the shortage margin. Thus, the ESCo takes on the risks related to the project fulfillment instead of the Customer. But the funding institution evaluates the credit risk with the Customer. This kind of Contract is suitable for Customers, which have better opportunities to borrow than the ESCo.

2. Energy Contracting (EC):

These Contracts have two parties:

- Company for energetic services (the Investor);
- Customer.

The investor funds the project completion and the customer repays it by means of monthly installments, which include also the cost of the consumed energy. This energy is measured through a certified gauge. Once the purchasing price is repaid, the customer becomes owner of the contracted equipment.

Software tools available on the following areas:

1. Solar and Biomass plants simulation and monitoring –evaluation
2. Economic evaluation tools;
3. Flexible optimization tools.

ESCO managed measurement and verification activities typically apply to small scale energy service contract projects. The ESCo and participant will often enter into contractual agreements that include expected energy savings, how savings are measured, who is responsible for near term and long-term project management, and compensation procedures.

These projects may have long development and construction cycles.

Business Plan main indicators

The main technical, judicial, financial and environmental indicators in the business plan applied to the proposed business model are as follows:

1. Proved technical solutions know how and advanced technology.
2. Mid-long term agreement with key actors.
3. Net economic profit.
4. Rational SWOT analysis.
5. Financing plan.
6. Project cash flow analysis.
7. Ecological benefits.
8. Risk and sensitive analysis.
9. Legal legislations.
10. Completed authorization cycle.
11. Compliance with National and EU environmental, health and safety standards and norms.

12. Actual project calendar schedule.
13. Proved social benefits.

The main performance economic indicators are generally to be expected:

EBIT: > 25%

EBITDA: > 22%

IRR: > 15%

PBP: up to 5 Yr.

Environmental and economic sustainability

The ESCO Business model includes establishing and managing of Consolidation center for validation of GHG emissions. The implementation of biomass energy projects will lead to the significant reduction of greenhouse gas emissions.

The protocol of Kyoto and new EU emissions rules have created a market in which companies and governments that reduce GHG gas levels can sell the ensuing emissions credits. These can be purchased by businesses and governments by developing biomass energy projects

Determination of the annual emissions of CO2 and of other harmful gases is according to Commission decision of 21.01.2004 establishing guidelines for the monitoring and reporting of Greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council. The emissions factors elaborated by the MOEW (Methodology for calculation of emissions of noxious substances (pollutants) released into the

environment based on balance methods) have been used for the CO2 emissions assessment.

The calculation of the emissions of CO2 and other noxious substances are made at the following premises:

- The emissions from biomass combustion are zero;
- The decrease of harmful gases emissions equals the emissions form, obtained from the combustion of an alternative fuel (electricity, heavy fuel oil, light fuel oil);
- The increase of harmful gases emissions is due to transportation, which emit these gases when light fuel oil is used;
- The increase of harmful gases emissions is also due to electricity usage for the needs of the boiler facilities.

The economic sustainability is expected through utilizing of potential resources to best advantages.

These resources can be efficient and responsible, and likely to provide long-term benefits. In the case of this business model, economic sustainability leads to rational using of resources so that the business model continues to function over a number of years, while consistently returning a profit.

2.3.2. Renewable trigeneration based on wood

Executive Summary

This business model shows a possibility of sustainable supply of cooling, heating and power to an industry area through an trigeneration [CCHP (combined cooling, heat and power)] plant, based on biomass (woodchips and/or waste wood). Local different SMEs set up together a GBE factory, and use the generated energy in their company buildings.

Quick Facts

GBE FACTORY MODEL

On an industrial area a trigeneration plant based on wood (wood chips & waste wood) is established. It supplies RES energy to enterprises of the industrial area.

TYPE OF INVESTMENTS

Renewable trigeneration power plants (woodchips and/or waste wood) to meet the needs (complete or partial) of heating and cooling of a cluster of industrial buildings in an industry area.

CUSTOMERS AND TARGET GROUPS

The main target groups are the local companies with a consistent and predictable energy consumption of their buildings and processes.

RANGE OF THE EXPECTED ECONOMIC INDICATORS (creating and running GBE FACTORY investments)

EBIT: 37.4 % (in the 5th year)

EBITDA: 47.8 % (in the 5th year)

ROI: 75.28 % (after 25 years)

ROE: 130 % (after 25 years)

IRR: 17.6 % (after 25 years)

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Strategic Vision at the base of the investment

Establishment of a biomass combined heat, cooling and power plant based on wood chips and / or used wood. By establishing a GBE factory financing and execution of the system is performed. The energy prices and guaranteed lower price increases compared to conventional energy sources for the future, are the main strategy and the reason of the investment.

The value perceived (by users)

The economics of such a project is the most important parameter for the investors (energy consumer). In addition, the SMEs can benefit from an increased independence from fossil fuels, greater security of energy supply and from a marketing value. Furthermore, operating and maintenance

savings can be achieved in the internal supply systems of the various participating SMEs.

Key Activities, Key Partners, Key Resources

THE MAIN KEY ACTIVITIES ARE:

- Inquiry of EPC (Engineering, Procurements, Construction)
- Energy Audit
- Dimensioning of the system
- Bid solicitation
- Preparation of a business plan
- Contract signing of all parties

KEY PARTNERS GENERALLY ARE: factory's owners (GBE factory members), investment banks, energy consultant and engineering company.

KEY RESOURCES OF FINANCING are bank institutions, private Investors (e.g.: EPC) and factory's owner (with their own equity). For the purchase of RES (wood chips & used wood) long term supply contracts should be signed, in order to obtain price stability.

Customers and target group

The main customers are the companies themselves near to the planned distribution grid.

The companies should have:

- A long-term location choice.
- Constant/predictable energy consumption
- Central heat/cold supply

Possible extensions of single factories and the industry area should be considered in advance, and taken into account in the planning phase.

Industrial areas which are not yet connected to a heating and cooling network are preferred. Otherwise the competitive pressure from the current energy supplier could be too large.

Operation

Due to the complexity of the plant, a new building will be the most sensible solution.

As the ORC process uses a pressurized boiler operation, no steam boiler attendant is necessary. Thus, the plant can be operated with reduced staff costs.

Waste wood is a cheap energy source (depending on market conditions: payment for the removal), but before using it has to be treated.

Power purchase contracts with minimum purchasing quantity (otherwise penalties) between the GBE factory and involved SME are important for the economic success

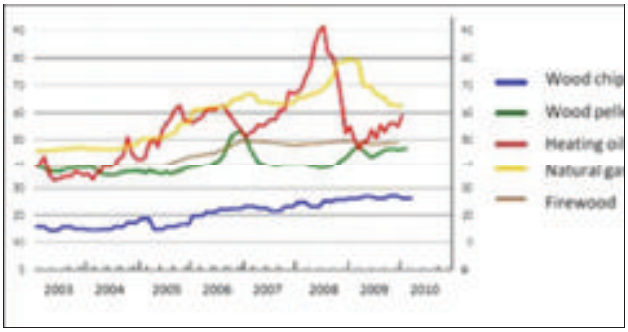
Cost structure ratios

The main operative costs are wood chips or the treating of waste wood and secondly to the maintenance of the system, attention should be given to the following points:

1. The cost structure should be based on a planned mid-long term supply agreement for wood chips and waste wood in order to obtain price stability.

2. It is necessary to have chosen reliable suppliers of wood not to incur in lack of resources.
3. Waste wood treating costs
4. Insurance costs
5. Ordinary and extraordinary maintenance costs
6. Safety costs
7. Control and monitoring costs
8. Costs of administration and management

In the following graph, you can see the price trend of wood chips compared to other heat sources:



Price trend of wood chips in € - Cent per 10 kWh.

As demonstrated in the graph above, wood chips are a cheap heat source with a constant price increase. The long term price increase is about 3%. By using this raw material, greater price stability can be expected.

Revenue Stream

Revenue sources are different. The GBE factory should run as a separate company, where the various SMEs proportionally involved.

From RES energy sales:

1. Thermal energy supply (variable income depending on SMEs consumption)
2. Refrigeration energy supply (variable income depending on SMEs consumption)
3. Connection fee for substation management, distribution and base load (minimum energy usage)
4. Generated electricity can be feed into the public grid or sold in an internal grid (mostly depending on different grant models).

From removal of waste wood:

1. In collaboration with a waste contractor or different communities a fee for removal and destruction of waste wood is possible.

From RES incentivizing system:

1. RES incentives are recognized by public authorities and energy authorities or related organizations (Green certificates or FIT, usually defined in advance for a fixed number of years);
2. Different public grants.

From membership status:

1. To join the network offered by the GBE FACTORY, an entering fee must be asked to cover part of the initial investment (Investment of equity).

Investment model and financial structure

The main investments are:

- CCHP plant;
- The heat- and refrigeration distribution grid;
- Local energy sub-stations (internal single unit distribution should be responsibility of the end user);

Operational main costs should regard:

- Wood chips and/or waste wood;
- The remote controlled supply system;
- The maintenance service.

The local energy coverage depends strongly on the base load and energy consumption profile of the SMEs. For the profitability the dimension of the plant with a high workload of the GBE factory is very important.

Through an intelligent storage management with a heat and cold storage, parts of the peak loads can also be covered. If there is no 100% coverage possible by RES, a centralized or decentralized back up source is necessary.

Through the GBE factory members the project is funded. There are different approaches possible:

The GBE factory is funded to 100% by their member's equity (energy users).

Additional to the GBE member's equity a bank loan could be necessary.

It is desirable that the engineering-, procurement and construction companies have shares of the GBE factory. This should/can achieve better efforts in the planning, construction and operational phase.

Business Plan main indicators

From the examination of the main aspects of a business plan applied to this type of GBE FACTORY, following parameters should be considered:

1. economic gain;
2. positive SWOT analysis;
3. environmental benefits;
4. safety with advanced technology;
5. legal framework;
6. authorization process;
7. expertise of the people involved;
8. support of key-stakeholders;
9. social benefits;
10. fiscal framework.

Below mentioned economic indicators are expected:

EBIT: 37.4 % (in the 5th year)

EBITDA: 47.8 % (in the 5th year)

ROI: 75,28 % (after 25 years)

ROE: 130 % (after 25 years)

IRR: 17.6 % (after 25 years

Environmental and economic sustainability

Because of the used renewable resource “wood chips and waste wood”, the biomass plant works CO2 neutral. Depending on the energy consumption profile and energy mix, it should be tried to cover most of the needed energy. Due to a flue gas cleaning the emissions of air pollutants is kept to a minimum. Resulting from sufficient resources in surrounding areas, the transportation costs and linked environmental impacts can be kept low.

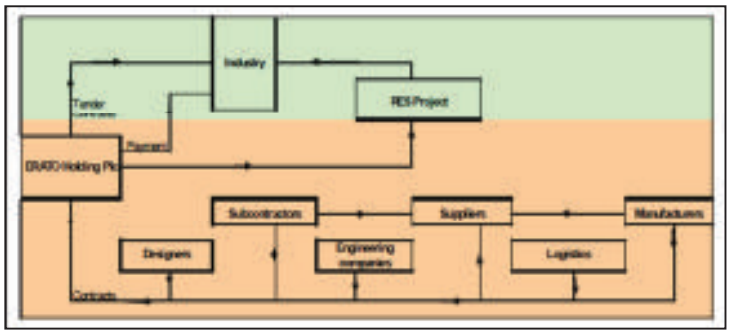
The main sustainability from an economic point of view is a predictable constant energy price for the future and greater independence from energy suppliers. Through energy cost savings SMEs can stay more competitive.

To be able to ensure an economical sustainability, long-term supply contracts and a safe financing scheme are important.

1.1.1. Biomass energy boiler using wood biomass as fuel and heat pump using electricity

Executive Summary

The proposed business model includes the implementation of RES projects for heating, domestic hot water and cooling of office buildings, small warehouses and premises in the industry. In the industrial sector the business model includes processes and schemes among owners, designers, manufacturers of system and equipment, engineering and logistic companies, suppliers and subcontractors.



Quick Facts

GBE FACTORY MODEL

The small scale buildings in industry are supplying with hot water for heating and every day's necessity by biomass energy boilers which are constructed on user's side. The heat pumps are used for cooling of the separate offices, small warehouses and premises of industrial buildings.

TYPE OF INVESTMENTS

Investment in installation which includes combination of a biomass energy boiler using wood biomass as fuel and heat pump using electricity. This installation meets the owners need for heating, DHW and cooling of theirs office buildings, small warehouses and premises.

CUSTOMERS AND TARGET GROUPS

The main target customers and target groups are the owners of the following industrial facilities: small and middle office buildings, small and middle industrial warehouses, molls, and hotels. The offices and warehouses in the industrial areas and business parks are also the potential target groups.

Strategic Vision at the base of the investment

Combined installation of biomass boiler and heat pump using renewable energy sources for heating, DHW and cooling supplied complete or partial individual or a group of industrial office buildings, molls, hotels and small warehouses at attractive price and high quality service level, in comparison with the existing conventional solutions.

The investment will improve the temperature comfort, living standards of the employers in the industrial buildings. Decreasing of energy cost is also achieved. The proposed business model will lead to the reduction of CO2 emission in the atmosphere.

The value perceived (by users)

Providing to the industry the opportunity to use high-efficiency and environment-friendly technologies for the generation of hot water for heating and every day's necessity by utilization of wood biomass at attractive prices. Possibility for cooling of the buildings is also expected.

Key Activities, Key Partners, Key Resources

Main KEY ACTIVITIES connected to the proposed business model implementation are as follows:

1. An energy audit – to establish the potential for saving energy;
2. A detailed exploration of the energy sets the base for the projecting, the current consumption of energy and the base scenario for one process, one building or a group of buildings;
3. The preparation of a project tenders/bids;
4. Finding a technical solution and a creating a working project;
5. Setting up the systems and the realization of complete engineering;
6. Full preparation of the site "to the key";
7. Training of the customer's personnel on the use and maintenance of the appliance;
8. Maintenance of the installation;
9. The proposed business model has compliance with National and EU environmental, health and safety standards and norms.

KEY PARTNERS are: owners; designers, manufacturers, subcontractors, suppliers, engineering companies and logistics.

KEY RESOURCES are provided by the owners of small and middle industrial office buildings, small warehouses, molls and hotels. In the case of new office buildings, hotels, molls and warehouses in industrial areas or business parks the target group can be real estate or facility management companies or group of actors for outsourcing the project

Customers and target group

The main customers are the companies themselves near to the planned distribution grid.

The companies should have:

- A long-term location choice.
- Constant/predictable energy consumption
- Central heat/cold supply

Possible extensions of single factories and the industry area should be considered in advance, and taken into account in the planning phase.

Industrial areas which are not yet connected to a heating and cooling network are preferred. Otherwise the competitive pressure from the current energy supplier could be too large.

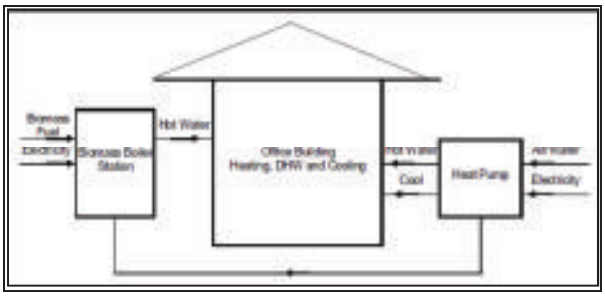
Operation

The proposed technology provides hot water, heating, and cooling for the office buildings, molls, hotels and are houses through combination of biomass energy boiler using wood waste as fuel and heat pump using electricity. The proposed technology is selected because it has the following advantages:

- relatively low investment costs;
- high efficiency;
- wood waste availability;
- internal microclimate improvement;
- contribution to the reduction of greenhouse gas emissions.

In defining the project results, the annual quantity of thermal and electricity energy used for heating and cooling per customer is calculated. A balance of the wood biomass quantities is made and the quantity of thermal energy produced by the boilers is defined. The electricity consumption for heat pump is also calculated. The influence of boilers efficiency on the wood biomass combustion process and COP for heat pump operation is considered.

The electricity consumption for the boiler's and heat pump own needs and operational and maintenance costs is not taken into account.



The proposed technology is a combination of biomass energy boiler for heating and heat pump for hot water and cooling. The main components of the selected technology are:

automatic hot water energy boiler fuelled by biomass, heat accumulator, internal boiler installation including distribution/returned water collectors, circulating pump, valves and insulation pipes, heat pump of type air-water, and C&I including LCD controller It is very important during the project completion in the industrial buildings to have very good partnership between the project provider, owners, subcontractors, suppliers, local authorities, installers, service organizations, designers and logistic companies.

Cost structure ratios

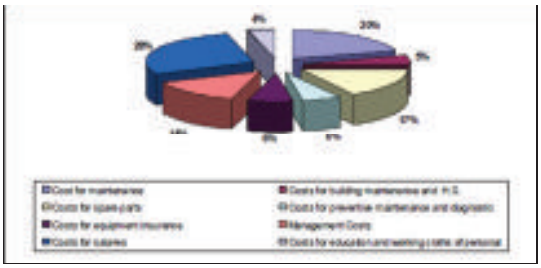
The main O&M costs (operational and maintenance costs) are due to consumption of wood biomass and electricity. There are also servicing, salary cost of the operational staff.

The costs structure has the following features:

1. Professional contracts designers, manufacturers, subcontractors and suppliers for the different stages of the project implementation.
2. Costs for system and equipment insurance.
3. Maintenance costs.
4. Costs for electricity for own needs.
5. Safety costs.
6. Costs for purchasing spare parts.
7. Transportation costs, office maintenance cost and accounting servicing costs.
8. The cost for training and outfit for the operational personnel.

9. Service staff salaries cost.

The allocation annual O&M cost for the exemplar installation is shown below.



Revenue Stream

The project savings include the following sources:

- Energy efficiency savings as a result of replacement of old sufficient conventional heating boilers with automatic biomass boilers.
- Using efficient heat pump for cooling with minimal electricity costs.
- Control and monitoring of the expected O&M Costs.
- Income from selling of CO2 emissions. It is depend on the quantities of the saved conventional fuels and methods for calculation of the reduced emissions.

Investment model and financial structure

Software tools available on the following areas:

1. Heat pump and biomass boiler facilities simulation and monitoring tools.
2. Economic evaluation tools.
3. Flexible optimization tools.

The Financial Structure should be shown as two different options:

1. Total costs by one actor who will implement and manage the project. The investors profit will be from the savings of the energy.
2. Costs by all of the users, who will be part of the industrial area, or business park, primarily to cut the energy costs. In this case the partners will invest by themselves (own capital).

Business Plan main indicators

The main indicators in the business plan applied to the proposed business model are as follows:

1. Proved technical solutions and appropriate technology and equipment.
2. Net economical profit.
3. Rational SWOT analysis.
4. Financing plan.
5. Project cash flow analysis.
6. Ecological benefits.
7. Risk and sensitive analysis.
8. Legal legislations.
9. Completed authorization cycle.

10. Compliance with National and EU environmental, health and safety standards and norms.
11. Actual project calendar schedule.

Environmental and economic sustainability

The proposed business model includes establishing and managing of Consolidation center for validation of GHG emissions. The implementation of biomass energy projects will lead to the significant reduction of greenhouse gas emissions. The protocol of Kyoto and new EU emissions rules have created a market in which companies and governments that reduce GHG gas levels can sell the ensuing emissions credits. Determination of the annual emissions of CO2 and of other noxious gases is according to Commission decision of 21.01.2004 establishing guidelines for the monitoring and reporting of Greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council. The emissions factors elaborated by the MOEW (Methodology for calculation of emissions of noxious substances (pollutants) released into the environment based on balance methods) have been used for the CO2 emissions assessment. The economic sustainability is expected through utilizing of potential resources to best advantages. These resources can be efficient and responsible, and likely to provide long-term benefits. In the case of this business model, economic sustainability leads to rational using of resources so that the business model continues to function over a number of years, while consistently returning a profit.

2.3.3. Biofuel- biogas CHP plant

Executive Summary

The model proposed allows sustainable supply to a whole industry area through an industrial building hosting a biofuel-biogas CHP plant, meeting partially or totally the H/C needs of the other companies. Organized as an ESCO o consortium among users and suppliers, it can allow to gain control over the energy streams of the area and achieve a better planning and price for the biofuel-biogas supply.

Quick Facts

GBE FACTORY MODEL:

Industrial building hosting a biofuel-biogas CHP plant supplying RES energy to the other buildings of the same industrial area

TYPE OF INVESTMENTS:

Renewable energy power plant (Biofuel-Biogas CHP) to meet the needs (complete or partial) of heating and cooling of clusters of industrial buildings

CUSTOMERS AND TARGET GROUPS

The main target customers are the owners of the warehouses of the industrial area, especially those who have high needs for air conditioning for their premises (e.g. sheds used for food processing and pharmaceutical activities).

RANGE OF THE EXPECTED ECONOMIC INDICATORS (creating and running GBE FACTORY investments)

EBIT: 28%

EBITDA: 27.06%

ROI: 23.83%

ROE: 11.00%

REFERENCES

1. www.binariospa.com/it/index.php
2. www.escoeurope.it

Strategic Vision at the base of the investment

Developing a local renewable energy power plant (Biofuel-Biogas CHP) to meet the needs (completely or partially) of heating and cooling of clusters of industrial buildings at competitive price and service level, if compared with old conventional H/C solutions.

The value perceived (by users)

The value perceived by the owners of the warehouses fuelled by renewable energy (users) is that of gaining control (both in terms of costs and physically close availability) over an important factor (energy) which influences the costs of property management. In addition there is the perception that this value will contribute to enrich the intrinsic value of the property in the near future.

Key Activities, Key Partners, Key Resources

THE MAIN KEY ACTIVITIES for carrying out the investment consists in a survey in the industrial area supported by local energy audits in order to consider the feasibility constraints and to calculate the realization costs that will affect the price of Renewable Energy offered (services after commissioning included).

KEY PARTNERS generally are: factory's owners; ESCO; investment banks and sometime users themselves.

KEY RESOURCES may be supplied both directly by private investors or retrieved through a financial operation ruled by agreements with bank institutions or finance companies.

Customers and target group

The main customers are the owners of the warehouses, especially those who have high needs for air conditioning (controlled and adjustable H/C) for their premises (e.g. sheds used for food processing and pharmaceutical activities).

In the case of new buildings (such as the case of expansion of industrial areas) the target becomes real estate companies and / or groups of operators who act as developers of these areas.

Operation

Particular attention must be given to the renovation of the building that will host the RES plant and the building of the heating and air conditioning

remote supply systems that should be compatible with the “already built” situation.

The H/C supply system must be locally and remotely monitored and controlled.

There will be an “energy balance” to establish the return of the investment, and in some cases, the change some parameters to get the best performance.

The relationship between the management organization of the real estates and the outsource partners (such as suppliers, authorities, and stakeholders) will be very important.

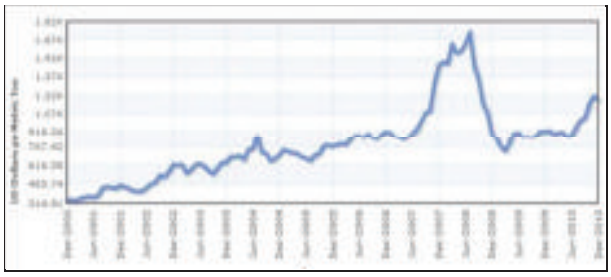
Cost structure ratios

Given that the main operative costs are due mainly to biofuel or biogas and secondly to the maintenance of the system working 24 hours round, attention should be given to the following points:

1. The cost structure should be based on a planned mid-long term supply agreement for biofuel-biogas, in order to have main operative costs under control
2. It is necessary to have chosen reliable suppliers of commodities not to incur in heavy penalties due to the unstable delivery of energy
3. Insurance costs
4. Ordinary and extraordinary maintenance costs
5. Safety costs
6. Control and monitoring costs

7. Costs of administration and management

In the following diagram, we may see the commodities historic price trend:



Price trends of Rapeseed oil on the European markets (in dollars)

Revenue Stream

REVENUE SOURCES ARE DIFFERENT:

From RES energy sales

1. Thermal energy supply (variable income depending on energy users consumption)
2. Refrigeration energy supply (variable income depending on energy user consumption)
3. Fixed tariff for substation management, distribution and eventual base load (minimum energy usage)
4. Electric energy surplus (overriding user needs) can be sold in the internal network or externally to the market

From RES incentivising system

1. RES incentives are recognized by state environment and energy authorities or related organizations (Green certificates or FIT, usually defined in advance for a fixed number of years)

From membership status

1. To join the network offered by the GBE FACTORY, an entering fee can be asked to cover part of the initial investment, especially for what concerns distribution and substations

Investment model and financial structure

The main needed hardware investments are:

- a power centre with an intensive technology RES energy production plant;
- the pipe line (sometimes pipe lines investment can be shared between the GBE FACTORY and the building constructor)
- local energy sub-stations (internal single unit distribution should be responsibility of the end user)
- Operational main costs should regard:
- the primary energy plant (RES combined or totally RES)
- the remote controlled supply system;
- the maintenance and repair services.

The building of the power plant and its technology should be owned by the GBE FACTORY in the form of an Energy Service Company (ESCO). Distribution and local energy substations should be exclusively used by the GBE factory due to the importance of the energy stream control.

Another possible investment model can be that the entire system (GBE FACTORY plus the other buildings and the surrounding area) are owned by a consortium, where producer and end user have shares.

The Financial Structure should be shown as two different options:

1. Total investment by one subject who will implement and manage all of the GBE FACTORY. The investors gain will be from the selling of the energy in and out of the local district (it's the energy that goes beyond the local consumption), and also by the incentives and other fees. This revenue will pay annual rates of a bank loan.
2. Investment by all of the users, who will be part of the GBE FACTORY, primarily to cut the energy costs. They will be allowed to use the RES energy produced, to save on the cost of it and also to benefit from the renewable energy's incentives currently in place. In such case the partners will finance by themselves (own capital) the investments required.

Business Plan main indicators

From the examination of the main aspects of a business plan applied to this type of GBE FACTORY, one should consider:

1. economic gain;
2. positive SWOT analysis;
3. environmental benefits;
4. safety with advanced technology;
5. legal framework;
6. authorization process;

7. expertise of the people involved;
8. support of key-stakeholders;
9. social benefits;
10. fiscal framework.

The following ranges for economic indicators are generally expected:

EBIT: > 25%

EBITDA: > 24%

ROI: > 20%

ROE: > 10.00%

These indicators are verifiable when the company is fully operational (after 5 years).

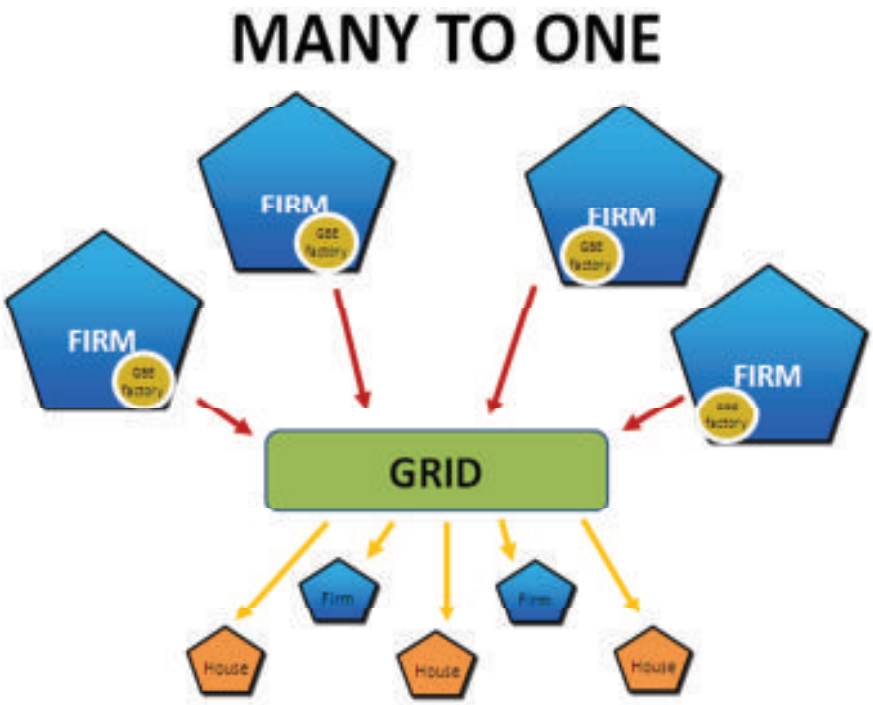
Environmental and economic sustainability

Satisfactory environmental sustainability can be considered achieved if the energy generated from RES in the GBE FACTORY is equal - or superior – to '80% of the total energy produced by the GBE FCATORY. This value may be optimal with respect to a trade-off that takes into account the costs to get a 100% RES GBE Factory and those necessary to have a GBE Factory with 80% RES and 20% fossil fuel. The 20% from traditional sources could in fact function to ensure back-up in case of inefficiency of the generation and distribution of renewable energy.

Sustainability from an economic point of view should be based on a portfolio of contracts of local supplies, which initially covers the cost of the system running well below its full capacity. The increase in supplies to

reach the full capacity should ensure the achievement of necessary room for business activities. This makes sense if the costs of biofuels-biogas are well-planned and are tiered in case of turbulence in the commodities market.

2.4. **"Many to one"**



PARTNERS TOGETHER WITH THEIR CUSTOMER CAN JOIN INTO A NETWORK EACH ONE PROVIDING PRODUCTION, CONSUMPTION AND RESOURCES NEEDS. THE EXTRA ENERGY PRODUCTION CAN BE SOLD TO OTHER SUBJECTS APART FROM THE NETWORK

2.4.1. Open self-energy production consortium

Executive Summary

The target of this project is to promote the replacement of the old asbestos cover present in the roofs of almost all the companies in a territory, while benefiting from the special government incentives currently in place.

It is well known, most of the industrial warehouses constructed until 1992 are covered using asbestos, and this model develops the idea to invest in disposing of the old covers , replacing them with new solar panels (PV ore solar thermic).

This project will increase the quality of life in the area and bring new jobs, as well as producing renewable green power that can been used by both the industrial processing plants and the local inhabitants.

Quick Facts

MINIMUM RES ELECTRICITY PRODUCTION: 80%

MINIMUM RES ELECTRICITY LOCALLY CONSUMED: 80%

MINIMUM HEATING AND COOLING ENERGY NEEDED: /

MINIMUM RES HEATING AND COOLING ENERGY: /

ELECTRIC OPEN SYSTEM: YES

HEATING AND COOLING OPEN SYSTEM: YES

FIT: YES

Strategic Vision at the base of the investment

The consumption and emission of greenhouse gases is the priority of the European administration which is working on meeting the targets of the Kyoto Protocol.

It's a "win-win" project because the administrations are able to achieve the Kyoto standards and at the same time the companies committed to achieving they gain work opportunities. Also the inhabitants are protected by the disposing of the asbestos from their environment.

All of the above will help to safeguard the environment by producing new renewable green power.

The value perceived (by users)

This project has numerous benefits such as:

- Disposing of dangerous substances;
- Dissemination of renewable energy;
- Awareness of citizenship;
- Creation of new jobs;
- Improvements to the Environment;
- Contribution to the achievement of the targets 20 20 20;
- Support of government incentives.

Key Activities, Key Partners, Key Resources

KEY ACTIVITIES:

Analysis and supervision of the territory; promotion of the project; creation of a network of businesses and stakeholders; implementation of project.

KEY PARTNERS:

The project involves the council and local authorities, companies which have to remove the old asbestos present in their roofs, companies grouped in the network that perform the work, and the local inhabitants.

Customers and target group

The project involves different partners such as: the local authorities, the owners of the warehouses that will be reclaimed, the companies which will remove the asbestos and the companies which will install the new solar panels. Also the inhabitants that will benefit from a better quality of life. Furthermore they will be able to make use of the green power generated.

Operation

The Project will be divided into 4 parts:

1. ANALYSIS and SUPERVISION the TERRITORY CONCERNED:

At this stage it will be important to conduct a census of the agricultural and industrial buildings (especially poultry buildings) to find where the roofs are covered by asbestos, followed by an evaluation of the circumstances.

2. PROMOTION of the PROJECT in the TERRITORY

At this stage the project owners will meet the potentials users, such as the owners of the warehouses that will be upgraded, explaining to them the countless benefits that they could gain by signing up to the project.

3. CREATION a NETWORK of COMPANIES and STAKEHOLDERS:

It will be important to create a network of companies which aims to implement the project. The achievements of the network coupled with a strong approach from the stakeholders will guarantee maximum success of the project.

4. PERFORM the PROJECT:

The last stage will be to remove the old asbestos covers and replace them with new solar panels, all of this it will be carried out by the established network of companies.

Cost structure ratios

Direct operation's costs:

- Removal and disposal of the asbestos cover : 10-25 €/m
- Cost of the new cover : 20-45 €/m (*)
- FV system installation : 3.000-3.400 €/KWp (**)

(*) It depends on the functional requirements; such are adjustment of/to the structure, as well at the local regulations, etc.

(**) From 100-200 KWp to up than 1 MWp .That depends on the building, geographic location, technology option and so on.

In addition to the directs costs, have to be considered the cost and times of the general activities such:

- Evaluation of the technical and economic feasibility
- Amministrative assistance
- Financial assistance

	Quantity	Price	Total
NEW ROOF (Worehouse)	**1.600 mq**	€ 35	**€ 56.000,00**
Disposal of dangerous substances (asbestos) and replacement with PV panels			
PV IMPLANT of 100 kWp (800 mq)	**100 kWp**	€ 2.400,00	**€ 240.000,00**
CONNECTION to the GRID			**€ 7.500,00**
TOTAL			**€ 303.500,00**

Example of costs substitution

Revenue Stream

Law 19 February 2007 introduces an incentive mechanism that supports the replacing asbestos roofs with PV or solar thermal implant.

This type of benefit was reconfirmed in the "Fourth Energy Law" (05.05.2011).

This extra benefit permit:

- In the worst case, to ask to the warehouse owners to pay a part of the operation's cost;
- Normally, to cover the total costs of disposing the asbestos and replacing it with the new "renewable" roof;
- In the best case, to produce extras revenue (if we considered that the owners could receive a fee for the rent of his roof.

Investment model and financial structure

The main needed investments are:

- study of the territory. It is necessary to check all industrial or commercial roof that have the asbestos above;
- dismantle of asbestos' roof;
- replacement with PV or solar thermic implant.

Operational main costs should regard:

- the construction of energy plants;
- the remote controlled supply system;
- the maintenance and repair services.

The building of the power plant and its technology should be owned by the GBE FACTORY in the form of capital company. It is constituted by a financial structure that is the team leader of the entire project.

The Financial Structure should be shown as follows: total investment by one subject who will implement the GBE FACTORY system. The investors gain will be from the selling of the energy in and out of the warehouses, and also by the incentives and other fees. This revenue will pay annual rates of a bank loan.

Maybe, the investment could be made also by all of the users, who will be part of the GBE FACTORY, primarily to cut the energy costs. They will be allowed to use the RES energy produced, to save on the cost of it and also to benefit from the renewable energy's incentives currently in place. In such case the partners will finance by themselves (own capital) the investments required.

Business Plan main indicators

The main indicators of a good business plan are:

1. economic gain;
2. positive SWOT analysis;
3. environmental benefits;
4. safety with advanced technology;
5. legal framework;
6. authorization process;
7. expertise of the people involved;
8. support of key-stakeholders;
9. social benefits;
10. fiscal framework.

Environmental and economic sustainability

From the Environment's point of view this is a winning model because: it's going to be eliminates a dangerous and noxious component such as asbestos, then replacing with solar panels which will produce energy and also hot water.

That energy will be exploiting from the warehouse and if in excess, it will be sell to the network, increasing the economic vantage of the operation.

From the Economics' point of view, the financial bill is going to sustain the requalification building's costs, and it's going to get the direct economic benefits of the operation.

The energy produced, instead, would be either used in the warehouse or sell outside.

The warehouse owners are monthly getting pay the rent of their roof's surfaces used. (So they will basically have a guaranteed income.)

3. BEST PRACTICES: THE EXISTENT GBE FACTORY IN EUROPE

3.1. "ONE BY ONE"

3.1.1. KVK Koerner Chemieanlagen GesmbH

Description of the project

The company KVK Körner manufactures pickling tanks for galvanizing processes and also for hot dip galvanizing of metal parts. The production of these plates happens on a "production table", which is heated by heating coils with hot water. The working surface of the table is always kept at a temperature of 30 °C and therefore requires a high energy consumption of natural gas. The installed solar thermal plant covers a significant part of the needed heat energy, saves natural gas thus reducing the CO2 impact.

Sales & Purchase Agreement

The solar thermal collectors are mounted on the south facing façade of the production hall.

This plant is an example for a cost - effective installation of RES in SMEs, with considerable savings. The simple design allows an easy transferability

of the concept to other SMEs. Thanks to the system 49.4 % of the heat demand of this process is covered by solar energy.

Quick Facts

LOCATION: Am Bahnhof 26, Eibiswald - Austria

PLANT SIZE: 85.8 sqm

TECHNOLOGY/RES: Solar thermal GS collectors

SITE OWNERSHIP: KVK Koerner GesmbH

INVESTOR: KVK Koerner GesmbH GmbH

PROJECT COST: 35,440 €

State grants: 30 %

KEY PARTNERS: S.O.L.I.D. GmbH (Design & Installation)

CURRENT STATUS: Operational

Design and construction

The solar plant feeds in over a heat exchanger into a storage tank with approx. 10 m^3. The storage tank supplies the production line with heat.

Due to the size of the storage tank and the continuous and ongoing operation of the production table, an overheating is not possible. Thus, an optimum of solar yield can be reached from the collectors.

<u>TECHNICAL DETAILS:</u>

TOTAL SURFACE: 85.8 sqm

NUMBER of thermal collectors: 6 (each 14.3 m^2)

HEAT STORAGE: 10 m^3

TOTAL solar yield: 41.5 MWh/year

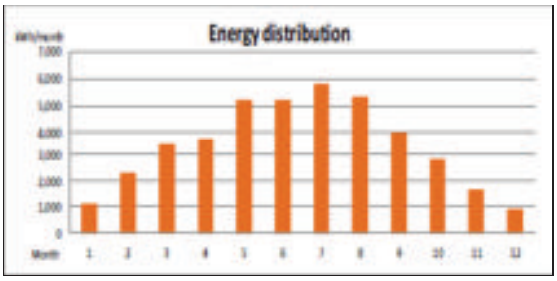
SPECIFIC solar yield: 485 kWh/m²BRUTTO*a

PARAMETERS OF INSTALLATION

Installation: 1nd QT 2007

Capacity [kWtherm]: 43.5

MONTHLY TOTAL ENERGY GENERATED



ENERGY DISTRIBUTION

The total produced solar thermal energy is used locally for the production.

Local energy consumption = 100% (41.5 MWh/a)

SUBSTITUTED ENERGY

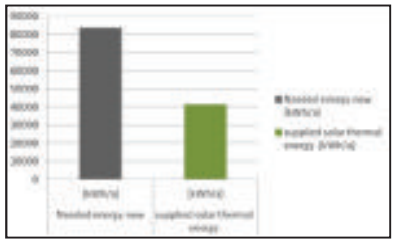
Form of conventional energy source: natural gas

Price, natural gas: 47.45 €/MWh net

Total heat consumption: 84 MWh/year

Solar thermal production: 41.5 MWh/year

SOLAR COVERAGE



Economic Basics

PARAMETERS OF ECONOMIC'S SIMULATION SALE

INTEREST RATE: 4.0 %

GRANTS: 10,632 €

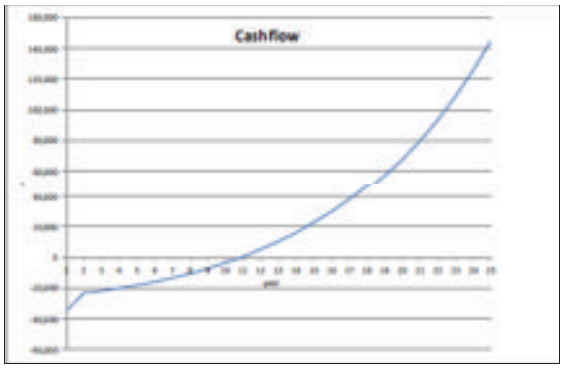
MAINTENANCE AND INSURANCE COST: app. 100 €/year

INSURANCE COST: app. 20 €/year

DEPRECIATION PERIOD: 25 years

SYSTEM'S DEPRECIATION CHARGE: 4 %

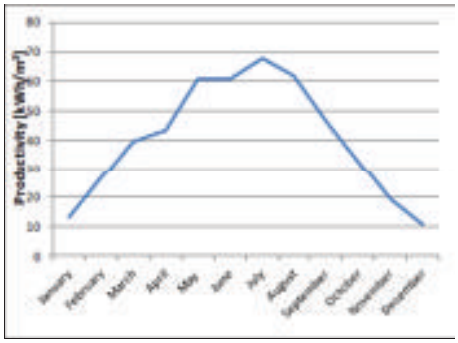
COST INCREASE FUEL: 8%



Environmental & Economic Sustainability

The measured total solar yield is shown in the table below.

	Total solar production [kWh/month]	Total solar production [kWh/brutto m² coll.]
January	1,122	19.1
February	2,285	26.6
March	3,397	39.6
April	3,733	43.5
May	5,220	60.8
June	5,809	66.7
July	5,804	67.7
August	5,322	62.0
September	4,015	46.8
October	2,811	32.8
November	1,653	19.3
December	920	10.7
SUM	41,494	10.8



TOTAL MONTHLY TREND ANALYSIS OVER THE YEAR:

Solar thermal energy is CO2-free and therefore environmentally friendly. In determining the CO2 savings following substituted heat source are

considered: natural gas. The impact of natural gas amounts to 205 kg CO2/MWh.

Contribution to the environment		
CO_2 Savings	8,506	[tons CO2/year]

Through this investment the company is less dependent on gas and unexpected fuel price increase.

Substituted quantity of fossil fuels		
natural gas	3.7	[tons/year]

Lessons Learnt

This solar thermal system shows us following points:

- High efficiency of small solar thermal applications;
- The solar yield depends strongly on the required temperature level of the process heat application;
- Good economy;
- Easy transferability to other SMEs.

This example shows the successful use of small solar thermal plants for industrial process heat application. Due to the easy transferability to other SMEs and possible duplication significant CO2 savings can be achieved.

3.1.2. Caixa Geral de Depositos

Description of the project

In Lisbon a large office building of the bank Caixa Geral de Depósitos (CGD) are supported by solar heat and cold. The collector area is installed in roof of the office building. The office building has 17 floors with an office space of 100,000 m². During the working time 6,000 employed persons are permanently in the building. The generated energy is used to power an absorption chiller. Furthermore, the energy is used for the reheating system of the ventilation appliances as well as contributing to the heating of hot water.

Sales & Purchase Agreement

On the one side CGD wished to install an economical RES to save energy, on the other side the architecture and appearance of the building had to be considered. Because of the location the only available useful area is the roof of the building. The design of the collectors could be optimal combined with the existing blue tile roof. With the integration of the system the existing energy distribution system has been optimized, and further energy savings achieved.

Thanks to the system app. 45% of the domestic hot water demand, 15 % of reheating and 8% of the cold demand can be covered with this solar thermal system.

Quick Facts

LOCATION: Rua Arco do Cego, Piso 1; Lisbon Portugal

PLANT SIZE: 1,579 sqm

TECHNOLOGY/RES: Solar thermal HT collectors

SITE OWNERSHIP: Caixa Geral de Depósitos

INVESTOR: Caixa Geral de Depósitos

PROJECT COST: 1,040,000 €

State grants: 0 %

KEY PARTNERS: S.O.L.I.D. GmbH (Design & Installation), Energia de Portugal (EdP)

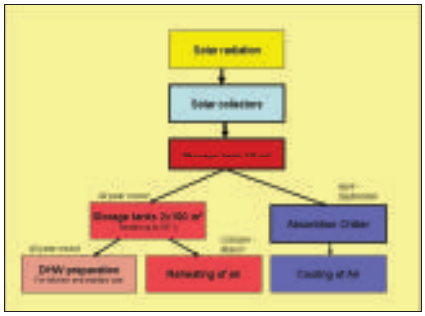
CURRENT STATUS: Operational

Design and construction

The solar energy is for building cooling and air conditioning in the CGD building, in the months of April to September. Extra thermal energy from the plant may also be used to heat up the water coming from the existing 100 m³ tanks in the basement and to replace the electric energy used by the heat pumps to cover the heat needs for

DHW and reheating the air. The solar energy is used for heating purposes mainly in the months of October to March. The energy output and current system data can be displayed on a monitor in the CGD offices as well as online, adding visibility and control of the energy output to the solar solution.

PRIORITY: 1. DHW, 2. reheating, 3. Cooling



TECHNICAL DETAILS:

TOTAL SURFACE: 1,579 sqm

NUMBER OF THERMAL COLLECTORS: app. 112

SOLAR HEAT STORAGE: 10 m^3

TOTAL SOLAR YIELD HOT: 978.2 MWh/year

SOLAR YIELD COLD (COOLING): 263 MWh/year

SOLAR YIELD REHEATING: 202.6 MWh/year

SOLAR YIELD DHW: 400 MWh/year

SPECIFIC SOLAR YIELD HOT: ~ 619.5 kWh/m^2BRUTTO*a

PARAMETERS OF INSTALLATION

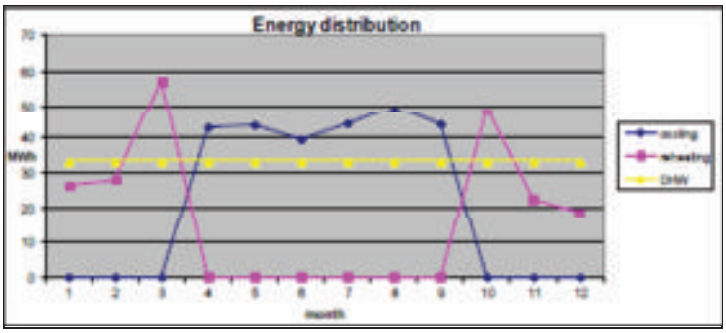
TYPOLOGY AND PROFITABILITY OF EQUIPMENT:

INSTALLATION: 1th QT 2008

CAPACITY [kWtherm]: 845

CAPACITY ABSORPTION CHILLER: 545 kW

MONTHLY TOTAL ENERGY GENERATED



ENERGY DISTRIBUTION

THE TOTAL PRODUCED SOLAR THERMAL ENERGY IS USED LOCALLY.

SUBSTITUTED ENERGY

FORM OF ENERGY: electricity (heat pump and compression chiller)

PRICE ELECTRICITY: 68 [€/MWh]

SOLAR THERMAL PRODUCTION: 978,2 [MWh/year]

SOLAR COVERAGE

The exact total consumption of the building are not known. Thus, the solar coverage can be roughly estimated.

SOLAR COVERAGE:

Cold: 8 %

DHW: 40 %

Reheating: 15 %

Economic Basics

PARAMETERS OF ECONOMIC'S SIMULATION SALE

INTEREST RATE: 6.0%

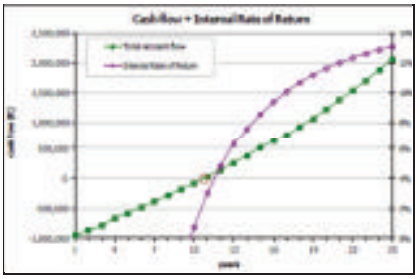
GRANTS: 0 €

MAINTENANCE AND INSURANCE COST: € 6000/year

DEPRECIATION PERIOD: 25 years

SYSTEM'S DEPRECIATION CHARGE: 4 %

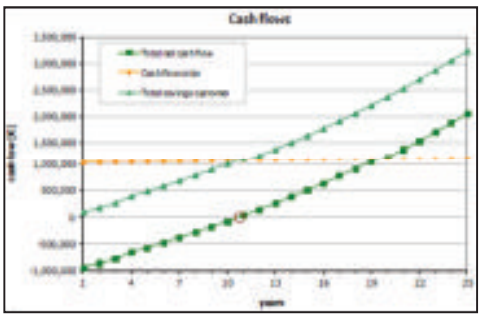
COST INCREASE FUEL: 6 %



PAYBACK TIME: 10.8 years

IRR after 25 years: 13.1 %

A comparison of the two cash flows for solar system (expenses) and electric energy savings results in the "Total net cash flow".



TOTAL ELECTRICITY SAVINGS: 1,252 MWh/year

Lessons Learnt

Solar thermal system shows us following points:

- Efficiency of a combined solar thermal system - cooling & heating;
- The peak of solar radiation and the peak demand of solar cooling match perfectly;
- The solar yield depends strongly on the required temperature level of the application;
- Provided energy is often limited by available collector area;
- Often, a optimization of the existing system is possible by the integration of RES;
- Solar cooling cuts off electricity peaks and saves the most expensive electricity;
- Absorption Chillers have a long life time (> 25 years);
- Cooling load reduction (external loads) because of the mounted collectors on/in roof;
- Good economy also without grants;
- Easy transferability to other office buildings.

3.1.3. Orgachim

Description of the project

Orgachim Jsc is situated within the territory of the town of Russian.

Orgachim SC is the biggest Bulgarian producer of paints, lacquers, dispersions, alkyd resins, epoxy resins, unsaturated and saturated polyester resins, amino resins, water based resins, maleic anhydride, plasticizers, pigments and other chemicals for machine-building, construction, furniture industry, electronics, processing plastics and other industrial branches. At present, the personnel of the company amount to 515 people. In 2008-2009 and energy efficiency project was developed and implemented with the support of EBRD European Union Energy Efficiency Finance Facility (EUEEFF). The EBRD provides a credit line to Unicredit Bulbank for qualifying projects, according to an Agreement between Unicredit Bulbank and the EBRD. One of the implemented energy saving measures is installation of solar system for domestic hot water (DHW) preparation.

GBE Factory Model

The project envisages a solar water heating installation replacing the existing gas fired boilers. The installation includes: 62 solar collectors with selective roofing of 133.3 m2, the heat exchanger of 150 kW, the pump unit, the pipeline and the auxiliary equipment. The choice of the solar collectors with selective absorbers allows for the solar installation continuous operation, even during cloudy weather conditions, which

increases its overall efficiency. The solar installation is installed on the building's Southern roof slopes.

Quick Facts

LOCATION: 21 Bul. Treti Mart, Russe, Bulgaria

PLANT SIZE (W/C0): 471

TECHNOLOGY/IES: Solar collectors

SITE OWNERSHIP: Orgachim JSC

INVESTOR: Orgachim JSC

PROJECT COST: 31 440 €

KEY PARTNERS: Unicredit Bulbank

CURRENT STATUS: Realized

Design and construction

System Characteristics and Estimated Annual Production of DHW by Solar Collectors

SITE CONDITIONS VALUE UNIT

PROJECT NAME: Installation of a solar system

PROJECT LOCATION: Town of Russe

NEAREST LOCATION FOR WEATHER DATA RUSSE

ANNUAL SOLAR RADIATION (tilted surface): 1.32 MWh/m²

ANNUAL AVERAGE TEMPERATURE: 12.1 °C

ANNUAL AVERAGE WIND SPEED: 4.9 m/s

NUMBER OF MONTHS ANALYSED: 12.0 month

ENERGY DEMAND FOR MONTH ANALYSED: 181.56 MWh

SYSTEM CHARACTERISTICS

APPLICATION TYPE: active with accumulate

SOLAR COLLECTOR TYPE: Select Classic

SOLAR WATER HEATING COLLECTOR MANUFACTURER: NES Ltd

ABSORBER TYPE: copper with Titanium Nitrit Oxide

MODEL: SL/C

AREA PER COLLECTOR 2.15 m²

FR (TAU ALPHA) COEFFICIENT 0.79 -

WIND CORRECTION FOR FR (tau alpha) 0.00 s/m

FR UL COEFFICIENT 3.56 (W/m²)/°C

WIND CORRECTION FOR FR UL 0.00 (J/m³)/°C

NUMBER OF COLLECTORS 62

TOTAL COLLECTOR AREA 133.30 m²

FIT and additional benefits

PARAMETERS OF INSTALLATION:

INSTALLED CAPACITY: 471 W/C0

NUMBER OF COLLECTORS: 62

TOTAL COLLECTOR AREA: 133.30 m²

ELECTRICITY TARIFF: 45 €/MWh

NATURAL GAS TARIFF: 182 €/1000 Nm3

ANNUAL HEAT PRODUCTION: 117.956 MWh.

ANNUAL ELECTRICITY CONSUMPTION FOR PUMPING: 1.050 MWh/yr

ANNUAL NATURAL GAS SAVINGS: 24,000 Nm3/yr

ANNUAL MONETARY SAVINGS: 4 263 €/yr

Economic Basics

CONSUMPTION PARAMETERS

ANNUAL NATURAL GAS CONSUMPTION FOR DOMESTIC HOT WATER - 24,000 Nm3/yr.

ANNUAL NATURAL GAS SAVINGS ANNUAL NATURAL GAS CONSUMPTION FOR DOMESTIC HOT WATER - 24,000 Nm3/yr. (100%).

FINANCING SCHEME

Support of EBRD European Union Energy Efficiency Finance Facility (EUEEFF) – loan from Unicredit Bulbank

Environmental & Economic Sustainability

CARBON EMISSION REDUCTION

From Natural Gas Savings: 44 (tCO2/yr.)

COST BENEFIT ANALYSIS

INVESTMENT: 31 440 €

ANNUAL MONETARY SAVINGS: 4 263 €/yr

INTEREST RATE: 8%

INFLATION RATE: 3.5%

PROJECT LIFE: 10 years

PAYBACK PERIOD: 7,4 years

NPV: 2292

IRR: 6%

COST BENEFIT ANALYSIS WITH 15% GRANT

PAYBACK PERIOD: 6,3 years

NPV: 7008

IRR: 10%

Lessons Learnt

The results of the completed project implementation are:

- reduction of consumption of natural gas by 24,000 Nm3/yr.
- reduction of carbon emission by 44 t/yr.

Use of solar panels for production of DHW is an economically sustainable project. Integration of this kind of projects with other energy saving and renewable energy projects increases their total environmental impact and financial results of the company.

3.1.4. MEGA Engineering Ltd.

Description of the project

Mega Engineering Ltd. specializes in the areas of design, development, implementation, maintenance/service/; complex engineering devices and systems for automation. Since its establishment in 1993 company constantly develops and implements the latest advances in electronics, microprocessors, and automation. Automation systems, implemented by the company comply with European standards and requirements relating to the implementation of the standards of Good Manufacturing Practices "GMP".

GBE Factory Model

The company is a systems integrator that implemented control systems instrumentation – SKIU. Before the project implementation the buildings at MEGA Engineering Ltd are heated with hot water generated by a hot water boiler using light fuel oil as a fuel. The hot water is delivered by circulation pumps via the existing pipelines. The condition of the temperature regimes in the production premises where concentrate workers are is not satisfactory. ERATO Holding Plc has signed a HDC (Heating delivery contract) for thermal energy sales. As a result of the project implementation (fuel switch project) MEGA Engineering Ltd will save 17 tons of light fuel oil or EUR 21,570 annually.

Quick Facts

LOCATION**:** 52 Makedonia Str., Haskovo (Bulgaria)

HEATED SPACE (m3): 3,300 m3

TECHNOLOGY/IES: Biomass heating

SITE OWNERSHIP**:** MEGA Engineering Ltd.

INVESTOR**:** ERATO Holding Plc. (ESCO provider)

PROJECT COST: 35,400 €

KEY PARTNERS: MEGA Engineering Ltd.

CURRENT STATUS: Implemented

Design and construction

The project included production and installation of biomass boiler facilities, including biomass hot water boiler, wood chips warehouse, system for feeding of chips into the boiler chamber, ash cleaning system, exhausted gases cleaning system and PLC control system. Commissioning test and start-up were also implemented. The hot water is transported through pipe network with diameter 100 mm to the local substation. From the substation the hot water is transported to the radiators in the plant's premises.

<u>TECHNICAL DETAILS:</u>

TOTAL SURFACE (m2): 1,222

BOILER CAPACITY (kWth): 80

TOTAL ANNUAL ENERGY (kWhth/yr.) 77,440

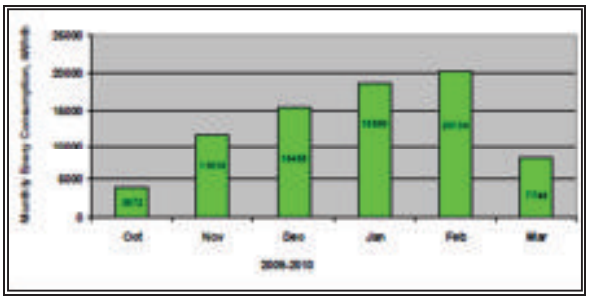
BOILER EFFICIENCY (%): 92

HOT WATER TEMPERATURE (oC): 80

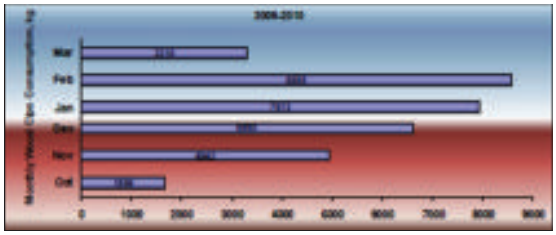
WOOD CHIPS CONSUMPTION (t/yr.): 33

WOOD CHIPS CALORICITY (kWh/kg): 2.56

MONTHLY TOTAL THERMAL ENERGY GENERATED



MONTHLY WOOD CHIPS CONSUMPTION



After the project completion the building at MEGA Engineering Ltd is heated by high efficient biomass energy boiler using ecological fuel in the type of wood chips. The wood chips with humidity up to 45% are produced by wood creeper with capacity of 12 m3/h. The generated thermal energy is distributed to the consumers through isolated pipe network.

FIT and additional benefits

PARAMETERS OF INSTALLATION:

PROJECT DESIGN PREPARATION: February, 2009

DELIVERY AND INSTALLATION OF EQUIPMENT: April, 2009

BOILER HOUSE CONSTRUCTION: May, 2009

COMMISSIONING TEST AND START UP: July, 2009

PROJECT COMPLETION: August, 2009

THERMAL POWER (KWTH): 80

THERMAL ENERGY PRICES (€/KWTH): 0.142

Economic Basics

An energy audit and business plan were prepared. The technical and financial calculation of ESCo operation has been made. The ERATO Holding Plc offers to the management of MEGA Engineering Ltd ESCo operation through energy contracting for selling of thermal energy. This energy is measured through a certified gauge.

CONSUMPTION PARAMETERS

COSTUMER'S ENERGY COST (€/KWHTH): 0.142

THERMAL POWER (KWTH): 80

CONSUMPTION TE (KWHTH/YR.): 71,245

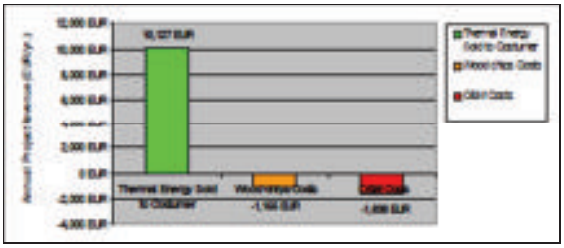
ANNUAL PROJECT REVENUES

THERMAL ENERGY SOLD TO CUSTOMERS (€/yr.): 10,127

WOOD CHIPS COSTS (€/YR.): 1,155

O&M COSTS (€/YR.): 1,636 approx.

CASH REVENUES (€/YR.): 7,336



FINANCIAL SCHEME

BASE PROJECT COSTS (€): 35,400

DEBT (€): 31,860

EQUITY (€): 3,540

INFLATION INDEX (%): 4.5

FIXED DISCOUNT RATE (%): 7

IRR (%): 18.3

NPV (EUR): 46,020

PAYBACK PERIOD (YR.): 5.45

BIOMASS BOILER

The biomass energy boiler with thermal capacity of 80kW and the auxiliary process equipment are installed into boiler room. The fuel feeding system and used biomass fuel are situated in the feel storage. The biomass hot

water boiler is compact one, made of steel, panel with control devices, and is equipped with an automated fuel feeding device for wood chips or wood pellets and fire safety system.

TECHNICAL PARAMETERS:

A system for automated regulation of the heat supply is also installed. The installation into the energy cabin includes also circulating pumps, expander, multicyclone, isolated pipes, valves, thermostats and C&I. Furthermore, a chimney for the separation of the exhausted gases will be constructed.

The hot water biomass boiler is using for burning of wood chips and wood pellets. These biomass energy boilers are suitable for heating and DHW preparation in the public building, industrial facilities, hotels and greenhouses.

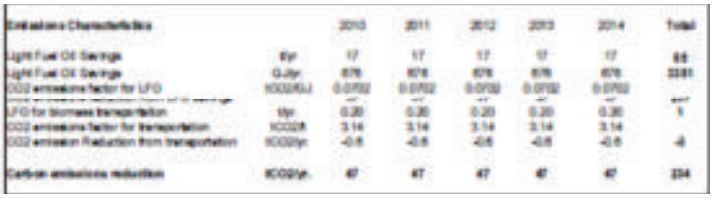
Nominal Thermal Power	Efficiency	Diameter of chimney	Hopper capacity	Weight	Length	High	Width
kW	%	mm	l	kg	mm	mm	mm
80	92	200	450	550	2200	1330	700

Environmental & Economic Sustainability

Determination of the annual emissions of CO2 and of other noxious gases is according to Commission Decision of 21.01.2004 establishing guidelines for the monitoring and reporting of Greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council. The

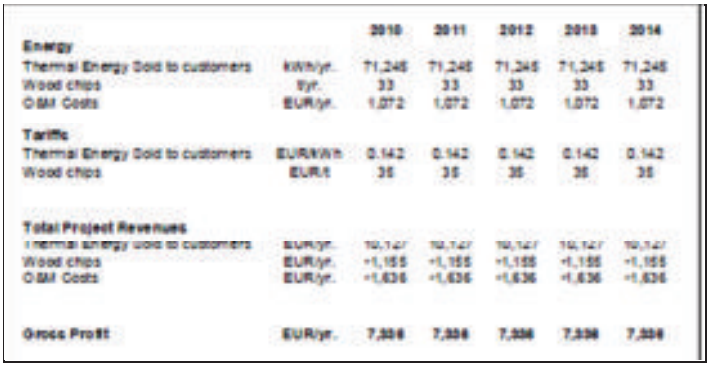
emissions factors elaborated by the MOEW (Methodology for calculation of emissions of noxious substances (pollutants) released into the environment based on balance methods) have been used for the CO2 and other noxious gases emissions assessment.

The CO2 emissions will decrease by 47 tons in 2010 and for the period 2010 - 2014 they will decrease by 234 tons, as a result of the project implementation.



The project is characterized with economical sustainability.

PROJECT REVENUES:



The construction of the biomass energy facilities will improve the comfort conditions of the operating personnel in MEGA Engineering Ltd. The operation is characterized with a lower noise level, better hygiene and decreased risks of failure.

Lessons Learnt

The proposed ESCO business scheme of ERATO Holding Plc will lead to the proved economic and ecological benefits to MEGA Engineering Ltd. The implemented fuel switch project is very efficient; the generated thermal energy is with high quality and this energy is sold to the customer on appropriate price.

The data analysis shown that this project is bankable with very good returning of investment cost.

3.1.5. ECOTHERM Project Ltd.

Description of the project

ECOTHERM Project Ltd is research and development organization with main business activities connected with the development of prototypes, testing and measurement of heating equipment and implementation of new products in the market in Bulgaria and EU. ECOTHERM Project Ltd has a large building in which is situated biomass training center with offices and conference room for education of sales and installers of biomass heating equipment. There is also heating laboratory and large warehouse in the biomass training center.

GBE Factory Model

The biomass training center is constructed in 2008. The separate premises and warehouse of ECOTHERM Project Ltd are heated with hot water generated by a hot water boiler with thermal capacity of 300kW, using light fuel oil as a fuel. The condition of the temperature regimes in the production premises where concentrate expert, operational staff and trained people are is not satisfactory.

ERATO Holding Plc has signed a HDC (Heating delivery contract) for thermal energy sales. As a result of the project implementation (fuel switch project) ECOTHERM Project Ltd will save 33 tons of light fuel oil or EUR 45,215 annually.

Quick Facts

LOCATION: Ring-road, Haskovo (Bulgaria)

HEATED SPACE (m3): 7,290 m3

TECHNOLOGY/IES: Biomass heating

SITE OWNERSHIP: ECOTHERM Project Ltd.

INVESTOR: ERATO Holding Plc. (ESCO provider)

PROJECT COST: 108,120 €

KEY PARTNERS: ECOTHERM Project Ltd.

CURRENT STATUS: Implemented

Design and construction

The project included construction of biomass boiler plant, including biomass hot water boiler, wood chips warehouse, system for feeding of chips into the boiler chamber, ash cleaning system, exhausted gases cleaning system and PLC control system. Commissioning test and start-up were also implemented. The hot water is transported through pipe network with length of 400 m and diameter of 150 mm to the local substation. From the substation the hot water is transported to the radiators and convertors in the biomass training center.

<u>TECHNICAL DETAILS:</u>

TOTAL SURFACE (m2): 2,700

BOILER CAPACITY (kWth): 300

TOTAL ANNUAL ENERGY (kWhth/yr.) 290,400

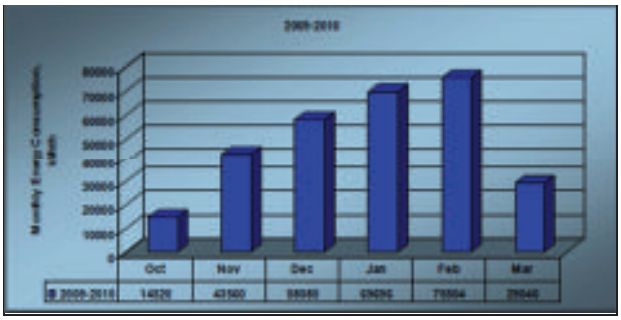
BOILER EFFICIENCY (%): 88

HOT WATER TEMPERATURE (oC): 90

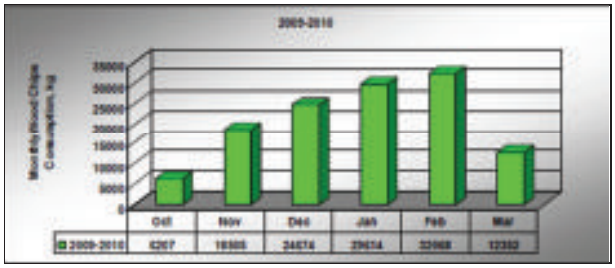
WOOD CHIPS CONSUMPTION (t/yr.): 123

WOOD CHIPS CALORICITY (kWh/kg): 2.56

MONTHLY TOTAL THERMAL ENERGY GENERATED



MONTHLY WOOD CHIPS CONSUMPTION



After the project implementation the building of ECOTHERM Project Ltd is supplied by hot water for heating through automatic biomass energy boiler using wood chips. The wood chips with humidity up to 45% are produced by wood creeper with capacity up to 15 m3/h. The generated thermal energy is distributed to the consumers through constructed pipe network.

FIT and additional benefits

PARAMETERS OF INSTALLATION:

PROJECT DESIGN PREPARATION: January, 2009

DELIVERY AND INSTALLATION OF EQUIPMENT: March, 2009

BOILER HOUSE CONSTRUCTION: May, 2009

COMMISSIONING TEST AND START UP: July, 2009

PROJECT COMPLETION: August, 2009

THERMAL POWER (kWth): 300

THERMAL ENERGY PRICES (€/kWth): 0.142

Economic Basics

ERATO's staffs has prepared business plan. The technical and financial calculation of ESCo operation has been made. The ERATO Holding Plc offers to the management of ECOTHERM Project Ltd ESCo operation through energy contracting for selling of thermal energy. This energy is measured through a certified gauge.

CONSUMPTION PARAMETERS

COSTUMER'S ENERGY COST (€/kWhth): 0.142

THERMAL POWER (kWth): 300

CONSUMPTION TE (Kwhth/yr.): 255,552

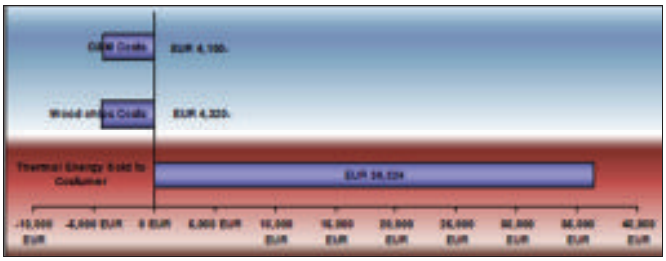
ANNUAL PROJECT REVENUES

THERMAL ENERGY SOLD TO CUSTOMERS (€/yr.): 36,324

WOOD CHIPS COSTS (€/yr.): 4,320

O&M COSTS (€/yr.): 4,100 approx.

CASH REVENUES (€/yr.): 27,905



FINANCIAL SCHEME

BASE PROJECT COSTS (€): 108,120

DEBT (€): 97,308

EQUITY (€): 10,812

INFLATION INDEX (%): 4.5

FIXED DISCOUNT RATE (%): 7

IRR (%): 25.4

NPV (EUR): 151,368

PAYBACK PERIOD (YR.): 4.4

BIOMASS PLANT

The biomass boiler plant use wood chips as a fuel. The wood chips are stored in a separate warehouse, located next to the biomass boilers. The wood chips are fed automatically from the warehouse to the Boiler hopper by screw conveyor with length of 4 m.

From the boiler hopper the biomass is transported in the boiler chamber by internal screws. The combustion of wood chips takes place in the burning chamber. On the display of the control panel it is Possible to read the current boiler output, load and all other relevant parameters. The control panel is fitted with PLC control.

The hot water by the heat accumulator with a temperature of 90C is transported to the distributing water collector by means of circulating pump. The heating units in the rooms are supplied with hot water from the distributing water collector. A returned water collector collects the water used by the heating units that has a temperature of 70 C. The water is fed from the returned collector into the water heating boiler by means of a circulating pump.

TECHNICAL PARAMETERS

Nominal Thermal Power (kW)	Fuel Consumption (kg/h)	Maximum Fuel Humidity (%)	Maximum Water Temperature (°C)	Maximum Water Pressure (MPa)	Water Capacity (l)	Length (mm)	Height (mm)	Width (mm)
300	132	45	90	0.25	1,310	5,100	3,150	1,500

All facilities of the boiler station are equipped with control and safety valves as well as with control, measuring and automated devices.

Environmental & Economic Sustainability

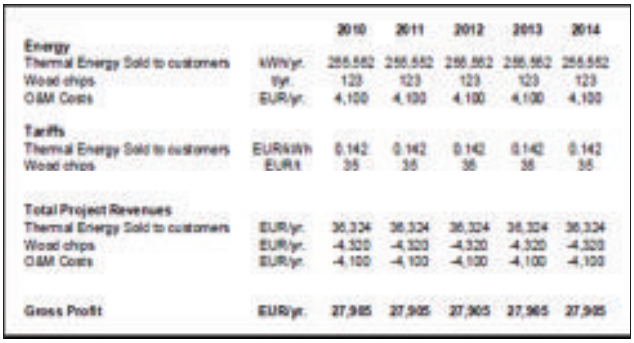
Determination of the annual emissions of CO2 and of other noxious gases is according to Commission Decision of 21.01.2004 establishing guidelines for the monitoring and reporting of Greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council. The emissions factors elaborated by the MOEW (Methodology for calculation of emissions of noxious substances (pollutants) released into the environment based on balance methods) have been used for the CO2 and other noxious gases emissions assessment.

The CO2 emissions will decrease by 87 tons in 2010 and for the period 2010 - 2014 they will decrease by 436 tons, as a result of the project implementation.

Emissions Characteristics		2010	2011	2012	2013	2014	Total
Light Fuel Oil Savings	t/yr	33	33	33	33	33	166
Light Fuel Oil Savings	GJ/yr.	1313	1313	1313	1313	1313	6564
CO2 emissions factor for LFO	tCO2/GJ	0.0702	0.0702	0.0702	0.0702	0.0702	
		-86	-86	-86	-86	-86	-461
LFO for biomass transportation	t/yr.	1.66	1.66	1.66	1.66	1.66	8
CO2 emission factor for transportation	tCO2/t	3.14	3.14	3.14	3.14	3.14	
CO2 emission Reduction from transportation	tCO2/yr.	-4.9	-4.9	-4.9	-4.9	-4.9	-24
Carbon emissions reduction	tCO2/yr.	87	87	87	87	87	436

The ESCO project is characterized with economical sustainability.

PROJECT REVENUES:



		2010	2011	2012	2013	2014
Energy						
Thermal Energy Sold to customers	kWh/yr.	266,562	266,562	266,562	266,562	266,562
Wood chips	t/yr.	123	123	123	123	123
O&M Costs	EUR/yr.	4,100	4,100	4,100	4,100	4,100
Tariffs						
Thermal Energy Sold to customers	EUR/kWh	0.142	0.142	0.142	0.142	0.142
Wood chips	EUR/t	35	35	35	35	35
Total Project Revenues						
Thermal Energy Sold to customers	EUR/yr.	36,324	36,324	36,324	36,324	36,324
Wood chips	EUR/yr.	-4,320	-4,320	-4,320	-4,320	-4,320
O&M Costs	EUR/yr.	-4,100	-4,100	-4,100	-4,100	-4,100
Gross Profit	**EUR/yr.**	**27,905**	**27,905**	**27,905**	**27,905**	**27,905**

The construction of the biomass energy facilities will improve the comfort conditions of the operating personnel in ECOTHERM Project Ltd. The operation is characterized with a lower noise level, better hygiene and decreased risks of failure.

Lessons Learnt

The proposed ESCO business model of ERATO Holding Plc will lead to the proved economic and ecological benefits to ECOTHERM Project Ltd. The implemented fuel switch project is very efficient; the generated thermal energy is with high quality and this energy is sold to the customer on appropriate price. The data analysis shown that this project is bankable with very good returning of investment cost.

3.1.6. RODOPI Kardjali Plc.

Description of the project

RODOPI Kardjali Plc was founded in 1959 first like "Rodop" printing house and was bringing the traditions since the times of "mettre-en-page" (maker-up) and typesetting. The company has the capacity to provide collared printing of brochures, catalogues, leaflets, calendars, paper and cardboard packaging. RODOPI Kardjali Plc works with a rich range of paper for the needs of the customers. The factory uses new computer technologies and their coming in the polygraph business the printing house started working with computers for the preparation of the printer's activity and they also bought large-format six-color printer.

GBE Factory model

The production workshops of RODOPI Kardjali Plc are located in two-store brick buildings with a total heating volume of 3,800 m3. Cast-iron radiators, connected to two pipelines are mounted at the workshops. The heating boiler facility is used wood waste as a fuel for the production of thermal energy. ERATO Holding Plc has signed a HDC (Heating delivery contract) for thermal energy sales. As a result of the project implementation RODOPI Kardjali Plc will save 11 tons of light fuel oil or EUR 15,350 per year.

Quick Facts

LOCATION**:** 50 Republikanska Str., Kardjali (Bulgaria)

HEATED SPACE (m3): 3,800 m3

TECHNOLOGY/IES: Biomass heating

SITE OWNERSHIP: RODOPI Kardjali Plc.

INVESTOR: ERATO Holding Plc. (ESCO provider)

PROJECT COST: 25,800 €

KEY PARTNERS: RODOPI Kardjali Plc.

CURRENT STATUS: Implemented

Design and construction

The heating boiler facility used wood logs with humidity of 20% as fuel for the production of thermal energy. A water heating boiler Atmos DC 100 with a unit heat capacity of 99 kW is mounted at the boiler room. The boiler is designed for pyrolysis burning of wood logs at a high efficiency of the combustion process - 80%. The hot water produced by the boiler with a temperature of 80 C is supplied to the production workshops by means of a circulating pump Grundfos UPS 32/80. The return water from workshops with a temperature of 60 C is fed into the water heating boiler. All facilities of the boiler room are equipped with control and safety valves as well as with control, measuring and automated devices.

<u>TECHNICAL DETAILS:</u>

TOTAL SURFACE (m2): 1,407

BOILER CAPACITY (kWth): 99

TOTAL ANNUAL ENERGY (kWhth/yr.) 95,832

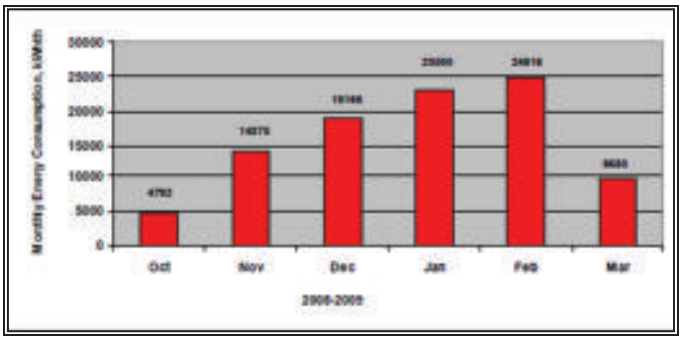
BOILER EFFICIENCY (%): 80

HOT WATER TEMPERATURE (oC): 80

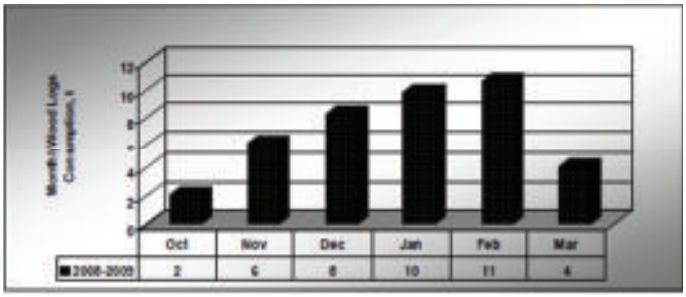
WOOD LOGS CONSUMPTION (t/yr.): 41

WOOD LOGS CALORICITY (kWh/kg): 3.00

MONTHLY TOTAL THERMAL ENERGY GENERATED



MONTHLY WOOD LOGS CONSUMPTION



After the project implementation the production workshops of RODOPI Kardjali Plc is supplied by hot water for heating through boiler using wood logs. The wood logs with humidity up to 20% are delivered to the boiler warehouse.

FIT and additional benefits

PARAMETERS OF INSTALLATION:

PROJECT DESIGN PREPARATION: March, 2008

DELIVERY AND INSTALLATION OF EQUIPMENT: April, 2008

BOILER ROOM RECONSTRUCTION: May, 2008

COMMISSIONING TEST AND START UP: June, 2008

PROJECT COMPLETION: August, 2008

THERMAL POWER (kWth): 99

THERMAL ENERGY PRICES (€/kWth): 0.123

Economic Basics

ERATO has prepared an energy audit and business plan. The technical and financial calculation of ESCo operation has been made. The ERATO Holding Plc offers to the RODOPI Kardjali Plc ESCo operation through energy contracting for selling of thermal energy. This energy is measured through a certified gauge.

CONSUMPTION PARAMETERS

COSTUMER'S ENERGY COST (€/kWhth): 0.123

THERMAL POWER (kWth): 99

CONSUMPTION TE (kWhth/yr.): 76,666

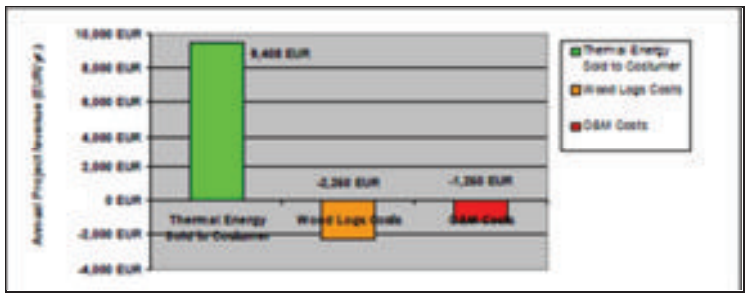
ANNUAL PROJECT REVENUES

THERMAL ENERGY SOLD TO CUSTOMERS (€/yr.): 9,408

WOOD LOGS COSTS (€/yr.): 2,250

O&M COSTS (€/yr.): 1,250 approx.

CASH REVENUES (€/yr.): 5,908



FINANCIAL SCHEME

BASE PROJECT COSTS (€): 25,800

DEBT (€): 23,220

EQUITY (€): 2,580

INFLATION INDEX (%): 4.5

FIXED DISCOUNT RATE (%): 7

IRR (%): 20.1

NPV (EUR): 33,540

PAYBACK PERIOD (YR.): 4.9ù

BOILER ROOM

The biomass boiler uses wood logs as a fuel. The wood logs are stored in a separate warehouse, located next to the boiler room. RODOPI Kardjali Plc has bought the produced thermal energy for heating of the production workshops by the seller company – ERATO Holding Plc. The preparation of the total invoice for the users is done based on the actual consumed amount of thermal energy, measured by certified technical devise.

TECHNICAL PARAMETERS

Nominal Thermal Power	Efficiency	Fuel Consumption	Chamber capacity	Weight	Length	High	Width
kW	%	kg/h	dm3	kg	mm	mm	mm
99	80	26	400	780	1,120	1,830	980

All facilities of the boiler room are equipped with control and safety valves as well as with control, measuring and automated devices.

Environmental & Economic Sustainability

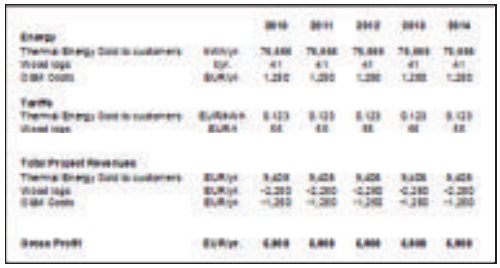
Determination of the annual emissions of CO2 and of other noxious gases is according to Commission Decision of 21.01.2004 establishing guidelines for the monitoring and reporting of Greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council. The emissions factors elaborated by the MOEW (Methodology for calculation of emissions of noxious substances (pollutants) released into the environment based on balance methods) have been used for the CO2 and other noxious gases emissions assessment.

The CO2 emissions will decrease by 8 tons in 2010 and for the period 2010 - 2014 they will decrease by 39 tons, as a result of the project implementation.

Emissions Characteristics		2010	2011	2012	2013	2014	Total
Light Fuel Oil Savings	l/yr	11	11	11	11	11	55
Light Fuel Oil Savings	GJ/yr	116	116	116	116	116	578
CO2 emissions factor for LFO	tCO2/GJ	0.0702	0.0702	0.0702	0.0702	0.0702	
		+	+	+	+	+	+1
LFO for biomass transportation	l/yr	0.12	0.12	0.12	0.12	0.12	1
CO2 emissions factor for transportation	tCO2/l	3.14	3.14	3.14	3.14	3.14	
CO2 emission Reduction from transportation	tCO2/yr	-0.4	-0.4	-0.4	-0.4	-0.4	-2
Carbon emissions reduction	tCO2/yr.	8	8	8	8	8	39

The implemented ESCO project is characterized with economical sustainability.

PROJECT REVENUES:



The construction of the biomass energy facilities will improve the comfort conditions of the company staff in RODOPI Kardjali Plc. The operation is characterized with a lower noise level, better hygiene and decreased risks of failure.

Lessons Learnt

The proposed Heating Delivering Contract (HDC) trough ESCO business scheme of ERATO

Company will lead to the proved economic and ecological benefits to RODOPI Kardjali Plc. The implemented fuel switch project is very efficient; the generated thermal energy is with high quality and this energy is sold to the customer on appropriate price.

The data analysis shown that this project is bankable with very good returning of investment cost.

3.1.7. Ebm-papst Mulfingen GmbH & Co.

Description of the project

The Ebm-papst Mulfingen GmbH & Co. KG is a producer of fans and motors, blowers, and pumps. When they planned a new branch in Mulfingen, they took issues like RES, energy efficiency and climate protection into consideration right from the beginning.

The company addressed different questions concerning renewable energy sources, climate protection and the use of waste-heat.

The company installed solar panels, a heat pump, an innovative ventilation system and took measures to utilize the waste heat. The company also installed a storage system for heat that is coupled with the heat pump.

The heat pump is also used to cool the building if the outside-temperature is above 24 degree.

Quick Facts

LOCATION: Hollenbach/ Germany

PLANT SIZE (kwe;kwt): photovoltaic: 153 kWp

TECHNOLOGY/IES: heat pump, photovoltaic panels, utilization of waste heat, innovative ventilation system with EC fans.

SITE OWNERSHIP: Ebm-papst Mulfingen GmbH & Co. KG.

INVESTOR: Ebm-papst Mulfingen GmbH & Co. KG

PROJECT COST: 1 m Euro

KEY PARTNERS: N/ A

CURRENT STATUS: Realized

Design and construction

- Installation of a heat pump with a coefficient of performance (COP) > 4
- Utilization of industrial waste heat of the machinery
- Installation of a 153 kWp-solar power-plant
- Optimization of the heat distribution
- Installation of pumps heating and cooling pumps of the energy-efficiency class A, utilization of energy-saving ventilation systems.

FIT and additional benefits

ENERGY COSTS SAVED PER YEAR: 87. 485 Euro

ENERGY SAVED TOTAL: 91 %

ELECTRICITY SAVED: 19 %

THERMAL ENERGY SAVED: 99 %

ROI ON THE ADDITIONAL COSTS FOR EFFICIENCY MEASURES: 146 %

(estimation on the basis of fixed prices on energy (oil/ electricity))

Environmental & Economic Sustainability

When the company decided to build a new production facility in Hollenbach, the aim was to cover the complete heating needs of the facility (750.000 kWh/ year for the five separate buildings, 13600 m2 altogether).

One key element was to use the industrial waste heat that is emitted by the machinery, robots and compressors.

A suppression ventilation system was installed that uses the waste heat/ high temperatures under the roof of the hall. This heat/ warm air can be used to heat the other buildings (e. g. buildings with not so much heat-emitting machinery like the canteen or the incoming goods department). Excess heat is stored in an 11.000 hl sprinkler tank. This tank is also used as a heat sink for the heat pump. If the outside temperature is above 24 degree, the buildings are cooled with the heat pump.

In comparison to a conventional system the consumption of electricity reduced by 19% and that of thermal energy by 99 %.

Lessons Learnt

This is a very interesting solution for a manufacturing company because different renewable energy sources and energy efficiency measures are combined, with a clear focus on heating issues.

This model also includes obvious RES like photovoltaic or heat-pumps with energy sources that are less common like the well-thought-out use of industrial waste heat and the possibility to store the heat at large scale with the sprinkler tank.

Another interesting feature is the combination of the different needs and possibilities of the buildings and their interconnection.

CO2 emissions were reduced from 340 tons to 43 tons a year.

3.1.8. SOLON Corporate Headquarter

Description of the project

SOLON is a leading producer of Solar PV systems, and dedicated to the principles of sustainable production and consumption and consequent use of renewable energy sources. The company's newly constructed corporate headquarters, joining administration and production under one roof, is a display of those principles as well as the company's constant striving for innovation. Architects and designers have worked closely together to create a smart, efficient, and highly productive building with a flexible, positive, and energizing environment for the people within.

Gbe Factory Model

Reducing energy demand to ¼ of that in similar buildings was a key demand as was to maximize generation on-site while the users' comfort is central. An integrated design and implementation process results in a positive energy balance where total production exceeds consumption.

Quick Facts

LOCATION: Am Studio 16, 12489 Berlin (Germany)

PLANT SIZE (kwe;kwt): PV: 210 kWp

BIOGAS COGENERATION UNIT: 530 kWth, 230 kWel

TECHNOLOGY/IES: Biogas Cogeneration, Solar PV, wireless communication technology, monitoring

SITE OWNERSHIP: SOLON SE

INVESTOR: SOLON SE

PROJECT COST: 47.000.000 €

KEY PARTNERS: EGS Plan GmbH Stuttgart

Design and construction

Design was guided by the goals of achieving a low heat load and primary energy demand, high energy production and flexible working space.

ENERGY EFFICIENCY

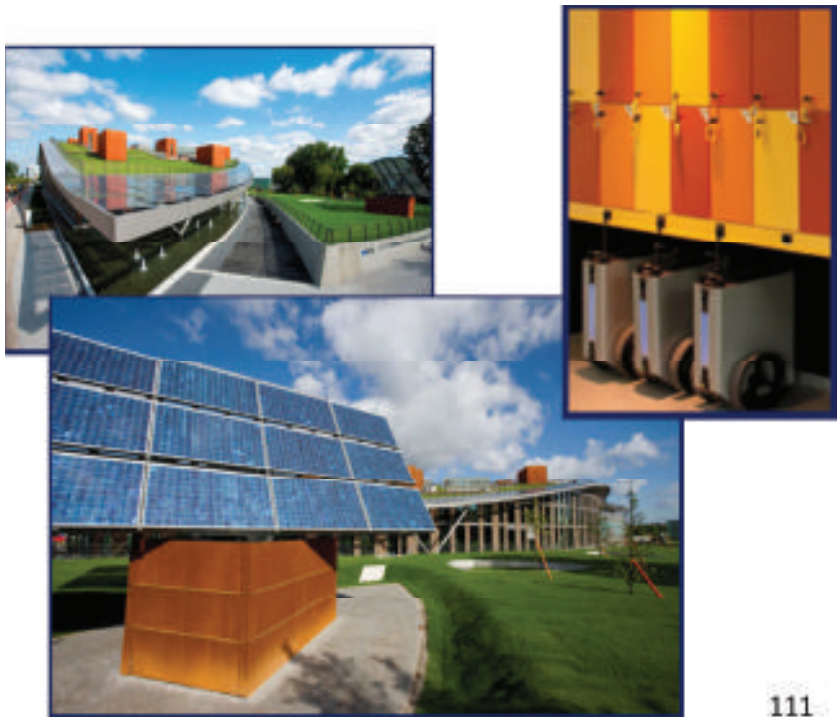
For the façade, pre-manufactured panels were developed. Triple glazing provides powerful insulation. Optimal sun protection is achieved by means of external shading devices and radiation control glazing. Great attention was paid to the possibility of natural ventilation via windows. Further, small radiators are part of the panel. The high-tech envelope has excellent insulating qualities, is made of quality and durable materials. (main: glass, wood, steel).

Electricity needs are supported by a building-integrated photovoltaic system with 210 kWp while a biogas cogeneration unit provides base loads of both heat and electricity, including supply for an absorption cooling machine in the summer time. The demand for heating and cooling across the building is achieved with a simple but effective technology, concrete core activation: water pipes are integrated into the concrete

ceilings/floors. In this manner 80% of the heating demand of ca. 25 kWh/m2 net floor area and 85% of the cooling demand (ca 30kWh/m2 net floor area) are covered. The remaining part is covered via convectors. The positioning of the building allows optimum use of natural lighting, but it is complemented by low general and targeted work space lighting.

Building Automation. The building is equipped with an innovative control system. Users control their work space comfort via touchpad and PC, while a system of wireless sensors monitor overall conditions, ensuring operations optimization.

E-mobility: A special feature and showing the integral approach are the eight company-owned electric scooters, fuelled by the PV system.



FIT and additional benefits

PARAMETERS:

POWER (kWp):

SOLAR PV 210 kWp

BIOMASS COGENERATION: 530 kWth, 230 kWel

FEED-IN-TARIFF PV (€/kWh): 0.4398

FEED-IN-TARIFF ELECTRICITY FROM BIOMASS CO-GENERATION (€/kWh): 0.0967

Economic Basics

The decision on following an integral concept is a display of the company's values and striving for innovation, a statement and demonstration of possibilities for future workspace organization already today. The building is also part of an RTD project, a living laboratory for further progress and innovation for tomorrow's buildings.

FEATURES BUILDING ENVELOPE

U-value of exterior walls 1.20

U-value window (including frame) 1.20

U-value roof 0.23

U-value roof lights (including frame) 1.60

U-value of basement ceiling / floor plate 0.30

Average U-value of the building envelope 0.75

Construction: Hybrid medium-duty construction

NETWORK INFRASTRUCTURE AND ENERGY

electricity network infrastructure, local district heating network, Building integrated Solar PV system.

SOLUTION STRATEGIES AREAS CONCEPT

Integrated planning, mechanical ventilation, vacuum insulation, combined heat and power using biogas, district heating network, own power supply, investment in biogas plant, Photovoltaic, quality assurance and operational optimization.

CONSUMPTION CHARACTERISTICS (2009) In kWh/m2

Heat energy consumption/demand measured 26, 60

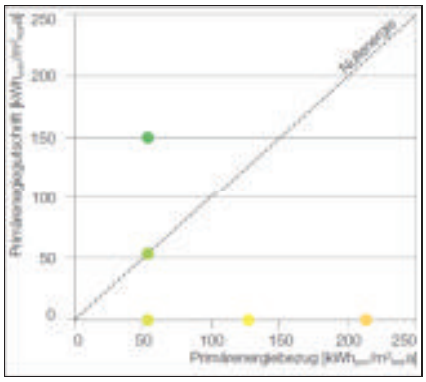
Water heating /demand 13.40

Final energy heat (incl. hot water) 69.09 / (40.00)

Electricity consumption / demand 42.91

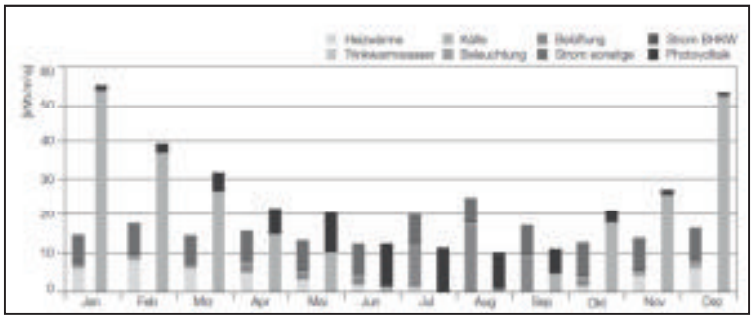
Primary energy consumption total 98.36

Primary energy feed-in 83.06



The dark green dot shows the overall energy balance is positive, providing more energy than is consumed.

MONTHLY ENERGY BALANCE



Environmental & Economic Sustainability

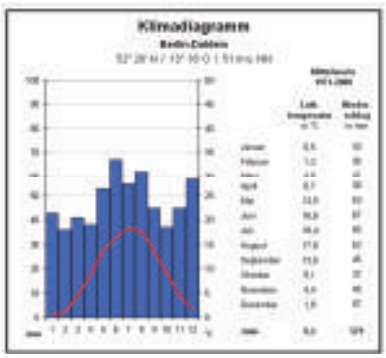
LOCATION PARAMETRES

LOCATION: Berlin, Germany

ANNUAL GLOBAL RADIATION: 1050 kWh/m2a

ANNUAL MEAN TEMPERATURE: 9,3 °C

ENVIRONMENT: urban



ENVIRONMENTAL PARAMETERS

The solar PV produces approximately 258.000 kWh of electricity per annum, the biogas co-generation unit with its 530 kWth contributes 100% district heating based on renewable sources.

The total amount of CO2 avoided ranges between 600.000 and one million tons per year.

Lessons Learnt

With the early set up of an interdisciplinary planning team and a careful analysis of the design, functional and organizational and technical possibilities, an optimal concept was developed. After nearly one year of intensive fine tuning and adjustments, the building is now under normal operation. It offers its qualities in terms of comfort and energy efficiency not only shown by test measurements, but also by the employees' feedback.

3.1.9. SMA Solar Technology AG

Description of the project

The SMA Solar Technology AG, a leading solar inverter producer, has in 2009 inaugurated the Solar Plant 1, a new production hall with a CO2-neutral energy concept. Every day up to 4000 solar inverters of different sizes and types can be produced, making it the currently largest factory of its kind. While not a fully self-sufficient energy supply, the model of the factory is linking regional availability of renewable energy sources with own production in a highly efficient and symbiotic manner.

A four-gigawatt production capacity spread over 18,000 square meters of floor space based on a CO2 neutral concept with:

- PV system of 1,2 MW peak;
- Biogas co-generation unit;
- Heat recovery (compressed air);
- District heating, 98,5 % via co-generation;
- 100 % renewable energy use.

Quick Facts

LOCATION: Sonnenallee 1, 34266 Niestetal, Germany

PLANT SIZE (kwe;kwt): 1,2 MW (PV)

TECHNOLOGY/IES: Photovoltaic, Co-generation

SITE OWNERSHIP: SMA Solar Technology AG

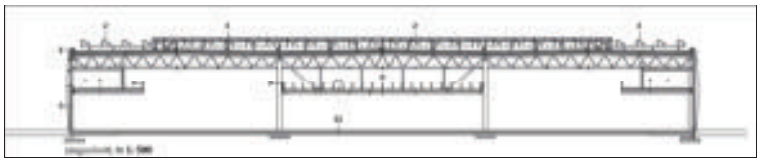
INVESTOR: SMA Solar Technology AG

PROJECT COST: 9.500.000 €

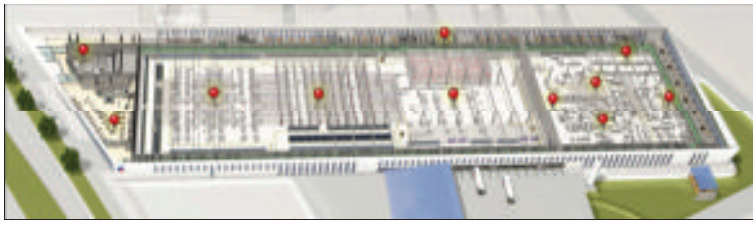
KEY PARTNERS: EGS Plan GmbH Stuttgart

CURRENT STATUS: Realized

Design and construction



Design was guided by the principles of minimizing the energy demand and CO2 neutralization via full use of renewable energy sources. High flexibility for the production was another demand. Assembly lines can be changed within hours. The energy and building technology follow suit equally open to various uses.



The building shell of the factory conforms to low-energy-building standards while cutting-edge technology ensures the optimum use of locally supplied biogas for heating and electric generation. PV generated electricity is fed on the low wastage side of the grid, and either used in-house or fed into the grid.

CO2 neutralization involves drawing renewable electricity from the public utility and combining the heat and power of the neighboring waste incineration plant with the refined biogas obtained from two regional installations in the internal co-generation unit. Another source of heat is an electric compressor, whose waste heat is recycled into the ventilation system, for example in cases of maintenance of other systems. A condensing boiler is only used as a back-up.

Cooling is generated in two ways. An absorption cooling machine uses the perpetual heat of the biogas plant to drive its cooling system. A vapor-compression system is powered by electricity and functions in the same way as a commercial air conditioning unit. The high lux needs (1000) were responded to by using particularly efficient technologies and control for lighting.

FIT and additional benefits

PARAMETERS OF PV INSTALLATION:

POWER (kWp): 1,2 MW

FEED-IN-TARIFF (€/kWh): 0.3448

(Installation larger than 1 MW and operational since 2009)

Economic Basics

The decision on the new factory with a climate neutral energy concept is to demonstrate the company's climate stewardship, and is more than an investment in a new production site.

INVESTMENT AND ROE

ENERGY & BUILDING TECHNOLOGY COSTS:

- Ca. 9.500.000 €;
- Total Investments ca 10.200.000€;
- Return on capital employed more to achieve efficiency levels: 21%.

GENERATION PARAMETERS

- Heat load 670 kW;
- Cooling load 1525 kW;
- Biogas-Co-generation 350 kWth, 225 kWel;
- Heat recovery compressed air 105 kW;
- District Heating 1600 kW;
- Gas-condensing boiler (back-up) 310 kW;
- Absorption cooling machine 270 kW;
- Vapor-compression system 2x 670 kW.

ENERGY DEMAND & CONSUMPTION

- Heat load 670 kW
- Cooling load 1525 kW
- Annual energy costs: ca. 536.000 €
- Annual Electricity consumption:
- 5.200.000 kWh
- Annual fuel consumption (biogas needed for the cogeneration unit): 1.700.000 kWh

BUILDING AUTOMATION & ENERGY MANAGEMENT

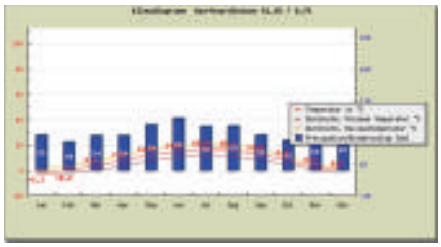
For heating, cooling and ventilation, some 3500 data points have been installed, building control overall has 4300 data points. Communication via BACnet ensures an optimal operation, flexible to react to current needs and situations.

Measurement data points for production relevant consumption further on enable monitoring and targeting via separate software, the modern way of efficient and sufficient use of energy resources.

Environmental & Economic Sustainability

SOLAR INPUT: Global solar radiation in the region is about 1030 kWh/2

CLIMATE CONDITIONS: The climate diagram for the location.



GREENHOUSE GAS EMISSIONS

The amount of CO2 avoided per year (calculation based on GEMIS) is 1.700 tons/an M&T.

The integration of a large number of measurement points not only for building automation, but also for energy consumption is on its own a relevant step for long term achievement of efficient operations in the solar plant under various conditions.

Lessons Learnt

The key lesson is that a clever combination of possibilities for local on-site and regional energy sources (renewable) allows a CO2 neutral industrial application to be successful, and set standards for other industrial applications.

3.1.10. Best Western Premier Hotel Victoria

Description of the project

The Best Western Premier Hotel Victoria is a 4 stars city hotel with 69 rooms, a breakfast room and two cocktail bars, situated in Freiburg, Germany.

They started their environmental project in 1985 but a big improvement was done during spring of 2002 when they replaced old oil-based heating system by a modern wood-pellet heating system with an exhaust-gas cleaning system.

Afterwards, during spring of 2007, eco-friendly air-conditioning for the historic main house was put into operation putting further milestones on the way to zero-emission hotel applying efficiency technologies helping them saving electricity and money.

The Victoria Hotel has won numerous awards for its commitment for the environment.

The environmental protection project in Hotel Victoria emerges in 1985. But it was in 2002 when the hotel developed into a zero-emissions building, referred to the CO2 emission value. The protection and care of its shared environment and acting according to solid ecological principles, such as environmental awareness, modernity and sustainability are the preconditions for this hotel to operate.

Quick Facts

LOCATION: Am Colombipark, Eisenbahnstraße 54
79098 Freiburg, Germany

PLANT SIZE: Photov. panels =200m²

4 wind turbines (with 2 kW produced Power each)

ENERGY PRODUCED: Solar Energy: 21 000 kWh per year

Wind Energy: 70 000 kWh per year

TECHNOLOGY/IES: Photovoltaics and aeolics (wind)

SITE OWNERSHIP: Astrid & Bertram Späth

INVESTOR: Best Western

CURRENT STATUS: Realized

Design and construction

After starting with its environmental protection project and since 2002 the hotel became a zero-emissions building (based on the CO2 value), due to the constant and continuous application of modern solar, eolic and many other environmental friendly technologies.

Its environmental performance continuously improve thanks its environmental management system EMAS.

The ideal insulation of the building is a requirement for low energy needs, therefore, 3 heat insulating panels were built in the windows of the entire building. The rear building was completely insulated in 2009 and an impressive primary energy requirement of only 82 kWh/m² was reached, which undershoots the set point of a new building by 70%. Intelligent air supply units, through which an inflow of tempered air is possible, were integrated in the face of the building. The inflow air is adjusted to the room size and number of guests in the room.

The heat for warm water and heating is up to 100% produced by only renewable energy: a wood-pellet heater combined with a thermal solar collector.

Oil heating was replaced by a modern wood pellet heater with exhaust gas treatment. The heater has a maximum performance of 300 kW. This means that about 100 tons of wood from natural finish saw dust are spent every year. Wood, when burnt, produces the same amount of the gas carbon dioxide (CO^2) as it absorbed from the atmosphere during its growth. The latter guaranties a closed CO2 circuit that is not dangerous for the greenhouse effect.

The thermal-solar energy plant with a collector area of 30 m^2 supports the warm water production. During sunny days, the required amount of heat for washing and showering is produced solely by the solar plant.

The environmentally friendly ground water cooling system was built in 2007 for the climate control of the hotel rooms. A pump furnishes 10 to 13 degrees (Celsius) cold water from a depth of about 16 to 20 meters from the water well located in the hotel courtyard and supplies the heat exchanger system. In the hotel rooms, the guests can adjust the requested room temperature with convector ventilators. The cool water circulates through a pipe system into the room for being then released back to the ground (well) with a maximum temperature of 16 degrees Celsius through an injection pipe, where it drains away and cools down.

TECHNICAL DETAILS

THE YEARLY ENERGY CONSUMPTIONS ARE:

Electrical energy: 210 000 kWh

Heating energy: 450 000 kWh

Since 2003 the consumed energy was completely eco-energy supplied by renewable energy sources.

MONTHLY TOTAL ELECTRICAL ENERGY GENERATED:

By Photovoltaic: 21 000 kWh

By wind turbines: 70 000 kWh

The energy produced by the wind turbines, which is then feeded into the net, is calculated and payed back in the electricity bill.

FIT and additional benefits

Its solar energy plant on the roof garden produces 21.000 kWh solar energy per year. The four wind turbines also installed have a nominal power of 2 kW.

Consequently almost all hotel rooms can be supplied with electricity. A display panel at the reception desk illustrates the production of solar and wind power.

The roof can be visited by guests and interested groups.

With its investment in the wind power station Ettenheim it produces about 70.000 kWh environmentally friendly wind power, which is a credit to its consumption. In 2002 the hotel shifted to green electricity, which actually buys for a small surcharge from its power supply company EWS in Schönau. With that surplus, the EWS arranges the installation of further regenerative current generators in the region.

Economic Basics

The Best Western Premier Hotel Victoria is a major energy consumer. 210 000 kWh electricity and 450,000 kWh of heat energy are annually consumed.

Each guest consumes about 30 kWh of energy per overnight stay. It saves energy through smart technology applications without a losing the comfort standard created for its guests. The Hotel uses energy sources such as sun, wind, water, wood coming from its region.

The solar power plant on the roof has a production capacity of 7,600 W per year, which means 7,000 kWh of solar electricity. Thus, about one-quarter of all rooms are supplied with electricity.

Through its participation in the wind power plant Ettenheim the hotel contributes to the production of environmentally friendly wind power. Its share in the 1.3 megawatt plant produces every year around 70,000 kWh which are then being calculated as bonus pay-back in the electricity bill.

Environmental & Economic Sustainability

The concept involves co-workers and guests actively in their approach to the environment, criticism and suggestions are recorded, the will to try something new and to maintain the achieved goals is promoted.

As an exemplary environmental hotel, it wants to encourage others to imitate their successful model. This applies to hotels, suppliers, guests, partners, neighbors and businesses, where the action.

The energy consumption (electricity, warm water) is read and entered into the monthly energy accounting. These out of plan fluctuations are detected immediately. The accounting department also serves as a basis for benchmarking and as a basis for a further saving measures. The acquisition and systematization of the company from running up and the energy and material flow, as for example, the purchase of regional and organic products is planned in advance. Ideally, this leads not only to improve the ecological, but also the economic and ecological performance of its operations.

Through the use of durable, high-quality materials, it often avoids superfluity renovation and construction debris.

When reconstructing or rebuilding the hotel pays particular attention to environmentally friendly materials and uses water-soluble paints and varnishes. Its environmental protection plans are continuing to develop. It follows the guidelines that are given from the European Union under the EMAS environment policy, indeed.

The combustion of pellets produces as much greenhouse carbon dioxide gas as the wood has absorbed during its growth from the atmosphere. The sustainable forest management of the Black Forest guarantees furthermore that the CO2-circle is closed and no greenhouse effect is built. The reduction of CO2 emissions annually is about 154 tons lower compared to the old oil heating-system.

The hotel achieves thus the following value:

CO2 Emission-values:

Pellets = 0.025 kg/kWh

Natural gas = 0.224 kg/kWh

Eco-energy (EZWS)=0.051kg/kWh

Lessons Learnt

All key suppliers, guests and multipliers were informed about environmental protection and their business philosophy. In this way, the hotel arranged meetings and guided visits for international groups, environmental and medical journals and also for current tourists.

An export monitoring program was developed jointly with the Energy Agency of the Freiburg Region, in order to be supervised on a monthly consumption of all values and be checked. These results are accessible for interested parties. The reduction of annual CO2 emissions values thanks to its modern wood pellet heating system, in comparison to the old oil heating system, is impressive.

3.1.11. Heineken Brewery

Description of the project

Heineken Slovensko has been the leader on the Slovak beer market for over 11 years, with an increasing market share of approximately 45 %. Heineken Slovensko has a strong brand portfolio with the famous international brand Heineken, the most valuable Slovak brand Zlatý Bažant, strong Slovak brands Corgo and Kelt, regional brands Martiner and Gemer as well as popular foreign brands Krušovice, Starobrno and Desperados. Heineken Slovensko brews its brands in Hurbanovo, the largest brewery in Slovakia, established in 1969.

Quick Facts

Heineken Slovensko performance in energy consumption has been very positive over the past year and the brewery managed to decrease the total energy consumption from 153.1 MJ/hl in 2009 to 149.6 MJ/hl in 2010, reaching the target of 155.2 MJ/hl.

The Heineken Slovensko brewery has met targets of 15% energy reduction between 2002 and 2010 within the global "Aware of Energy" Programme, which is aimed specifically at the reduction of thermal energy and electricity use in production.

Design and construction

Renovated wastewater treatment plant, supplemented by anaerobic treatment, which resulted in both increased capacity of waste water, but also the production of renewable energy source (biogas).

In the construction of biogas plants provide:

Phase 1 - Project part:

- The study site (feasibility study)
- Connectivity Study - Request for mount point
- Project (spatial, construction, enforcement)

Phase 2 - construction part:

- From a foundation - the supply of construction work
- Delivery of the cogeneration unit
- Delivery of the biogas process
- Putting into operation

Phase 3 - use / processing of waste heat from biogas plants:

- Secondary heat recovery operation
- Sales of heat to the surrounding buildings (heat pipes)
- Treatment of secondary heat for electricity generation

Phase 4 - servicing after starting the operation:

- Biogas Technology Service
- Providing running biogas plant - management protects

The cost structure should be based on a planned mid-long term supply agreement for biofuel-biogas, in order to have main operative costs under control.

It is necessary to have chosen reliable suppliers of commodities not to incur in heavy penalties due to the unstable delivery of energy, insurance costs, ordinary and extraordinary maintenance costs, safety costs, control and monitoring costs…

FIT and additional benefits

Electricity used for own purposes. Brings benefits concerning the decrease the external purchase of power, decreases operational costs.

Economic Basics

Actually, brewery in Hurbanovo has managed a 42% improvement since 2002. The thermal energy consumption decreased from 85.2 MJ/hl in 2009 to 82.9 MJ/hl in 2010, reaching the target of 85 MJ/hl set for 2010. However, its future goal, which corresponds to the technical state of the brewery, is to reduce thermal energy consumption by up to 77 MJ/hl or even less.

Obviously, additional investments are inevitable. In the first stage we plan to invest into heat recuperation from brew house vapors. In terms of electricity consumption we achieved a decrease from 7.5 kWh/hl in 2009 to 7.4 kWh/hl in 2010, reaching the target of 7.8 kWh/hl.

Environmental & Economic Sustainability

In 2011 the brewery starts using biogas from wastewater treatment plant for cogeneration of electric energy, increase OPI lines to optimize the energy consumption and also the various “minor” activities e.g. turning off lights after leaving the premises.

Lessons Learnt

Utilization of the waste products in food and distillery industry could provide additional free sources for operation costs, or covering human resources costs. The model of energy self-sufficient firms allows total decrease of the negative impact on environment and decrease of the negative effect on C2O.

3.1.12. AMS Engineering GmbH

Description of the project

AMSEC building is a modern office building and computing center housing more than 300 high end servers. The waste heat of the servers and the floor distribution racks is used for heating the building. Cooling is performed by heat pumps using groundwater. Comparing to a conventional office building 70% of the heating- and cooling costs and 40% of electricity can be reduced.

GBE Factory Model

Heating using waste heat of servers and the floor distribution racks. Cooling is covered by heat pumps using groundwater, alternative recooling systems implemented as architectonic elements. The building has 6.500 m² office space, including event center, server rooms, laboratories and workshops.

Quick Facts

LOCATION: Softwarepark 37, Hagenberg (Austria)

BUILDING SIZE (m2): 6.500 m2

30 kW CONTINOUS SERVER CAPACITY

TECHNOLOGY/IES HEAT: server waste heat using

SITE OWNERSHIP: AMS Engineering GmbH

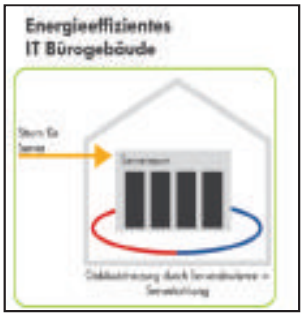
INVESTOR: STIWA Group

PROJECT COST: not known

CURRENT STATUS: Realized

Design and construction

- Building automation (intelligent systems for: lightning, ventilation, heating, cooling, software)
- "Software heats - Soil cools"
- IT-technology
- Integrated planning process
- Planning of heating, cooling, ventilation, electrical installation and control center

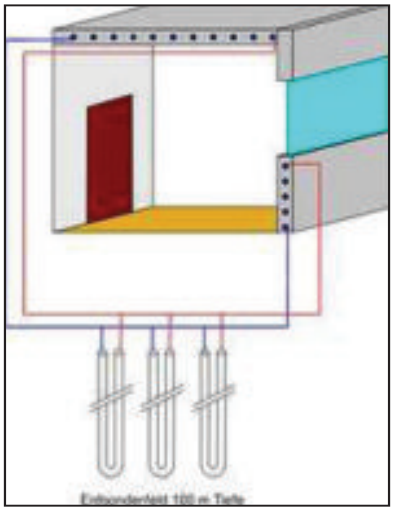


ENERGY CONCEPT

- 100% building heating by using waste heat from innovative server housing system

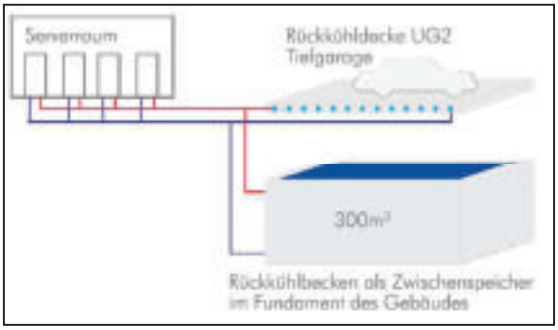
RECOOLING SYSTEM FOR SERVER HEAT

- alternative recooling systems in summer



Building recoolingsystem in summer

· temporary storage of 300 m3 water in building basement for recooling



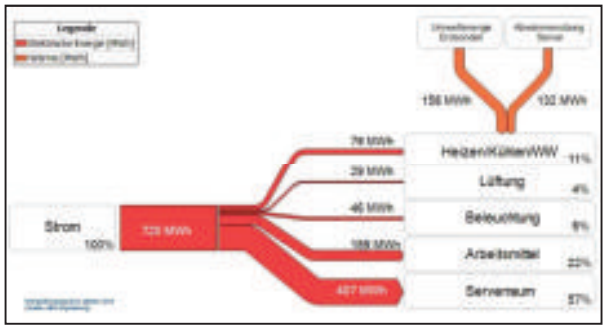
Serverhousing recooling in summer

ENERGY EFFICIENCY MEASURES

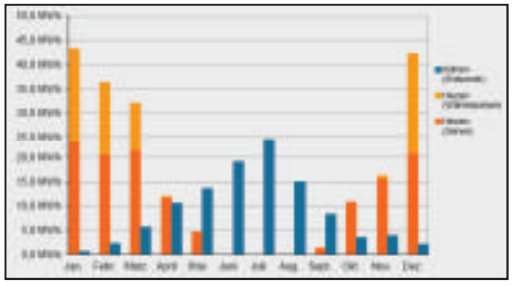
- Optimized building envelope

- Innovative & sustainable energy concept o Low temperature heating- and cooling-system o Using waste heat, solar, biomass, geothermal
- Integrated planning process

Architectonic elements for recooling



Energy flow chart



Energy demand per year

3.1.13. Va.lu.va. Srl

Description of the project

Va.lu.va Frutta s.r.l. deals with trade and production in the fruit processing (pears, apples, cherries, khaki). We consider the new warehouse situated in Via Torricelli, 52 (Verona, Italy).

GBE Factory Model

Here, there is a large and functional store, which is equipped with many big fridges used to conserve the wares. The magazine's roof has been covered with Photovoltaic panels after the old asbestos cover was removed.

Thanks to the new solar energy's system, the warehouse produces about 75% of the energy it needs.

Quick Facts

LOCATION: Via Torricelli, 52 - Verona (Italy)

PLANT SIZE (kwe;kwt): 1.147,47 mq

TECHNOLOGY/IES: Photovoltaic panel

SITE OWNERSHIP: Va.lu.va. S.r.l.

INVESTOR: Va.lu.va. S.r.l.

PROJECT COST: 500.000 €

KEY PARTNERS: Va.lu.va. S.r.l.

CURRENT STATUS: Realized

Design and construction

The type installation is grid-connected and has a three-phases medium voltage connection.

There are 690 Photovoltaic panels on 1.147,47 sq./m that are able to generate a high output power like 158.700 Kw and 158.046,05 KWh yearly.

The panels are connected to an inverter used to exchange the power on the site.

The installation has been divided in 4 lines inclined 6°20 at south-east each.

TECHNICAL DETAILS:

TOTAL SURFACE: 1.147,47 mq

NUMBER Of PHOTOVOLTAIC PANELS: 690

NUMBER Of INVERTER: 1

TOTAL Annual energy: 158.046,05 kWh

TOTAL OUTPUT POWER: 158.700 kW

ENERGY PER kW: 995,88 kWh/kW

BOS: 74,97%

FIT and additional benefits

PARAMETERS OF INSTALLATION:

Typology and Profitability of equipment:

Installation on building: (2nd QT 2011)

Power (kWp): 177.1

Feed-in-Tariff (€/kWh): 0.341

Tariff's bonus (€/kWh): asbestos+ 10%: 0.034

Feed-in-Tariff + bonus (€/kWh): 0.375

Economic Basics

Deciding to install a photovoltaic system, from an economic point of view, is deciding to carry out a financial investment at all of effects.

CONSUMPTION PARAMETERS

Costumer's energy cost (€/kWh): 0.15

Power: MT (200 kW)

Consumption EE (kWh/annual): 204.000

PARAMETERS OF ECONOMIC'S SIMULATION SALE

Inflation EE: 4.0%

Maintenance and insurance cost: € 9.000 approx.

System's Depreciation charge: 9%

Discount Rate: 3.0%

IRAP (TAX): 3.90%

IRES (TAX): 27.50 %

SIMULATION'S TECNICALS PARAMETERS

Self-consumption: 100 %

Annual performance degradation: 0.8 %

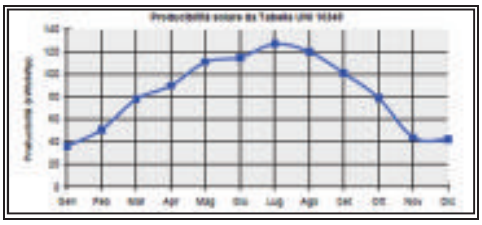
% Requirements covered by photovoltaic energy: 74.97%

Environmental & Economic Sustainability

In according to the district and its related solar belt, the average monthly production is set out in the tab below (amount per KWp installed). The database used is tab UNI10349 with respect the optimal producibility.

Provincia di Verona				
Mese	Giorni	Prod. media giorno (producibilità)	Prod. totale mensile (producibilità)	Prod. mensile impianto (kWh)
Gen	31	1,16	36	6.376
Feb	28	1,82	51	9.032
Mar	31	2,52	78	13.814
Apr	30	3,50	90	15.939
Mag	31	3,58	111	19.655
Giu	30	3,83	115	20.367
Lug	31	4,10	127	22.492
Ago	31	3,87	120	21.262
Set	30	3,37	101	17.887
Ott	31	2,55	79	13.991
Nov	30	1,47	44	7.792
Dic	31	1,35	42	7.436
Totale			994	176.037
Media giornaliera annuale			2,72	481,81

TOTAL MONTHLY TREND ANALYSIS ON THE YEAR:



The totally energy production from this kind of system is green-energy; therefore this is a really environmental friendly system.

Contributo per l'ambiente	
Emissione CO_2 evitate (tonnellate/anno)	88,0

Also the system allows reducing our dependency on petrol and carbon fuel.

Consumo di petrolio evitato	
Petrolio risparmiato (barili/anno)	5.788

Lessons Learnt

This is a very efficiently and interesting solar system model because it allowed a big company with a high energy request such as VA.LU.VA S.r.l. to generate its own energy's requirements.

Besides, looking at the data, the economic feasibility of this investment is clear.

3.1.14. Carrera Spa

Description of the project

Carrera is an Italian company, located in Verona, which has developed and maintains the secret of its success – namely, the ability to combine cutting-edge technology with craftsmanship, to transform a delicate flower like cotton into beautiful and tough products, in full respect of environment.

GBE Factory Model

The building roof has been covered with Photovoltaic panels in all areas. The logistic hub' roof has been covered with Photovoltaic panels after the old asbestos cover was removed. Thanks to the new solar energy's system, the warehouse produces about 100% of the energy it needs.

Quick Facts

LOCATION HQ: Via Sant'Irene - Caldiero - Verona (Italy)
LOCATION PV SYSTEMS: Warehouse in Stallavena (Verona) and Logistic hub in Povegliano Veronese (Verona)
TOTALE PLANT PV SIZE: 3.500 sq/m
TECHNOLOGY/IES: Photovoltaic panel
PV SYSTEMS NUMBERS: 3 (19.8, 110, 215)
SITE OWNERSHIP: Carrera Spa
INVESTOR: Carrera Spa
PROJECT COST: 1.000.000 €
KEY PARTNERS: Carrera Spa
CURRENT STATUS: Realized

Design and construction

The type installation is grid-connected and has a three-phase medium voltage connection.

The installation has been divided in 3 photovoltaic systems: 2 shed and plain roof in Warehouse Site and 1 shed roof in Logistic hub Site.

There are 1.590 Photovoltaic panels on 5.580 sq/m that are able to generate a high output power like 344,8 kWp and 357.902 kWh yearly.

The panels are connected to an inverter used to exchange the power on the site.

TECHNICAL DETAILS

TOTAL SURFACE: 1.590 sq/m

NUMBER Of PHOTOVOLTAIC PANELS: 1.590

NUMBER Of INVERTER: 6

TOTAL Annual energy: 357.902 kWh

TOTAL OUTPUT POWER: 344,8 kWp

ENERGY PER kW: 1.038 kWh/kWp

BOS: 74,97%

TOTAL ANNUAL ENERGY CONSUMPTION

The yearly energy's consumption is 435.000,00 KWh

FIT and additional benefits

PARAMETERS OF INSTALLATION:

TYPOLOGY AND PROFITABILITY OF EQUIPMENT: Installation on building (2009-2010)

POWER (KWP): 344,8

AVERAGE FEED-IN-TARIFF (€/KWH): 0,421

Economic Basics

Deciding to install a photovoltaic system, from an economic point of view, is deciding to carry out a financial investment at all of effects.

CONSUMPTION PARAMETERS

COSTUMER'S ENERGY COST (€/KWH): 0,16

POWER: MT (300)

CONSUMPTION EE (KWH/ANNUAL): 435.000

PARAMETERS OF ECONOMIC'S SIMULATION SALE

Inflation EE: 3%

Operations & Maintenance and insurance cost: € 8.000 approx.

SYSTEM'S DEPRECIATION CHARGE: 9%

DISCOUNT RATE: 3%

IRAP (TAX): 3,9%

IRES (TAX): 27,5 %

FINANCIAL DATA

Financial Index	**100% equity**
IRR 20 years	14,07%
IRR 25 years	14,27%
Revenues 20 years	€ 1.968.383
Revenues 25 years	€ 2.208.672
Payback Period	6,41

Financial Index	**30% equity** **70% bank financing**
IRR 20 years	30,83%
IRR 25 years	30,88%
Revenues 20 years	€ 1.695.766
Revenues 25 years	€ 1.936.054
Payback Period	3,21

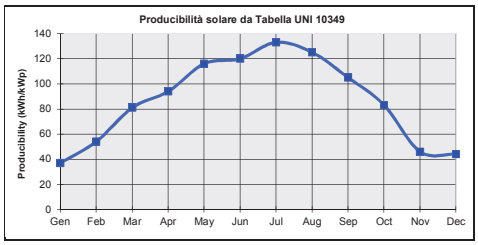
Environmental & Economic Sustainability

In according to the district and its related solar belt, the average monthly production is set out in the tab below (amount per KWp installed).

The database used is tab UNI10349 with respect the optimal producibility.

Carrera Spa, PV Systems				
Month	Day	Average daily producibility (kWh/kWp)	Total monthly producibility (kWh/kWp)	Total monthly production (kWh/kWp)
Gen	31	1,19	37	12.758
Feb	28	1,93	54	18.619
Mar	31	2,61	81	27.929
Apr	30	3,13	94	32.411
May	31	3,74	116	39.997
Jun	30	4,00	120	41.376
Jul	31	4,29	133	45.858
Aug	31	4,03	125	43.100
Sep	30	3,50	105	36.204
Oct	31	2,68	83	28.618
Nov	30	1,53	46	15.861
Dec	31	1,42	44	15.171
Totale			**1.038**	**357.902**
Annual average daily			**2,84**	**979,23**

TOTAL MONTHLY TREND ANALYSIS ON THE YEAR:



The totally energy production from this kind of system is green-energy, therefore this is a really environmental friendly system.

Contribution to the environment	
CO_2 emissions avoided (tons/year)	179,0

Also the system allows reducing our dependency on petrol and carbon fuel.

Compsumption of oil avoided	
Oil saved (barrel/years)	11.767

Lessons Learnt

This is a very efficiently and interesting solar system model because it allowed a big company with a high energy request such as Carrera to generate its own energy's requirements.

Besides, looking at the data, the economic feasibility of this investment is clear.

3.1.15 Johann Pengg AG

Description of the project

As the only Austrian manufacturer of oil tempered spring steel wire, the Joh. Pengg AG in Thörl/Styria, has specialised its product line for applications in the automotive, electrical and machinery industries. Manufacturing oil tempered spring steel wire is an energy intensive process with several heating and cooling process steps.

GBE Factory Model

The Project shows the potential of using renewable resources and the energy amount that could be saved through more efficiency in producing processes.
Using a hydro-electric power plant for electricity and a biomass plant for heat and hot water.

SPECIFIC PROJECT GOALS:

1. analyses the current energy flow (Sankey diagram), to assess the possibilities
2. increase the energy conversion efficiency
3. investigate the possibilities to increase the use renewable energy sources.

Quick Facts

LOCATION**:** 8621 Thörl (Stmk)

ELECTRICITY TECHNOLOGY: Hydro-electric power plant

TECHNOLOGY/IES HEAT: Biomass, Heat recovery

SITE OWNERSHIP: Joh. Pengg AG

INVESTOR**:** Joh. Pengg AG

PROJECT COST: not known

KEY PARTNERS: Johanneum Research

Design and construction

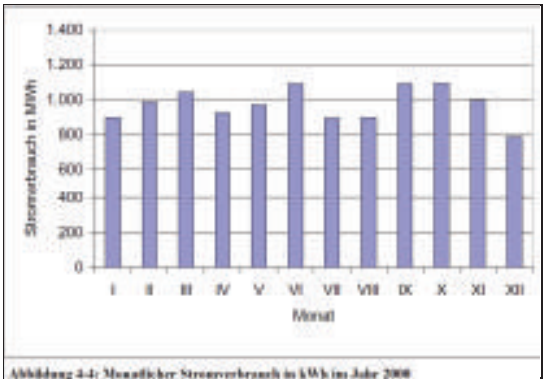
CURRENT ENERGY FLOW

Total energy consumption of 45,35 MWh/a

- 26% Electricity
- 74% Natural Gas

What is Electricity used for:

- 58% are used for mechanical energy to operate the manufacturing lines
- 32% are used for process heat
- 6% are used for lightning
- 4% are used for pressurized air



What is Natural Gas used for?

- 60% are used for direct process heat in the tempering process
- 29% are used for the production of hot water process heat and to heat production buildings
- 5% to operate the gas radiators
- 3% for heating offices and hot water production
- 3% for auxiliary power and the exomat.

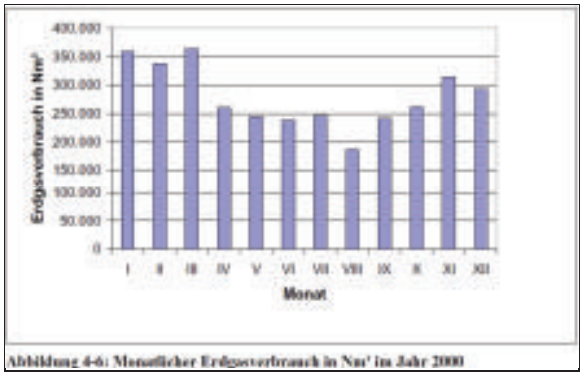


Abbildung 4-6: Monatlicher Erdgasverbrauch in Nm³ im Jahr 2000

ENERGY CONVERSION EFFICIENCY

During all the high energy productions steps new concept of using waste heat were established.

To increase the use of renewable energy it was suggested to replace the natural gas boiler by a biomass fired boiler for the production of the hot water process heat thus reducing the use of natural gas by additional 9,9 MWh/a.

In addition production waste may be incinerated in the boiler. The increased use of hydroelectricity is not recommended for economic reasons.

ENERGY REDUCTION POTENTIAL

The analysis of the energy conversion processes identified measures leading to a reduction of 5,70 Mio kWh/a of natural gas and 1,13 Mio kWh/a of electricity.

The biggest potential is seen in the use of waste heat of the gas burners heating the wire at the beginning of the tempering process for supplying heat to the subsequent process steps in an energy cascade.

3.1.16 Sunny Energy Building

Description of the project

This highly energy-efficient office building is a reference projects to increase popularity of highly energy-efficient construction projects. "ENERGYbase" office building was planned and initiated together by architects, scientists and specialist consultants in an integral planning process. It is an outstanding building due to its innovative architecture, advanced building technologies and the highest possible level of user comfort. The particularly low, cost-saving energy consumption in line with the passive house standard is completely covered by renewable, ecologically sustainable energy sources. The building is exemplary in its ability to harmonize economic and ecological considerations in the construction of state-of-the-art office and commercial real estate.

GBE Factory Model

The building concept is based on three main qualities:

- Energy efficiency (high developed energy- and facility-management)
- Application of renewable energy sources (geothermal energy, solar power)
- Highest level of comfort for occupants

By the use of different arrangements an energy reduction of 80%, means a reduction of 200t/a CO2, could be reached.

Quick Facts

LOCATION: Vienna (Austria)

BUILDING SIZE (m^2): 7.500m^2

TECHNOLOGY/IES: Passive house office building

SITE OWNERSHIP: WWFF

PROJECT COST: 14. Mio.€

KEY PARTNERS: POS Architects; Schneider, U.

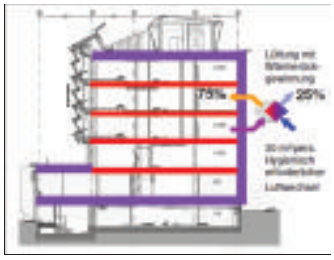
CURRENT STATUS: Realized since 2008

Design and construction

Three main principles serve as the underlying basis for the passive house concept:

- insulation against the loss of heat,
- air-tightness
- controlled ventilation with heat recovery.

One of the innovative features of ENERGYbase is the exclusive use of renewable energies. The passive house standard makes it possible to keep energy requirements at a particularly low level.



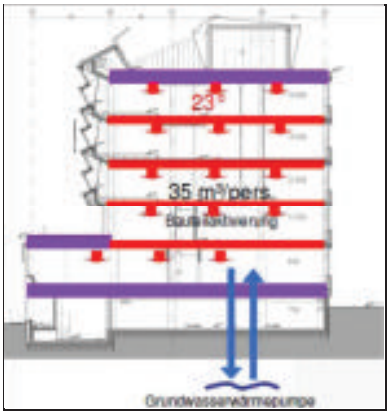
The passive application of solar energy will also be implemented at ENERGY base.

ENERGY CONCEPT

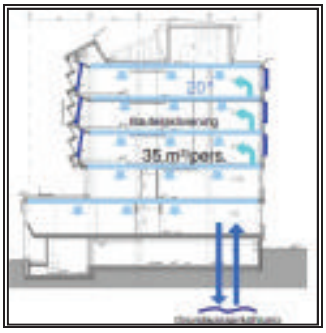
The generated geothermal energy completely covers all heating and cooling needs.

Furthermore, a 400m² photovoltaic facility located on the folded south facade of the building will also supply part of the total electricity requirements.

HEATING AND COOLING BY GEOTHERMAL ENERGY:



An innovative ventilation concept enables the integration of solar energy in summertime by means of solar cooling (solar sorption supported air conditioning), as well as the use of plants to ensure ecologically-friendly, controlled humidification in winter.



FIT and additional benefits

PARAMETERS OF INSTALLATION:

Heating Energy: <11 kWh/a/m^2

Cooling Energy: <15 kWh/a/m^2

=>Certified passiv building

Thermal insulation 26 cm, 75% heat and moisture recycling#

400 m^2 Photovoltaik with 46 kW peak (on south building side. 37.000 kWh solar energy

Environmental & Economic Sustainability

ACTIVE AND PASSIVE USE OF SUN ENERGY:

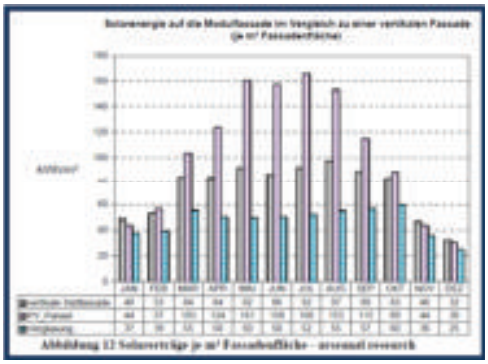
The passive thermal sun energy benefits are directly used on south building rooms and transferred to use the energy indirect in north building rooms.

In winter the building frontage gains sun energy and in summer the frontage is clouding by itself.

On the south building side is a 400 m^2 Photovoltaic sun energy plant where round 37.000 kWh sun energy can be produced in one year.

For solar Cooling there is a 285 m^2 thermal collector for cooling and dehumidify air.

The passive house standard makes it possible to keep energy requirements at a particularly low level. The generated geothermal energy completely covers all heating and cooling needs. Furthermore, a 400m² photovoltaic facility located on the folded south facade of the building will also supply part of the total electricity requirements.



Lessons Learnt

The building is exemplary in its ability to harmonize economic and ecological considerations in the construction.

This highly energy-efficient office building is a reference projects to increase popularity of highly energy-efficient construction projects.

An innovative ventilation concept enables the integration of solar energy in summertime by means of solar cooling (solar sorption supported air conditioning), as well as the use of plants to ensure ecologically-friendly, controlled humidification in winter.

3.1.17 NUNCAS Spa

Description of the project

The Nuncas company manufactures products for home cleaning and care, and has always been very concerned about renewable energy sources innovation. In 2009 it won the award "Ecotech 2009-11 edition-4TH Category" for the enterprises that are excellent in eco-friendly behaviors.

The new building was commissioned in 2005 and represents a clear signal of the awareness of the company to take care both of health and environmental impacts. For these reasons Nuncas realized a low- energy consuming building with zero emissions, combining many renewable energy sources as for example a photovoltaic plant composed by 264 modules of 135KW power that is able to supply the energy required by the entire building.

The realized plant is totally automatic with the possibility to check and register in every moment the situation of the use of renewable energy. Radiant tube feeds were installed over the covering with well water in order to avoid thermal accumulation in the summer time and the sudden change of temperature between the seasons.

GBE Factory Model

The model is "passive building" – these kind of plants are designed for a low energy consumption, to be covered by renewable energy sources. The building is equipped with several renewable energy systems:

- the photovoltaic plant is composed by 264 modules of about 135 kw of power and is able to provide energy to the entire building.

- There is n heating pump
- The entire plant is completely automatic, and it is equipped with a system that is able to check and notify the use of renewable energy for the production of electricity, heating and cooling
- The electric light is regulated by a presence detector, while natural lighting is the main source of light
- Adjustable chimneys serve for lightning the main rooms

Quick facts

LOCATION: Settimo Milanese (Milano)

BUILDING SIZE: Warehouse surface: 5.000 m2;

Warehouse volume: 70.000 m3; Office surface: 2.500 m2; Office volume: 10.000 m3

RENEWABLE ENERGY INSTALLED (kwe;kwth): PV plant 134,16 kwe; Heating pump 54-296 KW

TECHNOLOGY/IES: Heating pump, Circulation of well water on the roof of the building, Automatic curtains adjustment, Solar panels for hot water production, Photovoltaic panels, Lighting (adjustable chimneys).

SITE OWNERSHIP: Nuncas Italia

INVESTOR: Nuncas Italia

Design and construction

Summer and winter conditioning of the offices:

The demand for heating and cooling across the building is achieved with a heating pump that permits to heat and cool the water.

Instead the warehouse is heated with a system of radiating panels powered with boilers, recovering the latent heat of fumes.

The natural ventilation is guaranteed by several opening realized in the lateral walls and all windows are equipped with thermal glasses and sunshade curtains.

Electricity needs are supported by a photovoltaic plant composed by 624 solar panel realized in monocrystallin silicon; every single panel is able to produce around 215W, with a total power production of 134,16 kw.

The entire plant is completely automatic, and is equipped with a system that is able to check and notify the employment of energy sources for the production of electricity, heating and cooling. The electric light is regulated by a presence detector as well, and it is takes in account natural lighting, optimizing the use of it.

The plant is also equipped with a supervision system and a pc controller that allows to monitor the parameters of production all the time.

Warehouse surface: 5.000 mq

Warehouse volume: 70.000 m3

Office surface: 2.500 mq

Office volume: 10.000 m

FIT and additional benefits

The principles of economic sustainability of investment on RES is based on incentive tariff for photovoltaic system (with the rate granted in case of consumption of the energy produced on the spot: 0,36 cent*KWh, in 2007) and on credit taxation for the heating pump (55% for three years). Furthermore the energy savings pays for increased costs of the more efficient housing and of the control system. Another voice, which contributes to the affordability of higher costs incurred for the Nuncas building, is represented by the actual market price of the building, that increases.

COSTS OF THE FACTORY BUILDING

The construction cost increase of the Nuncas building, compared with an equivalent one built without all these environmental-friendly measures, is about 30%.

Economic Basis

The economic return was not the primary reason that prompted the company to build such a building. Instead the owner of Nuncas wanted to emphasize his commitment to environmentally friendly behavior and a comfortable working environment, that puts employees at ease. Nevertheless the investment in PV has a payback estimated at 8-10 years, while the heat pump in less than five.

Environmental & Economic Sustainability

One of the most important results is the CO2 emissions avoided with the use of the integrated plant.

Overall, the amount of CO2 emissions avoided with the plant is around 302 tonnes.

The plant has also obtained in 2009 the certificate of Regione Lombardia of Class A building.

CO2 SAVINGS

Summary of CO2 savings		
Description	**Annual savings (project data)**	**Actual savings (from january 2008 to the end of 2011)**
Condensing boiler	18.4	80.6
Heating pump	178.0	1247.66
Circulation of well water on the roof of the building	2.5	7.61

Automatic curtains adjustment	6.5	12.52
Solar panels for hot water production	0.7	2.86
Photovoltaic panels	82.1	286.33
Lighting (adjustable chimneys)	14.7	140.54
TOTAL CO2	**302.9 t**	**1778.12 t**

The actual savings values are checked and verified by electronic heat-meters supplied from Siemens for the heating pump, solar panels for hot water production and circulation of well water. The related value from the instruments are compared with a standard installation and the results are indicated in a table on our web-site.

About the lighting, every electrical panel is provided of the multimeters which take the electrical consumption of the lights compared with a standard lighting.

As already said, the decision to build the new estate Nuncas with criteria of efficiency and energy sustainability goes beyond only real economic reasons. We can say however, that for companies with the spirit of Nuncas it proves economically profitable both for the direct effects of the savings

achievable, economic incentives obtained, in terms of corporate image, improving of the working environment and the positive involvement of workers

Lessons Learnt

The building of Settimo Milanese, started in March 2007, hostes both the directional offices and the warehouse for the storage of finalized products. It's important because it is one of the first examples of totally sustainable and self-sufficient building realized in Lombardia. The plants have been constructed with the most advanced renewable energy sources technologies and represent a great example of green blue energy factory. Through this project the company management has wanted to emphasize the centrality of employees in corporate life and the importance of the work environment, with a noticeable return in company's reputation.

As the building was designed with climatic parameters that go back about a decade ago and now have changed, the summer air conditioning system struggles at times of maximum heat. This shows that even a super innovative building must be designed so that it can adapt its functionality to future climate change and environmental modifications.

3.1.18 ZEROCENTER

Description of the project

Starting from the idea to invest in the building of a new commercial centre (Zero Centre), the investors started to consider the building new structure using best energy efficiency and saving solutions, in tandem with renewable sources. The result was a commercial type of building high-tech and low power consumption with the presence of sources of renewable energy

GBE Factory Model

The Shopping Centre is equipped with a centralized plant for the supply of heating and cooling. The plant is characterized by a co/tri/generation system based both on methane and on renewable energy sources (the energy which comes from renewable energy source is superior or equal to 10% of the total energy produced).

Thanks to the wood pellet boilers and cogeneration solutions it is possible to avoid C02 emission equal to approximately 25-30% per year, and that

has allowed to obtain Energy Efficiency Titles (TEE). An ESCO (Energy Service Company) built the centralized plant through project financing, together with an area "developer" (75% the ESCO and 25% the developer). After that, the ESCO started managing the plant and provides the user with the supply of heating and cooling. The GBE factory model is "one to many", that means the management of a small local grid for the electric and thermal energy production. The adopted model is able to create a value chain that maintains "in balance" all stakeholders.

Such equilibrium keeps into account different time schedules:

1. the developer: the developer obtained immediate cost savings on the investment;
2. the ESCO: the ESCO intervened marginally during the phase of management of the energy business
3. the users: the users obtained savings on management costs.

Quick facts

LOCATION: Zero Branco (TV) Italy

FACTORY SIZE: 24,000 square meters

124,000 cubic meters (gross)

CENTRAL ENERGY PLANT:

- Heat (Hot water) 2,990 kw (t)
- Refrigeration 4,840 kw (f)
- Electricity 200 kw (e)

TECHNOLOGY/IES: Co- Tri-generation (methane gas)

Renewable energy sources (pellets boiler)

ENERGY SALE TARIFF: <10% than traditional solutions

SITE OWNERSHIP: Real Estate Solution S.P.A

INVESTOR: Real Estate Solution S.P.A

ENERGY PLANT COST: about 2.7 ML €

KEY PARTNERS (E.S.CO.) ASTRIM S.P.A.

CURRENT STATUS: Operative (may 2011)

SHORT RES INVESTMENT DESCRIPTION: High temperature heating generator fed by pellet boiler with a power of 300 kW(t) and yield 93%.

Design and construction

Starting from the idea to invest in the building of a new commercial centre, the best energy solutions have been used, in order to create a technologic building based on renewable energy sources. Therefore the best model to supply the demand for heating and cooling across the building has been chosen. Particular attention was addressed to primary energy transformation, hence the plant is composed by:

- Hot water heater powered through a battery
- Water refrigerator system with EER value >6,0
- Evaporative tower with fluent temperature
- Electric/ thermal tri- generation
- Renewable energy sources (pellet boiler)

Plants Solution used:

- Maximization of primary energy transformation process: natural gas and electricity
- Distribution of heat transfer fluids with a 4-pipe system

- Adoption of thermal jumps to reduce the fluid mass

Plants Solution employed:

- Maximization of primary energy transformation process: natural gas and electricity;
- Distribution of heat transfer fluids with a 4-pipe systems;
- Adoption of thermal jumps to reduce the fluid mass;

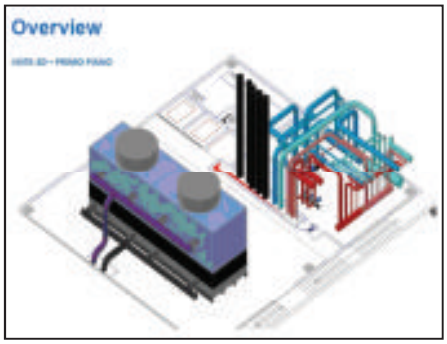
The technologic core is composed by:

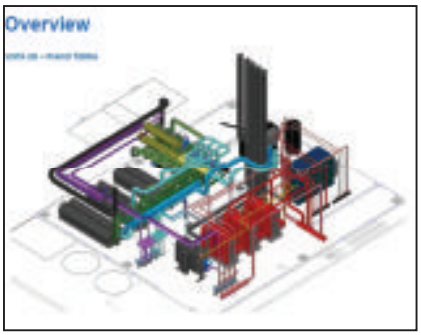
- Thermal power plant gas based: equipped with 3 hot water heater (feed through methane) - Total power: 2.800 kw
- Thermal power plant based on renewable energy source: equipped with 1 hot water heater (feed through pellet) - Total power: 300kw(t)
- Cogeneration plant: Equipped with 1 cogenerator with high performance (feed through methane gas)
- Total power: 200kw
- Total power (recoverable): 290kw
- Central cooling equipped with 3 group

Expected energy production

Thermal energy: 900.00kwh/year

Cooling energy: 2.400.000kwh/year





The technologic core is composed by:

- Thermal power plant based on gas: equipped with 3 hot water heaters (feed through methane)

  Total power: 2.800 kw

- Thermal power plant based on renewable energy sources: equipped with 1 hot water heater (fed through pellets)

  Total power: 300 kw(t)

- Cogeneration plant: Equipped with 1 high performance cogenerator (feed through methane gas)

  Total power: 200kw

  Total power (recoverable): 290kw

  Central cooling equipped with 3 group

Expected energy production

Thermal energy: 900.00kwh/year

Cooling energy: 2.400.000kwh/year

FIT and additional benefits

Thanks to the high efficiency co-generation plant it was possible to obtain the Energy Efficiency Titles (TEE) which consist in 100 Tep per year (around 12,000 euro/year), and a tax break on natural gas supply.

Economic Basis

The initial investment is higher than a traditional one of about 10/15%, and is estimated in 2,7 million Euro. Considering the supply of energy for the shopping centre, the investment allows saving 30% more than a traditional solution. In addition the signing of a long-term contract by users, allows an ESCO to deliver energy bills 10% lower than regular ones.

The business plan is very articulated, and it includes several phases:

- Architectonic sizing;
- Energetic sizing;
- Necessary technical power sizing;
- Production technological model, regulation, and energy vectors distribution;
- Definition of a business model shared by the involved actors (developers and ESCO)
- Definition of a business plan.

Environmental & Economic Sustainability

The technological solutions adopted are some of the best mixes existing. The total amount of CO2 avoided is around 400 Tons per year. The economic sustainability bases on the following considerations.

The initial investment for the energy production and distribution network, that reaches the metering equipment at the users (of approximately € 2.7 ml cost), is higher by a 10% to 15% compared to conventional distributed solutions with small utility bills. This additional cost is outweighed by the fact that the solutions adopted will, as regards the energy supplied to the users of the Zero Center by the ESCO, a cost saving of approximately 30% compared to what would have been required with conventional solutions. This fact, coupled with the signing of contracts for deferred delivery of energy by the end user, enables the ESCO to pay the investment made in a reasonable time and to charge tenants of the Zero Center with rates for the sale of heat and refrigeration less than 10% those resulting from traditional technological solutions.

Lessons Learnt

The achieved results both from a technological and environmental point of view show that it is possible to merge different kinds of energy sources, traditional and renewable ones, in order to create excellent solutions both for users and the environment.

Some obtained pills of wisdom:

"The best energy savings achievable is from energy not consumed ..."

"Following an intervention to improve efficiency, if there are economic savings, there is definitely at the base energy savings, but it is not always said the opposite ... "

"It is necessary to get specific knowledge (high competences required) on how to combine energy efficiency solutions with renewable energy sources, in order to reach the goal zero emission

3.1.19 SCHÜCO ITALIA

Description of the project

For its new headquarters in Padua, Schüco Italia, a leader in the field of envelope construction and energy efficient solutions for the exploitation of solar energy, has changed an obsolete and energy-intensive building in a facility that has obtained the "CLASS A" award, using Schüco systems. With the avant-garde architecture the building is a real example of successful industrial '80s building recovery. The new Schüco headquarters now save over 50% in terms of energy requirements through heating and cooling, approximately 440,000 kWh (170 tons of CO2 avoided every year). The building also produces energy thanks to a 540 kWp photovoltaic system and other "Schüco Made" solutions like the" solar cooling", a cooling system that uses hot water produced by high efficiency solar panels, a geothermal system made by 7 drills 80 meters deep and supported by solar thermal collectors, as well as a photovoltaic system on the roof able to meet the energy needs of the entire building (offices and warehouses) with a production of about 630,000 kWh/year. Schüco used the patented E2facade to provide an efficient building ventilation and solar shading solution with a high energy performance. On the other face of the façade architectural photovoltaic panels using micro-crystalline silicon thin film is present.

GBE Factory Model

Schüco shows how the new building architecture, when implementing solutions oriented to thermal insulation, efficient ventilation and careful management of the light, leads to energy savings of more than 50%, paying the extra investment in the medium term, evaluable in +20% cost with respect to the adoption of conventional building solutions.

In addition, the use of renewable energy to meet fully the electrical and thermal needs of the building, thanks to the tariffs of 2010 in Italy, shows an attractive pay back of the investment with good returns, if seen over the life of 20 years.

Furthermore, the application of a control and communication system for the management of external heat sources (sun and soil), the light (internal and external) and internal energy use, allows to achieve high average levels of comfort and to further reduce the energy consumption with the result of selling to the public grid the surplus of electricity generated from renewable energy sources installed.

Quick facts

LOCATION: Padova - Italy

TOTAL AREA: 31.401 sqm

OVERALL FLOOR AREA: 20.962 sqm

OFFICE FLOOR AREA: about 4.200 sqm

BUILDING ENVELOPE: Façade E2 (double skin, ventilation, solar shading, integration of thin photovoltaic film);

SOLAR THERMAL ROOF PANELS: 10 KWp (for geothermal plant);

SOLAR THERMAL ROOF PANELS: 36 KWp (for solar cooling system)

PHOTOVOLTAIC ROOF PANELS: 540KWp (providing energy to offices and warehouse)

ENERGETIC AWARD: Class A

Design and construction

Architectural concept: Unity despite differences. The complex consists of two parts: a new building housing offices and showrooms and the renovated warehouse. The new building is based on the existing column grid and runs parallel to the existing structure.

The façade performs important functions for the building: ideal thermal insulation, optimum natural illumination, protection from excessive solar radiation, and other functions such as electricity generation (For the east and south façades of the new building, the multifunctional Schüco E2 Façade including the thin-film photovoltaic module ProSol TF was used). Opening, solar-shading, and thin-film photovoltaic units, as well as decentralized air-conditioning modules, are integrated in the interior. Parallel opening windows ensure optimum ventilation. The photovoltaic

installation on the roof of the new building and the warehouse covers a total area of 4,550 m² with 3,570 monocrystalline modules and a total output of 540 kWp. To integrate the on-roof system into the architecture, the modules were mounted with a horizontal inclination of 6°. The on-roof system and the window and façade modules ProSol TF integrated into the façade guarantee solar energy generation on the south façades. The thin-film photovoltaic system in the south façade is characterized by an optimum utilization of diffuse lightand therefore is functional to the vertical arrangement of the façade. Geothermal energy is produced through a heat pump extracting low-temperature heat from the ground via 80 meter-deep earth sources and transfers heat to the ground, thus reducing heating and cooling energy consumption. The Schüco heat pump HPSol 17, which has an output of 17 kW, is operated by five solar thermal collectors. These collectors heat a combination cylinder that is used to produce hot water and controls the thermal cycle.

FIT and additional benefits

Photovoltaic energy: YES

Thermal energy: NO.

Geothermal energy: NO

Energy efficiency: NO

Feed-in-Tariff: (€/kWh): 0.422

Tariff's bonus: (€/kWh): 0.021

Since the connection the company produced more than 1.200.000 kWh of clean energy, avoiding more than 340.000 kg of CO2 and earning more than euro 550.000 thanks to this PV plant .

Economic Basis

Production parameters:

- Photovoltaic energy
  - PBT: 7 years
  - IRR: 12 %
- Thermal energy
  - PBT: 9 years
  - IRR: 8 %
- Geothermal energy
  - PBT: 11 years
  - IRR : 6%
- Energy efficiency
  - PBT: 9 years

- IRR: 8 %

Environmental & Economic Sustainability

To visibly demonstrate Schüco's corporate mission, "Energy2 – Saving Energy and Generating Energy" to every visitor, a display in the new building's entrance area shows the energy generated and the energy saved by the technologies in real time. The energy concept of the complex is based on photovoltaics, solar and geothermal energy, a solar cooling system, intelligent façades, and a heat pump. Another important element that reduces energy consumption is the building automation developed for system control.

Lessons Learnt

The innovative refurbishment project impressively shows how a former industrial building can be transformed into a sustainable, resource-conserving, comfortable office building. This is future-oriented energy-efficient construction.

By combining sustainable photovoltaic thin-film technology with tried-and-tested Schüco façade systems, Schüco opens up new possibilities for solar architecture, and sets new standards of efficiency and design.

3.3. “One by one plus”

3.3.1. SOFIYSKA VODA AD, City of Sofia

Description of the project

„Sofiyska voda“ AD provides for the services water supply, sewerage and purification of the waste waters on the territory of the Municipality of Sofia.

The company delivers water supply and sewage services to around 1 400 000 inhabitants of the capital city of Bulgaria. Our activity comprises the exploitation, maintenance and management of hundreds of facilities and thousands of kilometres of water-pipes and drains. Our team is set up by responsible and high-qualified employees who are oriented to clients and generate investments of millions of Euro every year for the development and future of the city.

„Sofiyska voda“ AD was established in October 2000 by virtue of 25-year concession contract. By means of it the Municipality of Sofia cedes to the company the exploitation and maintenance of the water supply and sewage system in Sofia.

Our share capital is allotted between the Sofia Municipality (22.9%) and the French company „Veolia Waters” C.A. (in total 77.1% of the shares).

„Sofiyska voda“ is not the owner but a concessioner of the water supply and sewage assets – they are public municipal property. All newly-built facilities with company investments belong likewise to the Sofia Municipality.

GBE Factory Model

The wastewater treatment station (WWTS) for Sofia purifies domestic, industrial and rainy waters incoming from the sewage network of the entire capital city. The plant was put into operation in 1984 and it is the largest by now on the Balkans. For over a quarter of a century the facility functions incessantly, as throughout the years it has undergone partial reconstructions and improvements, financed by European funds and through the capital programme of „Sofiyska voda".

The plant is located in the lowest northern part of Sofia – Kubratovo – and covers a total area of 6000 acres. According to the project its capacity is 480 000 cubic meters of wastewater per day. Today, the average daily quantity of wastewater going through the wastewater treatment station Kubratovo is around 400 000 cubic meters.

Since October 2000 „Sofiyska voda" AD took over the activity of delivering water supply and sewage services on the territory of the Sofia Municipality and the Kibratovo plant has become part of the assets run by the company. Since the beginning of December 2009 „Sofiyska voda" AD brought into operation the largest co-generation installation in the Bulgarian water supply and sewage sector for the production of electric and heat energy from biogas. To this end, the „Sofiyska voda" AD realized an extensive investment project to modernize and renovate the residual and gas management, in order to contain this biogas. Three co-generation units have been installed. Each of them has a capacity of 1063 kW electric energy and 1088 kW of heat energy.

Quick Facts

LOCATION: Benkovski area, Sofia

PLANT SIZE (kwe; kwt): 3189 KWe el. energy

3264 KWt heat energy

TECHNOLOGY/IES: Bio-gas co-generators

SITE OWNERSHIP: Sofiyska voda

INVESTOR: Sofiyska voda

PROJECT COST: € 2,6 mln.

KEY PARTNERS: Eur. Bank for reconstruction and development, United Bulgarian bank

CURRENT STATUS: realized

Design and construction

TECHNICAL DETAILS:

No. of Co-Generators: 3

Output of each co-generator:

- El. energy - 1063 KW
- Heat energy - 1088 KW

TOTAL ELECTRIC ENERGY GENERATED

2010 (January - December) – 1117160.3 KWh – average per month

2011 (January - September) – 999 090 KWh – average per month

TOTAL ANNUAL ENERGY CONSUMPTION

2010 (Jan - Dec) - 18034237 KWh

2011 (Jan - Sept) - 15975532 KWh

FIT and additional benefits

PARAMETERS OF INSTALLATION:

Typology and Profitability of equipment: Co-Generators with 83 % coefficient of efficiency

Installation on building:

Power (kWp): 3189 KWe el. energy

3264 KWt heat energy

Feed-in-Tariff (€/kWh): 61.02

Economic Basics

€0.8 mln. of the project cost have been financed under the BEERCL credit line (Bulgarian Energy Efficiency and Renewable energy Credit Line) with funds contributed by the EBRD and the International fund for decommissioning of Kozloduy nuclear power plant through the local bank partner on this credit line – United Bulgarian Bank AD. According to the mandatory procedures of BEERCL, and jointly with the project technical consultants Encon Services Ltd, we have developed a Rational Energy Utilization Plan. The project was finally approved by the financing bodies.

<u>CONSUMPTION PARAMETERS</u>

Costumer's energy cost (€/kWh) & internal consumption

Power: 3x 1063 KW el. energy and

3x1088 KW heat energy

Consumption EE (kWh/annual):

2010 (Jan - Dec) - 18034237 KWh

2011 (Jan - Sept) - 15975532 KWh

PARAMETERS OF ECONOMIC'S SIMULATION SALE

Inflation EE: 3,5%

Maintenance and insurance cost: 130 K€/year

System's Depreciation charge: 10 %/year

Discount Rate: 0 %

IRAP (TAX): 10 % nominal

IRES (TAX): 17.21 % (effective for 2010)

Pay-back period - 5 years

Net present value – NPV - € 2 858k @ 10%

SAVED EMISSIONS OF CO2/YEAR

Year	tCO_2e
2007	36,213
2008	68,321
2009	100,474
2010	116,026
2011	124,700
2012	139,200

Environmental & Economic Sustainability

The co-generation turns around 83% of the fuels energy content into efficient energy, which is about twice more in comparison with the conventional plants. This means higher efficiency, hence with a lower price and lesser pollution. Putting into operation of the co-generation installation has an ecologic, economic and social effect:

- considerable costs cutting down for fuels and energy
- making use of the waste product - biogas, which liberates in the process of residues purification;
- limiting the liberation of methane and carbon dioxide in the atmosphere, which conduces to improving the environmental state;
- reducing the harmful emissions brings benefits not only to the capital inhabitants but bears also national and global nature;
- contribution to discharge the state duties to reduce the harmful emissions in the atmosphere in conformity to the Kyoto Protocol.

This plant makes part of the project activities to reduce the carbon emissions according to the Agreement of fewer emission sales between „Sofiyska voda" AD, the Carbon fund of the EBRD and the Government of The Netherlands

Lessons Learnt

The co-generation in the wastewater treatment plant Kubratovo is an important project for „Sofiyska voda" AD because it makes another

confirmation of our commitment to safeguarding the environment. With the purified waters of Sofia flowing into the Iskar river and the stabilized residues, that are used in the agriculture, the "green energy", generated by the site, contributes to protecting the natural resources. The benefits represent 0,75 million Euro of saved costs for electric energy and a substantial contribution to the positive image of the company.

3.2.2. LEIBER GmbH

Description of the project

The Leiber GmbH is a modern biotech company and one of the leading producers of yeast for the food and feed sector. The company develops, produces and distributes dried brewer's yeast and yeast extract and is currently developing products for the health and cosmetics sector.

GBE Factory Model

The company installed a new waste-water treatment plant which also produces biogas. The biogas fuels a Combined Heat and Power Plant (CHP) which produces electricity and heat (CHP output: 190 kW electrical power/ 240 kW thermal power).

The company cannot only meet its own heating needs but also sell part of the heat produced to a neighboring company.

Quick Facts

LOCATION: Bramsche/ Germany

PLANT SIZE (kwe;kwt): CHP output: 190 kW electrical power/ 240 kW thermal power

TECHNOLOGY/IES: Biogas CHP

SITE OWNERSHIP: Leiber GmbH, Hafenstraße 24

49565 Bramsche

INVESTOR: Leiber GmbH

PROJECT COST: 850,000 Euro

CURRENT STATUS: Realized

Design and construction

ELECTRICAL POWER: 1.115.000 kWh/ year

THERMAL POWER: 641.000 kWh/ year

ECONOMIC PROFITS AND ASSOCIATED COST REDUCTIONS:

FEED-IN-TARIFF: 147.000 €/ year

HEAT USED (OWN CONSUMPTION AND DELIVERED): 22.000 €/ year

SAVINGS DUE TO EFFICIENCY MEASURES: 26.000 €/Jahr

FURTHER SAVINGS (LESS CHEMICALS USED, LESS WASTED PRODUCED): 81.000 €/Jahr

ELECTRICITY SAVED: 363.000 kWh/Jahr

ELECTRICITY SAVED: 72 %

REDUCTION OF CO2 EMMISSIONS: 1.109 t/Jahr

INVESTMENT: 850.000 €

RETURN ON CAPITAL: 33 %

Fit and additional benefits

Feed-in-tariff: 147.000 €/ year

Environmental & Economic Sustainability

The company had a really integrated approach to address the issues, not only focusing renewable energy sources but also addressing the topics of waste management and the use of chemicals in the production process:

- integrated innovative waste-water treatment with lower energy consumption, less waste and lees need to use chemicals;

- utilization of the biogas produced during the waste-water treatment in a Combined Heat and Power Plant (CHP);
- Induction of the electricity produced into the public grid according to the regulations on the feed-in tariffs;
- utilization of the heat produced by the CHP plant in the company's own production as well as in a neighbouring plant.

Lessons Learnt

This is a god example how different needs within a company can be dealt with: the need for an new waste-water treatment plant led to the increased use of renewable energies not only to generate electric power but also to meet the demand for heat.

3.2.3. Zimmerei Sieverke GmbH

Description of the project

The company Sieveke is carpentry with a long tradition, it was founded in 1912. They employ about 40 people, mostly engineers, master carpenters and carpenters. The company develops and produces wooden products like roof structures, wooden walls, window frames and wooden bungalows. The wooden parts are produced in the workshop with CAD/ CNC assistance and are integrated on the construction site by the company's own staff.

The company installed a warm-air heating system fueled with the waste-wood.

The company cannot only meet its own heating needs to heat the workshop but also the commercial and residential building next to it including the tap water.

The wood as a fuel does not have to be bought but is more or less waste from the production process.

Quick Facts

LOCATION: Lohne/ Germany

PLANT SIZE: 400 kW/ 32.000 m^3/h

TECHNOLOGY/IES: hot-air heating system fueled with renewables (briquet)

SITE OWNERSHIP: Zimmerei Sieveke GmbH, Ing.-Holzbau, Bakumer Str. 24, 49393 Lohne

INVESTOR: Sieveke GmbH

PROJECT COST: Euro

CURRENT STATUS: Realized

Design and construction

THERMAL POWER OF THE SYSTEM: 400 kW/ 16.000 m³/h

HEAT PRODUCED FOR THE WORKSHOP: 320 kW

HEAT FOR THE COMMERCIAL AND RESIDENTIAL BUILDING: 80 kW

HEATING EFFICIENCY: about 90 %

SAVINGS DUE TO THE NEW HOT-AIR HEATING SYSTEM WITH WOOD BRIQUET: about 20.000 €/Jahr

HEATING OIL SAVED: about 25.000 liters/Jahr

REDUCTION OF CO2 EMMISSIONS: about 70.000 kg/ year

FIT and additional benefits

Feed-in-tariff: N/A

Environmental & Economic Sustainability

Pellet and woodchip heating systems are pretty common in the housing sector but not in the commercial sector with large halls and workshops. There in most cases a hot-air heating systems are used instead of heating elements. The company had an oil-fueled hot-air system for the workshop and a gas heating for the adjacent commercial/ residential building. Both were quite cost-intensive.

At the same time the business grew and with the growth of the business there was ever more wooden waste. This waste was disposed of in containers before.

The company decided to address the different problems with an all-embracing approach. The contacted a regional company that has specialized on hot-air heating systems and that was able to construct a wood-fueled system for these special needs

To ensure a clean burning, the waste wood from the production process is chaffed and mixed at first to produce a homogenous fuel. At the end of this process, the briquettes produced have an amount of moisture of 15 – 20 % and a heat value of 4 kWh/ kilo. An automatic conveyor screw with adjustable speed transports the wooden fuel constantly from the silo to the furnace.

The air is taken in and filtered via an air-channel system before it is transported to a heat exchanger. The heating efficiency is about 90 % as air can be heated easier than water and air can use directly for heating purposes as there are hardly any losses. This saves fuel and costs.

Excess heat is also stored in a water-storage system that is connected with the commercial and residential building with a long-distance heating line.

In one year, the carpentry needs about 500 m³ wood-chips (30 to 40 tons). This equals to about 30.000 liters of heating oil.t

Lessons Learnt

This example demonstrates that careful planning, the cooperation with an external expert – in this case the specialist on hot-air heating systems – and the will to develop new, innovative systems can help to tackle different problems with one solution. The solution leads to the tailor-made utilization of RES, helps to cut costs and is also a contribution to climate

protection. It is a rewarding solution though there are no permanent benefits like e. g. feed-in tariffs.

The development of the innovative hot-air system was supported by the federal state of Lower-Saxony.

3.4. "One to many"

3.4.1. Solar.nahwaerme Energiecontracting GmbH

Description of the project

Solar.nahwaerme Energiecontracting Gmbh is a subsidiary company of nahwaerme.at Energiecontracting GmbH, which is an Energy services company. It was established and operates in collaboration with local partners, systems based on renewable energy sources. In the project "Wasserwerk Andritz" a large scale solar thermal plant was erected on the ground of the local water supplier. The system supports the local heating system (LH) of the office buildings of the local water utility. The surplus heat is fed into the district heating grid (DH) from the city of Graz. With the installed high temperature (HT) flat plate collectors, the necessary temperatures for district heating supply can be achieved. On the local water conservation area, enough open space was available for construction of the plant.

The free available area of the water conservation area zone is used for the construction of the solar field.

The installed solar thermal system covers about 40 % of the heating energy which is needed for the local office buildings. The large part of the heat production is fed into the district heating grid.

Quick Facts

LOCATION: Wasserwerkgasse 9-11; A-8045 Graz

PLANT SIZE: 3,855 sqm

TECHNOLOGY/RES: Solar thermal HT collectors

SITE OWNERSHIP: Holding Graz AG

INVESTOR: Solar.nahwaerme Energiecontracting GmbH

PROJECT COST: 1.57 Mio. €

STATE GRANTS: 550.000 €

KEY PARTNERS: S.O.L.I.D. GmbH; Holding Graz AG; Energie Graz AG

CURRENT STATUS: Operational

Design and construction

The solar plant feeds in over a heat exchanger into a storage tank with 62 m^3. As a matter of priority which serves as an inventory heat storage tank. In the case that the solar plant cannot deliver energy, the district heating as a conventional source of energy provides the storage tank. Furthermore it is planned to install a heat pump this year, which will operate, if the temperatures of the collectors fall below a decent temperature, because this temperature is still high enough for reaching a satisfying COP of the heat pump. Starting out from the storage tank the existing objects as well as the new building are provided with warmth. If there is a surplus of solar energy, i.e. storage tank is fully loaded and can take no more warmth energy; the solar energy will be fed directly into the district heating net of Graz. All collectors are free mounted on the area of “Wasserwerke Andritz”. This large-scale solar plant demonstrates the commitment of the city of Graz to renewable energies and the protection of the environment. The plant is the 4th solar system which is integrated into the district heating system of Graz.

TECHNICAL DETAILS:

TOTAL SURFACE: 3,855 sqm

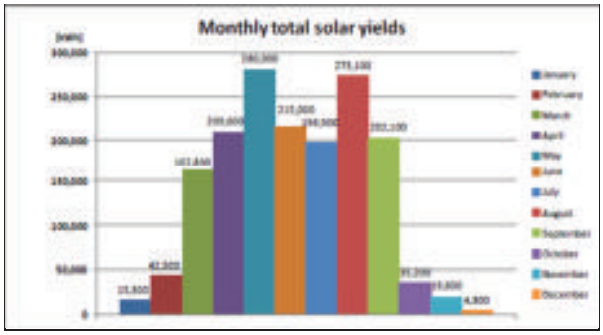
NUMBER of thermal collectors: 270

HEAT STORAGE: 62 m³

TOTAL solar yield: 1,657 MWh/year

SPECIFIC solar yield: 430 kWh/m²BRUTTO*a

MONTHLY TOTAL ENERGY GENERATED

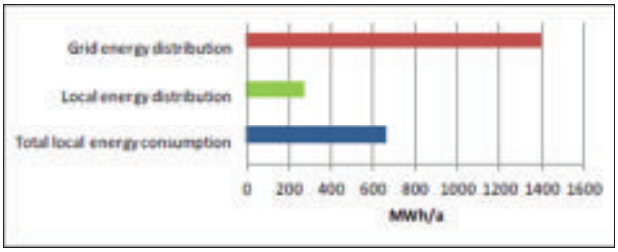


ENERGY DISTRIBUTION

Local energy consumption = 654 MWh/a

Local energy distribution = 262.3 MWh/a

Grid energy distribution = 1,394.6 MWh/a



FIT and additional benefits

PARAMETERS OF INSTALLATION:

Installation: 2nd QT 2009

Capacity [kWtherm]: 2,062.4

FEED-IN-TARIFF:

LH: 54,352 €/MWh

- Demand rate LH: 204,6 €/month
- Winter tariff: 31,51 €/MWh
- Summer tariff: 26,74 €/MWh

Economic Basics

PARAMETERS

See feed -in-tariffs.

PARAMETERS OF ECONOMIC'S SIMULATION SALE

Interest rate: 4.0%

Grants: 550,000 €

Maintenance and insurance cost: app. € 1.000

Depreciation period: 25 years

System's Depreciation charge: 4 %

Discount Rate:

LH: 0%

DH: 17.3 % (based on the winter tariff)

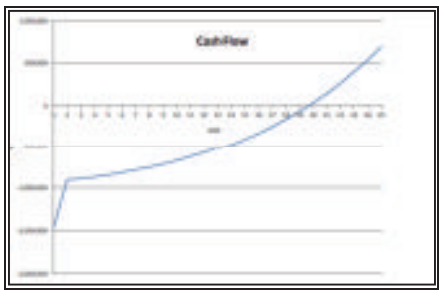
Income tax: 25 %

SIMULATION'S TECHNICALS PARAMETERS

District heating net: 84.2 % of total solar energy produced

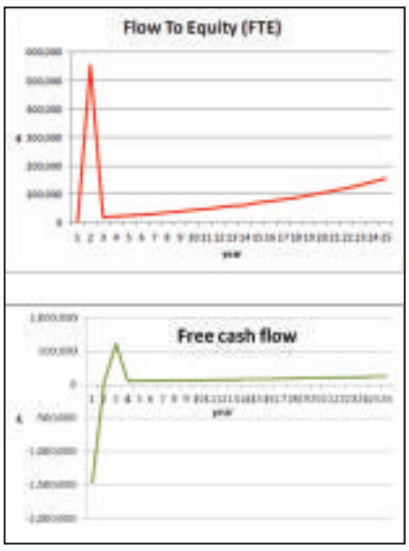
Local heating demand: 15.8 of total solar energy produced

Solar fraction: 40 % of the local heat demand



Payback period: 19.6 years

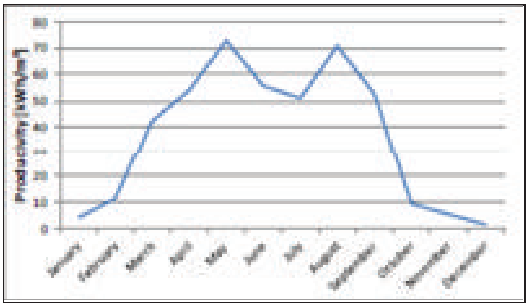
IRR after 25 years: 8.7 %



Environmental & Economic Sustainability

The measured total solar yields are shown in the table below.

	Total solar production [kWh/month]	Total solar production [kWh/brutto m² coll.]
January	15,300	4.0
February	42,500	11.0
March	162,800	42.2
April	209,600	54.4
May	280,000	72.6
June	215,000	55.8
July	196,900	51.1
August	273,100	70.8
September	202,100	52.4
October	35,200	9.1
November	19,600	5.1
December	4,800	1.2
SUM	1,656,900	429.8



<u>TOTAL MONTHLY TREND ANALYSIS OVER THE YEAR:</u>

Solar thermal energy is CO_2-free and therefore environmentally friendly. In determining the CO_2 savings following substituted heat sources were considered: Coal power plant, natural gas power plant, gas heating plant,

industrial surplus heat. The impact of the district heat amounts to 99.206 kg CO2/MWh.

Contribution to the environment		
CO_2 Savings	164	[tons CO2/year]

Lessons Learnt

This solar thermal system shows us following points:

- Efficiency of large solar thermal applications;
- Application of an ESCO model in this field of RES;
- Existing economy (also with a 17.3% lower feed in tariff compared to conventional heat sources, which feed into the district heating grid);
- Possibility of solar district heating supply.

This example shows the possible use of large solar thermal plants. Due to higher feed-in tariffs in an industrial area, the payback time could be significantly reduced.

3.4.2. HTMAS

Description of the project

HTMAS is a Slovak Industrial Park, located in-between Banska Bystrica and Zvolen in the village of Vlkanova. It has been developed to host a local and foreign investors companies, logistics and production lines. The Industrial Park was designed in full respect to environment.

Quick Facts

The HTMAS industrial park in Vlkonova opened in 2008 invested in green energy and installed sun collectors on the top roof of the industrial park with a total power of 855 MW/H officially producing electricity as of February 2010.

The Industrial park is hosting in total 7 companies of various SME investors and production lines and it uses 92% of he produced power for the need of the companies.

Design and construction

The owners of HTMAS have established a local grid with 3 power supply transformers.

LOCATION OF PHOTOVOLTAIC POWERPLANT: Vlkanova, district Banska Bystrica, middle Slovakia (altitude 315 metres above sea level)

EFFECTIVE AREA OF MODULES: 6.036,87 m²

INSTALLED POWER: 855,02 kWp

TYPE OF SOLAR MODULES: Yingli solar polycrystalline silicone (YL230P-29b)

NUMBER OF SOLAR MODULES: 3.716 pieces

INVERTORS OF ELECTRIC CURRENT: DELTA Electronics (7 x central invertor Delta CI 100; 9 x string invertor Delta SI 5000)

POSITION OF THE MODULES: 500 pieces, ground installation, orientation -5°; 716 pieces, roof installation, orientation -20°; 2.500 pieces, roof installation, orientation -5°

FIT and additional benefits

The company has a contract with the distribution network for 15 years (feed-in tariff 365 green energy state bonus and 60 Euro loss-benefit in case electricity is distribute to the national distribution network).

The owner of the solar panels is selling most of the power to the companies seated in the park.

Economic Basics

The investor, an owner of the park, uses the local grid to distribute electricity to all end-users in the park and 4 additional companies from the old industrial park of Vlkanova. This year the park produced 920 MW.

In 2012 the park will be constructing a new water power plant with a total installed power of 0,45 MW for the needs of the companies in the industrial park. The investment will be repaid for 7 years.

The investor is transferring the same model to Bulgaria and Romania in 2012.

Environmental & Economic Sustainability

CO2 reduction per year: 495.144 kg CO2.

Increased sustainability of the companies in the industrial park by minimizing the risks that could derive from the national grid.

Lessons Learnt

Installation of the roof-topped solar panels in industrial parks promotes development of self-sustained model for the use of power from the grid.
The companies in the industrial park are not depended on any shortage of the grid as well as weather changes or any other external factors that could cause any drop offs in the utility system.
Using the local grid enables the investors shorten the period of return of the investment from 15 to 7 years.
Decrease of C2O achieved.
Developed a model of one providing power to others in a closed grid system.

1.4. "Many to one"

1.4.1. Paderno Network

Description of the project

Paderno Network is the only example of a many to one GBE FACTORY. In fact here there are 5 factory owner positioned in the same area that decided to install 5 PV plants and to join them in a single grid.

This structure is installed in an industrial area near Milano where consumptions of energy are surely high.

Quick Facts

LOCATION: Paderno Dugnano (MI)

PLANT SIZE: 2.000 mq

TECHNOLOGY/RES: Photovoltaic Panel

SITE OWNERSHIP: Every single factory

INVESTOR: Every single factory

PROJECT COST: 890.190,00 €

KEY PARTNERS: ForGreen Spa

CURRENT STATUS: Operational

Design and construction

After a specific study, over single roofs were installed 5 singular photovoltaic implant that produce energy not only for the production of single factory but also, thanks to a "smart grid" between factories, for the others (obviously when they need more energy than what they need).

The type installation is grid-connected and has a three-phase medium voltage connection. The panels are connected to an inverter used to exchange the power on the site.

TECHNICAL DETAILS:

SURFACE: 1.800 mq

NUMBER of thermal collectors: 1.135

SECTION	SINGLE PV PLANT	POWER (kWp)	kWh/year	kWh/kWp
1	RDM	106,04	99.500	938
2	VISMARA	36,34	34.000	936
3	BI.ESSE	19,32	18.000	932
4	SCHIAREA	57,27	54.000	943
5	NIMA ERRE	37,26	36.000	966
TOTAL PADERNO DUGNANO		**256,23**	**241.500**	**943**

FIT and additional benefits

Installation: 1nd QT 2011

Feed-in-tariff: 0.355 (€/kWh)

Economic Basics

Deciding to install a photovoltaic system, from an economic point of view, is deciding to carry out a financial investment at all of effect. This is the case where there is an equity of 30% and the other 70% is from bank financing.

Economic Basics	
TIR 20 years	15,49%
TIR 25 years	15,81%
Revenues 20 years	€ 673.251
Revenues 25 years	€ 808.098
Payback Period	5,94

Environmental & Economic Sustainability

The totally energy production from thin network is green-energy; therefore this is a really environmental friendly system.

Contribution to the environment	
CO2 emissions avoided (ton/year)	120,2

Also the system reducing the dependency on petrol and carbon fuel.

Consumption of oil avoided	
Oil saved (barrel/year)	7.902

Lessons Learnt

This is a very interesting solar system model because it allowed energy needs of all factories and they'll can also supply to extra needs from the others. Even if there'll be an extra-production, all green-energy in plus could be sell to the national grid and make profit for participants of this network.

Conclusion

The described Business Models offer the general vision on the ways in which it is possible to organize and implement a GBE FACTORY. The collected Best Practices, show real examples of how these models can be implemented in different countries and geographical conditions. Finally, the market analysis allows to take in consideration specific market situations in the five countries members of the Project.

These markets analysis are currently undergoing and will be carried out in accordance with some strategic market sectors of relevant impact for regional or national economy. We hope that this exhaustive Guide may offer the knowledge and stimulus for a wide-range replication in all Europe's market industries.

The GBE Factory project aims at accelerating the deployment of bio-sources (Green), such as biomass, bio fuel, biogas and¨ or from other major natural sources (Blue) arising from the sky and the earth, such as sun, wind, the earth′s crust for heating, cooling and electricity production in new or rehabilitated commercial and industrial buildings.
In this way GBE FACTORIEs can not only be self-sufficient industrial\commercial energy buildings, tending to zero emissions, but also real RES generation plants, that can share renewable electricity and thermal energy with the surrounding industrial or commercial area.
GBE FACTORY will represent the transition from fossil fuel warehouses to second generation industrial or commercial buildings.

Picture Kilkis, Thessaloniki (GR)
Henning Larsen Architects take the ugly grind out of industry with this handsome solar panel factory in Greece. Commissioned for Kilkis, an industrial area north of Thessaloniki, the factory′s dual purpose as a production facility and office space required a comfortable, practical, and sustainable design. Like other Henning Larsen projects, such as the Campus Roskilde and Energy Flex house, the 100,000 square meter facility rises to the challenge by marrying passive design and modern technology to create a factory that is almost entirely self-sufficient.

Image credits courtesy of Henning Larsen Architects