GBE Factory

Green Blue Energy Factory

DEMO collection

BMW plant in Leipzig. technology supplier: WDP Windanlage GmbH & Co.KG

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GREEN BLUE ENERGY FACTORY

DEMO collection

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1. Foreword

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

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, favoring 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.

GBE FACTORY encourages the transition from industrial and commercial buildings using fossil fuel to second generation buildings/sites which are energetically sustainable and environment-friendly.

2. Introduction

By January 2014, GBE FACTORY already harvested relevant results across Europe in terms of triggered investments in Renewable energy installations in industrial and commercial buildings.
Many residential buildings are already equipped with new technologies which allow for electricity and heating/cooling without the use of fossil fuels. Now the time has come to extend this trend to 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.
Currently, more than 41 MW h/c/e have been realized thanks to the technological, administrative and business support given by the project partners to big and small companies.
The purpose of this publication is to boost the replication of these investments, leading other entrepreneurs and investors in Europe to evolve their concept of industrial/commercial building towards a more sustainable, competitive, and intelligent model.

3. Executive Summary

This publication starts offering a brief overview of the GBE FACTORY business models depicted in detail in the GBE Factory Business Model Guide (for consultation, download freely the document from http://www.gbefactory.eu/wp-content/uploads/2012/07/Final_Guide1.pdf), with a short reference of existing Best Practices per each model.
This is followed by a reader-friendly description of 10 GBE Factory realizations already existing across Europe, which unite a high degree of mid term sustainability and technological innovation, to an attractive economic return (Exemplary cases). To enhance consultation, the description is preceded by a table summarizing the activity sectors and technologies covered by the Exemplary cases.
The publication then gives an overview of 10 DEMO GBE FACTORY project proposals drafted in Germany, Austria, Bulgaria, Germany, Italy and Slovakia. The DEMO GBE FACTORY project proposals represent the shiniest examples of GBE realizations in Europe, according to the following features:

- Technological and system characteristics (design of system/process);
- Economic issues (expected benefits and savings, compared with project costs);
- Operational issues, how well the DEMO GBE FACTORY takes advantage of the opportunities identified during the requirements analysis phase;
- Scheduling, estimating how long the GBE FACTORY will take to develop, and showing detailed timetable of activities;
- Sustainability – how the DEMO GBE FACTORY will continue to have its role in the middle long range.

Technical readers can integrate the general descriptions offered in this section with full data and description of Exemplary cases in Annex I and the full data and description of the DEMO GBE Factories in Annex II.

Special effort is being put by project partners on replicating these DEMO GBE FACTORY models in other European companies, and strategies for stimulating replication in each covered market sector is given in the following section.
Finally, an outlook on the future is given by assessing which technologies and systems are the most promising for the development of GBE FACTORIES in Germany, Austria, Bulgaria, Germany, Italy and Slovakia according to the experience matured during the last 3 years by the project partners.

4. GBE FACTORY basics and models

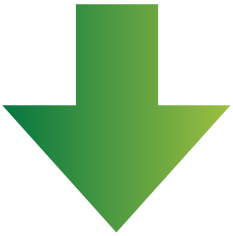
GBE FACTORY

PV

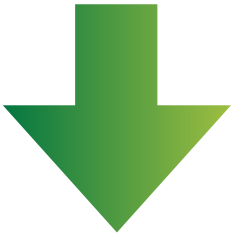
Solar thermal

Biomass

Wind



factory



Electricity

Goods

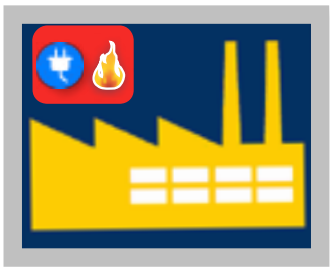
Thermal energy

A GREEN AND BLUE FACTORY PRODUCES &/OR SELLS GOODS AND GREEN ENERGY FOR ITSELF AND OTHER LOCAL FACTORIES

The project's main partners are public bodies, organizations and ESCOs coming from the EU. The project aims at promoting GBE best practice and business model in order to help companies identify investment plans for integrating renewable energy with their productive activities.
Less cost + more value

BUSINESS MODELS

ONE BY ONE



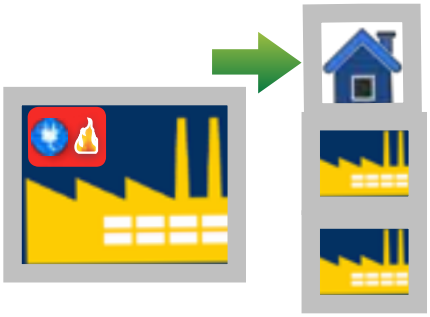
Characteristics

- Self production
- High energy consumption
- Expensive energy

How it works

FACTORY WILL PRODUCE ENERGY FOR ITS OWN NEEDS ONLY

ONE BY ONE PLUS



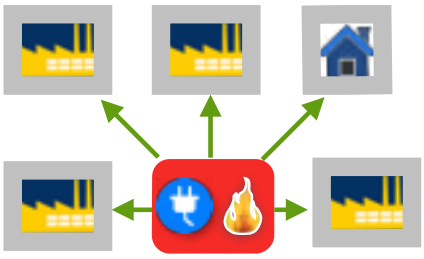
Characteristics

- High energy consumption
- Suitable areas
- Nearby factories with energy needs

How it works

FACTORY PRODUCES ENERGY FOR ITS OWN NEEDS AD SELLS OUT THE SURPLUS

ONE TO MANY



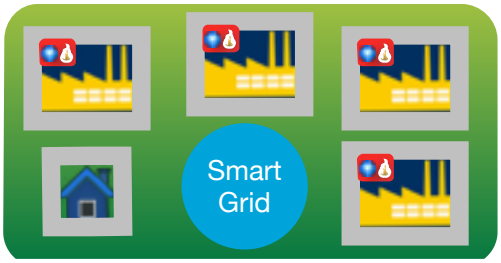
Characteristics

- High energy production potential
- Energy intensive industrial site

How it works

FACTORY SUPPLIES ENERGY TO VARIOUS FIRMS

MANY TO ONE



Characteristics

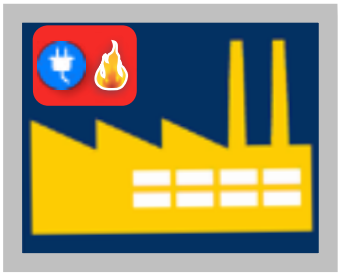
- Suitable areas
- Factory district
- Integrated energy needs

How it works

FACTORIES WILL PRODUCE ENERGY TO SHARE IN ORDER TO OPTIMIZE CONSUMPTION

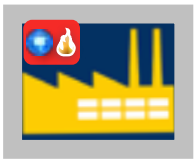
BEST PRACTICES

ONE BY ONE



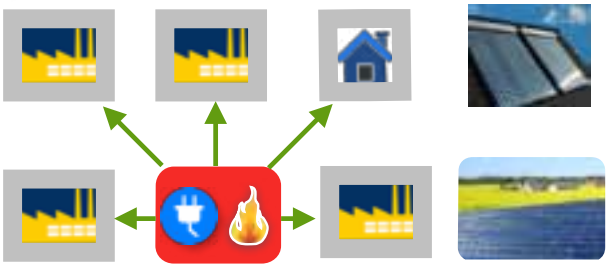
Project data	Results
Where: Haskovo (BG) **Who:** R&D, prototyping **Why:** heating **How**: biomass boiler	Project: 100 k€ IRR 25% 43 tons CO2 reduction/year Payback 4.4 years

ONE BY ONE PLUS



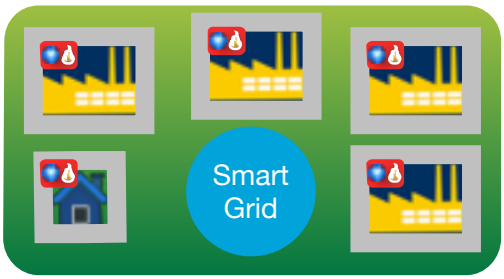
Project data	Results
Where: Bramsche (DE) **Who:** food & feed **Why:** electric & thermal energy **How**: biogas CHP	Project: 850 k€ ROE 33% 1.109 tons CO2 reduction/year Payback 3 years

ONE TO MANY



Project data	Results
Where: Graz (AT) **Who:** ESCo **Why:** Heating **How**: Solar thermal HT collectors	Project: 1.6 M€ IRR 9% 164 tons CO2 reduction/year Payback 19 years

MANY TO ONE



Project data	Results
Where: Milano (IT) **Who:** 5 factories **Why:** electricity **How**: Solar PV	Project: 890 K€ IRR 15,5% 120 tons CO2 reduction/year Payback 6 years

5. Activity sectors and related GBE FACTORY reference cases

Before selecting 10 GBE Factory Exemplary cases in Europe (i.e. realizations uniting a high degree of mid term sustainability and technological innovation to an attractive economic return), 30 high level realizations from different market sectors where investigated, in order to have a reference for the further selection of cases guided by excellence features.

As expected, given the nature of the GBE Factory project and the composition of the project partnership, that is closer to the world of industrial enterprises than to that of trade, the highest concentration of reference cases has been collected in the field of industry, while the commercial sector follows at a distance. Also, 4 additional reference cases are classified under "OTHER", that includes: energy providers, ESCOs, industrial parks, Living Labs, technical campuses. In the industrial sectors the highest concentration of reference cases is found in the food industry, followed by the fields of "mechanics", "pulp and paper production" and "wood and furniture".

As illustrated in Table 1, the examined cases cover the most of high-energy consuming industries, such as: food, textile, metal plating, pulp and paper, wood. The cases have been selected in the areas in which the need for energy conservation and the need to pay energy less during peak demand were more evident. The cases collected in the fields of trade and commerce instead focus on office buildings which require a strong dose of comfort and in the sector of distribution of goods to consumers, where the consumption of energy for sale is high. In the area of commerce-related cases we also find "Leisure and Water Parks Resorts", where demand for energy is high and the use of renewable energy contributes to the green image these sites often want to give themselves. In the area we labeled as "Others", we emphasize that an ESCO or in general an "energy provider" is present since these promote investments in sites that produce renewable energy for supplying power to the surrounding businesses. We highlight moreover the cases in the field of "passenger transport (airports, stations, ...)", in which the investments in renewable energy sources is treated as a structural investment, and hence is characterized by long run economic returns. Finally, the field of "Industrial parks, Incubator Labs, technical campuses,..." proved to be quite a receptor of initiatives that follow the GBE FACTORY approach. Not surprisingly, since political actors often joined these types of initiatives with co-financing measures, these represent very attractive investment projects.

SECTORS	Italy	Austria	Germany	Slovakia	Bulgaria
INDUSTRY					
• Agricultural primary transformation					
• Food industries	4	2			
• Textile factories	1				
• Laundries					
• Dry cleaners					
• Plating and metal machining/processing		1		1	1
• Industrial coating					
• Wood and forniture	1			1	
• Brick kilns and ceramics,					
• Mechanics (manufacturing and assembly)	1		1		1
• Pulp and paper production				1	1
• Electronic industries		1			
• Cross-sector (small buildings)			1		
COMMERCE					
• General purpose building (for offices, showrooms, restaurants, small shops,..)		2			1
• Large distribution					
• Show rooms					
• Shopping malls, rertail shops			1		
• Directional Centers					
• Hotels, Spas					
• Leisure and water Parks, Resorts					1
• Show rooms					
• Indoor ski halls			1		
OTHER					
• Energy providers				1	
• ESCOs					1
• Industrial parks Incubator Labs, technical campuses,...			1	1	
• Greenhouses					
• Livestock activities					
• Technology Parks					
• Waste processing activities (solid and liquid)					
• Transport of passengers and goods (airports...)			1		
TOTAL	7	6	**6**	**5**	6

Table 1 - GBE FACTORY Reference cases by market sector

SECTORS	Country	Reference case	RES technology	GBE FACTORY model	Other remarks
INDUSTRY					
Food					
	Italy	Cantina Valpantena Scarl -Verona (Italy)	• Biogas plant: 100 kW electric and 115 kW thermal, supplied by a MAN engine • Biomass plant: 1650 kW thermal • PV Roof plant: 109 kWp	"ONE BY ONE" (1)	The company has a clean technology project, consisting of the winery waste biogas generation, for electric and thermal energy. It also has in program the use vine pruning in a wood chips biomass plant for thermal energy generation. A PV roof plant cover the additional energy needed.
	Italy	Cantina Montezovo Verona (Italy http://www.montezovo.com/it/azienda.html)	• 400 kWt (biomass plant) and 280 kWc (for cooling absorber)	"ONE BY ONE" (1)	Using vine pruning in a wood chips biomass plant MONTEZOVO produces thermal energy. During the summer they convert thermal energy in cold by an absorber plant.
	Italy	Tenuta Pule Verona (Italy) http://www.tenutapule.com/it/home/	• Biomass plant: 165 kWth • PV roof plant 100 kWp	"ONE BY ONE" (1)	TENUTA PULE produces thermal energy using vine pruning in a wood chips biomass boiler. It also produces solar energy by a PV plant for the electrical need of the building.
	Italy	Food Industry Verona (Italy) http://www.newfoods.it/	• Biogas plant: 1.000 kWe and 1.300 kW thermal	"ONE BY ONE" (1)	It produces electric and thermal energy by a biogas plant using sludge slaughter.
	Austria	Fleischwaren Berger, Sieghartskirchen (Austria)	• Solar process heat plant; 650 kW thermal	"ONE BY ONE" (1)	The company use clean solar process heat for the (pre-)heating of the dehumidification of maturation chambers & feed water for the steam production. The company produces meat and sausages products
	Austria	Brauunion - Heineken beer, Leoben (Austria) http://www.brauunion.at/agegate/en	• Solar process heat plant; 1 MW kW thermal plus energy source change from gas to a biomass district heating grid	"ONE BY ONE" (1)	The brewery "Gösser" changed to a RES heat supply via a solar process heat plant & biomass district heating plant.

Table 2 - GBE FACTORY Reference cases by technology and business model

SECTORS	Country	Reference case	RES technology	GBE FACTORY model	Other remarks
INDUSTRY					
textile					
	Italy	Carrera S.p.A. Verona (Italy) http://www.carrerajeans.com/indexStores.php	• Roof PV: 38,64 kWp (38.000 kWh/year expected) plus a heat pump (fed by almost half of the PV output) with COP 2,8 and expected thermal power of 53.200 kWh/year	"ONE BY ONE" (1)	Carrera, a well known Italian clothing company, decided to embrace renewable energy, especially the solar one. It installed two new PV plants: one in the historical premises in Stallavena (Grezzana) and the other in the new logistic site situated in Povegliano
plating and metal machining/ processing					
.	Slovakia	PROFIL RAKOVO, spol. s.r.o., Rakovo, Central Slovakia http://www.izvoznookno.si/Dokumenti/Poslovne%20prilo%C5%BEnosti/Profil%20Rakovo%20-%20cooperation%20offer.pdf	• 4.444 FV panels JC SOLAR, type JCSM180D - 180 Wp (about 800 KW Total) • Biomss boiler of 180 kWth	"ONE BY NE" (1)	Great part of produced electricity is consumed by the factory, offices and nearby facilities. The surplus production is supplied to the distribution system Stredoslovenská Energetika a.s. A fine example of energy self-sufficiency of a small business that with a low investment aid could be easily replicated.
	Bulgaria	ZMM Haskovo Jsc: Construction of biomass boiler station for heating and DHW http://www.eratо.bg/zmm/index_en.php	• Biomass boiler using wood chips as a fuel (180 KWth)	"ONE BY ONE" (1)	The thermal energy output from the biomass boilers is 180kWth for heating and domestic hot water in the factory facility.
	Austria	Sun Master, Eberstalzell (Austria) http://www.sun-master.at/index.php/it/azienda/premere/173-sun-master-at-the-big-5-in-dubai-it	• Solar thermal heating plant 770 kW, solar thermal cooling 300 kW • PV 33.5 kW • Passive house standard production hall/office rooms	"ONE BY ONE" (1)	The company produces solar thermal collectors. The whole heat & cold distribution happens via solar thermal in combination with soil storage.

Table 2 - GBE FACTORY Reference cases by technology and business model

SECTORS	Country	Reference case	RES technology	GBE FACTORY model	Other remarks
INDUSTRY					
wood and forniture					
	Italy	PIEFFE UNION SPA - Motta di Livenza (Italy) http://www.pieffeunion.com/	• 249,84 kWp PV Plant; • 249.590 biomass boiler of kWh/year	"ONE BY ONE" (1)	PIEFFE UNION has a project to renovate the building roof in order to increase the thermal isolation and to produce green energy by a PV plant The biomass boiler has decreased the demand of external, mainly fossil based heat power.
	Slovakia	Bučina Zvolen a.s., Zvolen, Central Slovakia	• Electricity generation from the biomass through a vapor condensation cycle: • 2 moving grate type biomass boilers (SES Tlmače 16t/h, 2,8 MPa) • one controlled-extraction condensing steam turbine with electric generator 5,5 MWe 	"ONE TO MANY" (2)	The company uses a low quality biomass material, waste wood, wooden chips, bark, manufacture waste, saw dust and wooden dust from grinding wooden raw products. The company needs yearly about 3% of 37.300 MWh produced electricity for own consumption. The company supplies the electricity and heat to a wood processing company Bučina DDD s.r.o. situated in the same industrial area and to the regional distribution system operator Stredoslovenská energetika – distribúcia a.s. With production of 500.000 GJ of hot steam, Bučina supplies about the half of this production to the urban heating system of the city of Zvolen with population of 43 311 people (as of 31.12.2011).
Pulp and paper production					
	Slovakia	MONDI SCP a.s., Ružomberok, SlovakIA http://www.mondigroup.com/desktopdult.aspx/tabid-511/	• High Energy Recovery Boiler ANDRITZ (2.100 TDS/d) with implemented condensing steam turbine with generator (57,1 MW)	ONE by ONE PLUS (3)	Mondi SCP is the biggest integrated mill producing paper and pulp in the Slovak Republic. Recovery boiler is the part of kraft process of pulping where chemicals for white liquor are recovered and reformed from black liquor. Combustion of the organic portion of black liquor produces heat. In the recovery boiler heat is used to produce high pressure steam, which is used to generate electricity in a turbine. The turbine exhaust, low pressure steam is used for process heating. The recovered white liquor is used to further pulping. This investment increases pulp production, reduces the mill's environmental footprint and improves the overall cost position. Furthermore, the project reduces the price of heat supplied through the urban district heating company to the population of Ružomberok.

Table 2 - GBE FACTORY Reference cases by technology and business model

SECTORS	Country	Reference case	RES technology	GBE FACTORY model	Other remarks
INDUSTRY					
Pulp and paper production					
	Bulgaria	Svilotzel JSC: Construction of biomass boiler and co-generation for technology, heating and DHW) http://www.erhold.bg/en/companys/energoremont-kozloduy%20EOOD/Energoremont%20Kozluduy_About%20us.html	• Combined heat power generation system based on the biomass boiler, using wastes from processed wood-pulp (nominal capacity of 70 MWth heat and 8.8 MWel electricity)	"ONE BY ONE" (1)	CHP system will generate heat and electricity for process technology, heating and DHW. The biomass boiler has 28 MWth power, CHP system has nominal capacity of 70 MWth heat and 8.8 MWel electricity.
Mechanics (manufacturing and assembly)					
	Italy	ICI Caldaie S.p.A. Verona (Italy) http://www.icicaldaie.com/	• PV plant of 925 kWp an 919.041 kWh/year expected	"ONE BY ONE" (1)	ICI Caldaie is involved in advanced products development dealing with fuel cell and high efficiency condensing boilers. It has a project to renovate the building roof in order to increase the thermal isolation and to produce green energy by a PV plant
	Germany	GEO - Gesellschaft für Emaillierung und Oberflächentechnik mbH (Germany) http://www.geo-geithain.de/	• Construction of 3 photo-voltaic systems with an overall performance of 955kWp (Energy: 897.700 kWh/a) • One block-type thermal power plants	"ONE BY ONE" (1)	GEO is the only plating factory in Europe which self-produces and covers for 100% of its energetic needs with renewable sources. Until now over 3 Gigawatt have been generated, corresponding to the electricity consumption of 1.000 households for a year. The total investment for the above mentioned systems sums up to 2,1 Mil. Euros.
	Bulgaria	Motocar Service Ltd: RES project implementation in Motocar Service Company in the town of Plovdiv	• Wood chips steam boiler with thermal capacity of 1.2 MW supplies the production facilities in the plant with thermal energy	"ONE BY ONE" (1)	The production buildings of Motocar Serviceare is heated by 3 hot water diesel boilers with total installed thermal capacity of 900kW. The project envisages replacement of the exciting boilers for technological needs and heating with steam biomass boiler using wood chips as a fuel.

Table 2 - GBE FACTORY Reference cases by technology and business model

SECTORS	Country	Reference case	RES technology	GBE FACTORY model	Other remarks
INDUSTRY					
Electric industries					
	Austria	Electric hardware production, Styria (Austria)	• Solar thermal heating 1.2 MW plus solar thermal cooling 500 kW thermal	"ONE BY ONE" (1)	The electric hardware producer made a study about solar thermal heating and cooling of the productions halls and offices.
Cross-sector (small buildings)					
	Germany	Net Zero Energy Office Building Germany, Ruhr region (1st part of Daikin nZEB project)	• Heating: Air to Water heat pump with floor heating VRV; Air to Air heat pump used for heating • Cooling: VRV – Air to Air heat pump Cooling + dehumidification in summer • Ventilation: VAM – heat recovery ventilation (Sensible and latent heat recovery) • Lighting: use of LED; technology for night-lighting and spot-lighting • Power generation: thin film Photovoltaic with 27,3 kWp • Energy-monitoring: building management system	"ONE BY ONE" (1)	Net Zero Energy Building (nZEB) concept requires good calculation methodology in order to reach net zero energy level in reality; The project results next steps are to fit with economic goal expectations.

Table 2 - GBE FACTORY Reference cases by technology and business model

SECTORS	Country	Reference case	RES technology	GBE FACTORY model	Other remarks
INDUSTRY					
General purpose building (for offices, showrooms, restaurants, small shops,..)					
	Bulgaria	Sun Service JSC: Installation of PV systems in office buildings. http://sunlightandpower.com/news/	• Photovoltaic (PV) hybrid autonomous system (25KWp) for generating energy for lighting and cooling of building offices.	"ONE BY ONE" (1)	The PV system with installed capacity of 25kWp will be combined with an energy storage systems.
	Austria	REHAU Head office, Guntramsdorf (Austria) http://www.rehau.com/group_en/	• Heat pump system 71 kW thermal; • Geothermal collectors 700 kW thermal plus passive house standard office building with low energy demand	"ONE BY ONE" (1)	REHAU is a component supplier in the field of indoor installation. The company restores an old building with newest standards for cooling & heating of show rooms and office rooms.
	Austria	Technologie-zentrum Aspern, Vienna (Austria) http://www.aspernig.at/	• 140 kW PV plant, passive-house energy standard building	"ONE BY ONE" (1)	Economic agency of Vienna build a new Technology center for renting offices & labors

Table 2 - GBE FACTORY Reference cases by technology and business model

SECTORS	Country	Reference case	RES technology	GBE FACTORY model	Other remarks
INDUSTRY					
OTHERS					
Industrial park, incubators Labs, tech campus,…					
	Germany	BeMobility 2.0 (Germany) http://www.bemobility.de/bemobility-de/start/	• Future CO2 neutral city first simulation made of: 3 PV arrays, 5 vertical axis wind turbines, 2 stationary buffer batteries, an electric car sharing station with charging infrastructure for up to 28 simultaneous charging cars	"ONE TO MANY " (2)	The company uses clean renewable technologies for producing electric energy (renewable thermal energy generation plant is under planning). The Micro Smart Grid is part of the platform for electric mobility in the InnoZ. The site, the EUREF-Campus, is a project to build the CO2-neutral city of the future.
	Slovakia	HTMAS, a.s., Vlkanová, Central Slovakia http://www.htmas.eu/renewable_energy_development_fve/technical-plant-data-vlkanova.html	• Photovoltaic panels for a total of 850kWp	"ONE to MANY" (2)	Industrial park powered by photovoltaic energy of 850kWp. 13700 m2 of production area built, rented to different manufacturing companies.
Transport of passengers and goods (airports…)					
	Germany	Flughafen Hannover-Langenhagen http://www.hannover-airport.de/	• Enhancement of the PV installation to 490 kWp (Kilo Watt Peak). • Production per Year: 403.000 kWh	"ONE BY ONE"	The Hannover Airport is one of the largest in northern Germany and different projects has been realized, concerning RES and energy efficiency. The next project could be a drilled geothermal source.

Table 2 - GBE FACTORY Reference cases by technology and business model

SECTORS	Country	Reference case	RES technology	GBE FACTORY model	Other remarks
INDUSTRY					
Energy providers					
	Slovakia	TOP PELET s.r.o., Krnča, Western Slovakia	• ORGANIC RANKINE CYCLE • KOHLBACH K8 Biomass thermal oil boiler of 5.150 KWth thermal • TURBODEN 10 CHP SPLIT – ORC turbine	"ONE TO MANY" (2)	The first project of ORC cogeneration based on biomass in Slovakia. ORC is a unique technology which combines heat and power from various renewable energy sources. Is particularly advantageous for decentralized production of electricity and heat. ORC devices have a high overall efficiency: 20% of heat coming from the thermal oil is converted into electricity, while 78% remains available at a relatively high temperature to further heat use. The combined heat and power plant is situated in the premises of TOPHOLZ s.r.o., one of the biggest wood processing companies in the region. A wood processing company covers the entire need for biomass and purchases the supplied heat for heating, lumber drying and wood chips drying.
	Slovakia	HTMAS, a.s., Vlkanová, Central Slovakia http://www.htmas.eu/	• Photovoltaic pannels for a total of 850kWp	"ONE to MANY" (2)	Industrial park powered by photovoltaic energy of 850kWp. 13700 m2 of production area built, rented to different manufacturing companies.
ESCO					
	Bulgaria	Perpetuum Mobile BG JSCo: Construction of biogas Installation with cogeneration for combined electricity and thermal energy production by indirect utilization of the biomass in Momchil, region of Balchik.	• Combined electricity and thermal energy generation (1 MWel and 1 MWth) from biogas plant which will use organic waste .	"ONE TO MANY" (2)	CHP system with installed capacity of 1 MWel electricity and 1 MWth heat energy distributed as follows: - Electricity for local consumers and grid; - Thermal energy for a local factory processing fruits and vegetables; - Thermal energy for greenhouse factory; - Heating of an administrative building and workshop.

Table 2 - GBE FACTORY Reference cases by technology and business model

Some pictures of the above mentioned reference cases:

Figure 1 - Alpincenter Wittenburg

Figure 2 - Parkaus Flughafen Hannover

6. GBE FACTORY exemplary cases

6.1 GENERAL OVERVIEW

Thanks to the knowledge gained by investigating the 30 reference cases summarized above, 10 exemplary GBE FACTORY realizations have been selected. The identification process of these shiny cases occurred among:

- The described reference cases;
- New proposals, coming from European experts or innovative ideas/projects sponsored by the most advanced EPCs or high reputation testimonials from the European RES technology sectors.

The exemplary GBE FACTORY cases reported below have been selected on the basis of the following criteria:

- most attractive economic return;
- degree of mid term sustainability;
- degree of technological innovation.

The selected 10 GBE Factory exemplary cases use high technology equipment, systems and processes, and in some cases match renewable energy sources with energy efficiency measures.

No.	GBE Factory Exemplary Case	Type of GBE Factory*	Energy Use**	Total*** Installed Power	Country
1	Construction of PV roof plant for electricity generation and heat pump for thermal conversion	One by one plus	E/H	39 kW	Italy
2	Construction of PV roof plant on the industrial plant	One by one	E	925 kW	
3	Solar Process Heat in Meat Factory BERGER	One by one	H	650 kW	Austria
4	100% solar heated industry building - SUNMASTER	One by one plus	E/H/C	848 kW	
5	Biogas Plant in Albena AD	One to many	E/H	2000 kW	Bulgaria
6	Co-generation and biogas plant Momchil	One to many	E/H	2000 kW	
7	Reconstruction of heating distribution system and fuel switching to reduce greenhouse gas emissions in Hnúšťa	One to many	H	3627 kW	Slovakia
8	CHP plant using ORC	One to one	E/H	5100 KW	
9	BeMobility 2.0. Subproject Micro Smart Grid	One to many	E	n/a	Germany
10	Construction of PV installation on airport building	One to one	E	490 kW	
	Total:			15679 kW	

Table 1 - Summary of the data of the 10 exemplary cases

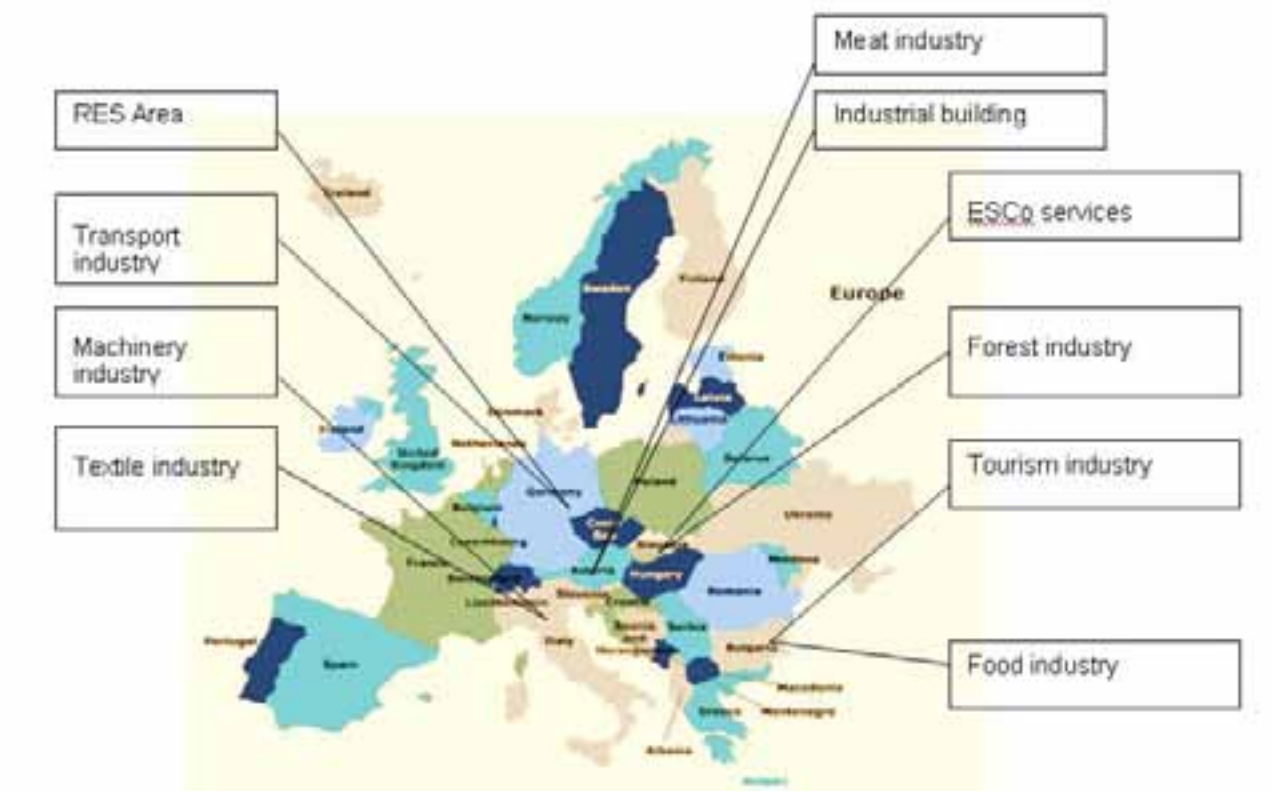


Figure 3 - Allocation of the evaluated exemplary cases by economic sectors

Each exemplary case was evaluated based on the main project characteristics: technical design and proposed technology. The financial project indicators and the green houses gas emissions reduction after the projects implementation were taken into consideration too. The current financial market in European Union presents opportunities for sustainable development, environmental policies, and for increasing the standard of life through a wider range of policies and investment tools. There are many financial bodies which have activated funds for supporting Green-Blue Energy Factory realizations. It is important that they are made aware of the financial needs of companies and administrations that are willing to take an important step towards green energy solutions. These financial bodies include banks, Ministries of energy, government agencies, energy partnerships, community foundations, funding groups, institutions and Energy Service Companies (ESCO). The energy supply chains as a part of sustainable development depend on the significant role of energy producers, its transport and logistic and distributors as well. There is significant interest of different type of stakeholders like producers, logistics, suppliers, project sponsors, promoters, advisors, distributors and local and regional authorities to support energy customers to reduce their energy consumption. The technical and high efficient solutions provided by designers, installers, providers and equipment producers are a warranty for achieving the foreseen cost energy savings and greenhouse gas emissions reduction.

The saved and avoided expenses following the implementation of energy conservation measures and RES in the 10 GBE Factory exemplary cases can also be redirected to significant social spheres of the community such as health and education. In fact, hospitals, nursing homes, health centers are the buildings with high and continuous energy consumption, where often there is room for intervention for energy recovery, with no bias to the quality of the service.

6.2 FOCUS ON THE EXEMPLARY CASES PER COUNTRY

6.2.1 ITALY

Cantina di Valpantena

Company Description

The Cantina di Valpantena is a co-operative association founded in 1958 in order to group more than 300 wine producers of the zone. With more than 600 ha of production. From the beginning of 2003 the cooperative includes 150 oil producers.
Cantina di Valpantena produces Wine and oil to be sold in Italy and abroad.

Figure 4 - Cantina di Valpantena

Figure 5 - Cantina di Valpantena

GBE FACTORY characteristics

The Project uses Clean Technology by a biogas production based upon winery waste recovery to produce a final electricity and heating energy by combined heat and power plant.
The project also include wine pruning wood chips biomass application for thermal energy generation.
Finally the project includes a PV power plant to be installed on rooftop.

Figure 6 - Cantina di Valpantena

Power Numbers:

1. The biogas power plant is 100 kW electricity and 115 kW thermal power supplied by a CHP (Combined heat and Power) engine
2. The wood chips thermal power plant is 1.650 kW of heating boiler
3. The PV power plant is 109 kWp of electric power

Economics Biogas power plant

1. Total cost of the project is 750.000 €
2. Total savings and revenues due to fuel and electric savings combined with an extra O&M cost is 145.500
3. Financing: 60% project cost financed at a cost of 7,5% in 15 years
4. IRR without emission credit is 12,72%
5. Payback period is 6,56 Years
6. Avoided CH4 is 206.700 Nm3

Wood Chip biomass thermal plant

1. Total cost of the project is 1.000.000 €
2. Total savings and revenues due to fuel and electric savings combined with an extra O&M cost is 370.000 €
3. No financing expected
4. IRR without emission credit in 10 Years is 14,1%
5. Payback period is 3,08 Years
6. Avoided Natural gas is 280.000 Sm3

PV power plant

1. Total cost of the project is 185.000 €
2. Total savings and revenues due to fuel and electric savings combined with an extra O&M cost is 30.833 €
3. Financing: 80% project cost financed at a cost of 7,5% for 15 years duration
4. IRR without emission credit is 19%
5. Payback period is 6 Years
6. Avoided emissions in terms of CO2 are 50 t/year

Why is it a GBE FACTORY exemplary case?

The Cantina di Valpantena has a strong visibility due to the importance in Italian wine sector for Verona Valpolicella wine and other type of wine from the region, and most of all the wine producers and customers can have direct experience from the Green Energy project . Each power plant has its owns value combined and by itself that's why it shows most of the opportunities in green energy application for the wine sector. Waste recovery for biogas and biomass power plant together with the solar plant represents the most replicable application of best practice in a factory like Winery consortium. It works best when there is a lot of biomass waste all over the year and at the same time the factory uses a lot of electric and thermal energy or best the factory is located in an energy intensive environment which can profit of the energy extra production via micro grids.

Carrera Jeans

Company Description

Carrera is an Italian clothing corporation founded in the mid 60's in Verona.

Carrera is a small clothing multinational industry and its production units are located in some of the major cotton producing countries in order to have access to the best raw material, while the logistics and final inspections operations still remains in Italy to ensure the highest Carrera standards.

In the last year, Carrera decided to aim at renewable energy, especially the solar one installing two new PV plants.

Figure 7 - Solar energy plant

GBE FACTORY characteristics

Figure 8 - Solar energy plant

The project focus on the usage of solar energy to provide power to the logistic plant and it combines with electric Heat Pumps in order to provide heating and cooling.

Project Numbers
Applied technology is 38,64 kWp PV power plant plus heat pump.

The energy production is 22.222 kWh and 50% of it is used by the heat pump to provide a total 53.200 kWh of thermal energy (with a seasonal COP of 2.8)

Economics

1. Total cost of the project is 133.000 €
2. Total savings and revenues due to fuel and electric savings combined is 22.220€
3. Financing: 80% project cost financed at a cost of 7,5% in 15 years
4. IRR without emission credit is 19%
5. Payback period is 6 Years
6. Avoided CO2 emissions are 19 t/year

Why is it a GBE FACTORY exemplary case?

Carrera Jeans is a leader company in its field in Verona and Veneto Region that's why they can provide to other similar factories a model to refer to. Most of all the good results in this application can be applied to the Carrera point of sales spread all over the world. Simplicity and effectiveness are the main results of the project.
The exemplary cases technical characteristics for Italy are given in the table below: type of technology, financial indicators and emission reduction.

No.	GBE Factory Exemplary Case	Installed Power Capacity			Total Installed Power	Energy Use	Revenues/Savings			
		Electricity	Heat	Cooling		(E/H/C)	Project Revenues		Energy Savings	
		(kWel/p)	(kWth)	(kWc)	(kW)		(MWh/yr.)	(EUR/yr.)	(MWh/yr.)	(EUR/yr.)
1	Construction of PV roof plant for electricity generation and heat pump for thermal conversion	39			39	E/H	91	6220	n/a	16000
2	Construction of PV roof plant on the industrial plant	925			925	E	919	7930		132342
	Total:	964			964		1010	14150		148342

Table 2 - Installed power capacity and revenues due to energy saving

No.	GBE Factory Exemplary Case	Technology	Total Project Cost	Financial Indicators			Emissions reduction
		Biomass/Solar/CHP/ PV Heat Pump/Other	(EUR)	NPV (EUR)	IRR (%)	Pay-back (yr.)	CO2 (t/yr.)
1	Construction of PV roof plant for electricity generation and heat pump for thermal conversion	PV, Heat pump	133000	n/a	19.0	5.0	19
2	Construction of PV roof plant on the industrial plant	PV	1309767	1571720	21.6	4.9	460
	Total:		1442767	1 571720			479

Table 3 - Financial indicators

6.2.2 AUSTRIA

Fleischwaren Berger GmbH

Company Description

Figure 9 - Aerial view of the premises of the company, Sieghartskirchen

Fleischwaren Berger GmbH & CO KG is a company located in Sieghartskirchen, Lower Austria. The company is operating in the meat processing industry with a production volume of approximately 80-90 tons of meat and sausage products per day. The meat processing industry counts approx. 1.030 companies in Austria with a yearly turnover of approx. 3.4 trillions € per year.
With the installed solar thermal process heat plant the company can cover approx. 15 % of its heat demand.

GBE FACTORY characteristics

Meat processing industry requires a high demand of heat. For this reason Fleischwaren Berger GmbH & CO KG were searching for a renewable heat source, to cut energy costs and to make a contribution to the environment. The decision was a solar process heat plant with 1.077 m^2 of collector area, which is able to produce 517 MWh heat per year. The total investment of 738,500 € has an internal rate of return of 15% and a payback period of 7.2 years. This RES investment represent the “one by one” GBE FACTORY MODEL.

Figure 10 - Collector field of the solar process heat plant

Why is it a GBE FACTORY exemplary case?

Solar process heat has an enormous potential in Europe and around the globe. A very big range of industries has a high potential on solar process heat (especially in food, metal, chemistry and laundry industry), which enables a high replicability. Solar process heat can achieve low specific costs (€/kWh heat) compared to other solar thermal applications (cooling, domestic hot water), which will result in feasible projects.

SUNMASTER Solar Collector Industries

Company Description

The solar thermal collector production company "Sun Master" (Greiner Renewable Energy GmbH) is operating in the field of metal & plastic industry and is a producer of solar thermal collectors. The solar thermal industry has a long history in Austria and is one of the most important RES industries in Austria. The company can cover up to 100% of the heat demand via the installed RES system and approx. 5 % of the electricity demand.

GBE FACTORY characteristics

Figure 11 - Office building & production hall of "SUN MASTER"

"SUN MASTER" realized the vision of 100% energy coverage commercial and industrial building via solar thermal in combination with a soil heat storage and use of internal surplus heat. The buildings were erected as passive house standards. The heat is also used for the cooling of the building (via absorption chiller) during the summer. A total collector area of 1,100 m^2 produce 545 MWh heat and a PV plant with 238 m^2 produces 47 MWh electricity per year. The total investment 3,150,000 € has an internal rate of return of 10 % and a payback period of 12 years. This RES investment represent the "one by one" GBE FACTORY MODEL.

Figure 12 - Solar thermal collector area on the roof of the "SUN MASTER" production hall

Why is it a GBE FACTORY exemplary case?

Commercial and industrial buildings have in general a high demand of energy (heat & electricity) for the room conditioning. This reference case shows the possibility of high renewable energy coverage of commercial and industrial buildings and shows also feasibility with a payback period of 12 years

No.	GBE Factory Exemplary Case	Installed Power Capacity			Total Installed Power	Energy Use	Revenues/Savings			
		Electricity	Heat	Cooling		(E/H/C)	Project Revenues		Energy Savings	
		(kWel/p)	(kWth)	(kWc)	(kW)		(MWh/yr.)	(EUR/yr.)	(MWh/yr.)	(EUR/yr.)
3	Solar Process Heat in Meat Factory BERGER		650		650	H			517	55370
4	100% solar heated industrial building - SUNMASTER	34	770	44	848	E/H/C	519	170000	519	170000
	Total:	34	1420	44	1498		519	170000	1036	225370

Table 5 - Installed power capacity and revenues due to energy saving

No.	GBE Factory Exemplary Case	Technology	Total Project Cost	Financial Indicators			Emissions reduction
		Biomass/Solar/CHP/PV Heat Pump/Other	(EUR)	NPV (EUR)	IRR (%)	Pay-back (yr.)	CO2 (t/yr.)
3	Solar Process Heat - Meat Factory BERGER	Solar thermal process heat plant	738500	200390	15.0	7.2	173
4	100% solar heated industrial building - SUNMASTER	Geothermal/Solar Thermal/PV	3 50000	n/a	10.0	12.0	303
	Total:		3888500				476

Table 6 - Financial indicators

6.2.3 BULGARIA

Perpetuum Mobile BG JSC

Company Description

Figure 13 - DEMO realization in Momchil

The GBE Factory Project sponsor and investor is the Bulgarian company Perpetuum Mobile BG JSC. The main company's activities are connected with investigation, construction, financing and operation of installations for utilization of wastes, production of electric and thermal energy by indirect use of the biomass, etc. The joint stock company's shareholders of the Perpetuum Mobile BG JSC are more then 50% property of Albena JSC.
The biogas plant and cogeneration facilities are situated in the terrain of Momchil, near to the town of Balchik, North-East Bulgaria of the total built up area of 2,300m2.

GBE FACTORY characteristics

The Perpetuum Mobile BG JSC operates in the field of RES investment projects for 3 years. The company has very good reputation regarding the small and large turn key projects implementation connected with solid waste utilization and production of electricity and thermal energy. The Perpetuum Mobile BG JSC invests in construction installation for production of electricity and thermal energy by indirect utilization of biomass. The electric power of the installation is 1,000 kWel. The thermal power of CHP plant is 1,000 kWth as well. The selected technology includes design, construction, installation and civil works, commissioning and start up of the biogas plant and cogeneration facility. The GBE Factory model is one to many and the facility will use organic waste, providing electricity for local consumers and grid, thermal energy for factory for processing fruits and vegetables, thermal energy for greenhouse factory and heating of an administrative building.
The CHP module which will be delivered by the Italian company AB Energy includes highly efficient gas engine and electric generator with nominal electric power 1.0 MWel. Nominal heat output of the CHP unit is 1.0 MWth. The hourly consumption of biogas in CHP is 351 Nm3/h. Cogeneration module has electrical efficiency - 42.5%, thermal efficiency - 45.1% and the overall efficiency of the unit - 87.6% at full heat recovery. The total generated electricity by the CHP Plant is 5,100 MWhel/yr. The annual expected electricity sales revenues are in the amount of EUR 651,897. The total generated thermal energy by the CHP plant with installed thermal capacity of 1 MWth is 7,550 MWhth/yr. 4,200 MWhth/yr.

of generated thermal energy will be used for technological needs of the factory for processing fruits and vegetables. The main factory technological consumers are:

- Fruit line NIKO for pasteurizing: 1,800 MWhth/yr.;
- Refrigerated cameras: 2,400 MWhth/yr.

The greenhouse for vegetables will consume 320 MWhth per year. The premises of the administrative building and workshop N5 will consume about 830 MWhth/yr. of the generated thermal energy for heating during the heating season. 2,200 MWhth/yr. will be used for the biogas plant and CHP own needs.

Figure 14 - Biogas plant

The total GBE Factory project cost is in the amount of 4,000,000 EUR without VAT. The project will be financed through a 3.2 million euro loan from Bulgaria's Societe Generale Expressbank. Albena's AD shareholders voted on the loan at the general meeting scheduled in May 2013. The project cash flow analysis indicates that the project has very impressive financial indicators: the project payback period is 8.0 years plus 1 year grace period, IRR is 12.0% and NPV amounts to EUR 4,800,000.
In 2014 the CO2 emissions will be reduced by 310 tons as a total result of the annual savings of electricity and natural gas by 960 MWh.

Why is it a GBE FACTORY exemplary case?

The proposed one to many GBE Factory project is attractive for the middle size enterprises in the fruit processing sector in Bulgaria. It is the potential DEMO GBE Factory with very important role to the different type of investors which have intention to invest in the renewable energy sector. The replication of this project on the regional and national level is achieved i.e. this GBE Factory will have multiplier effect.

Albena AD

Company Description

The GBE Factory Project sponsor and investor is the Bulgarian company Perpetuum Mobile BG JSC.
The main company's activities are connected with investigation, construction, financing and operation of installations for utilization of wastes, production of electric and thermal energy by indirect use of the biomass, etc. The biogas plant and cogeneration facilities are situated in the terrain of the town of Balchik, near to the the Albena resort with the total built up area of 2,000m^2.

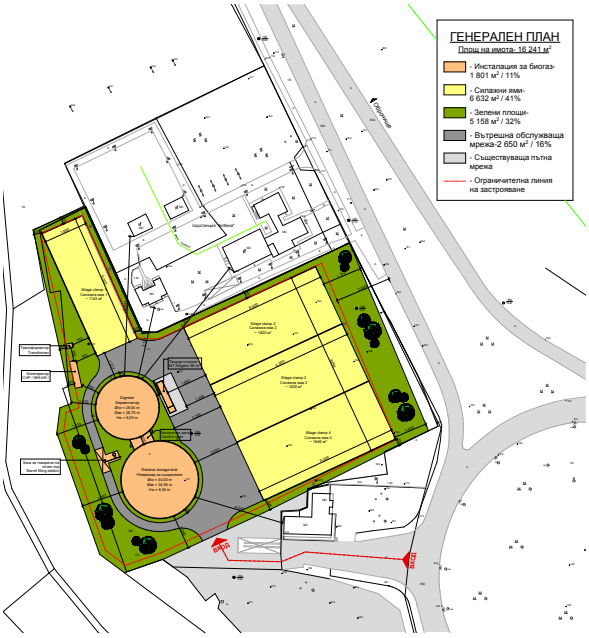


Figure 15 - Albena DEMO general plan

GBE FACTORY characteristics

The Perpetuum Mobile BG JSC operates in the field of RES investment projects since 3 years. The company has very good reputation regarding the small and large turn key projects implementation connected with solid waste utilization and production of electricity and thermal energy.
The electric power of the CHP facility is 1.0 MWel. The thermal power of the cogeneration plant is 1.0 MWth. The selected technology includes design, construction, installation and civil works, commissioning and start up of the biogas plant and cogeneration facility.
The GBE Factory model is one to many. The CHP will be installed in biogas plant which will use organic waste, providing:

- Electricity for local consumers and grid;
- Heating of hotels, restaurants etc in the Albena resort.
- Heating up water for the tourists needs in the Albena resort.

The organic wastes from the tourist resort hotels and restaurants in Albena complex will be use for production of electricity and thermal energy.

Figure 16 - Biogas plant

The combined heat and power facility has nominal electric power 1,000 kWel. The annual production of electricity by the CHP module is 5,200 MWhel. The annual expected electricity sales revenues are in the amount of EUR 664,679. The biogas installation is manufactured and is delivered by the
German Company MT Energie GmbH.
The Italian company AB Energy is supplied the CHP energy facilities and equipment. The construction of all fa-

cilities will be implemented by Eko Stroy AD, Bulgaria. The electric energy is transferred to the distribution grid and managed by the local energy provider the company Energo Pro AD, which operate in North-East Bulgaria. The GBE Factory total investment is in the amount of 3,500,000 EUR excluding VAT. The project payback period is 7.0 years plus 1 year grace period, IRR is 12.9% and NPV amounts to EUR 4,130,000. The CO2 emissions will be decreased by 389 tons in 2014.

Why is it a GBE FACTORY exemplary case?

The proposed exemplary GBE Factory is definitely attractive for the tourism sector, one of the faster development economical sectors in Bulgaria. It is the potential DEMO GBE Factory with very important role to the different type of stakeholders which have intention to invest in the renewable sector. The replication of this project on the regional level is achieved i.e. this GBE Factory will have multiplier effect.

No.	GBE Factory Exemplary Case	Installed Power Capacity			Total Installed Power	Energy Use	Revenues/Savings			
		Electricity	Heat	Cooling		(E/H/C)	Project Revenues		Energy Savings	
		(kWel)	(kWth)	(kWc)	(kW)		(MWh/yr.)	(EUR/yr.)	(MWh/yr.)	(EUR/yr.)
5	Biogas Plant in Albena AD	1000	1000		2000	E/H	5200	664679	3333	312500
6	Co-generation and biogas plant Momchil	1000	1000		2000	E/H	5100	651897	2500	250000
	Total:	2000	2000		4000		10300	1316577	5833	562500

Table 7 - Installed power capacity and revenues due to energy saving

No.	GBE Factory Exemplary Case	Technology	Total Project Cost	Financial Indicators			Emissions reduction
		Biomass/Solar/CHP/PV Heat Pump/Other	(EUR)	NPV (EUR)	IRR (%)	Pay-back (yr.)	CO2 (t/yr.)
5	Biogas Plant in Albena AD	CHP, Biogas Plant	3500000	4 130 000	12.0	7.0	389
6	Co-generation and biogas plant Momchil	CHP, Biogas Plant	4000000	4 800 000	9.0	8.0	310
	Total:		7500000				699

Table 8 - Financial indicators

6.2.4 SLOVAKIA

Heat distribution system in Hnúšť a

Untill 2007, in Hnúšťa, the heating was provided by 8 gas boilers in several separate circuits. All these areas were dependent on natural gas, which represented 100% of the fuel base.

A four-year investment program of city heating system modernization consisted in:

2008 – installation of one VESKO-B biomass boiler. At the same time the two largest heating circuits were interconnected, increasing the share of the heat produced from biomass.

- 1 pc of VESKO-B biomass boiler 3MW (Total heat production: 5833,38 Mwh/year)

2009 – realization of a connection for hot water from the biomass boiler to the industrial zone (chemical and rubber production) and the subsequent shut down of the gas boiler present in the industrial park. Gas boiler room spaces in the industrial park were used to expand the production.

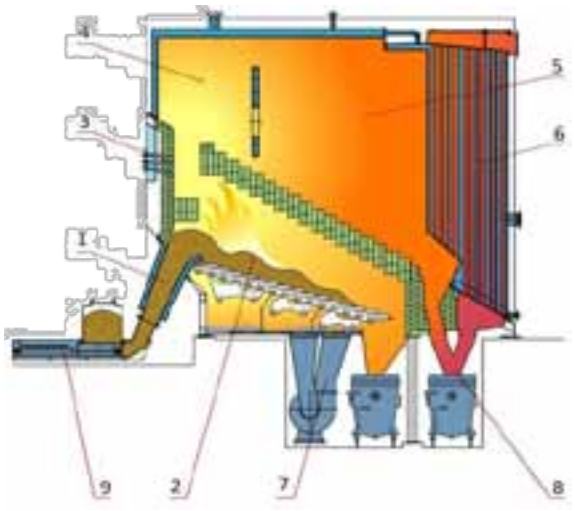


Figure 17 - Vesko-B Biomass Boiler

2010 - 2011 – a complete replacement of the whole heat distribution system and centralization of the heat production into a single source:

- construction of residential heat exchange stations
- installation of 360 solar collectors on 27 blocks of flats, decentralizing the domestic hot water supply system, removing distribution losses and improving the quality of the hot water supply
- 360 pc of solar collectors Citrin Solar CS 111-SF 0,627 MW (Total production: 10 454 GJ)

2011 – installation of a new biomass boiler VESKO-B, bringing the total share of renewable energy in heat production to more than 95%. Only two of he original gas boilers remained in operation as backup resources.

Figure 18 - Installation of biomass boiler

The purpose of this comprehensive project was to achieve the highest proportion of low-cost renewable sources (solar radiation and forest biomass) in heat production and thereby minimize the cost of production. These strategic objectives

were achieved. In addition to the benefits to society and heat consumers, a significant reduction of emissions of major pollutants SO2 and CO2 in the air has been ensured.

Figure 19 - Installed solar collectors

A new heating system in Hnúšťa is due to undertaken investments is one of the most modern and efficient in Slovakia. New technologies guarantee high efficiency of the whole system. The main advantage is stability based on the use of three primary energy sources - biomass, solar and natural gas. From the finalization of the project at the end of 2011 more than 95% of the heat in the city is produced from RES. From this point of view, the urban heating system in Hnúšťa is unique not only in Slovakia but also throughout Central Europe.

Figure 20: installed solar collectors

TOP PELET Ltd

Company Description

The company TOP PELET Ltd is situated in the village Krnča, a municipality in the Topoľčany District of the Nitra Region, Slovakia.

Figure 21 - Plant before realization

TOP PELET Ltd provides services in the production of clean fuels. The main activities of the company include:

- production of wood briquettes, wood pellets and wood chips
- manufacture and installation of boilers for heating and hot water
- combined production of electricity and heat

The major shareholder of the company, TOPHOLZ Ltd, is one of the biggest wood working companies in the region. It deals with wood processing and wood trading. The company has its own production areas and cargo hold, total area of company estate is 50 000 m2 . The company, TOPHOLZ Ltd is known for its environmental approach. In recent years has made several investments to increase the effectivity of the production and minimize the impact of production on the environment, like complex reconstruction of the heat production and distribution system in the factory and purchase of innovative technology for the development of ecologic production.

GBE FACTORY characteristics

This project has become GBE Factory exemplary case thanks to the innovation in technology choices. It is the first project of Organic Rankine Cycle cogeneration based on biomass in Slovakia.
ORC is a unique technology which combines heat and power from various renewable energy sources. Is particularly advantageous for decentralized production of electricity and heat. ORC devices have a high overall efficiency of 20% of heat coming from the thermal oil is converted into electricity, while 78% remains available at a relatively high temperature to further heat use. Heat loss by radiation and loss of generator is reduced to 2%.
Compared to competing technologies, the main advantages obtained with ORC in biomass applications are:

- High cycle efficiency (especially if used in cogeneration plants)
- Very high turbine efficiency (up to 90%)
- Low mechanical stress of the turbine, due to low peripheral speed
- Low RPM of the turbine allowing the direct drive of the electric generator without reduction gear
- No erosion of the turbine blades, due to the absence of the moisture in the vapour nozzles
- Very long operational life of the machine due to the characteristics of the working fluid, that unlike steam is non eroding and non corroding for valve seats tubing and turbine blades
- No water treatment system is necessary

There are also other advantages, such as simple start-stop procedures, quiet operation, minimum maintenance requirements and good partial load performance.

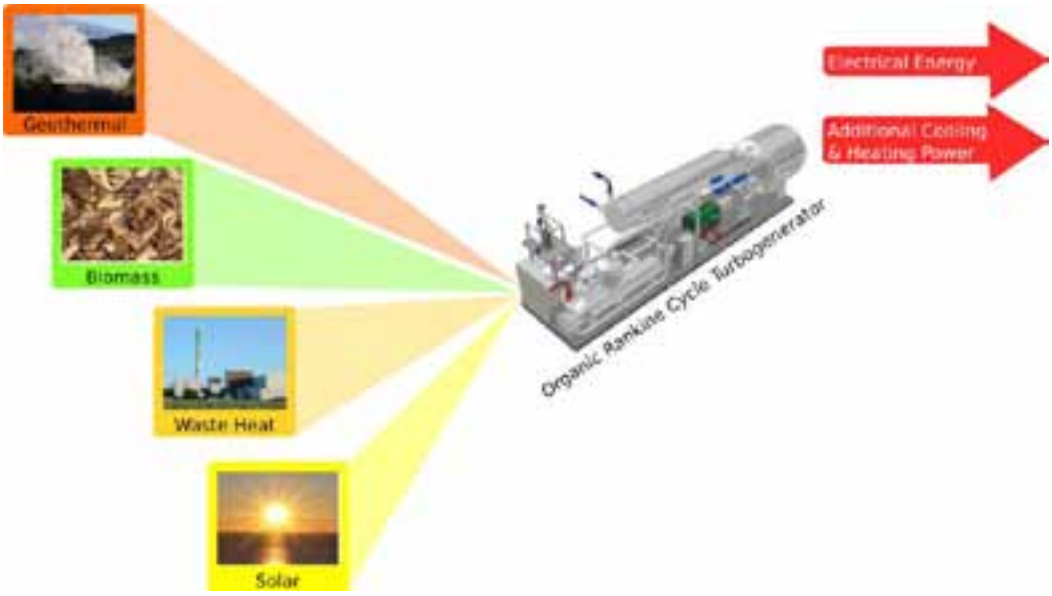


Figure 22 - Organic Rankine Cycle

Figure 23 - Biomass thermal oil boiler

→ Heat input to the ORC (thermo oil) total 5,14 MW thermal power
← Heat output of ORC (hot water) output 4,1 MW.
Temperature specification ORC:

- Rated Thermal oil temperature circuit (input/output) 310/250 °C
- Water temperature (in/out) 60/80 °C

The working principle of the organic Rankine cycle is the same as that of the Rankine cycle:

- Process 1-2: The working fluid is pumped from low to high pressure. As the fluid is a liquid at this stage the pump requires little energy input.
- Process 2-3: The high pressure liquid enters a boiler where it is heated at constant pressure by an external heat source to become a dry saturated vapour.

Figure 24 - Turboden 10 CHP SPLIT - ORC turbine

• Process 3-4: The dry saturated vapor expands through a turbine, generating power. This decreases the temperature and pressure of the vapour, and some condensation may occur.
• Process 4-1: The wet vapour then enters a condenser where it is condensed at a constant pressure to become a saturated liquid.

Figure 25: Turboden 10 CHP SPLIT - ORC turbine

The Organic Rankine Cycle uses an organic fluid in place of water and steam. This allows use of lower-temperature heat sources. The added value of the project is that since the beginning of its operation 80% of the generated heat can be used towards internal consumption and sale to the partners.

← Nominal output – electric: 950 kWe / 7372 Mwh p.a.
← Nominal output – heat: 4100 kWt / 118 000 GJ p.a.

Figure 26 - Before realization

Figure 27 - After realization

Why is it a GBE FACTORY exemplary case?

Biomass is an extremely important renewable energy source, available nearly everywhere. It can be stored for a long time and often it is economically viable. Biomass is utilized in the best way in Combined Heat and Power plants, in particular the energy obtained is maximized in small power systems (from a few hundred kW electric to one or two MW electric), built near the heat consumer. The plant is situated in the premises of TOPHOLZ Ltd in the village Krnča. The fuel used in the combustion boiler and ORC unit is uncontaminated wood waste from wood processing industry (wood material with a higher water content). The wood processing company covers the entire need for biomass and purchases the supplied heat for heating, lumber drying and wood chips drying.
Up to 80% of the produced heat is sold to the wood processing company TOPHOLZ Ltd., covering the needs of the factory. 100% of the produced electric energy is sold to the ZSE Distribution a.s. (EON GROUP). Thanks to the investment, the industrial building was equipped with single renewable energy source which provides heating of the premises and heat for production activities housed within. Cost savings and revenues from the sale of electricity are used to repay the bank loan and to create the resources for future investments in energy efficiency. Organic Rankine Cycle is a well-known and widely spread form of energy production, mostly in biomass and geothermal applications, but great rises in solar and heat recovery applications are also expected. Environmental concern over climate change and rising oil prices are powerful reasons supporting the explosive growth of this efficient, clean and reliable way of producing electricity. The added value of the project is that since the beginning of its operation 80% of the generated heat can be used towards their internal consumption and sold to the partners.
The exemplary cases technical characteristic for Slovakia are given in the table below: type of technology, financial indicators and emission reduction.

No.	GBE Factory Exemplary Case	Installed Power Capacity			Total Installed Power	Energy Use	Revenues/Savings			
		Electricity	Heat	Cooling		(E/H/C)	Project Revenues		Energy Savings	
		(kWel/p)	(kWth)	(kWc)	(kW)		(MWh/yr.)	(EUR/yr.)	(MWh/yr.)	(EUR/yr.)
7	Reconstruction of heating distribution system and fuel switching to reduce greenhouse gas emissions in Hnúšťa		3627		3627	H	8736	n/a		
8	CHP plant using ORC	1000	4100		5100	E/H	40141	n/a		
	Total:	1000	7727		8727		48877			

Table 9 - Installed power capacity and revenues due to energy saving

No.	GBE Factory Exemplary Case	Technology	Total Project Cost	Financial Indicators			Emissions reduction
		Biomass/Solar/CHP/PV Heat Pump/Other	(EUR)	NPV (EUR)	IRR (%)	Pay-back (yr.)	CO2 (t/yr.)
7	Reconstruction of heating distribution system and fuel switching to reduce greenhouse gas emissions in Hnúšťa	Biomass boiler, solar collectors	6819310	n/a	n/a	n/a	2097
8	CHP plant using ORC	CHP with ORC	7113352	8322622	13	n/a	11755
	Total:		13932662				13852

Table 10 - Financial indicators

6.2.5 GERMANY

BMW

Company Description

Figure 28 - View of the BMW Headquarters in Leipzig.
Supplier of the technology: WDP Windanlage GmbH & Co. KG

BMW (Bayerische Motoren Werke) is a German auto and motorcycle manufacturer headquartered in Munich that started out in the 1900s as an aircraft manufacturer. BMW's logo, which is based on the circular design of an aircraft propeller, repeats the colours of the Bavarian flag and was created in 1920. In its early days, BMW just occasionally manufactured motorcycle engines. It was not until 1929 that the company started to produce the Dixi, their first BMW vehicle, and thus became an automobile manufacturer. Right after the Second World War and as a punishment for its contribution to the war effort on behalf of Germany, the company was prohibited to produce anything at all. Later, in the 1970s, BMW established itself as a full-fledged car company and as a pioneer for emerging technologies, such as turbo charging and advanced vehicle electronics. Innovations, like the latter, gave BMW its well-known reputation for quality and leading edge auto performance technology. Since the 1990s, BMW has been expanding worldwide. In the second half of the 1990s, it also opened its first U.S. manufacturing plant and expanded its brand empire which now also includes Mini and Rolls-Royce. Today, BMW is still building motorcycles just as they did in the 1920s. BMW is one of the "German Big 3" luxury car manufacturers, and the bestselling car manufacturer worldwide. BMW nowadays is an extremely innovative manufacturer that has a renowned reputation for excellence, design and car quality . Today, the BMW brand is often cited as one of the "best" in the world, and the company continues to launch a stream of innovative products.

Figure 29: BMW factory in Munich

GBE FACTORY characteristics

Figure 30 - Wind turbines, Leipzig plant.
Supplier of the technology: WDP Windanlage GmbH & Co. KG

BMW has the vision of basing the whole production process for its new electric cars on the use of sustainable energies. In July 2013, the BMW Leipzig plant activated four wind turbines on the factory premises. These Nordex Wind Turbines have a total power output of 10 MW and produce around 26 GWh per year. The wind farm is operated by wpd, an external developer of wind power projects and one of Germany's leading designers and operators of wind parks headquartered in Bremen. The electricity produced by the wind turbines is entirely used at the plant. It is not fed into the public grid but wholly distributed to the many factory areas through a central power supply facility. Power is spread across more operating hours; in other words, the turbines do not have a greater generating capacity, but rather run near capacity for more hours per year. The four installed wind turbines cover about a fifth of the overall power requirement at the BMW Leipzig plant, making it possible to utilize wind power in many factory areas, in particular to cover the base load when, for example, the production of electric vehicles is halted.

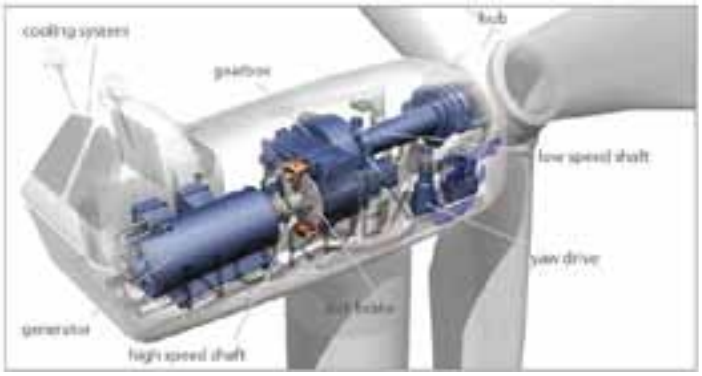


Figure 31 - Nordex turbine elements.
Supplier of the technology: WDP Windanlage GmbH & Co. KG

The energy vision of the company is the following:

- Environmentally friendly electricity The generated green power, which is fed directly into the factory grid, is as an auxiliary system for the conventional power supply.
- Power generation With the installed green power plant facilities, the company produces 100% renewable energy and covers for 100% of its energetic needs with it.
- More energy produced The standard tower height in Germany is 100 meters, but the tallest tower annually produces up to 20 percent more energy.
- No environmental impacts During power generation, neither chemical nor physical processes, which can lead to environmental changes and damages, are applied.

Why is it a GBE FACTORY exemplary case?

BMW can be classified as a One by One GBE FACTORY Model. The wind farm allows BMW to satisfy its own Energy needs to a great extent. Through the Wind farm, BMW has now set up a production that is not dependent on the conventional power supply grid. The energy created entirely covers the energy needs of the production plant for the new electric BMW i3 vehicle series. Even more importantly, the wind plant is emission-free, guaranteeing a minimal environmental impact.

G.E.O. - Gesellschaft für Emaillierung und Oberflächentechnik GmbH

Company Description

Figure 32 - The company in 1898

The “Gesellschaft für Emaillierung und Oberflächentechnik GmbH” looks back on 115 exciting years of industrial history. Since 1898 the enamelling process has taken place in Geithain (Saxony); on the borders of Germany and Europe, “Geithainer Emaillierwerk“ represents quality and innovative products in the enamelling industry. Founded in June 1898 by the “royal regional court in Geithain”, it lived throughout the World War, the economic crises, survived the almost complete dismantlement of the factory, endured incorporation in collectives, the turmoil of the post-reunification period and the privatization by means of a trustee. With the new start in 2005, the old traditions and successes are applied to the enamelling of boilers and polyurethane hard foam-proofed containers. In the last eight years the company has been investing in renewable energy in order to face the costs due to the wide consumption of energy and heat. It has created more than 45 jobs in the field of renewable energies and increased its competitiveness on the market.

GBE FACTORY characteristics

Due to the strong consumption of energy, the company has decided to invest in renewable energy. In 2011 was realized a power station (207 kWh therm. / 140 kWh elect.) and 2010 three photovoltaic systems, with an overall performance of 955kWp (energy: 897.700 kWh/a), were installed on every roof of the company’s modernized premises. With the commissioning of the power station and the electricity produced included in the price, it is the only enamelling factory in Europe which self-produces and covers for 100% of its energetic needs with proper renewable sources. Until now over 3 Gig watt ph. have been produced, which corresponds to the electricity consumption of 1.000 households per-year. The total investment for the above mentioned systems sums up to 2,1 Mil. Euros.

The energy vision of the company is the following:

- **Environmentally friendly electricity generation through PV & CHP**
  The company produces its own electrical energy. With a photovoltaic plant and a cogeneration (combined heat and power, CHP), it fully provides its customers with green electricity.
- **Maximization of space**
  The company installed a photovoltaic system up to 455 Kwp on the refurbished roofs of the production halls and warehouses.

Figure 33 - CHP Plant/Power station. Supplier of the technology:Thermic Energy RZ GmbH

- **Maximization of heat**
  The CHP plant (combined heat power) generates the necessary heat to warm the pickling baths and at the same time it produces electrical energy (384 kWh).
- **Power generation**
  With these facilities, the company self-produces and covers for 100% of its energetic needs, so as to provide 100% renewable electricity.
- **Oil savings**
  The amount of electricity generated covers the annual electricity needs for about 450 households and corresponds to an annual saving of 120,000 liters of oil or 144,000 m^3 of natural gas.
- **Totally renewable PV system**
  The factory exclusively uses silicon modules; these are completely recyclable and made in order not to burden the future generations.
- **No environmental impacts**
  During the power generation, neither chemical nor physical processes which lead to changes in the environment are being used.
- **CO^2 savings**
  The CO^2 savings through our photovoltaic system and the cogeneration plant amounts to 839.25 thousand kilograms of carbon dioxide annually. Therefore, we manage to make an active contribution to climate protection.

Why is it a GBE FACTORY exemplary case?

The Gesellschaft für Emaillierung und Oberflächentechnik mbH“ is a One by One GBE Factory Model. The savings of energy are very important for companies working in the enamelling sector, because they use a big quantity of electrical and heat energy Through the RES Plant, it is possible to save the energy costs; at the same time the factory satisfies the business energy needs and sells out the surplus of energy. The RES investment gave 45 workers the possibility to be employed and reduced air pollution and greenhouse gas emissions. Even more importantly, RES produces little or no waste products such as carbon dioxide or other chemical and mechanical pollutants, so it has minimal environmental impact.

7. DEMO GBE FACTORY collection

Taking as reference the 10 GBE FACTORY exemplary cases identified above, 5 project proposals of DEMO GBE FACTORIES have been drafted. According to the aim of the project these 5 proposals address Public Administrations or Public Organizations, in order to allow the public sector to achieve sustainable investments giving the example to the private sector. In fact, because of the rampant economic crisis in Italy and in other European project countries, which have almost blocked structural investments by public administrations, foreseen DEMO GBEFACTORYs have been addressed to private facilities of industrial sectors. They have become often proposals, which aim to promote additional investments, that improve and optimize existing ones. An overarching goal of DEMOGBE-FACTORY remains always to arrive at NZEB Factory and beyond it to carbon neutral factory. Furthermor, the Demo project proposals also become a means for transferability, since they will represent examples of viable projects that are replicable by other actors. Each one assesses the needs of the local market, will describe the foreseen realizations, will show the benefits and the potential impact of carrying out a DEMO GBE FACTORY in the specific location and analyzes the sustainability of the investments in the middle-long range. The project proposals provide information on: -technology and system issues, based on an outlined design of system requirements in terms of Input, Processes, Output, Programs and Procedures, considering also energy efficiency issues with reference to the existing tools; -economic issues, in order to determine the benefits and savings that are expected from the candidate system and compare them with costs; -operational issues, in order to measure how well the DEMO GBE FACTORY takes advantage of the opportunities identified during the requirements analysis phase; -scheduling, estimating how long the GBE FACTORY will take to be developed, and showing detailed timetable of activities; -sustainability, in order to demonstrate how the DEMO GBE FACTORY will continue to have its role in the middle long range. Furthermore, stable innovative applications and integrated systems that make the GBE FACTORY a DEMO are considered in this document. This document becomes a specific and well targeted document with detailed information on a significant number of DEMO GBE FACTORIES (10) , that will be used to reach other realizations (mainly business oriented), beyond the regions directly involved in the project.

The table below summarizes the identified DEMO GBE FACTORIES.

N.	Name of the GBE Factory	Country	Sector		
			industry	commerce	others
1	SUN nZEB Industry/Commerce Building (Rossi due – Marostica -VI)	Italy	X	X	
2	FERTITALIA S.r.l. (Verona)	Italy	X		
3	Cantina Sociale di Castelnuovo s.r.l. (Verona)	Italy	X		X (Wine production)
4	COAL	Italy			X (Wine production)
5	Perpetuum Mobile BG JSC	Bulgaria			X (Energy Utility)
6	Motocar Service Company Ltd. (Plovdiv)	Bulgaria			X (Energy Utility)
7	KOSIT a.s., Košice	Slovakia			X (Energy Utility)
8	J. Schmalz GmbH (Glatten)	Germany	X		
9	Crude oil company, Austria	Austria			X (Energy Utility)
10	ESCO Company	Austria			X (Energy Utility)

Table 11 - DEMO GBE FACTORIES per sector

For further information on each DEMO GBE FACTORY, specific templates that describe the individual cases exhaustively follow below.

7.1 GENERAL OVERVIEW

SUN nZEB

Company description

Figure 34 - Computer renderings of the company

SUN n ZEB is a new building nZEB (nearly zero energy building) sponsored by Rossi DUE S.n.c. based in Marostica (Vicenza) with the collaboration of the team of Unioncamere del Veneto involved in GBEFACTORY project. From a technical point of view the evaluations and proposals for the new building are the result of a collaboration with:

- Construction: VS associati – Marostica
- Thermographic analysis: Geom. Dal Cortivo Diego
- Air conditioning system and PV plant: Ariaclima Marostica Italy.

The building, located near the premises of Company Rossi Due, at the foot of the hill fortified with medieval walls that embrace the town of Marostica, took place during the development of the project GBEFACTORY.

GBE FACTORY characteristics

The realisation of an executive commercial nZEB (Near Zero-Energy Building) building designed while maintaining its costs within the average rate (€/cm) of what is usually spent for regular industrial/commercial buildings in the area of the Veneto Region - piedmont area of Vicenza, Italy. The average costs are considered with reference to a building that has an underground floor designated for machine parking activity and three surface floors that will host directional and commercial activities. The involved area will be around 1.000 sqm. The new building will include a commercial storage, offices, executive offices, multifunctional rooms for exhibitions/conferences/training courses, a meeting room, a technical office and a concierge room. The roof will host demonstration settings showing renewable energies-related technologies and a panoramic restaurant.

Specific criteria are at the basis of the construction of the new building, given the following needs as specified by the customers:

- HIGH ENERGY EFFICIENCY: the building itself and the plants have to be harmonised in order to create a comfortable environment which, at the same time, is environment-friendly in terms of low heating emissions and high plant efficiency.
- SELFCONSUMPTION: on the roof a PV plant will supply most part of the energy needed for running the entire building and its activities.
- SPACE FLEXIBILITY: rooms need to be spacious and suitable for possible different uses in accordance with future needs. The building has to be suitable to permit the installation of elevators aimed at an easy move of the exposed items. The roof will be destined as an accessible part for visitors where exhibitions and guided tours will take place. The elevators will cover all storeys – from the basement to the roof – and they will be capacious enough to permit heavy loads. The new headquarters will host educational events together with commercial and cultural exhibitions, conferences, guided tours for schools and also for professionals. The main concept is a building in which environment protection, energy saving and living wellness are condensed and perfectly matched.
- NO GAS: given the willingness of the owners to have no connections with the gas network, the whole plant will have to work to guarantee hot water using other energy sources: this implies the use of electric energy and the auto-consumption of the energy produced by the PV plant.
- LOW MANAGEMENT COSTS AND LONG-LASTING DURABILITY OF THE BUILDING: low costs have to be guaranteed in terms of energy efficiency as well as maintenance of the structure and of the whole plant.

The characteristic elements of the building can be summarised as follows:

- TYPE OF BUILDING: three over ground storeys, basement and accessible roof;
- TOTAL SURFACE: 1.000 sqm;
- VOLUME: 12.279,00 m3;
- THERMAL DEMAND (kWh/year): about 4.000,00 covered by locally produced electric renewable energy (no gas);
- PV PLANT: 35 kW polycristalline roof PV plant;
- ENERGY STORAGE: no energy storage at the moment (only input from photovoltaic energy with a system of local exchange); at a later stage, a storage mechanism will take place when storage batteries prices will be affordable.

In order to create a building in line with the described functional needs, whose construction costs will be on the average of the ones expected for similar buildings and what management expenses will be fairly low, it was necessary to analyse the environment where the structure will be placed: this study included solar exposure, shadow, winds etc. together with the analysis of the lot, its building capability and planning restrictions. The building structure was then chosen in order to minimize the thermal losses and special attention was given to appropriate inner environment and climatization. The Air Treatment Unit (ATU) purifies and makes external air hygienic. Treated air merges into another part of the unit which detects and controls the latent heat. The function of ATU is to dehumidify air before letting it flow in the distribution unit. The distribution unit is made of the so called cold beams which are used for cooling, warming, fan and dehumidification. Without fans or movement mechanisms, the air flows thanks only to the pressure generated by the ATU and the particular diffusion for setting the air conditioning in soft modality creating the “coanda” effect.
Temperature is controlled by a series of extremely sensible batteries/ exchangers. Water temperature in the batteries of ATU and of internal units is controlled by a Polyvalent Unit that can supply both cold and hot water (Cold Beams are made of 4 pipes). The protocol of the Cold Beams plant dialogues with the protocol of the Domotic plant so to manage the use of the electrical Energy produced by the PV plant in a regime of total self consumption.

Why is it a DEMO GBE FACTORY?

SUN nZEB Rossi Due is a high value project, since the renewable energy source (PV) plays the main role in a civil/industrial structure which will be “nZEB” (nearly zero energy building). Such buildings follow the goal of reducing nearly to zero the energetic consumption of the building and using solar power for the building’s main needs.
As no gas connection may be seen, this nZeb building model is also very suitable for those areas where gas pipelines are not available, see e.g. some mountain areas.
The feasibility study was not limited to the use of RES sources, but involves the entire building structure including materials, air conditioning and lighting solutions.
The importance of such proposal is due not only to thenumber of RES investments and nZEB features, but also to the high potentiality to be exported in the context of industrial/commercial buildings of small-micro enterprises in Veneto region and in most of North Italy as well as in other European regions.

FERTITALIA S.r.l.

Company description

Figure 35 - Fertitalia Srl headquarter

The identified industrial site is that of Fertitalia S.r.l., a company operating in the field of composting of the industrial organic in municipalities and fractions. The company has integrated the composting process with a system to produce energy from organic waste and uses the roofs of buildings to produce electricity from the sun.
Fertitalia Srl, headquartered in Italy, Villa Bartolomea of Verona, was founded in 1994. It boasts a long experience and a consistent "know how" about the disposal of organic waste. This knowledge has led to the realization of a composting process that guarantees a high level of reliability and does not require any interruption of operations, even for maintenance. This guarantee of continuity is essential to ensure with a high level of order and public health in the municipalities which collect the waste.
The main company activity is the urban organic waste disposal (biowaste) and industrial food waste by the fermentation and the composting of material. The industrial site Fertitalia S.r.l. covers an area of about 30,000 m2 and it is approximately 150,000 tons of material per year, of which about 120,000 tons come from the collection of municipal organic waste (biowaste or wet fraction) in Veneto, Trentino Alto Adige and Lombardy from scraps food production. The remaining 30,000 tons come from the collection of cuttings and prunings. The disposal process does not require plants to be shut down or storage for the waste collected that begins the process of transformation within 24 hours after collection from users. This technology therefore guarantees the continuous delivery of waste of Fertitalia S.r.l. without postponements, or emergency destinations. This has been strongly supported by the early investors involving an increased initial capital, but willing to stand out for its reliability, keeping the plant available 24 hours a day, 365 days a year.

Figure 35 - Biogas Plants

GBE FACTORY characteristics

The company's energy needs are mainly electric, with an annual consumption of 4,500 MWh necessary to the treatment of air (suction and blowing) and changes in the organic mass.
The heat demand is mainly related to the need to heat the air blown in heaps of organic material during the process of aerobic composting and in small part to the heating of offices. The hot air is now produced by a diesel fired boiler with an annual consumption of 42,000 liters, or about 410 MWh/year. Then there is a heat demand of about 6,500 MWh linked to the production of biogas to maintain digesters at the right temperature. This requirement is met by using part of the heat recovered from the cogeneration engines.
The company produces clean energy through a 1 MWp photovoltaic plant, built on the building roof in 2012. The energy produced by the photovoltaic system is used in large part to the company electricity needs while the available rare temporary energy surplus is introduced into the national grid.
Fertitalia S.r.l. has also created a biogas cogeneration plant of 2 MWe. About 50% of the conferred organic waste follows a traditional process of aerobic composting while the remaining 50%, before the step of composting and maturation, undergoes a phase of anaerobic digestion necessary to extract biogas. The biogas generated is used in two internal cogeneration combustion engines of 1 MWe each, made in 2010 and 2012.
Anaerobic digestion is a collection of processes by which microorganisms break down biodegradable material in the absence of oxygen. In this process there is a recovery of the organic substance otherwise lost as CO2 in the classical processes of aerobic stabilization. Once extracted, the matter (or DIGESTATE) is separated from the residual water content, by a mechanical centrifugation following the traditional process of composting mixed with the original organic waste.
Concerning affordability, related to the Italian incentive legislation, the electricity produced by the two engines is fed into the national electricity grid and sold to the Manager of Energy Services. The heat produced by a co-generator is currently used in winter to maintain the right temperature in the digesters.
The heat produced by the second cogeneration plant is part of the project: Fertitalia S.r.l. is considering the opportunity to realize a recovery system to heat the air blown into the aerobic stabilization process and to heat the air in the compost storage buildings avoiding the use of the a diesel boiler. The GBE FACTORY DEMO is inspired to the "ONE to ONE PLUS" model (GBE Factory Guide) with renewable energy production dedicated to business use and the surplus ceded to the grid. The amount of energy produced from biogas and roof photovoltaic solar are greater than the consumption and make the company Fertitalia S.r.l. "RENEWABLE POSITIVE ENERGY". There is the possi-

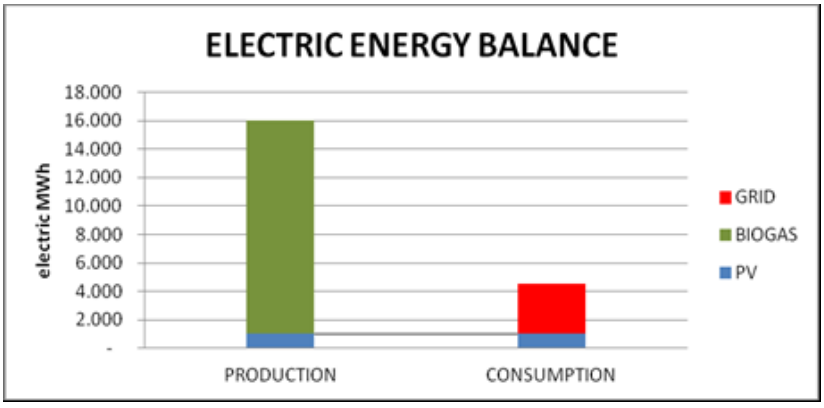


Figure 37 - Electric energy balance

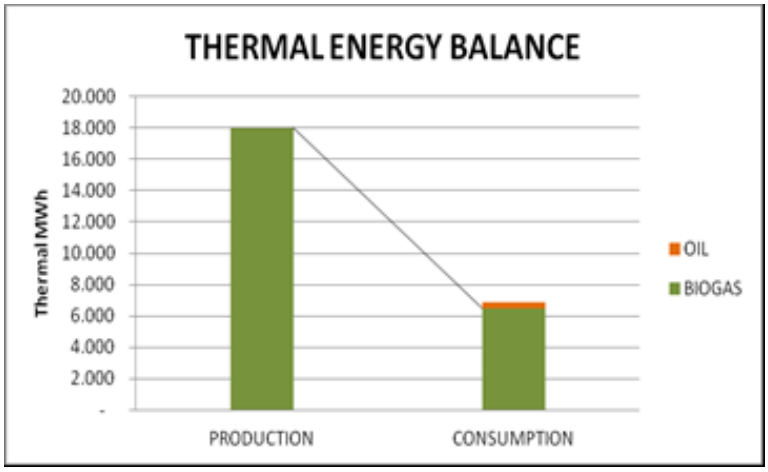


Figure 49 - Thermal energy balance

bility to transfer the heat recovered from the CHP through a small heating network district that connects the company to the nearby units. In this way the DEMO GBE FACTORY model could become "one to many". Figure 49: Thermal energy balance All different design options taken into consideration for the additional project in order to eliminate the use of diesel showed a limited investment (less than 200.000 €) and an attractive return of investment (Pay back = 3 years, IRR > 20%)

The result of the GBE Factory DEMO is an annual production of approximately 34,000 MWh from renewable sources, of which 1,000 electrical MWhe coming from the photovoltaic, 15,000 electrical MWhe and 18,000 thermal MWht coming from the two cogeneration engines.

Why is it a DEMO GBE FACTORY?

Fertitalia s.r.l has the features to be a GBE Factory DEMO because :

- Fertitalia model allows to take advantage of the potential energy from the organic waste fraction even before turning it into compost, through the extraction of BIOGAS and the resulting cogeneration of electricity and heat;
- It allows to exploit the large surfaces of buildings to produce electricity or hot water from the sun;
- it produces more renewable energy compared to how much the company needs, in order to run the entire production platform (company POSITIVE ENERGY) then the company is not only able to meet its energy needs but it can also produce clean energy for the surrounding community;
- Fertitalia model is attractive and replicable for the European territory wherever there is an urban waste collection plant.

The project can be an example for other organic waste disposal platforms, showing how it is possible to make more profitable the composting process, enhancing waste. The Fertitalia DEMO may contribute to create the necessary mood to push other organic waste platforms in Europe to adopt the proposed solutions becoming “RENEWABLE POSITIVE ENERGY” companies. In fact, the extraction process of biogas before the composting step does not alter in qualitative and quantitative terms the production of the final compost.

Cantina Sociale di Castelnuovo s.r.l.

Company description

The identified industrial site is Cantina Sociale di Castelnuovo S.r.l., one of the most important winery consortium of the West Veneto region. Since 2010 the company has been planning the recovery of bioenergy from grape pruning and the presidents are now determined to proceed with an updated economic evaluation for the beginning of the process.

Figure 39 - Cantina Sociale in Castelnuovo

Cantina Sociale di Castelnuovo Srl, headquartered in Italy, Castelnuovo del Garda of Verona, was founded in 1958. It gathers a long and consolidated experience in winery and its strength is based on the strong network of more than 250 associates. These strength points led the Company within the leader wineries of the north Italy and to the certification of the areas of Bardolino, Custoza and Lugana. The main company activity is the production of wine: the most important wine produced in these facilities are Lugana, Custoza, Bardolino and Bardolino Superiore. Nowadays Cantina Sociale counts more than 250 associates with more than 1200 hectars of vineyard surface. Every associate provides its grapes to the central facilities where the production process takes place. Every year the winery transforms more than 16.000 tons of grapes into wine: about 75% of these grapes come from Denomination of Controlled Origin lands which is one of the most important Italian certifications for wines.

Figure 40 - Cantina Sociale in Castelnuovo di Garda

Figure 41: : View of a vineyard of Cantina Sociale di Castelnuovo

The company pays attention to the environment in order to reduce the wine production footprint and thanks to GBEFACTORY initiative is going to develope a project for the recovery of the renewable energy available in the wood from wine pruning to produce heat by combustion or piro-gassification.

GBE FACTORY characteristics

The innovation lies in the utilization of the wooden biomass that is produced after grape pruning, and represents a huge energy resource for the consortium. The company's energy needs are mainly electric, with an annual consumption of 1,583 MWh necessary to cool down rooms of grapes and wine processing, handling of grapes and wine especially during the fermentation period that is usually in the months of September and October. The heat demand is mainly related to the need to heat the steam up for sterilization and washing processes and to heat offices. These requirements need two different enthalpic levels for hot water: for sterilization and washing processes low pressure (0.6-0.9 bar) steam is used, while hot sanitary water is used for heating up offices during cold seasons. This heat demand is provided by two diesel fuel burners. The diesel consumption every year is 26.000 liters for the domestic diesel and 37.000 liters for the agricultural diesel for a total thermal energy production of 410 MWh/year.
The cooling energy demand is related to temperature control for wine and must during stabilization and storage period and the temperature set point for the room-temperature is 15° C. The cooling energy is required only from May to October and the measured requirement is 1100 MWh/year, which is obtained with two refrigerating units.
The utilization of the residual biomass from grape pruning would allow the saving of 48.200€ and 98.500€ for the fuel expenses of heat and cold production, respectively. The total savings per year would be 146.700€ for fuel purposes.
The project proposal aims at the production of thermal energy for heat and cold purposes via biomass combustion. The requirements of the winery are 410 MWh/year for heating energy and 1100 MWh/year for refrigerating energy. An assessment on the productivity of the field is now required: we will define wood chips as a fine cut wood at 30% humidity in weight. We will start from a couple of assumption: the first one is that the productivity of wood is 1.2 tons of wood chips/hectare and a calorific value of 3 MWh/ton of wood chips. With these assumptions, the required vineyard surface is about 450 hectare, while the consortium has 1200 hectares among all its associates. In Table 1 the comparison between the available energy in the fields and the required thermal energy for make the winery working. This Project proposal aims to consider also the piro-gassification of the biomass. Piro-gassification is particularly indicated for low quality biomass, to produce Hydrogen, Carbon Monoxide and Carbon Dioxide from Organic solids such as coal, tar, char and biomas
The process would comprise both the heat and the cold production via an absorption plant. This process has already been developed and has spread all over the industrial facilities that requires both heat and cold. The energy production may be done in two different ways: biomass combustion and piro-gassification of the biomass. Attention will be focused on the combustion, but an economic overview on the piro-gassification will be also provided. The GBE FACTORY DEMO is inspired to the "ONE to ONE PLUS" model (GBE Factory Guide) with renewable energy production dedicated to business use and the surplus ceded to the grid. The amount of energy that would be produced from biomass would be greater than the consumption and that would make the company Cantina Sociale di Castelnuovo "RENEWABLE POSITIVE ENERGY". To use all the energy produced from the biomass recovery, a system of district heating may be implemented to provide heat to the close factories. From the financial point of view the investment has features compatible with a SME with figures like Pay Back of less than 5 years and IRR more than 15%.

Why is it a DEMO GBE FACTORY?

Cantina sociale di Castelnuovo s.r.l has the features to be a DEMO GBE Factory because:
• it allows the recovery of wood from grape pruning that would be otherwise discharged;
• it reduces the fossil fuel consumption for heating and cooling processes;
• the eventual integration of the piro-gasification for wood valorization, would make the Cantina Sociale the first user within a winery contest among Italy:
• its model is replicable in the European territory wherever there is a winery or wine factory.
The project aims to be an example for other winery consortium, showing how it is possible to make the process of wood recovery more profitable, enhancing the energy efficiency of the whole process of wine production, and potentially allowing a cost reduction of wine production. Wood recovery from vineyard allows the reduction of diesel fuels, the reduction of the environmental impact and the possibility to become a virtuous model for other wine consortium.

COAL Cooperative

Company description

The Livenza Agricultural Cooperative Company (COAL) represents an interesting territorial reality of the easternmost part of the province of Treviso, in the Veneto region, 60 km north of Venice. Started up in 1976, the cooperative is headquartered in Motta di Livenza (TV) and it currently counts about 150 members, including farmers and growers. The agricultural area pertaining to the company amounts to about 3,000 hectares, including 1,000 hectares of vines and the remaining 2,000 of arable land, especially of corn and soy. It aims to provide shareholders and farmers of the Opitergino-Mottense district with assistance in agricultural practices and in harvesting agricultural crops.
The various activities include grain drying and storage, marketing of technical materials (seeds, fertilizers, agro-chemicals, etc...) and of local farm products. In the last decade the COAL Cooperative has started to address the use of wood-energy, sensing in this field a strong potential as a source of income for farms.

Figure 42 - View of the cooperative

In addition to promoting the diffusion and the installation of Short Rotation Woodland (SRW) plantations, specialized in biomass energy production (use of various fast-growing species, including black locust, foxglove, and hybrid poplar), the cooperative is working on the themes of collection and use of different kinds of supplies for energy purposes. In this context, the activity of COAL is the result of many experiments regarding all stages of collection and transformation of sprouts (packing, chipping).
Besides having about 1,000 hectares of vineyards owned by its members, the cooperative have some other local vineyards in which they carry out the fruit picking, equivalent to other 4,000 hectares. It can therefore be estimated that a total of about 5,000 hectares of land can be organized and optimized for the annual collection of sprouts and for the setting of both the logistics of intermediate processing and storage locations, and for placing energy conversion facilities.
In order to try to internalize the added value, the cooperative is structuring a new business by way of the heating supply company “AGRIVITENERGY (A.V.E) Ltd”, through the installation of high efficiency modern boilers, powered by vine chips (Biocompact form). The A.V.E. is a company with widespread participation whose shareholders are COAL members, enterprises, professionals, citizens, and also associations and organizations for public benefit. Some COAL members are currently using the Biocompact form and other members are planning to install it in the near future. In this perspective, the company aims to provide its users with not only the biomass (vine chips) but with everything the user needs for benefiting directly from the heat. The users do not have to worry about finding

fuel, installing the boiler or maintaining it, because everything is managed by A.V.E. The company, indeed, deploys to customers the BIOCOMPAT modules for the generation of thermal energy, provides for their continued operation by refuelling of biomass in form of vine chips (as an alternative to briquette), and keeps their maintenance over time.
To achieve this goal, the new company A.V.E is setting up a new site with a large yard and a building designed with GBEFACTORY criteria for logistics and manufacturing of biomass (vine shoots) and for the management of BIOCOMPACT modules.

GBE FACTORY characteristics

In the situation described above, it should be identified the very interesting and replicable A.V.E model of DEMOGBEFACTORY: "ONE TO MANY", or rather, "ONE TO MANY DIFFUSED" consists of the GBE FACTORY HEAD OFFICE (or MOTHER COMPANY) star connected to many MINI GBE FACTORIES throughout the area. For the moment, these MINI GBE FACTORIES mainly consist of the agricultural processing branches of its members, who benefit from the heating service through the BIOCOMPACT's new boilers for heat and cold production, which A.V.E deploys. (See figure below).

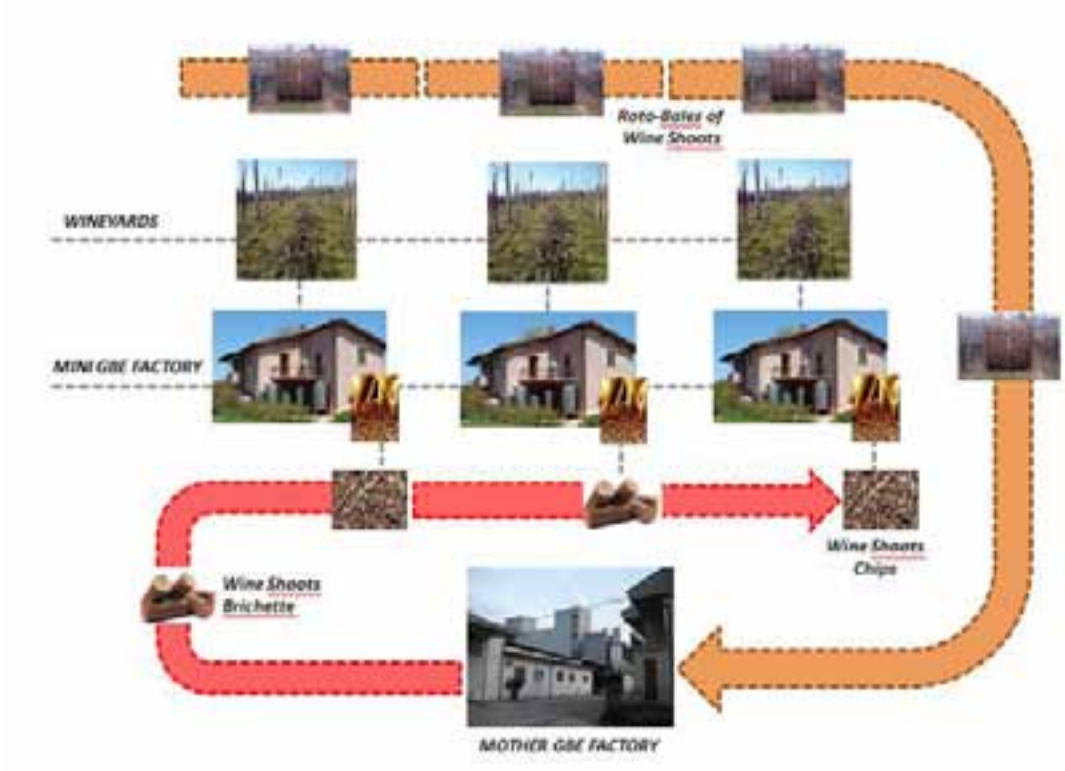


Figure 43 - Closed-Loop Biomass based A.V.E. Energy Supply System

The basic version of GBE FACTORY MOTHER COMPANY has significant potential for future developments related to the processing and the storage of biomass: they have been planning the building duplication, the diversification of raw material entering the shredding plant, and of the typology of combustion outputs (loose wood chips, briquettes, pellets - see figure below)

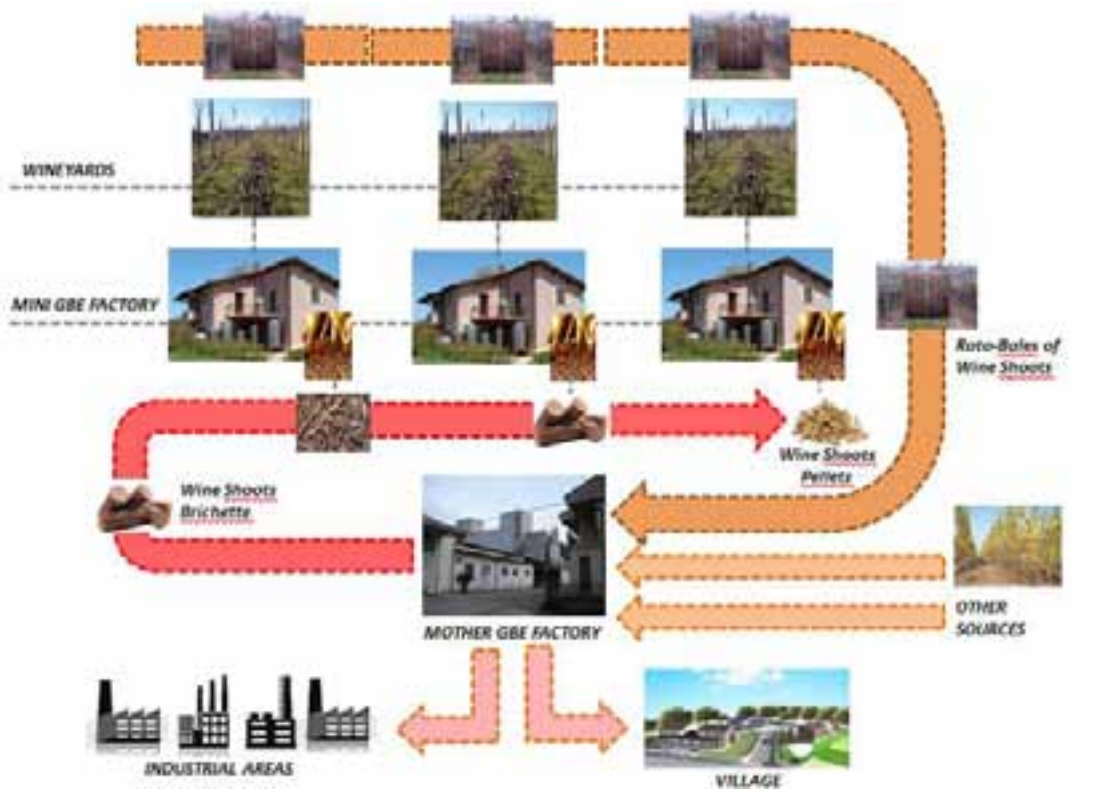


Figure 44 - Enhanced closed-loop Biomas A.v.e. Energy Supply System

Diversifications are provided also for BIOCOMPACT stations, both in terms of new applicable technologies and service forms that include the selling of electricity and thermal energy. As shown the figures below, a BIOCOMPACT module was also installed at the office building and at some warehouse of the COAL Consortium headquarters, which, thanks to the additional contribution of the photovoltaic system installed on the roof of the building, has become a site with nearly Zero-Carbon Buildings (nZCB) which has been recognized the GBE FACTORY label.

Figure 45 - Bio compact details

Figure 46 - Bio compact at coal consortium premises

Concerning the MINI GBE FACTORY, the purpose is the 100%-satisfactory functioning of thermal needs through renewable energy, and on a later stage it will be the satisfaction of electricity needs.
This involves the launch of A.V.E. with the promotion of the BIOCOMPACT product, in single configuration or in the “COMBINED” version, which consider the addition of an absorber for cold production. A.V.E bucks for charge its customers the 10-15% of thermal energy per KWh less than retail prices given on the market.
To achieve this and to exercise on your user very competitive caloric energy prices, the system must be characterized by groundbreaking combustion technologies, quality bio-masses and a telemonitoring system of the performance of BIOCOMPACT stations in the different configurations. An interesting evolution will see the use of pellet boilers and smart absorbers.

Why is it a DEMO GBE FACTORY?

Spill-over effects sought by the “AGRIVITENERGY (AVE) Ltd” company have ethical and environmental features: - encourage the use of waste materials coming from the process of vine cultivation to produce energy for the benefit of the actors of the process themselves; - help in transforming the wine cultivated plains of North-eastern Veneto in areas with lower CO2 emissions. The A.V.E energy model is based on a Circular Supply Chain, from scratch, with an array of transport logistics both as input and output that does not come from the local area, and which therefore gets high environmental and ecological implications. Significant is then the ambition to link the agricultural supply chain with the SMEs’ energy one. The A.V.E business model presents some deliberately not-brilliant economic characteristics, but acceptable if you consider that part of the valuable potential goes for the customers’ benefit, through a heating price that must be competitive on the market, compared to the price of fossil fuels. This is even more understandable, if you consider the nature of ‘widespread participation’ in a company well-established in the territory.
A growth-based company. By 2015 A.V.E will achieve the doubling of GBEFACTORY MOTHER; it aims for selling heat to 50 MINI-GBEFACTORIES and to some companies of the nearby industrial areas for an installed thermal capacity of 5 / 7 MW-thermal.
The equivalent CO2 saved amounts to a million of Kilograms.

7.2 BULGARIA

Perpetuum Mobile BG JSC

Company Description

The proposed investment project is in the town of Balchik. The project sponsor and owner is the Bulgarian company Perpetuum Mobile BG JSC. The main company's activities are connected with investigation, construction, financing and operation of installations for utilization of wastes, production of electric and thermal energy by indirect use of the biomass, etc. The joint stock company's shareholders of the Perpetuum Mobile BG JSC are more then 50% property of Albena JSC.

The biogas plant and cogeneration facilities built up an area of 2 300m2, which in the investments plans will supply energy to the near breeding premises, are situated in the terrain of Momchil in an old industry abandoned area with rehabilitation in progress, near to the town of Balchik, North-East Bulgaria.

The Perpetuum Mobile BG JSC invests in construction installation for production of electricity and thermal energy by indirect utilization of biomass. The electric power of the installation is 1000 kWel. The thermal power of CHP plant is 1000 kWth as well.

The project comprises the mounting of completely new facilities on an existing concrete site. According to the project a module will be mounted that includes: one tank for destruction (fermentor) (diameter: 26.00m, height 8.00m); one secondary tank for destruction (secondary fermentor) (diameter: 26.00m, height 8.00m); one tank for storage of the worked-off biomass/residual substances (diameter: 32.00m, height 8.00m); one solid gondola "MT Alligator" 96m^3.

GBE FACTORY characteristics

The installation works with substrates (raw material) of plant origin – silage corn. The biogas-installations usually work in continuous mode of operation. They are comprised of fermentors, tanks for additional slow fermentation/post-fermentors and tanks for storage of the products from the fermentation process. Inside the post-fermentor the same conditions of the liquid-media are prevailing as in the fermentor. The worked-off biomass is specially prepared for use in the agriculture with parameters similar to liquid natural manure.

The fermentors operate in mesophyle-gama fermentation under temperature of about 40°C. After the residual mass has stayed in the fermentor for certain period of time and has relieved the gas, it is transferred into a gas-resistant tank (second fermentor) through a gas-resistant pipe system. From there, again through the pipe system, the mass passes to the end tank, where it stays until it is transported for the spreading on the agro-land.

As a result of the fermentation of renewable sources (corn silage) high-energy gas is obtained. The gas produced is transferred to a combined electricity and heating plant in the form of fuel for production of energy by generators. Hot water is produced from the heat produced from the exhaust gases and water cooling, by heat-exchangers.

The worked-off biomass that remains after the anaerobic treatment is used as an agro-fertilizer and in this way is returned to the biological cycle of the farms that have supplied the initial raw-material.

The electric energy is transferred to the distribution grid and managed by the local energy provider - the company Energo Pro AD, which operates in North-East Bulgaria.

The heat produced is used as heat energy that participates in the production process of the biogas installation.

The biogas installation is manufactured and is delivered by the German Company MT Energie GmbH. The Italian company AB Energy has supplied the CHP energy facilities and equipment. The construction of all facilities will be implemented by Eko Stroy AD, Bulgaria.

Figure 47 - Tanks for waste fermentation

Figure 48 - CHP plant

One of a kind in the country, this project represents our understanding of the concept "renewable energy". The substrates we will use in the beginning are of plant origin – silage corn, but in the future we are planning to use the food waste from our mother company Albena JSCo. Using it we will not plant our fertile land with energy crops. With the technology we are using there is no waste from the process. At the end of the line we have high quality organic fertilizer which can be used directly on the fields. The facility for combined electricity and thermal energy generation will be constructed near the biogas plant which will use organic waste, providing:

- Electricity for local consumers and grid;
- Thermal energy for a factory for processing fruits and vegetables;
- Thermal energy for a greenhouse;
- Heating and cooling of an administrative building.

The total generated electricity by the CHP Plant is 5100 MWhel/yr. The annual expected electricity sales revenues are in the amount of 651897 EUR. 58% or 4852 MWhth of generated thermal energy will be used for technological needs of the factory for processing fruits and vegetables and greenhouse per annum. The premises of the administrative building will consume about 650 MWhth (8%) of thermal energy for heating during the heating season. 24% or 2050 MWhth will be used for the cooling of an administrative building. The biogas plant and CHP facilities will use 10% of the produced total thermal energy for its own needs.

The processing plant for fruit and vegetables owned by Eko Plod AD and for the greenhouse will be consumers of the generated thermal energy. The project sponsor has a preliminary agreement for selling thermal energy to customers. The processing of the plant biomass is not only an ecological approach but it is economically profitable and valuable market process regarding the environment protection and with high energy value as well. The implementation of the present GBE Factory project will improve the life quality and thermal comfort of the occupants at the administrative building.

Why is it a DEMO GBE FACTORY?

The implementation of the present GBE Factory project will improve the quality of the life and thermal comfort of the occupants of the administrative buildings of the surrounding industry area.
As a result of the implementation of this energy efficiency project, the competitiveness of the manufactured products at the fruit processing and vegetables's greenhouse factories will be expected. As a result of the energy carrier's costs decrease, an increase in the productivity and sales of final production in these two factories is also expected.
As a result of the DEMO GBE Factory project implementation the expected annual savings of the conventional fuels used in the factory for processing fruit and vegetable's greenhouse and administrative building are 2,500 MWh. The cost savings achieved after the project completion in will be of the amount of 250,000 EUR.
In view of the sufficient remoteness from villages and towns and from places included in the national environmental network, the additional activity – utilization of the energy from biomass is a prerequisite for the realization of the investment offer in accordance with the state policy for waste management and energy policy.
Other circumstances determining the expedience of the project are the following:

- Valuable and fertile agro-lands are not affected;
- There is theno impact on protected territories and breaking of the network of protected zones;
- Enough proximity to main road and to the permanent routes of the existing infrastructure;
- Remoteness from other project sites requiring zone for health protection.
- The GBE Factory project cash flow analysis indicates that the project's financial indicators are sufficient to serve debt (pay loan interest and repay loan principal) within the loan terms negotiated with the bank.
- The project cash flow analysis indicates that the project has very impressive financial indicators: the project payback period is 8.0 years plus 1 year grace period, IRR is 12.0% and NPV amounts to EUR 4,800,000.
- The final integrated model of GBE FACTORYs supplied with renewable energy from waste, which includes suggestions stated during GBEFACTORY project activity, make it a demonstrative case.

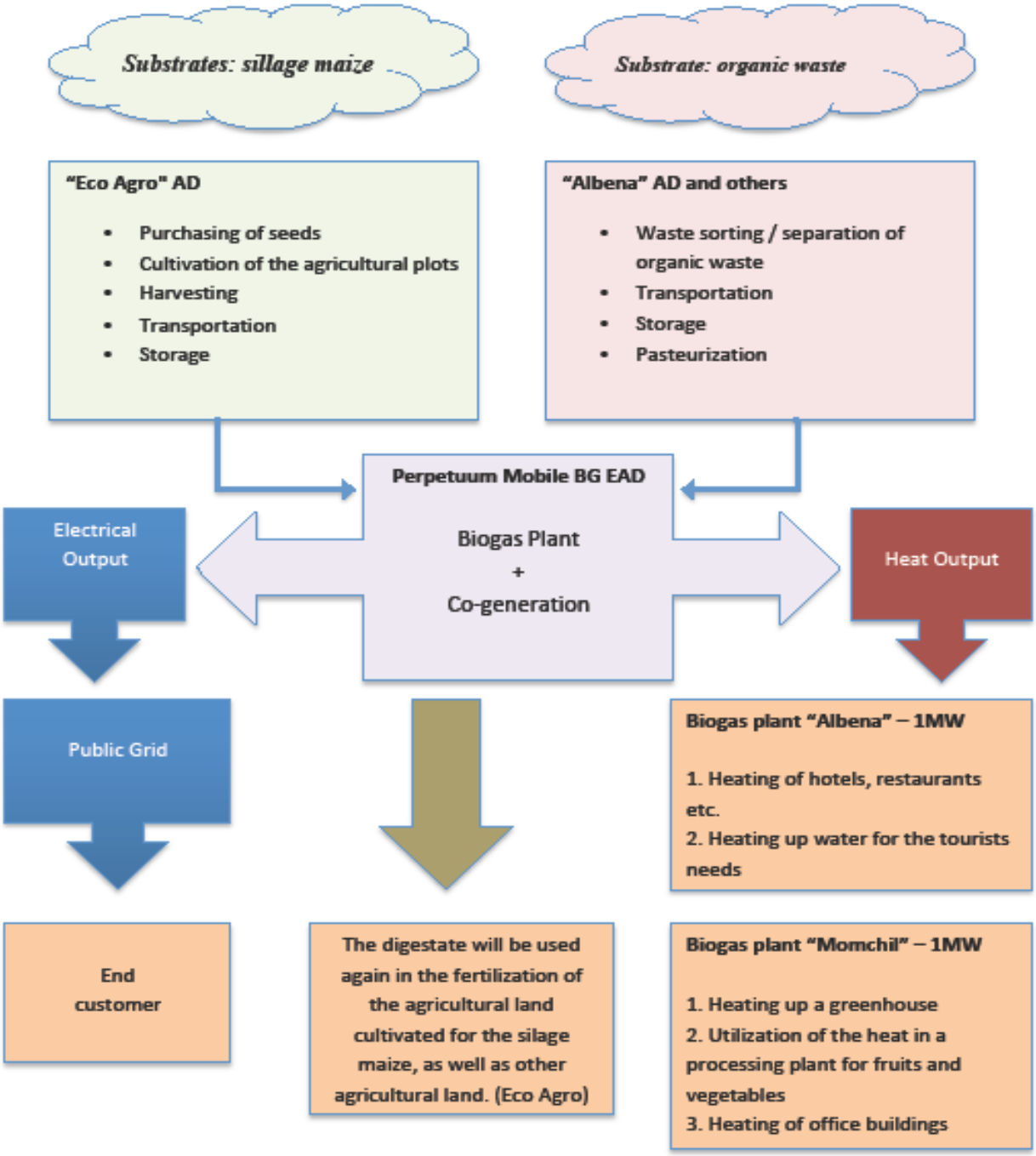


Figure 49 - Overview of the DEMO structure

Motocar Service Company Ltd

Company description

The proposed project is in the town of Plovdiv.
The project sponsor and owner is Motocar Service Company Ltd. Motocar Service is an official representative of the German manufacturer for forklift trucks Linde Material Handling in Bulgaria.
The company own a storehouse for spare parts for all models of forklift trucks Linde. Highly skilled professionals provide warranty and service of delivered equipment. In order to improve support services, a network of 5 branches is provided in the cities of Sofia, Plovdiv, Varna, Gabrovo, Shumen and Stara Zagora. The response time for the service staff of the entire territory of Bulgaria is within 24 hours. In parallel to these activities Motocar Service Ltd provides comprehensive processing of recycled equipment with brand Linde, designed for both the Bulgarian and the European market. Motocar Service started production of wood pellets on 01.04.2013 as an additional business in Bulgaria.

GBE FACTORY characteristics

The factory for production of pellets is located in Bulgaria, in the city of Plovdiv, South-central Bulgaria. The production of pellets started in April.2013. The biomass plant, as a part of pellets factory, is situated in the terrain with a total built up area of 1,200m2. Motocar Service invests in the construction and installation of high efficient steam boiler using wood chips as a fuel for the production of thermal energy.
The project included delivery and construction works of steam boiler type RRK 1,000 with installed nominal capacity of 1,200 kWth which uses wood chips as a fuel. The proposed steam boiler and auxiliary energy equipment are constructed on the territory of the plant for the production of pellets.

Figure 50 - Pellets factory

The steam boiler type RRK 1,000 is designed for production of saturated steam with pressure of 6 bar and temperature of 165 oC. The nominal boiler steam output is 1.5 ton per hour. The steam boiler is covered in thermal aluminium insulation with low heat transfer coefficient.

The installation of the water treatment system has a capacity of 2m3/h. The water treatment system is equipped with two column-filters, filter for raw water, and two feeding water pumps with power capacity of 11 kW each. The new equipment will increase the quality of the feed water for steam generation through softening of the feeding water. After softening the water will be transported to a tank for softened water. The tank for softening water will be completed by deareation installation. The deaeration installation is equipped with a thermal atmosphere deaerator with a capacity of 3 m3, mixed headstock, immersion pipe, reduce and temperature control valves and recirculation pumps. Deaeration installation will separates the oxygen and other aggressive gasses from the boiler feeding water.

The technical measure envisages delivery and installation of a metal chimney for emitting of the exhausted gasses after the steam boiler. The chimney has diameter of 400 mm and height of 15 m.

The total generated thermal energy to the dryer in the pellets factory is 2,880 MWhth/yr.

The produced steam will be transported to the drying with a capacity 2 tons per hour through a steel pipe with a diameter of 160 mm.

Figure 4 and Figure 5 shows visualisation diagrams of the technological process and monitoring of the boiler parameters in the biomass boiler plant.

Figure 51 - Pellets factory

The Motocar Sercice Company GBE Factory project cash flow analysis indicates that the project's financial indicators are sufficient to serve debt (pay loan interest and repay loan principal) within the loan terms negotiated with the bank.

The total GBE Factory project cost is in the amount of 1,400,000 EUR without VAT. The project cash flow analysis indicates that the project has very impressive financial indicators: the project payback period is 3.2 years plus 1 year grace period, IRR is 21.2% and NPV amounts to EUR 470,880.

The cash flow includes the sales of the forecasted reduced CO2 emissions, sold at the conservative price of 15.0 EUR/ton but with no additional cost for monitoring and verification. The forecasted revenues are based on the emissions in tons reduced due to the implementation of the GBE Factory project

The cash flow analysis in this scenario shows small improvements in all financial indicators, as IRR increases from 21.2% to 21.9%, NPV rises from EUR 470,880 to EUR 494,424, and the payback period is 2.5 years.

Why is it a DEMO GBE FACTORY?

In wood pellets factories the process of biomass drying, made by saturated steam generated by a boiler fed with wood chips at 160°C, shows an attractive return of the investment and it proves easily replicable in the many other factories of this type in EU regions.

As a result of this renewable project implementation the competitiveness of the manufactured products at processing of wood pellets will be expected.

Pellet production is a promising business. The market is steadily growing in Europe. All indicators show steady growth as demand is greater than supply. Key success factors of the project are the geographic location of the facility relative to the raw material and the organization of perfect logistics.

7.3 SLOVAKIA

Kosit

Company description

Kosit is a modern joint-stock company, which provides services in the field of waste management. KOSIT a.s. is one of the five most important companies in Slovakia active in this demanding and socially sensitive industry. 66 % percent of its shares are held by Italian investors, 34% by the city of Košice.
The company currently provides services to approximately 260 000 residents of eastern Slovakia and 500 businesses. It annually treats more than 80 000 tons of waste, employs more than 400 workers. In managing its processes the company uses a certified quality management system ISO 9001 and 14001. KOSIT is in charge of treatment and valorisation of the waste of Košice and its 14 neighbouring villages. Its activities are organized around collecting, sorting, storage and incineration of communal waste. It is one of only two MSW incineration stations in all of Slovakia. Any waste that cannot be recycled is incinerated, thereby producing heat, which offers more value and utility. This heat is sold in the form of steam to another local company, TEKO. The profits generated by the sale of heat and the economies of scale obtained make it possible to guarantee a low and dependable price.

Figure 52 - Kosit Headquarters

A network for integrated heat production and distribution

TEKO is a heat production company supplying Košice's network of remote heating, to which 85% of the city is connected. TEKO, with a production of 855 MW, is the largest producer of heat in both Slovakia and the Czech Republic together. Around 70% of heat from TEHO is sold in form of hot water steam to a municipal service enterprise TEHO, fully owned by the city of Košice. TEKO is responsible for the distribution network of heat that aliments 85% of the city. The flowchart represents the exchange between the three companies and the city of Košice.
After the project implementation, KOSIT's energy efficiency will significantly increase. Energy efficiency will both generate larger profits for the 3 companies and allow a total reduction of CO2 emissions. The CHP (combined heat and power) process itself assists such energy efficiency, even when certain steps are carried out individually.

Figure 53 - Steam system

Location

The project is located in the cadastral area of Barca 827,380, deed 2626 parcel number 2705/1, owned by the investor. The municipal waste incinerator, including related operations, is located at a distance of about 4 km from the southern edge of the urban area of the city, belonging to the land register of the Kokšov- Bakša village. In the northwest, the area of operation is adjacent to the municipal wastewater treatment plant Bakša, from the south-eastern side it is neighbouring with a broad gauge railway line. In the south side it borders with farmed agricultural land. An integral part of the area of operation is a waste transfer station with a capacity of 18 000 m^3. There are no protected or environmentally sensitive areas in the place of interest.

Figure 54 - Engeneering phase

Košice is the second largest city in Slovakia. It is a metropolis of eastern Slovakia situated near the borders of Hungary (20 km), Ukraine (80 km) and Poland (90 km). The town disposes of production sphere, shopping network, services, schools, scientific and research base, sport, recreation and other technical infrastructures. The city itself has an area of 242,768 km2, 240 688 inhabitants and a residential density reaching 991 people/km2.

The purpose of the project is to build a new steam generator boiler K2 in Kosit plant, which will be located inside the existing building, in the boiler room, in the area of the existing waste hopper, using also the area of the rubble treatment building, which is located by the boiled building. The existing fire grate will be retained and will be connected to the new boiler K2.

GBE FACTORY characteristics

In Kosit two parallel incinerating lines are operating (K1 e K2) - two steam boilers with natural circulation for the vacuum incineration grate, with a capacity of approximately 80,000 t/year each, using urban wastes and actually operating alternatively. Kosit has applied the Integrated Pyrolysis Combined Cycle technology which can upgrade existing plants through different fuels coutilization, so as to reduce the investment, fuels and operating costs and to increase the electric energy production and the overall reliability of the system. The integration of the pyrolysis technology with existing generation plants (or new ones) has the advantage to increase the hours of operation, the performances of the power section and the exhaust treatment section, so to strongly decrease the environmental impact of the plant. The environmental impact related to the electric energy unit is, consequently, lower than that produced by other technologies available now.
The main goal of the DEMO GBE Factory project in Kosit Plant consists in the improvement of the Waste to Energy System efficiency, by the addition of a new steam boiler generator K2 in the second incineration line, in order to improve waste treatment capacity and at the same time to lose energy produced the least possible.
As regards the efficiency improvements of the plant, the existing boiler K1 line maintains its original thermal energy efficiency equal to 35%, whereas after the installation of K2 boiler, the K2 line will operate with almost a 100% energy efficiency. The reconstruction and modernization of the second incineration line will increase incineration capacity from the previous 67 500 t to 135 000 t of waste per year. Disposal of these larger quantities of waste will increase electrical energy production and also the production of heat.

Figure 55 - View of Kosit after reconstruction

Technical solutions of new K2 line

The new K2 line of the KOSIT incinerator in Kosice will consist of the following components and systems:

a) Waste combustion, steam and electricity production:
   - combustion and steam generation system:
     - grid combustion system, air-cooled
     - power pusher
     - wet slag remover and slag conveyor
     - horizontal boiler equipped with the hammer cleaning system
     - ash extraction and ash conveying systems
   - flue gas treatment line:
     - cyclone dust collectors
     - water cooled cooling tower
     - bag filter, 4-cell, individually excludable
     - lime and activated carbon storage and injection systems
     - dry fly ash extraction system and recirculation system
     - induced fan with silencer
     - SNCR DeNOx system with urea injection in the boiler
   - analysis and monitoring system of the flue gas in the chimney
   - regulated turbogenerator
   - thermal cycle with air separator, feed pumps, turbine bypass
   - water-cooled condenser and heat recovery system
   - evaporative cooling system

b) Control and regulation system:
   - New DCS system with No. 2 operator stations and engineering workstation installed in the control room

c) Electric power plant and electrical substation 5kV/22kV:
   - transformer substation and PC and MCC switchboard;
   - double line 22kV underground cable for connection to the electricity distribution network

d) Auxiliary systems:
   - compressed air system
   - demineralization water circuit
   - plant producing hot water for district heating

Power capacity

The proposed steam generator, at a rate of 60,000 Nm3/h, flue gas temperature in the combustion chamber more than 850 ° C, the outlet of the combustion chamber around 1000 ° C and the entrance to the flue gas cleaning plants about 250 ° C, will achieve the following performance parameters:

- production of steam at maximal continuous filling: 29t/h,
- steam pressure at the boiler outlet: 4.0 MPa,
- the temperature of the steam leaving the boiler: 390 oC,
- working hours between two (temporary) shutdowns: 8,000
- production of electricity: 65,000,000 kWh

Financial aspects

Lifetime of the plant:	30 years	
Revenues:	4,000,000- EUR / year	Sale of electricity
Savings:	600,000	Electricity savings
		High maintenance costs
Internal Rate of Return:	15 %	
Pay-Back Period of Project:	8,7 years	

Table 12 - Financial aspects of the investment

Why is it a DEMO GBE FACTORY?

A plant for energy generation from waste is itself a GBEFACTORY, but we want to show how different approaches and investments evaluation can make such a system efficient in the use of renewable energy generated and not a site wasteful. The thing is not irrelevant because in Europe there are hundreds of sites that turn waste into energy, and many of these are working with enormous energy waste, which means “adding waste to waste”.
The numbers involved are large in terms of energy and then examples of efficiency through innovation in processes and the use of new technologies that we believe have to be clearly identified in the project GBE FACTORY. The technologies and processes shown may finally be fairly easily replicated in other incinerators especially in eastern Europe.

7.4 GERMANY

J. Schmalz GmbH

Company Description

Figure 56: J. Schmalz GmbH Headquarters

The identified industrial site is that of J. Schmalz GmbH, a positive energy company. Schmalz GmbH is headquartered in Glatten (Germany), and was founded in 1910 by Johannes Schmalz.

Today, the third entrepreneur generation is managing the company: the founder`s grandsons Dr. Kurt Schmalz and Wolfgang Schmalz. Schmalz is one of the worldwide leading providers of automation, handling and clamping systems, providing customers from numerous industries with innovative, efficient solutions based on vacuum technology. Schmalz products are used in a wide variety of production processes – for example, as grippers on robot arms in the production of car bodies, in CNC machining centers as clamping solutions for furniture pieces, or used by an operator to lift items ranging from boxes to solar modules. Schmalz customers can either choose from a diverse line of components or they can benefit from a complete solution that is custom-tailored to their requirements. Schmalz is dedicated to its customers, providing groundbreaking innovation, exceptional quality and comprehensive consultancy. The company is headquartered in Glatten (Black Forest region of Germany) and is active in 15 additional countries with their own subsidiaries. Schmalz employs a total of around 750 persons worldwide.

The Schmalz company has been collecting experience in the sustainable use of natural resources for three generations. The use of renewable energy was a permanent part of the company philosophy right from the early years. Schmalz increased its investments in sustainable energy generation proportionally to its energy requirements. Today Schmalz is a Positive Energy Company, generating more energy from renewable resources than it consumes. This commitment has already been awarded multiple times.

GBE Factory characteristics

Existing building

The transfer to the new building, in use since 2009, resulted in the merging of all production and assembly areas into one single area. All materials administration and logistics were reorganized and optimized. The energy demand of the new building lies approximately 57 percent below the value of the German Energy Saving Regulation (EnEV). Moreover, the new production building has the following ecological features:

- Gravel base under the new building consists of locally cut and crushed sandstone
- A rainwater cistern of 320 m^3 supplies the sanitary facilities as well as the outdoor irrigation and the operation of car wash stations
- North-light saw-tooth roof for optimum lighting conditions and for heat protection in the summer
- North-light saw-tooth roof serves as sub-construction for photovoltaic modules with an additional performance of 259 kWp (performance of the entire company-owned photovoltaic power plant: 533 kWp)
- Compensatory measures against surface sealing by means of our own flood retention basin upstream of the hydropower pond as well as an infiltration trench alongside the hall road
- Braking energy of the automatic small parts store is fed back into the electricity grid
- Hall lighting has a daylight detection control and is dimmed automatically (including DALI-Digitally addressable lighting interface- bus technology) with high-efficient bulbs
- All-over under floor heating, provided by in-house woodchip heating system
- Heat recovery from the manufacturing plants as well as the used air of the hall and controlled supply to the heating system by means of an efficient rotary heat exchanger in the ventilation facilities during winter
- Reduced air pollution and reduced heat transfer due to central exhaust ventilation in the machines as well as two ventilation facilities active in the summer
- Automated shutter windows for natural nighttime ventilation and cooling in summer
- Roofed recycling area with 11 container sites for the separation of recyclable material (99 % recycling rate)
- Electricity and heat balance: the electricity and heat balance shows a comparison of the production of renewable energy and energy demand. Over a long-term view of five years the balance reveals a positive result.
- Energy self-sufficiency: the supply of electricity and heat of the Schmalz company comes directly from their own energy sources whenever technically possible and economically reasonable. As the supply of electricity from renewable energies rarely corresponds to the electricity demand, a part of the self-generated electricity is fed into the public grid. For this purpose, Schmalz has been cooperating with the electric company Elektrizitätswerke Schönau, a multiple-award winning supplier of pure CO2-free green energy.

All the buildings included in the headquarters of J. Schmalz GmbH are incorporated in an energy network. It therefore seems appropriate to integrate all the other buildings that will eventually be built, viewable in the planning below, into the same energy network.

Figure 57 - Areal view of the plant

Some figures: the Renewable energy investments

Solar Energy Generation

Figure 58 - Solar Energy Generation

- Photovoltaic power plants: 533 kW nominal capacity;
- Energy yield per year (2012): 576,000 kWh
- Usage since 2005 (extension in 2009, 2010, and 2011)
- Pay-off period: 8-10 years
- Reduction of CO2 emissions: approx. 385 tonnes per year
- The photovoltaic power plants are mounted on the roof of the company building.
- The plants with a total of 2,187 polycrystalline and monocrystalline PV modules occupy an area of 3,800 square meters
- Solar thermal installations on the roof of the company's premises, with an annual gain of approximately 11,000 kWh, supporting the water heating.

Hydropower Generation

Hydroelectric power plant:32 kW nominal capacity

- Energy yield per year (2012): 123,000 kWh
- Usage of hydropower: since 1910
- Reduction of CO2 emissions: approx. 86 tonnes per year
- When Johannes Schmalz came to Glatten in 1910 and founded the company, he was dependent on the water wheel of the mill. He used it to operate his machines via transmissions. Although the municipality of Glatten had already been connected to the electric power supply, Johannes Schmalz in 1922 replaced the old mill wheel with two Francis turbines and thus opened the chapter of renewable electricity generation within the Schmalz company.

Heat generation by means of renewable raw materials

- Wood chip heating system: 500 kW Nominal capacity energy yield per years (2012): 1,303,000 kWh
- Usage of wood chips since 1986
- Pay-off period: 8-10 years
- Reduction of CO2 emissions: approximately 348 tonnes
- In 2007, the wood chip heating system was replaced by a plant that was significantly more efficient with 500 kW of nominal capacity. To date it supplies all the buildings occupied by the company headquarters via a district heating network. The untreated natural wood required for the plants from forestry from the local woodland.

Figure 59 - Heat generation

Further new investments

The construction of 2 new company buildings has been scheduled (2013-2015), which will be incorporated in the already existing energy network. The construction of further buildings in the coming years are: an office building as a research and testing center and a reception building as a communication center for visitors and employees.

Figure 60 -Research and test center

Office building B2: Research and test center

- Construction costs: approx. 4 million €.
- Start of construction: March 2013
- Move-in: February 2014
- Area: 2,916 square meters gross floor space
- Three office floors, each of 580 square meters
- Ground floor for fair store and logistics as well as for long-term testing and advanced development, for a total of approx. 830 square meters
- Space for 120 new office desks in the areas of research & development, construction and distribution

Ecological measures of the Research and test center

- Central mechanical ventilation facility with heat recovery and cooling or preheating of the supply air via the transmission through a rock cavity, as well as C02-air sensor
- Automatically controlled air-supply windows on all office floors for natural nighttime circulation and temperature reduction of the thermal mass in offices in summer
- Greening of rooftops for good climatic conditions, rainwater harvesting and microbiology, as well as roof-terrace for employees to use during breaks
- Intelligent area illumination with motion detectors and daylight sensors
- GPS-controlled external sun protection
- Sheet plate front with a small ecological footprint, high recycling rate and incorporated sun protection
- Installation of raised-floor system on the office floors
- Highest insulation standards by 32%below the threshold value set by ENEV.

Reception building A3: Communication center for visitors and employees

- Construction costs: approx. € 6.3 mln.
- Start of construction: October 2013
- Move-in: February 2015
- Area: 2,150 square metersgross floor space
- Ground floor: reception area, conference room, technical rooms, warehouse and cold-storage cells for the kitchen, dressing room for kitchen staff
- 1st floor: staff, applicants center, customer area with conference rooms and small exhibition area / hospitality area
- 2nd floor: company restaurant with bistro café and winter garden, terrace, kitchen with adjoining rooms, roofed walkway to the production facility.

Figure 61 - Communication center

Ecological measures of the Communication center

- Cooling by means of water from the Glatt river (adjacent small river)
- Three ventilation facilities with heat recovery and demand-oriented regulation (e. g. CO2-sensor, motion detectors)
- Connection to the grid of the in-house wood chip heating system
- Under floor heating system on the ground floor
- Pipes in the ceiling of the dining area in the company restaurant as well as the office rooms are used for cooling and minor heating (thermal component activation)
- External sun protection, optimized via daylight simulation
- PV modules on the walkway, shading elements on the side of the building and roof with an estimated 30 kW performance
- Use of demolition waste of the old buildings as ballast bed
- Triple glazing and high insulation standard of the building, optimized by means of thermal building simulation as well as thermal bridging calculation
- Use of the thermal discharge of the kitchen and cold-storage cells to feed into the heating system

- Consideration of construction materials with ecological demands
- Use of high-efficiency motors in ventilation, heating pumps and direct-drive cable elevators
- Building will be equipped with energy saving LED lighting, including motion regulation and daylight control
- High level of natural light due to additional courtyards and extensive glazing of the facade.

Why it is a DEMO GBE FACTORY?

Schmalz has the features to be a DEMO GBE Factory because:

- it creates ecological compensatory measures whenever technically possible and economically reasonable – despite strong business growth which makes the construction of new buildings inevitable
- it does not only focus on the production of renewable energies but saves on resources wherever possible
- it serves as an replicable role model and supports the fact that citizens to inform themselves on the measures adopted
- it allows to exploit the large surfaces of buildings to produce electricity or hot water from the sun
- it produces more renewa

7.5 AUSTRIA

CRUDE OIL COMPANY IN AUSTRIA

Company Description

The project owner of the planned RES project is a crude oil & gas corporation in Austria, which asked to be maintained unknown. Its core areas of business are oil and natural gas exploration and production, and oil and gas storage. Through its own storage capacity and its role as an operator, it plays an important part in the security of supply for Austria and the whole of Central Europe. Their activities also include crude oil stockpiling, natural gas trading and transportation, and renewable energy projects.
The GBE FACTORY demo plant investor operates a CHP plant, for covering their own electricity demand. The generated heat is used for heating up their oil which has to be kept at 30°C on the one hand and for feeding into the nearby district heating grid on the other hand. The district heating grid is connected with private households and commercial and industrial enterprises.

GBE FACTORY characteristics

The crude oil & gas corporation owns a gas-powered combined heat and power plant with 3 pcs. of gas engines, each has a capacity of 800 MW. The heat capacity of the CHP is 6 MW. Most of the generated electricity by the CHP is used for their own electricity grid with a total demand of approx. 14.3 GWh/year. The generated heat will be used to feed into the local heating grid on the one hand and to heat up 3 oil tanks with a capacity of each 60,000 m³ up to 30°C.

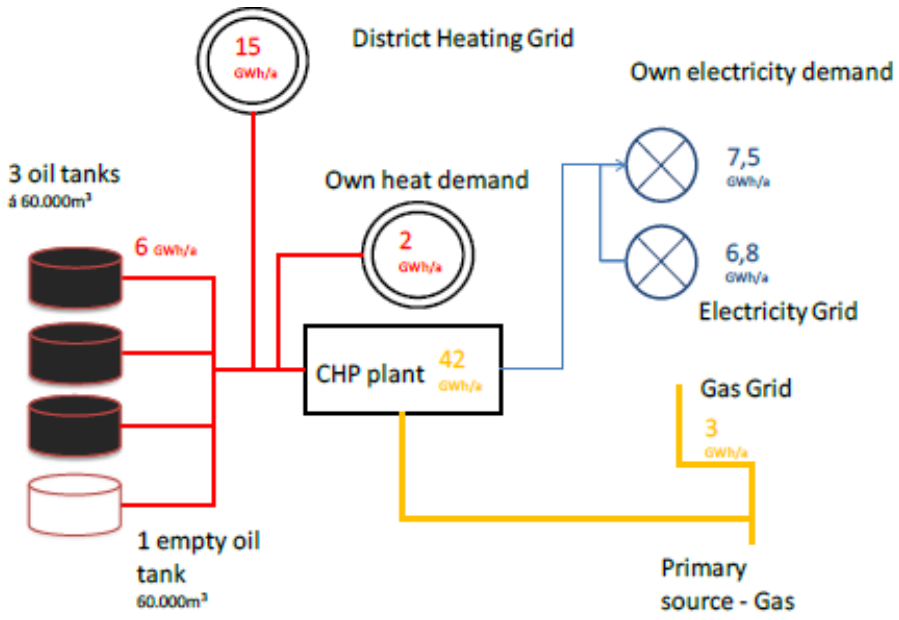


Figure 62 - Energy flow chart – Current situation

In future a solar thermal plant with a capacity of approx. 7 MW should be installed. One oil tank should be rebuilt to a seasonal storage, which allows to store the solar energy and surplus heat of the CHP plant during the summer and to use it in the winter months. This oil tank actually is not in operation and is empty. The 3 oil tanks will be heated with the solar thermal plant during the summer months.
This concept will lead to high natural gas savings (the CHP plant operation hour are more independent, due to the available heat of the solar thermal plant). With the seasonal storage also a highly efficiency operation of the CHP plant and solar plant is possible.

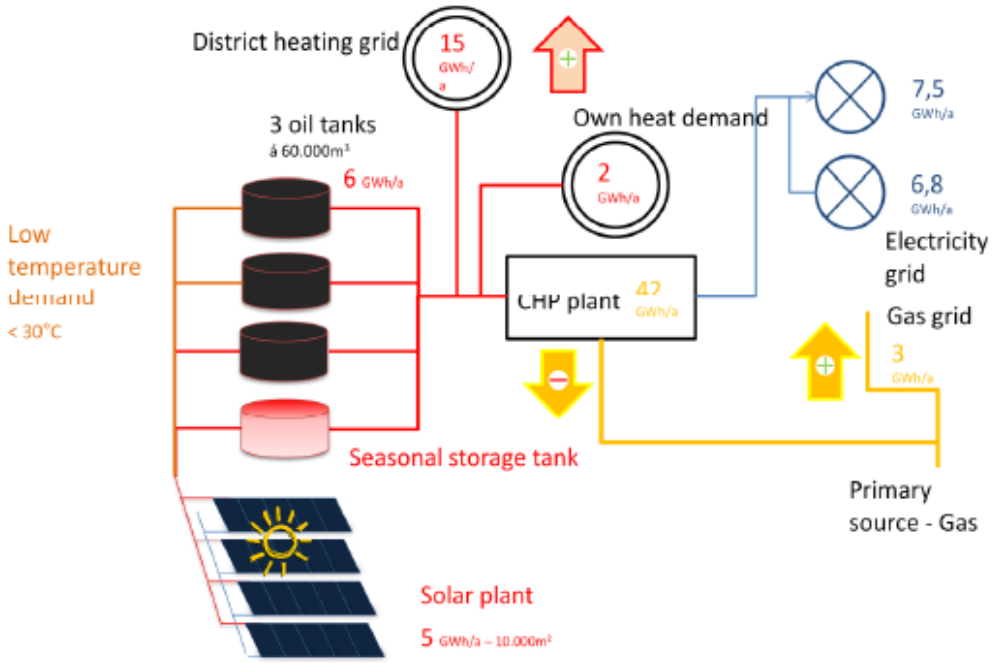


Figure 63 - Energy demand and production – Future situation

Key data of solar thermal project:
Expected Solar yield: 5,051 MWH/year
Expected investment: 3,000,000 EUR
National subsidies for investment: 40 %
Expected pay-back period: 6.1 years

Why is it a DEMO GBE FACTORY?

The proposed investment project in Austria may well be seen as a DEMO GBE Factory for following reasons:

- High replication factor; in Europe a lot of industries exists like this one described, which has a lot of heating demand for storing crude oil. This case represents a high profitable demonstration project for the oil producing industry, not only of Austria but also for many others in Europe;
- Of the huge energy demand for heating, a high portion of alternative solar energy can be used, thus savings a lot of natural gas;
- More independent operation of the CHP plant (heat available from the solar thermal plant);
- A highly efficiency operation of the solar thermal and CHP plant in combination with the seasonal storage tank (100 % use of surplus heat -> possible use shift to winter months);
- Integration of a large scale seasonal storage enables a high innovative and smart combination between different energy producers and energy consumers;
- The solar plant can improve social and environmental responsibility company image. The plant can be open for visitors; this will help to promote renewable energy projects and gain trust and confidence in green technologies. It will trigger and raise awareness of clean sustainable energy at commercial scale. (a similar already existing RES system is operating in Denmark, where the heat is used for low temperature district heating in combination with heat pumps and other RES energy sources - “Masterplan Denmark”).

Finally The project presents characteristics of innovativeness and as such may be funded through the use of co-financing provided by the Structural Funds in the European Regions.

ESCO company in Austria

Company Description

The DEMO GBE FACTORY company referred to in this document is a specialized company (name is omitted under request of the same company) on engineering of engines and operates its own motor power testing stations. The company has several office buildings on the settlement area, get cooled and heated by an internal cold and heat grid. The actual energy supply of the company is a conventional heating grid and a gas boiler for the needed heat generation and conventional electric chillers for the cold supply. The motor power testing stations need to be cooled and give off the heat to the environment (surplus heat). An ESCO company will install a large scale solar thermal plant on two buildings of the company DEMO GBE FACTORY and will also install heat exchanger in the motor power testing station system for a possible use of the surplus heat. The generated heat will cover parts of the existing heat and cold (via an absorption chiller) loads of the above mentioned internal grids. The ESCO company above mentioned is ”Energiecontracting GmbH” of Graz - Austria (WG 3 member) specialized on large solar thermal projects with different applications (heating, hot water, district heating, process heat, solar cooling). SOLID an Austrian partner of the GBE FACTORY project is solar.nahwaerme.at and worked out together with the Esco a proposal for the installation of a solar thermal plant combined with the use of the produced heat via the motor power testing stations (surplus heat). The generated heat will be used for heating and cooling (absorption chiller) purposes. The DEMO GBE FACTORY described belongs to the GBE FACTORY model “ONE by ONE”

GBE FACTORY characteristics

The actual heating system of the company, based on fossil gas, in accordance with the SOLID+ Energiecontracting GmbH, will be transformed into a GBE FACTORY providing a significant rate in term of renewable energy.

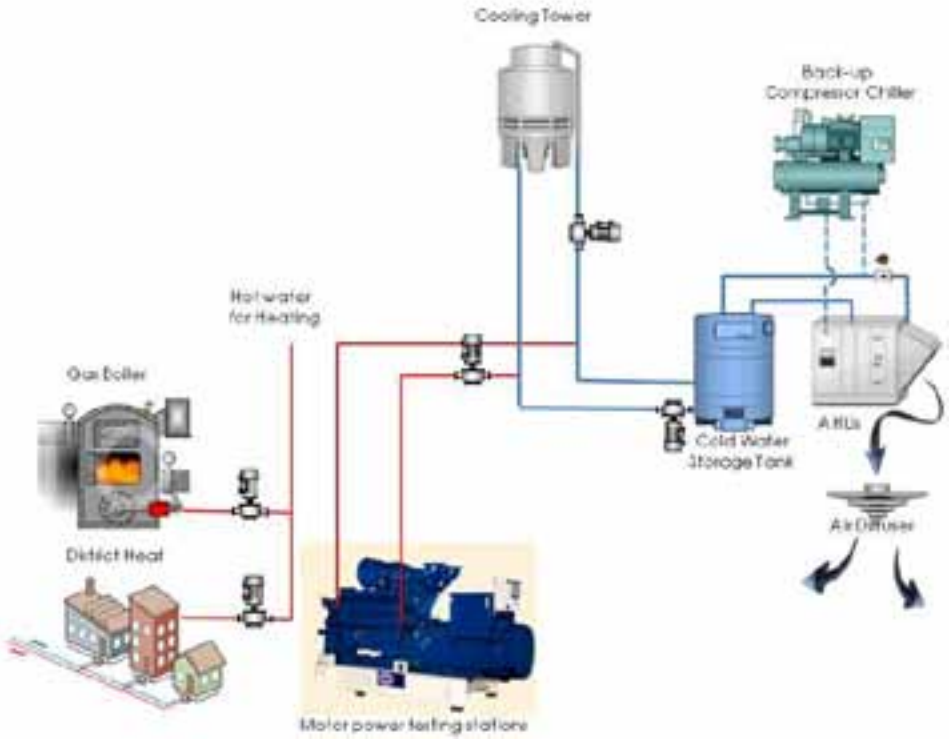


Figure 64 - Conventional energy supply of the client (heat & cold)

SOLID and solar.nahwaerme.at worked out together a proposal for the installation of a solar thermal plant combined with the use of the produced heat via the motor power testing stations (surplus heat). The generated heat will be used for heating and cooling (absorption chiller) purposes.

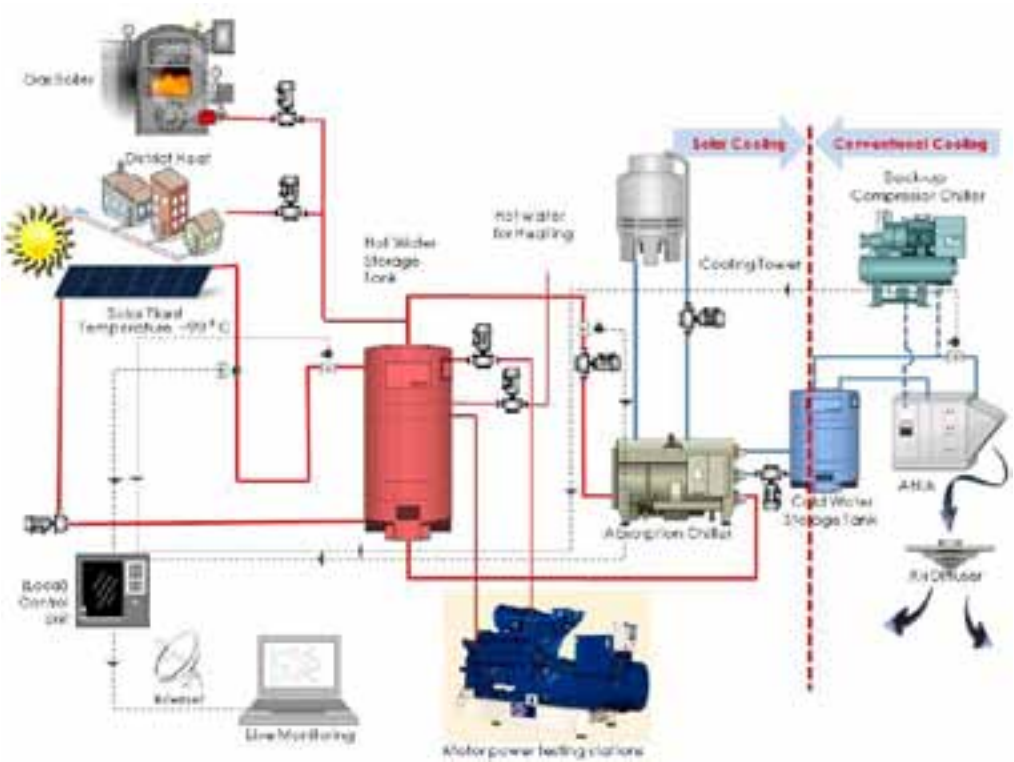


Figure 65 - Future energy supply - including the RES & surplus heat generation

Based on the current energy demand and consideration of the surplus heat potential, the collector field was dimensioned to a size of 3,304 m². The collector area will be installed on two roofs, one directly on roof and another one on a steel construction (canopy of a parking level).

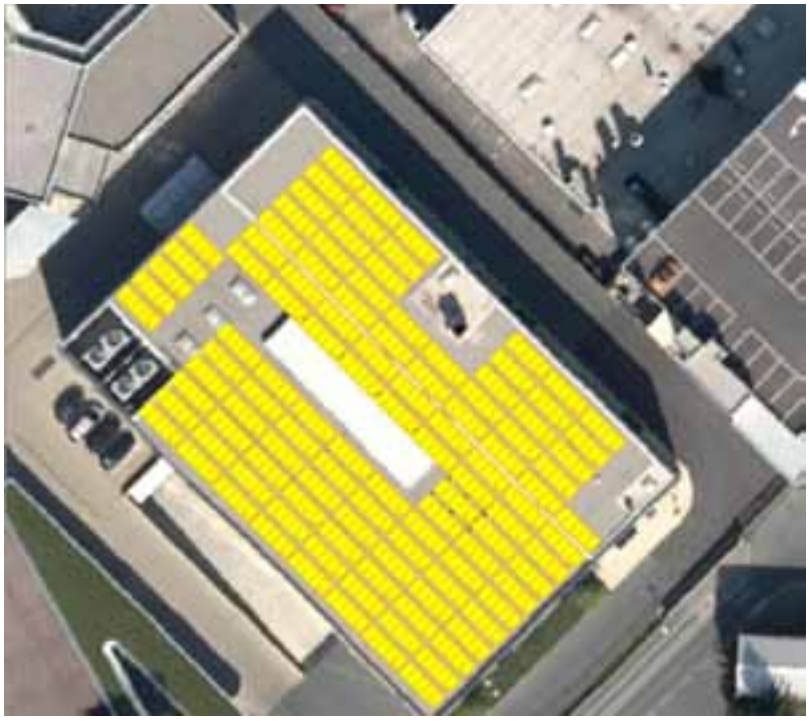


Figure 66 - Second roof with directly on roof mounted collectors

First priority of the plant is to cover the heat demand (lower temperatures -> higher solar yields). During the summer months mainly the absorption chiller will be in operation. With this concept high energy coverage of heat (35%) and cold (30%) are possible.

At the moment the current heat/cold supply is done with 91% by gas. The planned proposed project will lead to high natural gas savings.

Key data of solar thermal project:

Solar collector area:	3304 m²
Absorption chiller capacity:	1 MW
Expected solar yield:	1,319 MWh/year
Expected surplus heat potential:	1,415 MWh/year
Expected investment:	2,350,000 EUR
National subsidies for investment:	45 %
Expected pay-back period:	6.1 years

Why is it a DEMO GBE FACTORY?

The proposed investment project in Austria has significant potential to be considered a DEMO GBE Factory for following reasons:

- Is a model easily applicable to all existing companies which have significant losses of heat, that can be recovered and summed to the heat from an industrial solar plates system (newly installed), in order to provide enough heat energy (at temperature more than 100°C) to make the company buildings nCNB (nearly Carbon Neutral Building-CHG saving more than 80%).
- Buildings' cooling is provided through an absorption chiller in combination with a solar thermal plates system. The system uses high temperature solar flat plate collector specifically designed to achieve maximum efficiency in large-scale solar.
- The "surplus heat" using gives the project a high standard in the field of energy efficiency (....energy saving before additional energy supply).
- The financial sustainability is achieved through an ESCO company applying the model defined as "shared savings".

Finally the project presents characteristics of innovativeness and as such may be funded through the use of co-financing provided by the Structural Funds in the European Regions.

8. FROM GBE FACTORIES TO CARBON NEUTRAL FACTORIES: A VISION FOR THE FUTURE

The experience gained in various industrial sectors, exemplified by the GBE FACTORY project, has demonstrated that industrial enterprises which invest in renewable energy can be divided into five basic categories: a) those which have in their own mission renewable energies or more generally the environment (such as those providing services, producing biofuels, manufacturing products for the generation of renewable energy, or are concerned with the preservation, and more generally, management of land, water, air and soil); b) companies that are particularly energy-intensive (paper, food, metal processing, etc.); c) companies that have by-products created by manufacturing processes or that deal with waste; d) companies that choose it for economic reason, as the investment in renewable energies is more profitable than others (governmental incentives have an important role on the choice between the different types of investment); e) companies that have nothing in common with the above mentioned categories, for which the goal of carbon-free production becomes a sort of co-branding that reinforces confidence in their core business (see ICT companies, food companies, wellness and cosmetics companies, etc.).

This division, compared to that by commodity sector above-mentioned , helps us to better understand the motivations – both internal related to the product/process and market-external - that encourage companies to become GBE FACTORY.

The GBEFACTORY project made it possible to understand how RES implementations have been characterized and realized within these macro-categories and how the usage of renewable energies within the company does not have to be episodic and/or temporary related to the presence or absence of FIT, but may constitute a way towards CARBON NEUTRALITY. The real CARBON NEUTRALITY, pursued by the GBE FACTORY project, represents the ability of many companies to locally produce the energy they need from renewable sources, without resorting to offsetting the emissions. Offsetting can be misleading and ineffectual, sometimes a symptom of greenwashing rather than a sign of effective environmental progress. This goal may often be impractical for the companies mentioned above in category b), since the conditions to produce enough renewable energy to offset huge energy requirements are not always present. Nonetheless, there are cases in which the companies referred to in point b), which generally invest in renewable energies to lower and balance energy costs, can produce investments in renewables that can have a significant impact on the energy balance of the company. An exemplary case could be the biogas plant inaugurated in Pontelongo, located in the province of Padua, on 18th September 2013. It uses agro-industrial waste (sugar beet pulp), produced by the nearby sugar refinery COPROB - Cooperativa Produttori Bieticoli, which in turn uses the biogas instead of methane. This plant, like those already operating in Minerbio (BO) and in Finale Emilia (MO), is part of a wider project initiated by the COPROB Cooperative for the production of energy from renewable agricultural sources, particularly from production scraps. Overall, the three plants, which required a total investment of 18 million Euros and are all already working, absorb more than 63,000 tons of sugar beet pulp per year.

The environmental benefits are numerous, considering that devoting the pulps to biogas production, rather than the traditional production of pellets, allows COPROB to obtain a reduction of over 4.5 million cubic meters of annual consumption of methane, avoiding the release in the atmosphere of almost 9 million tonnes of CO, as well as to contribute to

reducing the greenhouse effect.
To become CARBON NEUTRAL, companies described in points b) and c) above, belonging to the agri-food sector, need to build larger bio digesters and integrate the company by-products with other sources of biomass available from the agriculture sector, such as straw, low quality grass cuttings, prunings, etc. Such biodigesters are not simple to build, as the presence of heterogeneous mixtures of biomass input imposes more sophisticated biodigestion processes in terms of technologies and control of the process. It also appears difficult to articulate the agricultural supply chain and overcome some bureaucratic - legislative problems. A "smart" project, which plans to use grass and other herbaceous residues originated from the management of the territory as a resource for the production of biogas, is promoted by the European Union. It is entitled "Energy from landscapes by promoting the use of grass residues as a renewable energy resource" (Intelligent Energy-Europe Programme of the European Union). The project involves 11 partners from 9 European regions: Flanders (Belgium), Veneto (Italy: VenetoAgricoltura and University of Verona), Saarland (Germany), Nordjylland, Midtjlland, South Denmark, Sjaelland and Hovedstaden (Denmark) and the Grande Lisboa (Portugal). The residues of the maintenance of urban, agricultural and protected areas are integrated into supply chain processes for their use in generating renewable energy on the basis of the latest technological developments available on the market. In energy-intensive companies (referred to in point b), renewable energy generation plans are integrated with energy-saving interventions, which become a priority when you cannot rely on biomass from production processes (see steel mills).
In the agri-food sector, innovative processes for the production of renewable energy with broad prospects for future development can be found also in the wine sector, where technologies and capabilities of the supply chain between farmers and producers often reach very high values of CARBON FREE.
Exemplary in this respect is the Italian company COAL (DEMO GBE FACCTORY n. 4) which, through the company "AGRIVITENERGY (A.V.E.) Ltd", has developed an articulated supply chain to collect shoots for the production of woodchips, pellets, briquettes in a GBEFACTORY parent company, which in turn are used to power mobile and remotely controllable modules for the production of heating and cooling at the associated farms producing wine (GBEFACTORY subsidiaries).
Many GBE FACTORY subsidiaries become almost CARBON NEUTRAL, as in the case of the Cescon farm, producing wine, which has no connections to the gas network and maintains only one 15 kWe connection to the electricity grid to meet its needs for lighting and spikes of summer cooling demand. In fact, renewable energies cover approximately 90% of the total requirement of the Cescon farm.
The use of biomass for energy production in the wine sector has considerable development potential in relation to the use of new machinery using gasification and pyrogasification processes, allowing the increase in electrical and thermal yields and a greater reduction in emissions.
The cases examined and the experiences gained within the project GBEFACTYORY also showed how in the categories a) and c) the shift from CARBON NEUTRAL to CARBON FREE has often been possible. An emblematic case is represented by the multinational Mossi & Ghisolfi. With an investment of 140 million Euros over 5 years of study, with the involvement of the Polytechnic University of Turin and ENEA, a new process (Proesa TM technology, patented) was developed, which allows the conversion of cellulosic biomass - straw and corn stalks, plant materials from non-food crops produced on marginal lands,

which do not require water and fertilizer - into fermentable high-quality and low-cost sugars. This technology has been used for the construction of the first plant in the world for the production of bioethanol derived from non-food biomass in Crescentino, in the province of Vercelli-Italy. The biorefinery, which occupies an area of 15 acres, will employ about three hundred people in the area and will have a production capacity of 75 million liters per year of second generation bioethanol for the European market. The plant is totally self-sufficient in terms of energy consumption (13MW of electricity produced from lignin, the residual material of the industrial process) and produces no waste arising from industrial production, ensuring 100% water recycling. The plant produces biofuels, which allow a reduction in greenhouse gas emissions by nearly 90% compared to the use of fossil fuels, significantly greater than the reduction achieved by the first-generation biofuels. The Mossi & Ghisolfi company was born as CARBON FREE, demonstrating that companies in category c) are already considering their new evolution with the 100% utilization of by-products of manufacturing processes.
Examples of ZERO CARBON Companies are quite popular in Germany also in the field of mechanical engineering and construction. A typical example may be the reference case of “GEO - Gesellschaft für Emaillierung und Oberflächentechnik GmbH”. GEO is the only plating factory in Europe which self-produces and covers for 100% of its energetic needs with renewable sources.
Companies, falling under category a), b), c) described above will in the future be designed from their inception to be nZEB Building and CARBON NEUTRAL and CARBON FREE in a SCP environment (Sustainable Consumption and Production).
An example of building designed for commercial-services use and born nZEB is represented by the “SUN NZEB Industry/Commerce Building” of Rossi Company 2 located in Bassano-Italy (DEMO GBE FACTORY n. 1). It combines the nZEB characteristic also with innovative features and realization costs which are competitive on the market. Two other examples of nZEB are the Austrian reference cases “Technologie-Zentrum Aspern, Wien (Austria)” and “REHAU Head office, Guntramsdorf”, which exemplify “passive-house energy standard building “ for small SMEs.
Another example of Net Zero Energy Office Building is representend by the German reference case “Daikin NZEB project” in the Ruhr area.
An example of company that falls under category a), which goes beyond CARBON FREE or ZERO CARBON to constitute a POSITIVE RENEWABLE ENERGY COMPANY, or a company that produces renewable energy to a greater extent of its needs, allowing to sell its surplus to local external users, is the J. Schmalz GmbH (described above as DEMO GBE FACTORY). J. Schmalz GmbH is headquartered in Glatten (Germany), and was founded in 1910 by Johannes Schmalz.
Today, the third entrepreneur generation is managing the company: the founder`s grandsons Dr. Kurt Schmalz and Wolfgang Schmalz. Schmalz is one of the worldwide leading providers of automation, handling and clamping systems, providing customers from numerous industries with innovative, efficient solutions based on vacuum technology. Schmalz products are used in a wide variety of production processes – for example, as grippers on robot arms in the production of car bodies, in CNC machining centers as clamping solutions for furniture pieces, or used by an operator to lift items ranging from boxes to solar modules. Schmalz customers can either choose from a diverse line of components or they can benefit from a complete solution that is custom-tailored to their requirements. Schmalz is dedicated to its customers, providing groundbreaking innovation, exceptional quality and comprehensive consultancy. The company is headquartered in

Glatten (Black Forest region of Germany) and is active in 15 additional countries with their own subsidiaries. Schmalz employs a total of around 750 persons worldwide.

The Schmalz company has been collecting experience in the sustainable use of natural resources for three generations. The use of renewable energy has been a permanent part of the company philosophy right from the early years. Schmalz has increased its investments in sustainable energy generation proportionally to its energy requirements. Today Schmalz is a Positive Energy Company, generating more energy from renewable resources than it consumes. This commitment has already been awarded more times.

Figure 67 - J. Schmalz GmbH Factory

As regards the companies in point d), in Europe there are several enterprises which invest in floor and roof photovoltaic, as well as in solar heat, but with the only aim to produce and sell energy to the market at profitable prices, without any attention to consumption of renewable energy on site through integrated energy saving plans. However, there are many cases, which we can find in the reference cases and in DEMO GBE FACTORIES, in which photovoltaic is integrated with other renewable sources such as solar heat, geo-heat and bio-cogeneration, with the aim to maximize and optimize the overall renewable energy production.

Category e) enterprises are usually enterprises operating at international level; they consider environmental responsibility as a governance element and a social mission which needs to be communicated to the market and to potential customers together with their own brand. This kind of policies, in the case of Microsoft for example, is based on three strategic pillars: be lean, be green, and be accountable. Be green means: -making more environmentally responsible choices with our energy, waste and water; -signing long-term renewable power purchase agreements; -investing capital in new renewable energy projects; -connecting data centers directly to innovative renewable energy sources; - purchasing market renewable energy certificates (RECs) and carbon offsets; establishing reduction goals for waste and water. Other examples of this Are Nestlè and L'Oreal. In the L'OREAL case, the Settimo Torinese-Italy hub will become completely self-sufficient from the energy point of view. The link to a co-generation network, fueled by a system using three renewable energy sources at the same time - thermodynamic solar system, a zero kilometers biomass gasification station, district heating and cooling network - could guarantee the energy necessary to produce 300 million products per year, such as shampoos and balsams, mascaras and cosmetic powders, exported to over 35 countries all over the world.

GBE FACTORY enterprise in the near future will represent the generative focus points of new local renewable energy microgrids in industrial areas, which will help to make these areas more CARBON FREE as a whole. Obviously, the foreseen widespread and shared availability of renewable energy in industrial areas will have to be governed by local SMART GRID, which will manage the excess production of each enterprise with respect to different energy demands from other enterprises located in the industrial area or in the immediate proximity. In this perspective, we could have GBE FACTORIES also in industrial areas, focused on the sole renewable energy production using production waste from smaller local enterprises and biomasses coming from urban waste cycle.

This prospective analysis of the development of GBE FACTORY with reference to 5 main categories of approach to investing in renewable energies, building light on understanding the trends and developments in industrial enterprises, but is less useful for commercial enterprises. Commercial enterprises pay more attention to the building itself, which must be energy-efficient and ensure a comfortable microclimate for operators and visitors. Considerable attention is devoted to energy consumption through the adoption of cogeneration systems to produce heat and cooling (usually using natural gas), high-efficiency lighting systems and heat recovery from air ventilation. There is therefore the widespread idea that nZEBs (nearly zero energy buildings) are necessary. The commercial sector has always been characterized by large buildings and therefore by large roofing. This lead to widespread investments in photovoltaic energy, since returns to investments in this sector were higher due to public subsidies. However, there are cases where the roofs and the walls of shopping malls house solar thermal collectors to produce hot water to be used internally, especially when there are services that consume heat. Sustainability, energy footprint and environmental impact are keywords that are widely used in building license applications nowadays, especially if we refer to new large buildings or shopping centers that result from restorations within cities or high urbanization areas.
In other words, these new commercial buildings are nZEB (nearly zero energy building) and the examples of functionally ZERO CARBON shopping malls are not rare, as their energy needs are met almost entirely by renewable energy.
Renewable energy is derived from the sun (photovoltaic, solar thermal, thermodynamic), from underground sources (geothermal) and sometimes from the wind. Renewable energy systems are well integrated into the design of buildings. In some cases, biomass for heat generation comes into play in the form of woodchip-pellets. A significant example is that of the City of London. The pilot-settlement known as BedZED (Beddington Zero Energy Development), made in the London Borough of Sutton, is energy self-sufficient and represents the first settlement with a zero carbon dioxide emissions balance (carbon neutral) built on a large scale in the UK. It consists of a hundred apartments, for rent or for property, 1600 square feet of offices, shops, sports facilities, a café, a medical-social center and a nursery. The site is also served by a post office.
The settlement has been built by adopting the most advanced techniques of environmentally sustainable development. BedZED uses only energy from renewable sources produced on-site.
The electricity and heating demand is satisfied by a cogeneration plant fueled by woodchips, which is converted into gas from a reversed air flow gasification unit. The orientation of the buildings to the South, inspired by the criteria of bioclimatic architecture, allows the maximization of solar heat; the installation of photovoltaic panels, the very high level of thermal insulation, triple glazing and the adoption of the most advanced low consumption electrical equipment contribute to keep the energy demand low.
The building materials were selected from those of natural origin, obtained from recycled or renewable sources, all produced at a distance of no more than 35 kilometers from the site.
In terms of water conservation, systems of rainwater collection and recycling of exhaust water reduce the consumption of drinking water supply by one-third. Regarding mobility, the focus was primarily on reducing the need to travel (for example by promoting on-line shopping and offering on-site facilities for commercial, social and recreational use) and incentivize alternatives to private cars, i.e. car sharing. Finally, each apartment is equipped with special containers for separate waste collection.

The goal of the GBE FACTORY project has been to shift the focus on small and medium sized centers in order to facilitate energy conversion through renewable sources and to facilitate the spread of new planning in line with GBE FACTORY concept. The goal was to have low energy footprint centers, oriented to maximize the customer's well-being.
A reference case for Italy was the innovative supermarket built in Conselice Municipality (RA-Italy), set up with the aim of increasing workers' and users' well-being by reducing environmental impact and energy consumption, which has also been an opportunity for urban regeneration. Effectively, the new Coop Adriatica supermarket consumes 65% less energy than the old structure (net of food refrigeration systems, ovens, dishwashers, motive power, ect.) allowing to compensate the investments in less than 4 years. The building is equipped with a 30 kW photovoltaic system (with a foreseen addition of 20 kW), a 15 kW geothermal heat pump, with 6 sensors 90 meters deep, for water heating and cooling servicing the areas occupied by staff, and a 61 kW "roof top" air cooled heat pump, with thermodynamic energy recovery from exhaust air, to cool and ventilate the sales area. The GBE FACTORY project can be applied also to coastal tourism destination centers, trying to reduce environmental footprint through the development of waste collection cycles integrated with renewable energy production. In Bulgaria, the Balchik area has already adopted the use of municipal waste for the production of renewable energy to power factories and buildings, which become GBE FACTORIES themselves (see DEMO GBE FACTORY n. 5) In the touristic settlement of Albena, in Balchik region, work has already began in order to create a collection system for hotels and tourist residences to produce biogas and generate electricity and heat for the users of the tourist resort. An important milestone has been set to think about the planning of the regeneration of tourist areas into Green Neighborhoods.