Multiple benefits of energy efficiency

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Table of Contents

Tables

1. Introduction and Method

M-Benefits - Valuing & Communicating the Multiple Benefits of Energy Efficiency project aims at creating a framework for the inclusion of the multiple benefits of energy efficiency in investment assessment and decision-making of companies and relevant stakeholders. This will be achieved through the collection of evidence-based information on the positive impact of multiple benefits to the industrial and service sectors, and through the development of a Tool Box enabling to identify, categorise, and value those benefits in any type of investment project.

The objective of WP3 is to provide practitioners and policy-makers with an evidence base containing data and practical examples on how Multiple Benefits (MBs) can be included in project analysis and energy-efficiency investment evaluations. The evidence base is organised along some key criteria such as business activity, energy-efficiency measure type, key benefits to the company, and geographical location as well as other criteria valued by users.

The main basis for the fact sheets developed in D3.3 is the experience from the pilot projects which were implemented in seven countries where implementation partners were located (Austria, Germany, Greece, Italy, Poland, Switzerland). The fact sheets will cover the experience from all these countries and a variety of companies that differ in terms of their size, sector, and the type of implemented energy efficiency measures. Table 1 gives an overview of the chosen examples.

Country	Example
Austria	Multinational company from the very energy-intensive glass industry, which implemented both a technical energy efficiency measure (waste heat utilization) as well as an organisational measure (energy monitoring system).
Germany	International technology company; implementation of a cross-cutting energy efficiency measures in a building (ventilation upgrading).
	Company from the food industry (Moll Marzipan GmbH); implementation of a heat recovery through waste heat usage.
Greece	Implementation of energy efficiency measures in warehouses of a supermarket chain (PV system, heat exchanger).
Italy	Implementation of an energy efficiency measure for air conditioning in the building of an utility providing energy, water and environmental services.
Poland	Small enterprise manufacturing custom made furniture; deployment of solar thermal collectors for hot water preparation.
	Medium-sized enterprise from the food industry; implementation of a rooftop PV installation.
Switzerland	Automation concept for meters for stores of a supermarket chain.
	Full renovation of a sports building at a university.

Table 1: Selected examples for the fact sheets

2. Fact sheets by country

2.2 Austria

Company, business activity and location	**Stoelzle Oberglas** is a multinational glass producer specialised in high-end glass packaging. They decided to implement energy efficiency measures in their headquarter glass plant in the Austrian town of Köflach.	
Sector	Producing industry (glass)	
Energy carriers	Natural gas & electricity (and district heat production)	
Implemented measures	*EEM 1:* Replacement of the cooling system with an absorption refrigeration unit with output feeding the local district heat grid	
	EEM 2: Central energy consumption monitoring and database as well as consequential process optimisations.	
Projected energy savings and district heat production	*EEM 1:* 1 336 000 kWh/year (natural gas) = 0.6% 5 000 000 kWh/year additional district heat feed-in = 27.1%	
	EEM2: 588 760 kWh/year (electricity) = 0.7% 2 107 270 kWh/year (natural gas) = 1.0%	
Economic benchmarks (Energy benefits only / all benefits)	*EEM 1:* Investment costs	1 000 000 €
	Net present value	-27 208 € / -22 424 €
	Discounted payback	7 years / 7 years
	Investment duration	9 years
	Discount rate	7.5%
	EEM 2: Investment costs	270 000 €
	Net present value	420 000 € / 850 000 €
	Discounted payback	3 years / 2 years
	Investment duration	9 years
	Discount rate	7.5%
Key benefits to the company	• Improvement of the end-product and associated sales volume and/or prices • Reduction of costs	
Main co-benefits	• Closer link to the town through district heat feed-in • Reduced risk through lower water and gas consumption • Better environmental impact	
Interesting aspect	Stronger integration into the town's district heat grid in order to make themselves positively indispensable for the community (beside the provided employments)	

2.3 Germany

Company, business activity and location	**Agilent** is a US-based multinational technology company with a focus on life sciences, diagnstics, and applied markets. The examined site is in the southwest of Germany in Waldbronn.	
Sector	High-tech industry	
Energy carriers	Natural gas & electricity	

Implemented measures	• New efficient HVAC system in one of the buildings using:
	  ○ Decentral VRV units
	  ○ Heat recovery
	  ○ Central district heating and cooling	

Projected energy savings	700 000 kWh/year (natural gas & electricity) = 8.0% ➔ Estimated financial savings of 65 000 €/year	
Economic benchmarks (Energy benefits only / all benefits / all benefits with postponed investment)	Investment costs	575 000 €
	Net present value	543 000 € / 1 220 000 € / 6 800 000 €
	Simple payback	6 years / 3 years / 1 year
	Investment duration	15 years
	Discount rate	2%
Key benefits to the company	• Comfortable environment through individual climate control setting for each room • Safe ventilation complying with indoor air quality standards • Reduction of costs	
Main co-benefits	• Contribution to the company's sustainability goals • Postponement of new building construction • Additional space (building would have been demolished) • Reduced contraction risk of Covid and other airbound diseases and of HVAC disruptions	
Interesting aspect	The energy management is partially subcontracted to the facility management company CBRE. Having agreed together on a 5-year energy savings target, CBRE is allowed to make related investment decisions with payback times of up to 7 years. Besides, Agilent has set 4 goals in order to become more sustainable: • 1% energy reduction per year • 95% solid waste diversion from landfill by 2020 • 2% water reduction per year • 1% CO2-eq reduction per year	

Company, business activity and location	**MOLL Marzipan** trades and refines almonds, nuts, and raw materials such as marzipan and persipan for the food industry. Based in Berlin, it employs 94 people and boasts of its commitment to quality.	
Sector	Food industry	
Energy carriers	Electricity & district heat	

Implemented measures	• Waste heat recovery from a refrigeration unit and a screw compressor
	  ○ Used to cover the on-site hot water demand
	  ○ Used to heat up the water in a brewing unit's tank to 60°C once a day in order to ensure its drinking water quality	

Projected energy savings	29 790 kWh/year (electricity) = 0.8% 436 760 kWh/year (district heat) = 11.0% ➔ Estimated financial savings of 21 939 €/year	
Economic benchmarks (Energy benefits only / all benefits)	Investment costs	84 084 €
	Net present value	44 118 € / 88 798 €
	Simple payback	3 years / 2 years
	Investment duration	6 years
	Discount rate	4%
Key benefits to the company	• Reduction of costs • Increased production volume through shorter preheating processes. • More stable and reliable cooling, which is paramount for the smooth and seamless running of the production	
Main co-benefits	• Contribution to the company's sustainable image and reputation as well as their aspiration to be a role model, an important aspect in relation to their slogan "Quality from Berlin" and the city's awareness for sustainability • Increased lifespan of equipment and machines • Reduced risk of increasing costs through CO2-pricing	
Interesting aspects	The main work with regard to this company's implementation of the project was absolved within the scope of a bachelor student's thesis. Due to limited capacities for this project, they only quantified a limited number of multiple benefits. Nevertheless, they identified a reduction of the payback period from 3 to 2 years, which satisfied their expectations. The company provided a solid database including data from energy and process analysis, collected and aggregated by employees from different departments.	

2.4 Greece

Company, business activity and location	**AB Vassilopoulos** is a large supermarket chain and subsidiary of Delhaize with 312 branches and 5 central warehouses dispersed throughout Greece. The examined energy efficiency measures have been implemented in a warehouse in Oinofyta.	
Sector	Food retail	
Energy carrier	Electricity	
Implemented measures	*EEM 1:* Installation of a PV system on the warehouse's terrace	
	EEM 2: Installation of a heat exchanger to cover the on-site hot water demand (particularly crate washing machine)	
Projected energy savings and district heat production	*EEM 1:* 2 362 223 kWh/year = 32.1% ➔ Estimated financial savings of 137 183 €/year	
	EEM2: 163 800 kWh/year = 2.2% ➔ Estimated financial savings of 17 340 €/year	
Economic benchmarks (Energy benefits only / all benefits)	*EEM 1:* Investment costs	797 538 €
	Net present value	18 314 € / 291 408 €
	Discounted payback	4.8 years / 3.6 years
	Investment duration	10 years
	Discount rate	10%
	EEM 2: Investment costs	53 828 €
	Net present value	29 662 € / 48 575 €
	Discounted payback	3.1 years / 2.8 years
	Investment duration	10 years
	Discount rate	10%
Key benefits to the company	• Reduction of costs • Response to "green consumerism"	
Main co-benefits	• Compliance with possible future environmental regulations • Contribution to the company's 2025 ambition regarding sustainability and GHG reductions	
Interesting aspects	Authorisation issues linked to the parent group Delhaize limited the extent of data provided, impairing the quantification of multiple benefits. Yet, AB Vassilopoulos is interested in applying the multiple benefits methodology in further projects. Overall, the measures played into the climate targets of both Delhaize and their Greek subsidiary, benefiting this pilot.	

2.5 Italy

Company, business activity and location	**Hera Group** is a multi-utility company covering the fields of energy and water provision, waste collection and disposal, sewerage, and water purification. Operating in Italy, they have implemented the measures in Warehouse-Factory building of their Ravenna headquarter.	
Sector	Energy supplier	
Energy carriers	Electricity & natural gas	

Implemented measures	• Replacement of the old air conditioning system with a new system AI-based advanced control system
	  ○ Capable of implementing predictive and multi-variable optimisationlogic
	  ○ Allows environmental monitoring and management of the buildig	

Projected energy savings	20 700 kWh/year (electricity) = 1.8% 169 743 kWh/year (natural gas) = 29.0% ➔ Estimated financial savings of 12 309 €/year	
Economic benchmarks (Energy benefits only / all benefits)	Investment costs	32 000 €
	Net present value	15 900 € / 69 000 €
	Simple payback	5 years / 3 years
	Investment duration	10 years
	Discount rate	6%
Key benefits to the company	• Reduction of costs • Increased productivity due to thermal comfort of employees • Improved health and well-being and associated reduction of employees' absenteeism	
Main co-benefits	• Reduced maintenance costs	
Interesting aspects	The impacts of good climate control on employee's productivity has only been described qualitatively. In light of the high quality standard provided in that regard by the air conditioning system, a major benefit has been left unquantified and should be considered in the future. The potential energy savings associated with the intervention were quantified beforehand through a preliminary study by a market technology provider and estimated to 30% of the current energy consumption.	

2.6 Poland

Company, business activity and location	**Carletti Polska** is a company producing several different chocolate products and owned by Danish shareholders. Based in Pruszków, Poland, it exports its products to the Polish as well as to international markets. It still imports US corn in order to produce a variety of related products.	
Sector	Food industry	
Energy carrier	Electricity	
Implemented measures	• Deployment of 767 PV modules on the rooftop with a total capacity of 230 kW	
Projected energy savings	209 804 kWh/year = 4.7% ➔ Estimated financial savings of 83 229 PLN/year	
Economic benchmarks (Energy benefits only / all benefits)	Investment costs	847 000 PLN
	Net present value	-59 831 PLN / 95 274 PLN
	Simple payback	14 years / 12 years
	Investment duration	25 years
	Discount rate	6%
Key benefits to the company	• Reduction of costs • Alleviation of the impact of predicted price surges	
Main co-benefits	• Delivery of a more sustainable product using greener energy • Image of an environmentally friendly company following sustainability standards	
Interesting aspects	A prefeasibility study has been carried out by KAPE, recommending a system where all PV electricity is consumed within the factory without any surplus feed-in into the grid. Due to the electricity mix in Poland, which heavily relies on hard coal and lignite, the estimated primary energy savings are thrice as high as the expected final energy savings. Due to the Danish shareholders, environmental targets regarding an energy transition are playing a role at Carletti Polska.	

Company, business activity and location	**DEKOR-MEBLE** is a micro-scale enterprise manufacturing high-quality custom-made furniture. With its 12 employees, it runs its own manufacturing facility in Szczecin, Poland.	
Sector	Micro-scale manufacturing	
Energy carriers	Wood & coal	
Implemented measures	*EEM1:* Replacement of the old inefficient boiler with a new system including three flat-plate solar thermal collectors	
	EEM2: Deployment of an air heat pump and a PV system providing hot water preparation and space heating	
Projected energy savings and additional energy consumption	*EEM1:* 3 418 kWh/year = 100.0% ➔ Estimated financial savings of 222 PLN/year	
	EEM2: 42 948 kWh/year (wood) = 100.0% 46 366 kWh/year (coal) = 100.0% 3 042 kWh/year additional electricity consumption ➔ Estimated financial savings of 8 288 PLN/year	
Economic benchmarks (Energy benefits only / all benefits)	*EEM1:* Investment costs	10 600 PLN
	Net present value	-7 102 PLN / 25 200 PLN
	Simple payback	38 years / 4 years
	Investment duration	20 years
	Discount rate	5%
	EEM2: Investment costs	144 000 PLN
	Net present value	-60 343 PLN / 4 262 PLN
	Simple payback	22 years / 13 years
	Investment duration	20 years
	Discount rate	5%
Key benefits to the company	• Maintenance-free space heating and hot water system • Full time availability of a highly qualified employee, who until then had to devote his time to run the boiler in summer • Image of an environmentally friendly enterprise	
Main co-benefits	• Reduction of costs • No need for wood and hard coal storage space • No need to plan energy delivery arrangements • Reduced emissions of air pollutants and particulate matter • Lower risk of occupational diseases and increased well-being • Higher safety and alleviation of the risk of heating outages	
Interesting aspect	The second measure was implemented as a reaction to the success of the first one.	

2.7 Switzerland

Company, business activity and location	The federation of **MIGROS cooperatives** is a Swiss cooperative supermarket chain. In the Ticino region, the regional subsidiary operates 34 stores.	
Sector	Food industry	
Energy carriers	Electricity & heating oil	

Implemented measures	• Installation of smart meter systems in all regional stores
	  ○ Central data collection and monitoring
	  ○ Rendering the previously obligatory monthly meter readings by one of seven responsible janitors superfluous
	  ○ Allowing better analysis and optimisation of consumption	

Projected energy savings	16 797 kWh/year (electricity) = 2.7% 3 023 kWh/year (heating oil) = 2.7% ➔ Estimated financial savings of 2 929 CHF/year	
Economic benchmarks (Energy benefits only / all benefits)	Investment costs	18 159 CHF
	Net present value	-5 517 CHF / 9 734 CHF
	Simple payback	21 years / 5 years
	Investment duration	25 years
	Discount rate	9%
Key benefits to the company	• High quality and resolution consumption data • Rapid remote identification of suboptimal operating modes • Reduction of costs	
Main co-benefits	• Extension of the systems' lifetimes through consistent monitoring • Supports future planning and identification of optimisation potentials (systems can be dimensioned more precisely) • Compliance with their commitment to a sustainable future	
Interesting aspects	The initial investment per store is rather small (12 106 CHF), since a major share arises from the ongoing automatic monitoring and meter verification service provided externally. The main approval factor was the rapid payback period below the threshold of 8 years, rendering additional arguments redundant. However, it was only met thanks to the consideration of non-energy benefits.	

Company, business activity and location	The **University of Lausanne (UNIL)** is a Swiss university with 15 900 students and 3 900 employees. Its examined omnisports hall is also open to students of the École Polytechnique de Lausanne (EPFL).	
Sector	University	
Energy carriers	Electricity & district heat	

Implemented measures	• Renovation of the omnisports hall
	  ○ Roof insulation and domes replacement (including lighting system and false ceilings)
	  ○ Windows replacement
	  ○ Natural and renovated ventilation: renovation of walls and roof openings and addition of an automated regulation
	  ○ Replacement of the heating mat
	  ○ DHW production moved to a new building
	  ○ Replacement of control and thermostatic valves	

Projected energy savings	60 800 kWh/year (electricity) 288 500 kWh/year (district heat) ➔ Estimated financial savings of 43 222 CHF/year	
Economic benchmarks (Energy benefits only / all benefits)	Investment costs	3 394 909 CHF
	Net present value	-3 043 724 CHF / -1 870 352 CHF
	Simple payback	>50 years / 19 years
	Investment duration	10 years
	Discount rate	4%
Key benefits to the company	• Increased safety and reduced health risks through better thermal, lighting, and air quality conditions • Reduction of costs through diminished maintenance needs, lower energy consumption and avoided CO2 tax	
Main co-benefits	• Possibility to hold exams, even in case of hot weather • Compliance with UNIL's sustainability values and energy strategy	
Interesting aspect	The financial analysis above does not consider the increased asset value of the omnisports hall and with a more conventional investment duration in the real estate sector of 20 years, the project scores significantly better with regard to financial indicators.	

3. Summary and Conclusions

Within the M-Benefits project, 24 pilots accompanying companies along their energy efficiency measures have been conducted. For nine of these pilots, general descriptions, key performance indicators, implementation experiences, and important multiple benefits are summarised in the fact sheets above.

Despite the variety of sectors, quantified multiple benefits, and implemented energy efficiency measures, a significant impact of multiple benefits for companies' decisions has been observed. On the one hand, the financial benchmarks have drastically improved for the vast majority of projects when non-energy benefits were taken into account, in particular regarding measures' net present values. Many projects' payback periods have diminished significantly after consideration of co-benefits. Yet, for some enterprises aspects beside profitability were more central to the decision in favour of energy efficiency measures.

Thus, the project M-Benefits shows that companies are more likely to decide in favour of energy efficiency measures when multiple benefits are taken into account. This conclusion can be used to improve energy consultations in order to better promote energy efficiency measures.