

SOLAR PAYBACK - TRAIN-THE-TRAINER

SOLAR HEAT FOR INDUSTRIAL PROCESSES

Energy Efficiency



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SPB Train-the-Trainer Workshop

Pune, Dec 3-5, 2019

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Content

- Energy Efficiency in Industry
 - Rationale
 - Best Available Techniques
 - Energy Audit, Energy Management System and Standards
 - Energy Profile
 - EnPI's



Content

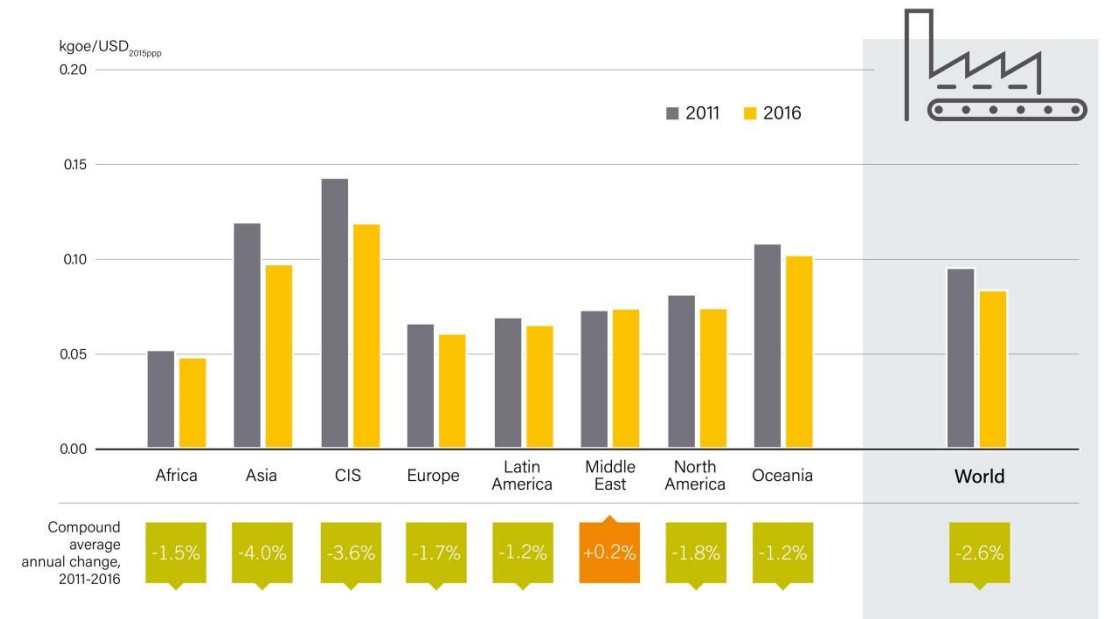
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Energy efficiency in Industry

Rationale

- EE regarded as the first step towards a reduction of energy intensity in Industry
 - improving industrial energy efficiency by implementing best practice technologies (BPT) could reduce total final industrial energy demand more than 25% [1]
 - Industry stands for 25% of final energy consumption (EU28, 2017) [2]
 - Specific actions to contribute to EU goal of 20% energy savings by 2020 set by the EU Directive on energy efficiency [3], translated into member States National Energy Efficiency Plans [4]

Average Energy Intensity of Industry, Selected Regions and World, 2011 and 2016



Source: Enerdata

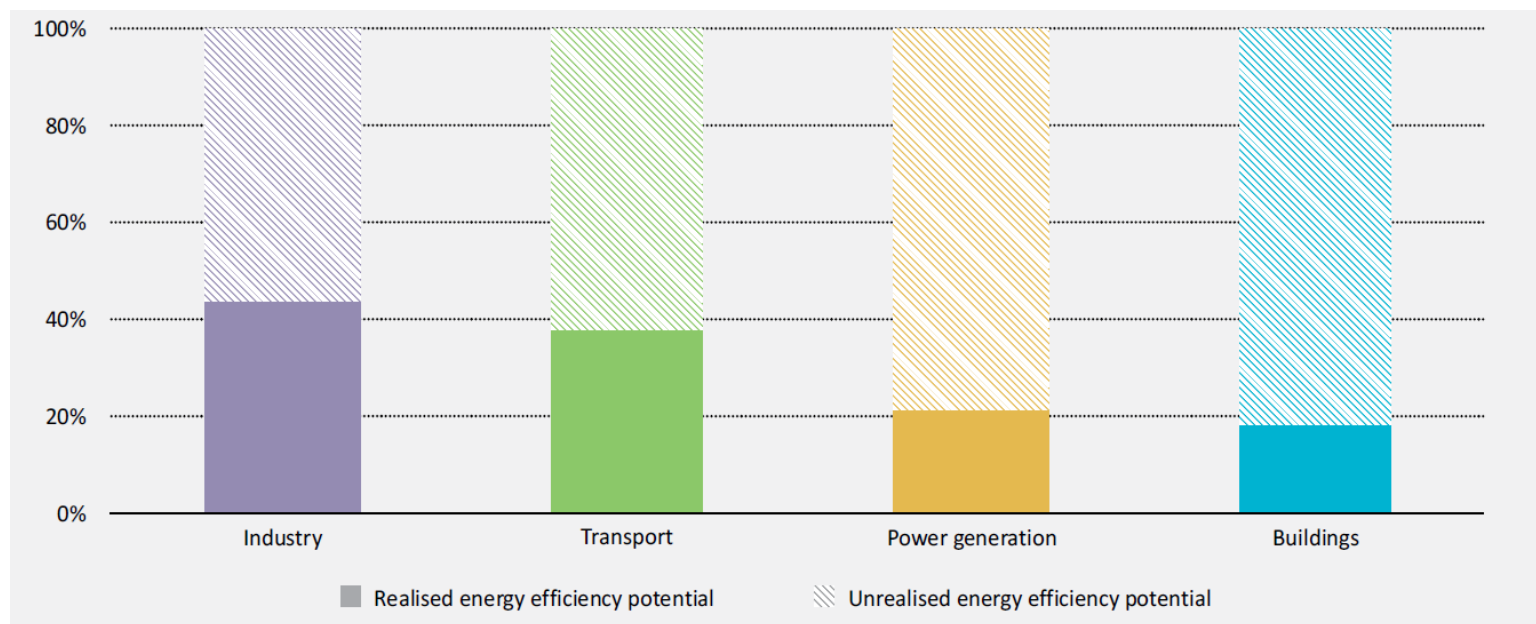
REN21 RENEWABLES 2018 GLOBAL STATUS REPORT

[5]

Energy efficiency in Industry

Rationale

- EE regarded as the first step towards a reduction of energy intensity in Industry
 - whereas efforts have been developed from the 70's at both political and technological levels, the remaining potential is still considerable



Long term energy efficiency economic potential by sector

Energy efficiency in Industry

Rationale

- EE regarded as the first step towards a reduction of energy intensity in Industry
 - it is cost-effective and various technologies exist which are suitable for different production processes [1,2]

Table 1 Project returns by sector and lifespan

Sector	Number of projects	Investment (US\$)	Payback years	IRR 3 years (%)	IRR 4 years (%)	IRR 5 years (%)	IRR 10 years (%)
Automotive/autoparts	4	98.250	1.93	26	37	43	51
Cement/ceramics	15	43.702.213	2.19	18	29	36	45
Chemicals	14	26.370.874	2.90	2	14	21	32
Equipment manufacturing	16	9.538.587	2.10	20	32	38	47
Food and beverages	9	2.684.000	1.10	74	83	87	91
Metal	14	4.882.517	1.50	45	55	60	66
Paper	12	6.249.000	0.90	96	105	108	111
Textile	22	3.204.540	2.20	17	29	36	44
Others	13	23.602.000	2.40	12	24	31	40
All cases	119	120.332.181	1.95	25	37	43	50

The estimated IRRs are mean values for each respective lifespan

[2]

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Energy efficiency in Industry

Best Available Techniques

- Implementation of EE measures is already supported by different technologies and Best Available Techniques (BAT) are identified [1]
 - Combustion:
 - Reduction of flue gas temperature
 - Recuperative and regenerative burners
 - Combustion regulation and control (excess air, burner regulation)
 - Thermal insulation

Energy efficiency in Industry

Best Available Techniques

- Implementation of EE measures is already supported by different technologies and Best Available Techniques (BAT) are identified [1]
 - Steam systems:
 - Design of steam distribution network
 - Throttling devices and use of backpressure turbines
 - Preheating of feed-water
 - Prevention of scaling on HX surfaces
 - Thermal insulation
 - Re-use of condensate and flash steam

Energy efficiency in Industry

Best Available Techniques

- Implementation of EE measures is already supported by different technologies and Best Available Techniques (BAT) are identified [1]
 - Heat recovery and cooling:
 - Heat Exchangers
 - Heat Pumps
 - Chillers and cooling systems
 - Cogeneration
 - Space heating and cooling



Energy efficiency in Industry

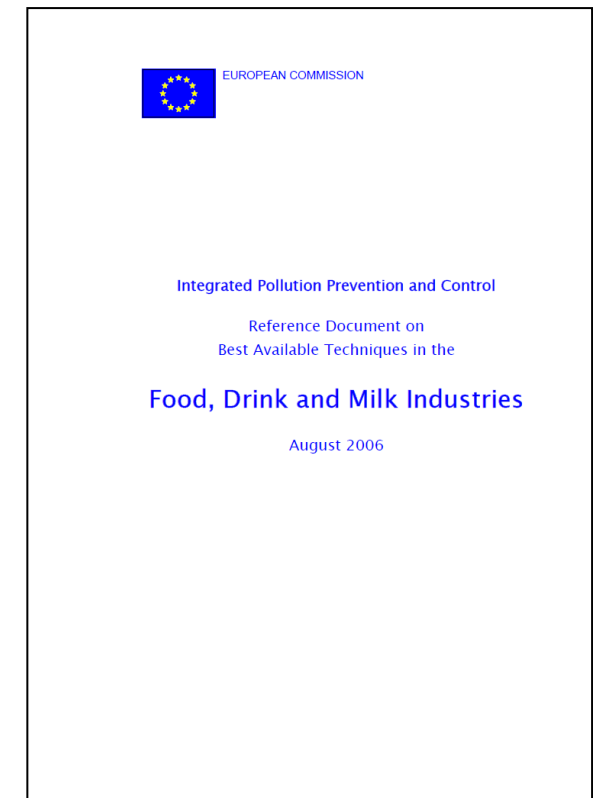
Best Available Techniques

- Implementation of EE measures is already supported by different technologies and Best Available Techniques (BAT) are identified [1]
 - Drying, separation and concentration processes:
 - Mechanical processes
 - Thermal drying techniques
 - Radiant energies

Energy efficiency in Industry

Best Available Techniques

- Industrial processes descriptions and specific BAT for several branches [1]
 - Ceramic Manufacturing
 - Ferrous Metal Processing
 - Food, Drink and Milk
 - Organic and Inorganic Chemicals
 - Glass
 - Non-ferrous Metals
 - Iron and Steel
 - Pulp, Paper and Board
 - Textiles
 - ...



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Energy efficiency in Industry

EMS

- BAT include Energy Management Systems: ISO 50001 [1]
 - Extensive to strategy, procedures, monitoring, management
 - Based on PLAN-DO-CHECK-ACT approach
 - Energy Audit compliance

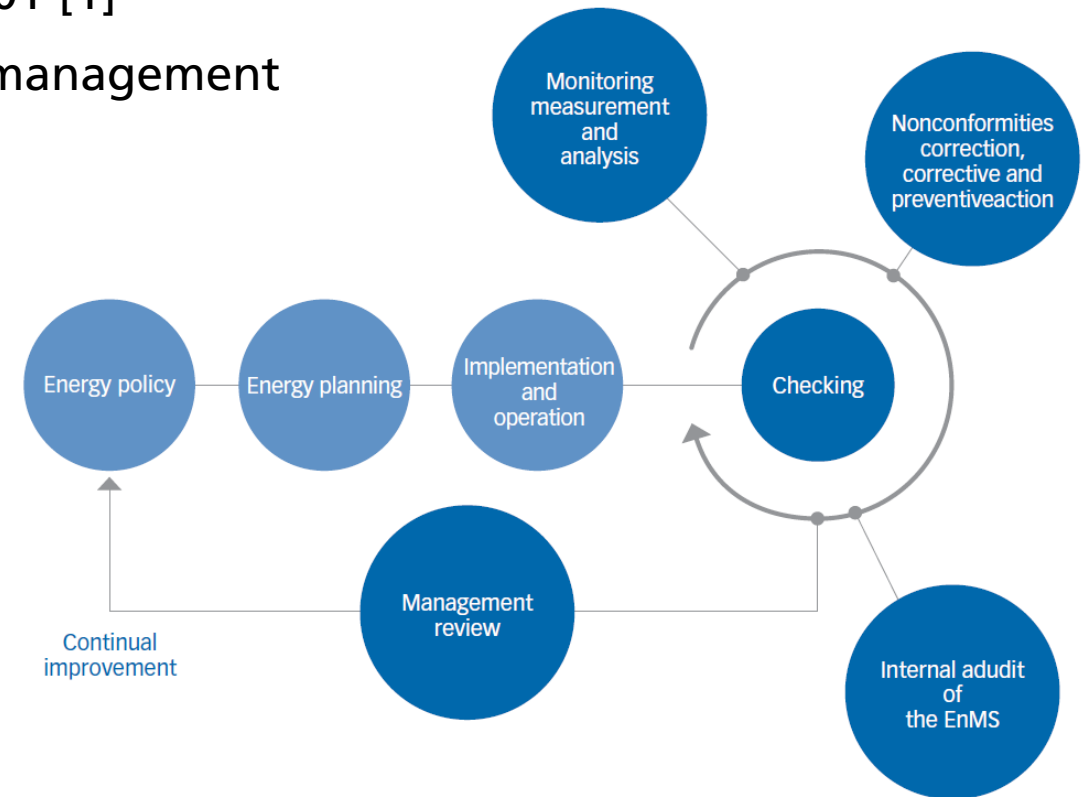


Figure 1. Main Elements of Energy Management System

[2]

Energy efficiency in Industry

Energy Policy

Viessmann Energy policy

Based on the Viessmann company principles, our energy policy specifies the following principles of conduct for all employees of the Viessmann Group.

Objective

With this energy policy, the Viessmann Group undertakes to continue reducing energy usage and therefore CO2 emissions. This takes place on the basis of defined strategic energy objectives. The board of directors of the respective Group company defines these objectives annually in accordance with the higher ranking objectives of the corporate group. The basis for defining the objectives is provided by weather data or production-adjusted consumption data from the preceding period, as well as the cost-effectiveness of the respective decisions in terms of sustainability.

Continuous improvement in energy-related performance

We seek to achieve continuous improvement in energy-related performance. In so doing, compliance with statutory requirements is assumed to be the minimum standard.

[2]

Energy efficiency in Industry

Energy Policy

Viessmann Energy policy (cont.)

Sustainability

Sustainability is also a factor when making decisions relevant to energy. Life cycle assessments are prepared wherever practical.

Personnel

The active involvement of all employees is necessary for implementation of the energy policy. Employees of the Group companies are provided with comprehensive information, notified of energy-related issues and integrated into the energy management program.

General public

The public is informed regularly about energy aspects, energy consumption and the energy management program in the Viessmann Group.

[2]

Energy efficiency in Industry

Energy Policy

Viessmann Energy policy (cont.)

Emissions

In conjunction with the energy objectives, emission targets are also defined for the Viessmann Group. Emissions are constantly reduced through improved energy efficiency and a steadily higher proportion of renewables in the energy mix.

Energy monitoring

Energy consumption at the Group companies is constantly measured and monitored. Important energy aspects are regularly recorded, verified and communicated.

[2]

Energy efficiency in Industry

Energy Audit

- **Energy Audits and Energy Management Systems under Article 8 of the Energy Efficiency Directive [1]**
- **Implementation and Incentives (in Germany)**
 - Large Companies >250 employees and/or > 50 Mio. € turnover have to perform an Energy Audit according to DIN 16247 every 4 years or implement an Energy Management System according to ISO 50001
 - SME can receive up to 80 % funding for an Energy Audit according to DIN 16247



Energy efficiency in Industry

Energy Audit

- Energy Audit is a management tool aiming the gathering of information enabling the achievement of improved energy efficiency targets
 - analysis of critical points
 - assessment of the current energy flows
 - assessment of overall energy production
 - assessment of energy consumers (processes and process cycles)
 - determination of enhancement strategies and measures

Energy efficiency in Industry

Energy Audit

- Includes preparation, execution and analysis phasis
- preparation
 - definition of audit team, targets, scope and audit criteria
 - definition of required information and access
 - schedule
 - analysis of previous audit results (when existing)

Energy efficiency in Industry

Energy Audit

- Execution:
 - Introductory conference (Engage all relevant persons)
 - Evaluation of scope, audit scheme and schedule, roles and responsibilities
 - Collection and assessment of information
 - Define energy and environmental relevant areas
 - List of sites to be inspected (major energy users, measuring points, documents, structural alterations, expansions, ...)
 - measurements in all relevant areas
 - detect waste of energy
 - examine alternative energy supply

Energy efficiency in Industry

Energy Audit

- Analysis:
 - evaluation of processes
 - description of internal and external interfaces
 - check consumptions and compare with benchmarks
 - analyze energy reports
 - analyze major consumers
 - nonconformities (clarify where necessary)
 - recommendations (clarify where necessary)

Energy efficiency in Industry

Energy Audit

- The Audit report shall include:
 - Suggestions for the implementation
 - Action plan and Description of measurements
 - Deadlines , responsibilities and ressources
 - Summary of the auditing process (including constraints, problems)
 - Confirmation of audit targets where achieved in compliance with the audit scheme
 - Description of not covered areas, although they are within the scope
 - Unsolved disagreements between the involved parties
 - Recommendations for improvements
 - Confidentiality agreement

Energy efficiency in Industry

Energy Audit

■ Some references:

- Guidance Note on Energy Efficiency Auditing: <http://www.epa.ie/pubs/advice/licensee/guidancenoteonenergyefficiencyauditing.html>
- EINSTEIN Experts System for an Intelligent Supply of Thermal Energy in Industry and other Large-Scale Applications: <http://www.einstein-energy.net>
- Best Available Techniques (BAT) reference documents (BREFs) from the European Integrated Pollution Prevention and Control IPPC Bureau: <http://eippcb.jrc.ec.europa.eu/reference/>
- Optimal Audit: <http://www.cheme.utm.my/prospect/index.php/software/19?task=blogcategory>

Energy efficiency in Industry

EMS

- Typical obstacles and overcoming actions
 - Insufficient communication between departments → well mixed energy team with people from all relevant departments
 - Inexistent transparency → Analysis of energy flows, energy consumers and their responsible person
 - Ignorance about legal requirements → Development and maintenance of a legal registry
 - Lack of command authority → Must be covered by the energy manager
 - Lack of awareness & Lack of knowledge → Periodical training of employees, conversations with the employees, proposals of employees

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Energy efficiency in Industry

Energy Profile

- The purpose of developing an energy profile of the organization is to understand the areas of significant energy consumption
 - I.e. the buildings, equipment and processes which account for the greatest energy use or which offer the most potential for energy savings
 - The identification of the energy profile is critical in understanding where energy is used within the organization and forms the basis for prioritizing the efforts to reduce energy consumption.
 - The organization that intends to implement an energy management system should start by establishing its current position.

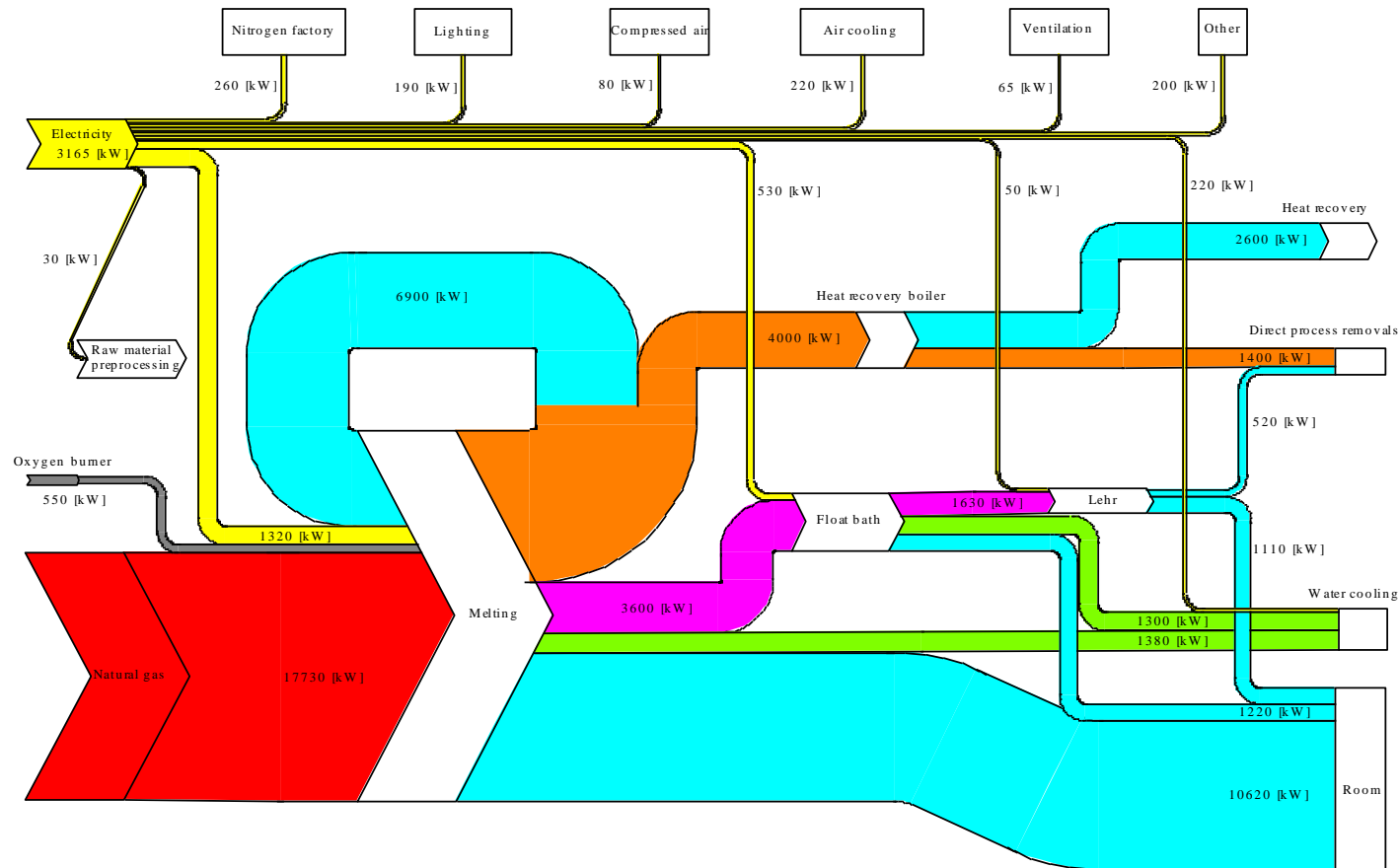
Energy efficiency in Industry

Energy Profile

- Analyze energy use based on measurement and other data
 - How much energy the organization consumes and its trends, changes, etc.
 - Estimate how much energy will be consumed in the coming period, typically the next financial budget period.
 - Examine where energy is currently being sourced which will typically be a local utility company and examine other potential sources including e.g. internal waste heat.
- Based on energy use analyses, identify the areas of significant energy use
 - Where the energy is being used, i.e. what are the significant consumers?
 - What is driving the energy use? This is often difficult to determine but is very important.
 - Which people have significant impact on energy use and identifies their relevant training needs.

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Energy Profile- Sankey Diagram



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EnPI's

- EnPIs are a quantitative index of energy performance as defined by the organization. The concept of an EnPI can be used to compare organizational performance at different points in time
 - The organization shall identify EnPIs to be used to determine energy performance and to subsequently evaluate progress towards objectives and targets.
 - The method(s) used for definition and update of the EnPIs shall be recorded.
 - EnPIs shall be reviewed and compared to the energy baseline on a regular basis.
- Methods for defining EnPI will vary depending on the organization's operations and complexity. EnPI should be easy to understand which will aid its usefulness for sharing
- information and improving motivation to make improvements.

Energy efficiency in Industry

EnPI's

Intensity: amount of energy per unit output, e.g. kWh/l beer

Total Baseline Primary Energy Consumed (MMBtu/year)

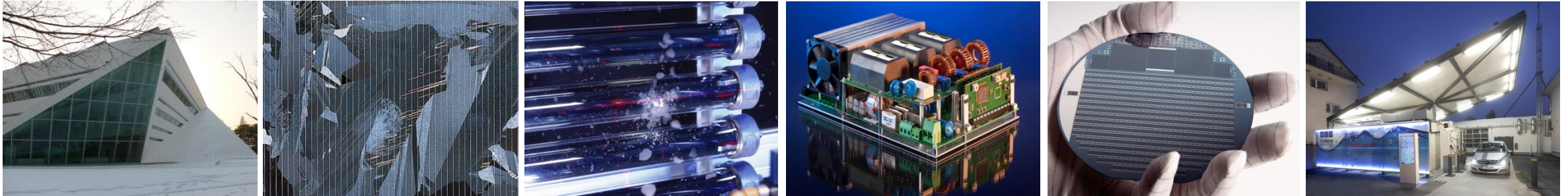
Total Current Year Primary Energy Consumed (MMBtu/year)

Savings for Current Year (MMBtu/year)

Total Energy Savings since Baseline Year (MMBtu/year)

Annual Improvement in Energy Intensity for Current Year (%)

Thank you for your Attention!



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