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Technological and organizational innovations as levers for increasing energy & resource efficiency

OECD/UNEP Conference on Resource Efficiency

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Paris, April 24, 2008

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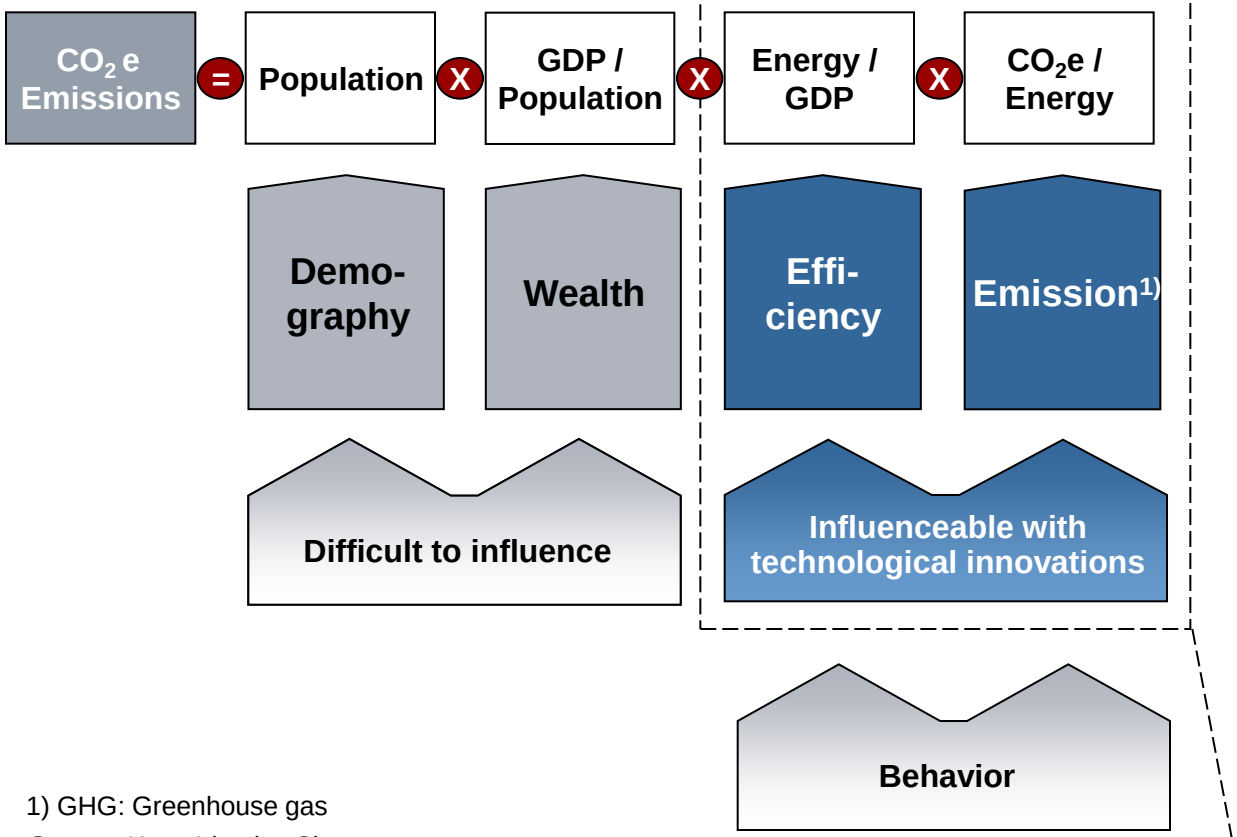
Innovation is a key lever to combating climate change



Innovative solutions for reduction of CO_2 emissions

Efficient energy generation
- Highly efficient gas and steam turbines
- Carbon capture and storage (CCS) for coal fired power plants
- Coal-to-gas shift
- …

Switch to renewables
- Wind
- Biomass
- Solar
- …

Efficient energy distribution
- Smart grid
- High-voltage DC transmission systems
- …

Efficient energy consumption
- Building technology measures
- Energy saving lighting
- Green mobility …

1) GHG: Greenhouse gas

Source: Kaya Identity; Siemens

Siemens offers a broad range of products – already or in development – with high CO2 abatement potential

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High-efficiency turbines	Renewables	High-voltage DC Transmission Systems	Power Distribution	Environmental Technologies
				

Energy-saving household appliances	Green Mobility	Industrial energy efficiency	Energy-saving lighting	Energy-efficient buildings
				

Example 1: Technological Innovation
Gas turbine technology development

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SGT5-2000E	SGT5-4000F	SGT5-4000F	SGT5-8000H
52 % CC efficiency	56 % CC efficiency	58 % CC efficiency	60 % CC efficiency
			
CCPP* Killinghome 940 MW	CCPP* Didcot 699 MW	CCPP* Mainz-Wiesbaden 406 MW	CCPP* Irsching 4 530 MW

Reduction of CO_2 emissions

1992	1996	2001	2010
Basis	- 7,1%	- 10,3%	- 13,3%

Advanced gas turbine technology leveraged significant improvements in competitiveness and CO_2 emission reduction of gas-fired power plants.

*CCPP: Combined Cycle Power Plants

Example 1: Technological Innovation – Nanocoatings
Key challenges for gas turbine applications

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Challenges

- Increased inlet temperature (up to 1500° C) / increasing operational temperature for higher efficiency
- Long term component durability
- Maintenance costs reduction
- Cooling air reduction
- Multi-fuel operation
- Increasing fuel contamination

Expected results from future nanotechnology applications

- Superior wear and cooling properties
- Increased hydrophobicity
- Improved antifouling capability
- Enhanced oxidation resistance
- Novel slurry concepts for local repair.

An efficiency increase by 1-2%, would result in up to 40,000 tons less CO2 per year in a combined cycle power plant (500 MW)

Example 2: Organizational Innovation – Energy Service Companies (ESCO) help to exploit saving potential in buildings

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Current situation in the building sector

- 80% of the Building-Life-Cycle-Costs are driven by operating expense
- 30-40% of the operating costs in commercial buildings are seen as potential that can be exploited in an economic way – today
- EU-Studies point out, that this potential can be exploited by ESCOs with up-to-date technology.

Main levers to exploit potential

1. Advanced technology
2. Appropriate procurement or business models
3. Available financing
4. Favorable legislations
5. The right people –Experts on Energy Efficiency

Source: G. Liehr, Siemens Building Technologies

Example 2: Pre-conditions to exploit saving potential
1. Advanced Technology

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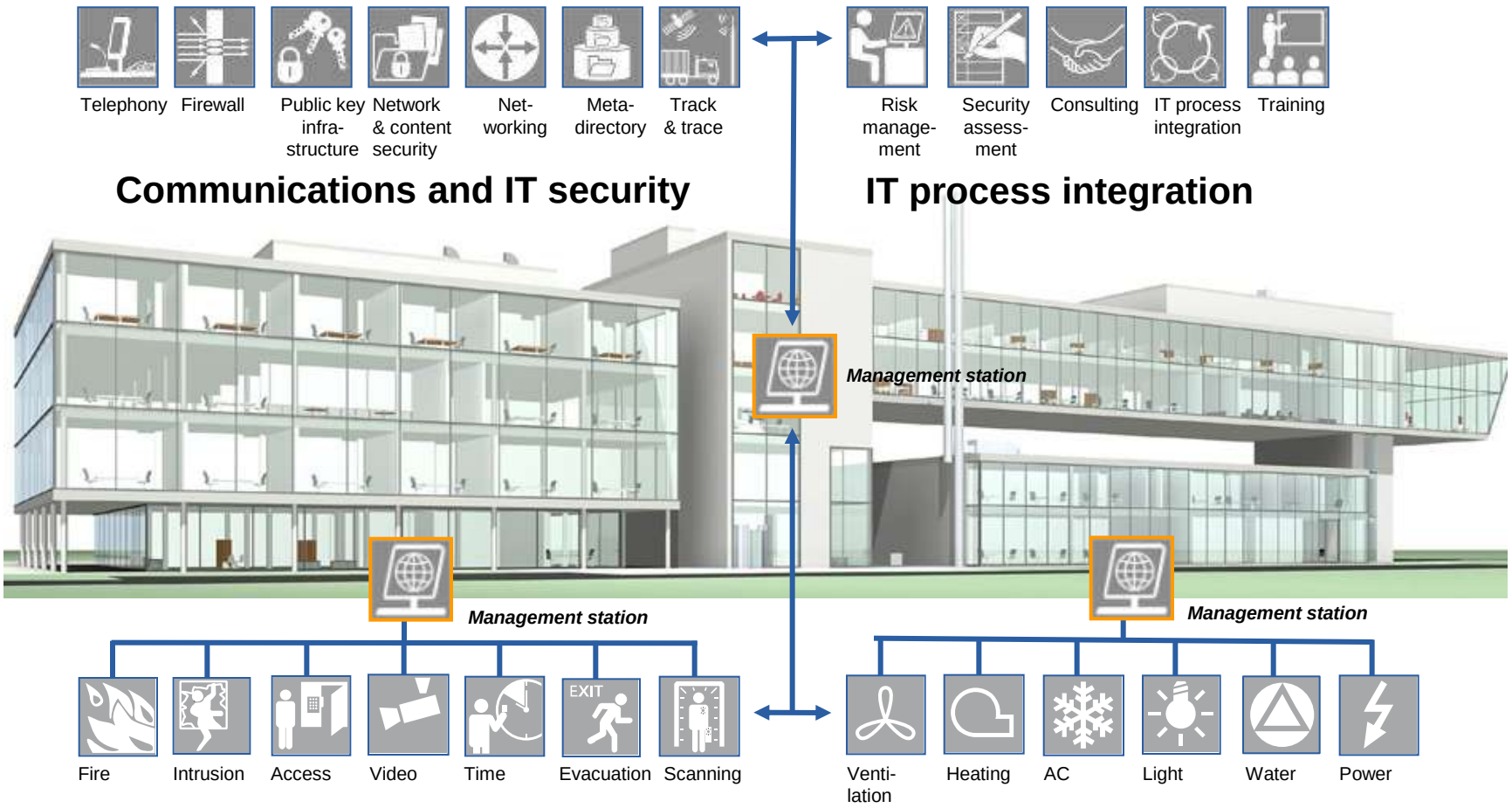

Source: G. Liehr, Siemens Building Technologies

Example 2: Pre-conditions to exploit saving potential
2. Appropriate Business Models: Performance Contracting

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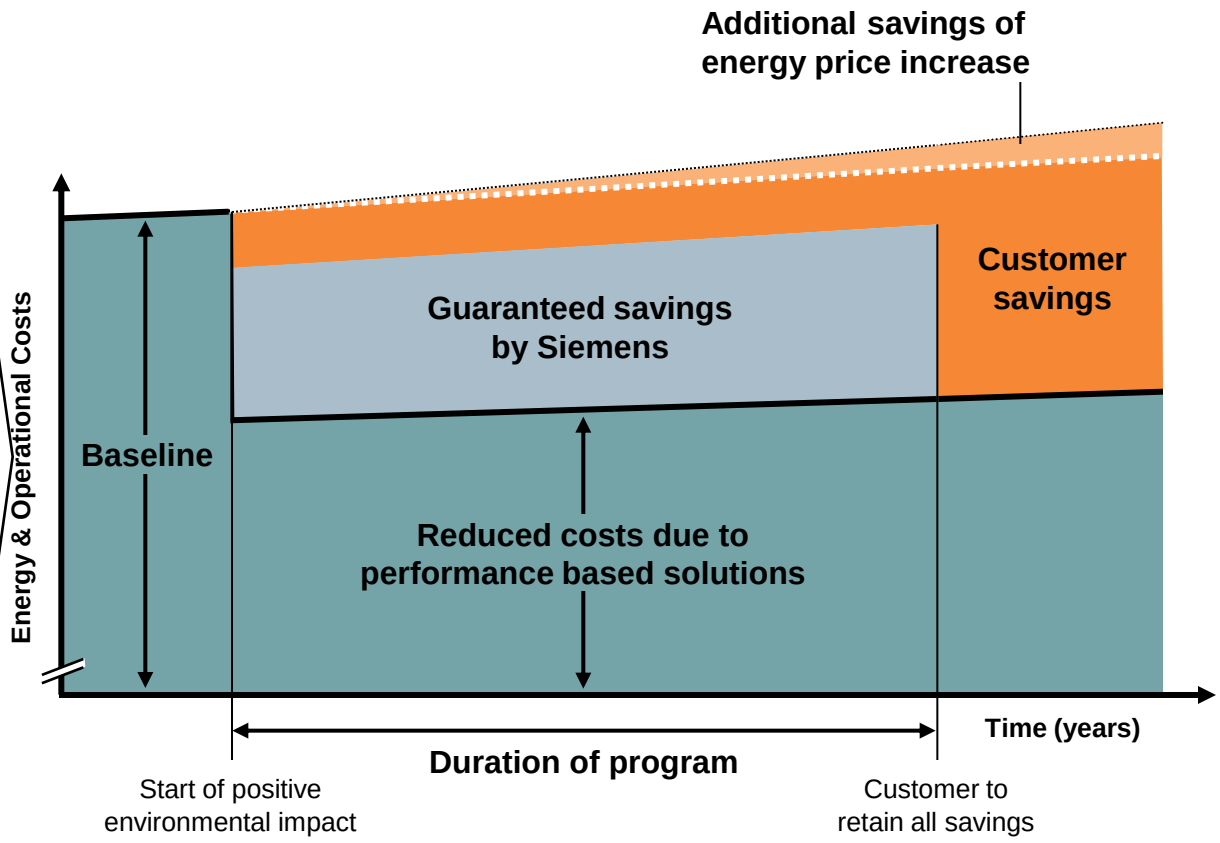
Characteristics

- **Specially tailored to customer's requests**
- **Guarantee promise ensures success**
- **Innovative technical solutions**
- **Optional financing of the investment possible**
- **Integration of users and operators**
- **Standardized procedure (EUROCONTRACT)**
- **Energy-price changes are neutralized in the baseline**



Since 1996, Siemens has equipped **6,500 buildings**, guaranteeing savings of nearly Euro **2 billions** with **total CO_2 savings of over 700,000 tons, equivalent to 230,000 cars each driving 20,000 km/year!**

Summary

- Both, technological and organizational innovations lead to an increase in resource and energy efficiency
- Many technologies are already available – integrated solutions (technology, financing, services) promote successful business cases (e.g. energy performance contracting)
- Focused R&D cooperation and funding is an important success factor
- Incentives for resource saving – calculation of life cycle costs, promoting awareness, training – help to exploit saving potential