World Energy Perspective:

Energy Efficiency Technologies

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WORLD ENERGY COUNCIL
CONSEIL MONDIAL DE L'ÉNERGIE
For sustainable energy.

Energy Efficiency Technologies: Rationale

- WEC carries out well established work on Energy Efficiency Policies, Energy Trilemma and Scenarios, and in 2011 established its Energy Efficiency Knowledge Network.

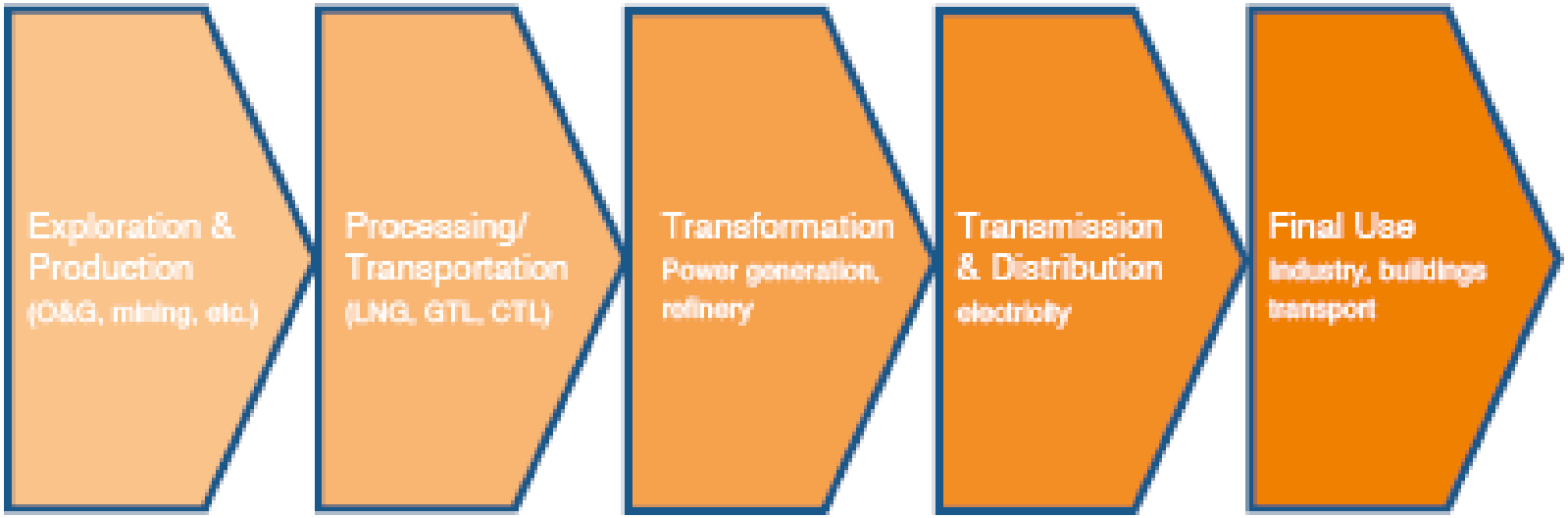
- Energy efficiency improvement opportunities carry a huge potential – technology is one of the main factors affecting competitiveness of the final product in the global market.

- Policies, market or technology driven – from exploration and production of primary energy resources, to power generation and oil refineries to power grids, to the final use in industry, buildings and transportation.

Original objectives

- Pilot project
- Industry driven
- Inform the debate about technological advances

Process



- Value chain overview and case studies/technical reports
- Study Group with experts in individual business areas
- Participants from WEC Member Committees mainly OECD

Project Background

Outline of Reports (1)

Part I: Overview Report

1. Global Trends
2. Integrating Energy Efficiency Across the Entire Energy Value Chain
3. Energy Efficiency in Exploration and Production of Oil & Gas
4. Efficiency in Processing Industry
5. Efficiency in Thermal Power Generation
6. Efficiency and Power Grids
7. Efficiency in Industrial Use of Energy
8. Energy Efficiency in the Transportation Sector
9. Efficiency in Commercial and Residential Use of Energy

Case Study for the United States (EPRI): Energy usage in buildings

Outline of Reports (2)

Part II: Technical Reports	**led by**
A. Energy Efficient Solutions for Communities	GDF Suez (published)
B. Energy Efficient Buildings	GDF Suez (planned)
C. Energy Efficiency in Deep Water Offshore Production	Petrobras (planned)
D. Energy Management in Refineries	Petrobras (planned)
E. Energy Efficient Solutions for Industry	Siemens (published)
F. High Efficient Solutions for Thermal Power Plants	Siemens (published)

Characteristics of analyses:

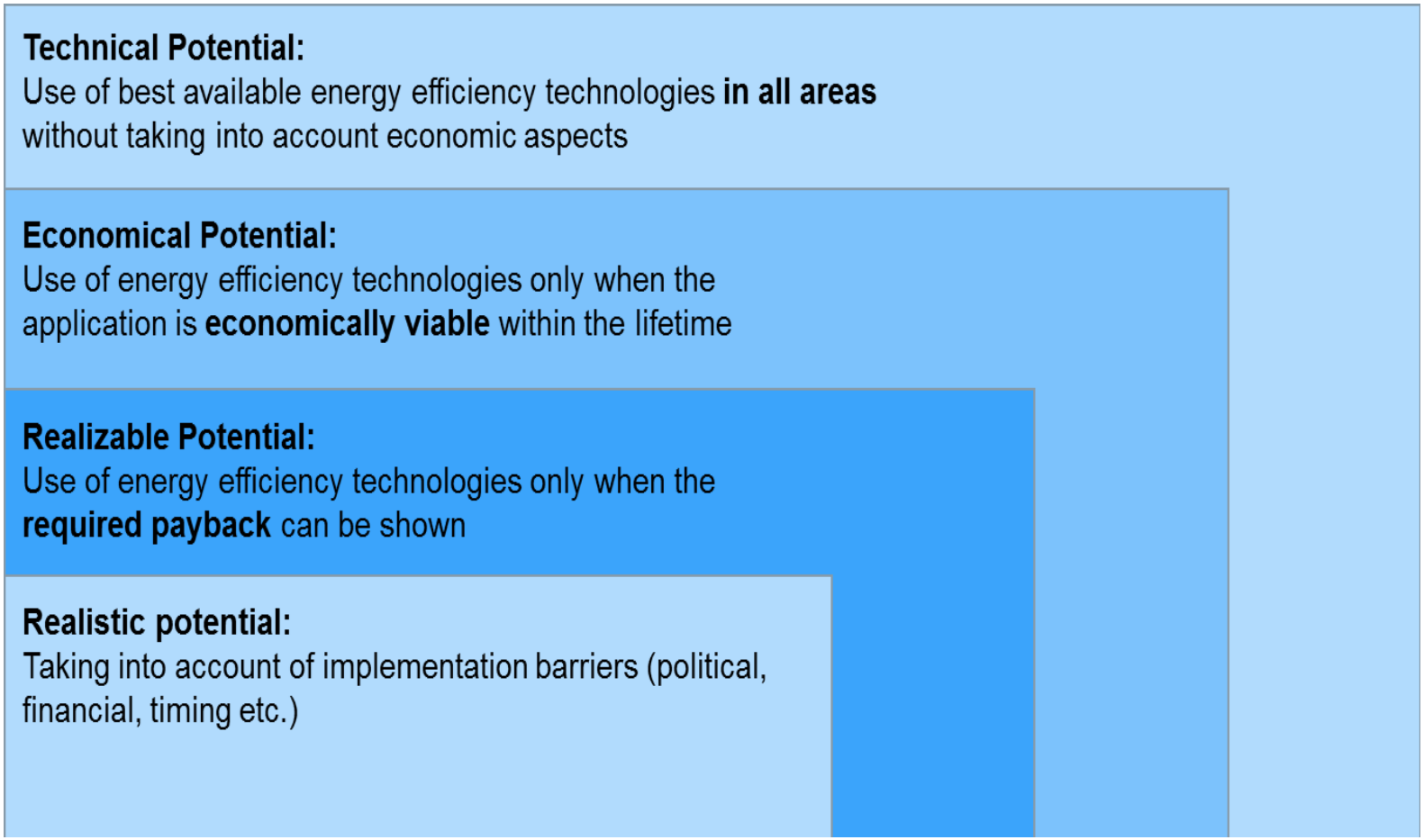
Beside technical performance the stakeholder perspective should identify crucial factors for the successful implementation and use of energy efficient technology like

- Economics and operational practice
- Safety and maintenance
- Behavior

Key Messages and Recommendations

Energy Efficient Solutions

Distinction between technical, economical and realizable potential is essential for the evaluation of the energy efficiency potential



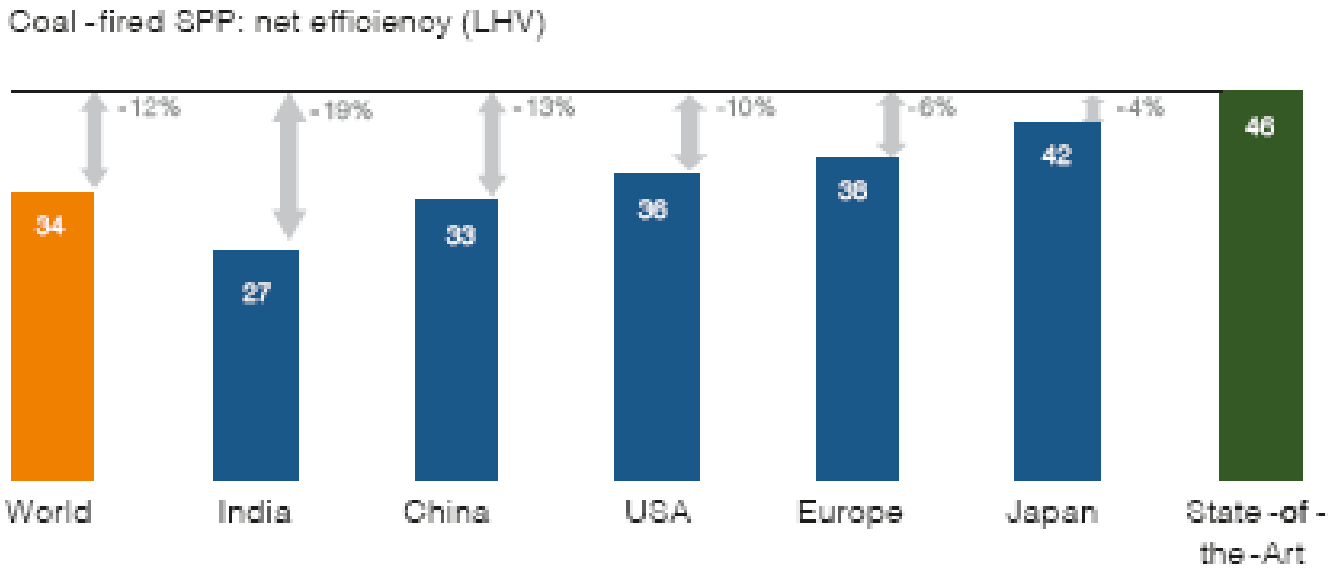
Key Messages: Overview Report

- **Technical potential of Best Available Technology (BAT) today:**
  - **Oil & Gas exploration:** Energy efficiency in upstream is around 20%, with all electric system approach the energy efficiency could be increased up to 50%
  - **Power Generation**: World average efficiency is 34% compare to BAT for coal-fired power plants (46%) and BAT for gas-fired power plants (61%)
  - **Transmission & Distribution grids:** Transport losses up to 12% for global average; BAT for high voltage transmission is less than 4%/1000km
  - Effective energy management systems increases energy efficiency by at least 5% irrespective of size, technology, or process
  - Holistic approach is needed to fully understand and leverage efficiency gains in communities including efficient buildings and transport systems

- **Economical and realistic potential of Best Available Technology (BAT) today:**
  - A system analysis is in many cases required to leverage the full potential, e.g. energy efficiency of buildings using insulation, automation, heating, cooling etc.
  - **Investor perspective:** short-term gains (3 year pay-back) versus long-term planning (10 year payback)
  - Shift from CAPEX driven perspective to life-cycle driven perspective is required

Efficiency in Thermal Power Generation

- **Net efficiencies of coal-fired Steam Power Plants compared to state-of-the-art**



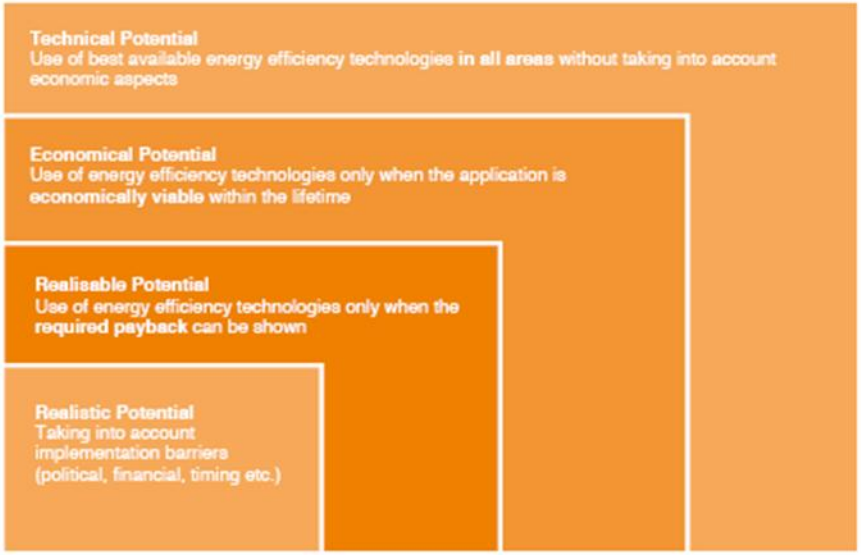
NOTE: The total installed capacity of steam power plants in Europe is around 2,300 GW (2011) and 40% will be retired in the next two decades, indicating 1,000 GW capacity needs to be replaced. With an average global coal fired plant efficiency of 34%, it becomes obvious that there is a huge efficiency potential.

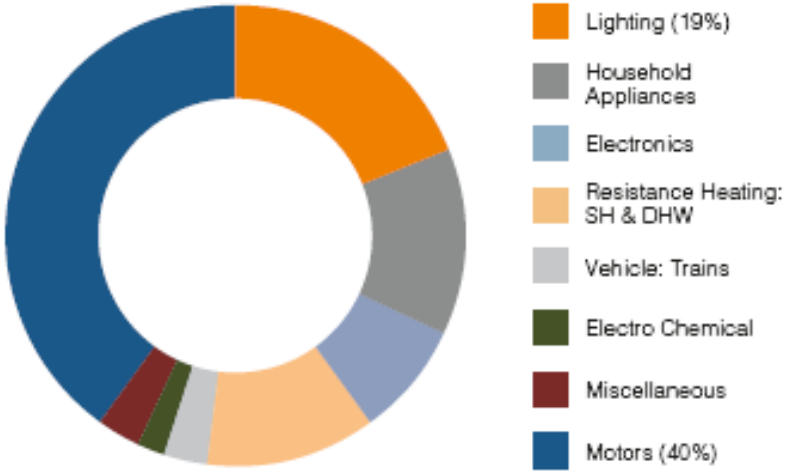
Efficiency in Thermal Power Generation (continued)

- **Burning fossil fuels requires large scale technology for mitigation of GHGs. CCS comes with a 6 – 10 % efficiency penalty.**
- **Decrease start-up time.**
- **Increase overall power production through CHP and co-firing biomass and coal power plants.**
- **Improving reliability of power plants could result in savings of at least US$80 billion per year and avoidance of 1Gt of CO2, if all power plants could operate with the same degree of availability.**

Energy Efficient Solutions for Industry

- **Energy efficiency potential in industrial branches depend on electricity demand and prices, processes and the already realized measures**
- **In countries with lower energy prices the technical potential is higher, but the economical potential is still only 20%**
- **Many barriers exist to leverage the economical potential**
- **New framework conditions are needed**
  - In industry: Life-cycle analysis and approach for mid-to-long-term evaluation
  - In politics: incentive schemes





Energy Efficient Solutions for Communities

- **Energy efficiency in buildings is an important factor**
- **Technical solutions are and will be available**
- **Cities can act at different levels: urban infrastructure, transport and in public buildings**
- **Need of holistic approach**
  - Reduce the demand
  - Increase the system performance
  - Change the behavior
- **Energy savings alone do not foster the use of energy efficient technologies**
- **A proposed methodology for the solutions: Energy Savings versus Profitability**

Energy Efficient Buildings

- **Energy efficiency in buildings is important factor**
- **Technical solutions are available, new technologies are on the way (roadmap)**
- **Energy demand moving from heat to electricity**
- **Trend: hybridization, smart technologies**
- **Many barriers – organizational, financial and behavioral**
- **Need of holistic approach**
  - Reduce the demand
  - Increase the system performance
  - Change the behavior

Best Practice Demonstration

- **Six technologies being analyzed for energy saving potential and customer satisfaction:**
  - **Heat Pump Water Heater:** on average 50% less energy than conventional technology, customer satisfaction and high reliability
  - **Variable Refrigerant Flow**: annual savings from 20 to 45% possible, customer satisfaction with performance and improved comfort
  - **Ductless Heat Pumps:** energy savings from 18 to 44%; customer satisfaction with system performance, reliability, controllability, comfort, savings; training of contractor, installer, technician is important
  - **Light-Emitting Diodes:** Energy savings from 20 to over 70%; with a lifespan of 100,000 hours, reducing maintenance costs
  - **Energy Efficiency in Data Center:** energy savings around 20%; switch from AC to DC system could reduce 15% of energy consumption
  - **Residential Appliances Demonstration:** Energy savings for refrigerator up to 45%, water savings for washer by 2.1 gallons with energy savings up to 17%

Recommendations

Recommendations: Technical Reports

Technical solutions are already available for many sectors - buildings, industry and even for cities. Ambitious goals set around the world in energy efficiency require to go further in terms of cost-effectiveness, financing, decision making, acceptance of the solutions, innovation and environment impact assessment.

- **Cost-effectiveness of technical solutions:** profitability in investing in energy efficiency technology are often unknown or questioned. Governments should promote neutral comprehensive studies of profitability merit-orders in different sectors such as buildings or cities.
- **Financing:** Energy efficiency is a long term issue, financing should adapt to this specificity and duration of loans should be extendable up to the lifetime of the solution. For buildings, this loan should also be linked to the property not the owner (examples are PACE in the US and the Green Deal in the UK).
- **Decision making process**: The motivations of the different stakeholders into the decision making process explain many failures in deciding to undergo energy efficiency actions. Not only the famous landlord-tenant issue but as often the investor versus operator issue are relevant. Emphasis should be put into finding solutions to overcome these issues.

Recommendations: Technical Reports (continued)

- **Acceptance of solutions:** savings are not always as expected (rebound effect). Evolution of lifestyles, human acceptance and adaptation to the new technological solutions are essential to obtain the expected reduction in consumption. Analyses of social trends and human behaviors should be carried on. Emphasis should be put into following up the beneficent after implementation in order to help him adapt to the new technology.
- **Innovation:** technology roadmaps are useful to design possible futures and to help decisions in the present but they need to be complemented with “out of the box” thinking and enlargement of the perimeter. For example, better solutions might be found at the level of a city (transport, energy) than an individual building.
- **Environment impact assessment**: in order to ensure sustainable solutions, life cycle analysis should be promoted for all significant environmental impacts as much as realistic and operational.

Thank you

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