



## The Role of Power Generation in Reducing Greenhouse Gases

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Committee on the Performance of Generating Plant

Promoting the sustainable supply and use of energy for the greatest benefit of all

# Outline

1. WEC Committee on the Performance of Generating Plant (PGP): Objectives and Activities
2. Existing/Future Power Generating Plants: Efficiencies, GHG Emissions
3. Terminology, Definitions, Standardisation

## Recent History

|                                |                 |
|--------------------------------|-----------------|
| World population               | +12%            |
| East and South-East Asia       | 60%             |
| No access to commercial energy | ~25%            |
| Primary energy consumption     | +20%            |
| Electricity consumption        | +32%            |
| Oil price                      | 10–147 US\$/bbl |

## WEC Committee on the Performance of Generating Plant (PGP): Objectives and Activities

Promotes international exchange of information and data on the performance of generating plant to facilitate the most effective use of generation assets and energy resources worldwide.

Collects plant performance indicators for fossil, renewable and nuclear plant from around the world.

Holds plant benchmarking workshops to improve performance of the existing plants.

## **WEC Committee on the Performance of Generating Plant (PGP): Objectives and Activities**

Current focus on the analysis of factors determining the performance of generating plant and on wider deployment of the recommendations for performance improvement using methodologies and tools (commercial availability, emissions assessments, etc.) developed or identified by the Committee.

**[www.worldenergy.org](http://www.worldenergy.org)**

## Existing/Future Power Generating Plants: Efficiencies, GHG Emissions

The only technically and economically viable solutions to limit/reduce GHG emissions in the electricity supply industry, now and for decades to come:

- Conservation
- Generation efficiency
- Fuel switching

## Relative Benefits of the Options

### **New Generation**

CO<sub>2</sub> mitigation benefits = combined value of efficiency impact + CO<sub>2</sub> capture rate

- Large impact at the plant level
- Lower impact at national level due to a small share of new facilities in the overall generation mix

### **Existing Generation**

CO<sub>2</sub> mitigation benefits = CO<sub>2</sub> scrubbing and/or performance improvements

- Can be relatively modest at the plant
- Large number of plants at national level provides an excellent opportunity value

## Existing/Future Generating Plants: Efficiencies, GHG Emissions

The challenge for the electricity production sector is to reduce its carbon footprint by improving environmental performance, operational efficiency and reliability:

- Better reliability reduces CO<sub>2</sub> emissions from existing plants.
- Retire/replace existing coal (fossil) generation with “clean” technologies.

## Power Generating Plant: Thermal Efficiency

| Time Period                               | Thermal Efficiency   |
|---|--|
| Beginning of the 20 <sup>th</sup> Century | <10%   |
| Existing Generation in 2009               | 34% (world average)<br>40% (EU average)                          |
| Future (short-term)                       | 45% (hard coal-fired, state-of-the-art technology)<br>58% (CCGT) |

## Future Coal and Gas Fired Plants

| Commercial operation                              | 2005         |                       | 2030         |                       | 2050         |                       |
|---|--------------|-----------------------|--------------|-----------------------|--------------|-----------------------|
|   | Efficiency % | CO <sub>2</sub> g/kWh | Efficiency % | CO <sub>2</sub> g/kWh | Efficiency % | CO <sub>2</sub> g/kWh |
| <b>Hard coal, steam</b>                           | 46           | 730                   | 52           | 644                   | -            | -                     |
| - with carbon capture                             | -            | -                     | 40           | 84                    | 44           | 38                    |
| <b>Hard coal, CC with integrated gasification</b> | -            | -                     | 52           | 645                   | -            | -                     |
| - with carbon capture                             | -            | -                     | 43           | 78                    | 48           | 55                    |
| <b>Natural gas, combined cycle</b>                | 58           | 350                   | 62           | 330                   | -            | -                     |
| - with carbon capture                             | -            | -                     | 57           | 35                    | 59           | 20                    |

Source: Eurelectric/VGB PowerTech

## Significant Opportunity to Reduce Emissions through Plant Performance Improvement

- Performance monitoring systems (sources of efficiency leakage)
- Coal quality analytics
- Optimisation tools
- Advanced controls (dynamics of start-ups and ramping)
- Major modifications to improve the overall cycle capability (turbine, rotor, generator H<sub>2</sub>-cooling)

## Terminology, Definitions, Standardisation (benchmarking, international compatibility)

|                              |   |
|------------------------------|---|
| Terminology:<br>(generation) | World Energy Council<br>UNIPED/Eurelectric<br>VGB   |
| Definitions:<br>(generation) | Performance Indicators<br>WANO (nuclear)<br>IAEA (nuclear)<br>UNIPED/Eurelectric/VGB PowerTech<br>WEC (fossil, renewables)<br>IEEE762 (US)<br>NERC (US)<br>Eurostat |

## Internet Sites

[www.worldenergy.org](http://www.worldenergy.org)

Performance of Generating Plant

[www.eurelectric.org](http://www.eurelectric.org)

“The Role of Electricity”

[www.wano.org](http://www.wano.org)

Performance Indicator Programme

[www.iaea.org](http://www.iaea.org)

PRIS database (Power Reactor Information System)

[www.vgb.org](http://www.vgb.org)

Performance Indicators

[www.solomononline.com](http://www.solomononline.com)

Benchmarking, GHG emissions performance measurement

[www.ec.europa.eu/eurostat](http://www.ec.europa.eu/eurostat)