

# Siemens Energy Sector

“Energy Supply – Future Trends“



## Energy is an essential part of our daily lives



Industry



Education



Mobility



Workplace



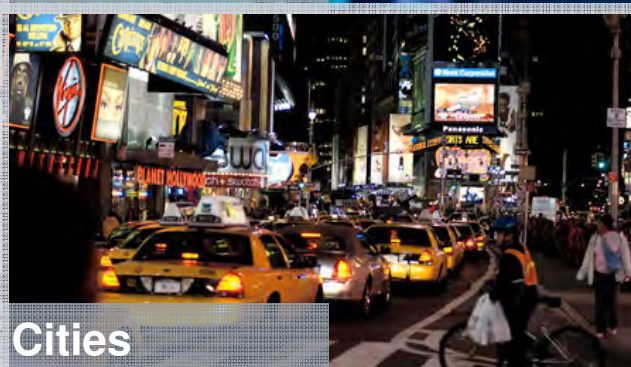
Entertainment



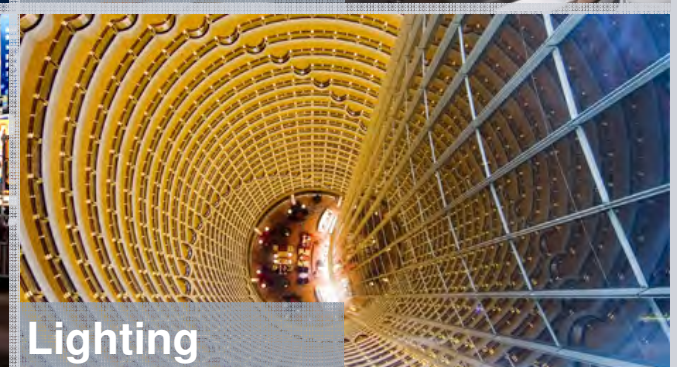
Homes



Healthcare



Cities



Lighting



# Megatrends – the world's toughest questions



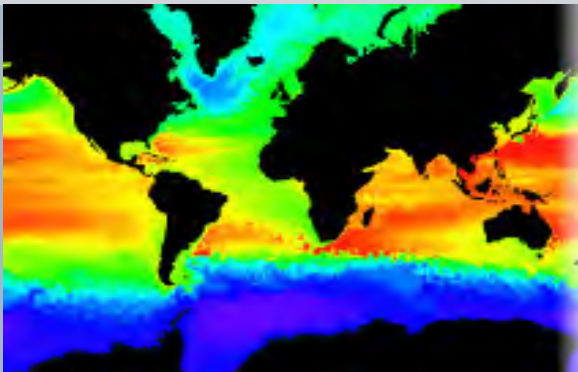
## Urbanization

- 2007: for the first time in history, more people live in cities than in rural areas.
- Today: 280 million people live in megacities (> 10 million residents)
- 2030: 60 % of the world's population will live in cities
- Urban conglomerations contribute a high share of a nation's economic output: Tokyo provides 40 % of Japan's GDP, Paris generates 30 % of France's GDP.

## Demographic Change

- Average life expectancy worldwide will increase to 72 years in 2025 from 46.6 years in 1950.
- World population will grow from more than 6 billion now to 8 billion by 2025
- 95% of the global population growth is taking place in developing countries.
- The 65+ generation will nearly double worldwide by 2030 (from 7 % to 12 %)

# Megatrends – the world's toughest questions



## Climate Change

- The average global surface temperature has increased by 0.76° C compared to the 18th century
- 11 of the 12 years between 1994 and 2005 rank among the 12 warmest since weather observations began
- Greenhouse gas emissions haven't risen dramatically since industrialization. Today we face the highest CO<sub>2</sub> concentration in the atmosphere for the past 350,000 years.

## Globalization

- From 1950 to 2004, the volume of global trade has increased 27.5-fold.
- The number of global players has grown from 17,000 in 1980 to over 70,000 today.
- Ocean freight has increased over the past four decades from less than 6,000 billion ton-miles to over 27,500 billion ton-miles a year.

# The usage of electrical energy will increase due to higher efficiency

## Example: E-car

In an electric car, electricity from batteries is converted to kinetic energy with 95-percent efficiency.



## Example: All-electric oil & gas

### Traditional concepts:

Gas turbine direct drive of compressors and pumps

**Efficiency:**  
20-25%

### All-electric solutions:

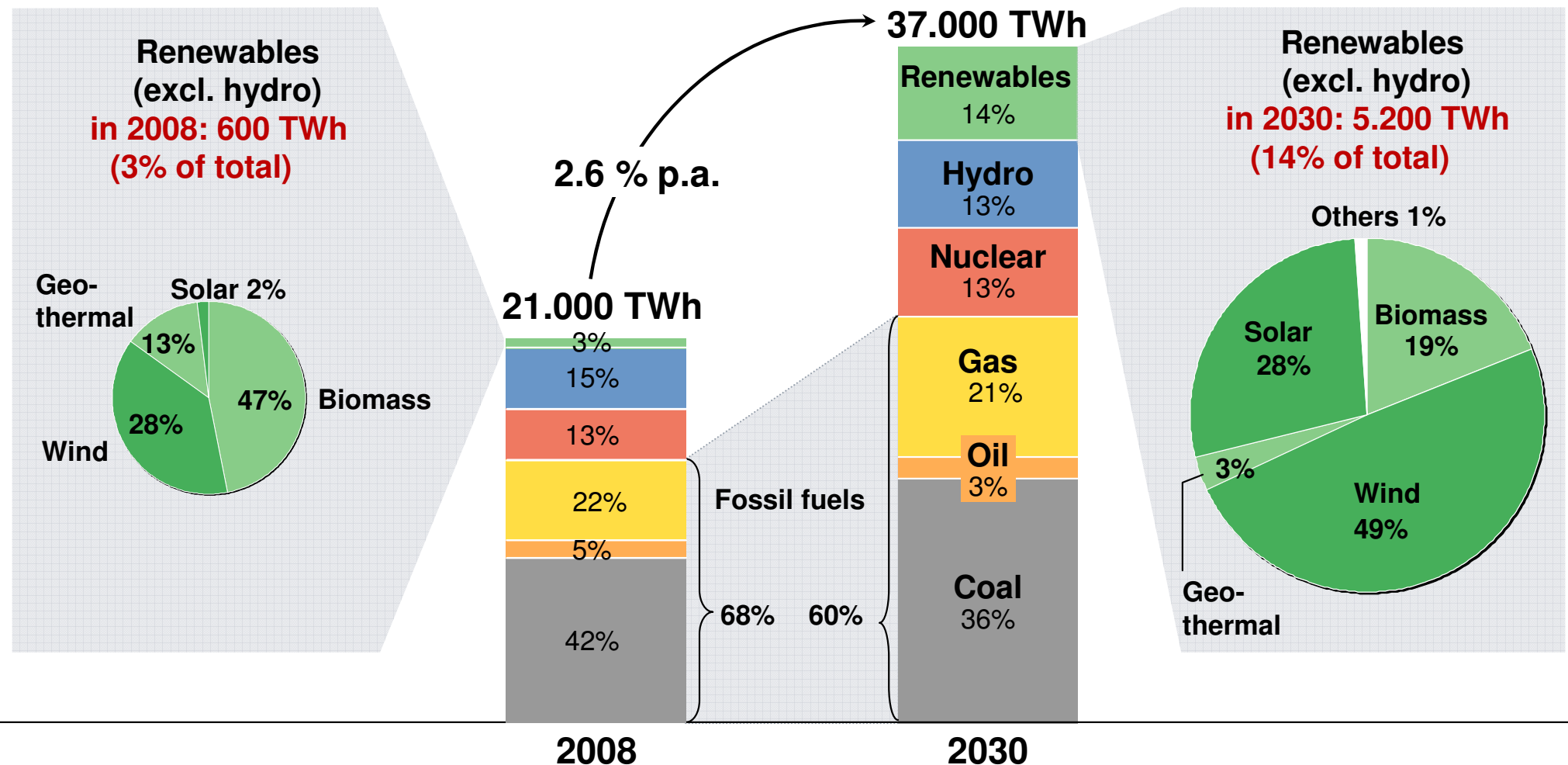
Central power generation and all drivers E-motors

**Efficiency:**  
34-50%



# Renewables are gaining in importance – but fossil fuels will continue to be the mainstay

## Power Generation (in 1000 TWh<sup>1</sup>)



Quelle: Siemens Energy Sector, GS4 base case

<sup>1</sup> Terawatt-hours



## Innovation is our lifeblood

### Major R&D investments

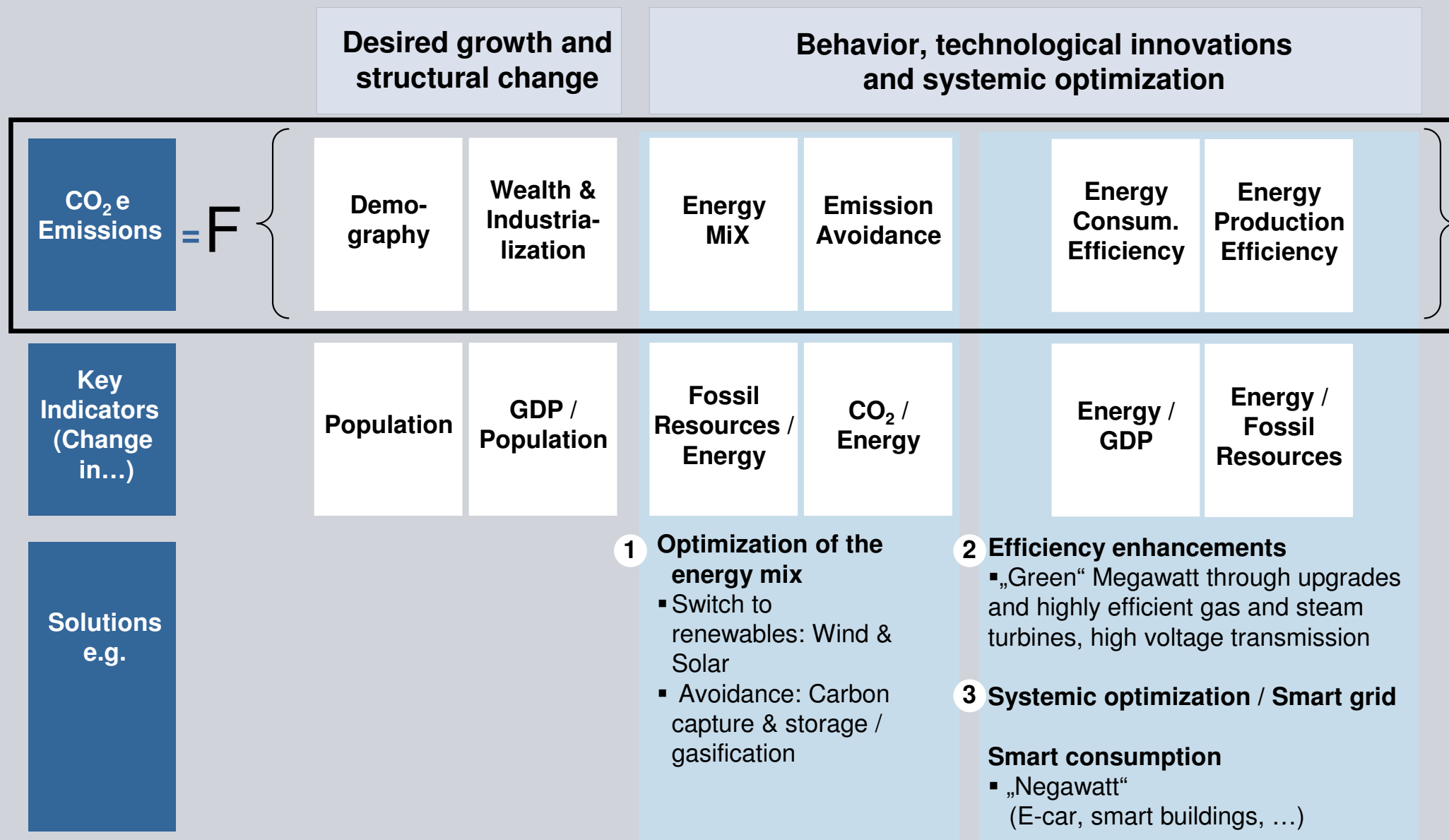
- €3.8 billion in fiscal 2008, or 4.9% of revenue
- 32,300 R&D employees worldwide
- 20,000 software engineers
- 150 R&D locations in over 30 countries around the world
- 8,200 inventions in FY2008
- 55,000 active patents



### Major innovations

- **Our patent position in fiscal 2007:**
  - ➔ Germany: No. 2
  - ➔ Europe: No. 3
  - ➔ USA: No. 11
- **Most recent innovations:**
  - ➔ Somatom Definition Flash: Worldwide first CT with fastest imaging and lowest radiation dosage
  - ➔ Efficient power transport (HVDC): the new 800-kV high-voltage, direct-current transmission system minimizes power losses
  - ➔ Digital factory: virtual factory makes production more efficient and flexible

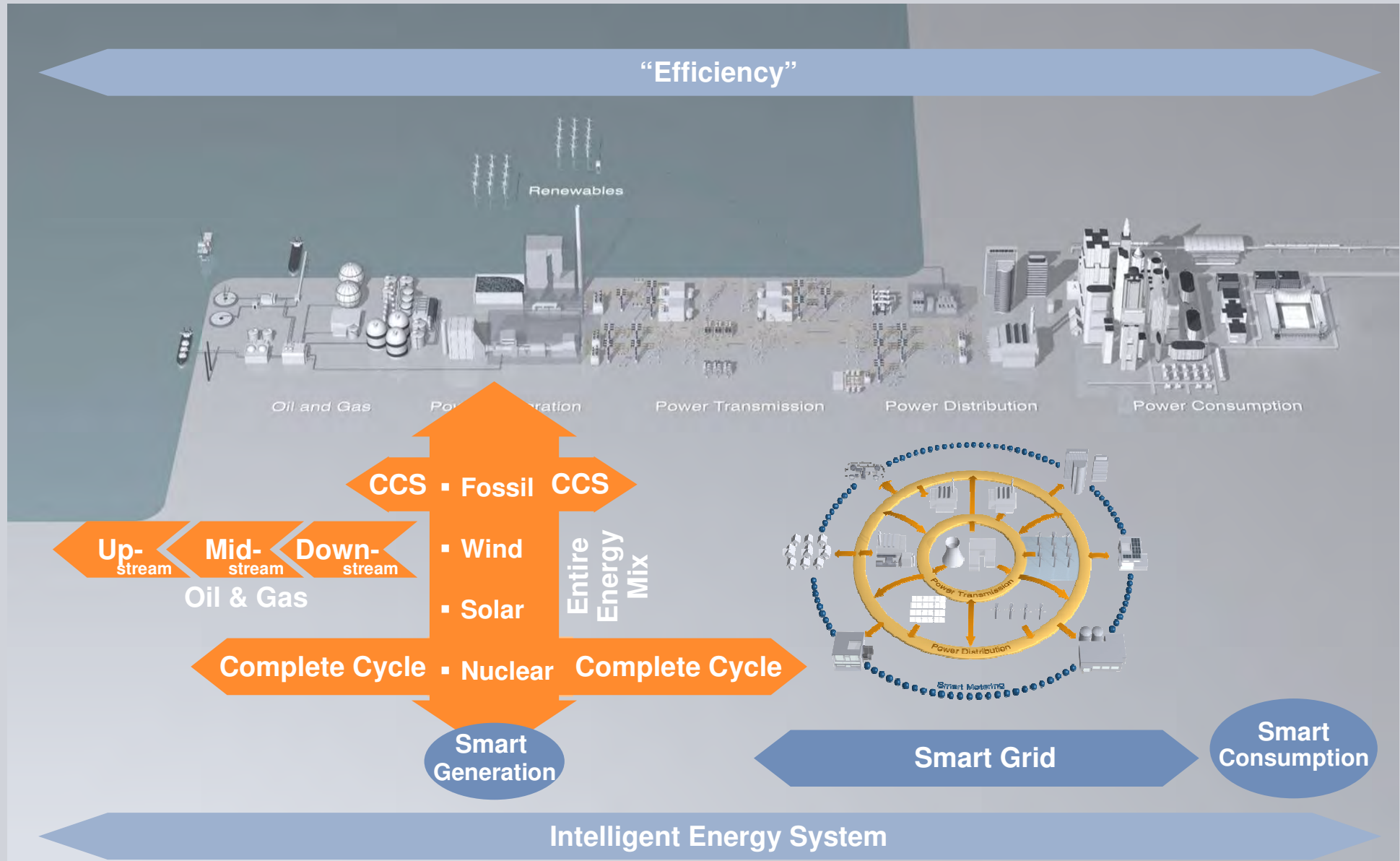
# Challenges for sustainable energy supply – Can innovation make growing energy demand more efficient?





# Siemens Energy: Solutions along the entire energy conversion chain

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## The three steps to a sustainable energy supply

**The three steps to a sustainable energy supply:**

- 1 Optimization of the energy mix**
- 2 Efficiency enhancement along the entire energy conversion chain**
- 3 Smart Grid / Systemic optimization**

**Energy supply in the future:**

**Integrated energy system**

## First step: Optimization of energy mix

### Privileged feed-in of renewables

- Renewables:
  - Wind power
  - Solar thermal power
  - Photovoltaic



### Intermediate-load/peak-load for load leveling

- Gas-fired combined cycle power plants:
  - High efficiency
  - Low emissions
  - Fast startup



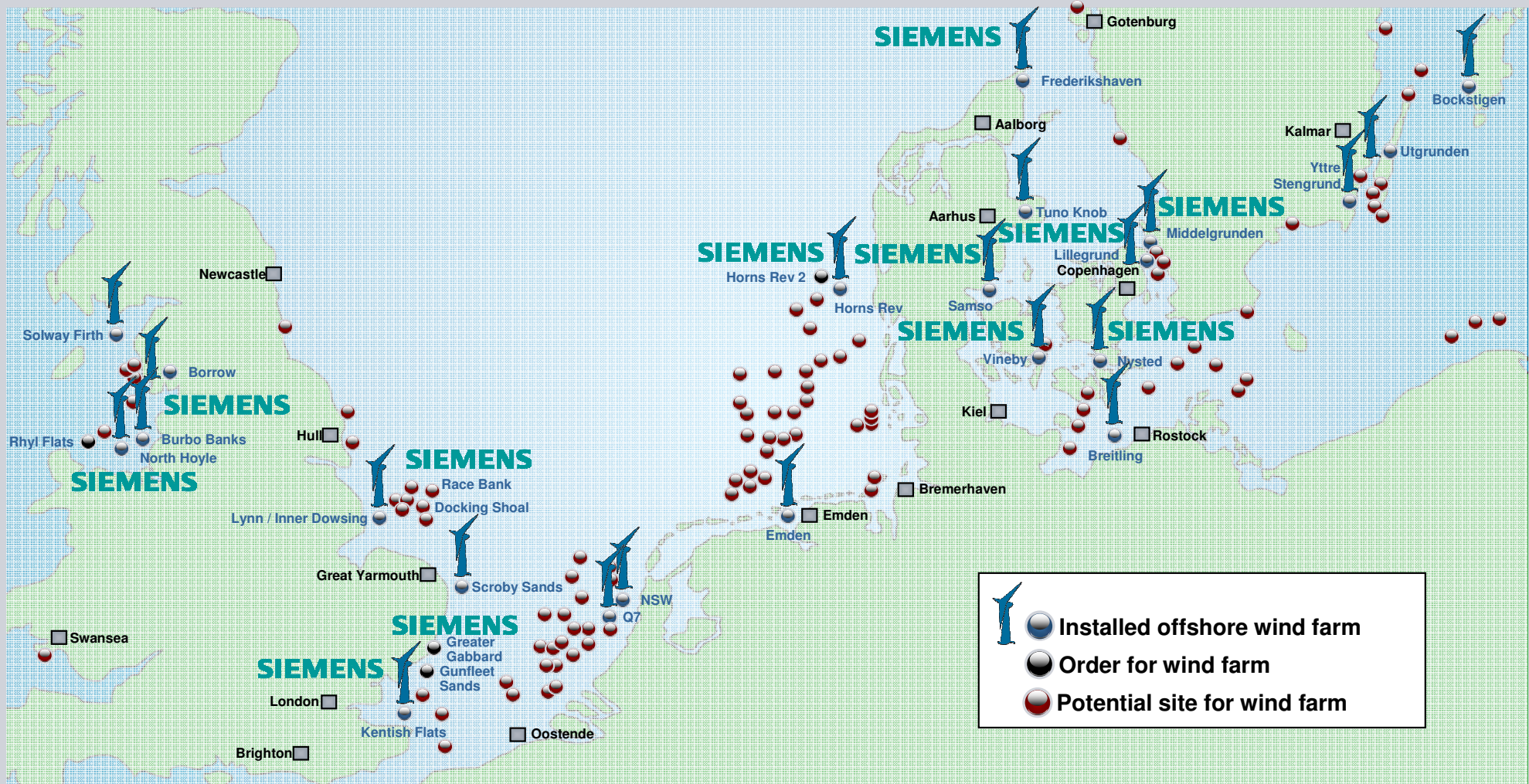
### Low-emissions base load

- Coal-fired power plants:
  - Clean, high-efficiency STPP
  - IGCC pre-combustion capture
  - Post-combustion capture for retrofitting and new plants
- Nuclear power plants
- Hydro power plants





# Example wind: Almost unlimited offshore possibilities – North Sea and Baltic



**Estimated 70 GW offshore potential for Europe – only 1.5% of this is installed**

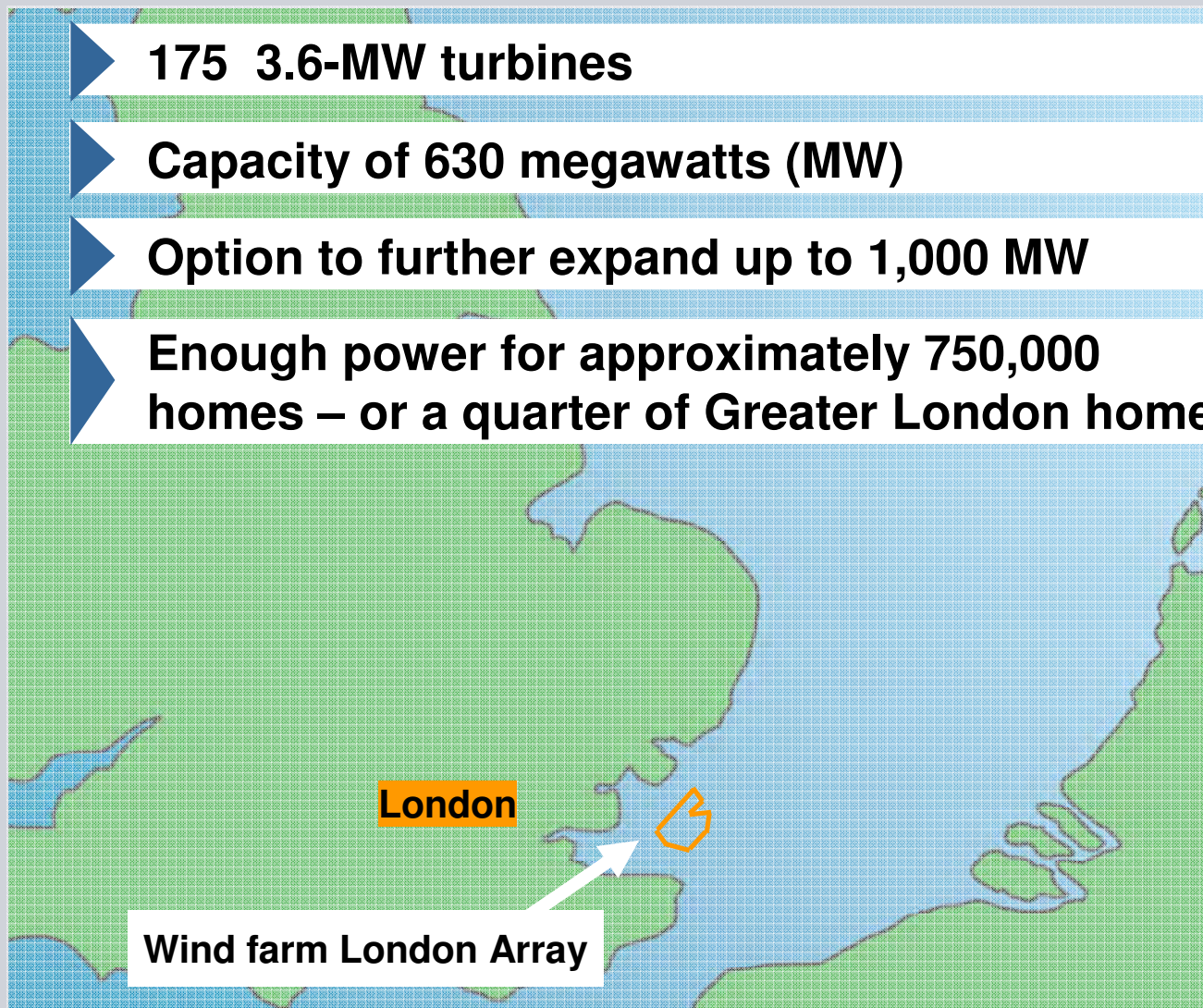
Source: Siemens E R WP OF BD



# Siemens to build the world's largest offshore wind farm

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- ▶ **175 3.6-MW turbines**
- ▶ **Capacity of 630 megawatts (MW)**
- ▶ **Option to further expand up to 1,000 MW**
- ▶ **Enough power for approximately 750,000 homes – or a quarter of Greater London homes**



# Example CCS: Technology features

▶ **CCS means: >95% CO2 capture achievable**

▶ **CCS means: 9-10% points efficiency drop**

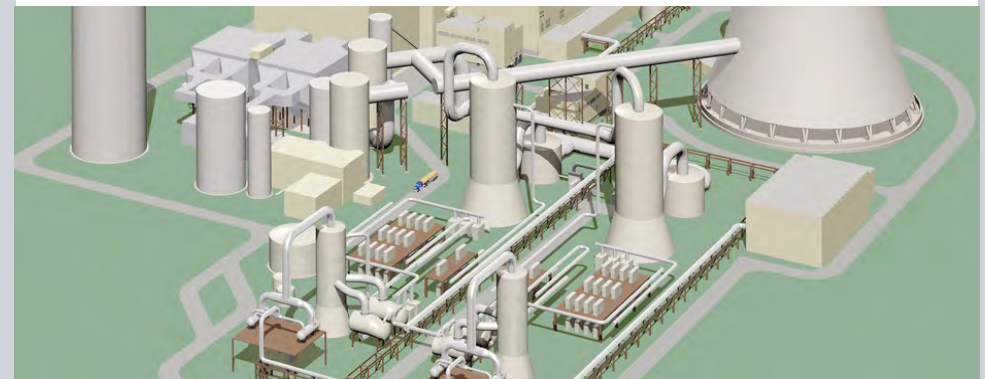
## Pre-combustion

- **Pre-combustion can reduce other emissions significantly below world bank and local standards compared to coal.**
- **All components and processes have been proven at industrial scale, so ready for market introduction.**
- **Technology highlight: First 500 MW gasifier installed in China.**



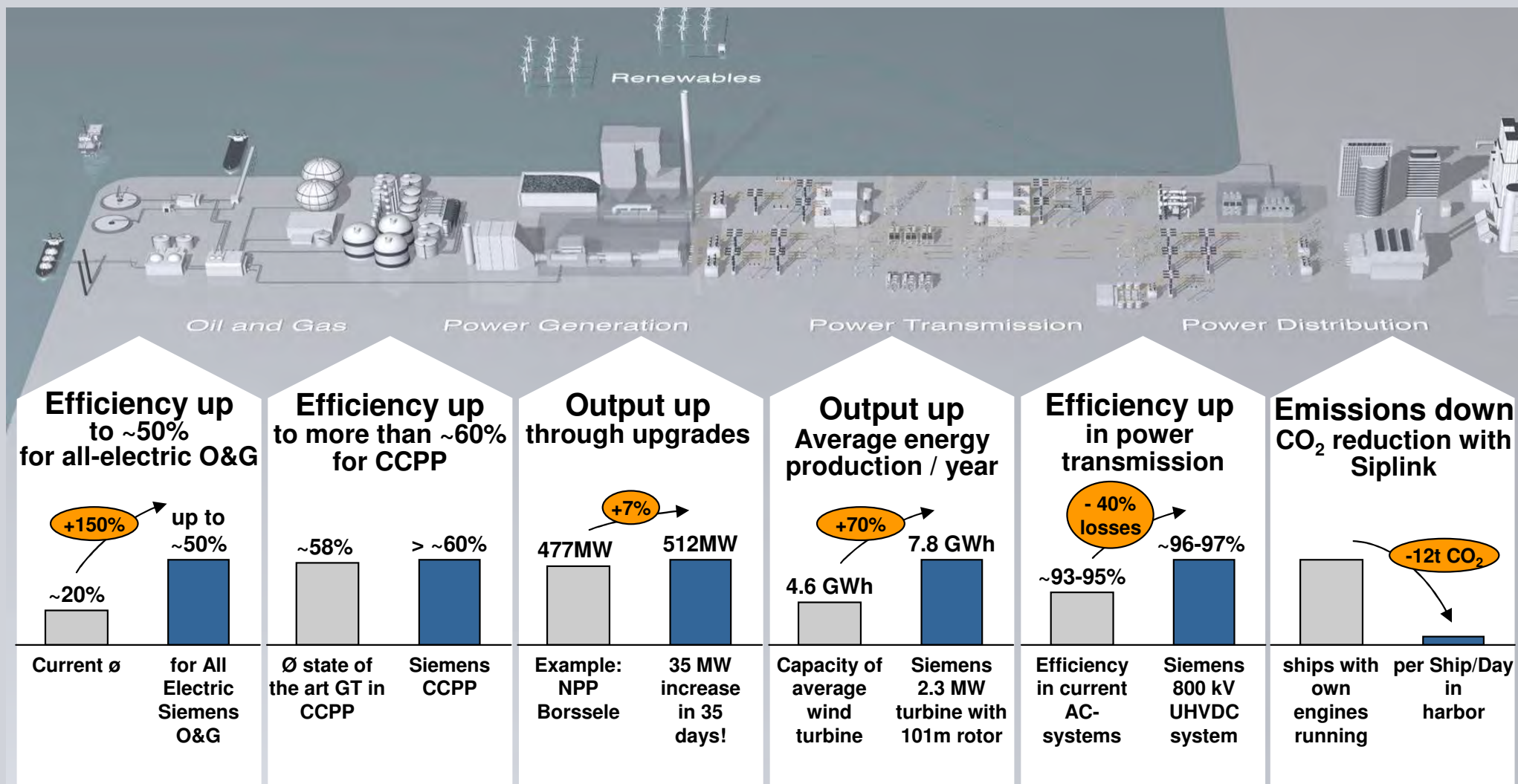
## Post-combustion

- **Scaled market introduction possible.**
- **Capability for retrofit.**
- **Based on established steam power plant technology**
- **Currently testing in pilot plants**





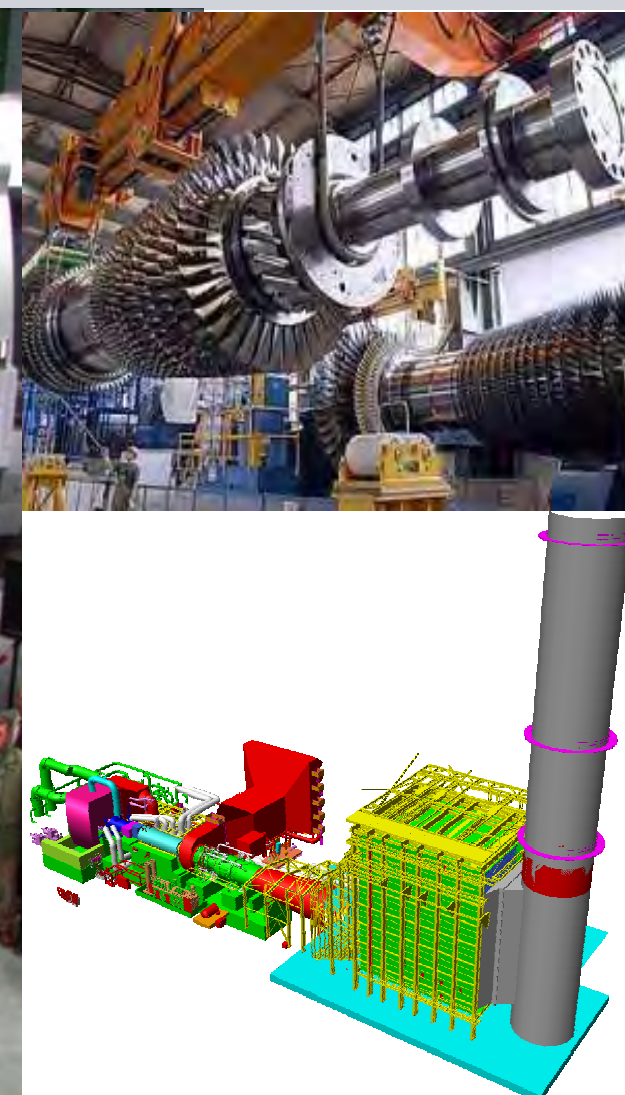
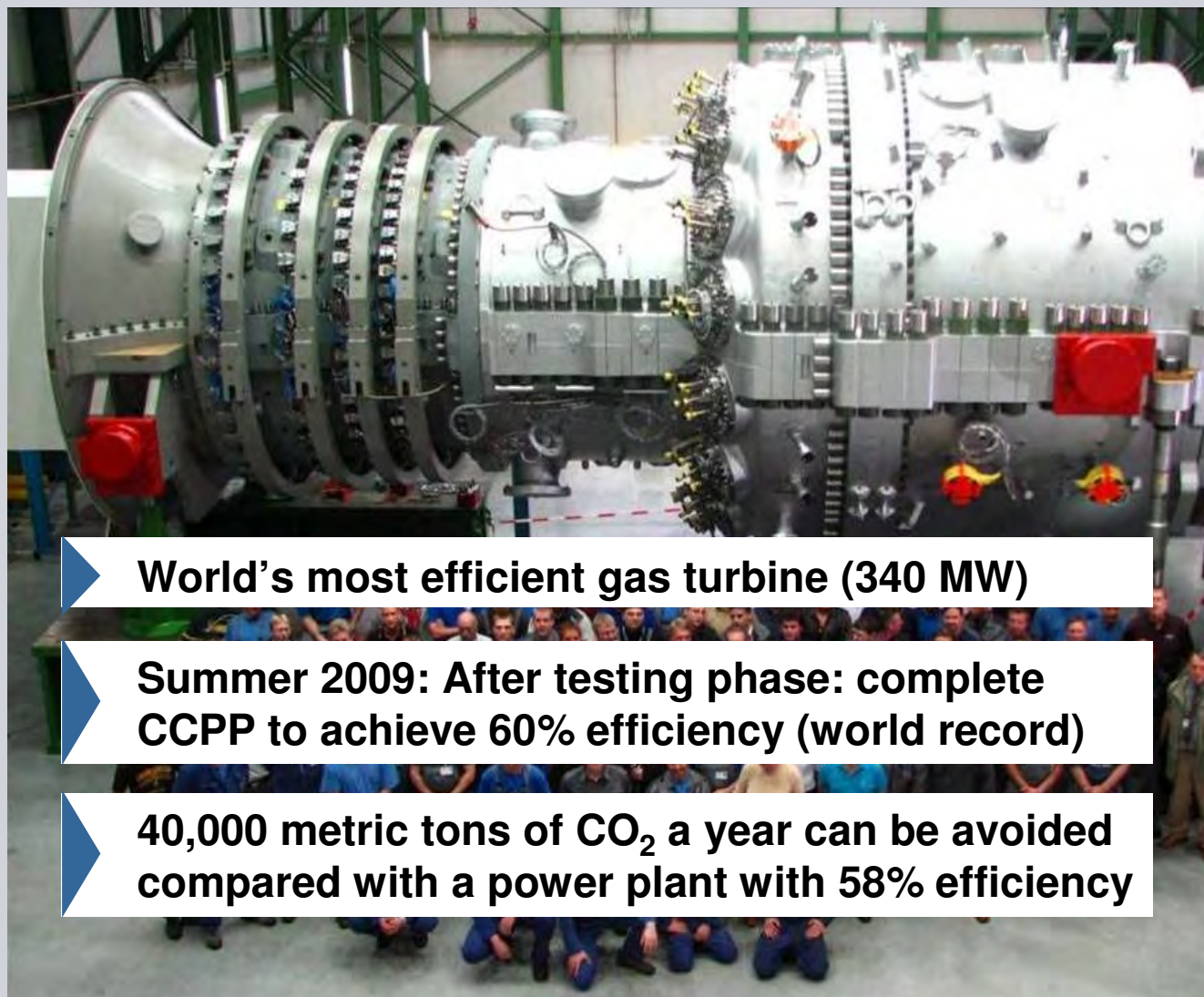
# Second step: Efficiency along the entire energy conversion chain



► Optimization with most advanced technology for intelligent grid management ◀

# Example Fossil Power Generation: World record efficiency in combined cycle

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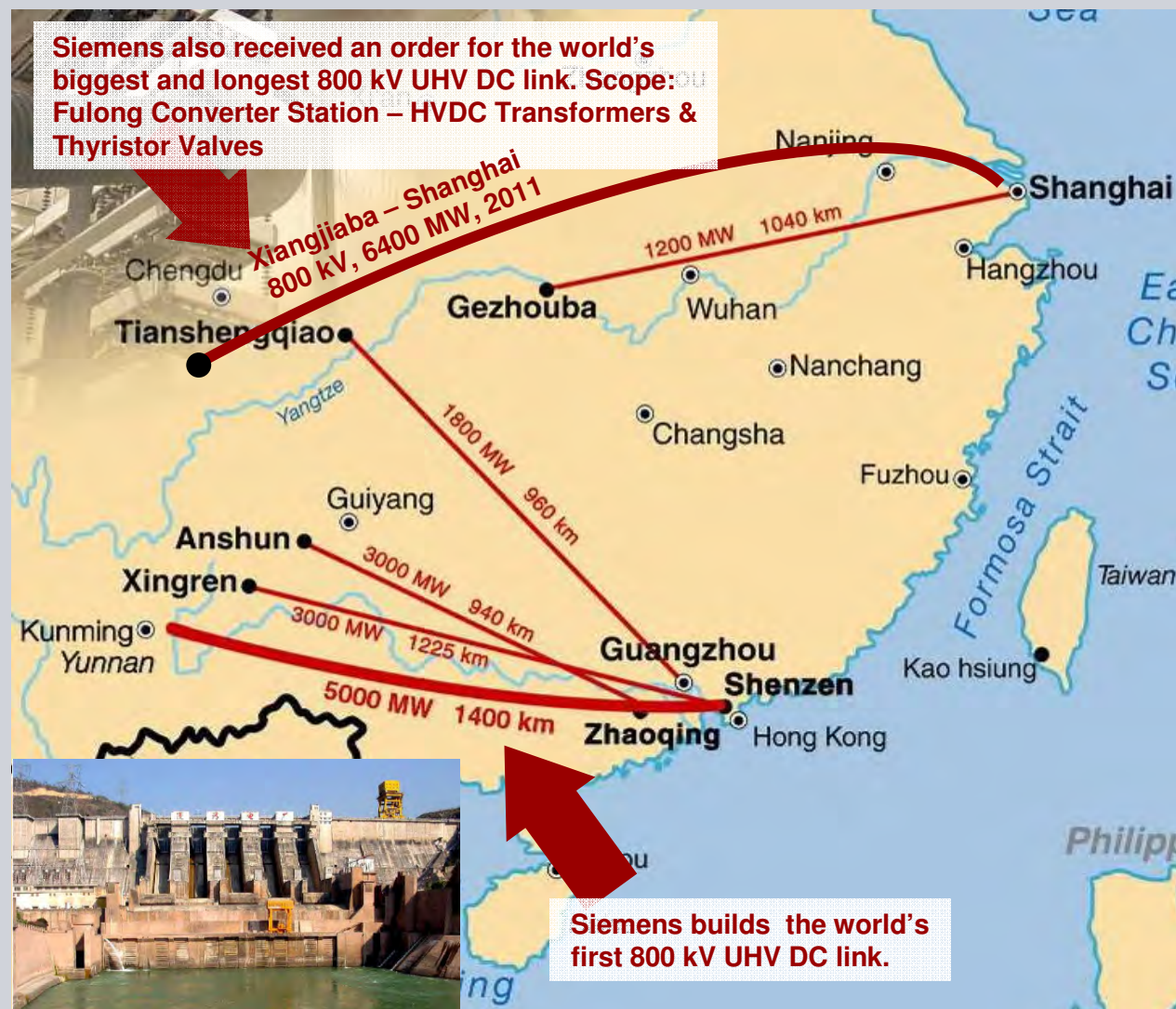




## Example HVDC: Use of hydro power with efficient power transmission

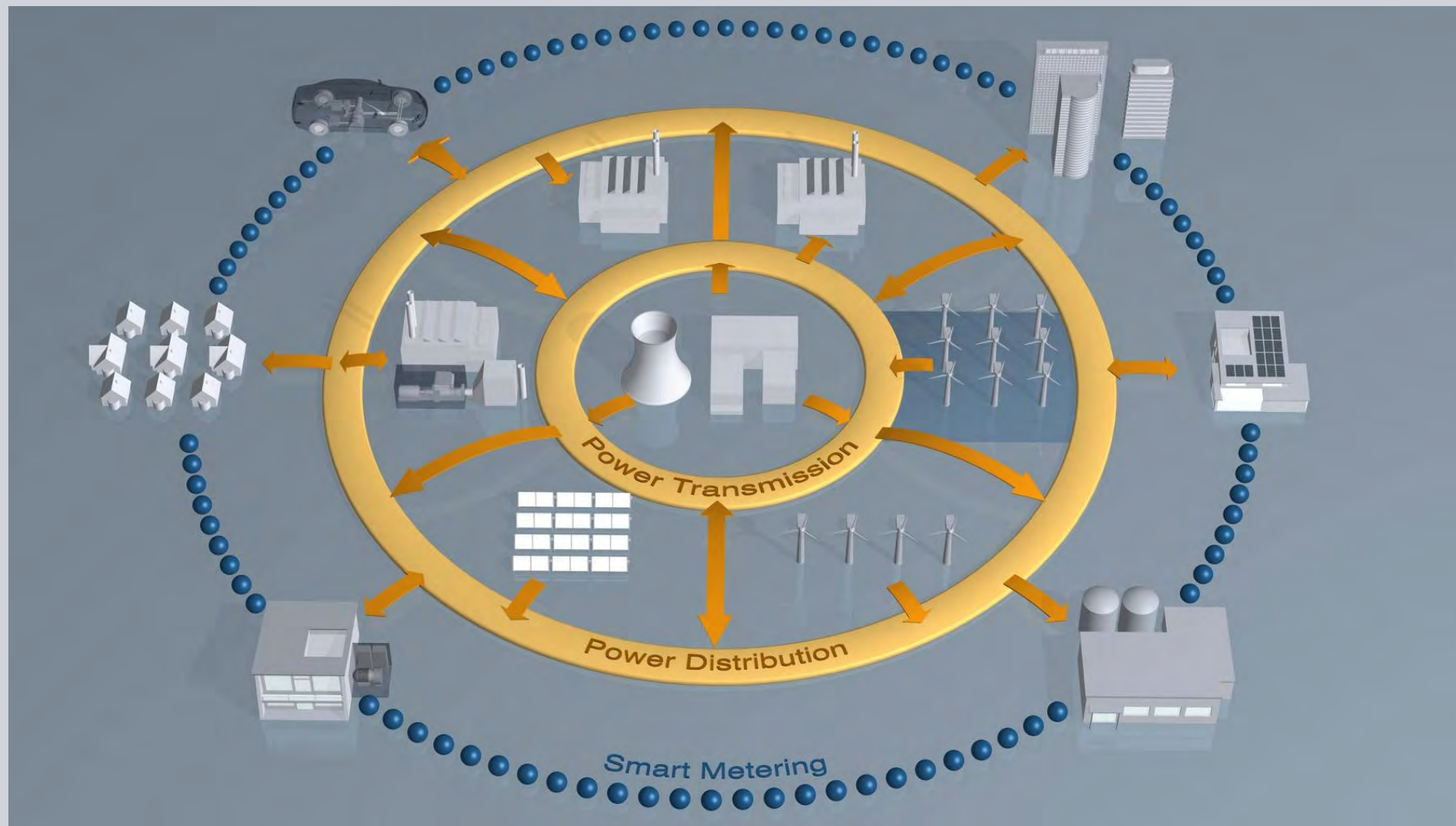
- First 800kV HVDC line
- Capacity: 5,000 MW
- Length: 1,400 km
- Electricity generated by several hydro-electric power plants will be transmitted to Guangzhou region

Avoidance of 30 megatons CO<sub>2</sub> per year (hydro power instead of fossil power generation)





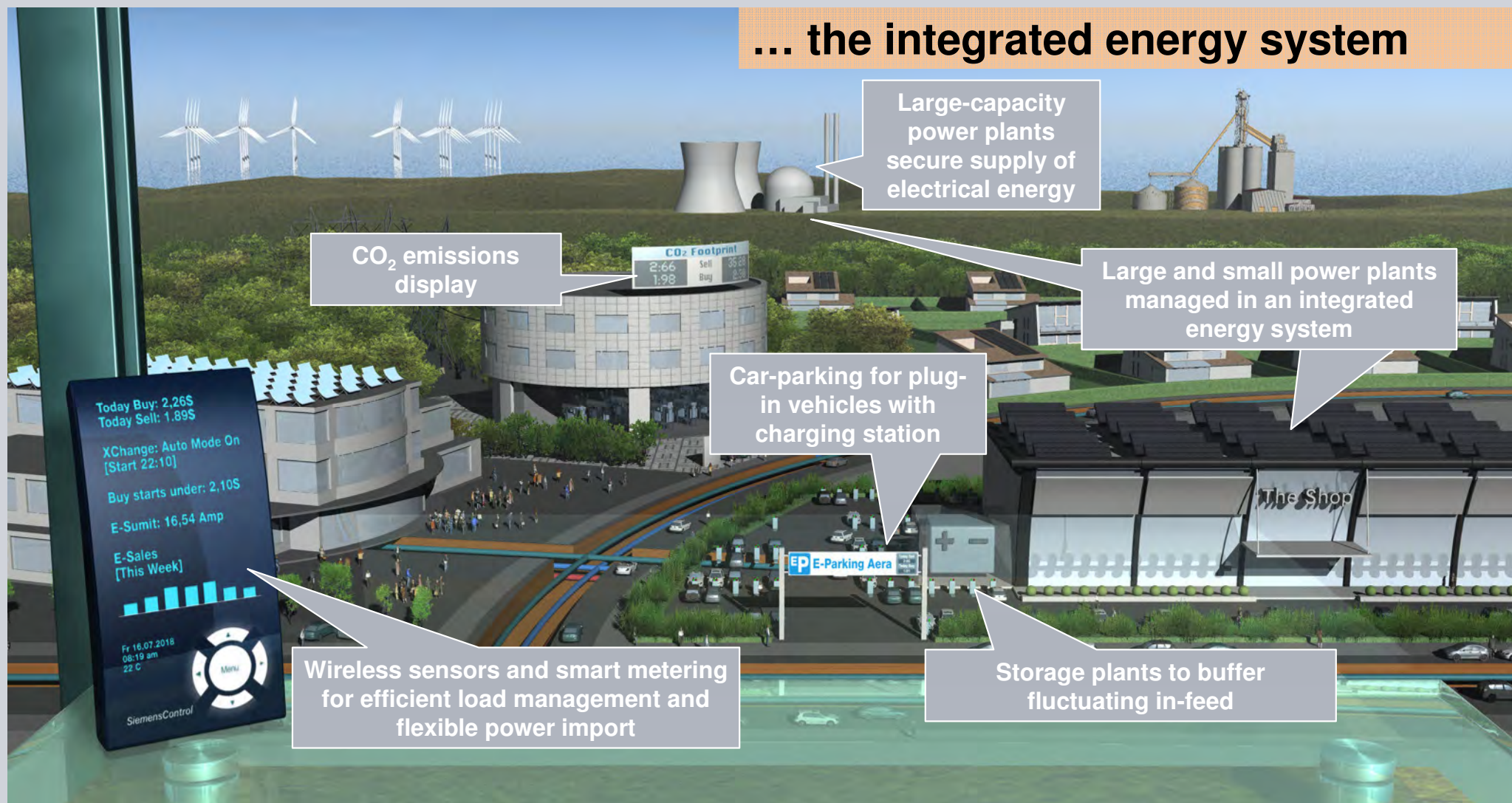
## Third step: Systemic optimization / Smart Grid



# The future of energy supply: Smart Grid and intelligent, efficient energy mix meld to produce...

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## ... the integrated energy system





**Thank you!**