Meeting Growing Demand for Cleaner Energy: Fossil Fuels in a Balanced Energy Portfolio

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Global Energy Trends
The Past 10 Years...

- World population: +12%
- Primary energy consumption: +20%
- CO₂ emissions: +30%
- Fossil energy consumption: +21%
- Coal consumption: +35%
- Electricity consumption: +32%

Continuing these trends is unsustainable.
“This significant increase in CO₂ emissions and the locking in of future emissions due to infrastructure investments represent a serious setback to our hopes of limiting the global rise in temperature to no more than 2ºC.”

“Our latest estimates are another wake-up call. The world has edged incredibly close to the level of emissions that should not be reached until 2020 if the 2ºC target is to be attained.”

-- Dr. Fatih Birol, Chief Economist at the IEA

http://www.iea.org/index_info.asp?id=1959
Fossil Fuels: Meeting 21st Century Challenges

Demand Grows Rapidly

Projected Change in Demand by Energy Source 2008 to 2035

- Coal
- Oil
- Gas
- Nuclear
- Hydro
- Biomass
- Other renewables


CO₂ Emissions Also Rise

Projected Global Carbon Dioxide Emissions to 2030

- Increase of 11.4 Gt (40%)
- 1990: 15 Gt
- 2007: 22 Gt
- 2015: 28 Gt
- 2020: 35 Gt
- 2025: 42 Gt
- 2030: 49 Gt

Global Challenge: Meeting increasing needs for electricity.

Source: IEA, World Energy Outlook, 2009
People without access to electricity in (millions)

World population without access to electricity
2008: 1.5 billion people
2030: 1.3 billion people

Source: IEA. World Energy Outlook, 2009
What is a sustainable power generation strategy?

- Nuclear
- Natural Gas
- Hydropower
- Coal
- Renewables
- Fuel Cells
A sustainable strategy: basic principles.

1. Create a portfolio of diverse options to meet needs and balance costs and risks.
2. Develop and deploy new power generation technology.
A drop in coal-fired generation in the OECD is offset by big increases elsewhere, especially China, where 600 GW of new capacity exceeds the current coal capacity of US, EU & Japan.
Coal has a role in the portfolio.

The Traditional Role
- Serving baseload power needs
- Supplying secure, domestic resources
- Offering stable and affordable energy pricing

The New Role
- Providing multiple technology options
- Serving markets for utilization of byproducts
- Virtually eliminating emissions
Carbon Capture and Storage (CCS)
a.k.a. “Carbon Sequestration”

**CO₂ Capture**
(Séparation & pressurization)

**CO₂ Utilization**

**CO₂ Transport**
(If necessary)

**CO₂ Geologic Storage**

| Purpose: Reduce CO₂ emissions to avoid climate change. |

*Carbon Capture Utilization and Storage* (CCUS)
Carbon Capture and Storage (CCS) to Meet the Challenges

Carbon Capture and Storage (CCS) to Meet the Challenges

Capturing Carbon Dioxide

*Industry: some applications commercial today; others not yet ready.*

- Natural Gas Separation
- Capture From Industrial Processes

*CCS is not just about “clean coal”…*

*Power Generation: Mostly Under Development*

- Post-Combustion Capture
- Oxyfiring
- Pre-combustion Capture
Utilization: Moving from CCS to CCUS

Enhanced Oil Recovery (EOR)

EOR in Saskatchewan, Canada

Capture at Great Plains Gasification Plant, ND, USA
Achieving Commercial Scale and Reducing Costs

Required:

- R&D to advance technologies and create breakthroughs
- Experience with large-scale injection of CO₂
- Industrial-scale, integrated demonstration projects
  - At least one million tonnes per year
  - Involving capture, storage and, if needed, transport

- 80 such projects are at various stages in development
- Overcoming financial, legal and regulatory hurdles
Major U.S. Demonstrations

- Large-Scale Geologic CO₂ Storage
- CO₂ Capture from Industrial Facilities
- Post-Combustion Capture
- IGCC with CO₂ Capture
- IGCC with Enhanced Oil Recovery
- Oxy-combustion

Advanced Technology for Carbon Capture, Utilization and Storage
Unconventional Gas: The Shale Revolution

Source: National Energy Technology Laboratory

Source: Energy Information Administration
Role of Government in Securing a Balanced and Clean Energy Portfolio

Research Development & Demonstration

Safety and Environmental Standards and Regulation

Creating Fair and Effective Markets for Energy and Energy Technologies

Collaborating with Industry, Civil Society and Other Governments
Europe's Eclipsing Sensation
Houdini
The World's Handcuff King & Prison Breaker

Nothing on Earth Can Hold Houdini A Prisoner