

A Future with Fewer Carbon Emissions*

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Key Points

Projected Demand Increase and Growth of Emissions

- Developing world projected to drive the demand increase
- Coal, oil, and gas continue to supply ~80% of total energy
- 60% of emissions growth in developing world

Pathways to CO₂ Stabilization

- Illustrative stabilization pathways
 - Pathways are not unique
- Stabilization requires CO₂ emissions to peak and decline ... ultimately to zero
- Uncertainty regarding CO₂ exchange between the atmosphere, ocean, and biosphere affects quantitative results
- Temperature outcomes affected by:
 - Uncertainty in climate sensitivity
 - Contribution of other GHGs

Carbon Mitigation

- Continued use of fossil fuel in a carbon-constrained world will require:
 - Moderating demand by improving energy efficiency
 - Developing low / no-carbon energy sources
 - Implementing large-scale carbon capture and sequestration

Defining the Technology Change, Given Two Key Metrics: CO₂ Emissions and Cost of Electricity

- De-carbonize the electricity infrastructure
- Meet binding economy-wide CO₂ reduction targets
- Provide reliable, affordable, and environmentally responsible electricity to consumers

CO₂ Challenge and Actions / Options for Addressing Carbon Constraints

- 80% reduction in emissions from 1990
- Provide effective global framework for carbon management
- Establish transparent, predictable, economy-wide cost for CO₂ emissions
- Focus on energy efficiency
- Better informed public debate

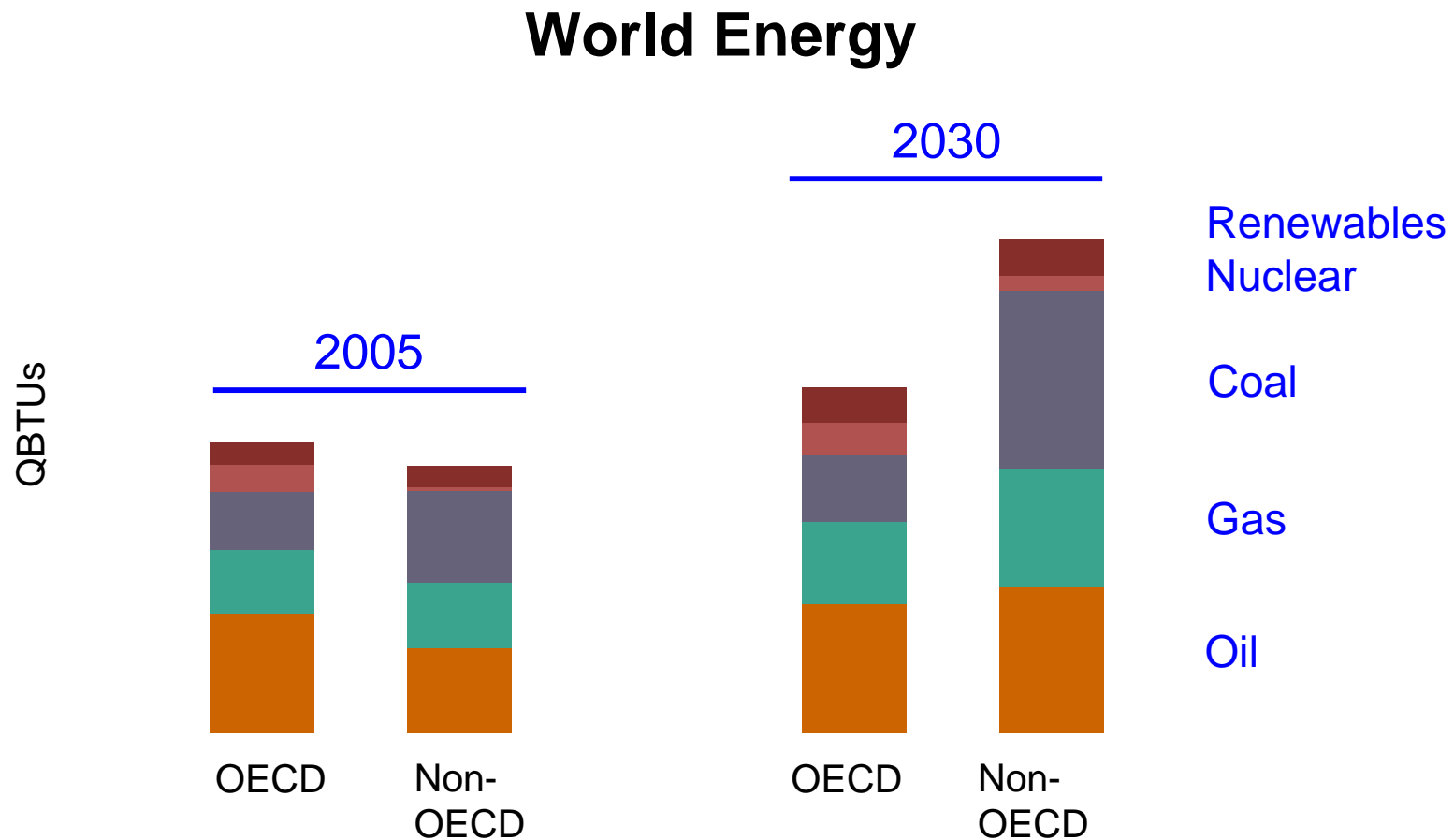


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Rod Nelson, Schlumberger
AAPG Mid-Continent Section Meeting
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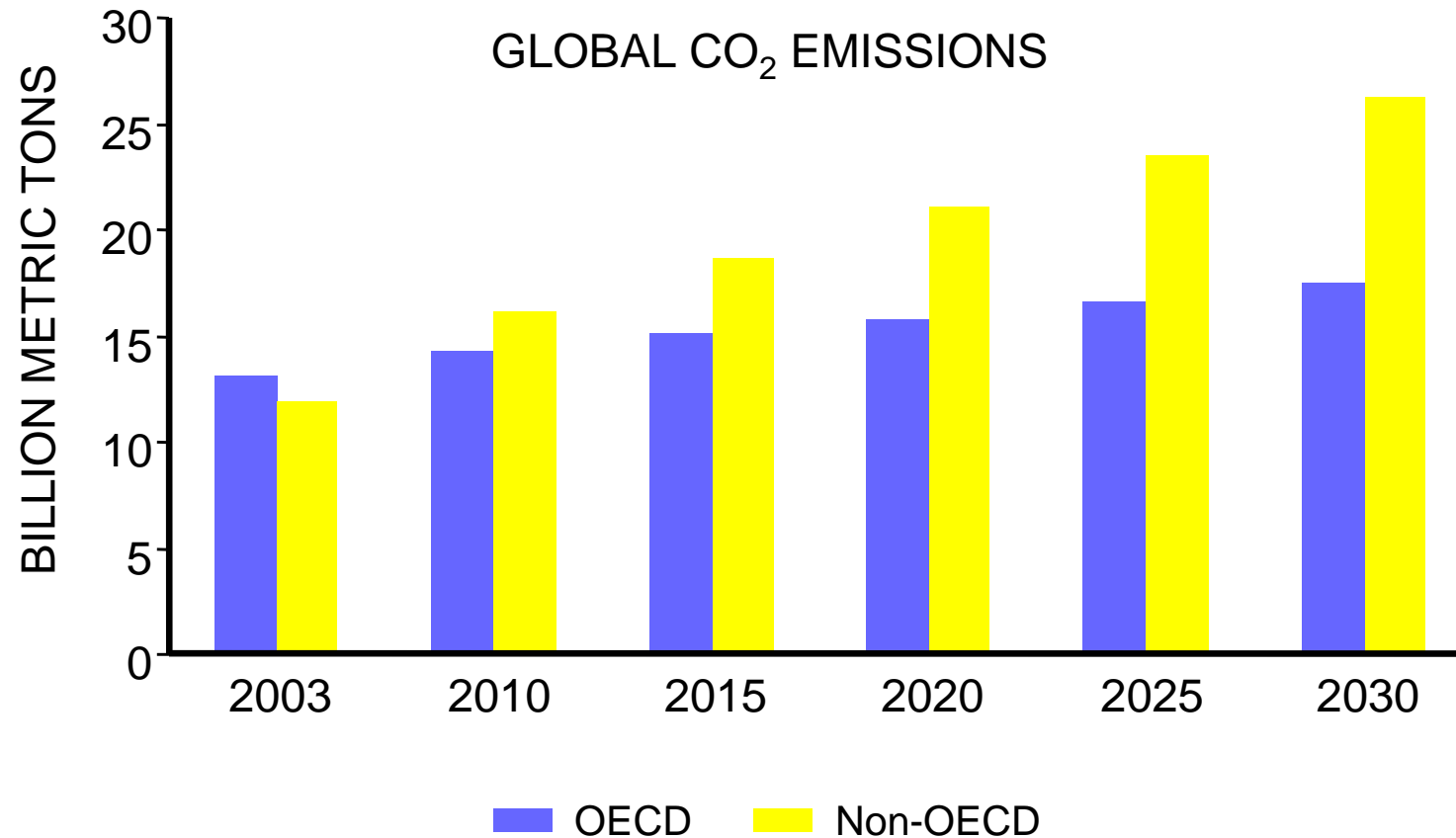
Projected Demand Increase

- Developing world projected to drive the demand increase
- Coal, oil, and gas continue to supply ~80% of total energy



Source: DOE EIA 2008 International Energy Outlook.

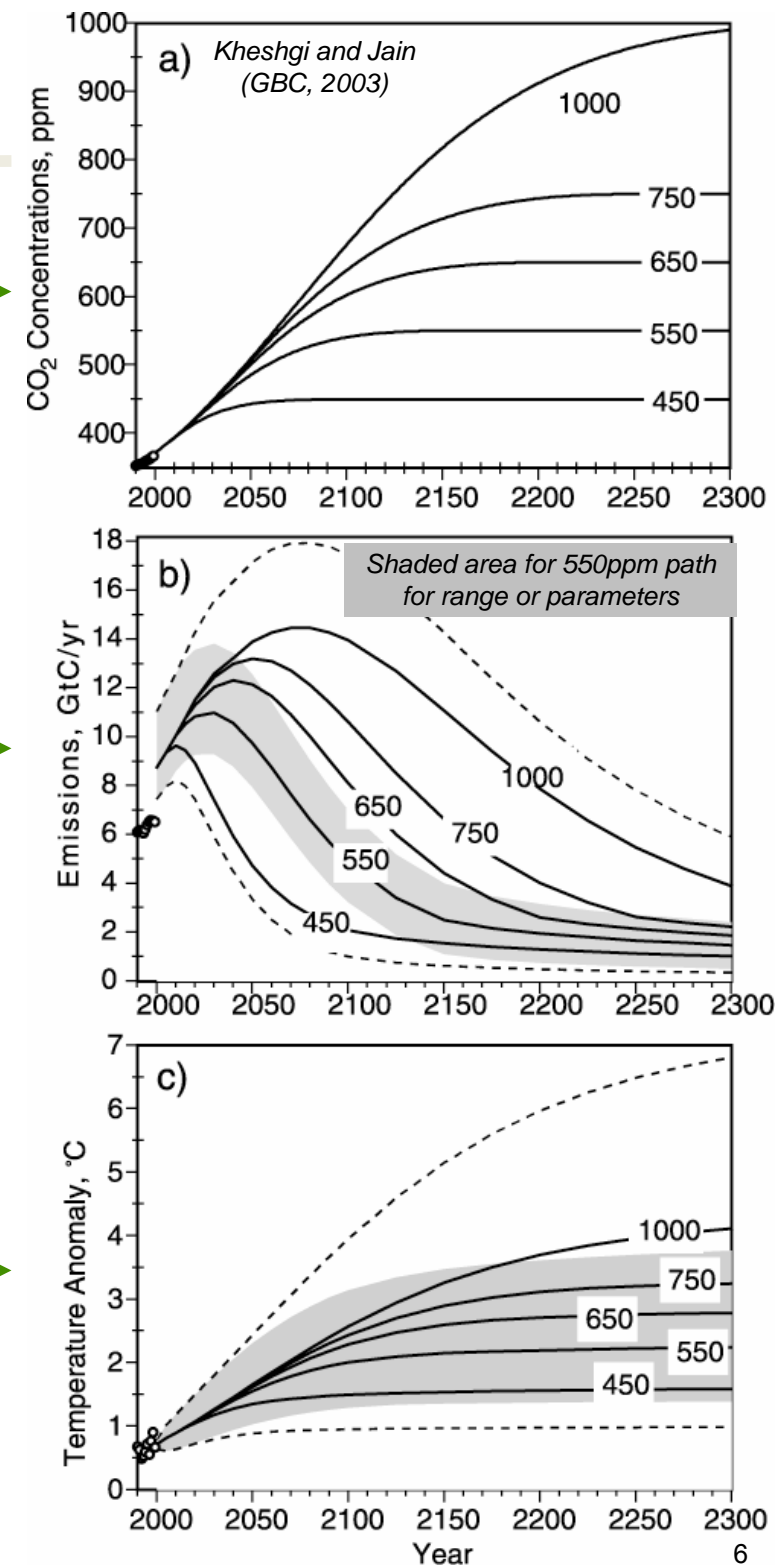
60% of Emissions Growth in Developing World



Source: EIA 2006

Pathways to CO2 Stabilization

- Illustrative stabilization pathways
 - Pathways are not unique
- Stabilization requires CO2 emissions to peak and decline ... ultimately to zero
- Uncertainty regarding CO2 exchange between the atmosphere, ocean and biosphere affects quantitative results
- Temperature outcomes affected by
 - Uncertainty in climate sensitivity
 - Contribution of other GHGs



Carbon Mitigation

Continued use of fossil fuel in a carbon-constrained world will require:

- Moderating demand by improving energy efficiency
- Developing low / no-carbon energy sources
- Implementing large-scale carbon capture and sequestration

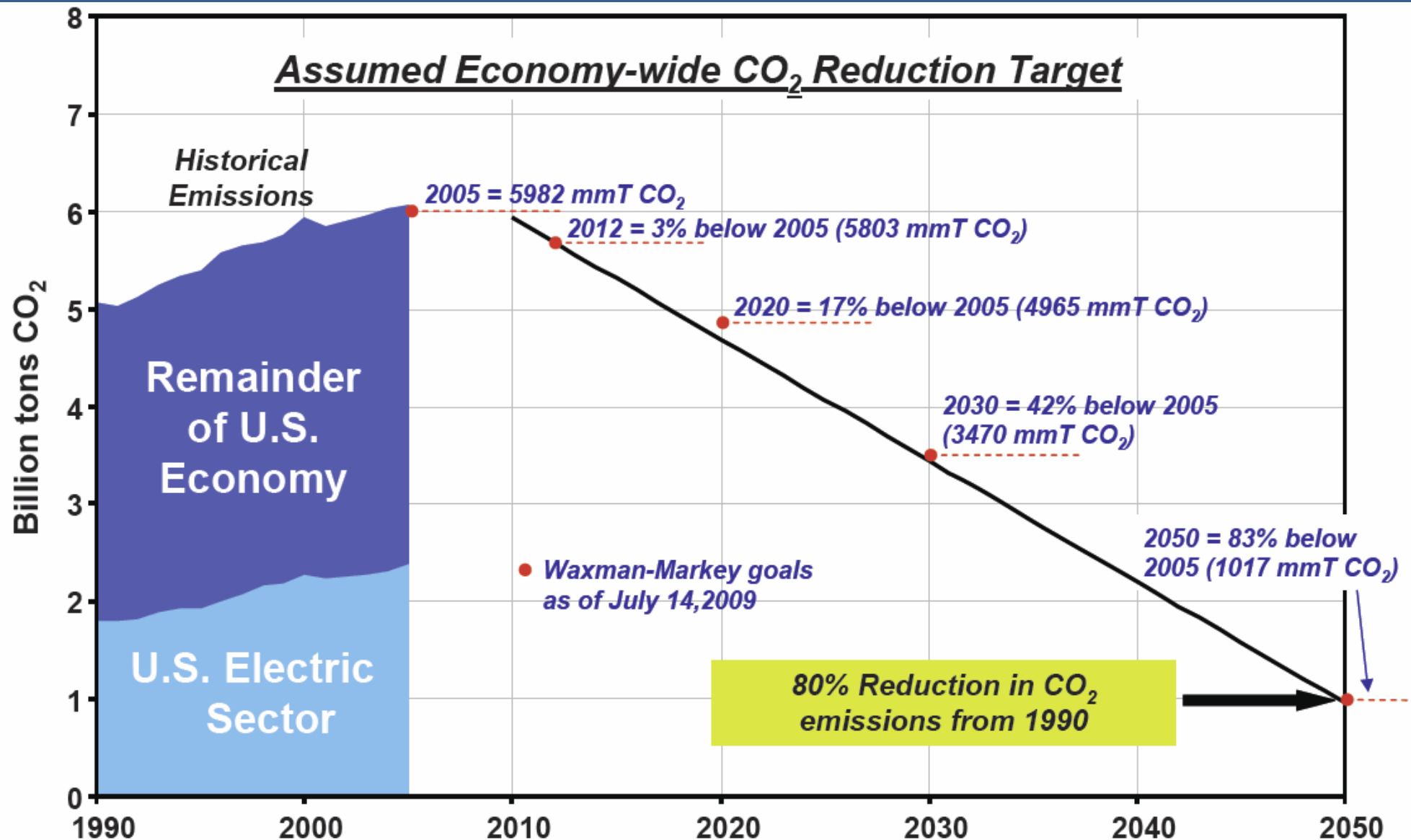
Defining the Technology Challenge



- *De-carbonize the electricity infrastructure*
- *Meet binding economy-wide CO₂ reduction targets*
- *Provide reliable, affordable, and environmentally responsible electricity to consumers*

Two Key Metrics: CO₂ Emissions and Cost of Electricity

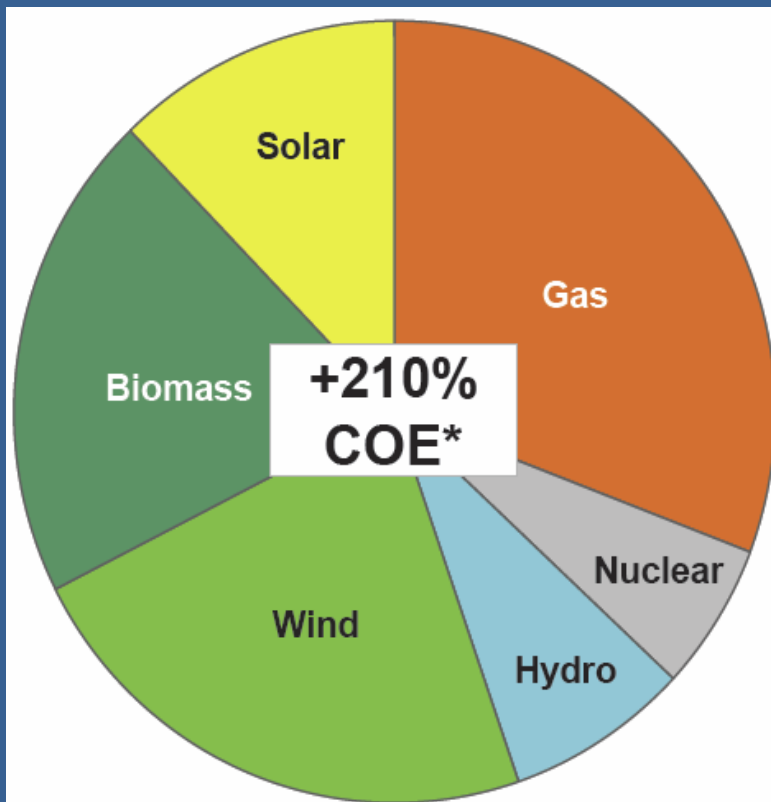
The CO₂ Challenge



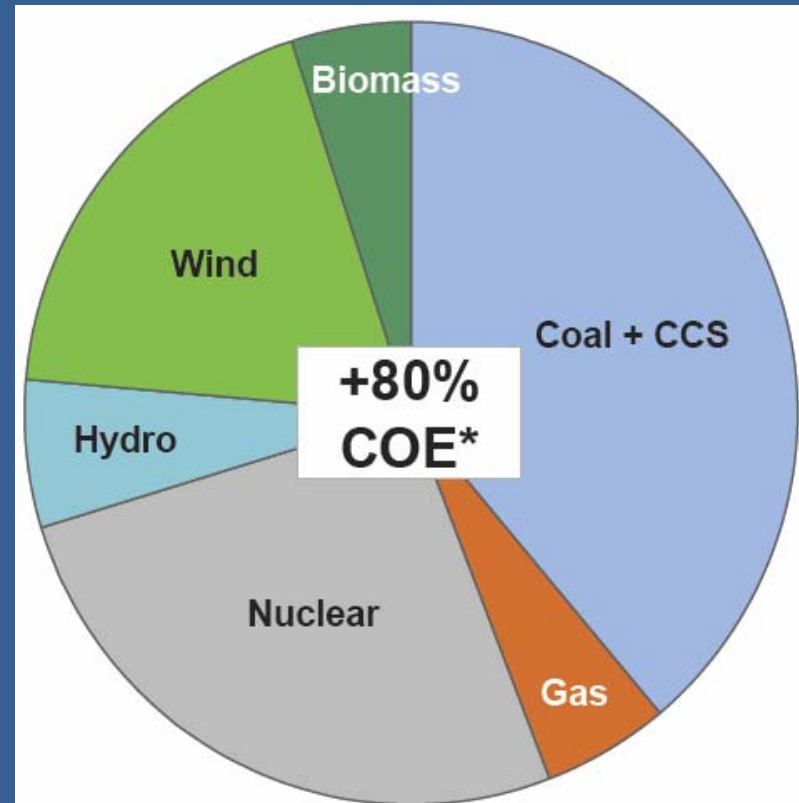
Generation Mix and Electricity Cost* in 2050



Totally different futures in 2050



Limited Portfolio



Full Portfolio

* Cost of electricity increase relative to 2007

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Actions to Address Carbon Constraints

As options are considered to reduce CO₂ emissions:

- Provide effective global framework for carbon management
- Establish transparent, predictable, economy-wide cost for CO₂ emissions
- Focus on Energy Efficiency
- Better Informed Public Debate

Notes to Accompany Slides

Slide 2. Projected Demand Increase

Reinforcing the role of the developing world in future energy demand, we show here the 2005 actual and 2030 projection from EIA for the developed and developing world energy by primary fuel.

Two key points from this chart –

- First, most of the demand increases from 2005 to 2030 is in the developing world.
- Second, the fossil fuels, coal, oil, and natural gas, are projected to continue to supply over 80% of world energy needs.

In spite of rapid annual percentage growth in renewables, they are starting from such a small base that they simply cannot displace significant amounts of fossil fuel in this time frame.

You can also note that oil use is nearly flat in the developed world, and that coal use increases dramatically in the developing world.

This coal increase will have substantial implications for greenhouse gas emissions and the degree of mitigation required.

This projection is not carbon-constrained.

Currently coal, oil, and gas provide 83 percent of OECD energy supply.

Oil supplies 41 percent, gas 22 percent, and coal 20 percent.

The EIA 2008 IEO Reference Case for 2030 projects these three fuels to provide 81 percent of OECD energy with oil at 38 percent, gas at 24 percent, and coal at 19 percent.

Nuclear's share of OECD energy supply is currently about 9.5% and is expected to remain about the same.

Renewable energy's share is expected to grow from 7.5 percent today to 10 percent in 2030.

In the non-OECD countries coal, oil, and gas currently provide 90 percent of energy supply.

Coal is largest at 34 percent followed by oil at 32 percent and gas at 24 percent.

The EIA 2008 IEO Reference Case for 2030 projects these three fuels to provide 90% - the same.

However, coal's share increases to 36% while oil's share declines to 30%.

Gas' share remains about the same at 24 percent.

Nuclear energy currently provides about 2% of non-OECD supply, growing to a projected 3 percent in 2030.

Non-OPEC renewables share of energy supply is projected to remain stable at about 7.5 percent of total.

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Slide 3. 60% of Emissions Growth in Developing World

Energy-demand growth is accelerating in the developing world and CO₂ emissions follow.

In addition, the energy mix in these geographies includes a higher concentration of fossil fuels.

The US and China together make up about 40% of the world's total CO₂ emissions going forward. This points to a global issue requiring global solutions.

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Slide 5. Carbon Mitigation

While addressing carbon concerns, we need to enable the continued use of fossil fuels.

A carbon-constrained world requires that we:

- Moderate demand by improving energy efficiency across the transportation, industrial, and commercial sectors.
- Accelerate development of low-carbon energy.
- And finally, implement large-scale carbon capture and sequestration at large point sources, something the oil and gas industry is well suited to implement.

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Slide 9. Actions to Address Carbon Constraints

Reducing CO₂ emissions is a long-term, global issue and must be dealt with as such. It is also an opportunity for US leadership.

A transparent, predictable, economy-wide cost (price) for CO₂ emissions will allow the market to find the most efficient means of addressing this complex challenge.

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Reference

EIA, 2008, International Energy Outlook 2008: U.S. Department of Energy,. DOE/EIA-0484(2008), 260 p.
([http://tonto.eia.doe.gov/FTPROOT/forecasting/0484\(2008\).pdf](http://tonto.eia.doe.gov/FTPROOT/forecasting/0484(2008).pdf)) (accessed December 2, 2009)