Getting Real on Climate Change

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The Problem

The world's economic and geophysical systems have enormous momentum, and only great force over a long time can change its direction significantly. Because it is perceived that climate change is very long term, the pressure to act is inadequate. Therefore, some climate change is going to continue to happen and worsen. And it is very urgent to take aggressive action to reduce human-induced climate change.

Economic Realities

- The world is getting richer
- More subsistence high impact societies

The world is growing richer

Growth in Total Global GDP: 1970-2006



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Source: IMF World Economic Outlook, 2007

The world is growing richer

Change in Global GDP *per capita*: 1970-2006



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Source: IMF World Economic Outlook, 2007

Geographic Realities

- Size matters
- History matters
- Density matters

Demographics

Which countries are growing/shrinking?

Population Size of Major World Areas (2000, 2050)



Note: Medium Scenario Projections Source: UN: Long-range World Population Projections

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Cultural Realities

 People want a higher standard of living, especially those at the bottom

 Movements to simplify have not taken hold

• Even gains are often taken as amenity

Not All Hybrids Are Created Equal

Toyota Prius

Lexus RX400H





60 mpg city* 51 mpg highway* 32 mpg city* 27 mpg highway*

Note: * EPA rating

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Transportation Realities

- MORE...MORE...MORE...MORE...
- More and bigger cars, more miles
- More transit
- More freight
- More flying

Converging Technology Markets

Today electricity and transport fuels live in very separate worlds, with little interconnection

Over time, these two markets may converge as transport comes to rely on electricity

- For charging vehicle batteries
- For producing hydrogen as a vehicle fuel

Best Transportation Case

 Movement toward an all electric ground transport environment to concentrate pollution control...batteries or some form of hydrogen

 Hydrocarbons for hard-to-replace applications like aviation fuel, even then perhaps better biofuels

Technology Realities

 All the supply technologies are needed, but efficiency has the highest near term leverage

All technologies have major issues

 All supply improvements will be slow to have major impacts

Technology Options

- 1. Efficiency
- 2. Hybrids
 - 3. Electrics
 - 4. Biofuels
 - 5. Hydrogen
 - 6. Clean coal
 - 7. Renewables
 - 8. Nuclear

Power play

Capital cost estimates for different plant types £ per KW, 2004



Source: The Economist

Vehicles

Electricity

Energy Realities: The real "surprise-free" scenario

 High-demand growth, even with major efficiency improvements

- Higher and volatile prices
- Alternatives to conventional hydrocarbons are slow to scale up
- More hydrocarbons, especially conventional coal

World Oil Price Scenarios

Three theories on oil supply



The Real "Surprise-Free" Scenario: Much More Coal



BAU Means Carbon Lock-In IEA New Coal Forecast



year

New Coal--BAU CCS Coal--BAU

New Coal Plant Emissions Equal All Historic Coal CO₂



Climate Realities

• Climate change is underway now...not an uncertain, distant prospect

- Increasing frequency extreme events
- High impact on vulnerable societies

Abrupt Climate Change



The Climate Will Be increasingly Variable and Extreme



The Climate Will Be increasingly Variable and Extreme



The Climate Will Be increasingly Variable and Extreme



Policy Realities

 Like the climate, policy is chaotic, inconsistent and variable

 Policy needs to be coherent, effective and global

Big Surprises

- 1. Carbon not an issue
 - Climate change not an issue...short-term cooling
 - Something else implicated
 - CO₂ is good for you?
- 2. Technology surprise...clean cheap energy
- 3. Nuclear revival

Where Are We Headed?

 No real consensus on reality and the need to act...no policy consensus

Increasing wealth across many industries

Slow implementation of new energy technologies

Continued growth in ghgs...carbon caps don't really cap

Increasing climate change

Where Should We Be Headed?

 Increasing wealth based on accelerating technological change toward clean technologies

 Perceived urgency of climate change and the need to act...strong policy consensus

 Broad and rapid implementation of many new energy technologies

Decoupling ghgs and economic growth

Slowing climate change

What Can We Do?

- Improve the science of climate change
- Improve the performance of the technology options
- Move toward all electric ground transport

 Regulate downward ghg emissions, create a global-carbon pricing system and rapidly raise the price of carbon

Create a global EPA