Translating Climate Change and Energy Constraints into Competitive Advantage

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CH2M HILL
Industrial Systems Business
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Today’s Presentation

• CH2M HILL--Who we are
• Global Market Drivers
  – Climate Change
  – National Security
  – Economics
• Supply Side Alternatives
  – Renewable energy
• Demand Side Alternatives
  – Energy Efficiency
• New Market Opportunities
  – The Rise of Cleantech
• Take away messages
CH2M HILL Today

- Headquartered in Englewood, Colorado
- Five-year revenue growth reached over $5 billion in 2007
- More than 24,000 employees operating in 77 Countries
- Diversified Business Base
Comprehensive Service Delivery

Global Consulting & Technology
- Climate Change Services
- Environmental Compliance and Auditing
- Water / Wastewater Treatment and Resource Management
- Alternative Energy Analysis and Development
- Facility Siting and Licensing / Master Planning
- Program Management
- Infrastructure Planning
- Transportation Management and Planning
- Security Planning and Management

Information Solutions
- EHS Information Management System Implementation
- Information Systems Development and Integration

Sustaining Services
- Facility Management
- Energy Audits
- EHS Information Management

Sustainable Design and Construction
- LEED certified Design and Construction
- Civil and Federal Infrastructure

Facility Management
- Energy Audits
- EHS Information Management

LEED certified Design and Construction
- Civil and Federal Infrastructure

Sustainable Design and Construction
- LEED certified Design and Construction
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We will partner with our clients to deliver project solutions or integrated programs that help them define corporate goals and achieve their desired climate change outcomes in the areas of – carbon, energy, and water management.
Global Market Drivers
Core Drivers

- Environmental Protection
  - Climate Change

- National Security
  - Oil supply vulnerability
  - Vulnerability of infrastructure to terrorism, natural disaster, or human error
  - Avoid funding of “our enemies”

- Market Economics
  - Prices of electricity, gasoline, natural gas
  - Price volatility: oil, natural gas, wholesale electricity
  - Management for energy efficiency can be very profitable
A Brief History of Energy Use

- 800,000 BCE? Fire domesticated.
- 2500 BCE Wind-driven sailing vessels
- Middle ages: wind mills used for grinding grain, pumping water.
- 1700s – steam engine, various versions
- 1864 – internal combustion engine
- 1879 – invention of light bulb
- 1892 – diesel engine
- 1880s (DC), 1896 (AC) – central electricity generation and early electric grids
- 1930 – jet engine
- 1950 – photovoltaic cells
- 1990s—Commercialization of hybrid drive train
Greenhouse Gas (GHG) Concentrations in Atmosphere since Pre-Industrial Revolution
Greenhouse Gases and Global Temperature

(a) the past 140 years

Departures in temperature (°C)
from the 1961–1990 average

1860 1880 1900 1920 1940 1960 1980 2000

Year

GLOBAL

Data from thermometers.

(b) the past 1000 years

Departures in temperature (°C)
from the 1961–1990 average

1000 1200 1400 1600 1800 2000

Year

NORTHERN HEMISPHERE

Data from thermometers (red) and from tree rings, corals, ice cores and historical records (blue).
Recent History of Oil Supply and Demand

1973: Arab oil embargo—prices more than quintupled between September 1973 and February 1974
Jan. 1979: Iranian revolution; Shah deposed

Iran-Iraq war begins

Aug 1990: Iraq invades Kuwait

Gulf War

Jan 1999-Sept 2000: prices triple due to production cuts, higher demand, and cold weather

9/11: oil prices fall

March 2003: Iraq War begins

2002: production cuts, strikes in Venezuela, Middle East tensions cause oil prices to rise

Source: Energy Information Administration
U.S. Energy Consumption Today

The bar chart shows the energy consumption in quadrillion Btu for various sources in the years 2005, 2006, and 2007. The most significant sources are Petroleum, Coal, Natural Gas, Nuclear Electric, Hydroelectric, Biomass, Geothermal, Wind, and Solar/PV.

- **Coal**: 23 (2005), 23 (2006), 23 (2007)
- **Biomass**: 3.6 (2005), 3.6 (2006), 3.6 (2007)
- **Geothermal**: 0.35 (2005), 0.35 (2006), 0.35 (2007)
- **Wind**: 0.32 (2005), 0.32 (2006), 0.32 (2007)
- **Solar/PV**: 0.08 (2005), 0.08 (2006), 0.08 (2007)
United States CO$_2$ Emissions by Sector and Fuels

Source: U.S. EPA Inventory of Greenhouse Gas Emissions, April 2002
Supply Side Alternatives
What Energy Resources Can We Use? Total Exergy Flow of Planet Earth (TW)

Human activities = ~15 TW, ~30 by 2050

The Opportunity: Renewable Global Exergy Flows

Exergy sources scaled to average consumption in 2004 (15 TW)
Total Land Area Required to Power 100% of US Onroad Vehicles

The Challenge: Current Cost of Electricity

Levelized Cost Comparison for Electric Power Generation
With $100 per Ton Tax on Carbon (2007 Fuel Prices)

Source: J. Weyant, Energy Modeling Forum, Stanford University
Market Solutions To Levelize Alternative Energy Supply Side Costs

• Leverage a **Power Purchase Agreement**. A PPA a customized contractual vehicle under which an organization can receive the benefits of solar energy with one or more of the following characteristics:
  – **Long-term hedge** against energy cost volatility
  – Immediate **electricity cost savings** opportunity
  – Shifts administration of **tax benefits** to third-party
  – **Cash preservation** for competing capital requirements

• Capture State and Federal Incentives.
  – California Solar Initiative (~30%)
  – Federal Investment Tax Credit (~30%)--Just renewed with Financial Bailout Bill
Demand Side Alternatives
Conversion Efficiency of ‘Engines’ Still Moderately Low

Source: C. Edwards, GCEP
Inefficient Energy Saving

Energy Efficiency Improvement

Waste

Economically Efficient Energy Intensification

Decreased Energy Use

Increased Economic Efficiency
Putting It All Together: The Total Cost of Optimizing Carbon and Energy

U.S. mid-range abatement cost curve – 2030

Source: McKinsey analysis

4.2 gigatons/yr
Negative or No Life-Cycle Costs
New Market Opportunities—The Rise of Clean, Green Technology
Clean Technology

“Cleantech is any knowledge-based product or service that improves operational performance, productivity or efficiency; while reducing costs, inputs, energy consumption, waste or pollution.”

Cleantech Group, 2005
Number of media articles mentioning Cleantech & Clean tech, Greentech & Green tech
1990-2007 (Factiva Search)
Source: Anastasia O'Rourke, Yale University, 2007.
North American and European Venture Capital investments in cleantech

Total yearly amount invested ($US M) and Number of deals

Source: Cleantech Group & SVB Alliant, 2007
Amount of VC invested per Cleantech Segment, North America and Europe 2003-2006

Source: Cleantech Venture Network

- Energy Generation: $2,976M
- Energy Efficiency: $782M
- Air & Environment: $637M
- Agriculture: $404M
- Transportation: $285M
- Water & Wastewater: $406M
- Materials: $849M
- Manufacturing/Industrial: $456M
- Energy Storage: $1,308M
- Recycling & Waste: $568M
- Energy Infrastructure: $510M

Clean Energy is 58% of cleantech VC
Conclusions
Take Away Messages

• Growth in global energy demand coupled with awareness of Climate Change, will require that innovative energy technologies be brought on line if GHG emissions are to be reduced at the same time.
  – Clean technology development and technology transfer will lead to significant market opportunities

• Opportunities for energy efficiency improvement exist at every turn – there is plenty of room for cost-effective efficiency improvement with technologies we have today, especially in the US (lots of near-term opportunities in buildings, lighting, vehicles, etc).

• The challenges go well beyond technical issues! We need behavioral changes, better economic policies to level the playing field for energy, and plenty of local, national and international effort.

• Above all, we need to stimulate new ideas and talented people to put them to work.
Thank You!

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