Climate Change -
Threat or Opportunity?
September 2008
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Climate change - threat or opportunity?

**Atmospheric CO₂ at Mauna Loa Observatory**

- 1974-2008 NOAA/ESRL

**Global Population**

- Source: [http://www.esrl.noaa.gov/gmd/ccgg/trends/co2_data_mlo.html](http://www.esrl.noaa.gov/gmd/ccgg/trends/co2_data_mlo.html)
- Blue: Scripps Institute data; Red: NOAA data

- Source: [http://www.unfpa.org/6billion/pages/worldpopgrowth.htm](http://www.unfpa.org/6billion/pages/worldpopgrowth.htm)
The implications are dire - for us and the planet alike

- Water shortage, especially mid/low latitudes
  - 3.5bn people in water stressed areas by 2025
- Cereal production shifts from low to high latitudes
- Health
  - Mortality from heat, drought, floods, malnutrition
  - Changing distribution of some infectious diseases
- Up to 30% of species facing extinction
  - Ocean acidification - coral bleaching, widespread disruption to oceanic food chains
  - Land species
- Coastal sea level rise
  - Up to 30% loss of coastal wetlands globally
  - Low lying areas at risk from storm events

Your sector’s GHG emissions?
Water usage is as unsustainable as GHG emissions

“We estimate that the combined direct consumption of five food and beverage giants, Nestle, Unilever, Coca-Cola Co, Anheuser-Busch and Danone approached 575 billion liters per year, enough to service the daily water needs of everyone on the planet”

Raw material availability is also becoming an issue

- We may or may not have reached “peak oil”
- We only have 50 years’ supply of copper, lead, mercury, nickel, gallium, tin and zinc.
  - All copper in ore, plus all copper currently in use, would be required to bring the world to the level of the developed nations for power transmission and construction.
- Platinum is difficult to recover from catalytic converters and only located in specific areas.
- Aluminum ore is expected to be depleted in about 250 years

UN 4th Global Environmental Outlook. IHT Oct 25, 2007
Markets are starting to respond…

Visible today

- **Meaningful investments in green production**
  - Walmart, PG&E, BP, Chevron

- **Higher investment hurdles for “brown”**
  - KKR/Texas Pacific and TXU
  - “Carbon Principles”

- **Commodity prices**
  - Oil, foods, fertilizer, copper and others

- **Pricing reputational or operational risk**
  - CDP, Innovest
  - JP Morgan on water

- **Widespread carbon cap and trade (or tax)?**
  - The threat in the US is already affecting energy decisions
  - Impact on JIT, or outsourcing to China?

To come?

- **Revenue protection/ opportunities**
  - Toyota, GE, IBM, Coca-Cola
  - Brand valuations

- **Water pricing**
  - Regional water cap and trades?
  - (Already in ANZ, Chile and Western USA)

Next ???????
The investment industry is forming its own views about where carbon risk lies

This is Merrill Lynch’s European “carbon laggards” list

“The Carbon Leaders - Quality Win-Win Stocks”: Merrill Lynch, 08/31/07
The market’s view of water risks

<table>
<thead>
<tr>
<th>Risk</th>
<th>Supply Chain</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical</strong></td>
<td>Disruption from non availability</td>
<td>Temporary suspension of supply - disruption to operations</td>
</tr>
<tr>
<td></td>
<td>Scarcity drives up prices</td>
<td>Increased capital spend on treatment, extraction</td>
</tr>
<tr>
<td></td>
<td>Competition for scarce resources limits growth</td>
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</tr>
<tr>
<td><strong>Regulation</strong></td>
<td>Suspension of supplier’s license or discharge permit disrupts supply</td>
<td>Reallocation to more urgent needs during drought disrupts operations</td>
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<tr>
<td></td>
<td></td>
<td>Suspension of license or discharge permit disrupts manufacturing</td>
</tr>
<tr>
<td><strong>Reputation</strong></td>
<td>Competition with household demand limits growth</td>
<td>Increase capital spend on wastewater treatment</td>
</tr>
<tr>
<td></td>
<td>Brand damage by association with suppliers’ pollution or water use</td>
<td>Competition with household demand damages reputation and limits growth</td>
</tr>
</tbody>
</table>

(Source: synthesized from World Resources Institute, quoted in JP Morgan, “Watching Water”, April 1st 2008)
So the need for innovation is clear…

- Increasing regulatory requirements - many enforced globally
- Drives a new focus on compliance

- Rising energy, raw material, waste disposal costs
- GHG emissions, water increasingly being priced
- Environment costs becoming strategic
- Drives a new focus on efficiency and effectiveness

- Customers becoming environmentally aware
- May be willing to pay?
- Most want “painless green”?
- Drives a new focus on product and service strategy

Significant need to innovate in all areas of product design, sourcing, manufacturing, supply chain and execution
We face a profound inflection point - but therein lies the opportunity for innovation…

- New levels of process understanding
  → New incentives for resource efficiency?
- New consumer dynamics
  → New product, service, branding opportunities?
- New design and manufacturing processes
  → New supplier capabilities, collaborations?
- New software and systems categories?
  → Metering and sensing
  → New information aggregation opportunities?
- New business models
  → Reinvention of energy, water, automotive….?
- Next phase of the Industrial Revolution??
Case study - IBM’s Big Green Innovations
Big Green Innovations is the latest step in a journey that IBM began 35 years ago

- 1971 - First corporate policy on the environment
- 1976 - Think! (IBM magazine) devoted whole issue to IBM conservation programs
- 1987-2006 - 95% reduction in hazardous waste
- 1989 - First take-back program
- 1990-2006 - saved 18.8 billion kwh of energy (= 9.7 million tonnes CO2), valued at $291m
- 1992 - Founder member of EnergyStar
- 1996 - Cited by Al Gore for our PFC reductions
- 1997 - First major corporation to gain global ISO 14001 certification
- 2006 - 96% of each computer we recycle is reused
- 2007 - 100,000 IBMers are mobile or work from home, saving $90m per year in real estate costs
Big Green Innovations’ portfolio has four core areas

- Advanced Water Management
- Alternative Energy
- Carbon Management
- Computational Modeling
Innovation from a known base - we are building the portfolio from an existing core

- Organization capability
- Energy management
- Carbon measurement and optimization
- Business process improvement
- Integration of alternative energy sources
- Advanced meter infrastructures
- Photovoltaic technologies
- Our track record
- Systems integration
- Intelligent Utility Network
- “Maximo”
- “Deep Thunder”
- Modeling and optimization
- Supply chain consulting
- Semiconductor mfg
- Large-scale sensor networks
- Data analysis and visualization
- Water optimization
- Traffic pricing
- Hydrology
- Energy sourcing
- Supply chain
- Pandemics
- Climate and weather
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“One barrier to better management of water resources is simply **lack of data** — where the water is, where it's going, how much is being used and for what purposes, how much might be saved by doing things differently. In this way, **the water problem is largely an information problem.** The information we can assemble has a huge bearing on how we cope with a world at peak water.”

Applying information management to water

**Natural scale**
- Land use management
- Extraction monitoring (surface/subsurface)
- Water quality management
- Pumping and energy management
- Flood control

**Municipal scale**
- Asset management
- Water quality & usage
- Leak and corrosion management
- Energy management
- “Smart levees” and monitoring systems
- Weather event assimilation
- Flood control

**Enterprise Scale**
- Water usage tracking
- Water quality control (into and within plants, discharges)
- Supply chain optimization
- Energy management
- Business process improvements
- Metrics, management
Opportunity - bringing carbon management into the operational mainstream

Our internal experience

Carbon model

Big Green Datacenters

Energy management

Support for carbon trading

Sensor networking, application integration

Carbon management dashboard

Carbon diagnostic
Rounding out the opportunity

Strategy

Customer and Product

Supply Chain

People

IT

Property

Information
The Long View
The ultimate opportunity - “instrumenting the planet”, and creating information utilities

- Much of Big Green Innovations is based on enhanced understanding of planetary & human systems, and their interactions.

- Sensing and metering will be in ever greater detail and ever closer to real time/ continuous.

- Modeling & optimization will be “whole business, real-world, operational”, no longer “function-based, off-line, advisory”

- Green “Information utilities” will emerge that make use of the data that will be available.

New technology capabilities

- Ubiquitous Sensing
- Advanced Metering
- Application integration

More “granular” data (multiple spatial and temporal scales)

New technology capabilities

Analytics, optimization, visualization = **Insight**

Environmentally aware decisions

“Information Utility” businesses

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Today’s “information utilities”

- “Information Utilities” per se are not new.
- They are businesses based on the aggregating data from multiple sources, that move well beyond the originating transactions. Examples:
  - Google (DoubleClick), Yahoo
  - Bloomberg, Reuters, Lexis-Nexis
  - Experian, Equifax, First Data Corp.
  - AC Nielsen
  - Amazon
  - 3rd party component catalogs and sourcing guides, contract design
  - Ariba
  - Navteq
- We believe that they will emerge in the green arena, too
Towards Carbon Management “Information Utilities”

Operational/ Transactional

- Some companies monitor & reduce GHG emissions.
- They optimize within their own boundaries, often “exporting” GHGs to suppliers or customers.
- They may focus on less productive areas, not realizing where the true “hotspots” are.

Business Optimization

- Monitor GHG emissions within whole supply chains by linking ERP, MES systems, supported by some sensing.
- Insight grows into GHG emissions drivers
- Insight grows into trade-offs between GHGs and other business variables

Information Utilities

- Design, sourcing
- Pan-supply chain GHG optimization
- Carbon trading
- Emergence of supply chain “carbon clearing house” role, played either by channel-master or 3rd party - for share of carbon trading profits.

2008-9

2009-11?

2010-13?
Towards Water Management “Information Utilities”

Operational/Transactional
- Most utilities still use manual readings of water/discharge quality and quantity.
- First experiments with differential pricing.
- Little or no data integration.
- Some sensing to manage water on a natural scale (rivers, bays).

Business Optimization
- Growing use of sensing & meters enables monitoring in greater detail.
- Data on usage drives differential pricing.
- Utilities & enterprises share natural water resources link data.
- Use of models and automation to actuate infrastructure actions.

Information Utilities
- Regional water trading requires integrated picture of consumption.
- 3rd party aggregators integrate data for entire natural systems - quantity and quality alerts, impact on land use decisions etc.
- Paid for by valuation of ecosystem services.

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<thead>
<tr>
<th>Time Period</th>
<th>Operational/Transactional</th>
<th>Business Optimization</th>
<th>Information Utilities</th>
</tr>
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<tbody>
<tr>
<td>2008-10</td>
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<td></td>
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<tr>
<td>2010-13?</td>
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<tr>
<td>2011-15?</td>
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Thank you!

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