Sustainability Planning and Climate Change Considerations

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Historical Climate

- CO₂ concentration, ppm
- Antarctic temperature, °C

Graph showing historical data of CO₂ concentration and Antarctic temperature over years before present.
The Holocene

- We are taking a different path than previous 7 interglacial periods.
- For all GHG gasses.
- CO2 & CH4 dominate.

Source: Ruddiman et al. 2011
Human Influence

- Human influence on the climate system is clear. This is evident from the increasing greenhouse gas concentrations in the atmosphere, the resultant positive radiative forcing, observed warming, and our understanding of the climate system.
Greenhouse Gas Sources

- GHGs comes from many processes.
- The building sector seems small, until you look at the electricity.

Source: IPCC 4th Assessment Report, Fig 2-1
Climate Change

Sustainability

Unequal Access to Resources

Disaster Risk Management

Linking Adaptation & Development

Economic Dimension

Global and Aggregate Impacts of Climate Change

Mitigation/Adaptation

Sustainably Manage Natural Resources

Social Dimension

Implications for Environmental Quality

Ecological Dimension

Enhancing Adaptive Capacity

Poverty

Inadequate Human & Institutional Capacity

Hazards/Extreme Events

IPCC AR4, WG2, Chap 20, 2007

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Climate Change

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Hazards/Extreme Events
Climate Action – Planning and Policies

- Climate Action Planning must address:
  - Mitigation
  - Adaptation
- Two sides of the same coin.
- Mitigation benefits all.
- Adaptation is regional/local.
Mitigation

- Mitigation focuses on describing, analyzing, and assessing strategies for reducing the net future human influence on climate.
- Mitigation includes actions to reduce domestic greenhouse gas emissions and the negative aspects of other human drivers of climate change, such as changes in land use and agricultural techniques.
- Also includes enhancing sinks.
Mitigation Opportunities

The chain of factors that determine how much CO2 accumulates in the atmosphere. The blue boxes represent factors that can potentially be influenced to affect the outcomes in the purple circles.
Current Situation in the U.S.

- Most GHG emissions remain largely unregulated and continue to be discharged without penalty.
- New EPA proposed Clean Power Plan.
- With no price on carbon, or regulatory pressure yet, there exist few incentives to mitigate emissions.
- We continue to “lock in” incumbent technologies and systems that are typically carbon-intensive.
EPA Clean Power Plan 6/2/14

- Sets nation-wide goal of 30% reduction from 2005 baseline (lbs CO2 / MWh).
- National framework for states:
  - Individual state goals.
  - States have flexibility in how to apply based on their power systems and policies.
  - States may establish hard tonnage goal rather than rate based goal.
- Illinois goal is a 33% cut from 1,895 lbs/MWh to 1,271 lbs/MWh.
Steps of the Mitigation Plan Process

- Collaborate with stakeholders.
- Develop and understand GHG emissions profile.
- Set goals for action.
- Identify, analyze and select options.
- Design program, implementation, and funding strategy.
- Implement program.
- Measure, track, and evaluate progress.
### Overview of Scopes and Emissions

<table>
<thead>
<tr>
<th>Scope 1</th>
<th>Scope 2</th>
<th>Scope 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIRECT</td>
<td>INDIRECT</td>
<td>INDIRECT</td>
</tr>
</tbody>
</table>

#### Purchased Electricity for Own Use
- Scope 2: Indirect
- Scope 1: Direct
- Scope 3: Indirect

#### Owned Vehicles
- Scope 1: Direct

#### Commuting
- Scope 3: Indirect

#### Business Travel
- Scope 3: Indirect

#### Contracted Waste Disposal
- Scope 3: Indirect

#### Fuel Combustion

<table>
<thead>
<tr>
<th>Gas</th>
<th>Code</th>
<th>Scope 1</th>
<th>Scope 2</th>
<th>Scope 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td></td>
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</tr>
<tr>
<td>SF6</td>
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<td></td>
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</tr>
<tr>
<td>CH4</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>N2O</td>
<td></td>
<td></td>
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<tr>
<td>HFCs</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>PFCs</td>
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</tr>
</tbody>
</table>

- PURCHASED ELECTRICITY FOR OWN USE
- OWNED VEHICLES
- COMMUTING
- BUSINESS TRAVEL
- CONTRACTED WASTE DISPOSAL
Evaluating Sources

• You can’t manage what you can’t measure.

• Categories of emissions:
  ▫ Scope 1 – All direct emission sources (stationary combustion, including boilers, furnaces, emergency generators, mobile combustion from transportation vehicles, chemical production from owned or controlled process equipment, and fugitive emissions, including leaks or unintended releases.
  ▫ Scope 2 – Indirect emissions from purchased electricity.
  ▫ Scope 3 – Other indirect sources such as travel, contracts, waste disposal.
Many GHG Protocols out There

- ICLEI – Local Governments for Sustainability GHG Emissions Accounting and Reporting Protocols for Communities and for Local Governments
- World Resources Institute – US Public Sector and Corporate Protocols
- USEPA Emissions and Generation Resource Integrated Database (e-GRID).
Take Home Messages

• In order to avoid a doubling of atmospheric CO$_2$, we need to **rapidly** deploy low-carbon energy technologies and/or enhance natural sinks.

• We already have an adequate portfolio of technologies to make large cuts in emissions.

• No one technology can do the whole job – a variety of strategies will need to be used to stay on a path that avoids a CO$_2$ doubling.

• Every action has associated impacts and costs, but many are self compensating and make a profit.
Actions Available

• Realize practical near-term emission reductions:
  ▫ Increase energy efficiency.
  ▫ Increase usage of low GHG electrical production.
    • Accelerate use of renewable energy sources.
    • Increase use of nuclear power.
    • Accelerate usage of CCS power plants.
  ▫ Advance low GHG transportation options.
• Accelerate the retirement, retrofitting, or replacement of emissions-intensive infrastructure.
• Enhance adoption of new technologies.
McKinsey & Company 2010

Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €80 per tCO₂e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.

Source: Global GHG Abatement Cost Curve v2.1
Innovation Required

• Changing these practices requires scientific and engineering genius to create new energy systems that avoid emitting all but a small fraction of today’s GHGs while simultaneously powering global economic growth.

• Success will require institutional, economic, social, and policy innovations to foster the widespread and rapid deployment of transformational technologies.
Adaptation

- Adaptation focuses on methods to reduce the impacts of Climate Change.
- Adaptation includes methods to describe, analyze, and assess actions and strategies to reduce vulnerability, increase adaptive capacity, improve resiliency, and promote successful adaptation to climate change in different regions, sectors, systems, and populations.
Adaptation Planning

- Adaptation depends on an understanding of projected climatic changes at geographic and temporal scales appropriate for the needed response.
- Projected changes include average and extreme temperature; average and extreme precipitation; the intensity, frequency, duration, and/or location of extreme weather events; sea level rise; and atmospheric carbon dioxide (CO2) concentrations.
- Impacts will be highly local and diverse.
What is Ahead for Illinois

- In the next few decades, longer growing seasons and rising carbon dioxide levels will increase yields of some crops, though those benefits will be progressively offset by extreme weather events.
- Increased heat wave intensity and frequency, increased humidity, degraded air quality, and reduced water quality.
- Extreme rainfall events and flooding have increased and will get worse.
Climate Adaptation Planning

1. Identify current and future climate hazards
2. Conduct inventory of infrastructure and assets and begin to identify vulnerabilities
3. Characterize risk
4. Develop initial list of strategies
5. Identify opportunities for coordination
6. Prioritize strategies
7. Prepare and implement Resilience Plans
8. Monitor and reassess

Source: NPCC, 2010
Characterize Risk

Source: City of New York (NPCC 2010)

The diagram illustrates the characterization of risk based on the likelihood of impact on infrastructure and the magnitude of consequence of impact on infrastructure. The strategies for each quadrant are as follows:
- **Develop Strategies**: High likelihood and high magnitude.
- **Evaluate Further/Develop Strategies**: High likelihood and medium to low magnitude.
- **Watch**: Low likelihood and low to medium magnitude.

Likelihood of impact on infrastructure occurring during asset’s useful life.
Setting Priorities

Funding Needed to implement adaptation strategy

Source: City of New York (NPCC 2010)
Limits to Adaptation

• There are physical, institution, and economical limits to adaptation:
  ▫ Institutional practice (custom, regulatory, legal) further constrains adaptations.
  ▫ Financing and time horizons can conflict.
  ▫ Some options have maladaptive or unanticipated effects.

• Adaptation plans should address these limitations.
The Inconvenient Truth

- Neither adaptation nor mitigation alone can avoid all climate change impacts.
- They can complement one another and can significantly reduce the risks of climate change.
- Both must be addressed, mitigation alone isn’t the end-game.
### Synergies Abound

#### Energy

<table>
<thead>
<tr>
<th>Mitigation</th>
<th>Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce emissions by expanding use of renewable sources</td>
<td>Reduce vulnerability to widespread power grid outages by encouraging distributed generation from multiple renewable sources (solar, wind, biogas, landfill methane, etc.)</td>
</tr>
<tr>
<td>Reduce emissions by improving efficiency of energy and water delivery systems</td>
<td>Reduce potential for grid overload and failure by decreasing demand.</td>
</tr>
</tbody>
</table>

#### Food Production and Distribution

<table>
<thead>
<tr>
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<th>Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce emissions by encouraging local food production through local agriculture, community gardening, etc. to decrease the number of miles food must be transported</td>
<td>Reduce reliance on centralized food system where commodity production is concentrated in a few locations that may be vulnerable to climate disruptions such as storm damage, pest outbreaks, etc.</td>
</tr>
</tbody>
</table>
# Synergies (Cont)

## Green Building Strategies

<table>
<thead>
<tr>
<th>Mitigation</th>
<th>Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce emissions by curbing energy use through greater efficiency</td>
<td>Lower energy use will create less demand on the grid during extreme events such as heat waves, decreasing the likelihood of blackouts</td>
</tr>
<tr>
<td>Adopt or encourage LEED building standards for commercial, residential,</td>
<td>Building standards could include greater resistance to high winds, flooding, etc.</td>
</tr>
<tr>
<td>retrofit and municipal projects</td>
<td></td>
</tr>
<tr>
<td>Implement a weatherization program</td>
<td>Better insulated buildings that rely on day lighting and natural ventilation will be more functional and comfortable during power disruptions, reducing the potential for heat- or cold-related illness and death during power supply disruptions</td>
</tr>
</tbody>
</table>

## Water

<table>
<thead>
<tr>
<th>Mitigation</th>
<th>Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce emissions by reducing water use (less energy required for treating and transporting water)</td>
<td>Conserve water so more is available during more frequent and severe droughts</td>
</tr>
</tbody>
</table>
## Smart Growth and Transportation Strategies

<table>
<thead>
<tr>
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<th>Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce emissions by decreasing vehicle miles traveled through compact development</td>
<td>Improve delivery of disaster assistance and reduce costs of rebuilding</td>
</tr>
<tr>
<td>Promote high-density and in-fill development through zoning policies</td>
<td>Reduces area that emergency personnel must cover, making delivery of disaster assistance more efficient</td>
</tr>
<tr>
<td>Institute growth boundaries, ordinances or programs to limit suburban sprawl</td>
<td>Makes evacuation easier and more efficient</td>
</tr>
<tr>
<td>Give incentives and bonuses for development in existing downtown areas and areas near public transit</td>
<td>Reduces number of miles and costs of repairing or replacing infrastructure (i.e. roads, bridges, electrical and sewer lines) when climate-related disaster strikes; also reduces fragmentation of ecosystems, allowing them to function more effectively.</td>
</tr>
<tr>
<td>Discourage sprawl through impact, facility, mitigation, and permit fees</td>
<td></td>
</tr>
</tbody>
</table>
Philadelphia’s Plans

Source: Alex Drews, 4/17/13
Mitigation and Adaptation Flexibility

A risk management issue → Flexible Adaptation Pathways as the response

- Acceptable risk
- Status quo
- Setting inflexible adaptation standard with mitigation
- Flexible Adaptation Pathway without mitigation
- Flexible Adaptation Pathway with mitigation

Source: NPCC 2010
What are the benefits of climate action planning?

• Generates stakeholder interest in and support of climate, sustainability, energy actions.
• Identifies actions that can help save money and protect people’s health and environmental quality.
• Lays out a well thought out consensus of actions for the community.
• Supplies program ideas to local and regional NGOs and other stakeholders.
• Provides methods that can be used to secure funding opportunities.
Cities are emerging as first responders to climate change

Mitigation: Planned cuts in greenhouse gas emissions (percent below baseline year) for cities around the globe
Municipal Policies and Actions

- Mayors Climate Protection Agreement.
- Electricity Procurement and Aggregation.
- Sustainability and Climate Action incorporated into Comprehensive Plans.
- Transit Initiatives.
- Mandating Green Building.
- Adopting new building and infrastructure Codes.
- Development Incentives and Requirements.
- Renewable Energy Siting Ordinances (Solar Access, etc.) and simplified permitting.
- Requirements for Renewables, Green Landscaping or other design elements for new construction.
Take Home Messages

• Both Mitigation and Adaption are key to long term sustainability.
• Sustainability plans must incorporate climate action.
• We need to assess our local current and future impacts and respond accordingly.
Conclusion

- The United States is already experiencing impacts of climate change that require adaptation.
- Climate change impacts are certain to increase throughout this century, requiring significant effort to adapt in order to avoid socially, economically, and environmentally disruptive changes in systems with high value to society.
- We need to address current and projected changes in mean weather variables as well as increases in the frequency and intensity of many extreme events.
Climate Change

Sustainability

Economic Dimension

Social Dimension

Ecological Dimension

Mitigation/Adaptation

IPCC AR4, WG2, Chap 20, 2007

Sustainability
What if it's a big hoax and we create a better world for nothing?

- Energy independence
- Preserve rainforests
- Sustainability
- Green jobs
- Livable cities
- Renewables
- Clean water, air
- Healthy children
- Etc., etc.
Resources

• General:
  www.epa.gov/statelocalclimate/resources/strategy-guides.html

• Greenhouse Gas Savings:
  ▫ Waste Reduction Model (WARM),
    http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_home.html
  ▫ ICLEI Tools,
    http://www.icleiusa.org/climate_and_energy/climate.mitigation_guidance
  ▫ California Air Pollution Control Officers Association Resources,
• Environmental Benefits:
  ▫ Motor Vehicle Emission Simulator 2010 (MOVES 2010),
    http://www.epa.gov/otaq/models/moves/index.htm
  ▫ Emissions & Generation Resource Integrated Database (eGRID),
    http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html

• Public Health Benefits:
  ▫ Co-benefits Risk Assessment (COBRA) Screening Model,
    http://www.epa.gov/slclimat/resources/cobra.html

• Economic Benefits:
  ▫ Assessing Multiple Benefits of Clean Energy,
    http://www.epa.gov/statelocalclimate/resources/benefits.html
• Energy Benefits:

• Societal Benefits:

*Resources marked with “*” are not EPA resources therefore may be available for a fee.