Confronting Climate Change:

An Early Analysis of Water and Wastewater Adaptation Costs

2010 Winter Conference
Transcending Tradition…
The Expanding Roles & Relationships
of the Clean Water Utility

CH2MHILL

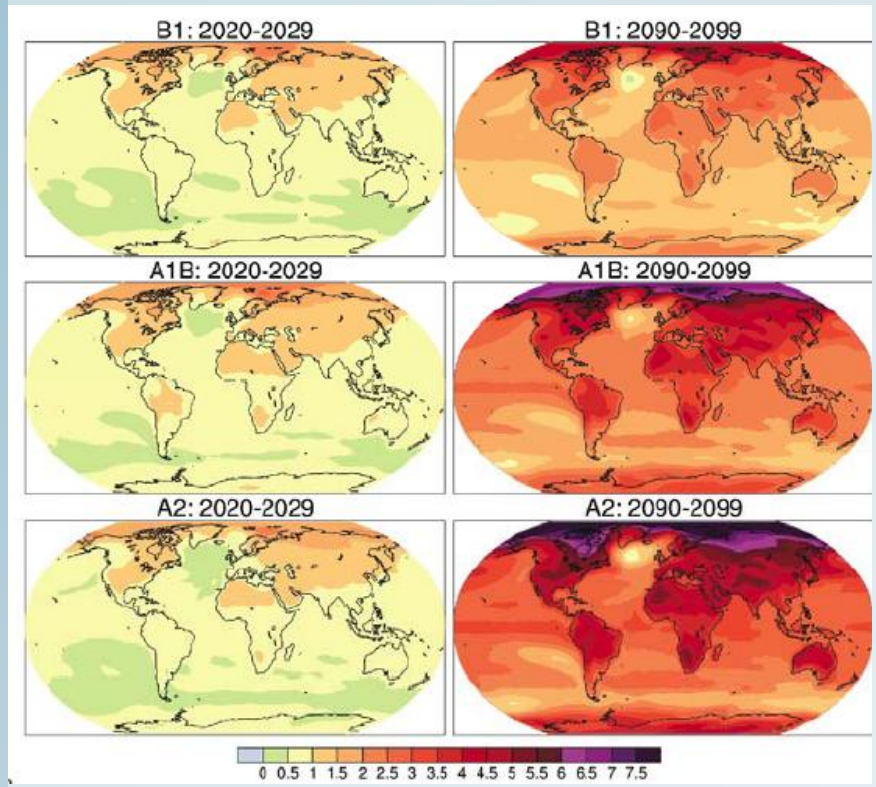
Genesis of the analysis

- Recognition by NACWA and AMWA of climate change challenges to sustainable wastewater and drinking water services
- Need for an early analysis of impacts and an estimate of potential adaptation costs through 2050
- Support for NACWA/California Association of Sanitation Agencies (CASA) testimony to Congress on ***"The Clean Energy Jobs and American Power Act"*** (October 28, 2009)
- Support to help utilities understand climate change challenges and offer a basis for adaptation planning

Acknowledging our partners

- Member Utilities
  - Metropolitan Water District of Southern California
  - Miami-Dade Water and Sewer Department
  - Metropolitan Water Reclamation District of Greater Chicago
  - New York City Department of Environmental Protection
  - Southern Nevada Water Authority
- Utility Reviewers
  - Ed Torres, Orange County Sanitation District
  - Tony Quintanilla, MWRD of Greater Chicago
  - Greg Adams and Sharon Green, Sanitation Districts of Los Angeles County
- The CH2M HILL Team
  - Water community technical experts

Climate change effects are here and are projected to grow



Projected Temperature Changes (IPCC 2007)

General climate change effects:

- Changes in temperature
- Changes in precipitation
- Increasing overall uncertainty

Results:

- Hydrograph changes
- Drought
- Flood
- Water quality changes
- Fire
- Increased energy costs
- Increased ER&R costs
- Ecosystem degradation

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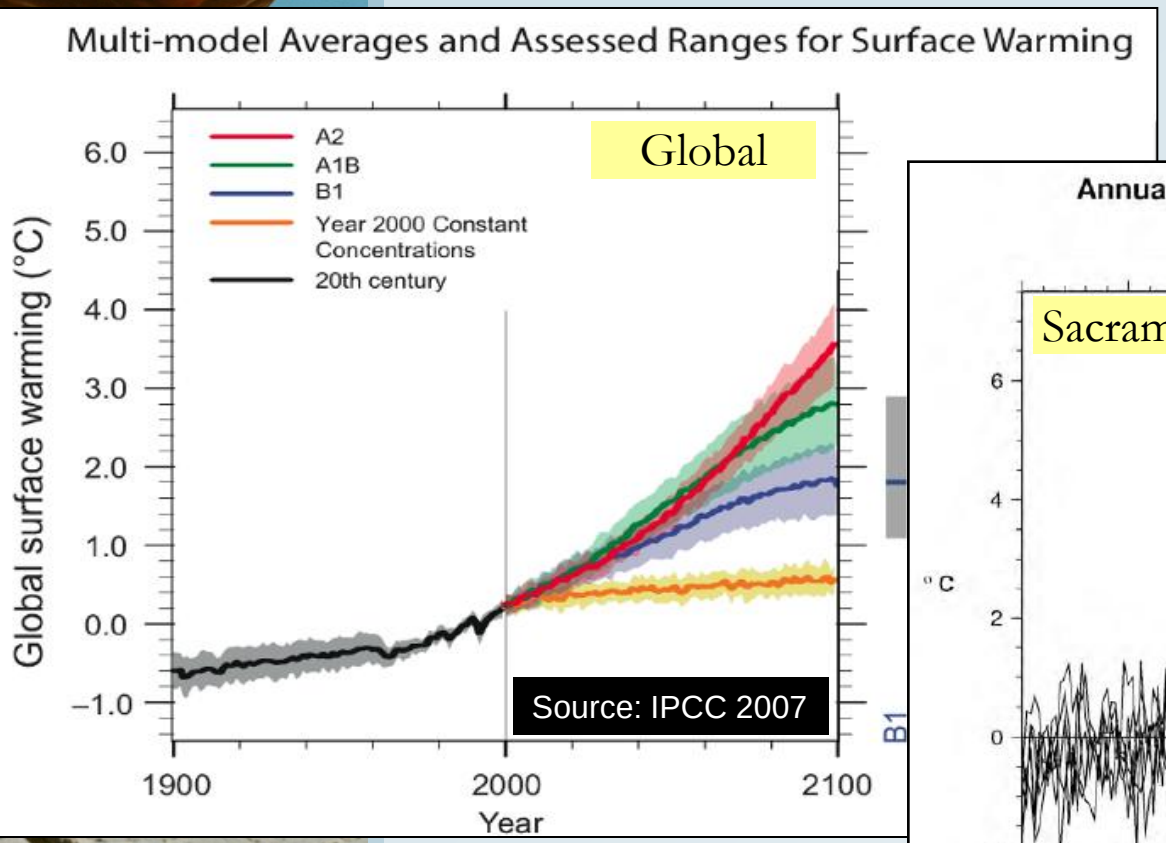
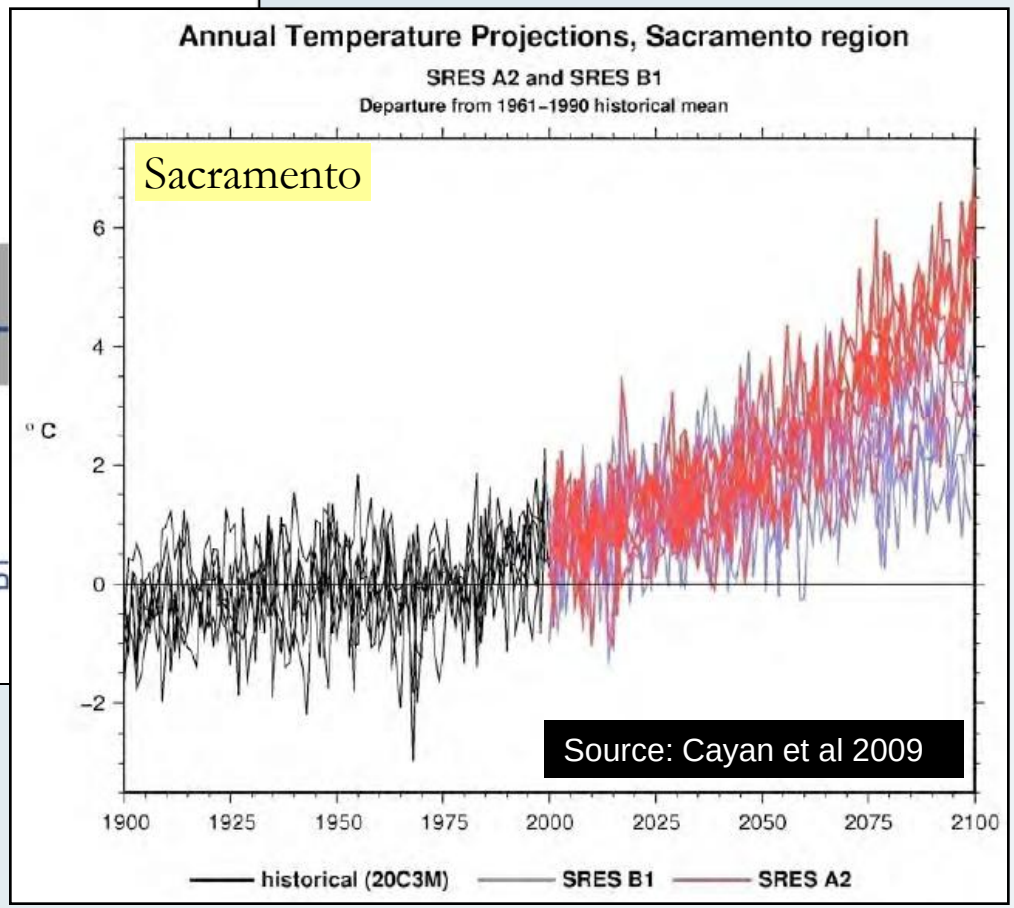
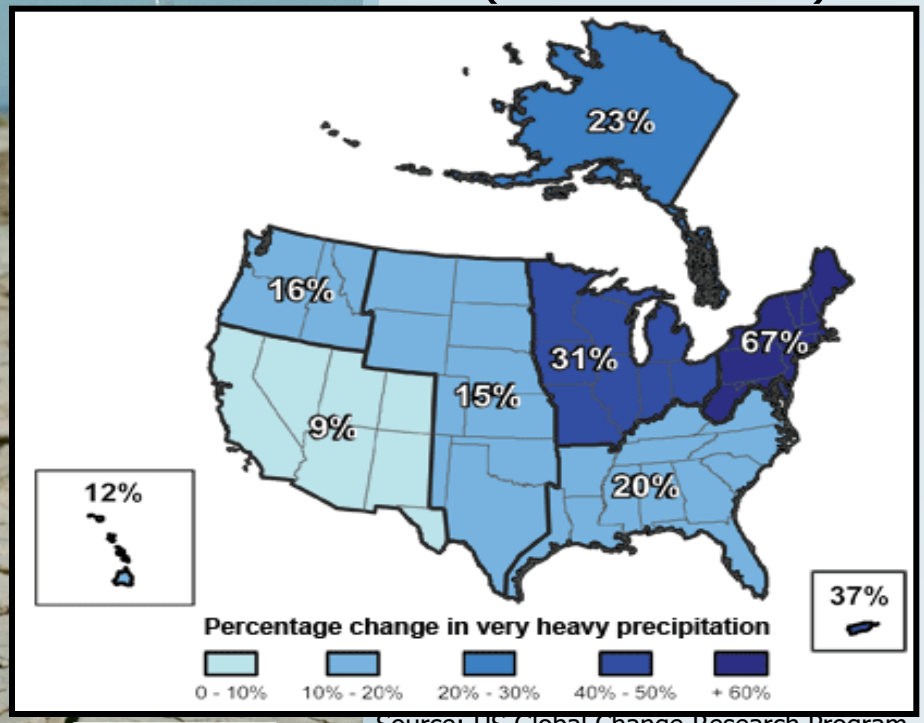
Climate change effects are here and are projected to grow: Temperature





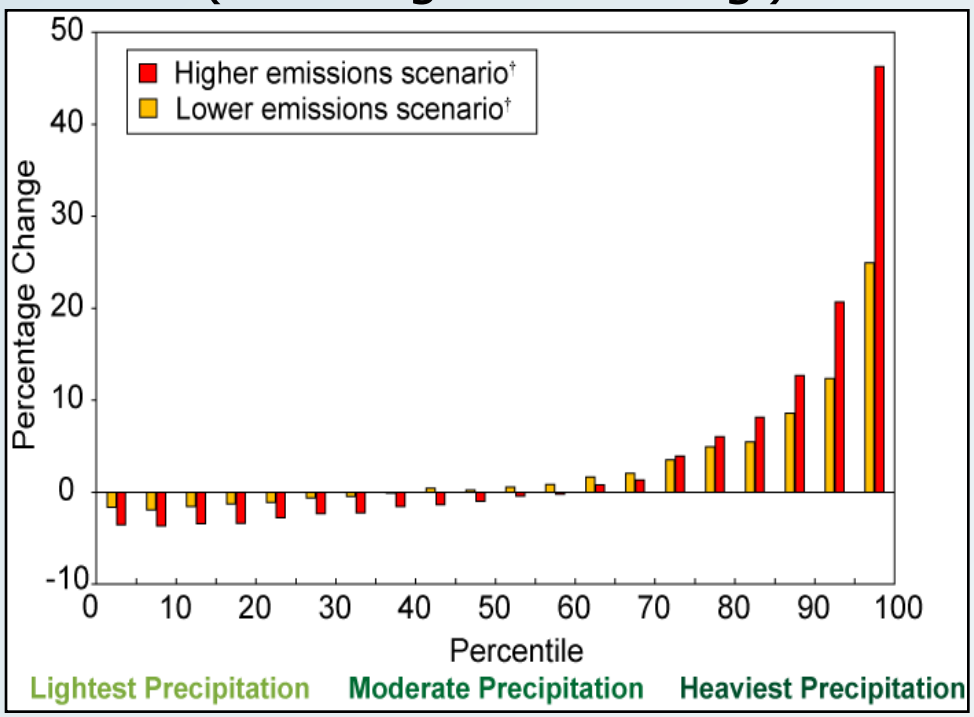
Climate change effects are here and are projected to grow: Precipitation

Observed Increases in Very Heavy (top 1%) of Daily Precipitation (1958 to 2007)



Source: US Global Change Research Program

Projected Change in Precipitation Intensity (1990 avg. v 2090s avg.)



Climate change effects create impacts to water and wastewater

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Assumptions, methods, and tools:

Similar processes for water and wastewater analyses allow comparable results

- Assessed likely impacts for each U.S. region using projections from readily available models and databases
- Identified potential adaptations for impacts, assumed that utilities will employ a mix of adaptations and that adaptations will be customized by region, including coastal areas
- Developed cost estimates for potential adaptation mixes based on detailed cost assumptions for water and wastewater individually, then rolled them up to regional costs
- Reviewed and revised according to reviewer utility, NACWA, and AMWA feedback

Assumptions, Methods, and Tools:

Simplifying assumptions and consistent methods are key to early cost estimates

- 2009-2050 timeframe
- Public utility systems only; capital, operation, and maintenance costs
  - General distribution and sizes of utilities is constant
- 2 emission scenarios—3 GCMs, generally
  - Medium and high emission scenarios combined with appropriate General Circulation Models (GCMs) provide the basis for projections of future temperature and precipitation
- Climate scientists "comparabilized" available data for consistent assessment
- Temperature and precipitation projections translated to expected impacts per region

Assumptions, Methods, and Tools:

Some costs are excluded

- Increased incidence of and costs for Emergency Response and Recovery activities
- Costs to local, state, and federal agencies for modifying planning, implementing infrastructure adaptations not directly related to water and wastewater utilities
- Detailed cost estimates for Green Infrastructure adaptations
- Larger societal and human health costs for potential loss of water supply and sanitation services, including environmental costs, costs to agriculture and industry
- $500B in estimated infrastructure needs already identified by EPA not specifically related to climate change

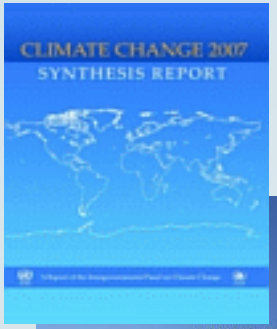
Assumptions, Methods, and Tools:

Compressed time-frame requires rapid analysis through accessible tools

The Nature Conservancy

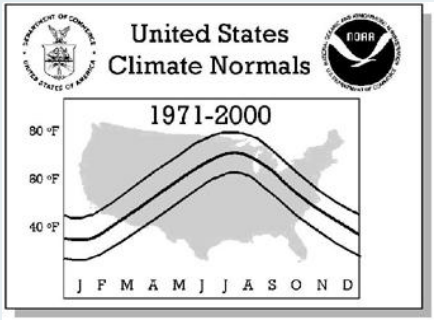
ClimateWizard

US Global Change Research Program
www.usgcrp.gov



ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

National Climatic Data Center
U.S. Department of Commerce



CLIMsystems

SimCLIM

NACWA, AMWA, and multiple other utility and population data sources

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Assumptions, Methods, and Tools:

U.S. Global Climate Research Group regions were adapted to databases and projected impacts

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Results:

Summary of projected drinking water impacts

- Source water impacts
  - Quantity of runoff
  - Timing of runoff
  - Seawater intrusion to aquifers
- Treatment impacts
  - Quality of runoff
  - Changes in maximum temperature
    - Toxicity and T&O problems
  - Regulatory changes
- Infrastructure flood protection
  - Sea level rise, storm surge and inland flooding

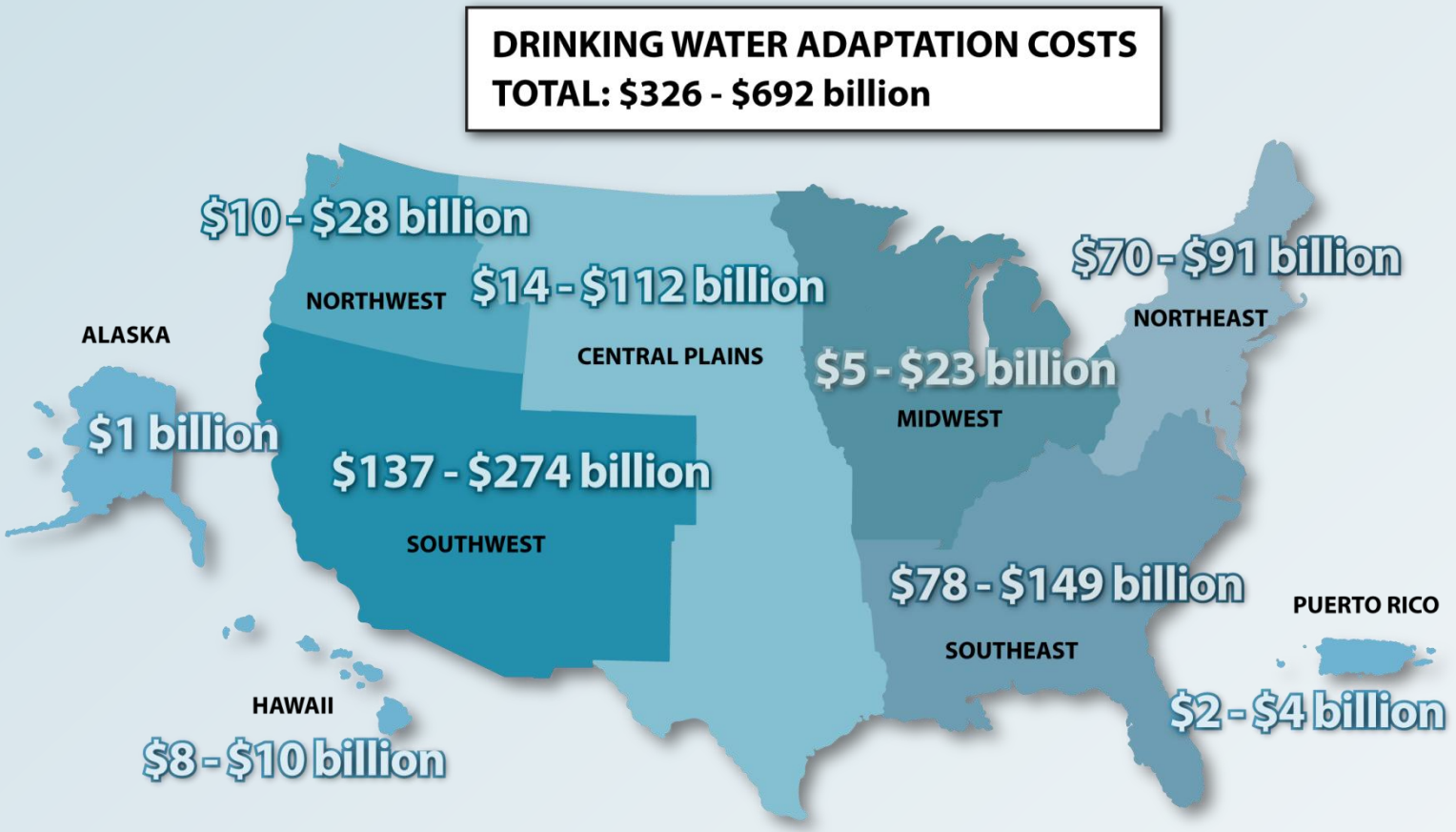
Results:

Summary of potential drinking water adaptations

- Source water adaptations
  - Diversify water management portfolio
  - Increased conservation/demand management
  - Additional and integrated sources
    - Integrated water cycle planning
    - Reuse
    - Desalination
    - Shifting between surface and ground sources
    - Increased storage/conveyance
- Treatment adaptations
  - Additional treatment
    - Filtration
    - With more marginal sources, microfiltration and reverse osmosis
- Infrastructure flood protection
  - Levees and sea walls, relocation of especially vulnerable infrastructure

Results:

Early estimated range of drinking water costs for climate change adaptation through 2050



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Results:

Summary of projected wastewater impacts

- Increased wet weather impacts
  - Changes in frequency and intensity of extreme storm events with need to reduce infiltration and inflow into sewers
  - Regulatory changes
- Effluent water quality impacts
  - Changes in maximum temperature and other environmental variables
  - Regulatory changes
- Infrastructure and Operations flood protection impacts
  - Sea level rise and storm surge in coastal areas
    - Outfall elevations
  - Increased inland flood events
    - Critical infrastructure and service at risk

Assumptions, Methods, and Tools:
Summary of potential wastewater adaptations

- Increased wet weather impacts
  - Assess potential CC impacts during CSO and other wet weather infrastructure planning
  - Cooperation among stormwater , wastewater, and other planning agencies-integrated water cycle planning
  - Combined green (for site specific runoff) and grey infrastructure solutions
- Effluent water quality impacts
  - Potential cooling of effluent by various means
    - Wetland treatment
    - Riparian restoration
    - Mechanical, evaporative, blending options
- Infrastructure and Operations flood protection impacts
  - Levees and seawalls
  - Effluent pumping
  - Worst case scenario, infrastructure relocation

Results:

Early estimated range of wastewater costs for climate change adaptation through 2050

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Results:

Combined early estimated range of drinking water and wastewater costs for climate change adaptation through 2050

SUMMARY
Drinking Water = $325 - $692 billion
Wastewater = $123 - $252 billion

GRAND TOTAL
Drinking Water and Wastewater = $448 - $944 billion

Does not include $500B in estimated infrastructure needs already identified by EPA not specifically related to climate change

Considerations and qualifiers for climate change adaptation planning

- Climate change uncertainty and model uncertainty
  - Science is evolving rapidly, but climate change continues to bring us surprises
  - Models are models, not hard numbers and not guarantees of future events
- Many adaptations can increase energy demand
  - Conventional energy sources increase GHG footprint; alternative renewable solutions are emerging
  - Integration between GHG management and potential adaptation options could lead to more efficient and cost effective outcomes
- Not all utilities will require all identified adaptations
  - For example, start with developing a phased portfolio of adaptations, focusing on "no regrets" options
- Climate change risk assessment and planning can be integrated with other water planning
  - Uncertainty is inherent in all water management planning; affects precision, but should not delay overall planning
  - Customized local and regional climate change risk assessment can focus planning and drive longer term sustainable water management

What's Next?

- Build on positive Congressional response
- Increase interest in adaptation planning for utilities
- Continue to improve understanding of climate change impacts and adaptation costs

Questions?

Follow-up questions to:
kathy.freas@ch2m.com

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