Cornell University

CERTS

CONSORTIUM FOR ELECTRIC RELIABILITY TECHNOLOGY SOLUTIONS

PSERC

Nexus of Systems Reliability, Energy Costs, the Environment during High Energy Demand Days

K. Max Zhang

Sibley School of Mechanical and Aerospace Engineering

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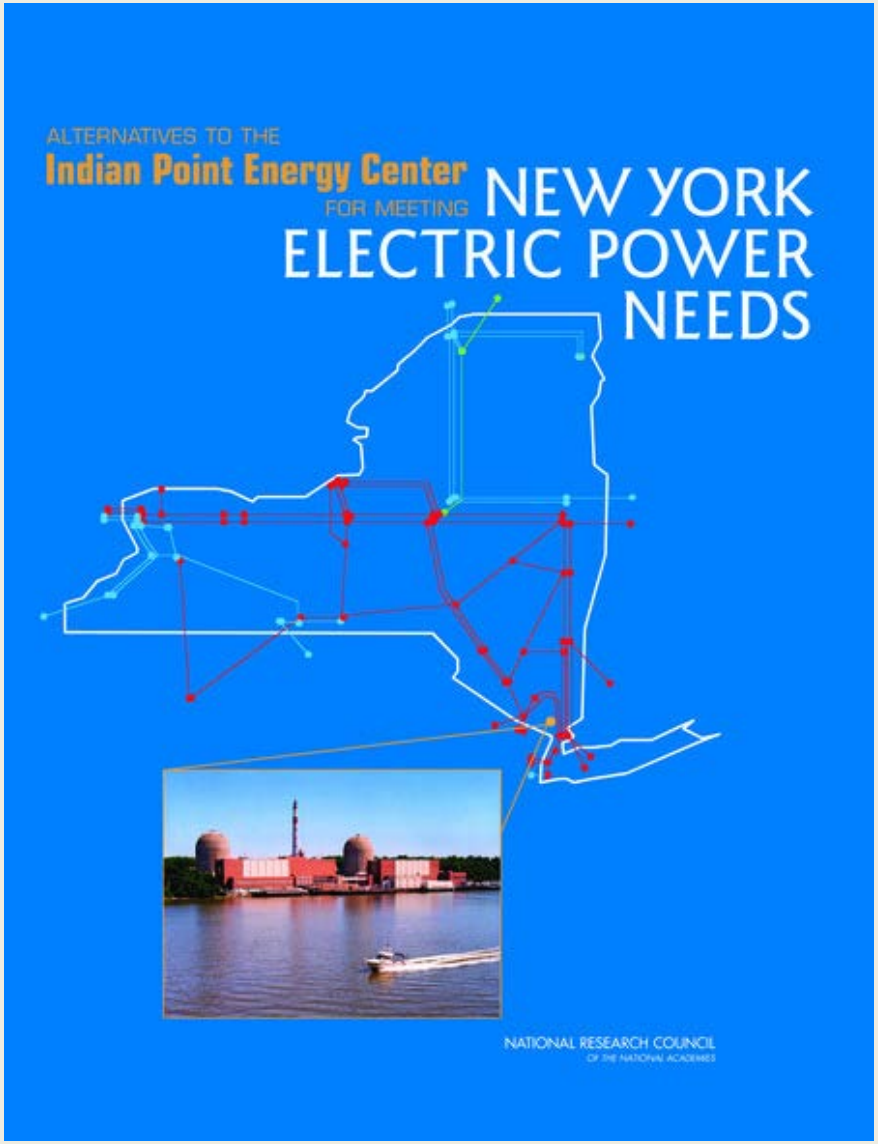

U.S. DEPARTMENT OF ENERGY

Office of Energy Efficiency and Renewable Energy
Office of Electricity Delivery and Energy Reliability

Load Participation in Ancillary Services

WORKSHOP REPORT

DECEMBER 2011

Demand Response
Spinning Reserve Demonstration

Prepared for
Energy Systems Integration
Public Interest Energy Research Program
California Energy Commission

Principal Investigator
Joseph H. Eto, Lawrence Berkeley National Laboratory

Project Team
Janine Nelson-Hoffman, Carlos Torres, Scott Hirth, Bob Yinger, Southern California Edison
John Kueck, Brendan Kirby, Oak Ridge National Laboratory
Clark Bernier, Roger Wright, RLW Analytics
Arup Barat, Connected Energy
David S. Watson, Lawrence Berkeley National Laboratory

Demand Response
Spinning Reserve Demonstration – Phase 2 Findings from the Summer of 2008

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Dave Sheehan, BPL Global
[illegible]eck, Brendan Kirby, Oak Ridge National Laboratory

Spinning Reserve From Responsive Loads

March 2003

Prepared by
B. J. Kirby

Oak Ridge National Laboratory

Loads Providing Ancillary Services: Review of International Experience

Technical Appendix: Market Descriptions

Grayson Heffner, Charles Goldman, Michael Kintner-Meyer, and Brendan Kirby

Demand Response Providing Ancillary Services

A Comparison of Opportunities and Challenges in the US Wholesale Markets

Jason MacDonald[†], Peter Cappers[†], Duncan Callaway[‡], Sila Kiliccote[†]

[†]Lawrence Berkeley National Laboratory, [‡]University of California, Berkeley
1 Cyclotron Rd, Mailstop: 90R3011, Berkeley, CA 94720

jsmacdonald@lbl.gov, pacappers@lbl.gov, dcal@berkeley.edu, skiliccote@lbl.gov

Outline

- Context: A “peak” problem
- Research statement
- Methodology
- Synergy
  - DOE’s research needs
  - NYC’s resiliency planning

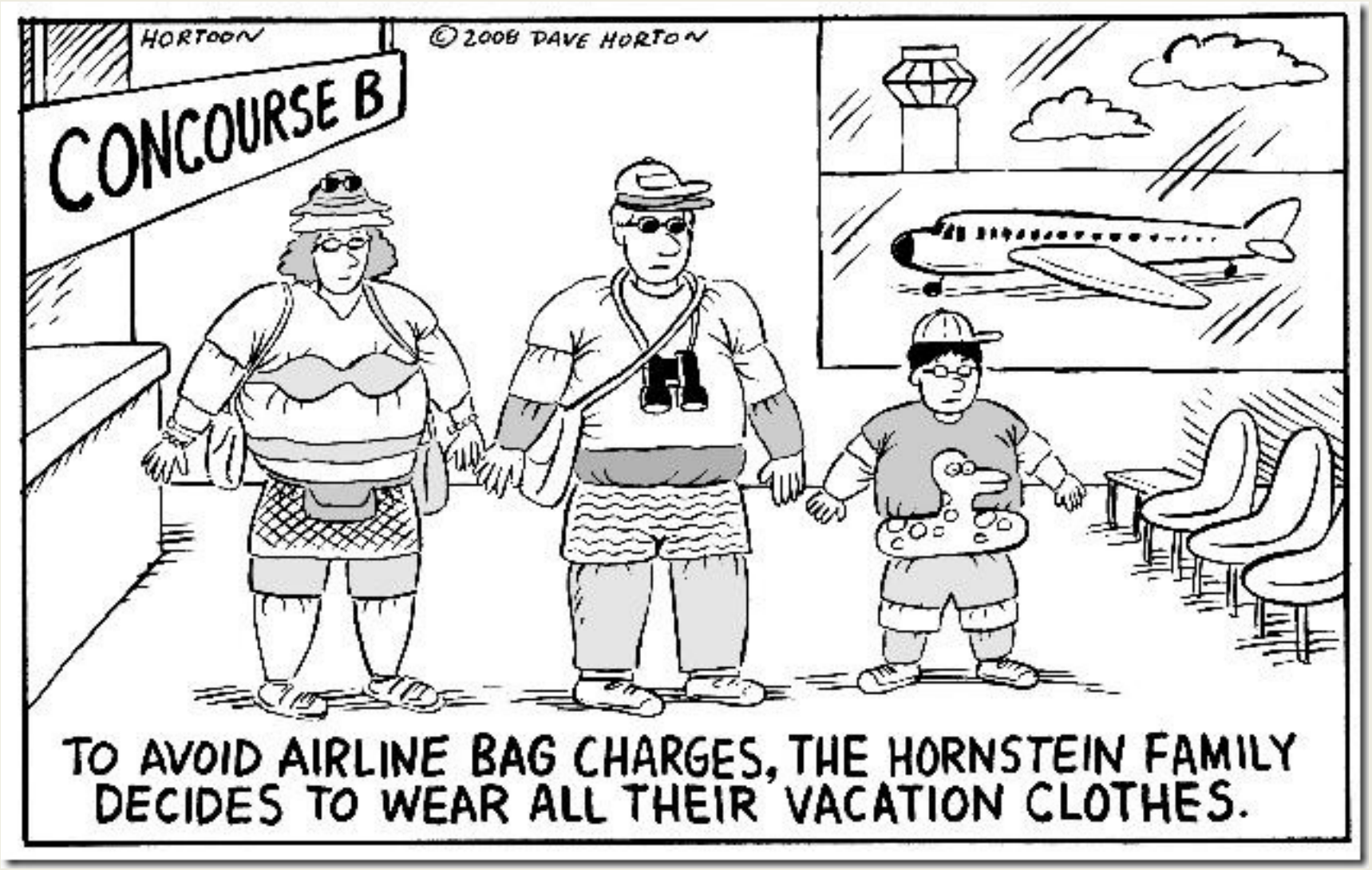
High Electric Demand Days (HEDD): A "Peak" Problem

- Hot summer days and heat waves
- Power Systems
  - **Reliability** is compromised
  - **Cost** of electricity is high: expensive peaking generators
- Environment
  - High **ozone** air pollution
  - ***Double threats*** to public health: *heat* and *air pollution*
- A portfolio of solutions are needed
- The role of demand side resources is critical

July 19, 2013: 33,955 MW in NYCA

- A record hourly peak load for NYISO
- Demand response programs of more than 1,200 MW were deployed in the Hudson Valley and southeastern New York every day in the week of July 15-19.

Wall Street Journal, July 21, 2013:
"Reward for Cutting Power at Peak Times"



Target: Peaking Units

- Low capacity factor, Low efficiency
- High costs, Highly polluting

1 MW of clean demand side reductions is NOT necessarily a full equivalent to 1 MW of peaking supply: Location? Services?

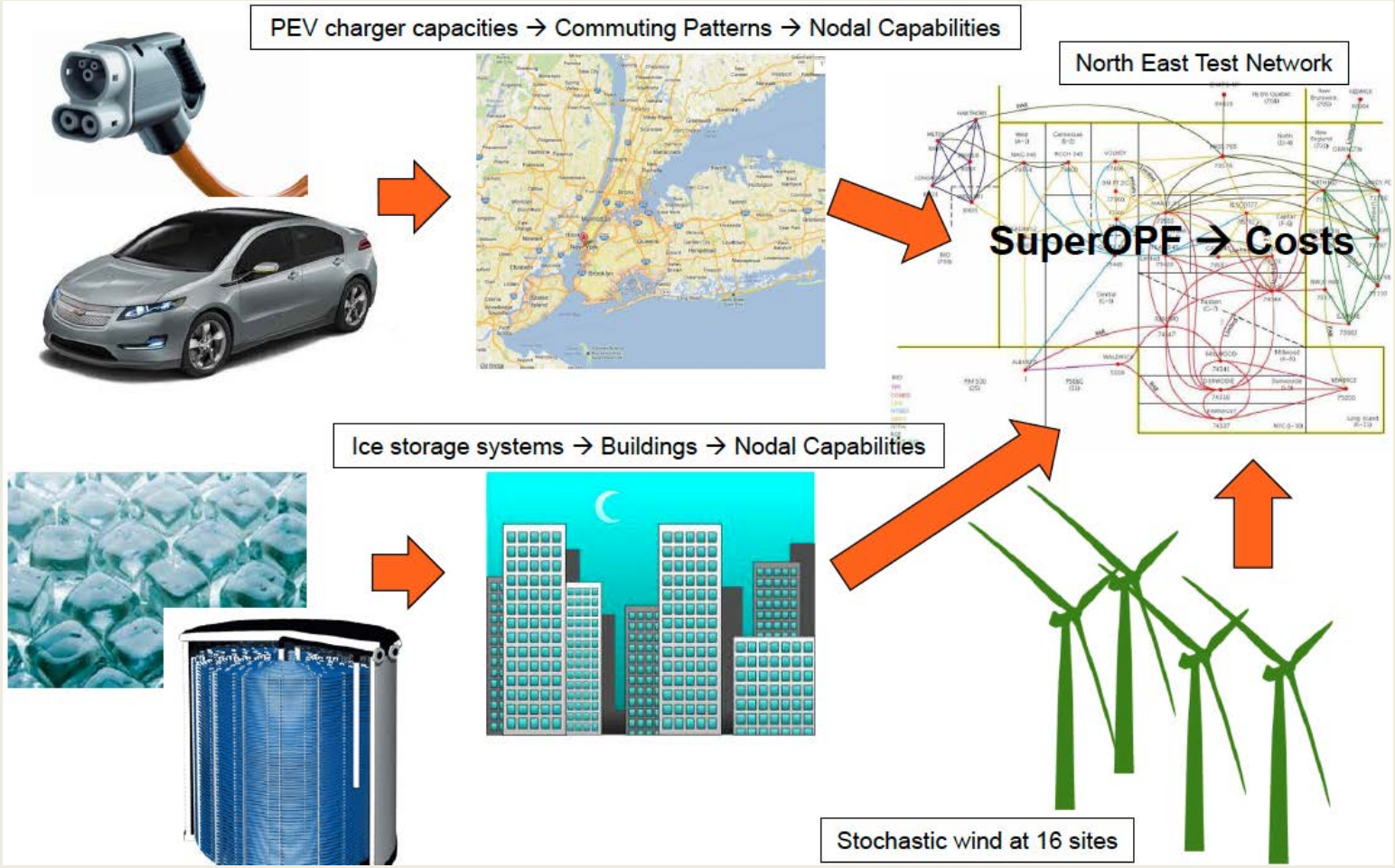
- Serve peak demand and provide at least one type of ancillary services to the system including:
  - Black start capability
  - Load pocket support
  - Voltage support
  - Spinning and non-spinning reserves

Research Statement

- A class of costly and high-emitting generation resources provide a whole spectrum of power system reliability services during HEDDs.
- Can we identify a portfolio of alternative resources from both the supply and demand sides to not only provide same or better reliability services, but also at lower financial and environmental costs?
- New York City as a testbed.

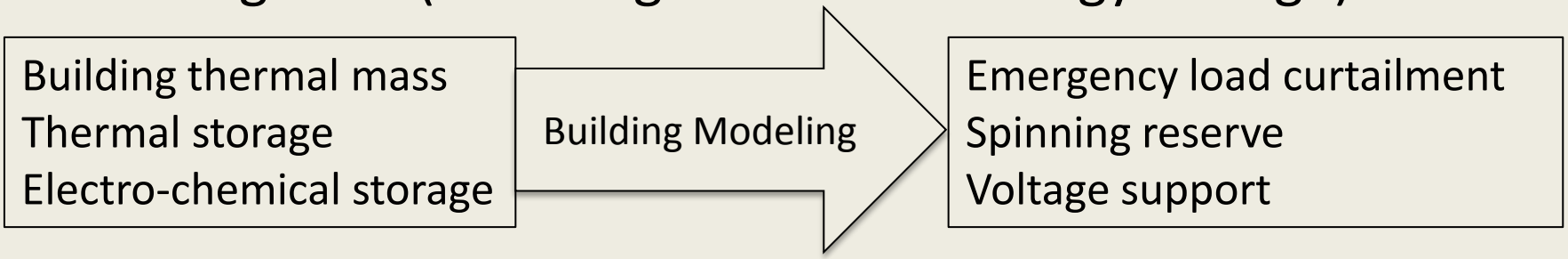
Existing framework

- Improve the quality of economic analysis by introducing engineering constrains



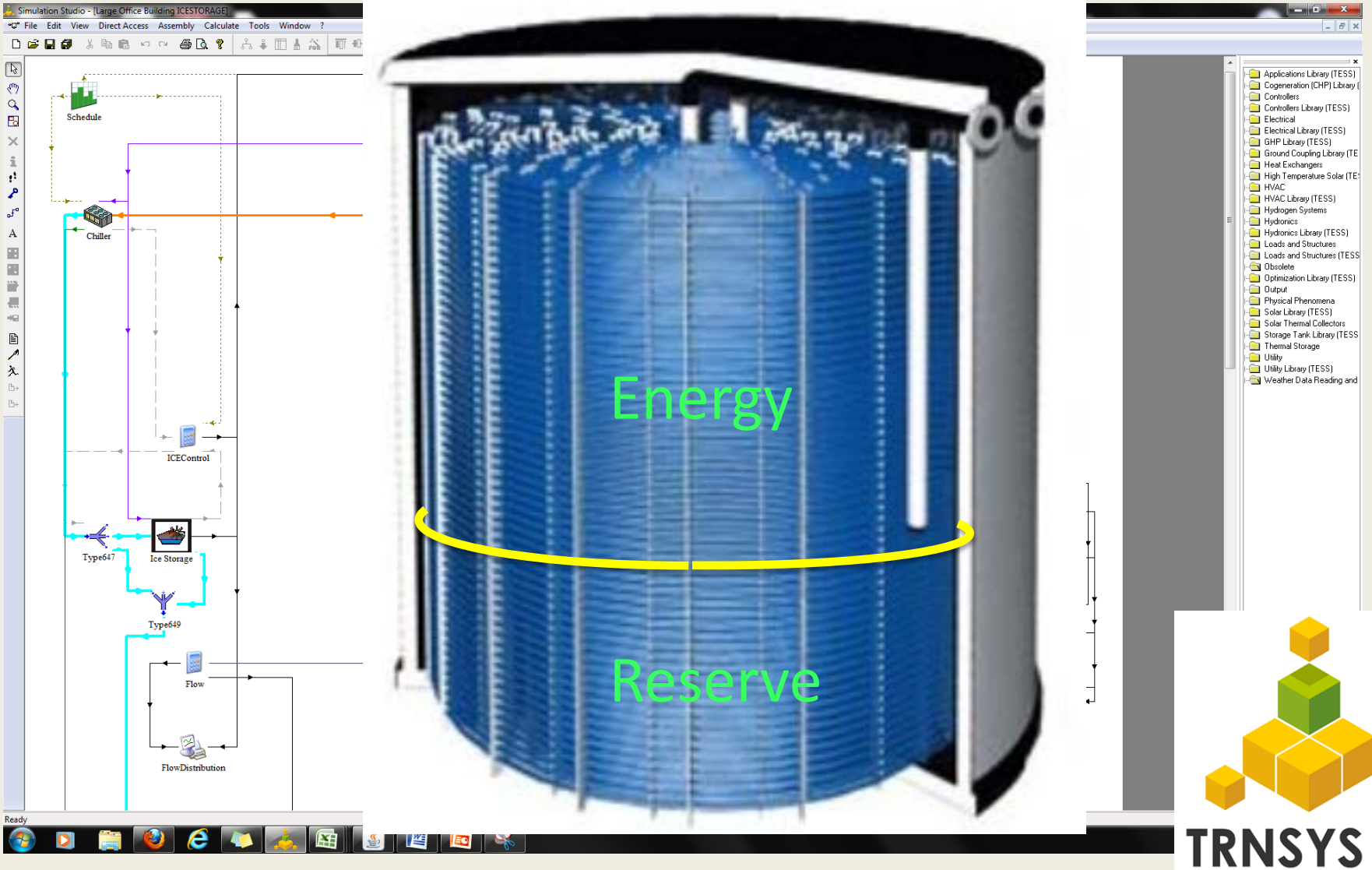
Multi-scale modeling: Integrating building energy and power system simulations

- Building-level (including distributed energy storage)



- Load Pocket-level
  - Whether a cluster of buildings can provide aggregated services equivalent to peaking units in the same load pocket
- System-level
  - Further improve the representations of demand resources in SuperOPF

Building Energy Simulations



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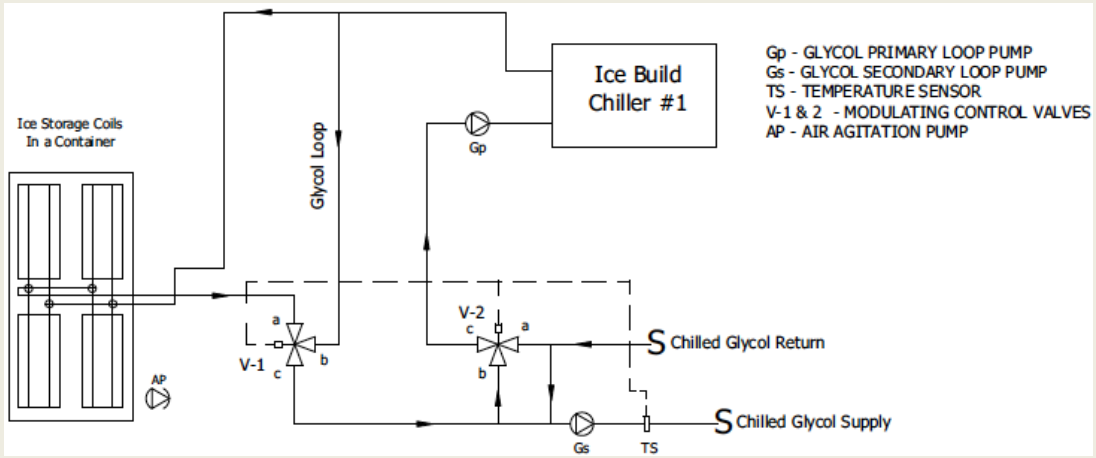
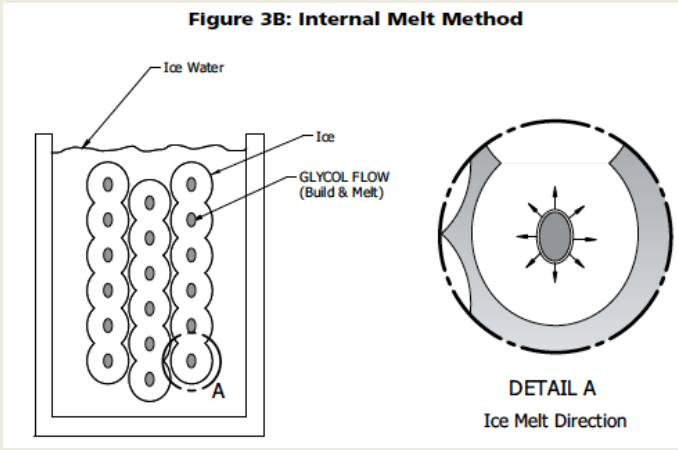
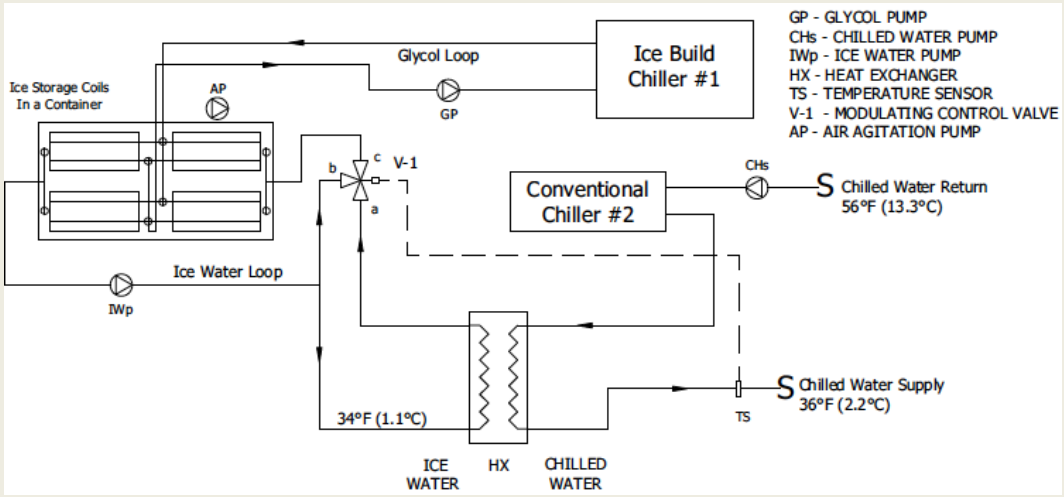
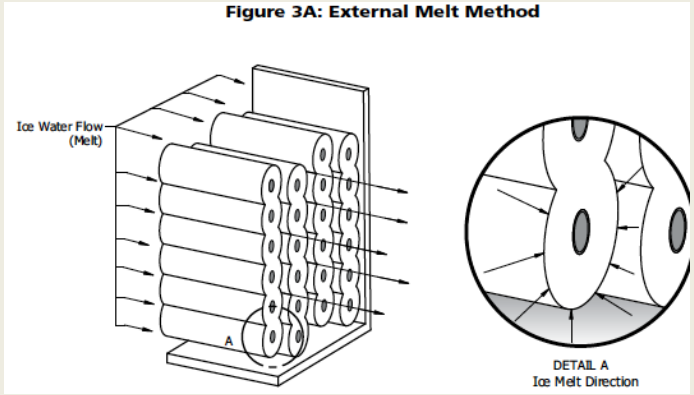
Internal Melt and External Melt

- Design devices to meet power systems' needs





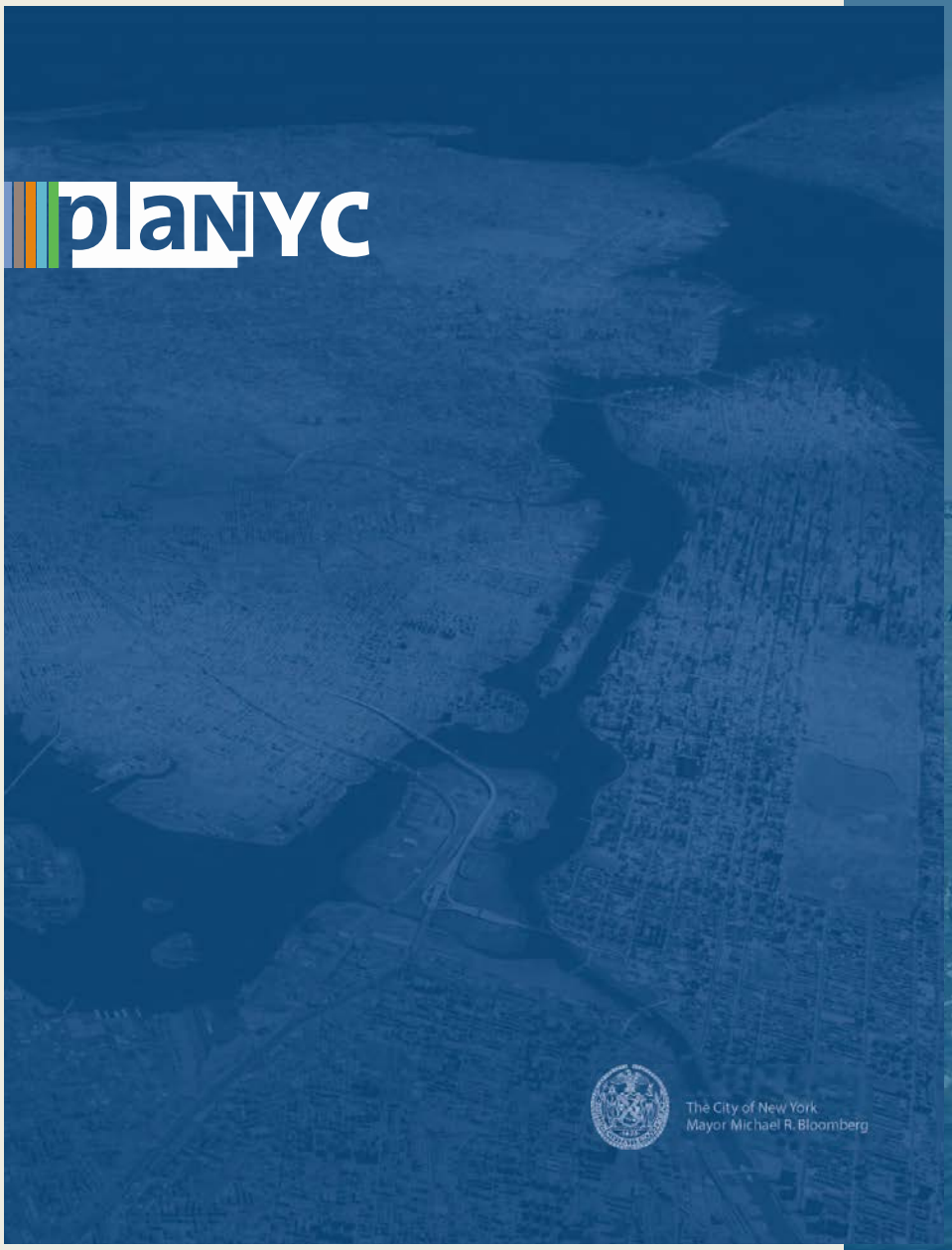




Thermal storage for ancillary services (e.g., ramping and spinning reserve)

Address research needs identified in the 2011 DOE Report

- Characterize the technical potential of load participating in ancillary services (AS)
- Improve building energy management to deliver sustainable and reliable demand response (DR) for AS
- Develop decision support tools for building operators
  - Co-optimization of energy and AS for building systems with thermal or electrochemical storage
- Evaluate the impacts of DR for AS to the operational efficiency of the conventional generation fleet and quantify system-level changes in energy consumption and emissions.
- …



re•sil•ient [ri-zil-yuhnt] adj.

1. Able to bounce back after change or adversity.
2. Capable of preparing for, responding to, and recovering from difficult conditions.

Syn.: TOUGH
See also: New York City

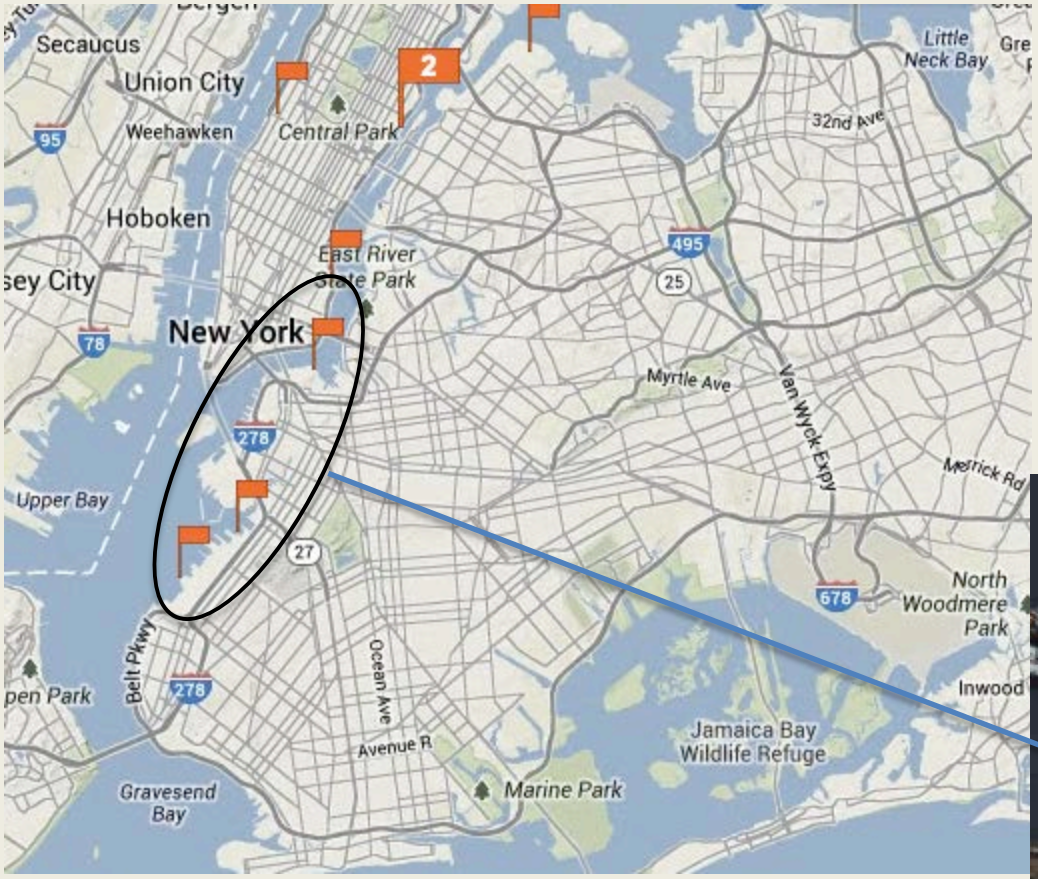
Synergy with NYC's Resiliency Planning

- 90 degree day: ~18 days present to ~57 by 2050.
- By 2050, heat waves could more than triple in frequency, lasting on average one and a half times longer than they do today in NYC.
- Initiatives
  - *Work with utilities and regulators to expand citywide demand response programs*
  - *Work with government and private sector partners to expand the energy efficiency of buildings*
  - *Work with public and private partners to scale up distributed generation (DG) and micro-grids*
  - *Incorporate resiliency into the design of City electric vehicle initiatives and pilot storage technologies*
  - *…*

Data Challenges

- Data
  - While on developing PlaNYC, the Mayor's Office have created a detailed inventory for energy use in different sectors
  - Acquired GIS tools from the Mayor's Office
  - Managing data is still a challenge
- Load pocket information is regarded as proprietary
  - Locations of load pockets can be deducted from locations of peaking units

Peaking Units -> Load Pockets



Example: Much of the generation capacity that supplies Brooklyn on a daily basis is located outside the Borough and flows through interconnections across Staten Island or directly into Brooklyn.

Thank you!