

Greening the Grid

Challenges & Opportunities

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Transition to a Green Economy

Newburgh, NY

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Topics

- ◆ **About the NYISO**
- ◆ **New York's Electric System**
- ◆ **Natural Gas & Electricity**
- ◆ **Integrating Renewables**
- ◆ **Smarter Grid**



Roles of the NYISO

Reliable operation of the bulk electricity grid

- *Managing the flow of power on 11,000 circuit-miles of transmission lines from more than 300 generating units*

Administration of open and competitive wholesale electricity markets

- *Bringing together buyers and sellers of energy and related products and services*

Planning for New York's energy future

- *Assessing needs over a 10-year horizon and evaluating projects proposed to meet those needs*

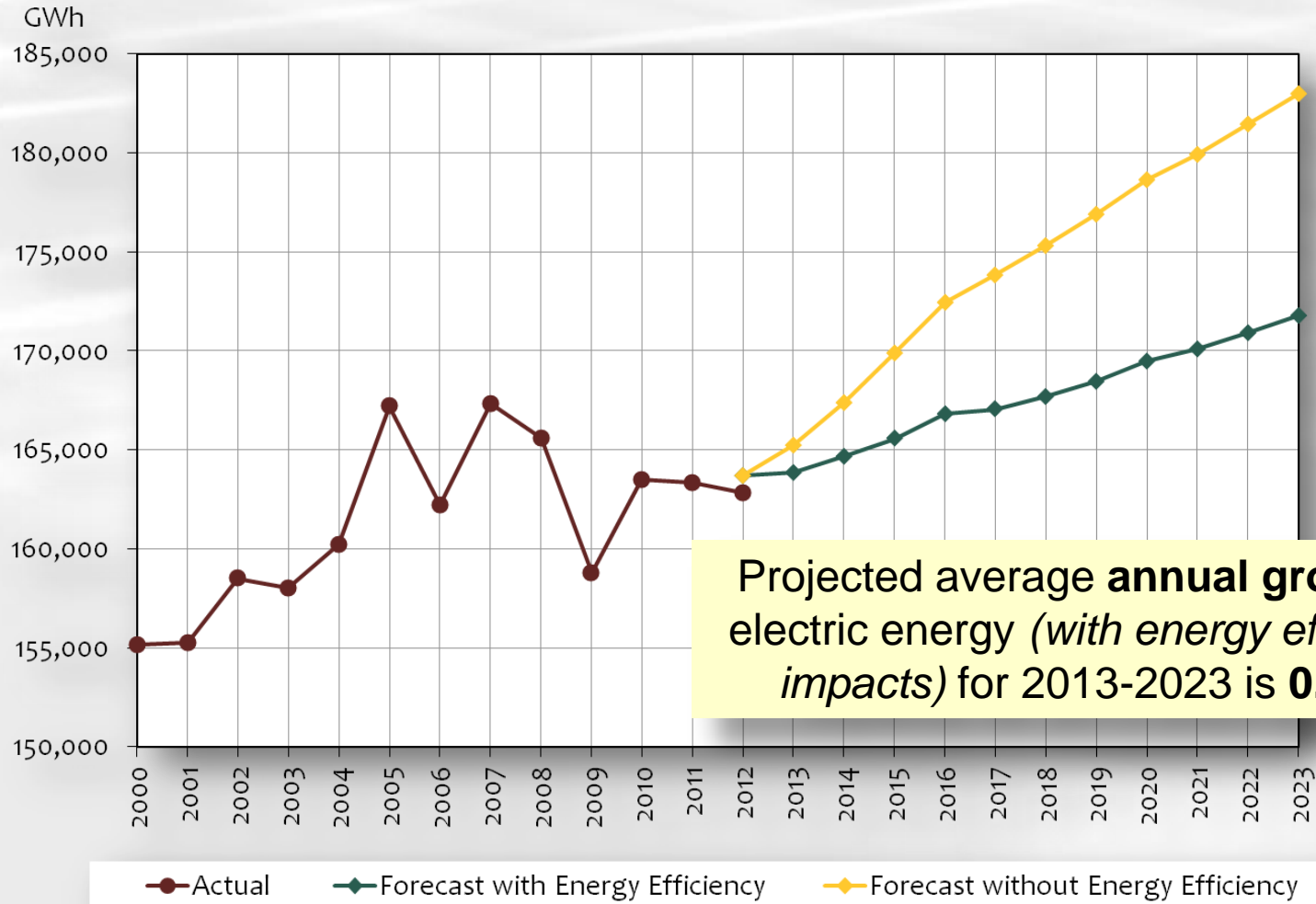
Advancing the technological infrastructure of the electric system

- *Developing and deploying information technology and tools to make the grid smarter*



NYS Energy Trends

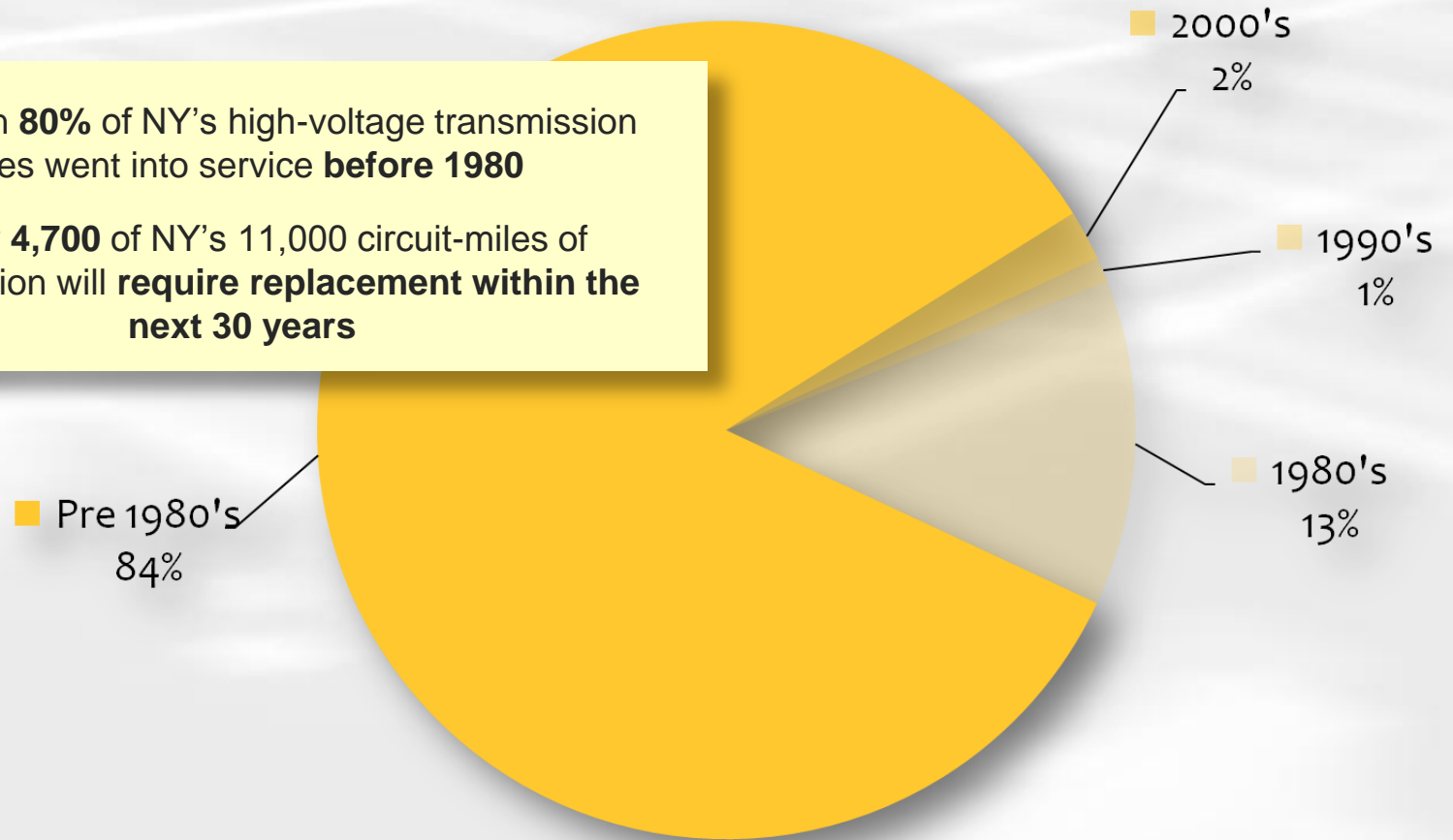
Actual & Forecast: 2000-2023



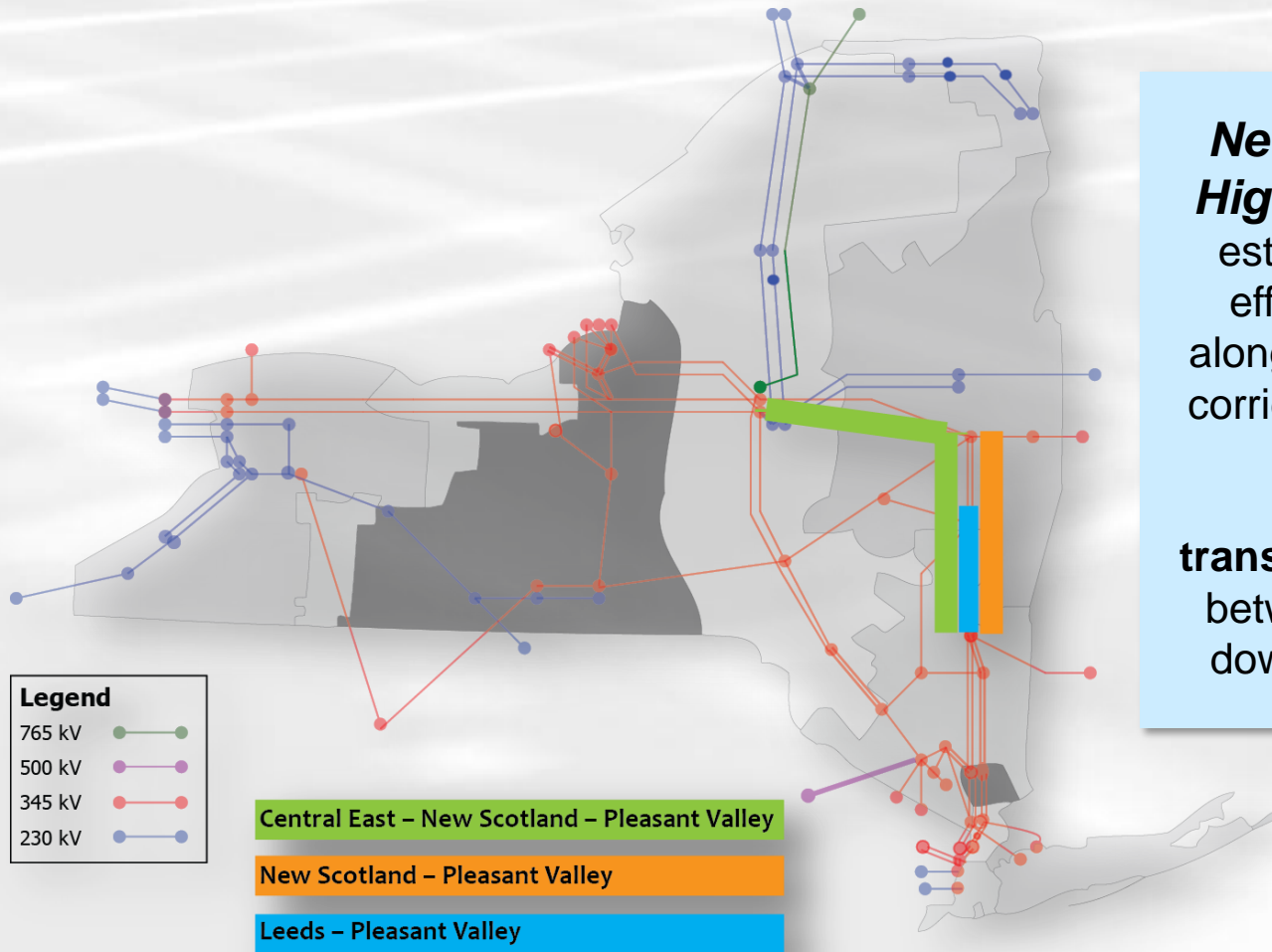
Aging Transmission

More than **80%** of NY's high-voltage transmission lines went into service **before 1980**

Nearly **4,700** of NY's 11,000 circuit-miles of transmission will **require replacement within the next 30 years**



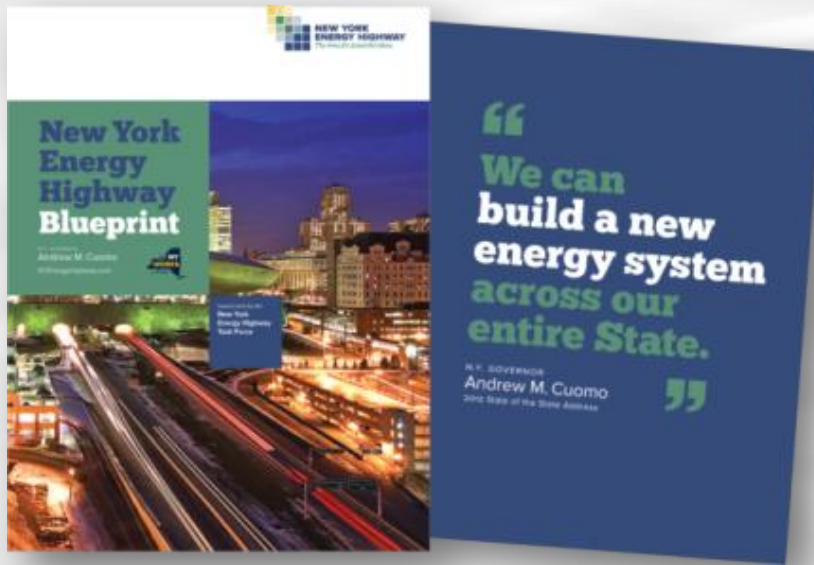
Congestion Corridors



New York Energy Highway Blueprint estimates that cost-effective upgrades along these congested corridors could provide **1,000 MW of additional transmission capacity** between upstate and downstate New York

Source: *New York Independent System Operator 2011 CARIS Phase 1 Report*, March 2012

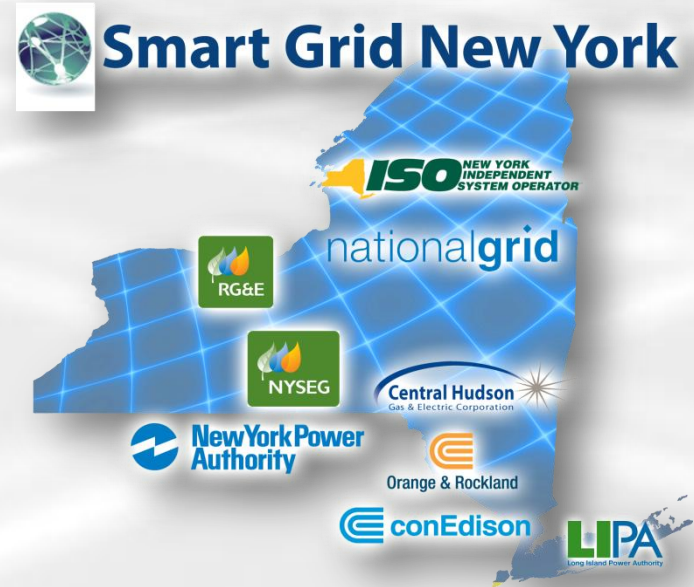
New York Energy Highway



Governor's initiative includes 3,200 MW of new generation and transmission funded by public/private investment of up to \$5.7 billion

Smart Grid Investments

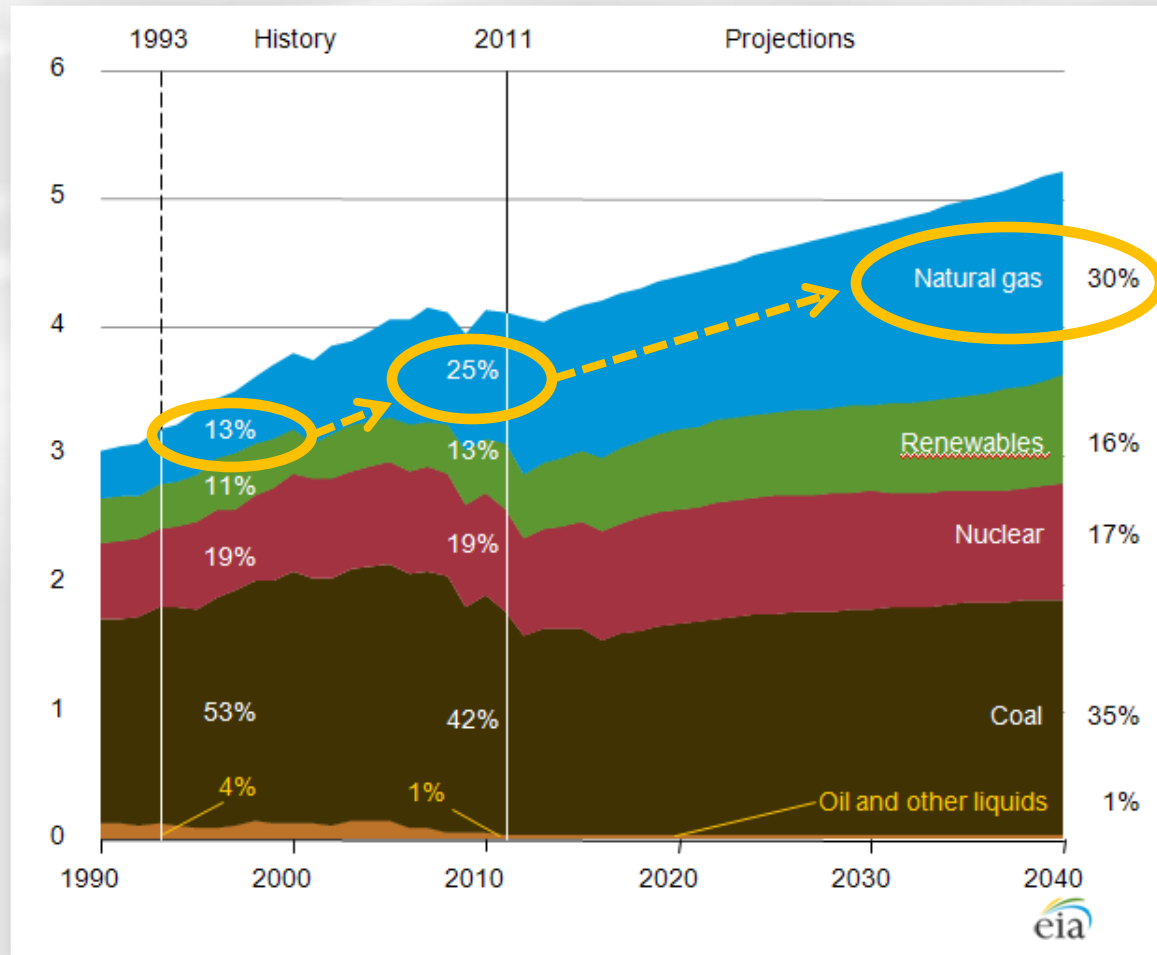
- ◆ **Smart Grid NY Project** included installation of new statewide Phasor Measurement Unit (PMU) network
- ◆ **PMU data enhances grid operator ability to see and respond to developing issues**



- *PMU technology relays system conditions 60 times per second -- 360 times faster than previously available*
- *PMU data from across a broad geographic area can be readily compared to detect system anomalies that could possibly evolve into more serious system events*

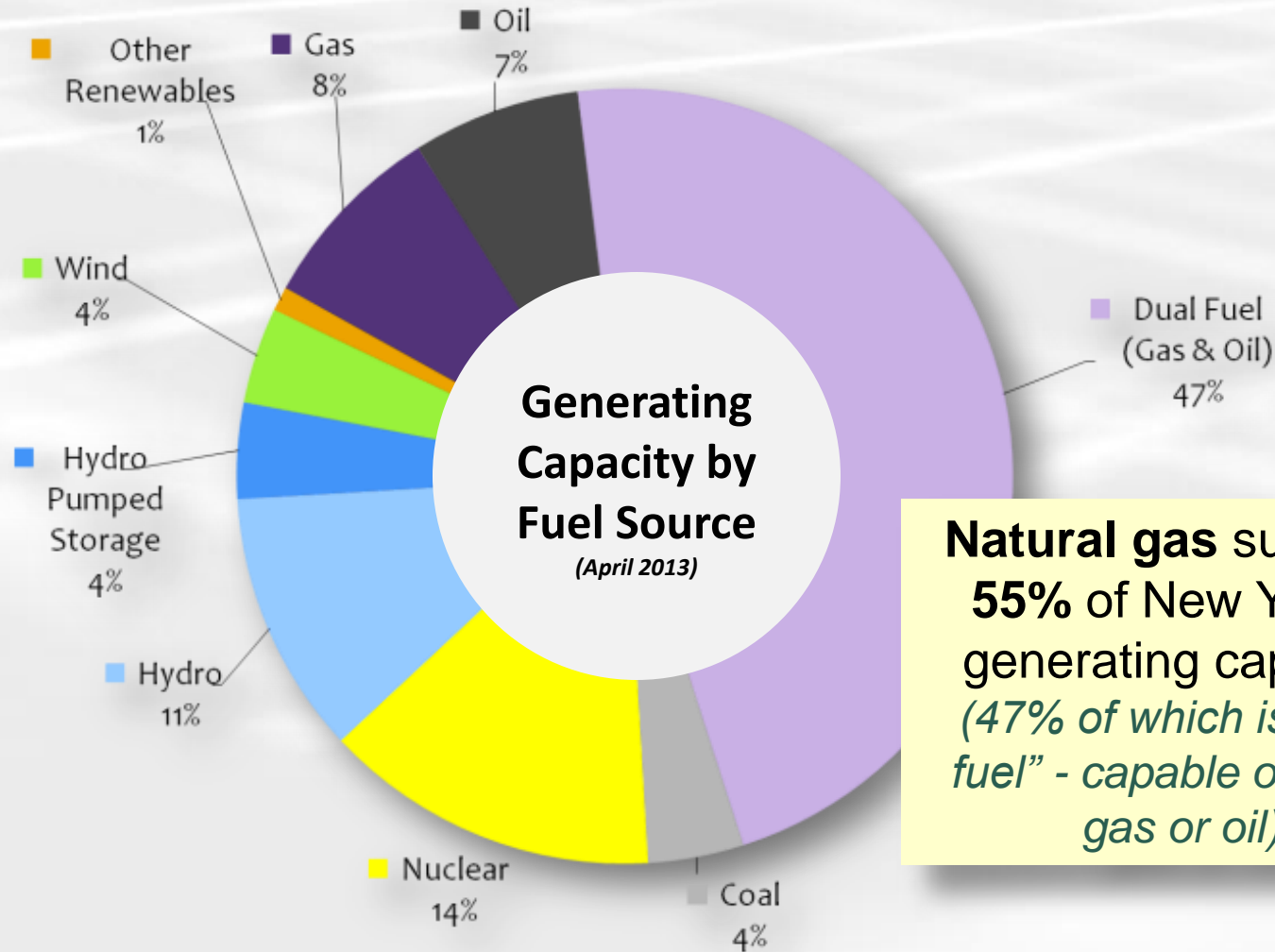
Fuel of the Future?

Electricity generation by fuel: 1990-2040
(trillion kilowatt-hours per year)



SOURCE: U.S. Energy Information Administration *Annual Energy Outlook 2013 Early Release* - December 2012

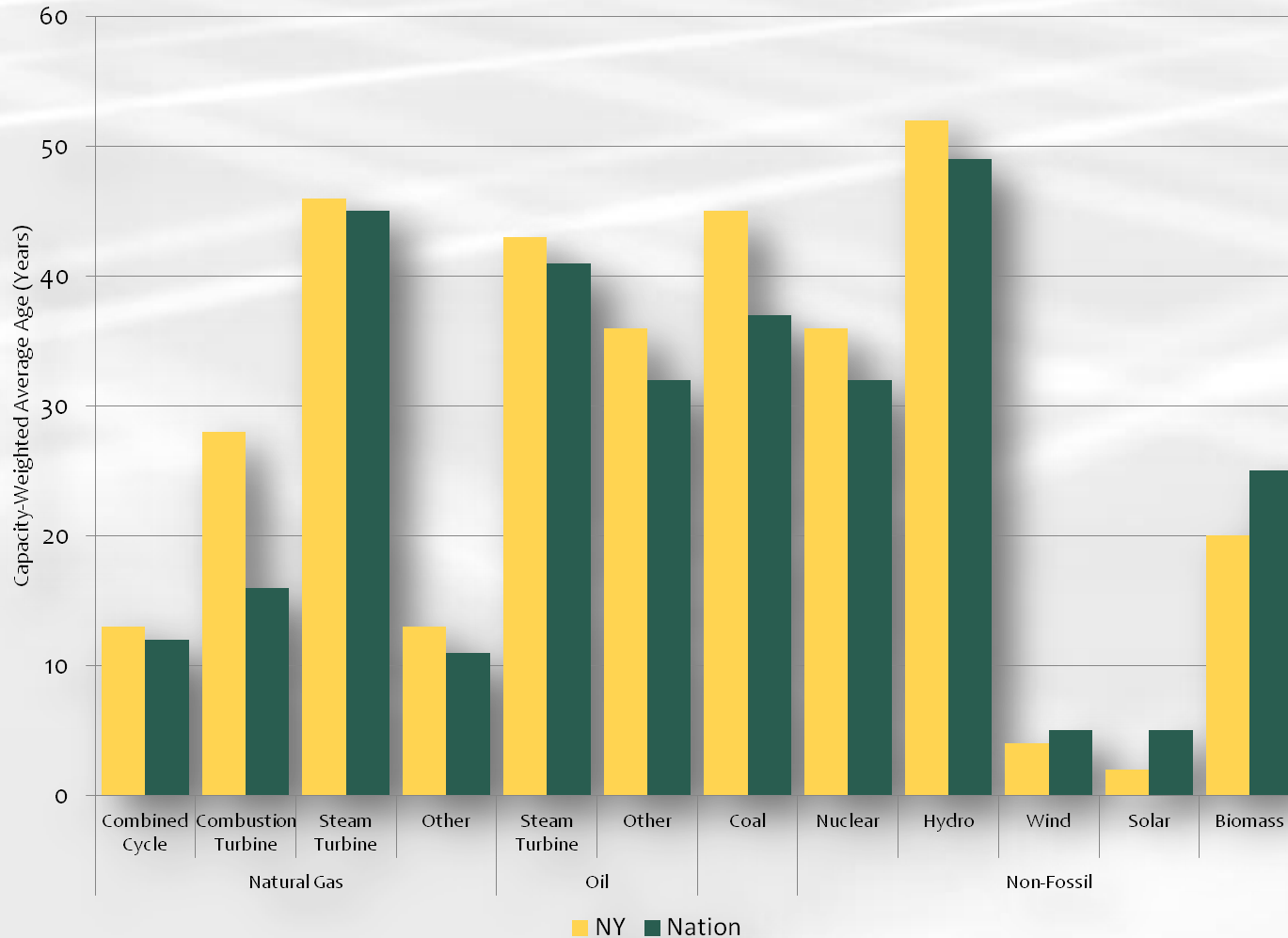
Fuel Mix



Natural gas supplies 55% of New York's generating capacity (47% of which is "dual fuel" - capable of using gas or oil)

Generation Vintages

Average Age of Generating Facilities in NYS and U.S.

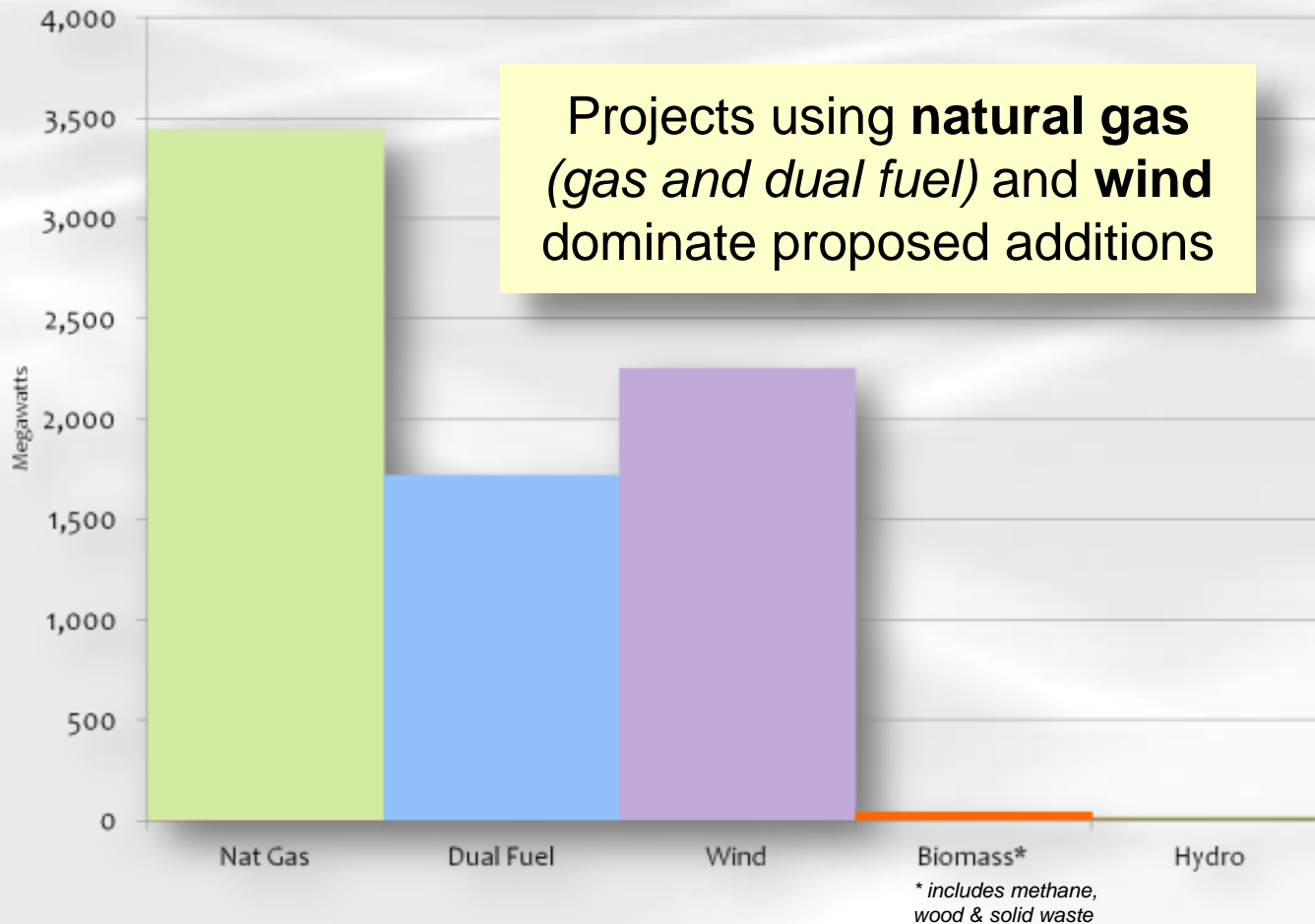


SOURCE: SNL Financial, December 26, 2012

Proposed Generation

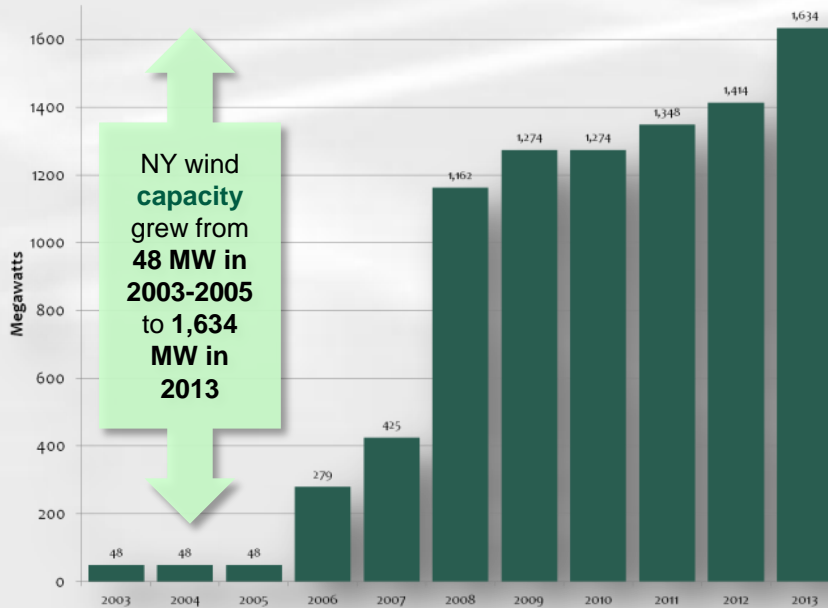
Proposed Power Projects

(New York Independent System Operator Interconnection Study Queue, March 31, 2013)

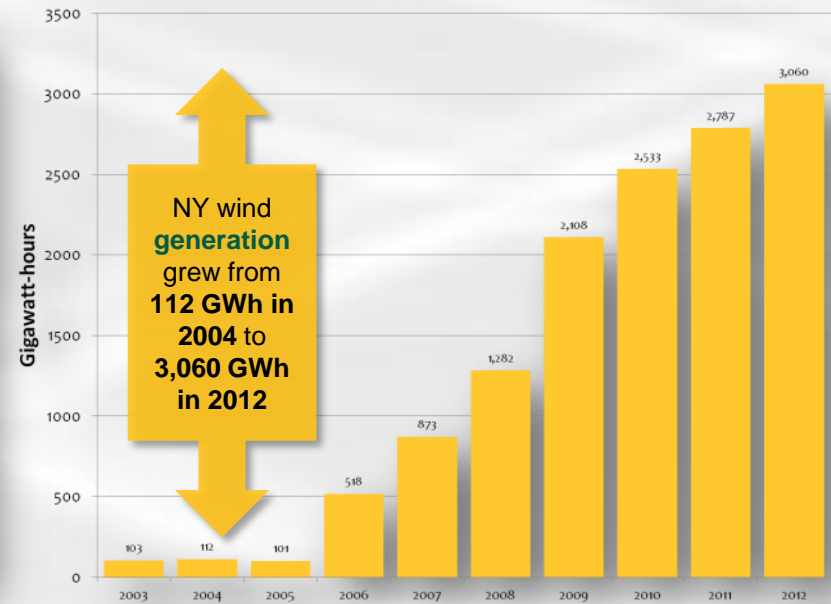


Wind Power in New York

Installed Capacity: 2003-2013



Energy Generated: 2003-2012



Renewable Resources

- ◆ **Conventional generating resources**
 - *Relatively stable, schedulable, controllable*
- ◆ **Renewable energy resources**
 - *Variable, output significantly influenced by weather and geography*
- ◆ **Grid operating procedures and market rules were originally designed around conventional generation**
- ◆ **Integrating renewable resources requires enhanced forecasting, improved visibility of output and changes in market design that recognize unique attributes of wind, solar and other renewable resources**



Wind Market Innovations

- ◆ 2006 – NYISO exempts wind from undergeneration penalties as a variable energy resource
- ◆ 2008 – NYISO establishes centralized wind forecasting system established
- ◆ 2009 – NYISO integrates wind into Economic Dispatch system (*First in nation*)

Growing wind in NY...

- *Wind-powered generating capacity in NY grew from 48 MW in 2005 to 1,634 MW in 2013*
- *2010 wind integration study found that ~8,000 MW of wind could be interconnected without adverse reliability impacts*



Solar in the Markets

- ◆ In NYISO energy markets, solar resources are:
 - *Exempted from under-generation penalties and compensated fully for all energy production*
- ◆ Future considerations for solar resources in the energy market expected to parallel wind integration initiatives:
 - *Meteorological data collection requirements*
 - *Solar power production forecasts*
 - *Integrating solar resources into economic dispatch*



Grid-scale solar in NY...

- *The largest photovoltaic array in the eastern US is the 32-MW Long Island Solar Farm at Brookhaven National Laboratory – completed in Nov. 2011*

Regional Integration of Renewable Resources

- **Broader Regional Markets**
 - *Address “seams” between regional markets and grid operations*
 - *Collaborative effort - NYISO, PJM Interconnection, Midwest ISO, ISO-New England, Ontario’s Independent System Operator and Hydro Quebec*
 - *More frequent scheduling can facilitate better regional integration of variable, renewable resources*



Distributed Energy Resources

- ◆ “Behind-the-Meter” & “Off-Grid” applications
 - *Smaller Solar PV*
 - *Electric Vehicles*
 - *Combined Heat & Power*
 - *Micro-Grids*





The New York Independent System Operator (NYISO) is a not-for-profit corporation responsible for operating the state's bulk electricity grid, administering New York's competitive wholesale electricity markets, conducting comprehensive long-term planning for the state's electric power system, and advancing the technological infrastructure of the electric system serving the Empire State.

www.nyiso.com