ISO on Background—

Wholesale Pricing in New England and Summer 2009 Operations

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About ISO New England

- Private, not-for-profit corporation created in 1997 to oversee New England's restructured wholesale electric power system
  - Independent of companies doing business in the market
  - Regulated by the Federal Energy Regulatory Commission (FERC)
- 460 employees headquartered in Western Massachusetts

New England's Electric Power Grid at a Glance

- 6.5 million households and businesses; population 14 million
- More than 300 generators
- Over 8,000 miles of high-voltage transmission lines
- 13 interconnections to electricity systems in New York and Canada
- More than 31,000 megawatts of total supply (plus 2,000 megawatts of demand-response)
- All-time peak demand of 28,130 megawatts, set on August 2, 2006
- More than 400 participants in the marketplace
- $12 billion annual total energy market value (2008)

About the *ISO on Background* Series

- An informal opportunity for media to learn more about the trends affecting New England's electricity industry
- Sessions will be hosted by ISO New England senior management and other subject matter experts
- Content is considered on-the-record and attributable to the speaker in publication

Overview of Discussion

- What is Economic Dispatch?
- What is the Uniform Clearing Price?
- What is Locational Marginal Pricing?
- How do these three concepts relate to one another?
- What approaches are used in other commodity markets?
- Why is this approach used in New England?

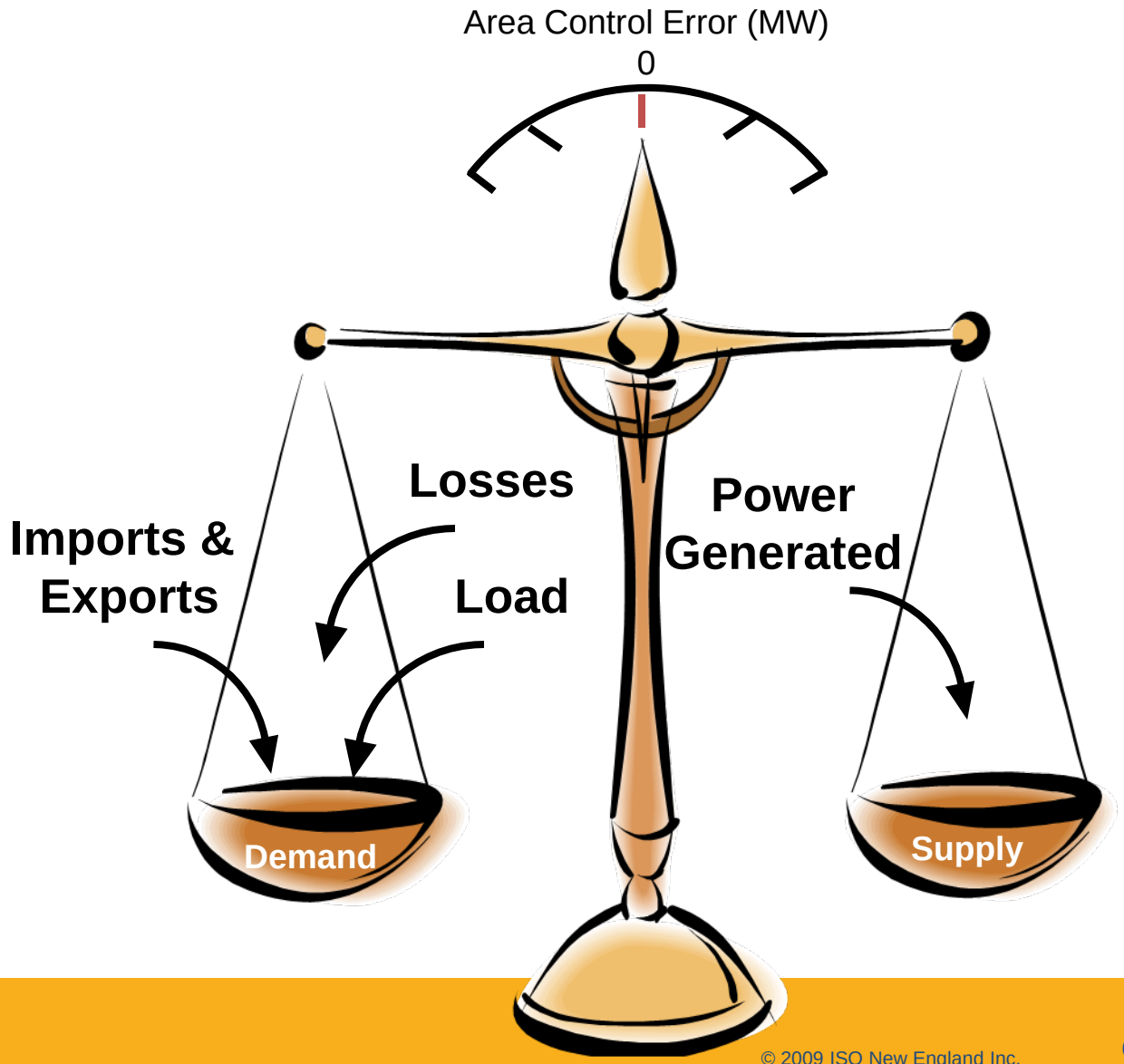
Maintaining Normal System Operations

Achieving Energy Balance

At any moment, the sum of all generation must meet the combined demands of regional electricity use, transmission line losses, and scheduled imports and exports.

Tools to accomplish this include:

- Load Following
- Automatic Generation Control
- Economic Dispatch



Economic Dispatch

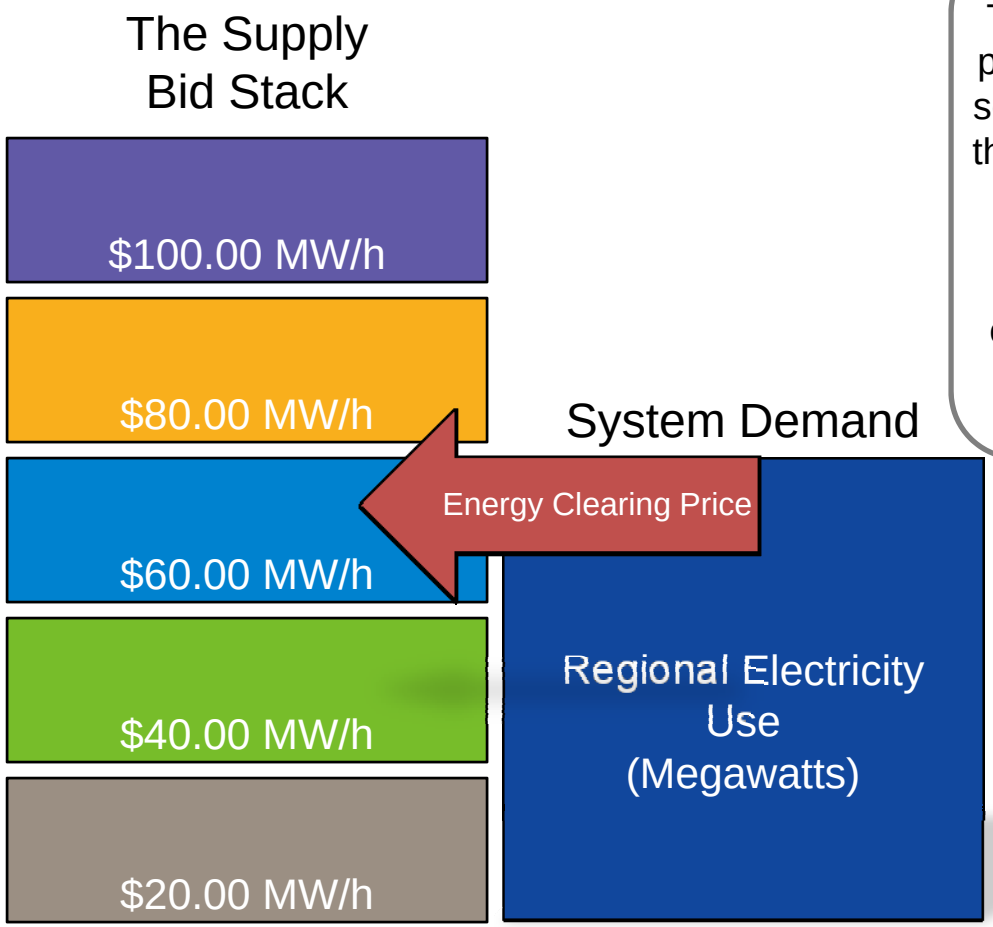
Selects Lowest Cost Resources to Meet Demand

- Objective is to minimize the total cost of producing electricity while keeping the system in balance
- Economic Dispatch uses the least-cost resources in a single period to meet the demand
- New England assesses hourly resource costs and establishes the wholesale cost of energy based on a **Uniform Clearing Price** auction
  - This same price formation is used in all other wholesale electricity markets in the United States

The Uniform Clearing Price Auction

"Bid Stack" Allows ISO to Compare Resource Offers; Establishes Single Price for Resources Used to Meet Demand on the System

Each resource submits an offer that specifies its incremental cost of producing energy and represents the price at which it is willing to run. These offers are stacked from highest to lowest.



The energy clearing price for the region is set at the point where the offers from supply intersect with the demand levels to serve the next expected megawatt of electricity use.

Economic Dispatch – Marginal Pricing

Highest-priced Generator is not dispatched.

C
$20/MW
capacity:
200 MW

B
$15/MW
capacity:
200 MW

A
$10/MW
capacity:
300 MW

Not dispatched

199 MW @ $15

300 MW @ $10

Dispatcher

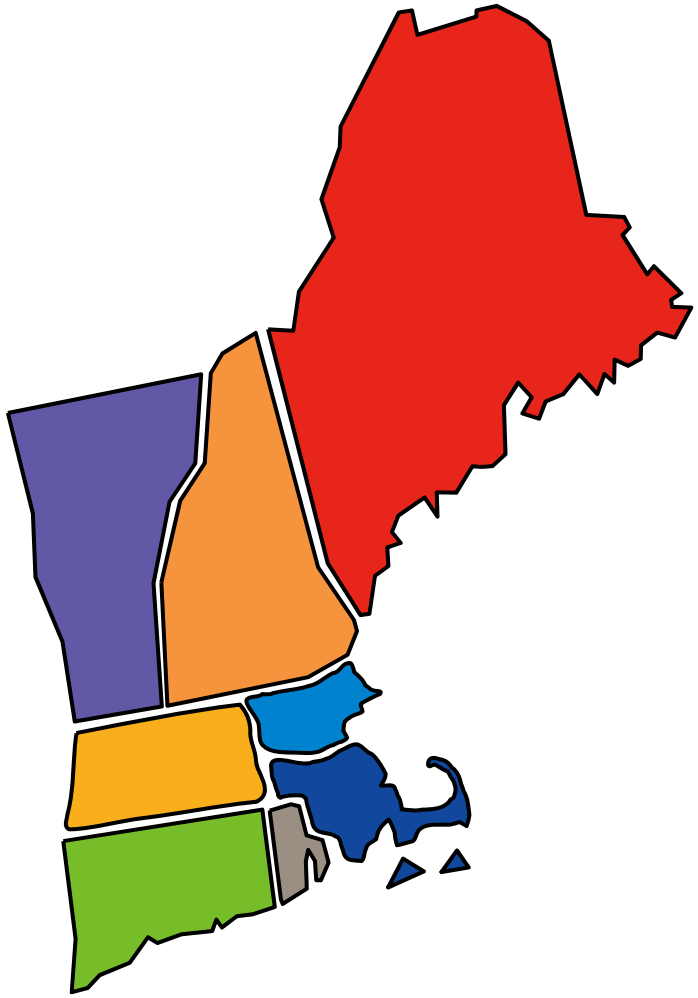
Load
499 MW

$15
Marginal price of Energy

Locational Marginal Pricing

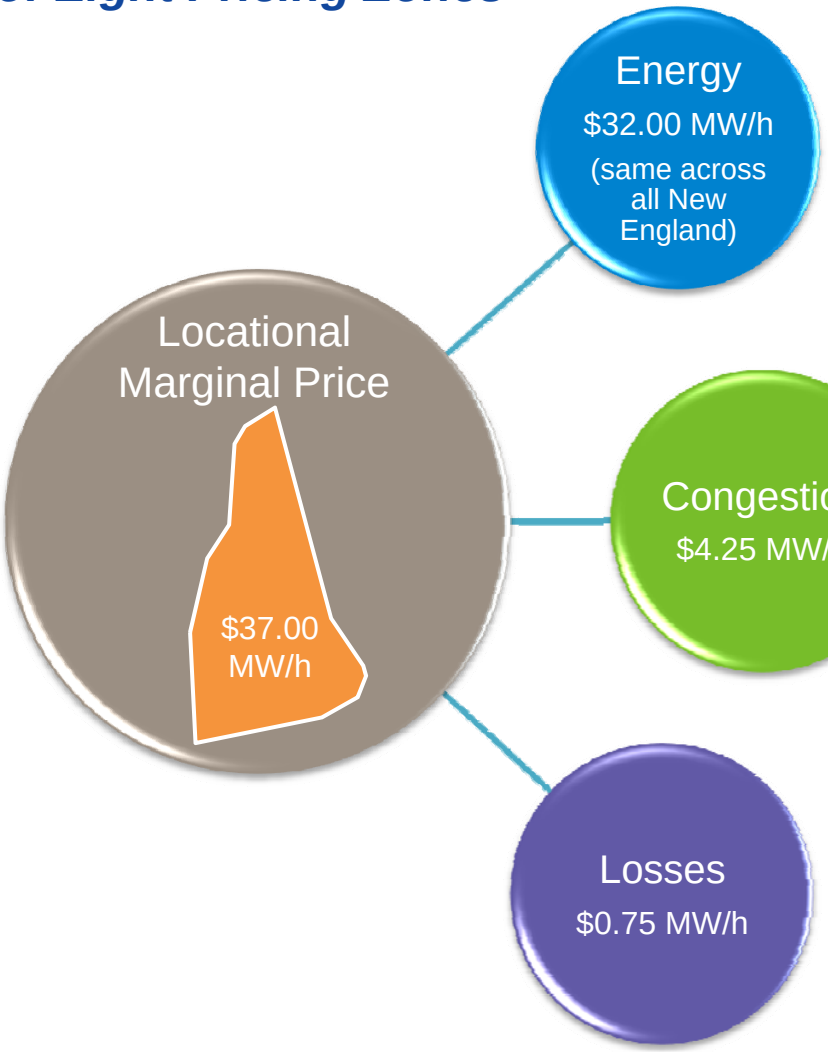
Hundreds of Regional Price Points Help Establish Wholesale Costs

- Since 2003, the Energy Market features Locational Marginal Pricing (LMP)
  - 900+ nodes or points on the system at which prices are calculated; generation is priced nodally
  - Node prices are averaged into eight pricing zones. Load pays zonal price for wholesale electricity.
- Zonal prices are made up of energy, congestion, and losses
  - Energy price is the same across New England
  - Congestion and losses are also priced to reveal local system conditions and constraints



The Elements of LMP

Energy, Congestion, and Losses Reflect Local System Conditions in Each of Eight Pricing Zones



- The same price across all of New England; established hourly by the UCP
- The added cost of operating a more expensive, local power plant to meet local demands due to transmission constraints
- Small amounts of energy that are lost as power is transmitted across long distances

Interplay of Wholesale Pricing Constructs

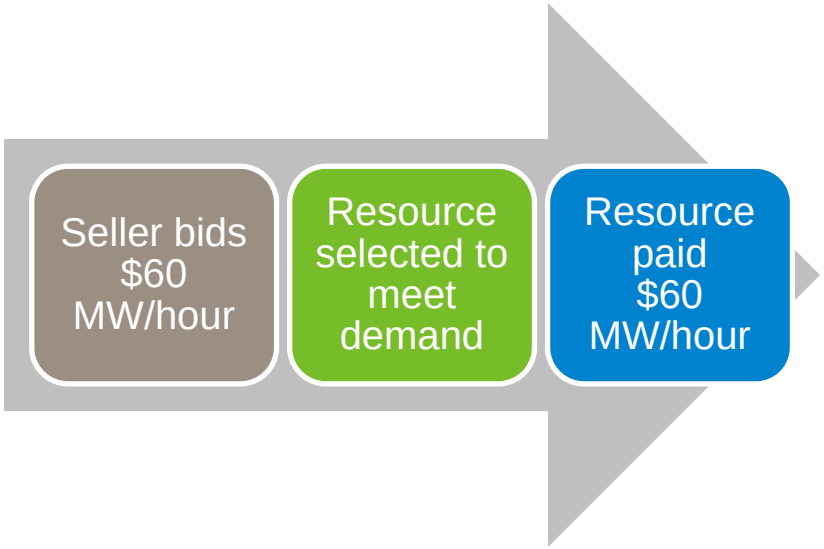
Economic Dispatch, UCP, and LMP Provide Consumers with Efficiencies and Savings

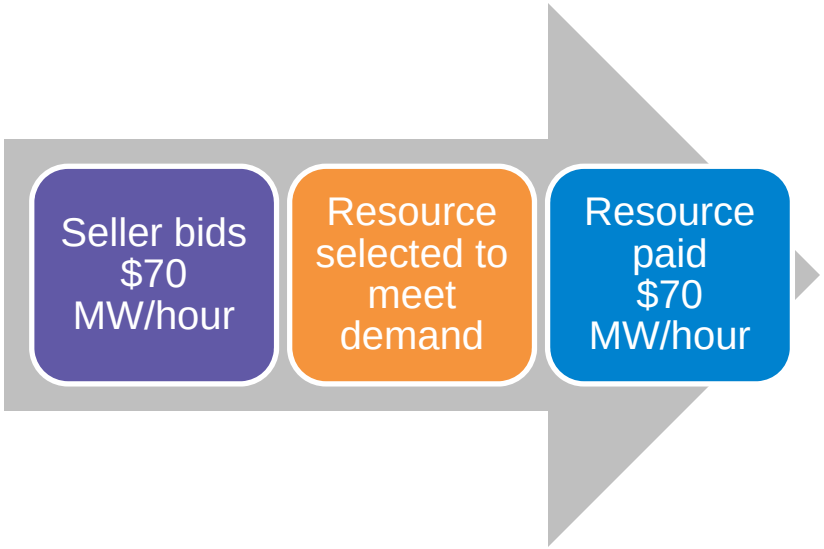
- Selects least expensive generation to meet power needs
- Sellers have incentive to bid operating costs; if owners overbid, they risk not being called upon to run
- Certain resources bid low to ensure that they are dispatched
- Results in efficiencies and lowers the cost of power for the entire region
- Provides important price signals to direct investment and relieve transmission congestion

Other Approaches to Resource Dispatch

Pay-as-Bid Provides Compensation based on a Resource's Offer

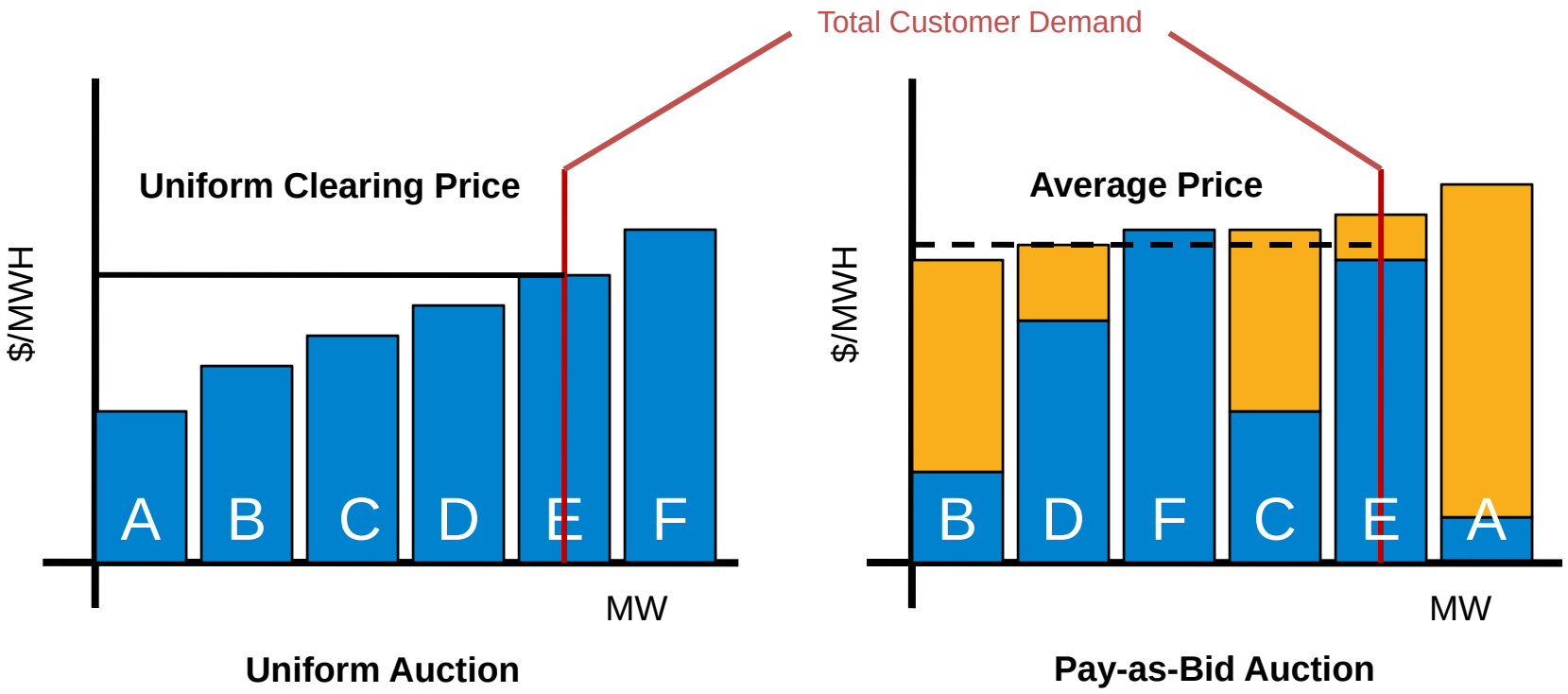
- Pay-as-bid construct pays sellers selected to run the price the resource offered into the market
  - Generators bid submissions presume the highest expected price to be paid and offer resources in at that level





Pay-as-Bid Not Likely to Lower Prices

Bidding Behavior Differs Dramatically Between UCP and Pay-as-Bid Models; Pay-as-bid Incents Bidders to Mark-up Prices



Advantages of Uniform Clearing Price

- Recognizes that one unit of a product is like another, regardless of how it is produced
- Creates transparency, making certain sellers bid just their true costs—not a best guess as to what the highest price will be
- Provides an opportunity for existing generators to recover capital costs
- Creates strong incentives for new investment by new, low-cost resources, such as hydro, wind, and nuclear
- Ensures the selection of the least expensive, most efficient resources

2009 Summer Demand and Wholesale Price Trends

Vamsi Chadalavada, Senior Vice President
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Overview of Discussion

- Link between fossil fuel prices and wholesale electricity costs
  - Uniform Clearing Price efficiently reflects real-time system conditions
  - Review of periods of high-priced fossil fuels (Summers of 2005 and 2008)
- Summer of 2009
  - Economy and mild weather impacts power usage
  - Falling fossil-fuel prices affect wholesale power costs

Wholesale to Retail Connection

Physical

- **Bulk Power System**
  - Electricity is produced in New England by more than 300 generators
  - Region's 8,000 miles of high-voltage transmission lines move electricity to substations where it is stepped down in voltage to feed into local distribution lines
  - Federal regulation (FERC)
- **Local Distribution System**
  - Local utilities distribute the electricity to businesses and homes
  - The region's 6.5 million households and businesses create the demand for electricity, which must be produced the instant it is needed
  - State regulation (DPUC)

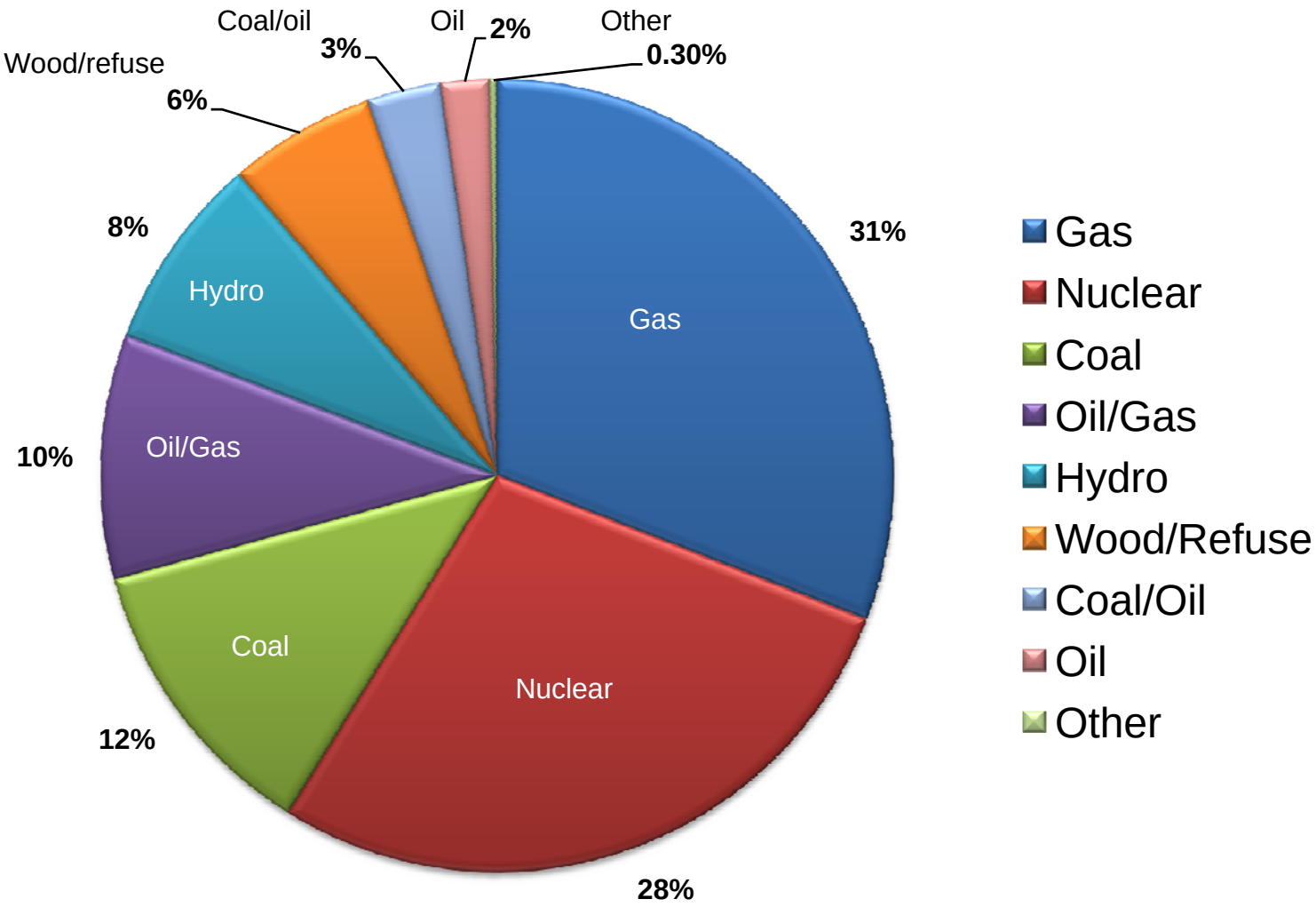
Wholesale to Retail Connection

Financial

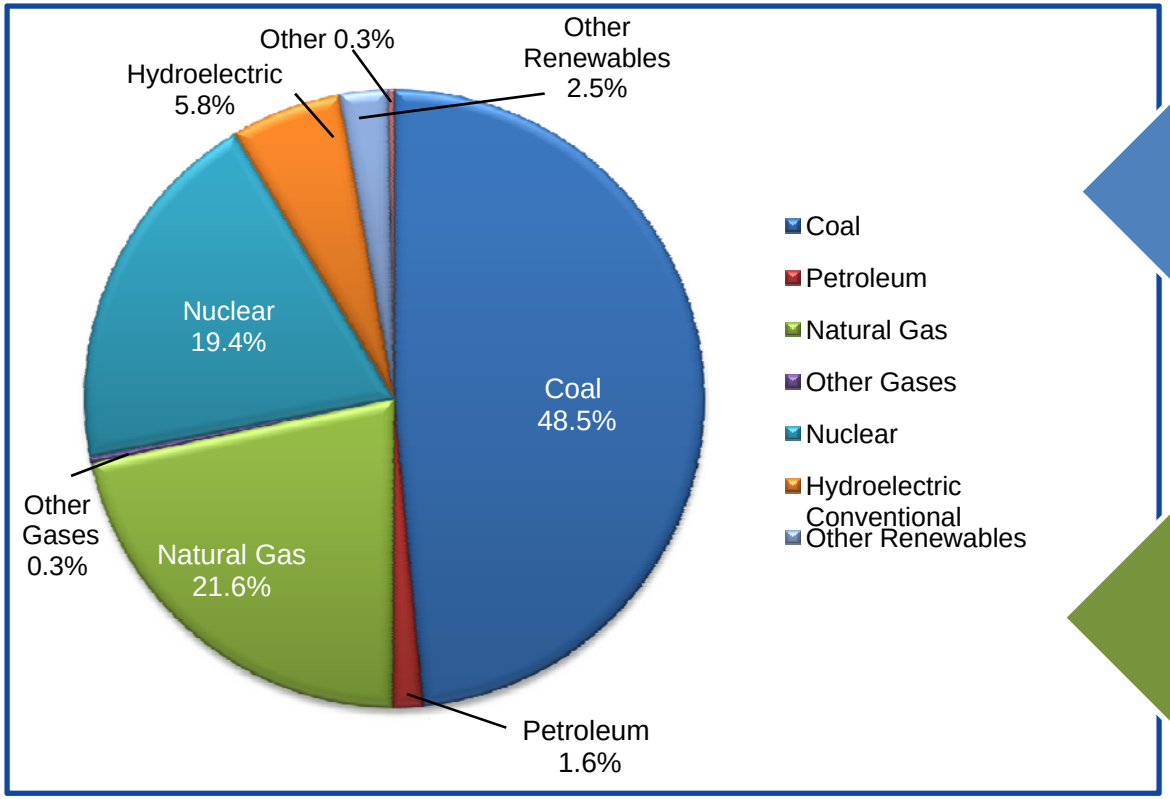
- **Wholesale electricity**
  - Generators sell the electricity through either wholesale markets or contracts with utilities and competitive suppliers
  - Wholesale costs/prices result from the generation and transmission of the product of electricity
  - Federal regulation (FERC)
- **Retail electricity**
  - Electric utilities and competitive suppliers buy electricity through markets or contracts with power producers
  - Households and businesses bills include both wholesale and retail costs of producing and delivering electricity
  - State regulation (DPUC)

New England's Generation by Fuel Type

Regional Sources of Energy in the Year 2008



National energy sources by fuel type



Coal fuels almost 50% of US generation

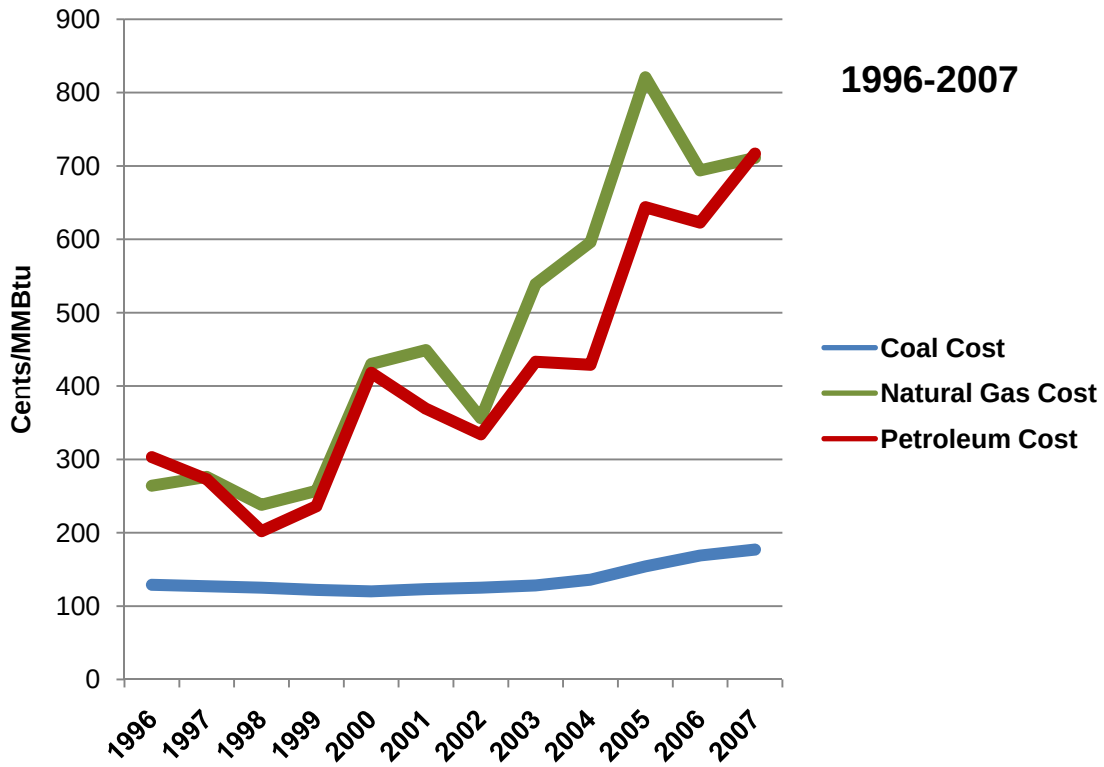
Gas & oil fuel 23% of US generation

Source: U.S. Energy Information Administration

U.S. energy sources by fuel cost trends

Gas & oil costs have risen dramatically

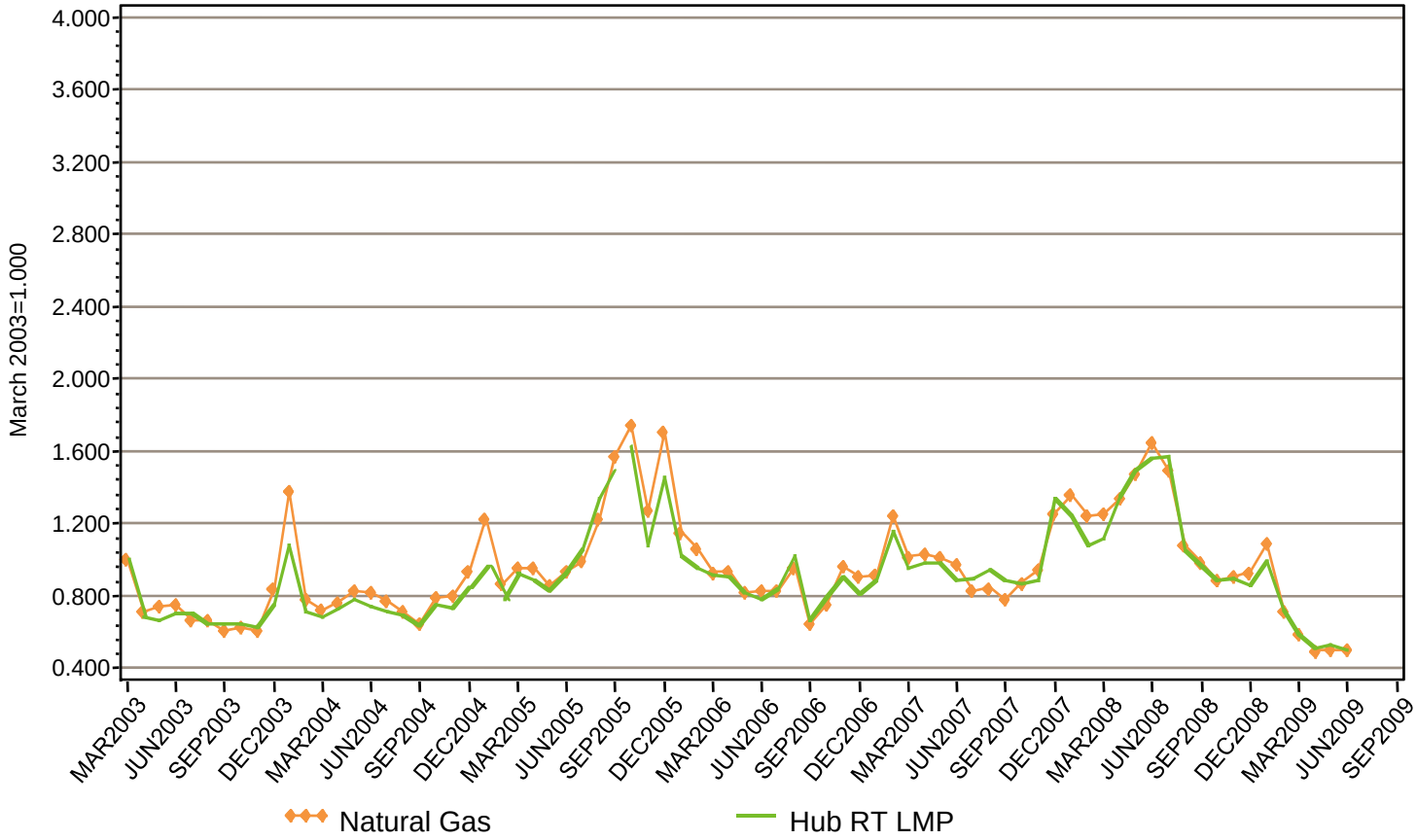
Coal cost has remained low and stable



Source: U.S. Energy Information Administration

Wholesale Electricity Prices Closely Track Fuel Prices

Monthly Average Fuel Price and RT Hub LMP Indexes

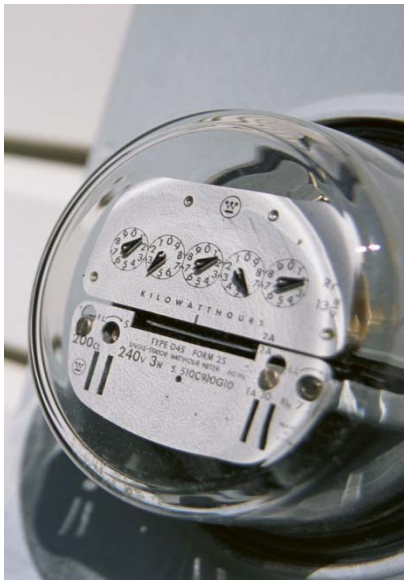


Underlying natural gas data furnished by:

ICE Global markets in clear view

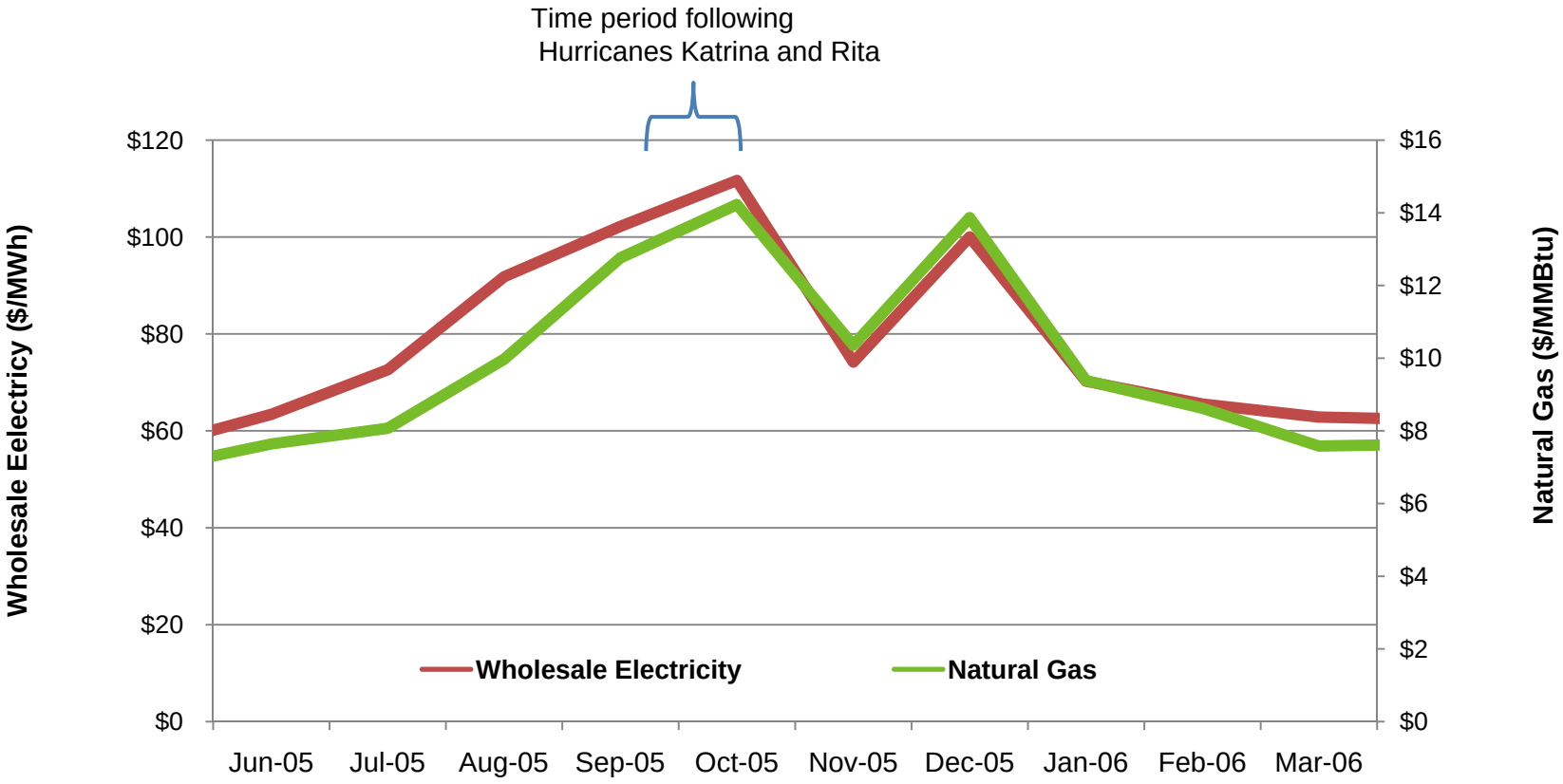
UCP Reflects Real-time Conditions

- When demand is low, lower-cost resources can provide all the energy required
- As demand increases, fossil-fuel units set the clearing price
  - Wholesale electricity prices will tend to rise, especially when demand is also high

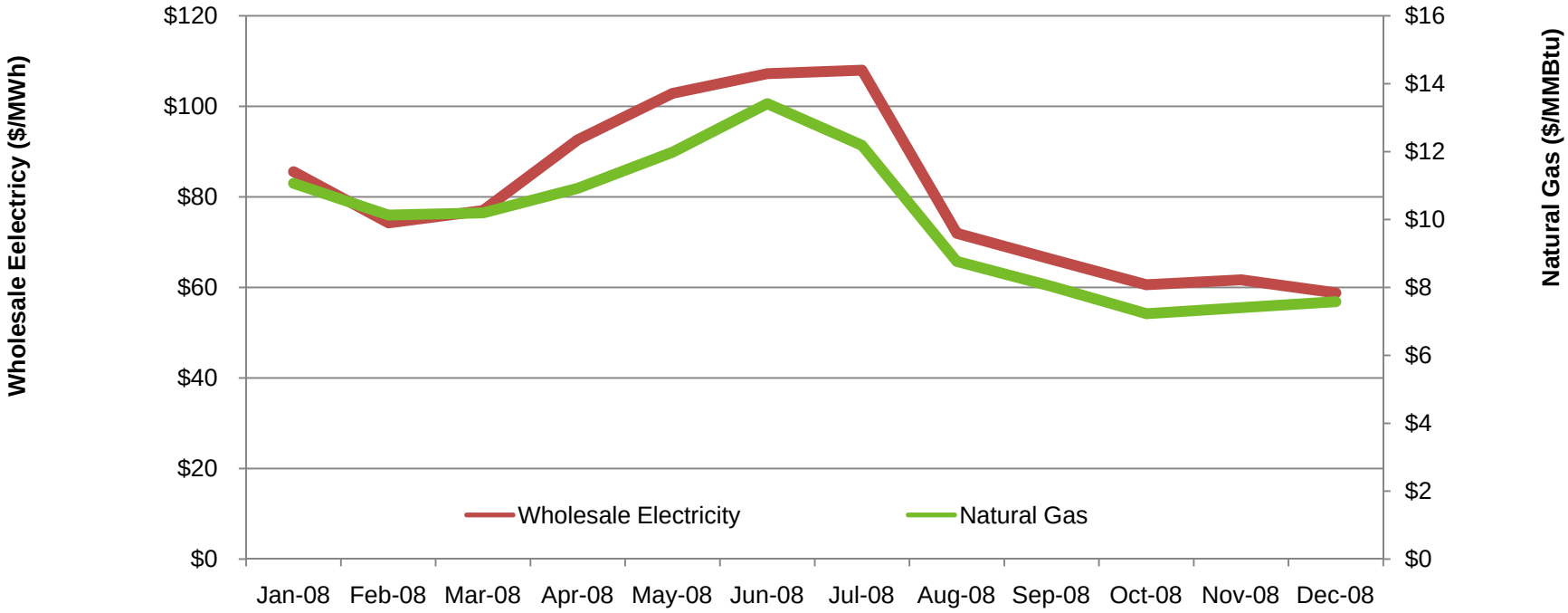
Hurricane Katrina damage to oil and gas rig in Gulf of Mexico

Wholesale electricity prices recover along with natural gas prices, June 05-March 06



Natural Gas Price Rises and Falls in 2008

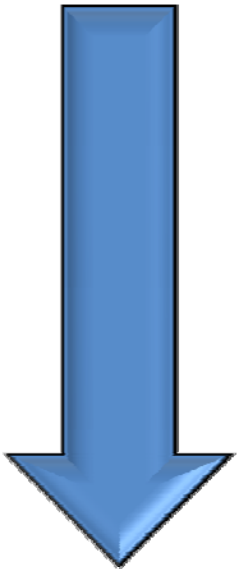
Wholesale Electricity Price Increases and Decreases Follow Along



Consumption Drops from Summer 2008 to 2009

Weather, Economy, and Efficiency Push Power Demand Down

	2008 (GWh)	2009 (GWh)	% change
June	11,338	9,954	-12.2
July	13,021	11,292	-13.3
August	11,569	12,553	8.5
Total	**35,928**	**33,799**	**-5.9**



New England Demand Peaks in the Summer

Top 5 Demand Days of All Time

Date	Peak (MW)
August 2, 2006	28,130
August 1, 2006	27,467
July 18, 2006	27,329
August 3, 2006	27,118
July 27, 2005	26,885

Top Demand Day Each Summer 2005-2009

Date	Peak (MW)
August 18, 2009	25,081
June 10, 2008	26,111
August 3, 2007	26,145
August 2, 2006	28,130
July 27, 2005	26,885

Fuel and electricity prices, 2008 vs. 2009

	2008	2009	% change
Natural gas (MMBtu)	$11.43	3.75	**-67**
Oil (MMBtu)	$16.46	$9.88	**-40**
Avg. New England LMP (MWh)	$95.58	$35.48	**-63**

Underlying natural gas data furnished by:

ICE Global markets in clear view

Influencing the Drivers of Wholesale Prices

- Wholesale electricity prices move in tandem with fossil fuel prices
- A diverse fuel mix will lessen the region's vulnerability to volatility in natural gas and oil prices