

# Overview of the Electricity Market in North America

Joint Public Advisory Committee, Commission for  
Environmental Cooperation

March 24, 2010



# Outline

- Electricity: The Basics
- North American Supply
- Transmission and Connectivity
- Fragmented Energy Policy
- Carbon Policy and Energy Mix

# What do we think of when we think about Electricity?

- “The Holes” – Seinfeld Episode 174
- Appliances
- Making our lives easier and more comfortable
- Simplicity and Reliability



## The Reality

- Complexity
  - Capital Intensive Infrastructure
  - Energy markets
  - Regulatory oversight
  - Environmental Impacts



# Electric Power Industry - Unique Commodity Business

- Electricity is a highly valuable commodity:
  - Demand is close to infinitely inelastic
  - There is no economic replacement (for most applications)
- Electricity cannot be stored:
  - Converting electrical energy into other forms of energy for storage is inefficient
  - Current storage options include: pumped storage, batteries, flywheel, compressed air and hydrogen
- Thus, the generation of electricity must occur at the same time the electricity is needed to instantaneously balance supply and demand
- US Electricity (\$352 billion/year)
  - Natural Gas (\$115 billion/year)
  - Oil (\$410 billion/year)
  - Coal (\$34 billion/year)

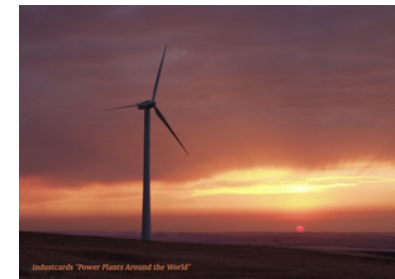
The software industry—approximately \$180 billion/year.

# Electricity is.....

- Electricity is simply the flow of *electrons* through a *conductor*
  - Conductors have a low *resistance* to electron flow
  - Insulators are the inverse of conductors
  
- External energy is required to spontaneously force an electron from an atom and create the necessary flow, or current

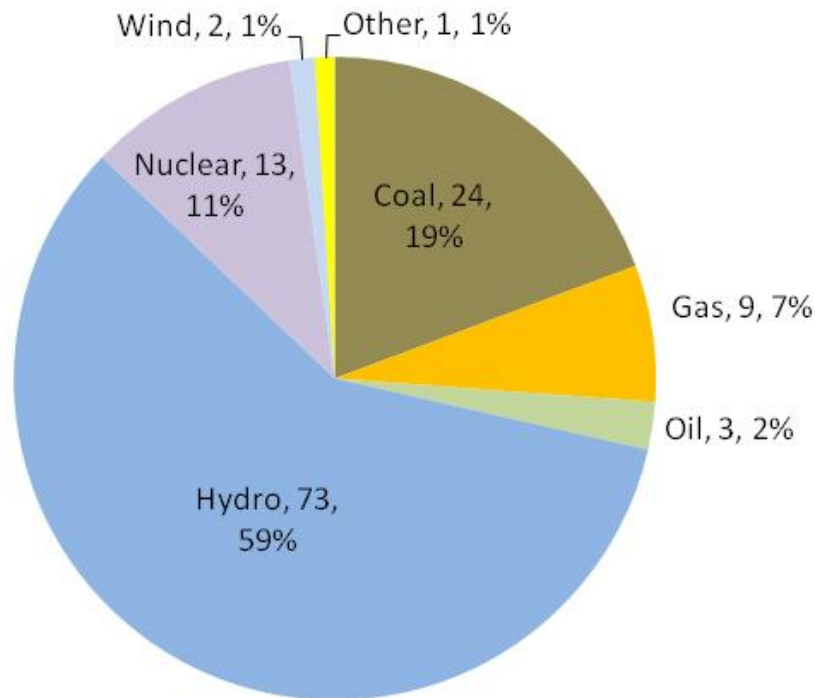
- Hydro (Ubiquitous term)
- Steam
  - Coal
  - Oil
  - Natural Gas
  - Nuclear
- Combustion Turbine
- Wind
- Solar
- Biomass

Aberfeldie Hydro, BC.  
 Ravenswood CC, NY. Battle  
 River, AB. Cypress Wind,  
 SK.

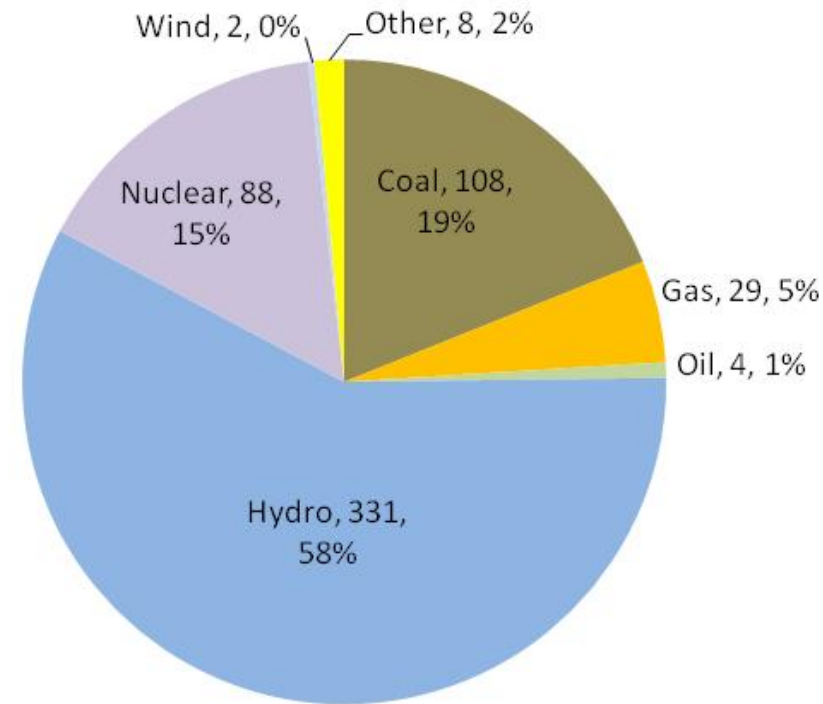


# Canadian Electricity Supply – 571 TWh

## Generating Capacity (GW)



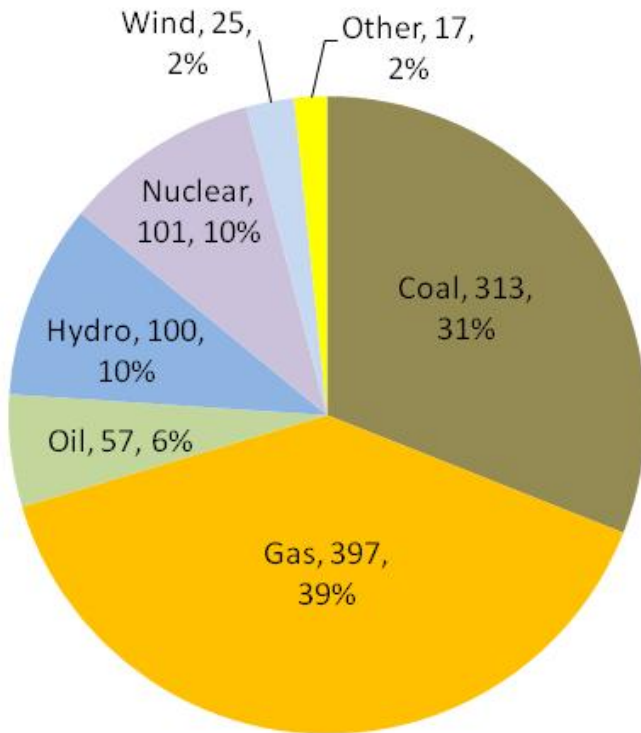
## Net Energy Output (TWh)



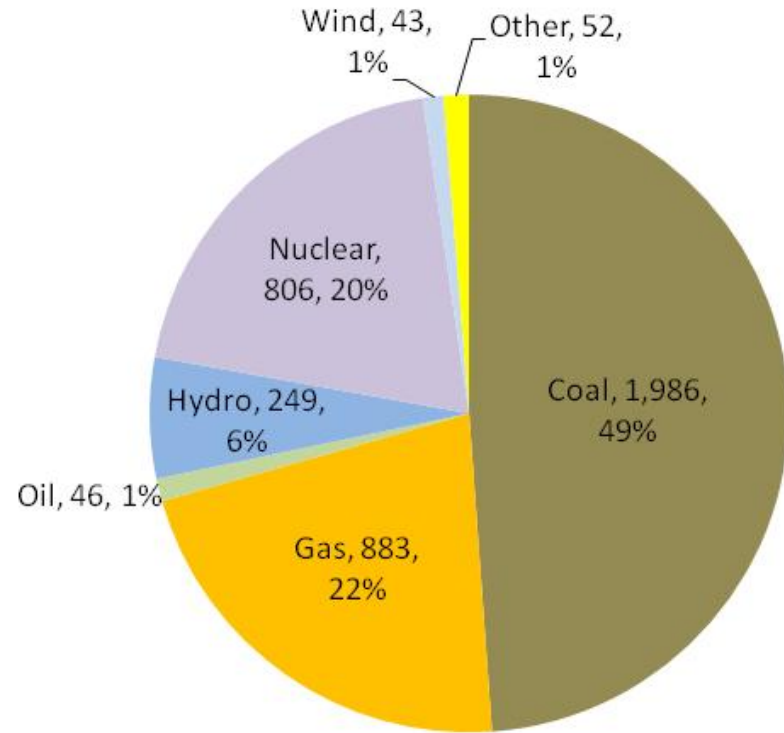
Sources: Canada National Inventory Report 1990-2007. Table A9-1: Electricity Generation and GHG Emission Details. Stats Can. Electric Generation, Transmission Distribution 2007

# US Electricity Supply – 4,065 TWh

## Generating Capacity (GW)



## Net Energy Output (TWh)

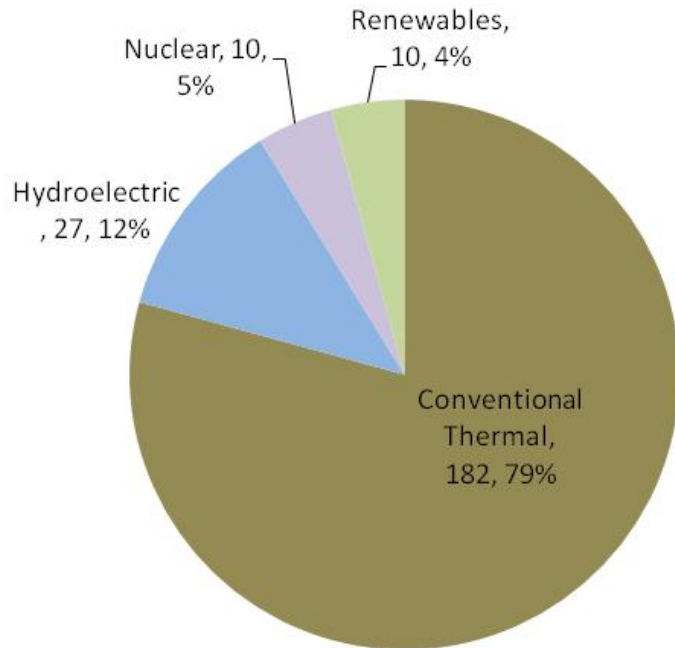


Source: US EIA Independent Statistics and Analysis 2008 and SNL Financial 2008



# Mexico Electricity Supply – 229 TWh

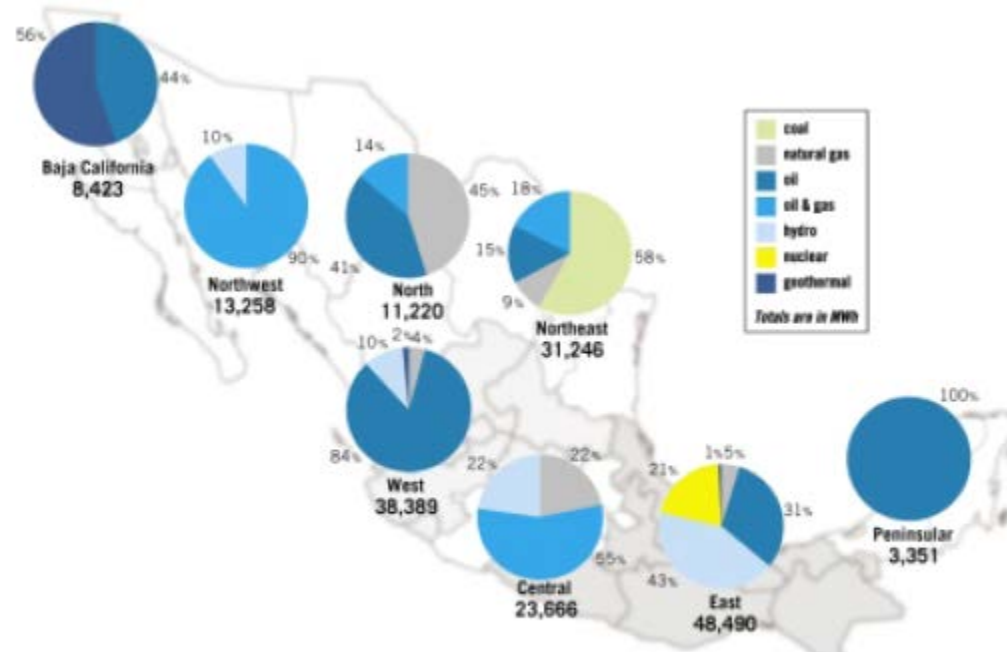
## Net Energy Output (TWh)



Source: US EIA International Electricity Statistics, 2005

- Substantial Regionalization

- Regions bordering the US nearly entirely fossil existing
- Newer developments and Resources include Substantial renewables



Data based on: Sector Eléctrico, Secretaría de Energía México 2000. Numbers may not total 100 due to rounding.

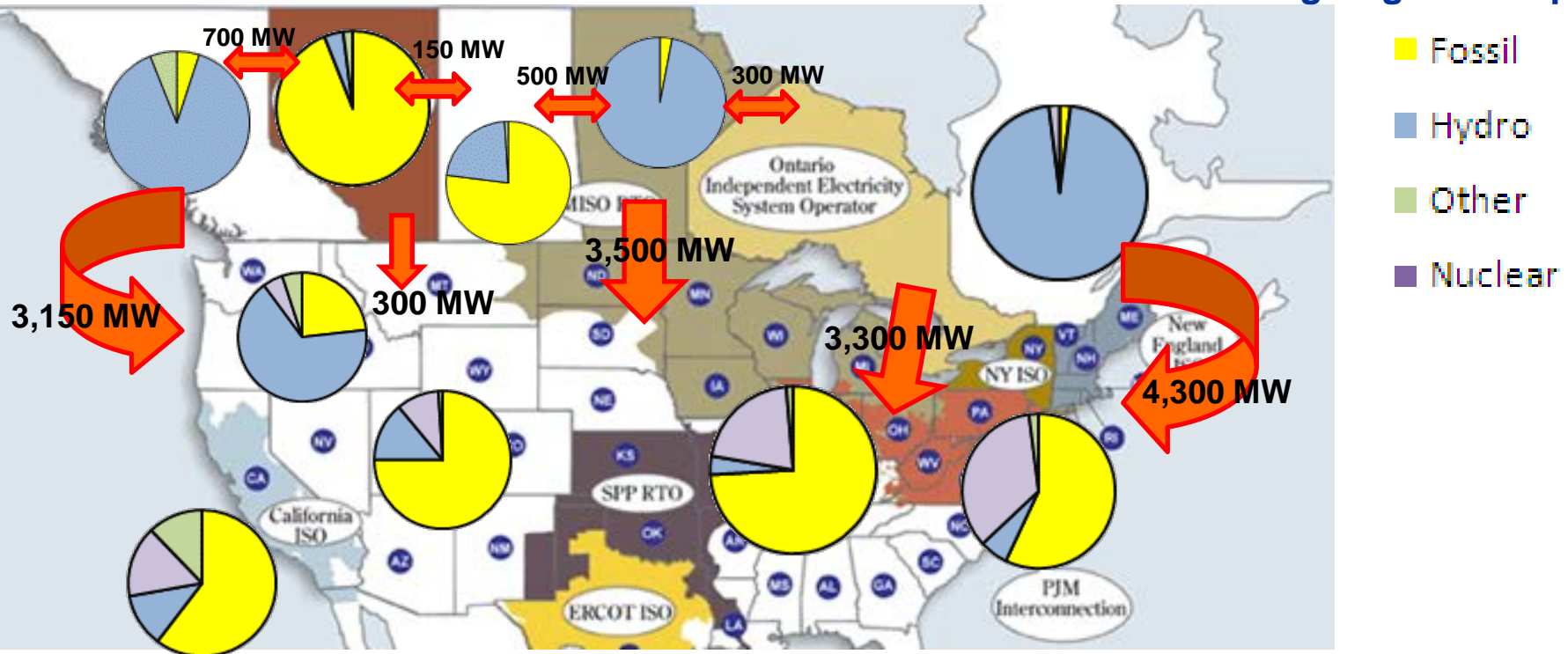


# Transmission, Imports and Exports

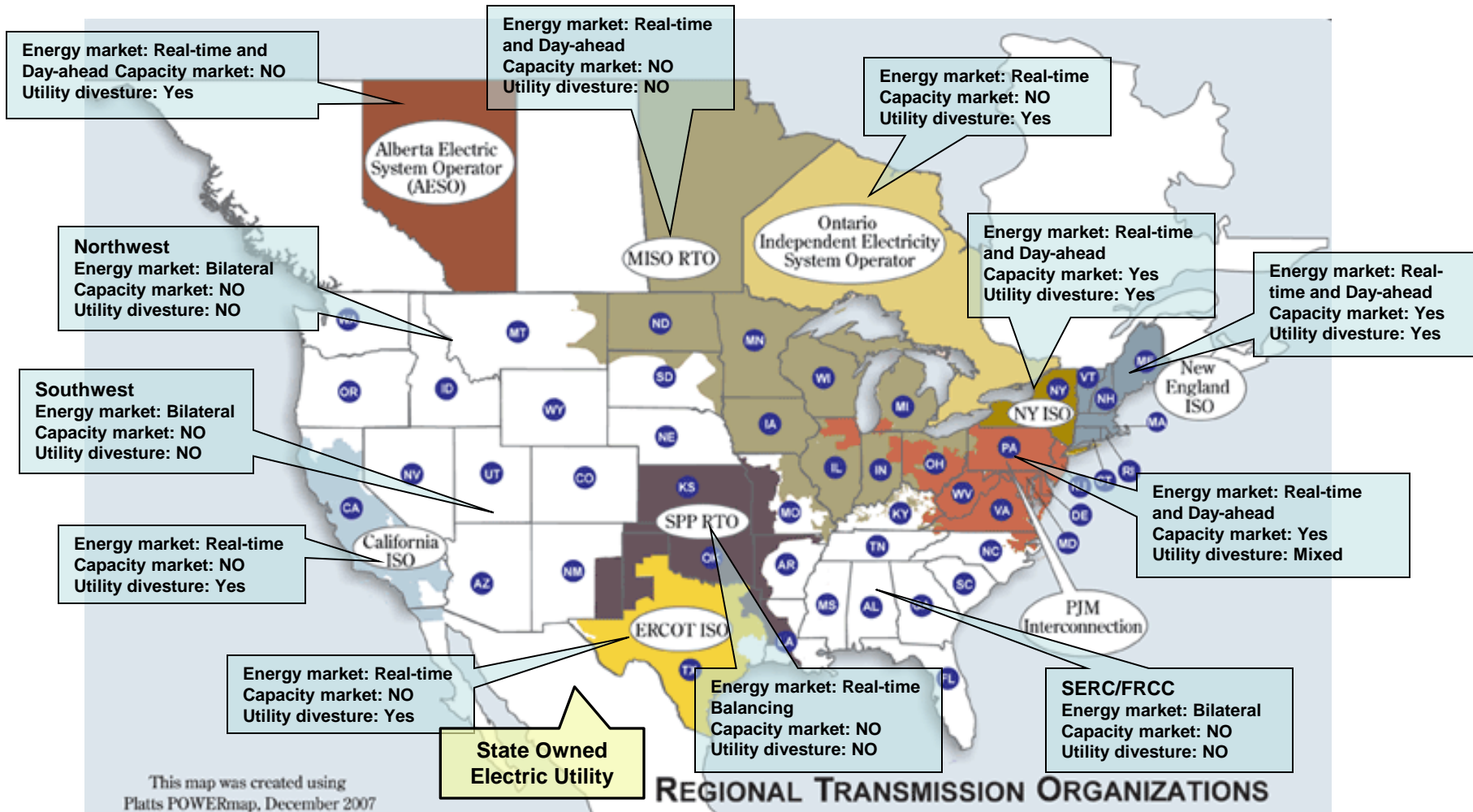
TWh 2006	
Canada to US	41.5
US to Canada	23.4
Mexico to US	1.1
US to Mexico	0.8
Net Canada	-18.1
Net US	18.4
Net Mexico	-0.4

- Regional Existing Supply
- Interties Can Diversify Resources

## Existing Regional Supply



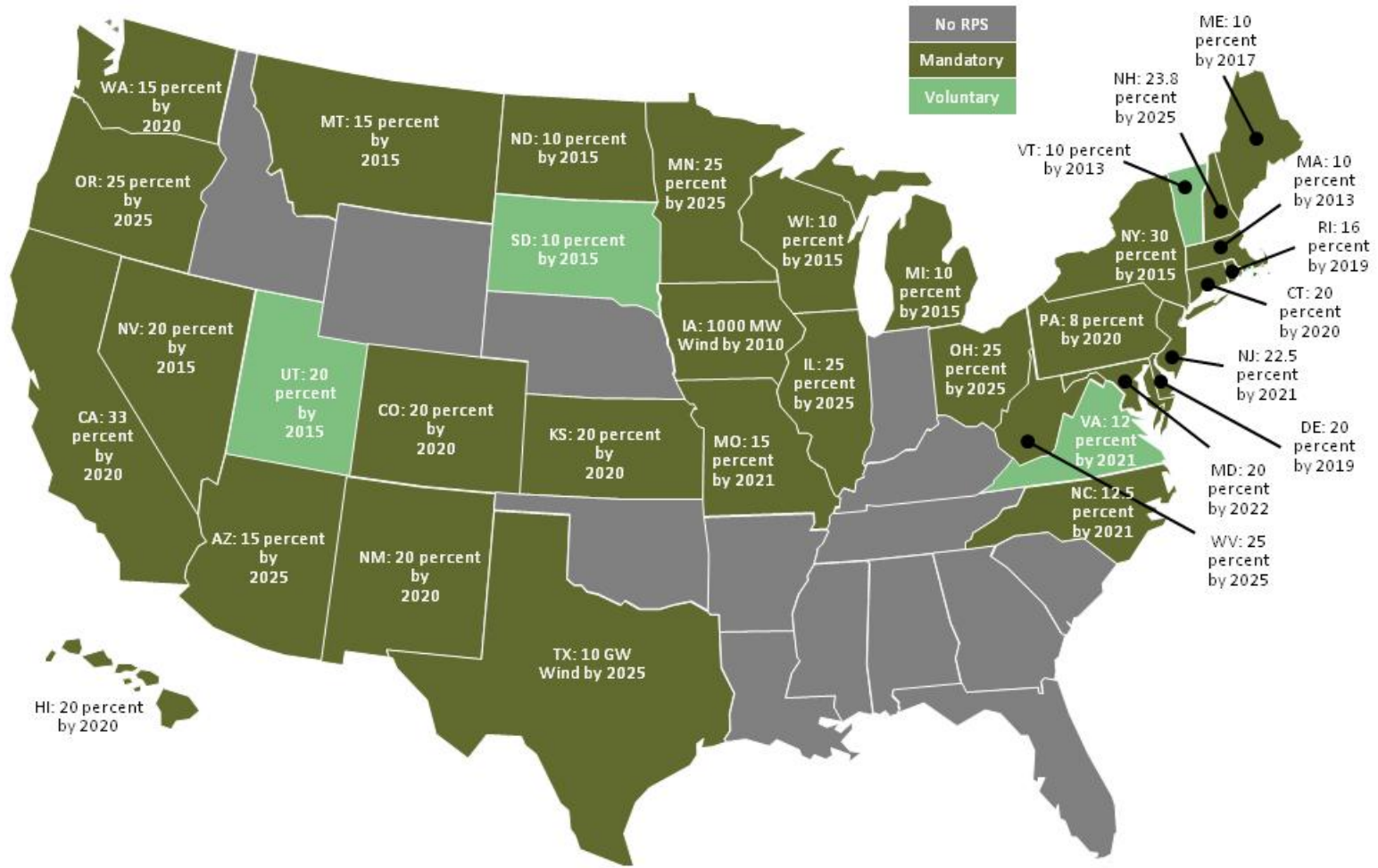
# Utility Deregulation: Evolving Competitive Market Structure



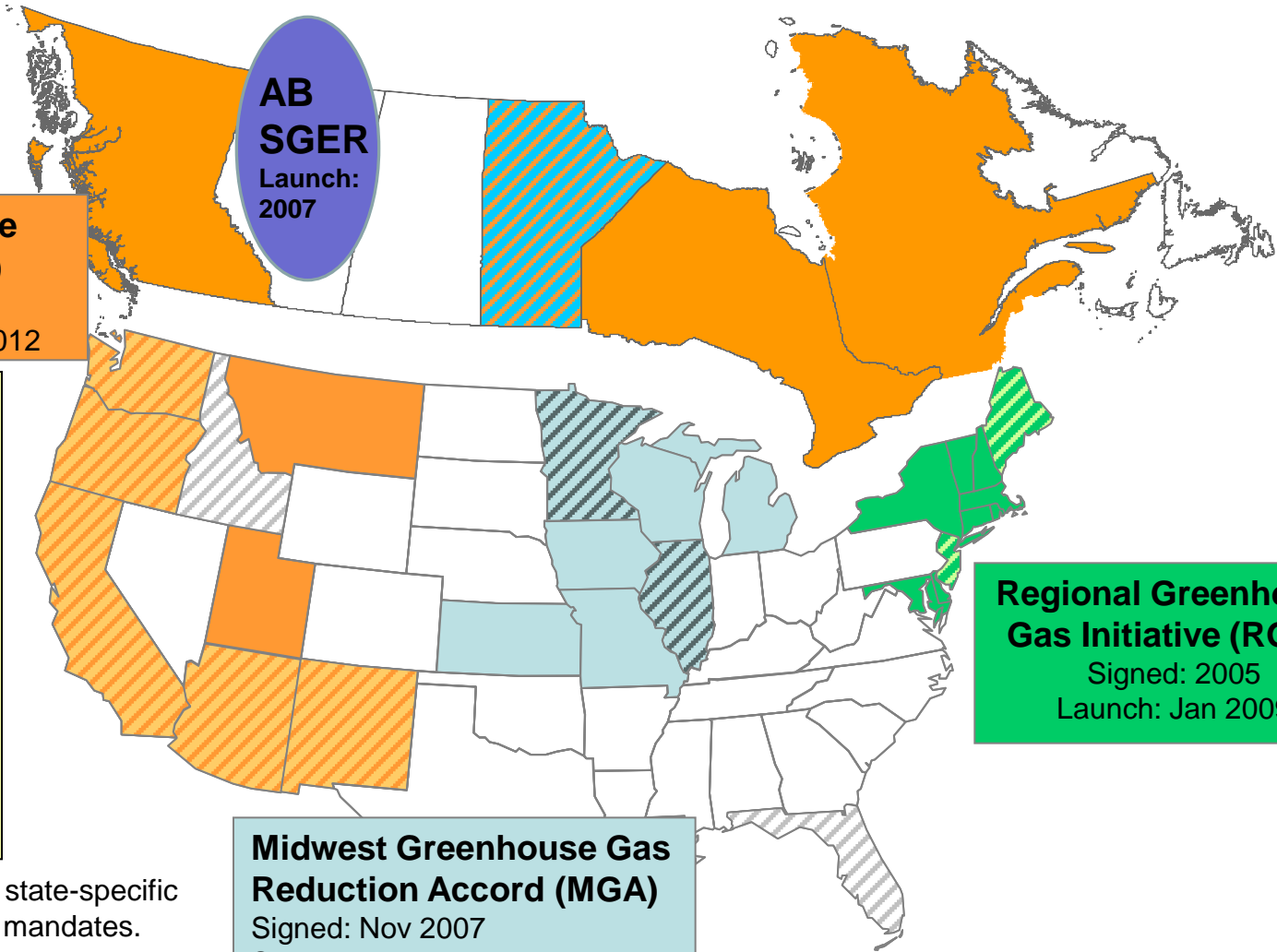
Note: All the markets have bilateral real-time and bilateral day-ahead markets.

Source: FERC 2006 SOM

# Renewable Portfolio Standards



# Regional Carbon Market Initiatives likely to be Superseded by Federal Climate Policy



**AB  
SGER**  
Launch:  
2007

**Western Climate Initiative (WCI)**  
Signed: Feb 2007  
Scheduled launch: 2012

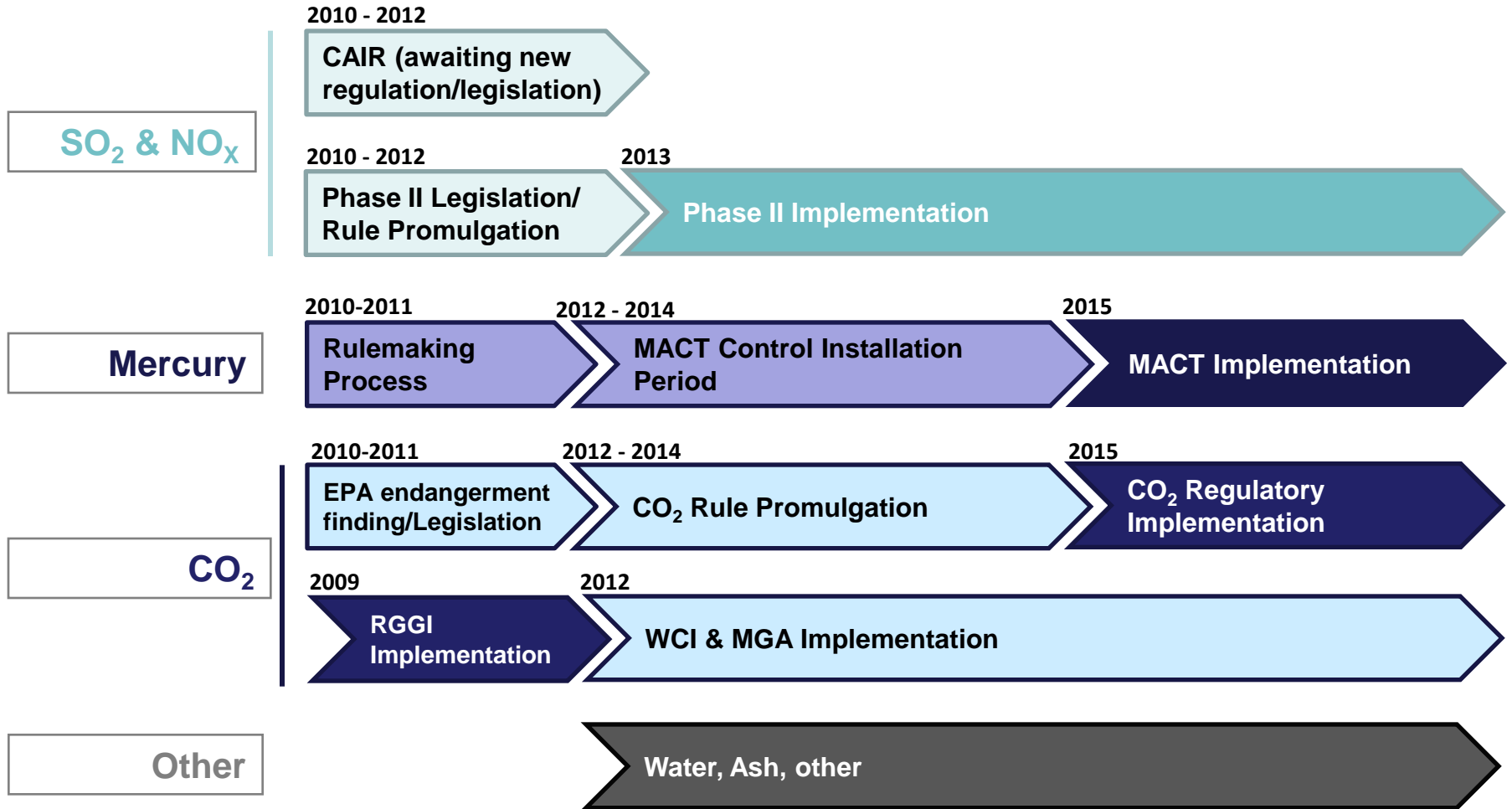
- WCI Observers**
- Tamaulipas
  - Nuevo Leon
  - Coahuila
  - Chihuahua
  - Sonora
  - Baja California
  - Saskatchewan
  - Nevada
  - Colorado
  - Wyoming
  - Alaska

**Regional Greenhouse Gas Initiative (RGGI)**  
Signed: 2005  
Launch: Jan 2009

**Midwest Greenhouse Gas Reduction Accord (MGA)**  
Signed: Nov 2007  
Scheduled launch: 2012

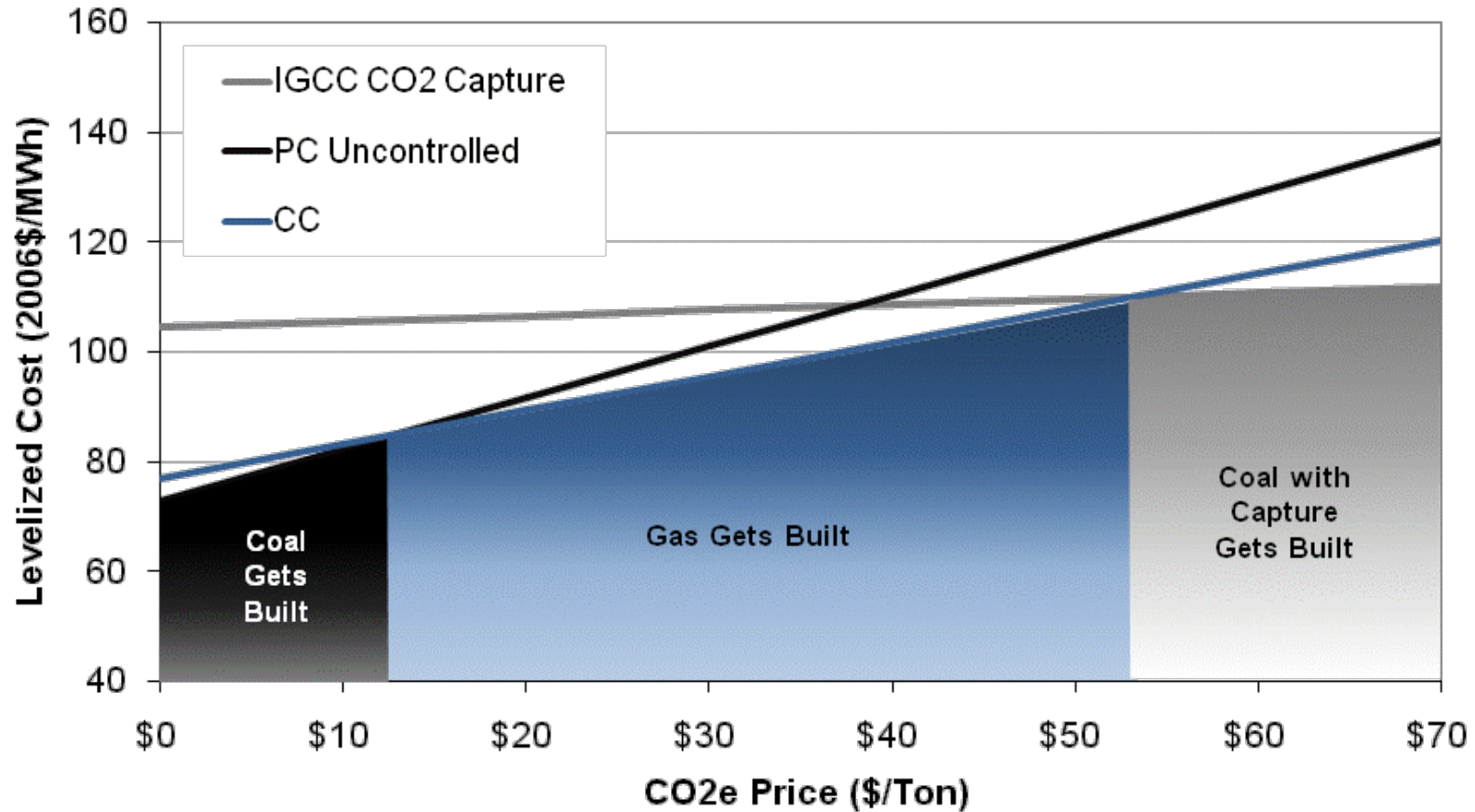
States with stripes have state-specific GHG reduction goals or mandates.

# Environmental Regulatory Uncertainty on Multiple Fronts



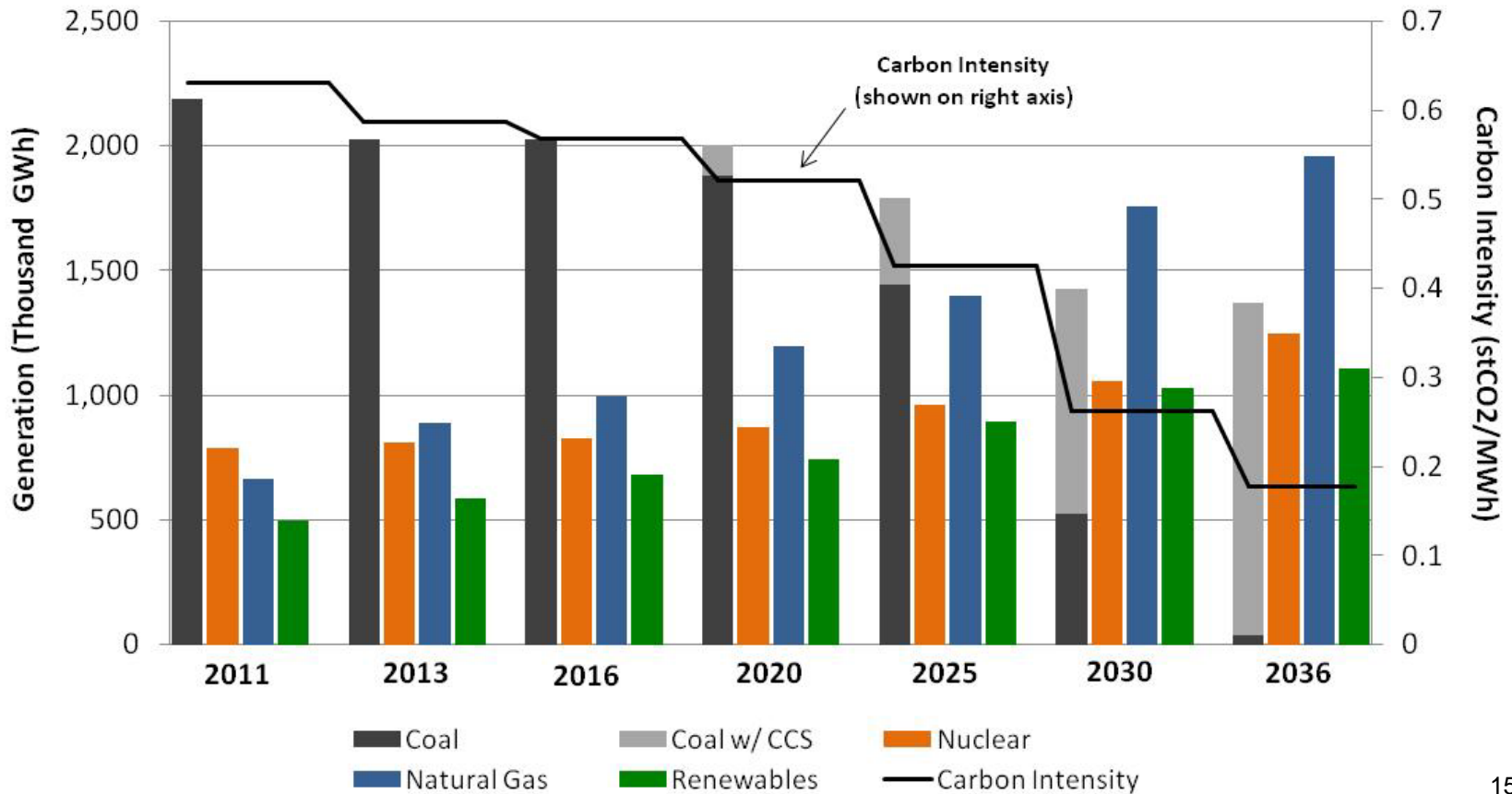


# Monetizing CO<sub>2</sub> Impacts Build Decisions and Technology Innovation



# Carbon Fundamentally Changes the Electric Generation Mix and Carbon Intensity

- Carbon intensity plummets with the expectation of a rising carbon price, which incites investment in more nuclear and renewables capacity, accelerates coal retirements, and leads to cleaner dispatch
- Total generation declines (by 17% in 2036) as a result of energy conservation measures taken in response to higher wholesale electricity prices





# Canada's Generation Mix Achieves a Substantially Lower Emission Intensity

- Currently, policy initiatives are projected to drive a nearly 50% reduction as capital stock turns over and more investment is directed toward lower or non-emitting sources

