NUCLEAR ECONOMICS
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Nuclear Power and Electricity Deregulation: Lessons from the U.S. Experience

51st JAIF Annual Conference
Nuclear Power, A Key Energy Solution for the Future?

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Introduction

- U.S. has considerable experience with both deregulation and nuclear power
- This experience has not been positive
- U.S. nuclear power
  - Faces financial problems in deregulated regions
  - May not be compatible with electricity markets
  - Requires extra revenue to survive in electricity markets

What is deregulation?

Traditional electricity industry approach

- Vertically-integrated regulated/government utility
- Cost recovery through customer rates
- Long-term resource planning

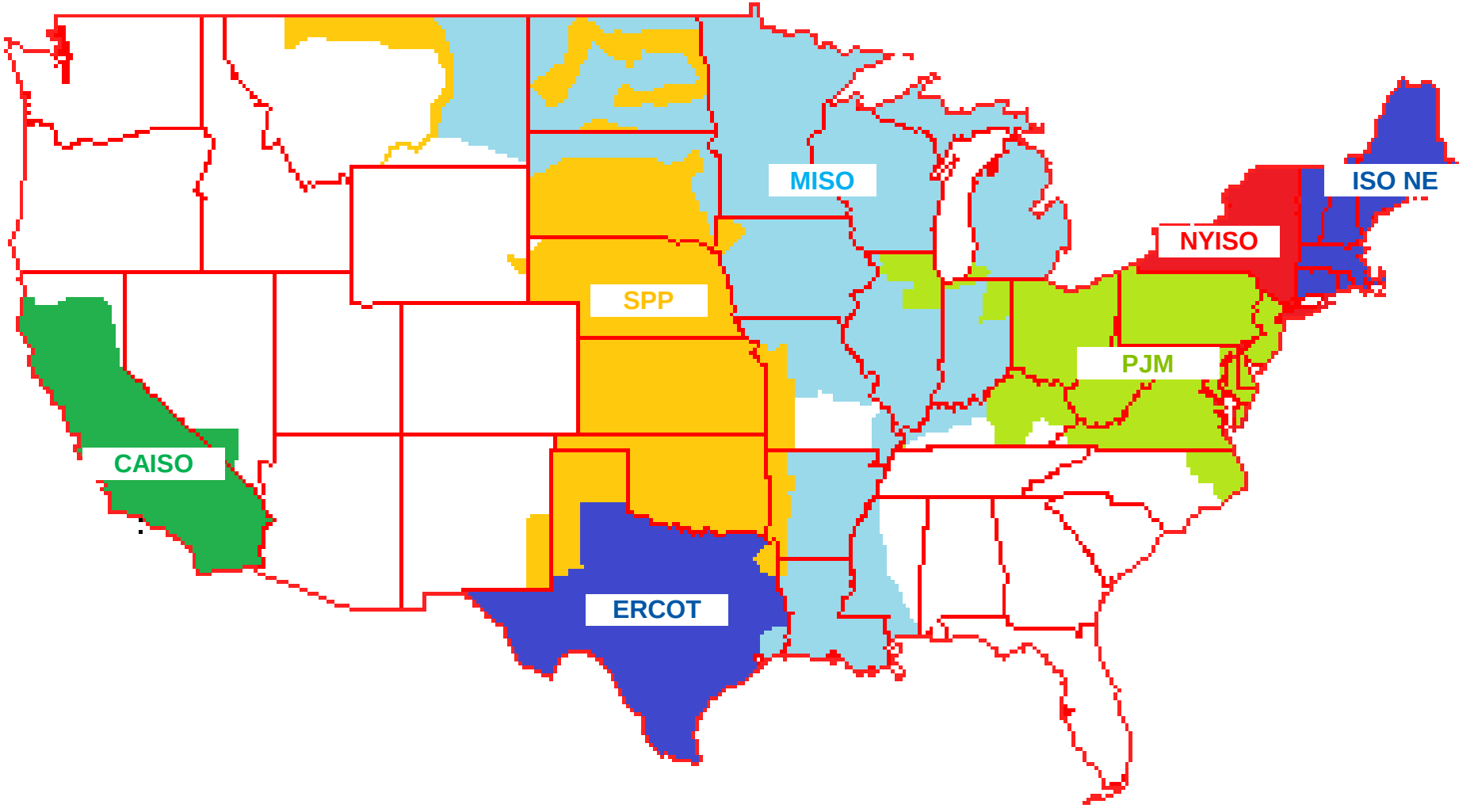
Deregulation approach

- Separate generation sector
- Bid-based electricity market to manage system dispatch and set wholesale electricity market price
- Generation depends on market for revenue
- Long-term resource planning replaced, in theory, by market entry/exit of generators

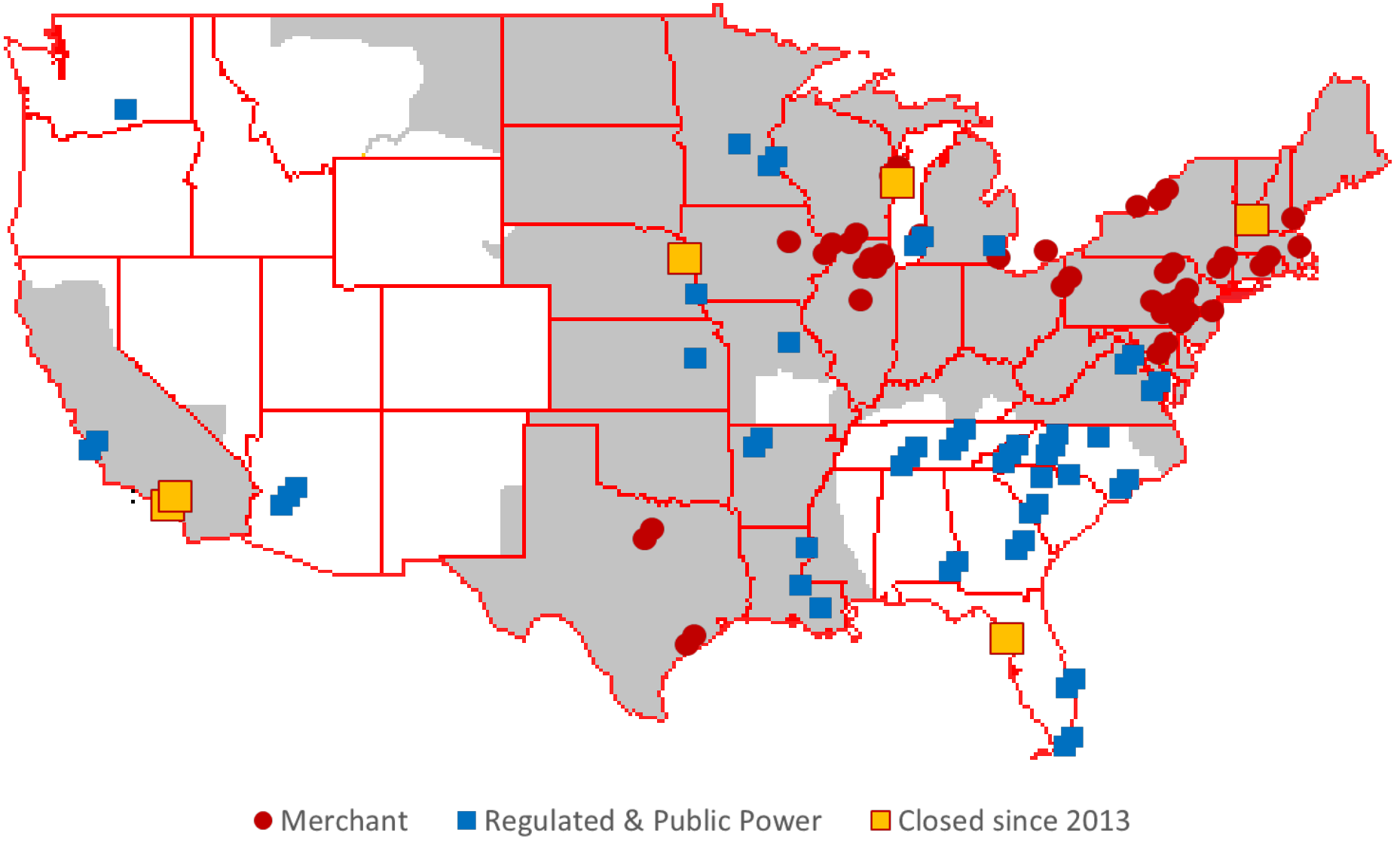
Nuclear experience

- All operating nuclear power plants were built in traditional (regulated or government) model
- All nuclear power plants under construction today are in traditional (regulated or government) model
- U.S. merchant new nuclear projects cancelled
- A few exceptions outside U.S.
  - UK – long-term power contracts to attract investors
  - Turkey – power contracts + market sales of power

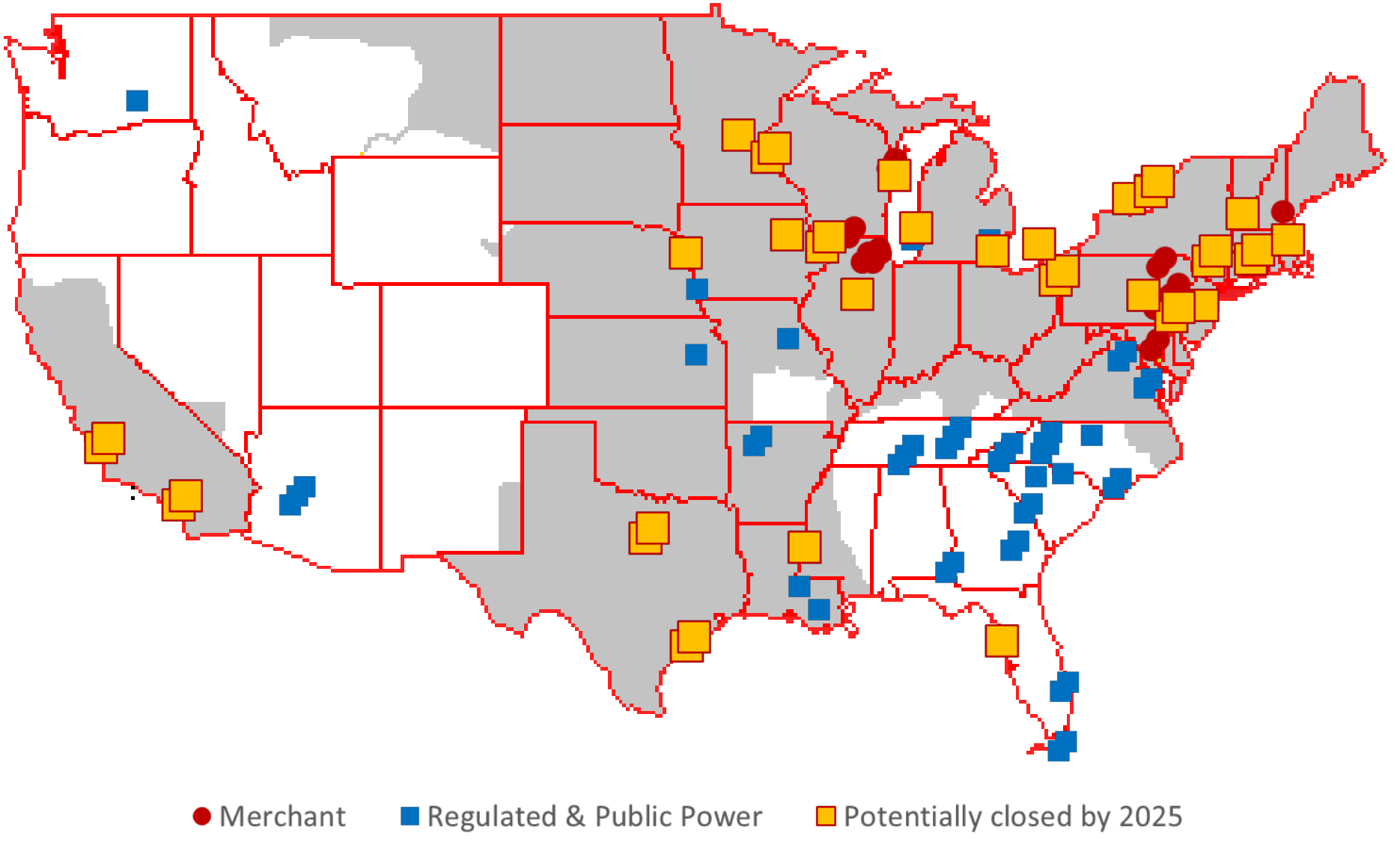
U.S. Electricity Market regions



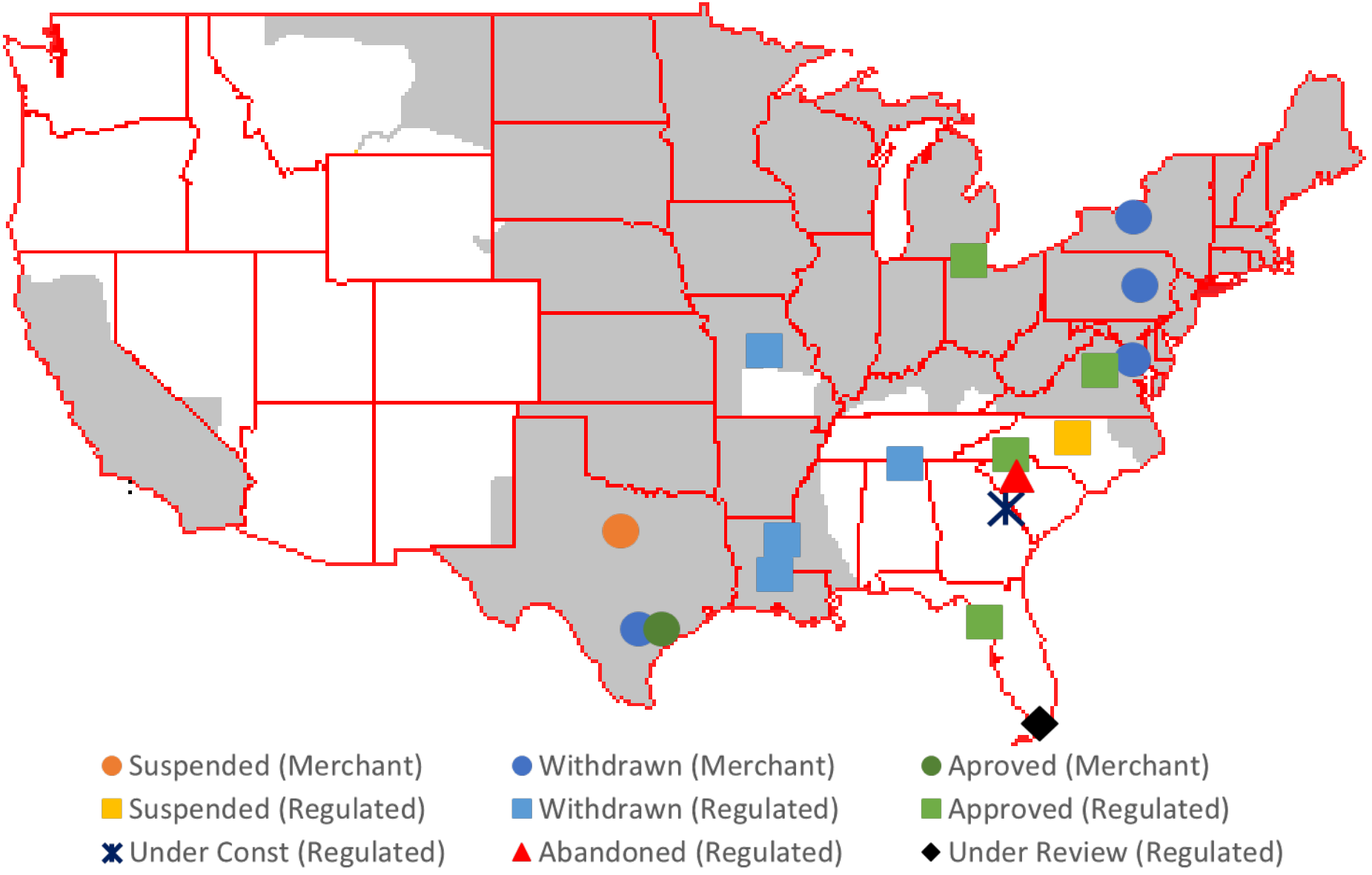
Current U.S. nuclear fleet



More nuclear units may close by 2025



COL Application Status



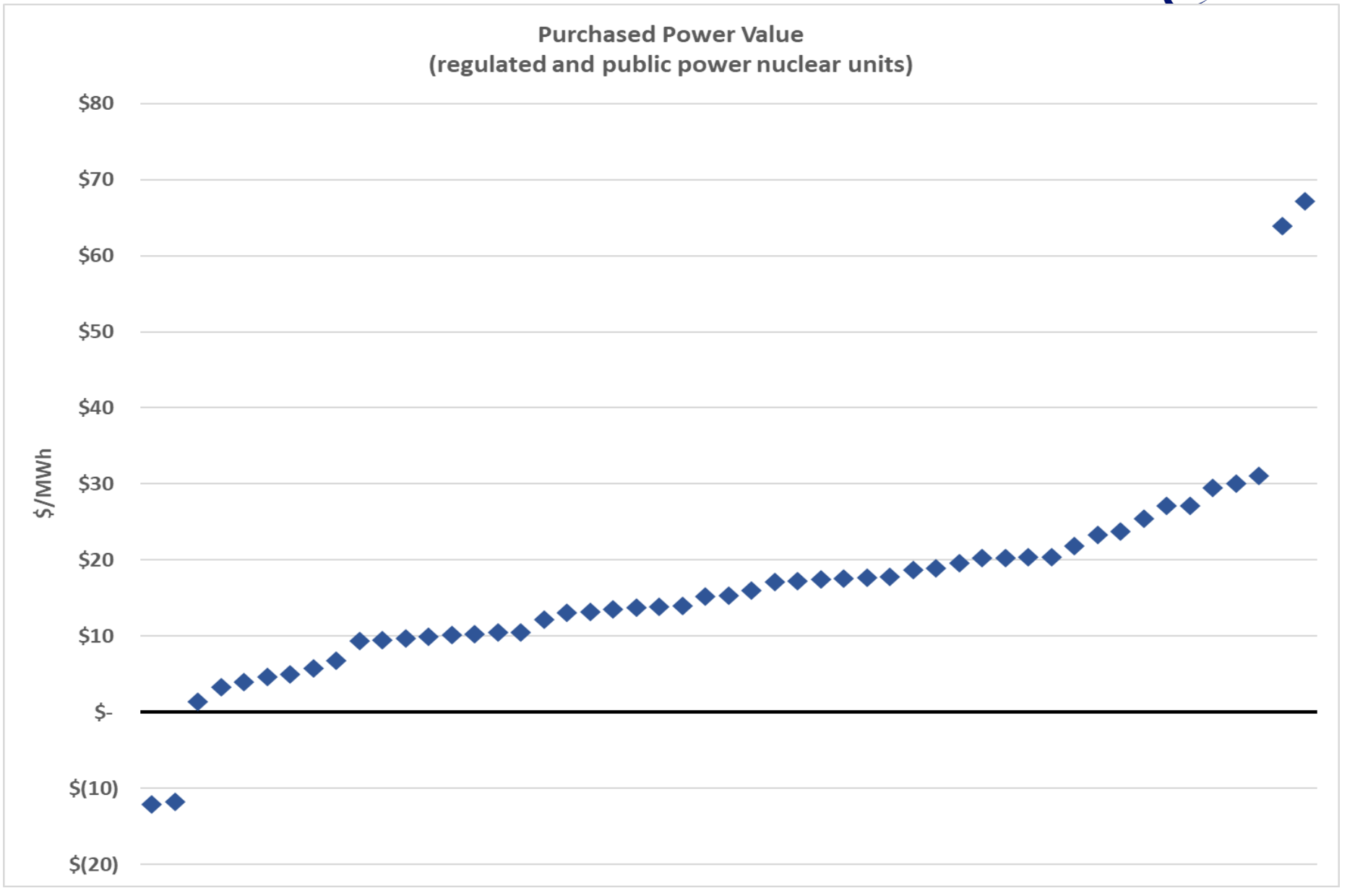
Analyses of nuclear value

Value	Basis	Nuclear units
Replacement	Avoided cost of new CCGT	All
Purchased Power	Avoided power purchases	Regulated & Public Power
Total Generation	Avoided generation costs	Regulated & Public Power
Market	Electricity market revenue	Merchant

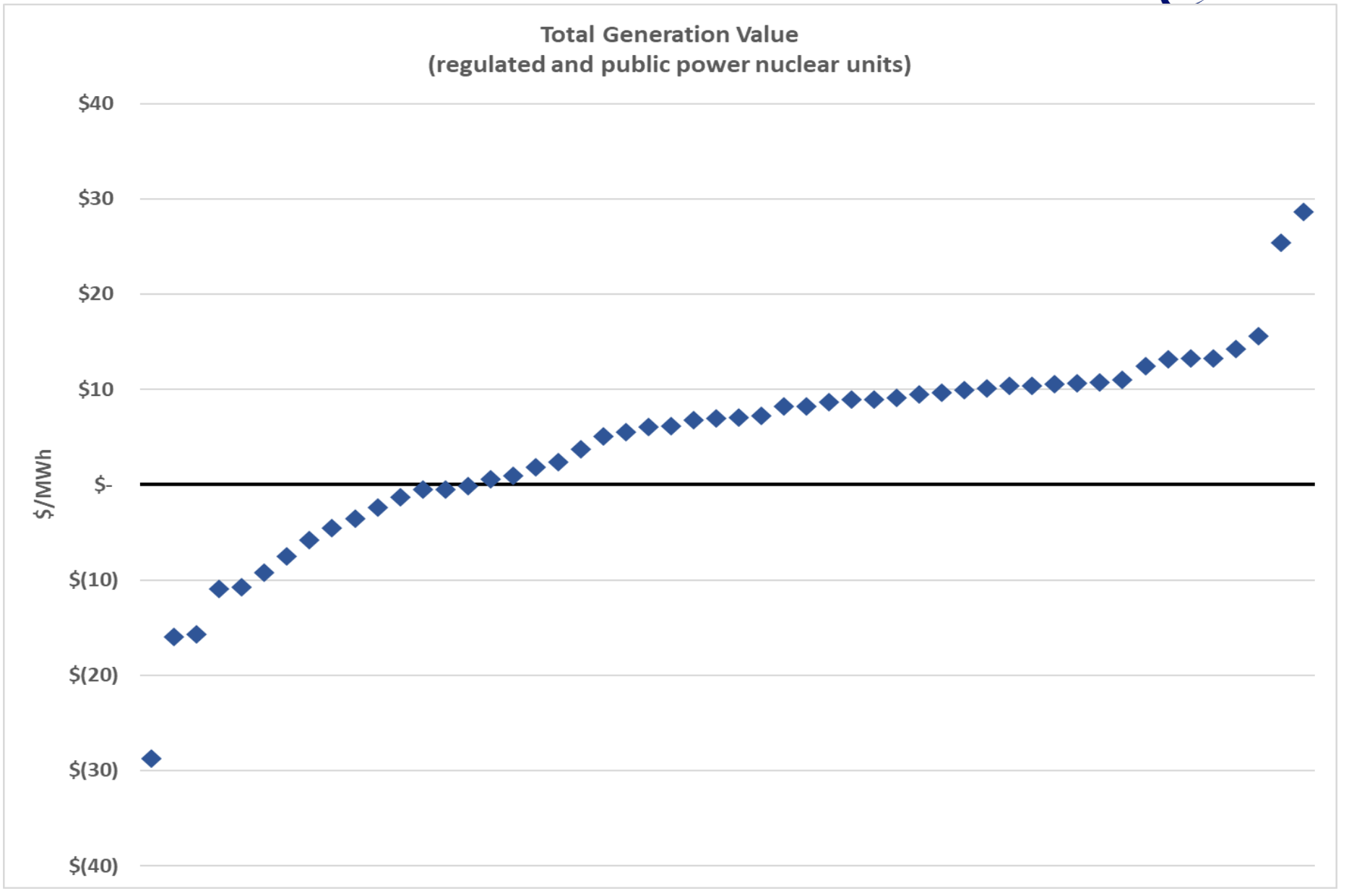
http://nuclear-economics.com/2017-09-market-challenges-for-nuclear-fleet-essai-study/

Replacement value high for all units

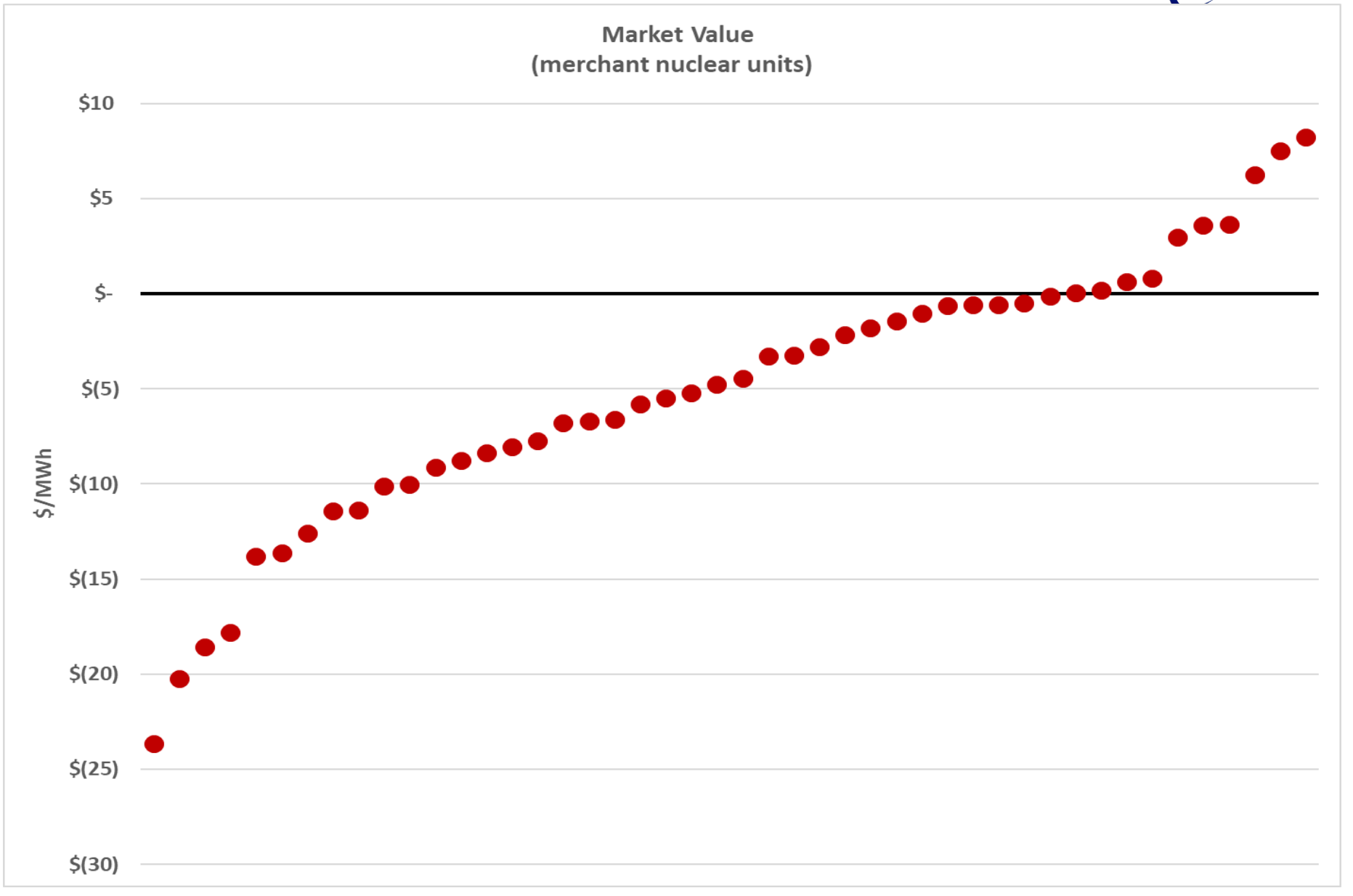
Purchased power value high



Total generation value high



Market value is low



Merchant nuclear low market value

- Merchant nuclear compared to regulated nuclear:
  - Merchant nuclear generating costs and operating performance ***similar to*** regulated & public power units
  - Merchant nuclear has lower revenue in markets
- Lower value of merchant units is due to fundamental problems with deregulation
- U.S. headed for a future where
  - Only selected regulated & public power units remain
  - No new units are built

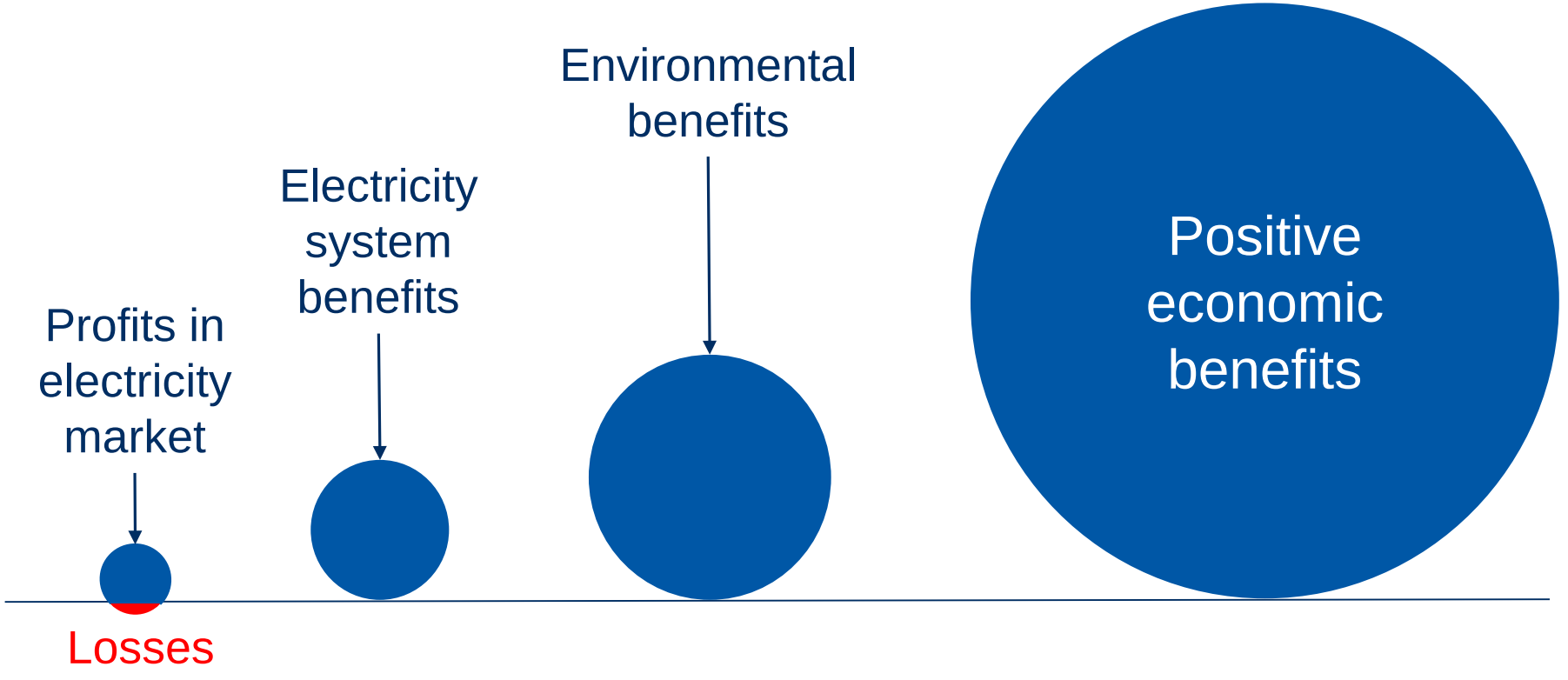
Market Failure and nuclear power

- Low profits at existing and new nuclear result in early retirement and cancelled projects
- Early retirement means loss of net public benefits
- Markets failure is when net public benefits lost
- Two different futures
  - Markets - No nuclear, loss of net public benefits
  - Traditional - Nuclear net public benefits valued

NECG Commentary #14 - ***http://nuclear-economics.com/14-market-failure/***

DOE 2016 - ***https://gain.inl.gov/Shared%20Documents/Economics-Nuclear-Fleet.pdf***

No value for nuclear public benefits



What can be done?

- Return to regulation or government ownership
- Out-of-market revenue
  - Capacity market payments
  - Externality payments (Zero Emission Credits / ZECs)
  - Power contract revenue (UK Contract for Differences)
- Separate markets (baseload/nuclear + the rest)
- Price on externalities (carbon tax)

More ideas at American Nuclear Society Toolkit:
http://nuclearconnect.org/wp-content/uploads/2016/02/ANS-NIS-Toolkit-V2.pdf

U.S. state nuclear policy initiatives

- Why are U.S. states involved?
  - State jurisdiction over regulated retail electricity
  - States already add revenue for renewables
  - Adding revenue for nuclear is similar
- State actions
  - New York – Zero-Emission Credits (ZECs)
  - Illinois – ZECs
  - New York (earlier) - reliability contract for Ginna
  - Iowa – renewed power contract for Duane Arnold

Summary

- U.S. nuclear market failure caused by
  - Market approach to electricity
  - Low electricity market prices
  - No compensation for nuclear public benefits
- Need action to fix this problem
  - State action to provide more revenue (e.g., ZECs)
  - Re-regulation / exit from electricity markets
  - Federal government role may be needed

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