Identifying the total economic value of hydropower at Glen Canyon Dam and implications for adaptive management

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Photo Credit: Amy S. Martin

LTEMP EIS Hydropower Resource Goal

Maintain or increase Glen Canyon Dam electric energy generation, load following capability, and ramp rate capability, and minimize emissions and costs to the greatest extent practicable, consistent with improvement and long-term sustainability of downstream resources.

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Project N.1

Project N will identify, coordinate, and collaborate with external partners on monitoring and research opportunities associated with operational experiments at GCD designed to meet hydropower and energy resource objectives, as stated in the LTEMP ROD.

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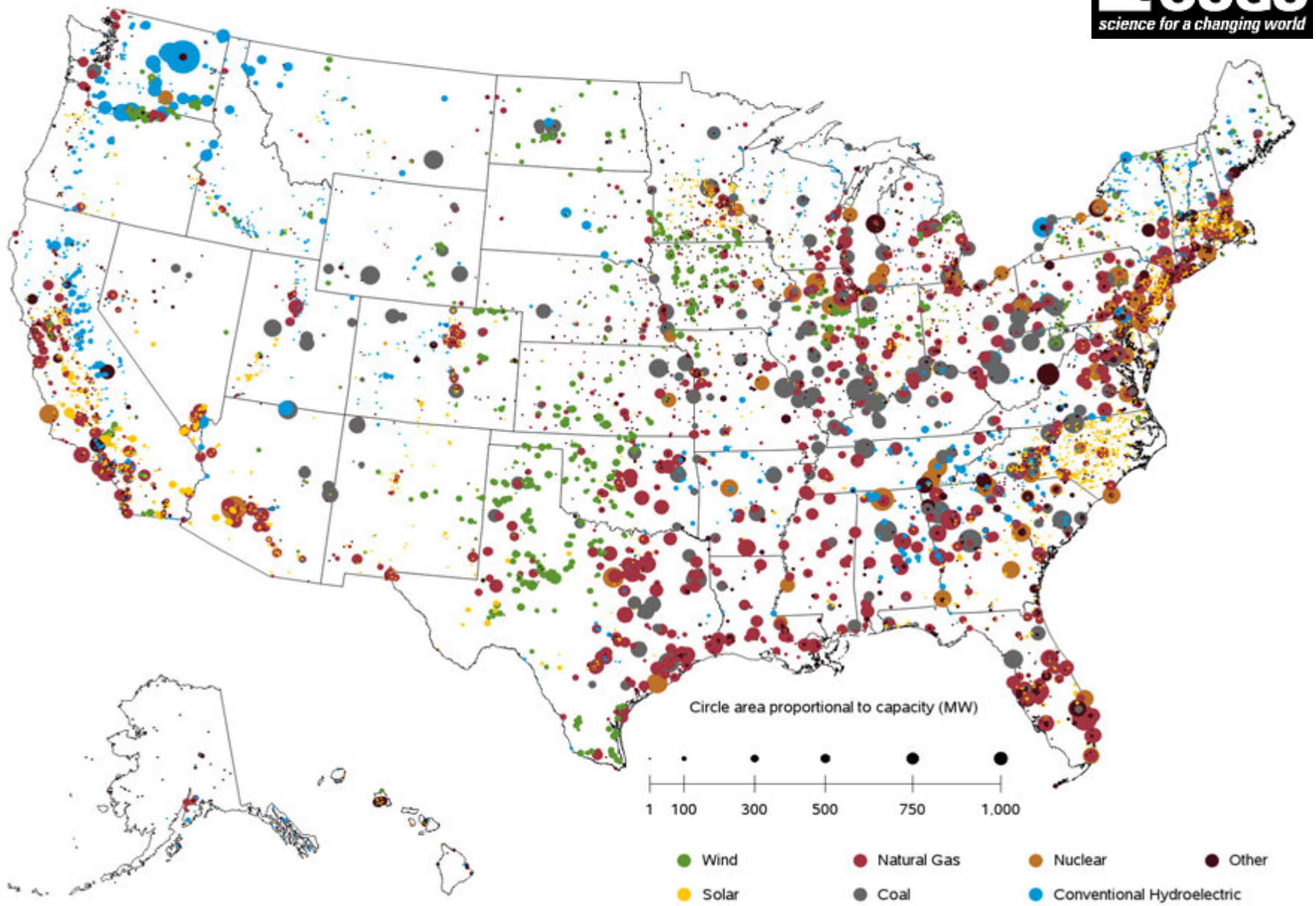
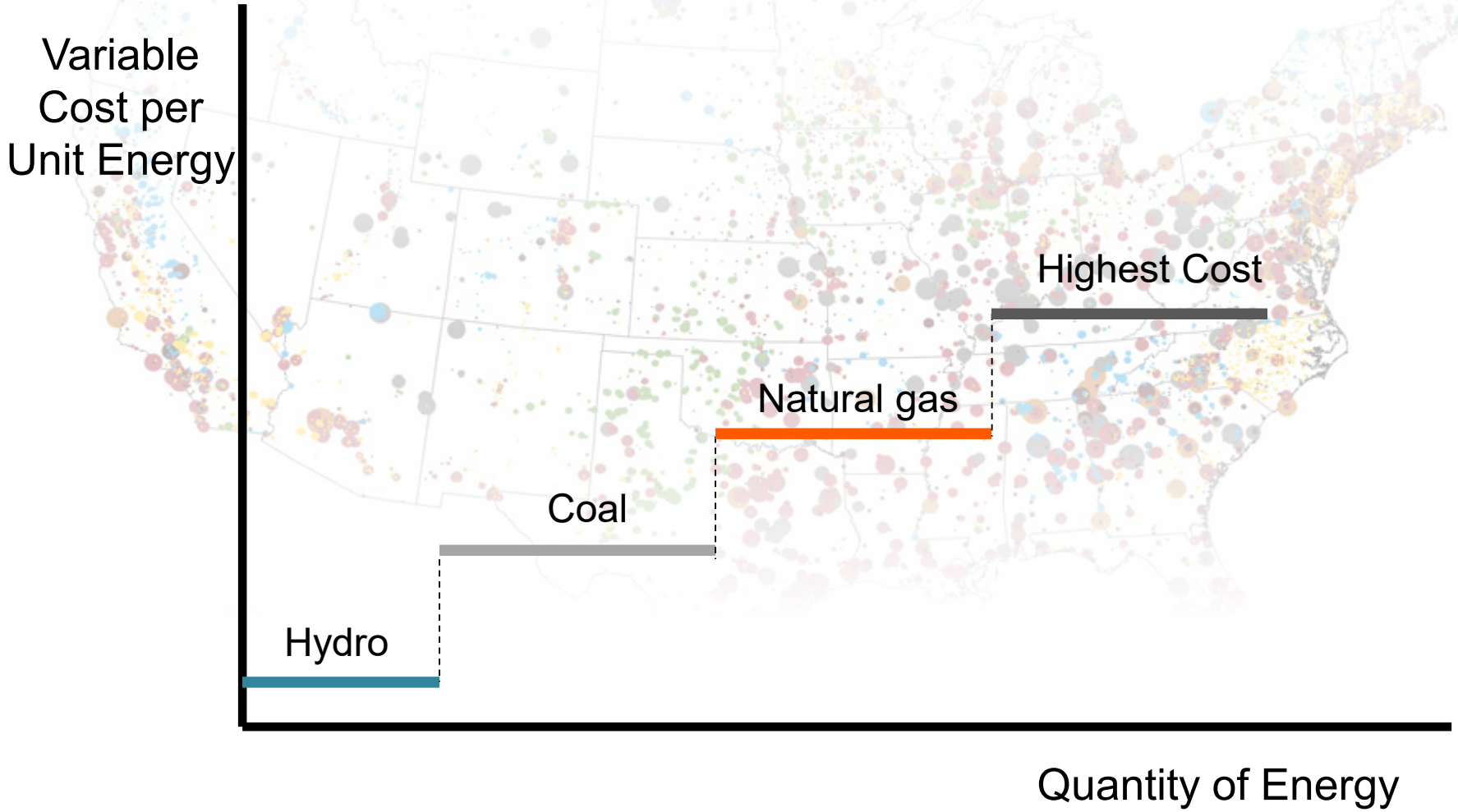
Operable utility-scale generating units as of July 2018



Sources: U.S. Energy Information Administration, Form EIA-860, 'Annual Electric Generator Report' and Form EIA-860M, 'Monthly Update to the Annual Electric Generator Report.'

Economic Cost of Energy



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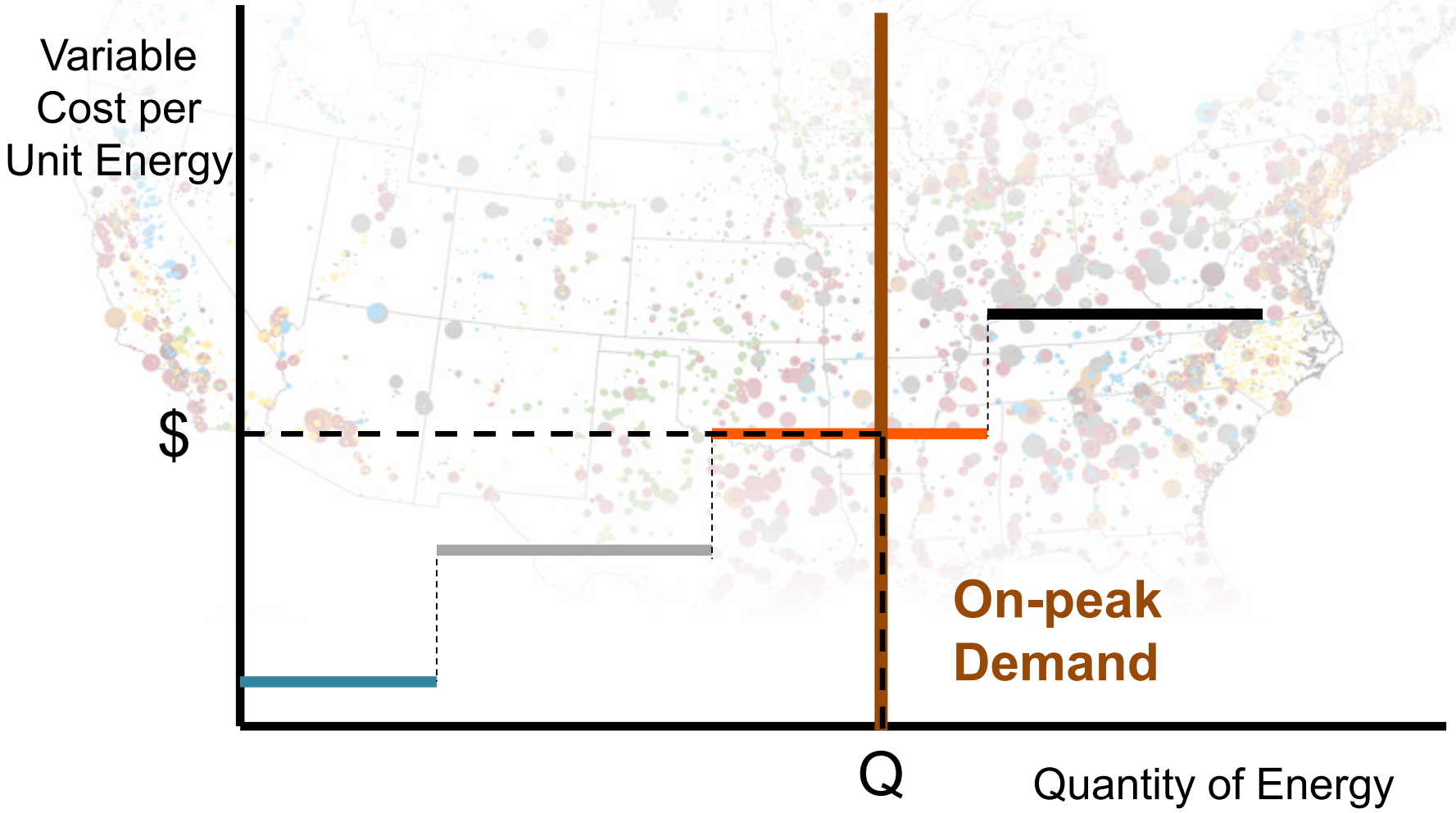
Economic Value of Energy



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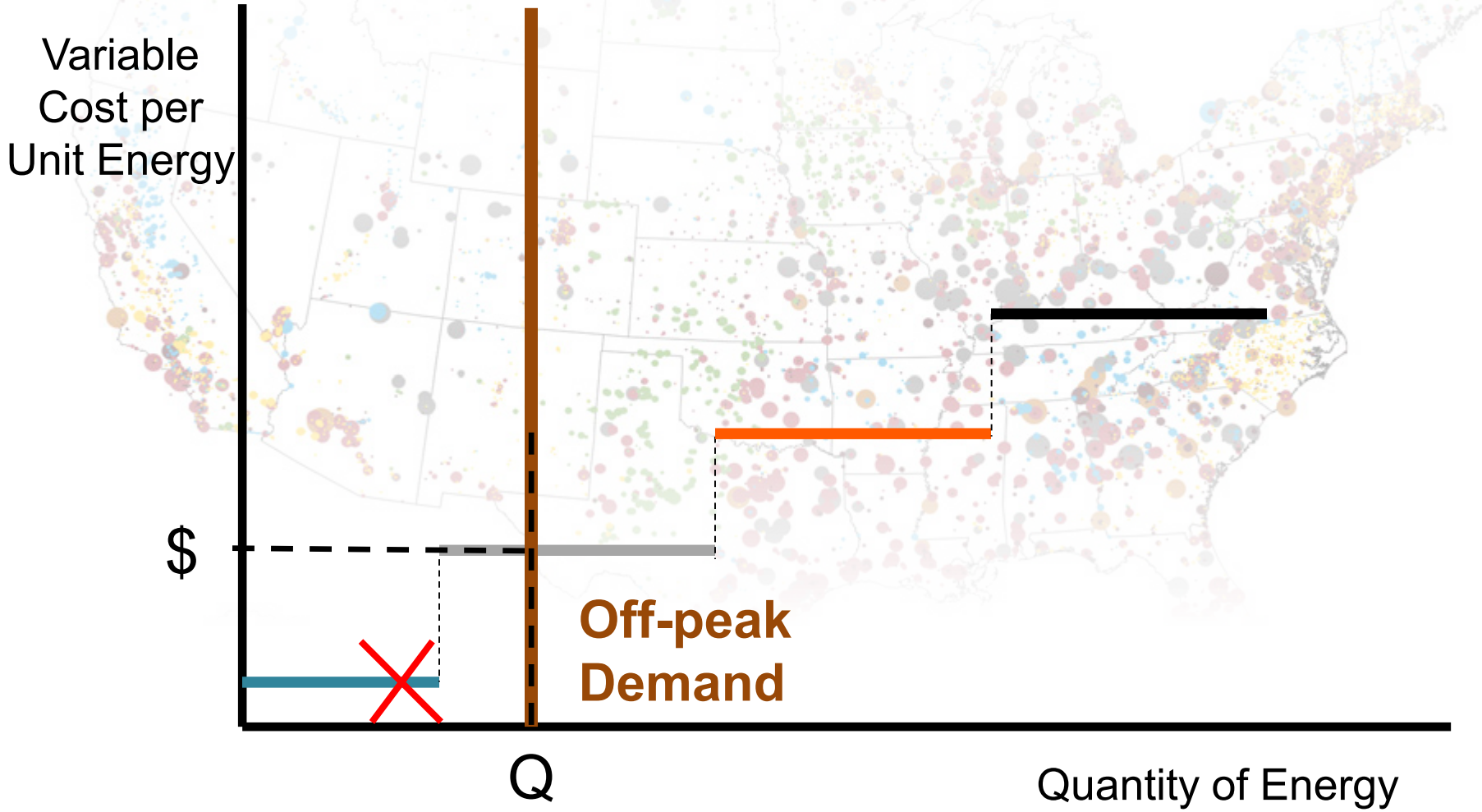
Economic Value of Energy, cont.



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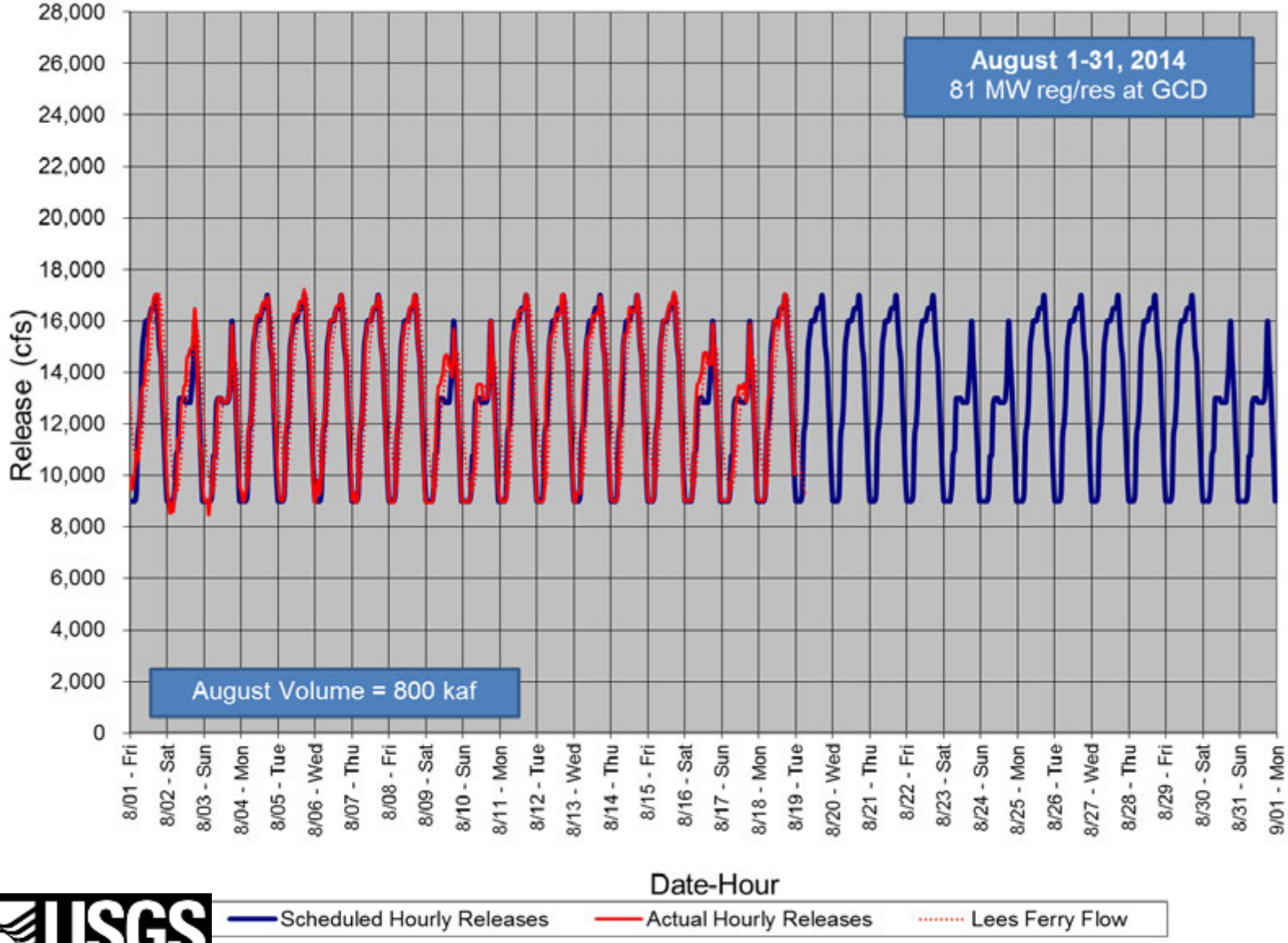
Glen Canyon Dam Hourly Release Pattern AUG 2014



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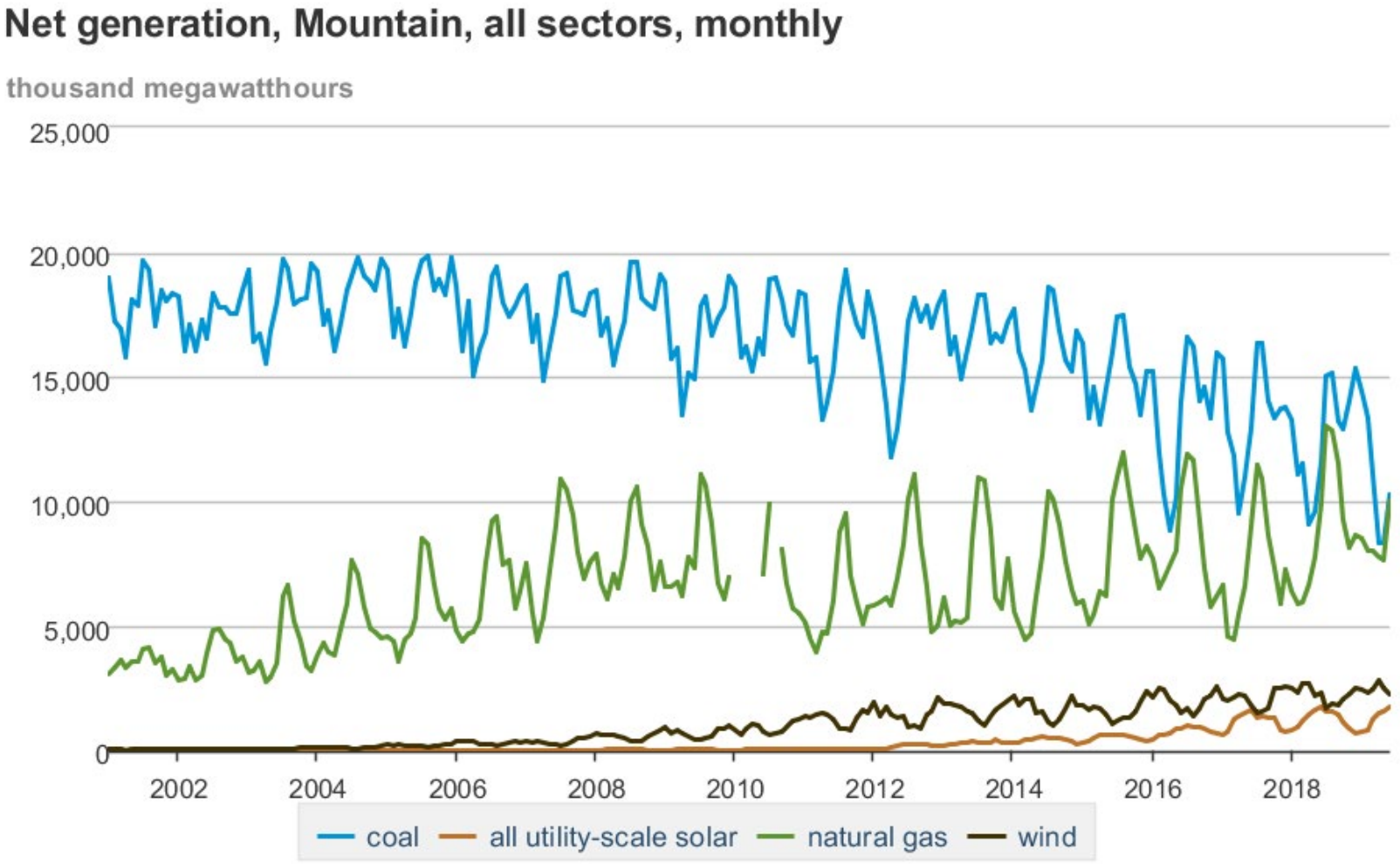
U.S. Department of Interior, Bureau of Reclamation. August 2014 DOI-DOE Federal Family Call Glen Canyon Operations Coordination August 19, 2014

Structural Changes in the Electricity Sector



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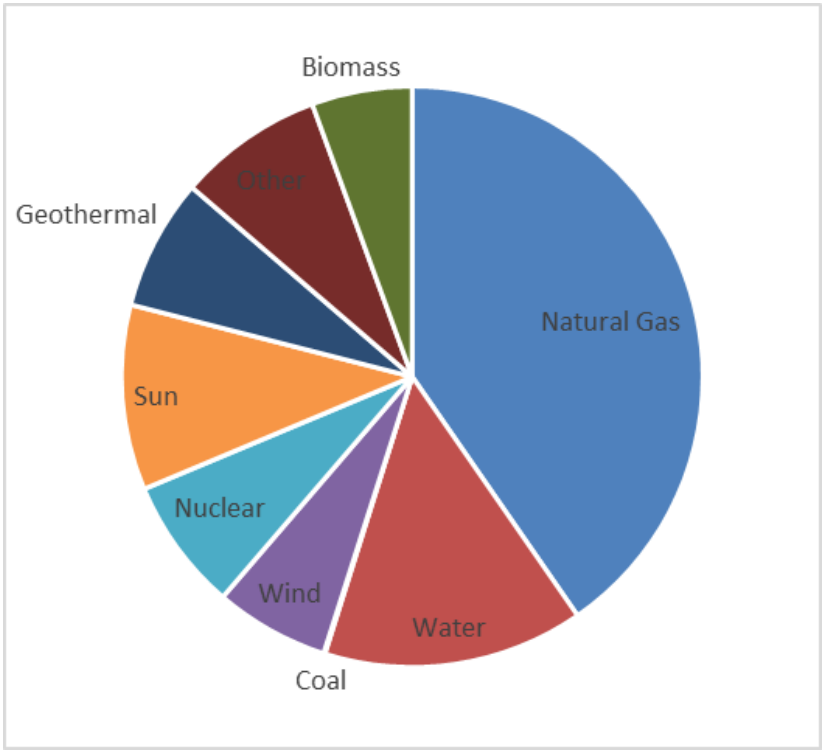
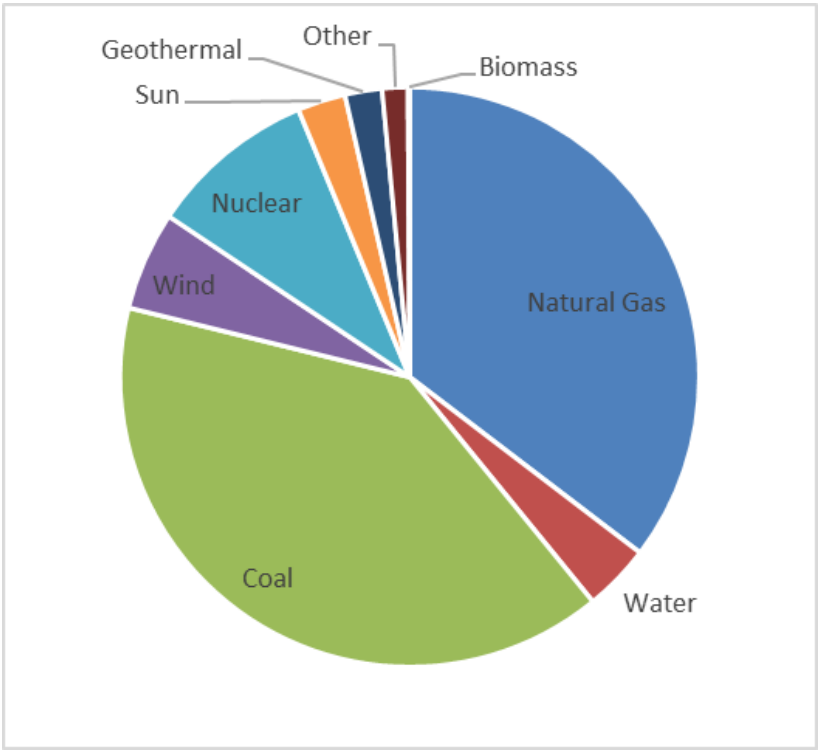
Annual Share of 2024 Generation

California



Colorado River Basin States
Excluding California



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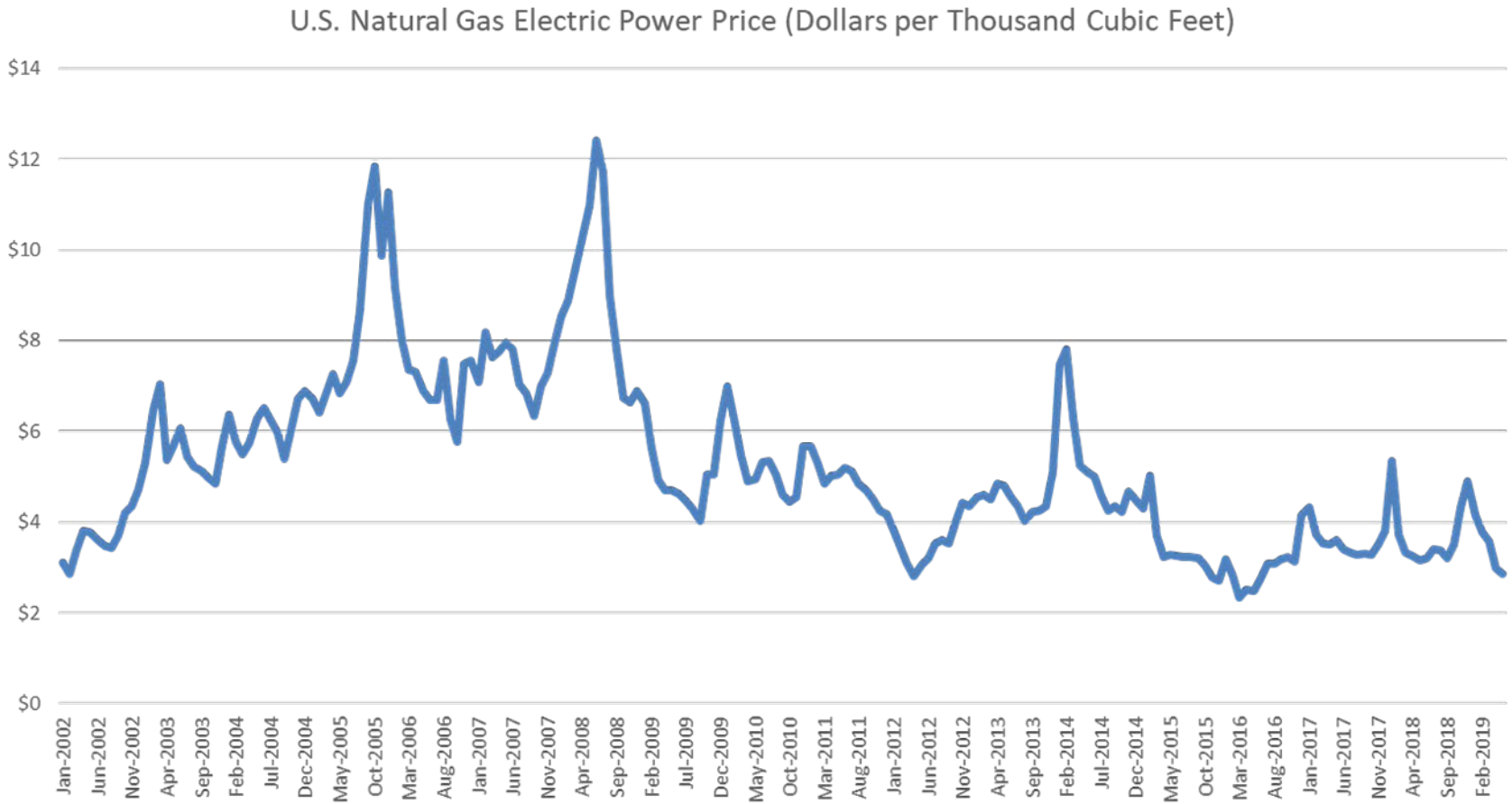
Preliminary data, do not cite

Natural Gas Prices



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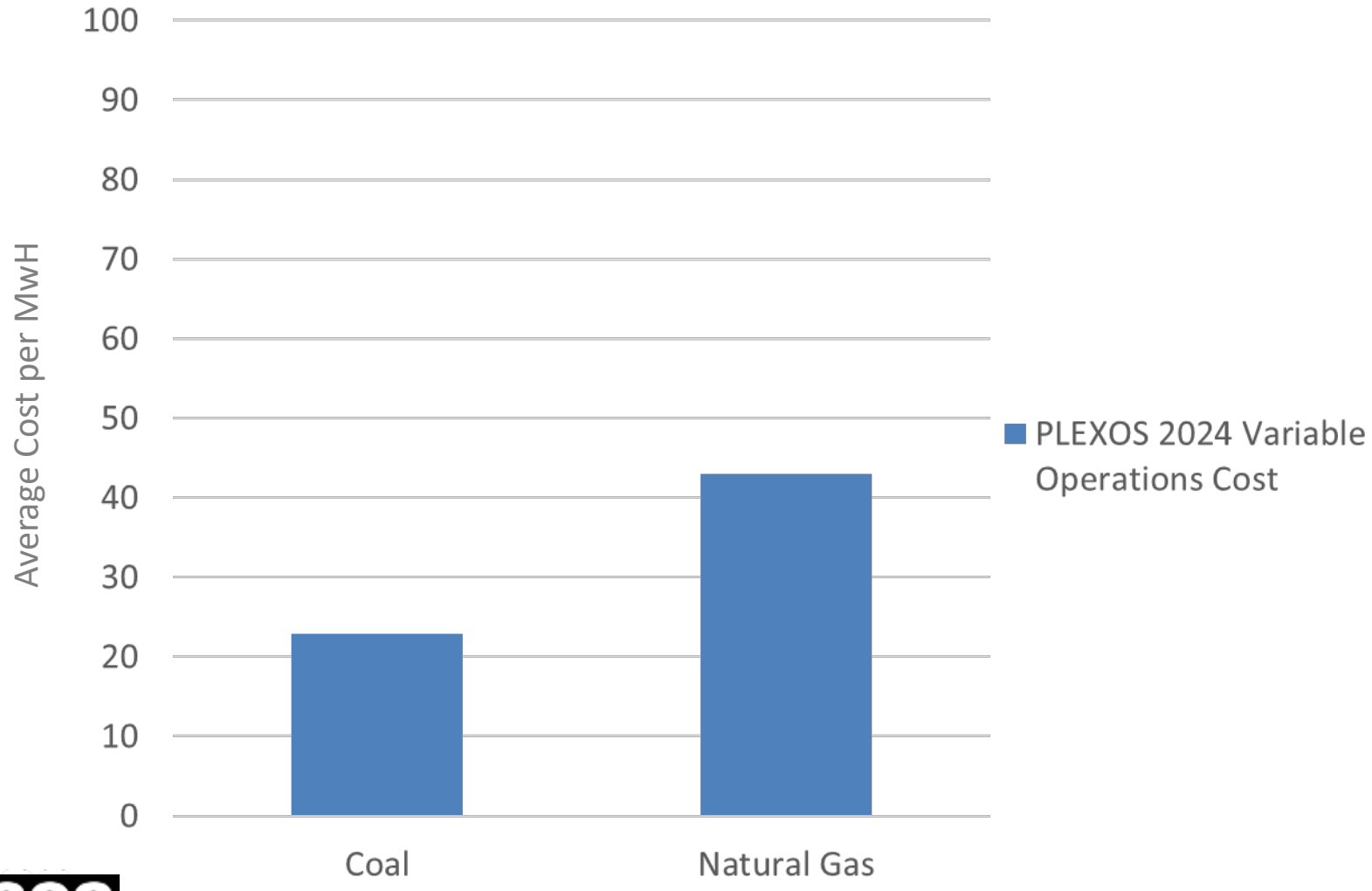
https://www.eia.gov/dnav/ng/hist/n3045us3m.htm

Total 2024 Variable Operations Cost by Generation Type



Preliminary data, do not cite

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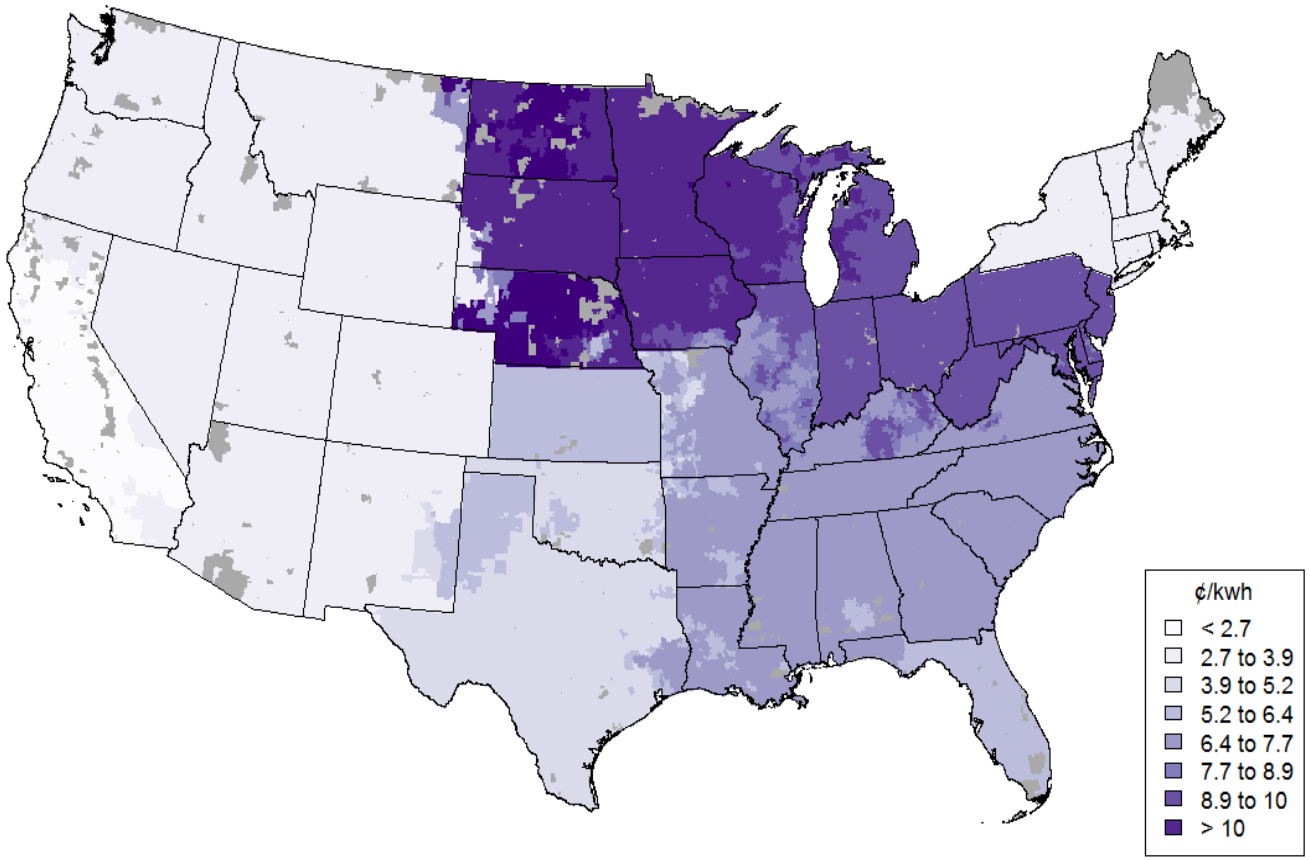
Social Cost of Emissions



Average External Marginal Cost per kWh

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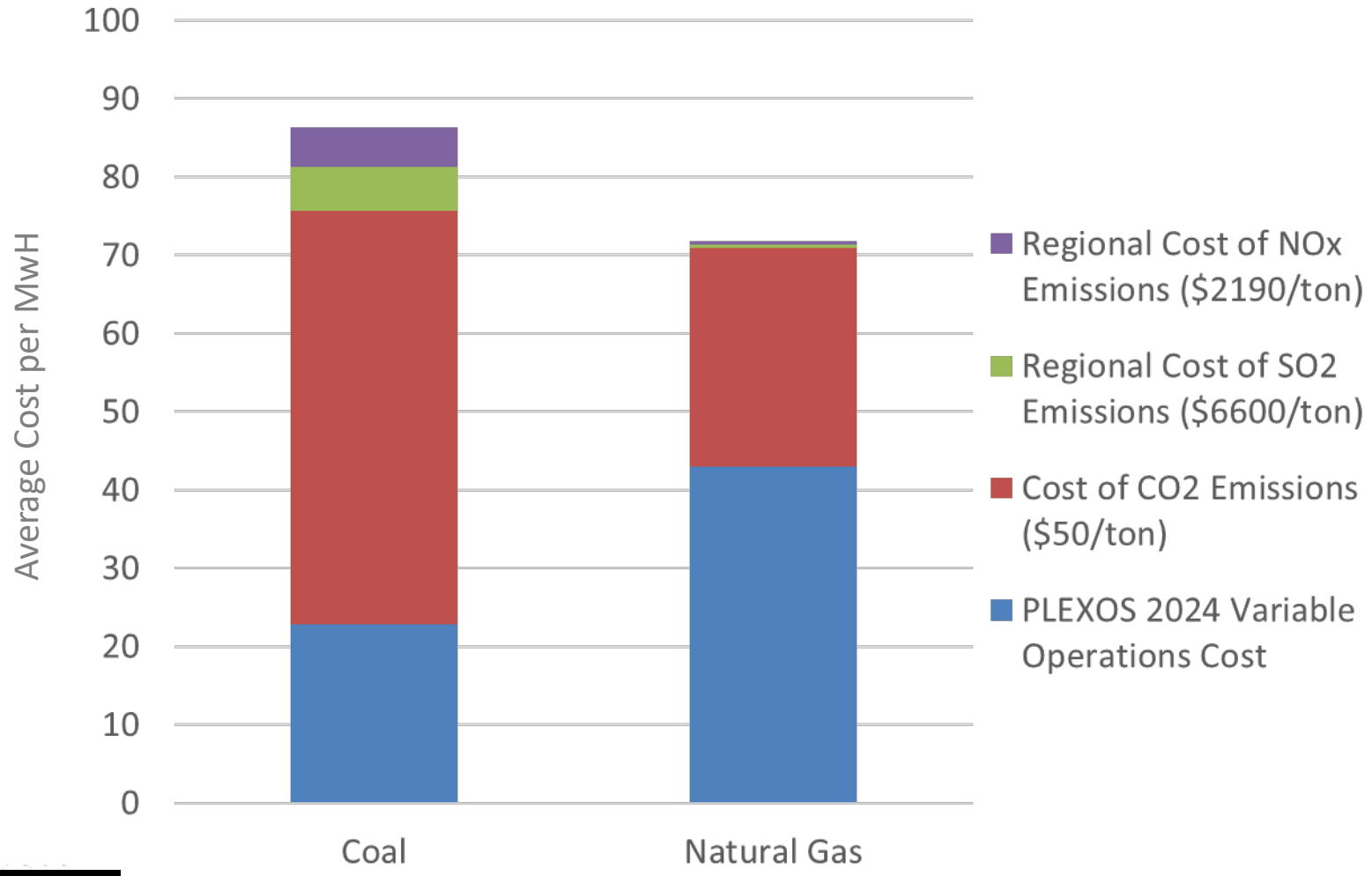
Borenstein S: The private and public economics of renewable electricity generation. Journal of Economic Perspectives, American Economic Association 2012, 26:67-92.

Total 2024 Variable Operations and Emissions Cost by Generation Type



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Preliminary data, do not cite

Hypotheses

- Using Glen Canyon Dam as baseload generation will reduce total economic costs associated with electricity generation in the Western Interconnect when considering generation mix and fuel and emissions costs.
- Glen Canyon Dam baseload generation would be ‘consistent with improvement and long-term sustainability of downstream resources.’

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Methods and Assumptions

- PLEXOS, a production cost model was used to estimate variable costs of generation in 2024 under economic dispatch and flat flows at GCD.
- External CO_2 costs and costs by county associated with SO_2 and NO_X were estimated following optimization runs.
- This is a short run economic analysis. We are assuming that power capacity requirements are met across scenarios.

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2024 Electricity Sector Scenarios

- Business as usual
- Low natural gas price $2/MMBtu
- High natural gas price $6/MMBtu
- Additional 700 MW solar in Arizona
- Low natural gas price with additional solar
- High natural gas price with additional solar

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Modeling Results

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Total Economic Costs

Western Interconnect Production and Emissions Costs with Flat Flows at Glen Canyon Dam (dollars in thousands)

Electricity Sector Scenario	Baseline Production Cost	Change in Production Cost	Change in Emissions Damages			Total Change in Economic Cost
			Carbon Dioxide	Sulfur Dioxide	Nitrogen Oxides	
Business as Usual	$22,445,443	$4,698	-$6,611	-$59	-$1,754	-$3,725
High Natural Gas $	$25,699,633	$16,556	$5,681	-$31	$204	$22,410
High Natural Gas $ with Solar	$25,636,912	$15,838	-$3,683	-$711	-$2,579	$8,865
Low Natural Gas $	$16,693,376	$2,850	$8,917	$1,614	$6,158	$19,539
Low Natural Gas $ with Solar	$16,660,672	$4,162	$1,844	$297	$1,864	$8,167
Solar	$22,396,835	$10,245	-$4,362	-$326	-$2,216	$3,341

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Total Economic Costs, cont.

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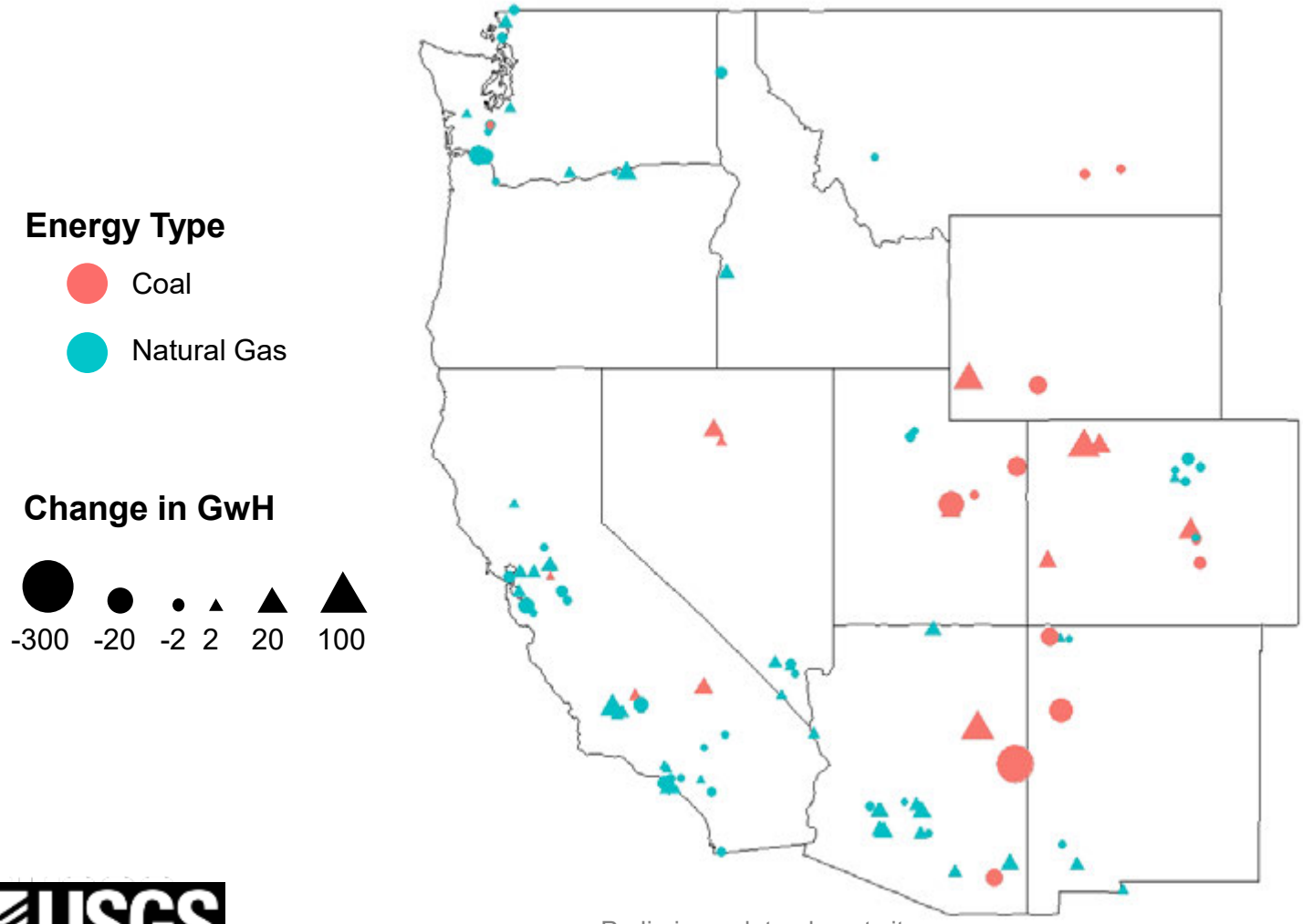
Change in Annual 2024 Generation – Flat Flows Compared to Economic Dispatch



Preliminary data, do not cite

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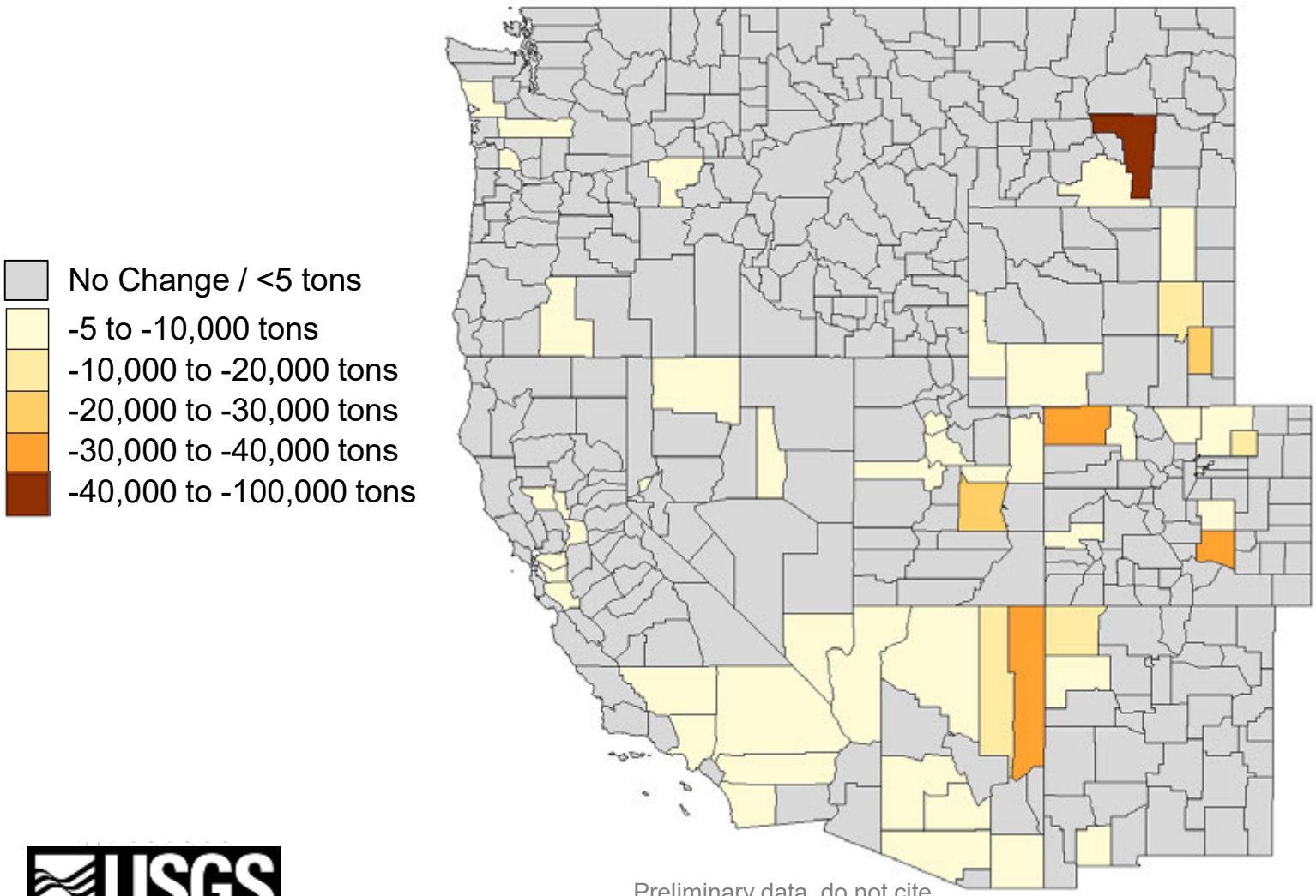
Change in Annual 2024 SO_2 Emissions – Flat Flows Compared to Economic Dispatch



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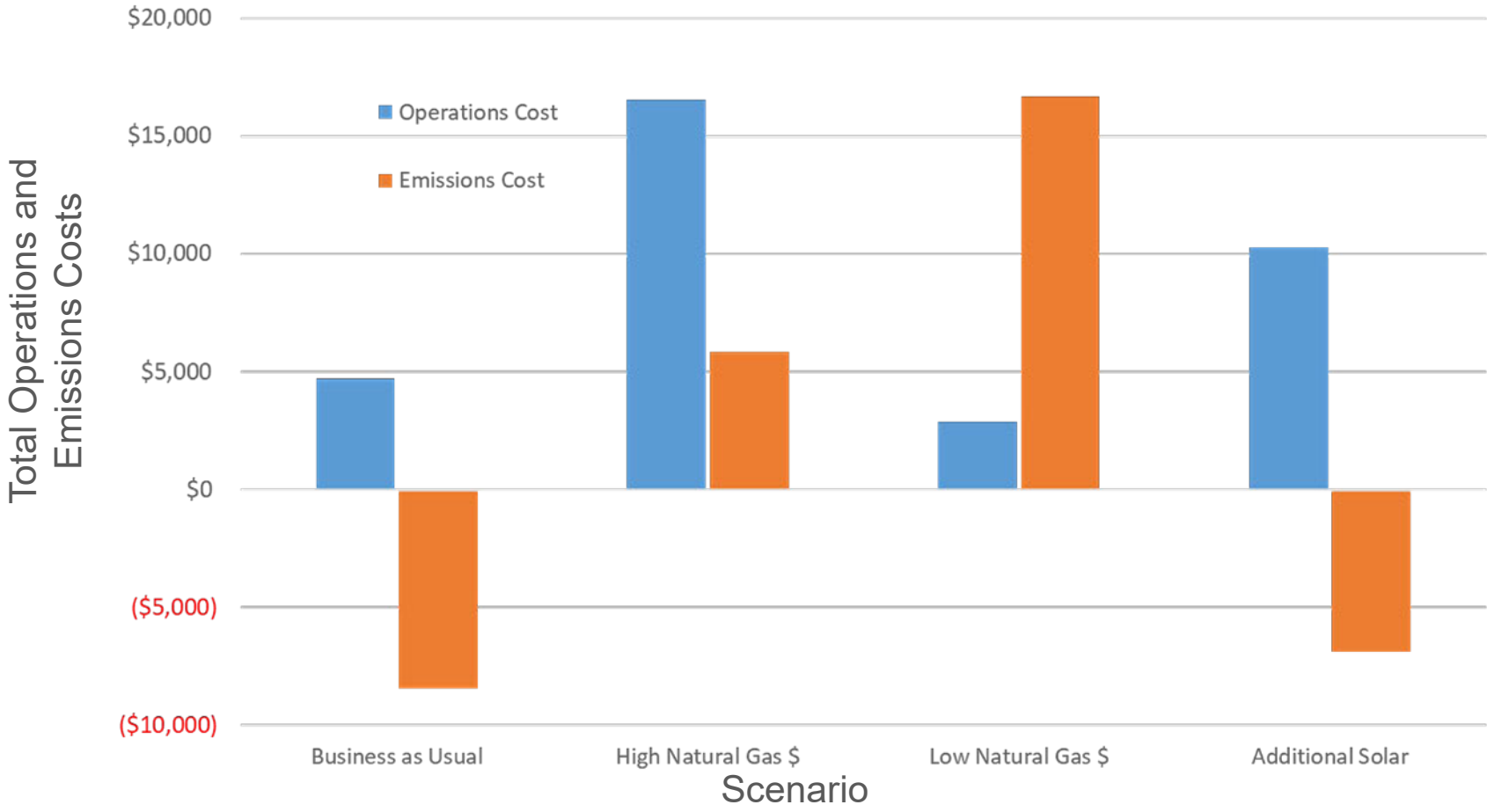
Change in Operations and Emissions Costs with Flat Flows at Glen Canyon Dam (dollars in thousands)



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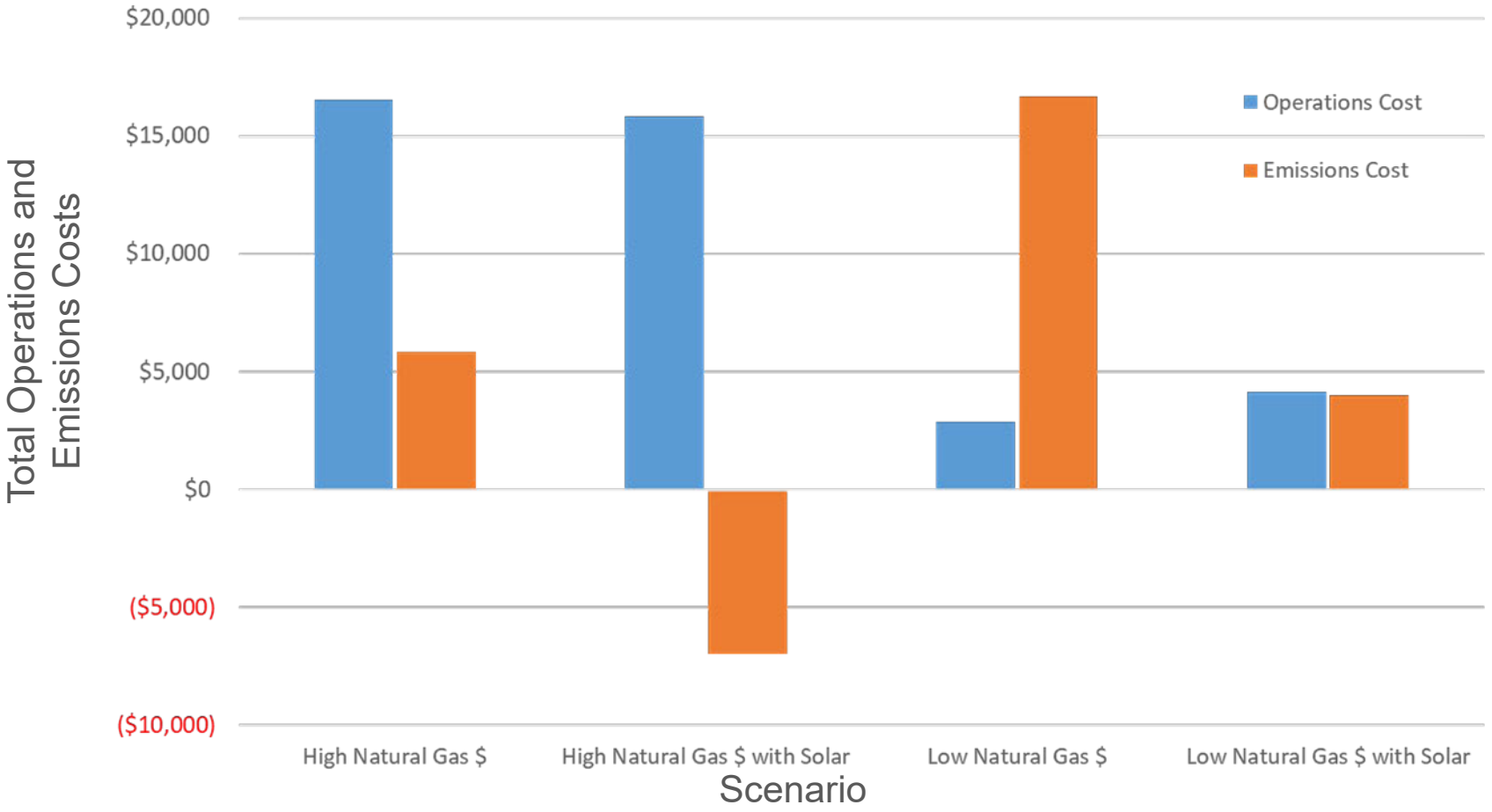

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Conclusion

- Structural changes in the electricity sector are altering the role of hydropower and how costs associated with experimental flows might accrue.
- Total economic costs of our proxy experimental flow are significantly different when emissions costs are included.
- Decisions we make today in electricity sector expansion will impact the role hydropower plays in the sector and costs associated with environmental and adaptive management of rivers.

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Photo Credit: Amy S. Martin

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