Decarbonizing the Generation Stack

Aligning Wholesale Electricity Markets with Environmental Policy

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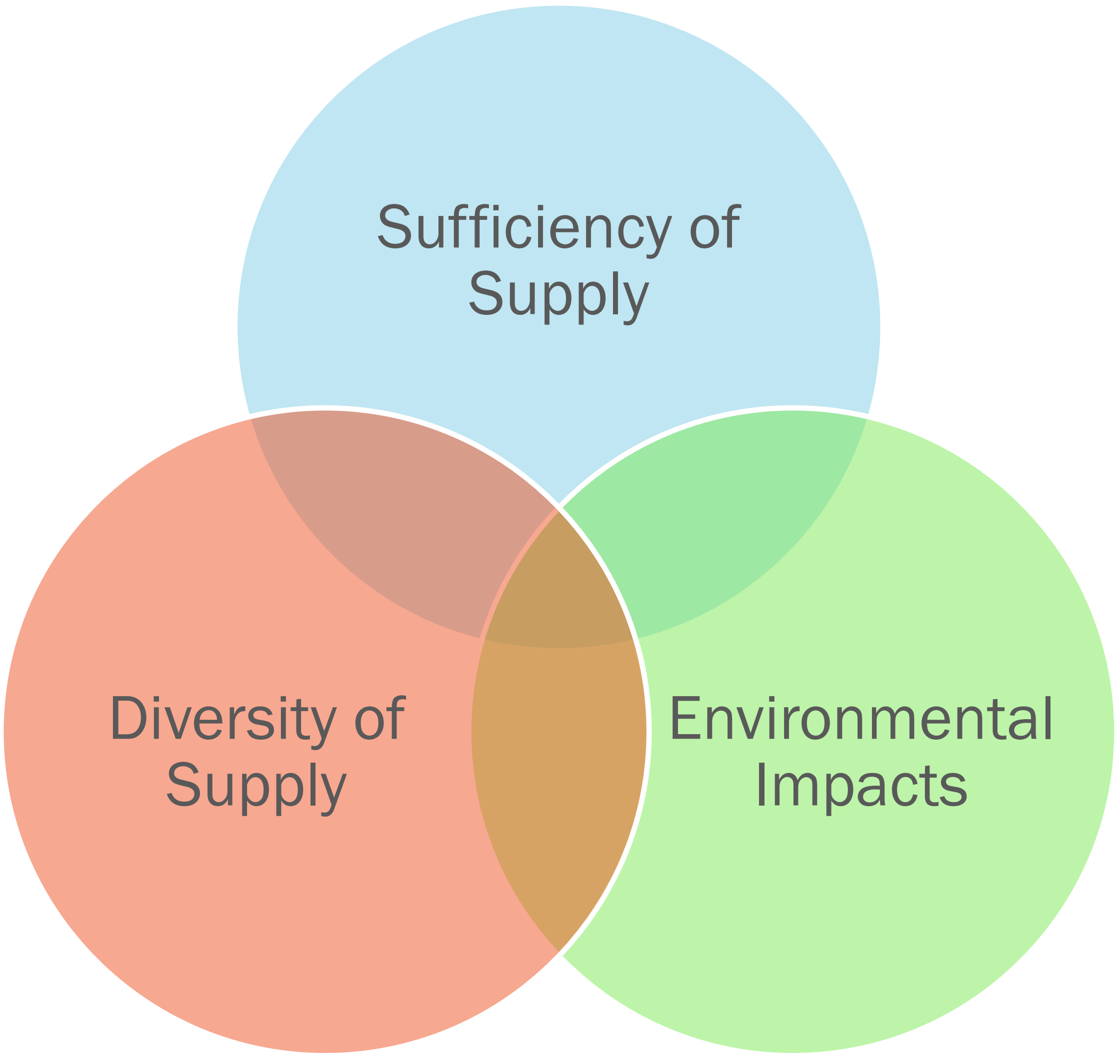
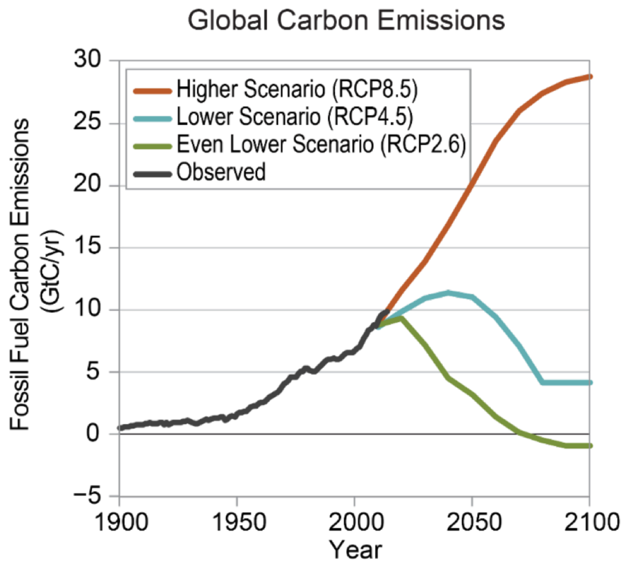
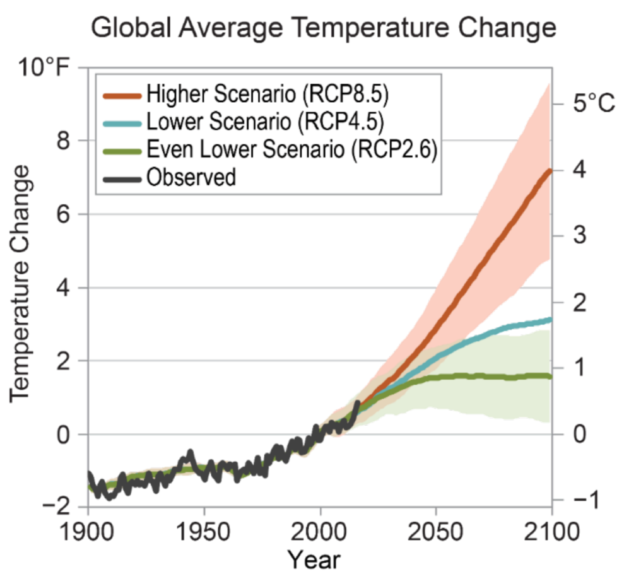
What problem are we trying to solve?



The carbon challenge





Annual Economic Damages in 2090		
Sector	**Annual damages under RCP8.5**	**Damages avoided under RCP4.5**
Labor	$155B	48%
Extreme Temperature Mortality◊	$141B	58%
Coastal Property◊	$118B	22%
Air Quality	$26B	31%
Roads◊	$20B	59%
Electricity Supply and Demand	$9B	63%
Inland Flooding	$8B	47%
Urban Drainage	$6B	26%
Rail◊	$6B	36%
Water Quality	$5B	35%
Coral Reefs	$4B	12%
West Nile Virus	$3B	47%
Freshwater Fish	$3B	44%
Winter Recreation	$2B	107%
Bridges	$1B	48%
Munic. and Industrial Water Supply	$316M	33%
Harmful Algal Blooms	$199M	45%
Alaska Infrastructure◊	$174M	53%
Shellfish*	$23M	57%
Agriculture*	$12M	11%
Aeroallergens*	$1M	57%
Wildfire	−$106M	−134%

Source: Fourth National Climate Assessment, U.S. Global Change Research Program (2018).

Decarbonization tools

Electrification

Emissions-Free Generation

Efficiency

CES

RPS

Carbon Pricing

PTC

ITC

The New England example

Figure 2: State-Sponsored Resources v. Competitive Market Resources
(Estimated Energy Production, MWh)

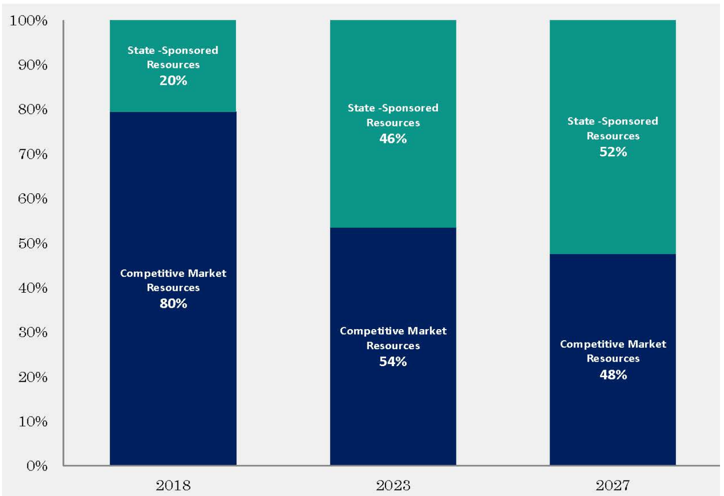
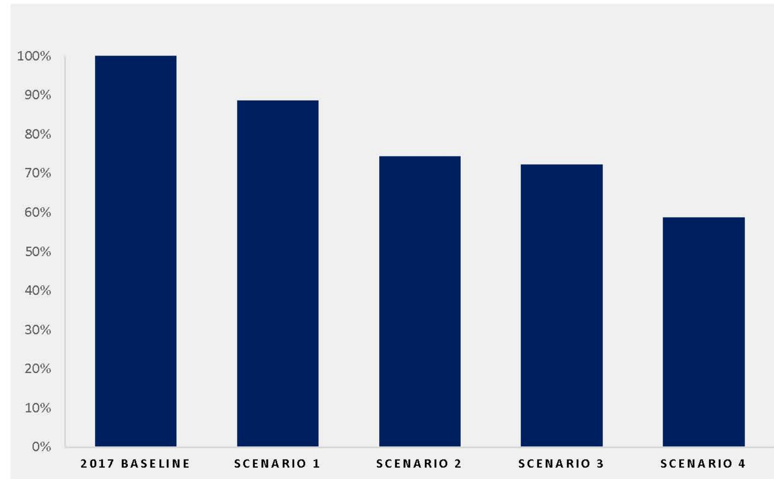
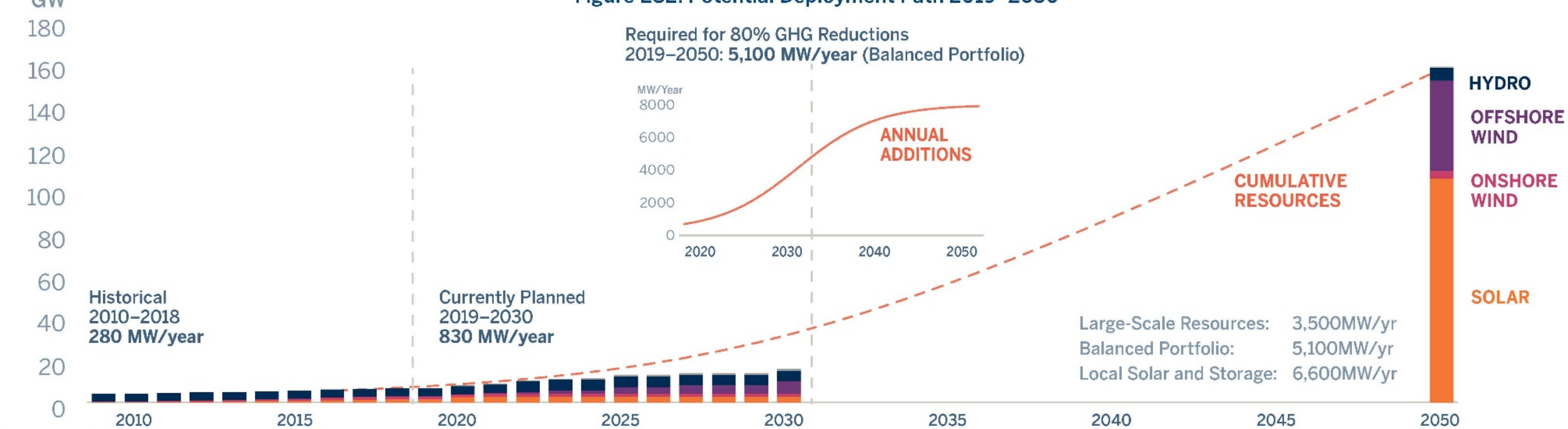


Figure 5: Estimated Percentage Energy Market Revenue Reductions for Select Combined Cycles Due to Increased Clean Energy Resources (2017)



Source: Promoting Competitive Power Markets and Growing Zero-Emission Resources in New England, A. Joseph Cavicchi (Nov. 7, 2018)

Figure ES2: Potential Deployment Path 2019–2050



Source: Achieving 80% GHG Reduction in New England by 2050, Jürgen Weiss and J. Michael Hagerty (Sept. 2019).

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The California example

Figure 2.6 **Hourly frequency of day-ahead prices near or below $0/MWh (January – June)**

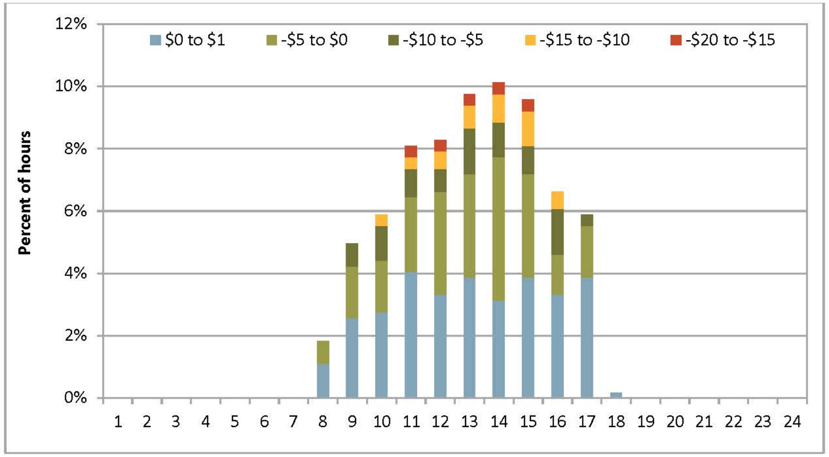
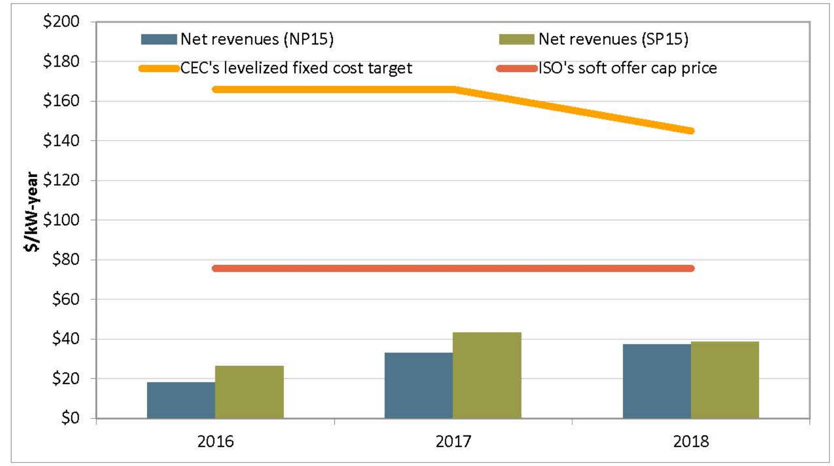
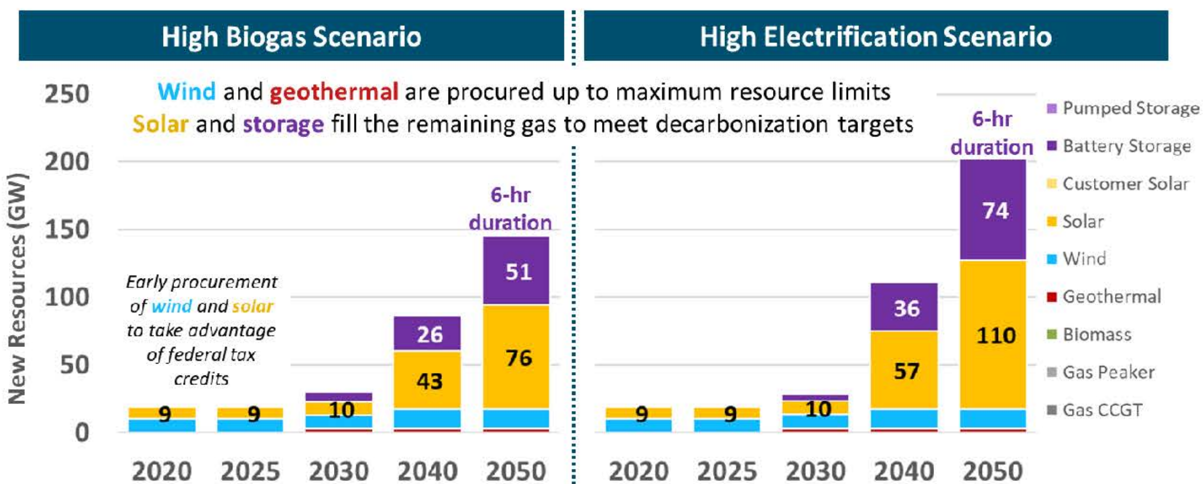


Figure E.11 **Estimated net revenue of hypothetical combined cycle unit**



Source: Annual Report on Market Issues and Performance, CAISO Department of Market Monitoring (May 2019).

Figure 9. New Build Selected Resources Results



Source: Long-Run Resource Adequacy under Deep Decarbonization Pathways for California, E3 (June 2019).

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(Re)Aligning responsibilities

State(s)

Generation Mix

Revenue Sufficiency

RTO/ISO

Regional commitment and dispatch

Operational requirements (e.g., ramping needs)

Backstop procurements (e.g., local reliability, resource adequacy)