# Prospective Costs, Benefits, and Impacts of U.S. Renewable Portfolio Standards


NREL
NATIONAL RENEWABLE ENERGY LABORATORY

BERKELEY LAB

**January 9, 2017**

# Presentation Overview

- Overview and Project Background
- Modeling Framework and Electric Sector Results
- Electric Sector System Costs and Electricity Price Estimates
- Air Pollution Emissions
- Greenhouse Gas Emissions
- Water Use Reduction
- Gross Renewable Energy Workforce Requirements
- Natural Gas Price Reduction
- Summary and Conclusions

# Project Goal, Coverage, Audience

- **Goal:** Evaluate the potential costs, benefits, and impacts of state RPS policies going forward, monetized where possible, based on a consistent analytical framework and set of tools: considering both an existing RPS scenario and an expanded RPS scenario
- **Intended Audiences:**
  - **State RPS administrators**: Provide a framework and methodology that states can build upon and refine for their own analyses; methods, assumptions, and caveats are all fully documented
  - **Broader audiences**: Communicate aspects of the value of state RPS programs and the scale of various potential costs, benefits, and impacts, to inform decision making
- **Previous Work:**
  - Wiser et al. (2016). A Retrospective Analysis of the Benefits and Impacts of U.S. Renewable Portfolio Standards.
    - Uses AVERT to estimate avoided generation and emissions
    - Applies range of methods to estimate benefits and impacts from incremental RE used to meet state RPS policies in 2013
    - Does not address costs or prospective impacts
  - Heeter et al. (2014) & Barbose et al. (2015): Cost and Benefits of State-Level RPS.
    - Survey approach using reported costs and various methods
    - Focuses primarily on recent retrospective annual costs

# Project Support and Team

- Supported by DOE EERE Office of Strategic Programs
- Executed by a respected LBNL/NREL analysis team

| Category | Researchers |
|---|---|
| Coordination | Galen Barbose, Lori Bird, Jenny Heeter, Trieu Mai, Ryan Wiser |
| ReEDS analysis | Trieu Mai, Venkat Krishnan |
| Air Pollution | Dev Millstein, Ryan Wiser |
| GHG | Ryan Wiser, Trieu Mai |
| Water | Jordan Macknick |
| Workforce requirements | David Keyser |
| Natural Gas | Trieu Mai |

# Key Limitations

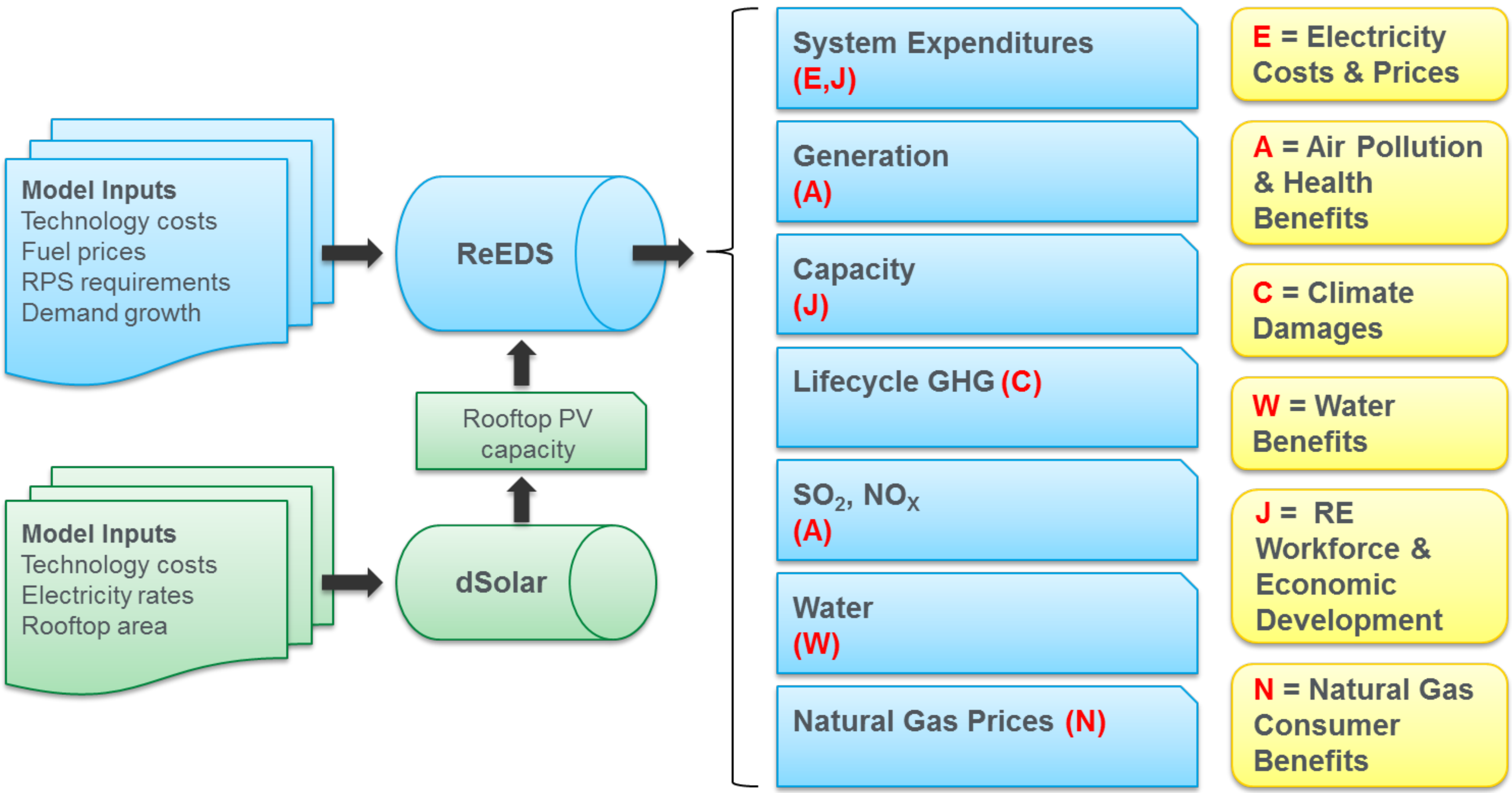
- **Benefits versus Impacts**: We distinguish between potential societal *benefits* (air pollution, GHG, water use reductions) and other *impacts* (gross jobs, natural gas prices)
- **Scope of Costs, Benefits, and Impacts**: We consider an important subset of—but not all—potential costs, benefits, and other impacts (e.g., land use, wildlife, and distribution-level integration are not considered)
- **Cost-effectiveness**: RPS programs are not the only possible way to achieve the outcomes discussed in this paper, and may not be the least-cost approach
- **Additionality**: We estimate the impacts *associated with RE used to meet* RPS demand growth, but do not seek to *attribute* those effects solely to RPS policies
- **Uncertainty**: Considerable uncertainty underlies many elements of our analysis

# Modeling Framework and Electric Sector Results

Trieu Mai, Venkat Krishnan

# Methodology

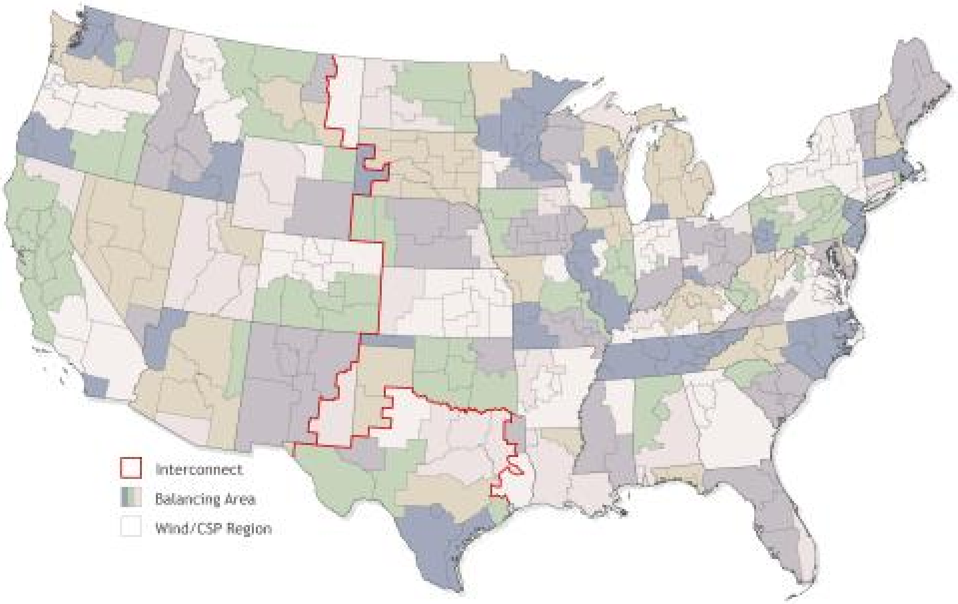
**Methods closely follow other DOE-funded reports, using ReEDS and dSolar in concert with other analytical tools and computations to estimate costs, benefits, and impacts**



# Regional Energy Deployment System (ReEDS) model

## ReEDS is a spatially and temporally resolved capacity expansion model that identifies optimal scenarios for the U.S. electric sector

- High spatial resolution to represent both transmission and spatial mismatch of resource and load
  - 134 Balancing Areas (BAs), 356 wind/CSP regions, 48 States
- High temporal resolution to represent seasonal and diurnal variations in load and resources
  - 17 time-slices for each year
- Statistical consideration of integration issues due to variability and uncertainty of RE supply
- Constraints designed to address: reliability, resource supply, transmission, national and state policies




http://www.nrel.gov/analysis/reeds/

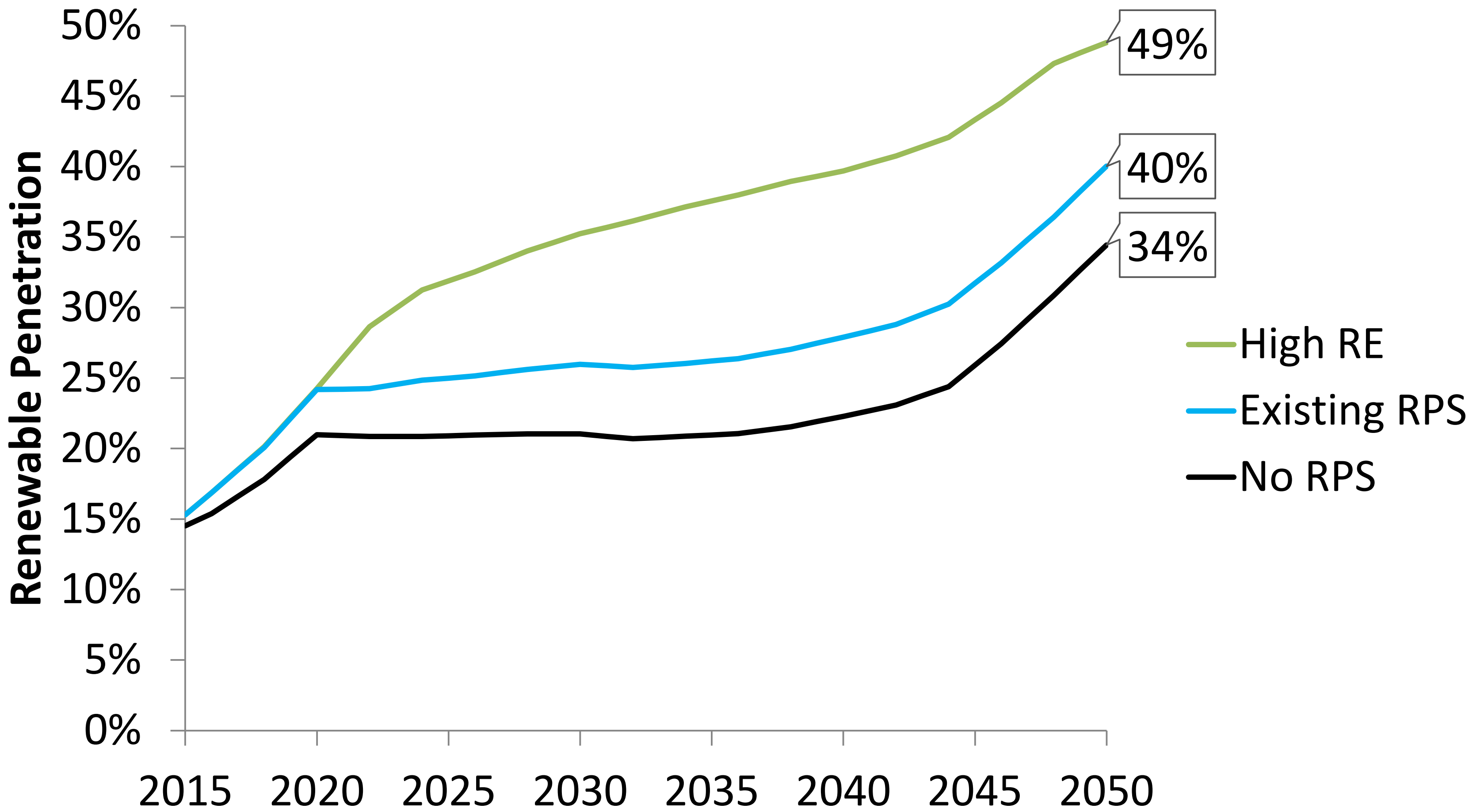
# Scenarios and Sensitivities

| Scenario Parameters | No RPS Scenario | Existing RPS Scenario | High RE Scenario |
|---|---|---|---|
| RPS treatment | No RPS after 2014 | Includes recent RPS revisions<br>- through early 2016 | Includes recent RPS revisions<br>- through early 2016 |
| CPP treatment | No CPP | No CPP | CPP<br>- mass-based targets with new source complements<br>- no credit trading |
| Bounding assumptions | - Upper bound on RE generation based on "economic" RE from RPS scenario | | - Upper bound on NG generation (at the state level) from the Existing RPS scenario<br>- Reflects an RE-based compliance pathway for the CPP |
| DPV assumptions | DPV reduced by RPS DG carve-outs | DPV from Standard Scenarios | DPV from Standard Scenarios |

- *Uses ReEDS v2016 Final Release version with RPS updates*
- *Key assumptions from AEO 2016 Reference case and ATB 2016 Mid case*
- *Additional sets of sensitivities modeled with low/high natural gas prices (based on AEO 2016 High/Low Oil & Gas cases) and low/high RE technology costs (based on ATB 2016 High/Low Cost cases) – these are used to inform estimated cost ranges only*
- *Results presented at the census division level to better capture the net impacts over a broader region as electricity imports/exports can be impacted by state policies*

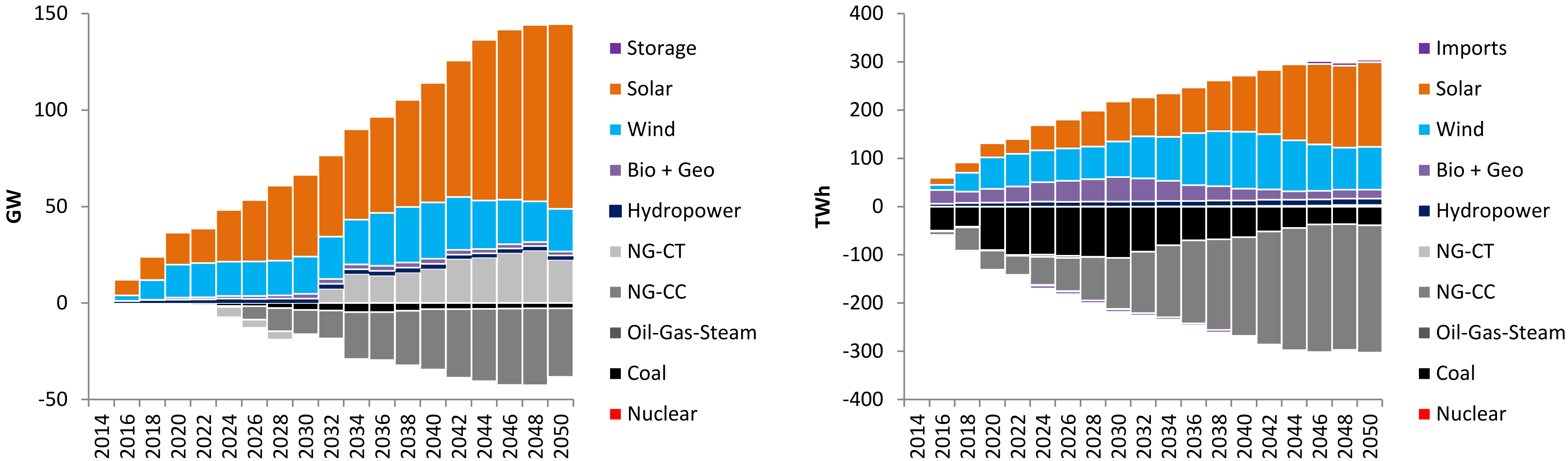
Scenario design used to measure the impacts of RE used to meet existing and expanded RPS policies

# U.S. Renewable Penetration Varies from 34% to 49% in 2050




2015 RE penetration was 14% with about half from hydropower generation

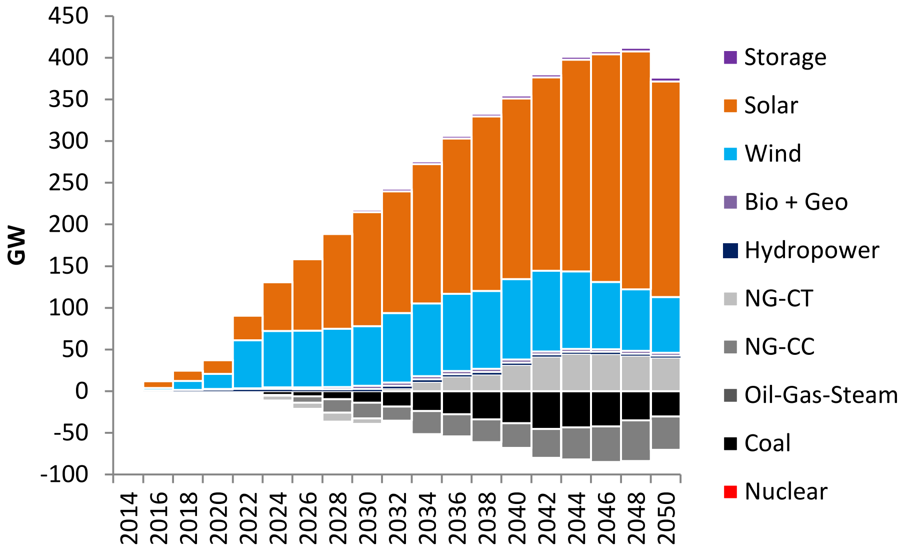
# Existing RPSs Require 66 GW RE Above Non-RPS RE by 2030; 218 TWh

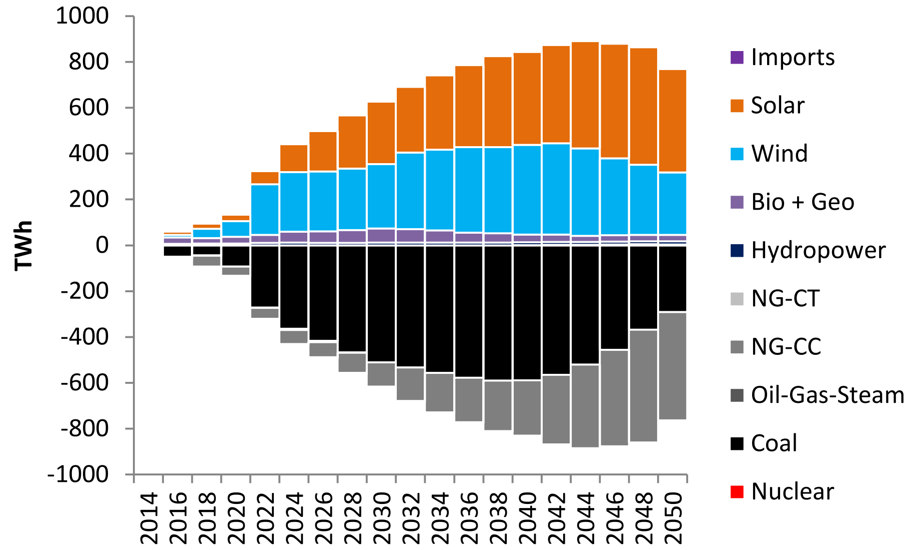



Note: distribution of incremental RE generation is sensitive to technology cost assumptions

- Most incremental capacity and generation split between wind and solar, but significant incremental generation from biomass and geothermal as well
- Incremental RE generation largely offsets fossil generation, with slightly greater coal offset before 2030, but larger share of natural gas offset in the longer term

# High RE Scenario Requires 215 GW RE Above Non-RPS RE by 2030; 627 TWh



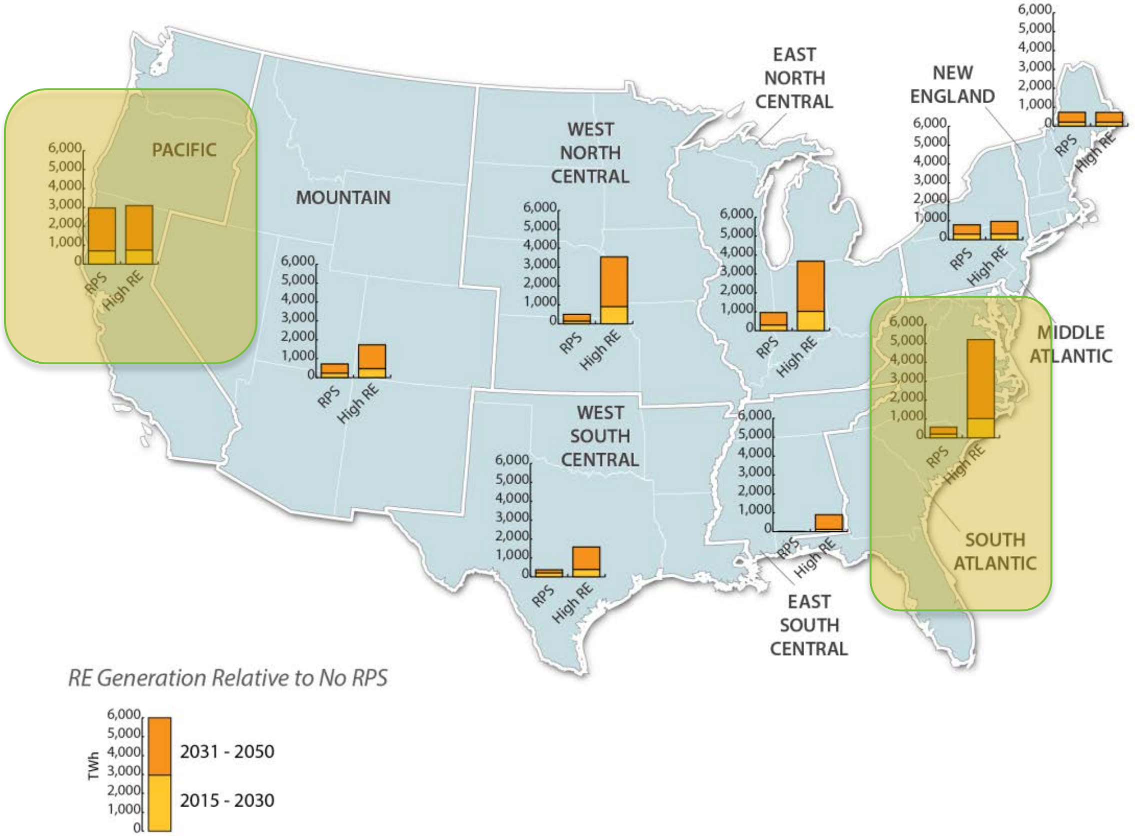




Note: distribution of incremental RE generation is sensitive to technology cost assumptions

- Nearly all incremental RE is from wind and solar generation
- Coal comprises the dominant avoided generation, even more so than in the Existing RPS scenario due, in part, to the location of RE deployment and the design of the scenario with a carbon emissions constraint
  - After 2030 greater amounts of coal capacity are estimated to retire in the High RE scenario and incremental NG-CT capacity is deployed offsetting the avoided NG-CC capacity

# Regional Cumulative Incremental RE Generation

- Existing RPS drives greatest absolute amounts of incremental RE in Pacific region
- More uniform spatial distribution of incremental RE generation found in the High RE scenario



# Electric Sector System Costs and Electricity Price Estimates

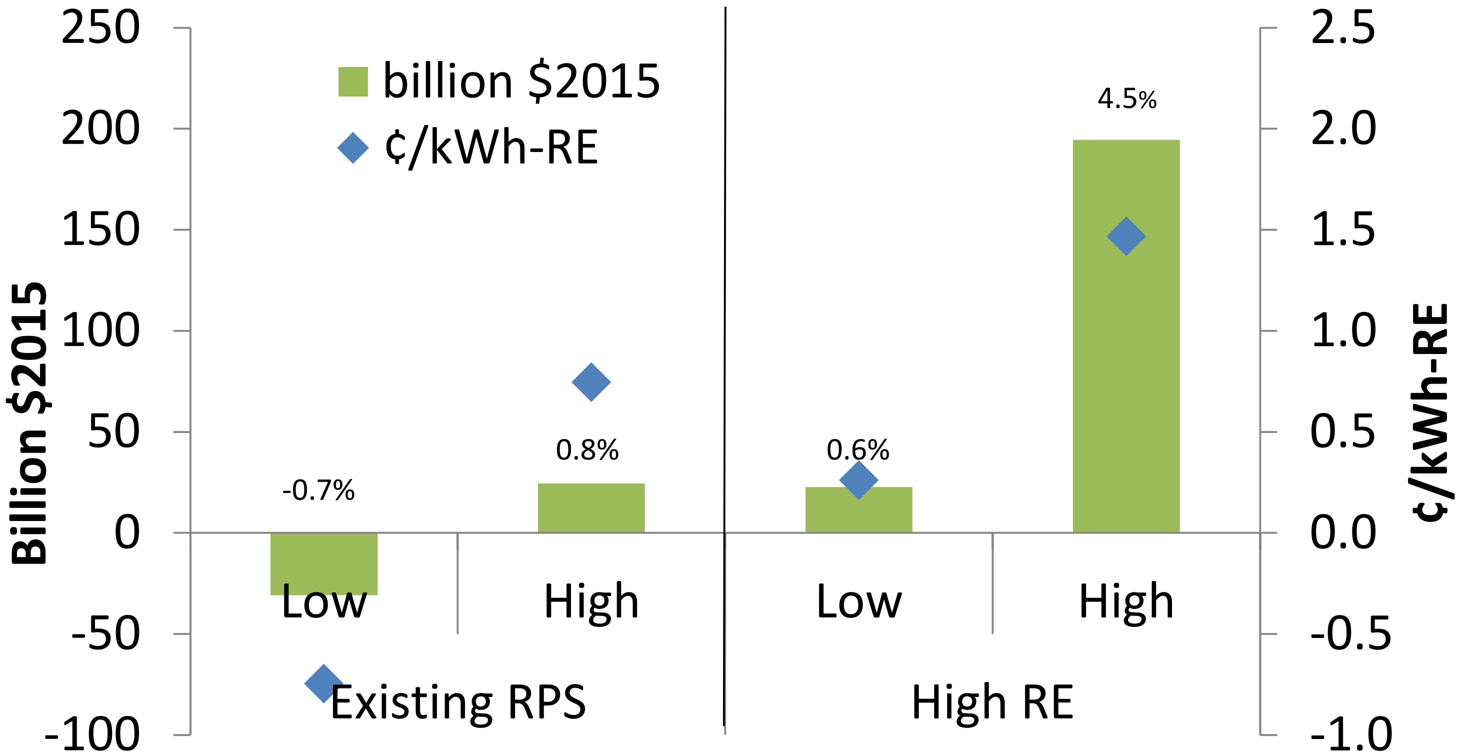
**Trieu Mai, Venkat Krishnan**

# Cost Estimates: Considerations and Limitations

- Cost estimates include capital, O&M, and fuel costs for generation, storage, and transmission infrastructure and operations
  - Incremental system cost results exclude Federal tax incentives
  - Electricity price results include Federal tax incentives
- Uncertainty ranges are estimated based on ReEDS renewable technology cost and natural gas sensitivities; quantified ranges of other benefits and impacts are based on other underlying uncertainties

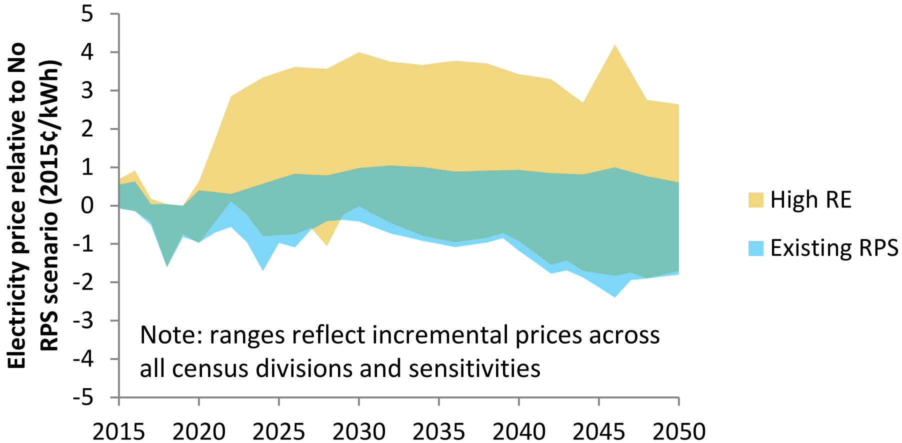
- **Key limitations and caveats**:
  - *System-wide optimization*: Investment and dispatch considers the contiguous U.S. as a whole; non-economic decisions are not considered
  - *Siting and supply chain*: ReEDS does not explicitly model siting and supply-chain constraints
  - *Foresight*: Only limited foresight is modeled in ReEDS

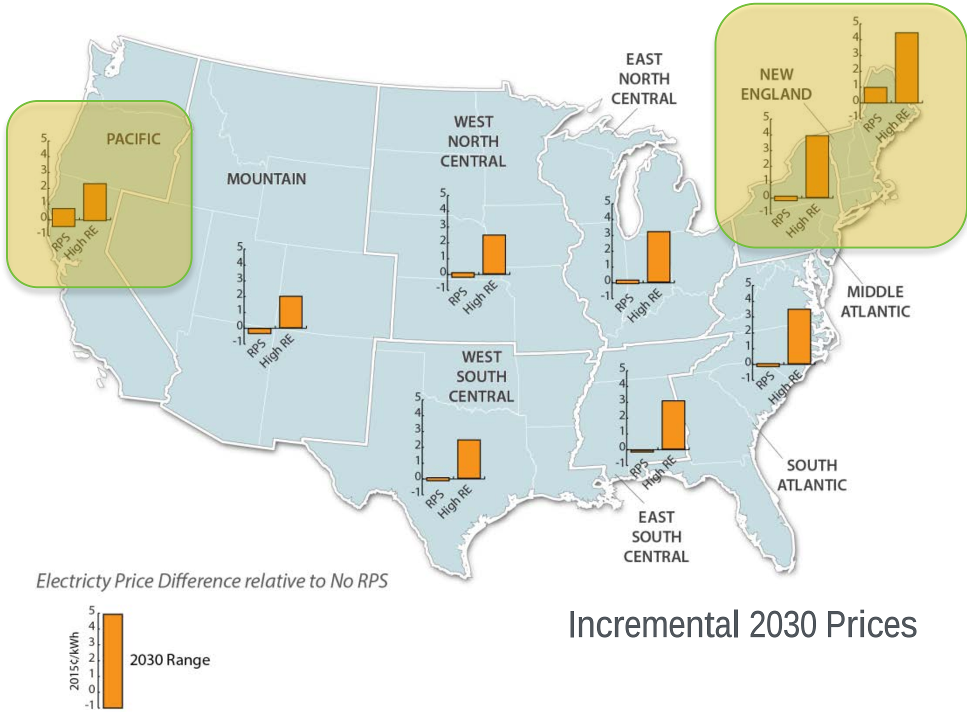
# Present Value of Incremental System Costs Vary Depending on Scenario, Natural Gas Prices, and Renewable Technology Costs




- Existing RPS scenario is found to have an impact of less than ±1% (±0.75 cents/kWh-RE, ±$31 billion) across all sensitivities
  - Negative costs (i.e. benefits) indicate that RE is economic beyond the bounding levels set for the No RPS scenario
- Higher RE scenario results in larger incremental costs ranging from 0.6% ($23 billion) to 4.5% ($194 billion) (0.25 cents/kWh-RE to 1.5 cents/kWh-RE)

# Incremental Electricity Price Estimates Follow a Similar Trend, but Price Impacts Vary by Region




Incremental 2030 Prices

- For the Existing RPS scenarios, 2030 incremental prices fall within ±0.35 cents/kWh for most regions but with incremental price impacts ranging from -0.4 cents/kWh to nearly 1 cent/kWh in the NE and PA regions
- High RE scenario results in a wide range of possible 2030 incremental prices: from negligible price impacts on the low end up to about 4 cents/kWh in some regions

# Air Pollution Emissions and Human Health and Environmental Benefits

**Dev Millstein, Ryan Wiser**

# Methods and Caveats

Estimate combustion-related $SO_2$ and $NO_x$ emissions impacts (ReEDS)

Estimate combustion-related $PM_{2.5}$ emissions impacts and biopower $SO_2$, $NO_x$, and $PM_{2.5}$ (post-processing of ReEDS outputs)

Calculate impacts & monetized benefits of reductions w/ multiple methods (EPA, AP2, EASIUR)

**EPA, AP2, EASIUR all account for pollutant transport & chemical transformation as well as exposure & response; each does so differently, considering different impacts**

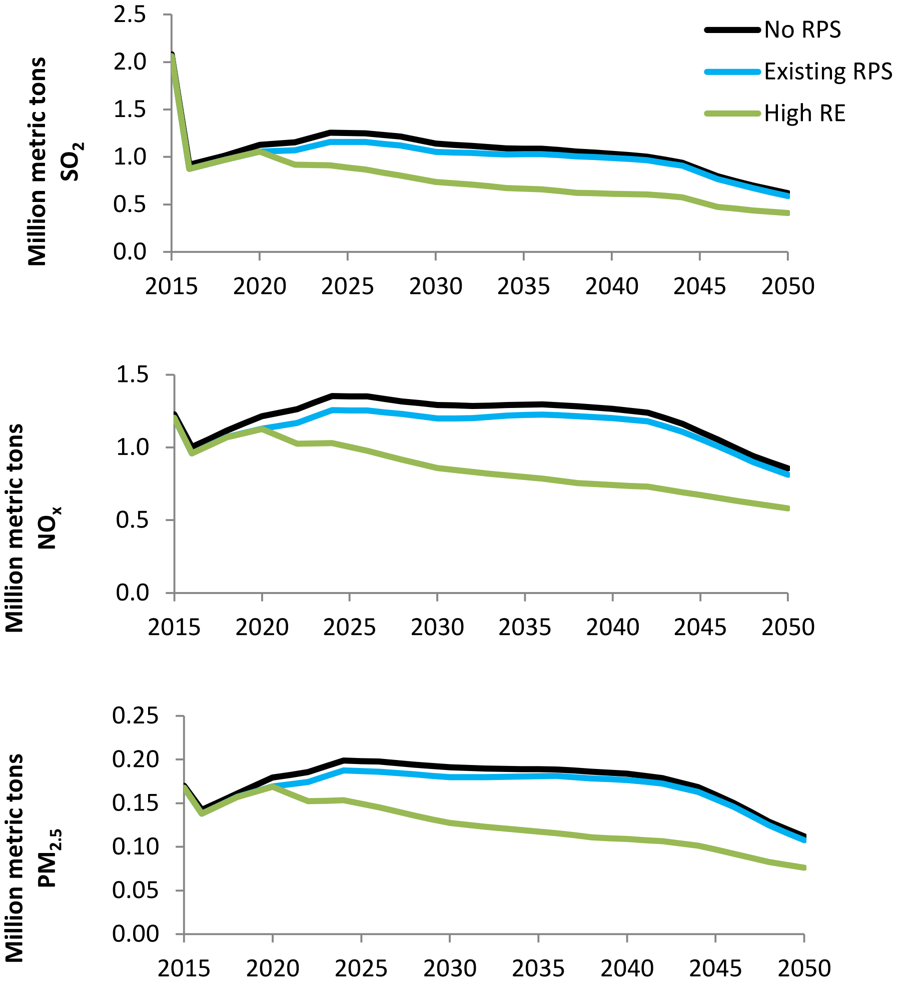
- Focus on subset of air emissions impacts: $SO_2$, $NO_x$, and $PM_{2.5}$ emissions, and implications for fine particulate and ozone exposure; only consider plant operations, ignoring life cycle
- ReEDS models air regulations, including CSAPR and MATS, resulting in non-binding caps; actual benefits dictated in part by future regulations, and possible future binding cap-and-trade
- Estimates of health and environmental benefits associated with emissions reductions are uncertain; some of that uncertainty reflected in diversity of methods and estimates
- Do not fully consider erosion of air emissions benefits due to increased cycling, ramping, and part loading required of fossil generators
- Uncertainties in $PM_{2.5}$ and biomass emissions are more substantial than fossil-based $SO_2$ & $NO_X$

# Summary of Key Results: Physical Impacts

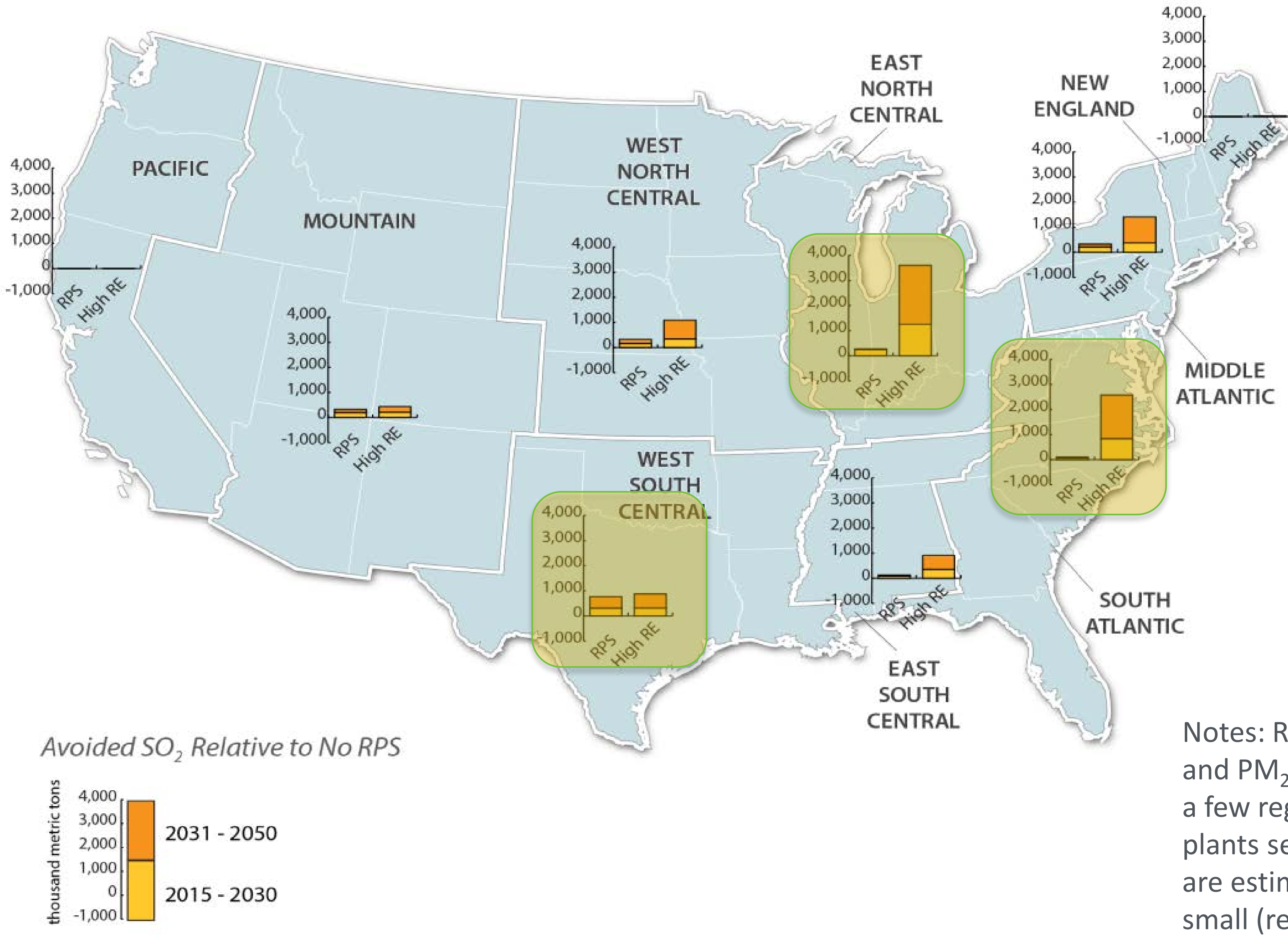
In later years, greater proportions of natural gas are offset, so percentage savings do not grow with time

Cumulative emissions savings under the <u>Existing RPS</u> scenario: 2.1 million metric tons $SO_2$ (5.5%), 2.5 million metric tons $NO_x$ (5.7%), and 0.3 million metric tons $PM_{2.5}$ (4.5%)

Cumulative emissions savings under the <u>High RE</u> scenario: 11.1 million metric tons $SO_2$ (29%), 12.8 million metric tons $NO_x$ (29%), and 1.8 million metric tons $PM_{2.5}$ (29%)



# Summary of Key Results: Emissions Reductions by Region--$SO_2$



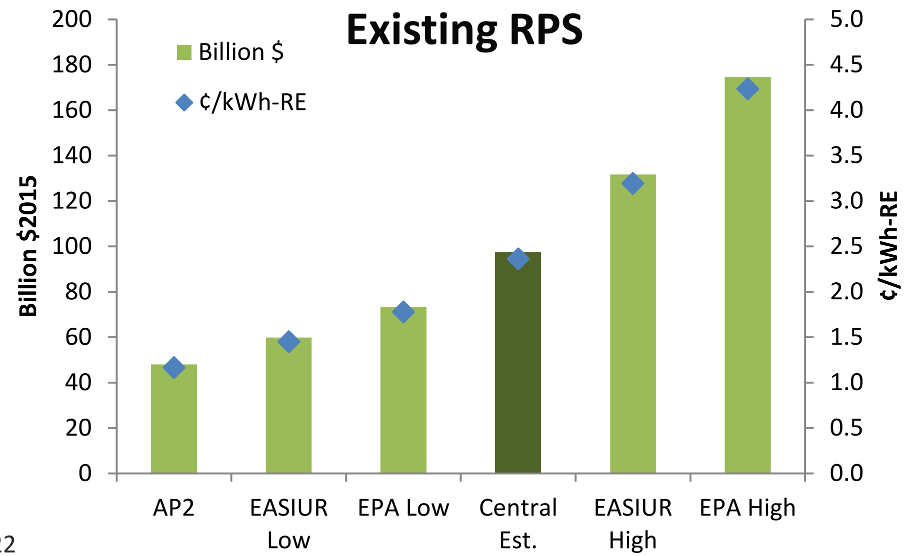

Notes: Regional results for $NO_x$ and $PM_{2.5}$ show similar trends; a few regions with biomass plants serving RPS compliance are estimated to have had small (relative to emission reductions in other states) emission increases

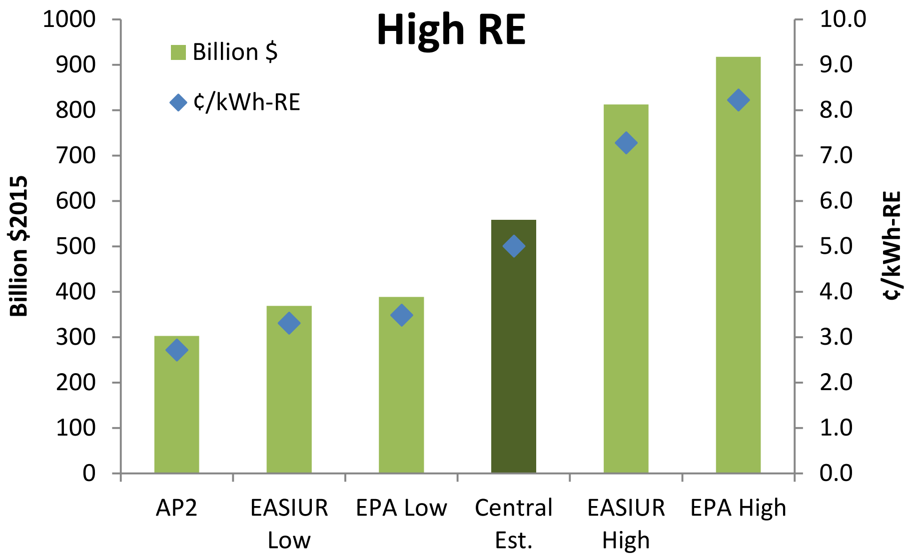
# Summary of Key Results: Monetary Benefits

Present-value benefits of Existing RPS scenario (vs. No RPS) range from **$48 billion** to **$175 billion (central = $97 billion); Equivalent to 1.2 to 4.2 ¢/kWh-RE (central 2.4 ¢/kWh-RE)**

Present-value benefits of High RPS Scenario (vs. No RPS) range from **$303 billion** to **$917 billion (Central = $558 billion); Equivalent to 2.7 to 8.2 ¢/kWh-RE (central 5.0 ¢/kWh-RE)**

*Majority of benefits derive from reductions in $SO_2$, and come from reduced premature mortality (12,000-28,000 fewer premature mortalities under Existing RPS, and 70,000-160,000 fewer under High RE)*



# Greenhouse Gas Emissions Reduction Benefits

**Ryan Wiser, Trieu Mai**

# Methods and Caveats

Estimate combustion-related $CO_2$ emissions reductions (ReEDS)

↓

Estimate GHG emissions impacts from other life cycle stages (literature review, integrated into ReEDS)

↓

Valuation based on: (a) range of social cost of carbon (SCC), (b) range of carbon-reduction compliance-cost estimates

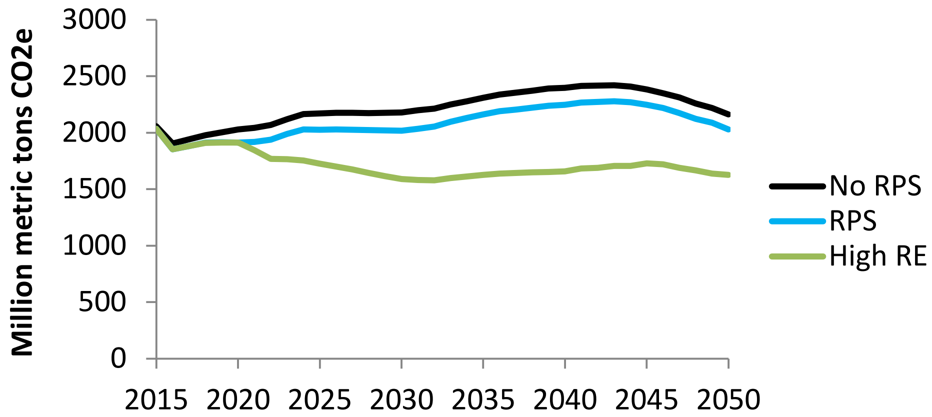
- Rely on 4 SCC estimates from IWG, apply to life-cycle $CO_2e$; SCC used in federal rulemakings; reflects future global reduced damages to agricultural productivity, human health, property damages, ecosystem services
- Separate valuation based on cost of complying with legal requirements to reduce GHG emissions, under assumption that RE can offset compliance costs; value based on EPA CPP estimates for mass and rate compliance and based on low/medium/high Synapse estimates, using combustion-only emissions
- Both sets of “valuation” estimates are uncertain, as are underlying emissions reduction estimates
- Do not fully consider possible erosion of GHG benefits due to increased operational flexibility of fossil plants
- Indirect land-use emissions from biomass not considered; assume that landfill gas used for electric production would otherwise have been flared

# Summary of Key Results: Physical Impacts

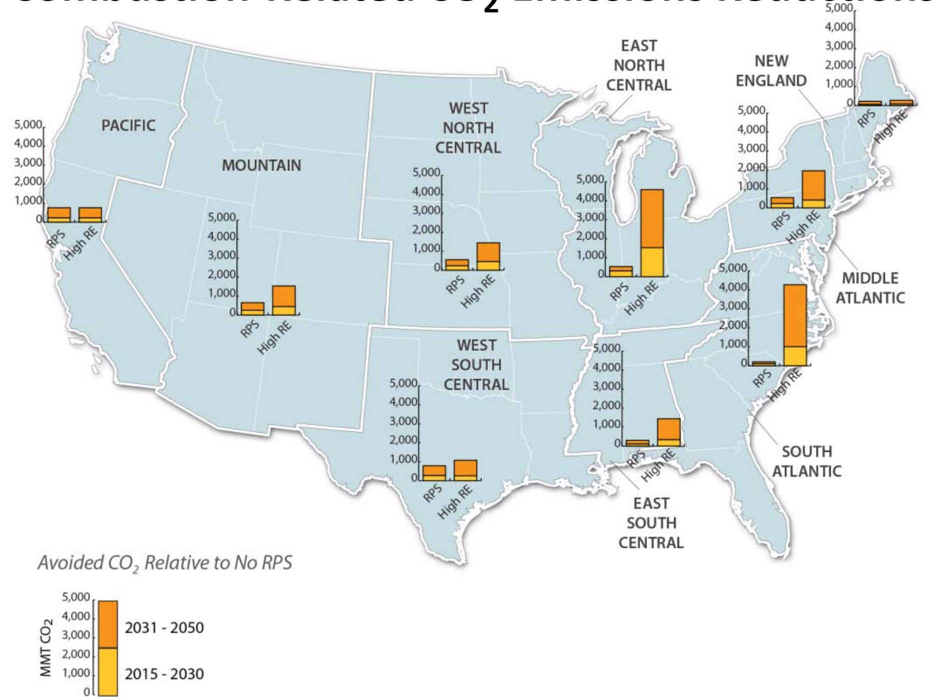
Existing RPS scenario results in life-cycle GHG savings in power sector of 7% in 2030 and 6% in 2050 relative to No RPS

High-RE scenario results in savings of 27% in 2030 and 25% in 2050

## Life-Cycle GHG Emissions Reductions

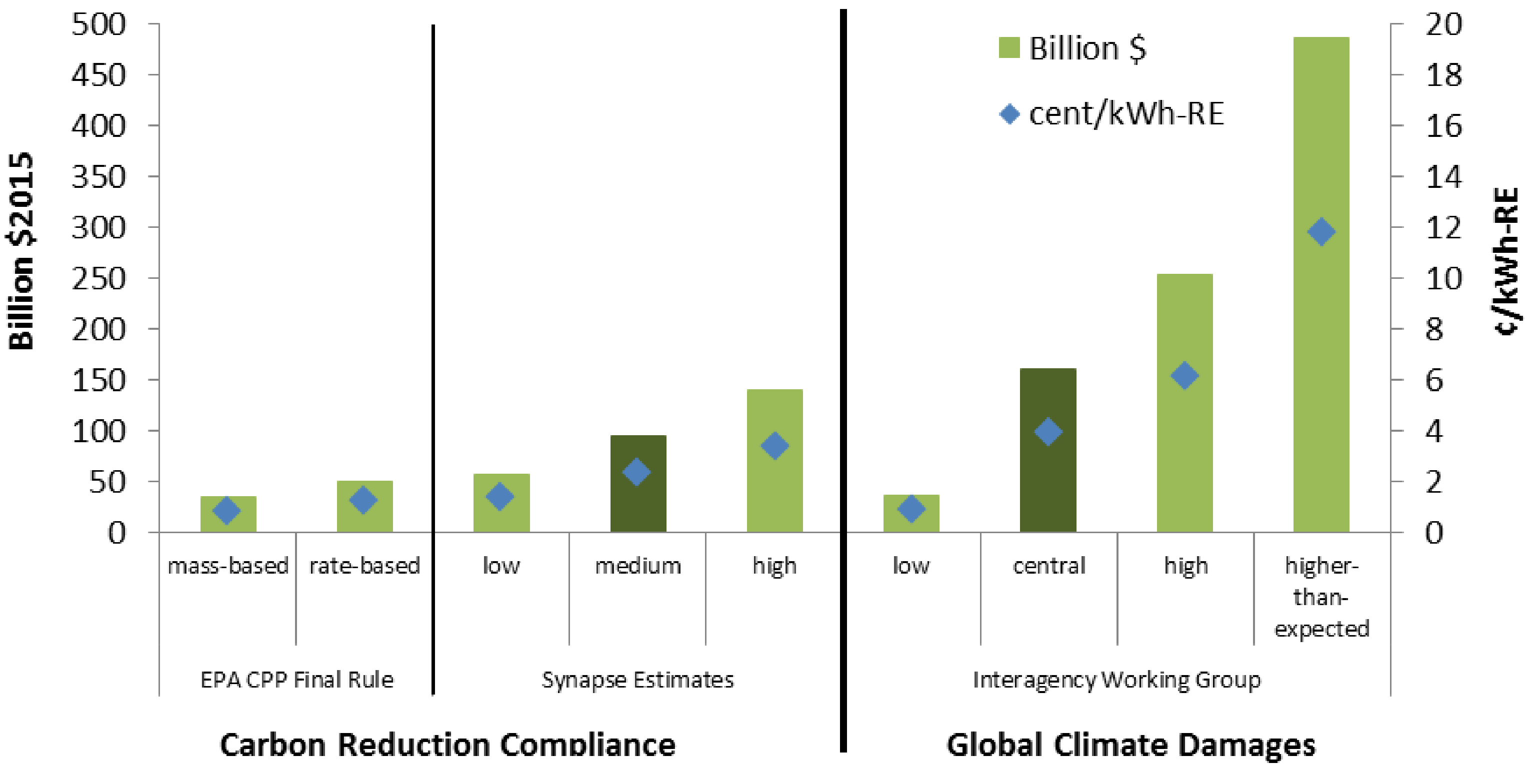



## Combustion-Related $CO_2$ Emissions Reductions



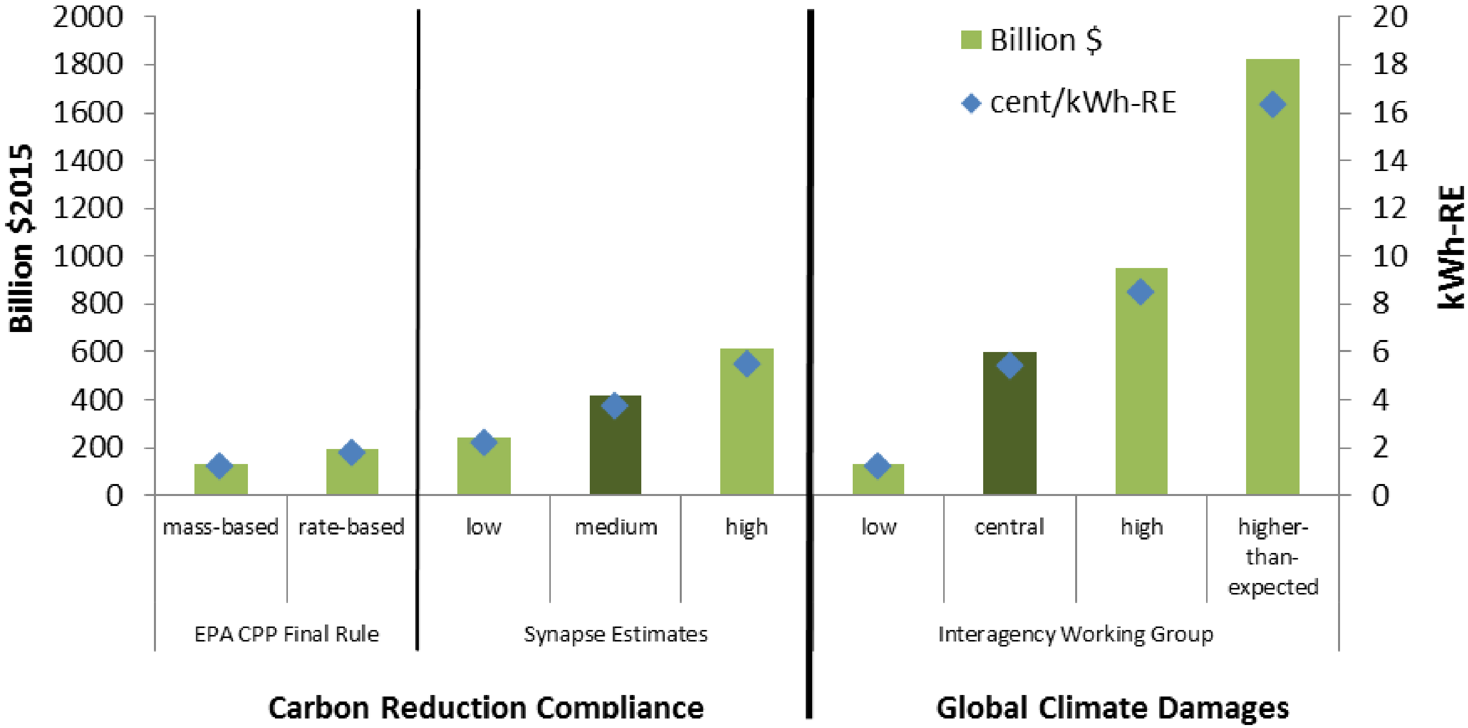
# Summary of Key Results: Monetary Benefits, Existing RPS

Present-value benefits of Existing RPS scenario (compared to No RPS) range from $34 billion to $140 billion using compliance cost estimates from EPA CPP and Synapse (equivalent to 0.8 to 3.4 ¢/kWh-RE); global damage reduction benefits range from $37 billion to $487 billion **(central = $161 billion)** based on IWG SCC (0.9 to 11.8 ¢/kWh-RE, **central = 3.9 ¢/kWh-RE)**



# Summary of Key Results: Monetary Benefits, High RE

Present-value benefits of High RE scenario (compared to No RPS) range from $131 billion to $614 billion using compliance cost estimates from EPA CPP and Synapse (equivalent to 1.2 to 5.5 ¢/kWh-RE); global damage reduction benefits range from $132 billion to $1,821 billion **(central = $599 billion)** based on IWG SCC (1.2 to 16.3 ¢/kWh-RE, **central = 5.4 ¢/kWh-RE)**



# Water Use Reduction Benefits

**Jordan Macknick**

# Methods and Caveats

Estimate renewable and fossil changes in generation (ReEDS)

↓

Estimate cooling technology and water withdrawal and consumption by region (ReEDS)

↓

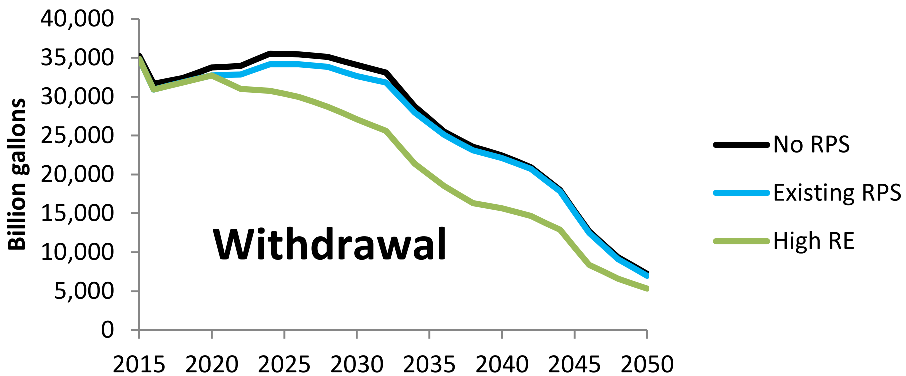
Quantify national and regional net water use reductions

**Considers operational water withdrawal and consumption of all fossil, nuclear, and renewable energy sources**

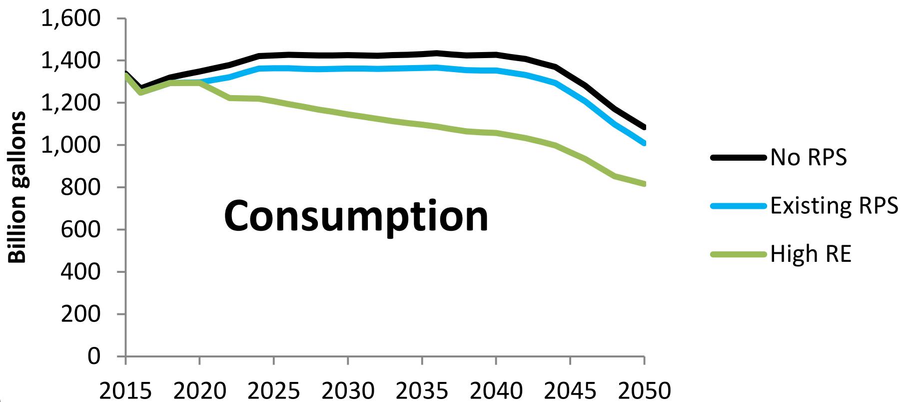
- Do not quantify benefits of water use reductions in monetary terms: methodological challenges
- Only consider operational water use and do not estimate full life cycle uses; including upstream uses would likely increase RPS benefits
- Assessment relies on assumptions about which prime mover technology type and cooling system is associated with individual generators
- Biomass (non-gas) sources are assigned water use characteristics of simple-cycle steam turbine solid-biomass power plants, biomass (gas) sources are assigned characteristics of biogas-based power plants, and landfill gas plants are assumed to require no water for operations
- Do not consider hydropower evaporation due to uncertainties in allocation among multiple uses

# Summary of Key Results: Physical Impacts, National

Existing RPS scenario results in reduced national operational water withdrawals / consumption in the U.S. power sector of **4%/4% in 2030** and **3%/7% in 2050** relative to No RPS scenario; High-RE scenario results in savings of **20%/20% in 2030** and **26%/25% in 2050**




2030 consumption savings = annual water use of 420,000 U.S. households for the Existing RPS scenario; 1.9 million households for High RE scenario

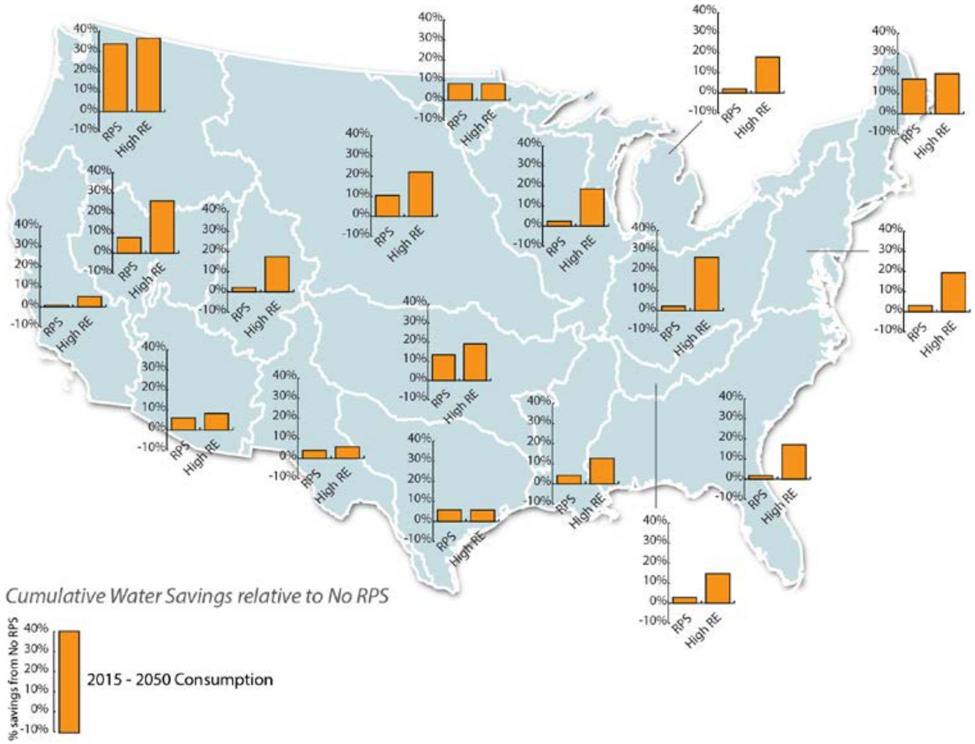



Cumulatively (2015-2050), each MWh of RE serving existing RPS represents average savings of 3,400 gallons of water withdrawal and 290 gallons of consumption

# Summary of Key Results: Regional Water Consumption Savings

- Amount of water savings is affected by the amount and type of incremental RE supply and by the water use associated with the displaced fossil units
- Water consumption (and withdrawal) declines more under Existing RPS and High RE scenarios than under No RPS scenario in most watershed regions
- The largest water savings, especially under the High RE scenario, are from regions that currently withdraw and consume larger amounts of water for power generation

**Percent cumulative consumption savings**



# Summary of Key Results: Monetary Benefits

Standard methods do not exist to value—in monetary terms—water use benefits, but water use reductions can be considered a co-benefit of RE deployment, especially where water is scarce

- Reduce the vulnerability of electricity supply to the availability or temperature of water, potentially avoiding electric-sector reliability events and/or the effects of reduced thermal plant efficiencies
- Frees water for other uses, whether for other productive economic purposes or to strengthen local ecosystems
- By avoiding upstream water demands from fossil fuel supply, RE can help alleviate other energy-sector impacts on water resource quality and quantity

# Gross Renewable Energy Workforce Requirements

David Keyser

# Methods and Caveats

Incremental renewable generation, capacity, and investments during 2015-2050 (ReEDS)

↓

JEDI models and IMPLAN

↓

Gross jobs, earnings, output, and GDP impact estimates

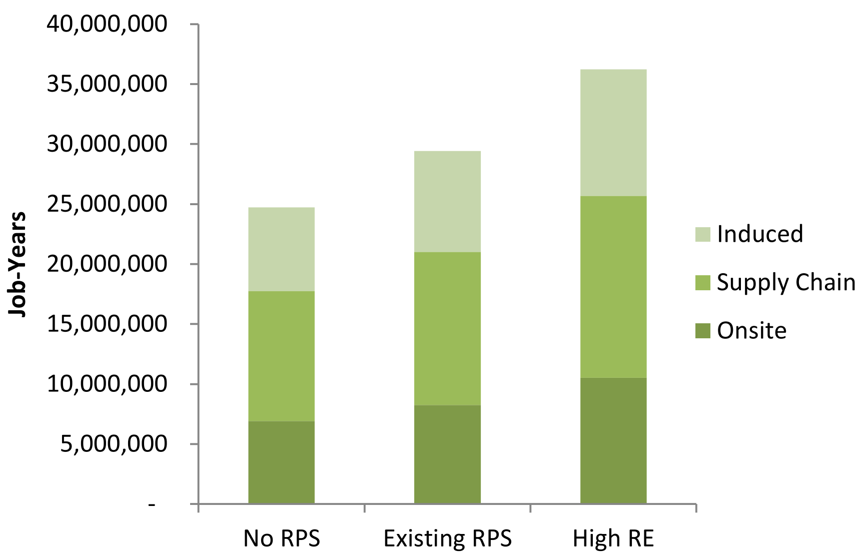
**JEDI used for all estimates, except for landfill gas, where IMPLAN is used instead; costs and assumptions for "domestic content" largely based on JEDI default data**

- Results are reported based on onsite, supply chain, and induced impacts, for both operation and construction; results presented on a national and, for onsite jobs only, on a regional basis
- All results produced by JEDI and IMPLAN are for the equivalent of a single year—O&M jobs can be assumed to be ongoing, however, while construction jobs are inherently limited
- Estimates represent gross impacts: do not reflect other potential economic impacts such as displaced fossil plants, changes in utility electricity rates, or changes in property values or other prices—results should not be considered net economy-wide impacts or societal benefits
- Inherent uncertainty due to unknown future changes in technology and the economy

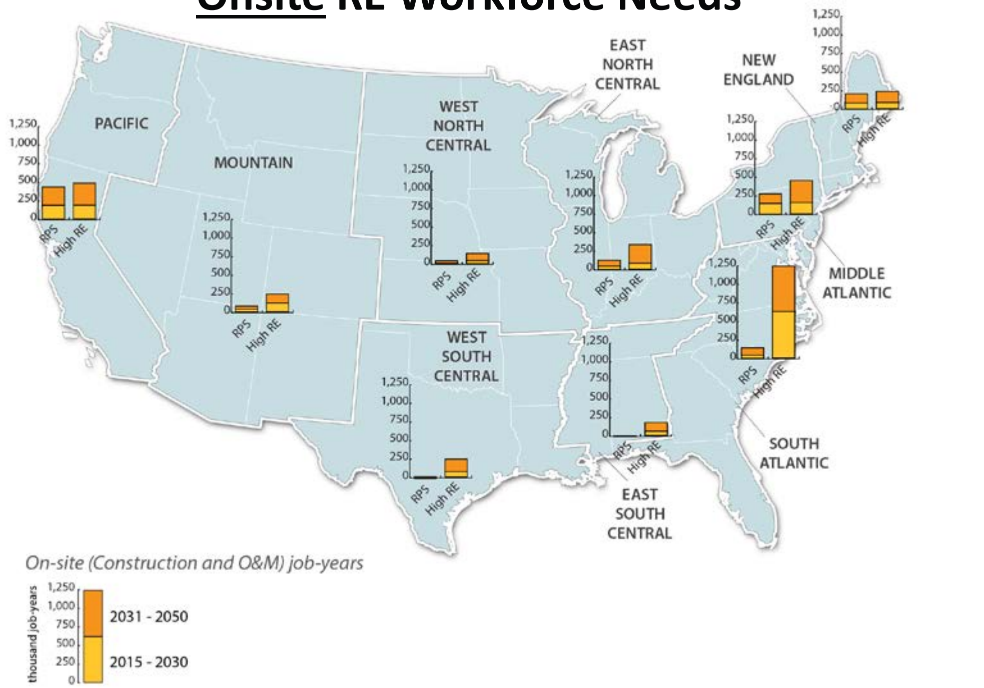
# Summary of Key Results: RE Workforce Requirements

- The Existing RPS scenario relative to No RPS scenario requires 4.7 million additional RE-related job-years; a 19% boost in RE-related employment and equivalent to an average of 134,000 more workers annually
- The High RE scenario requires 11.5 million additional RE-related job-years; a 47% boost in RE-related employment
- Location of onsite jobs affected by level of RE deployment and labor intensity of the specific RE technologies deployed in each region

**Total RE Workforce Requirements**

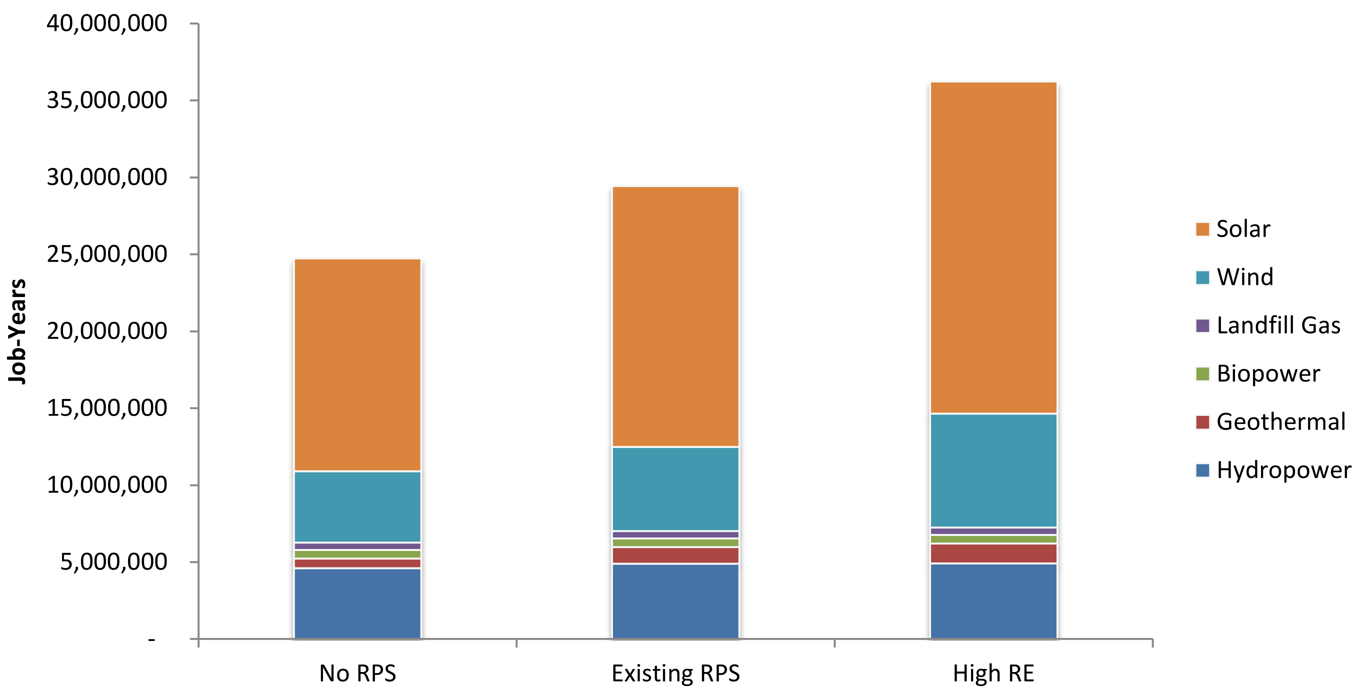



**Onsite RE Workforce Needs**



# Summary of Key Results: Details on Impacts

- Distribution of RE workforce needs among RE technologies reflects expansion as well as characteristics of operation and construction: some technologies are more labor intensive than others
- Most incremental deployment and jobs in solar PV and wind



# Natural Gas Price Reduction Impacts

Trieu Mai

# Methods and Caveats

Derive regional "inverse price elasticity of natural gas" supply curve from EIA AEO

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Implement in ReEDS, and estimate regional natural gas prices in all scenarios (ReEDS)

↓

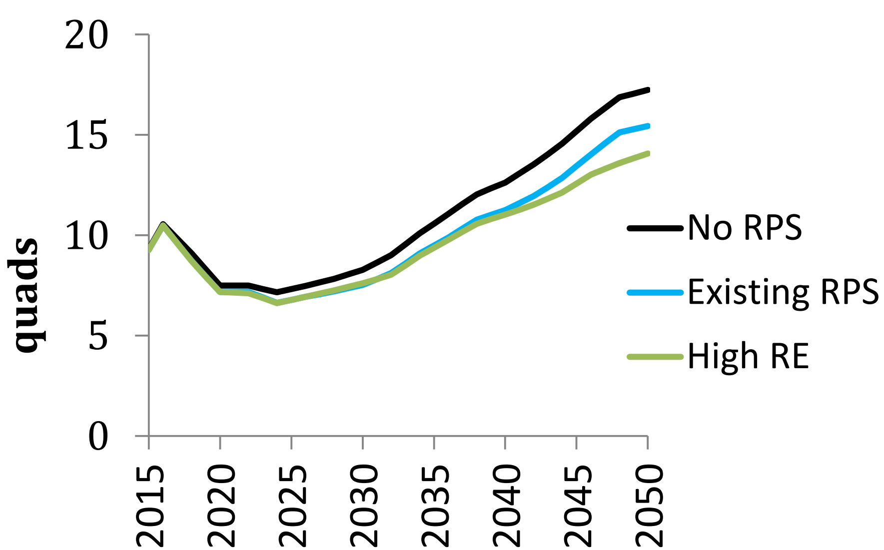
Apply resulting natural gas price changes to forecast of regional natural gas demand outside of power sector (EIA)

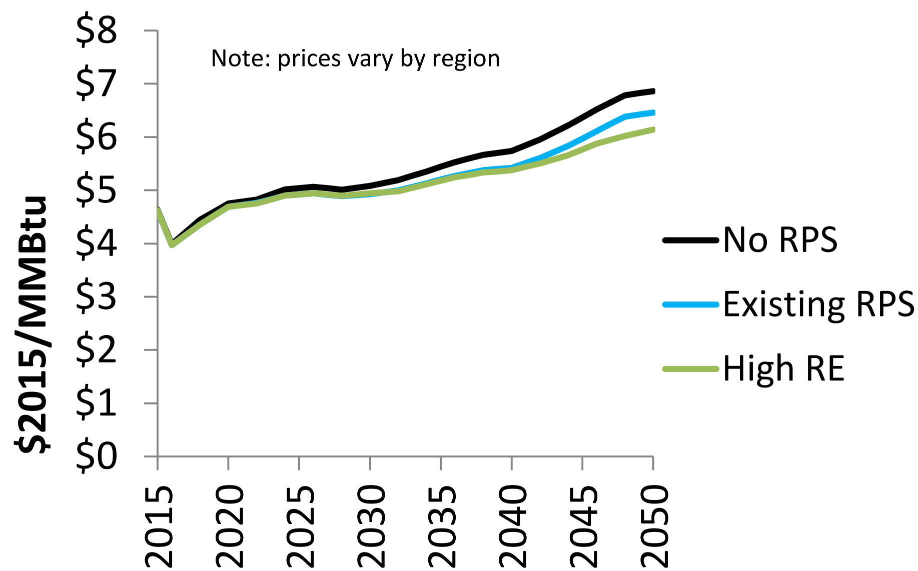
- Consumer benefits calculated here represent a wealth transfer from producers to consumers: no net societal benefit is claimed, at least nationally
- Natural gas price reductions in power sector are accounted for in "cost" impacts earlier; focus here is on impact of reductions outside power sector
- Though roughly consistent with past literature, the accuracy of the inverse elasticity curves derived from EIA AEO are uncertain
- Assume that national average wellhead price changes flow through fully to delivered gas prices in all regions and sectors; assume that consumers are 100% exposed to wellhead price changes
- Do not fully account for possible rebound effect whereby gas price reductions spur additional demand

# Summary of Key Results: Physical and Price Impacts

Existing RPS scenario results in reduced demand for natural gas by 35 quads from 2015-2050, representing 3.3% of total consumption in U.S. as estimated and extrapolated from the AEO 2016 Reference case: lowered gas prices by $0.36 to $0.59/MMBtu in 2050 across all regions

Cumulative reductions in the High RE scenario total 46 quads (4.3%) and lowered gas prices by $0.69 to $0.89/MMBtu in 2050



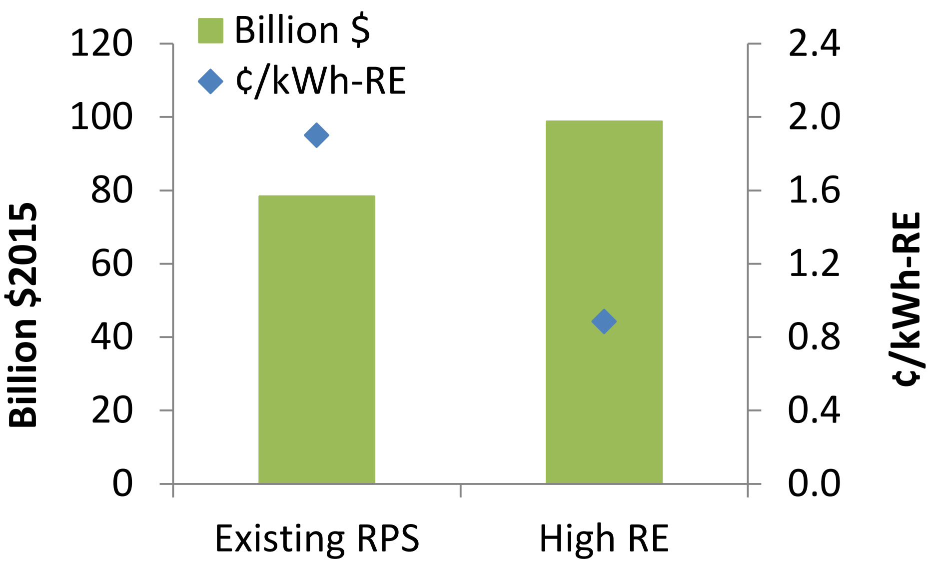



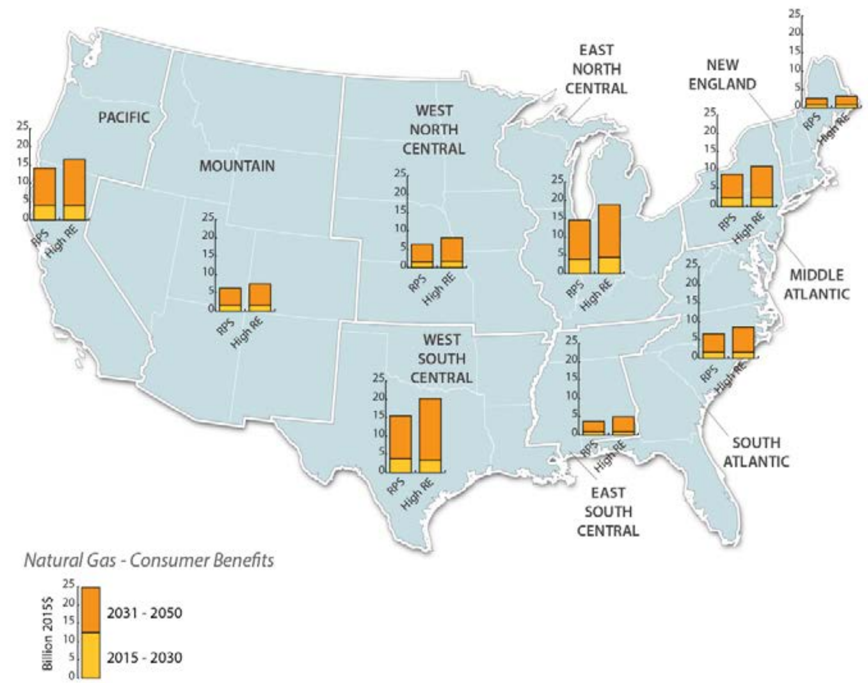
# Summary of Key Results: Monetary Impacts

When lower gas prices are applied to all non-electric gas-consuming sectors of the economy, aggregate present-value consumer savings are estimated to be:

- Existing RPS: $78 billion (1.9 ¢/kWh-RE)
- High RE: $99 billion (0.9 ¢/kWh-RE)

Consumer benefits vary by region depending on regional gas price reduction and delivered gas consumption in each region



# Summary and Conclusions

# Summary of Prospective Costs, Benefits, and Impacts of RE Supported by State RPS Policies

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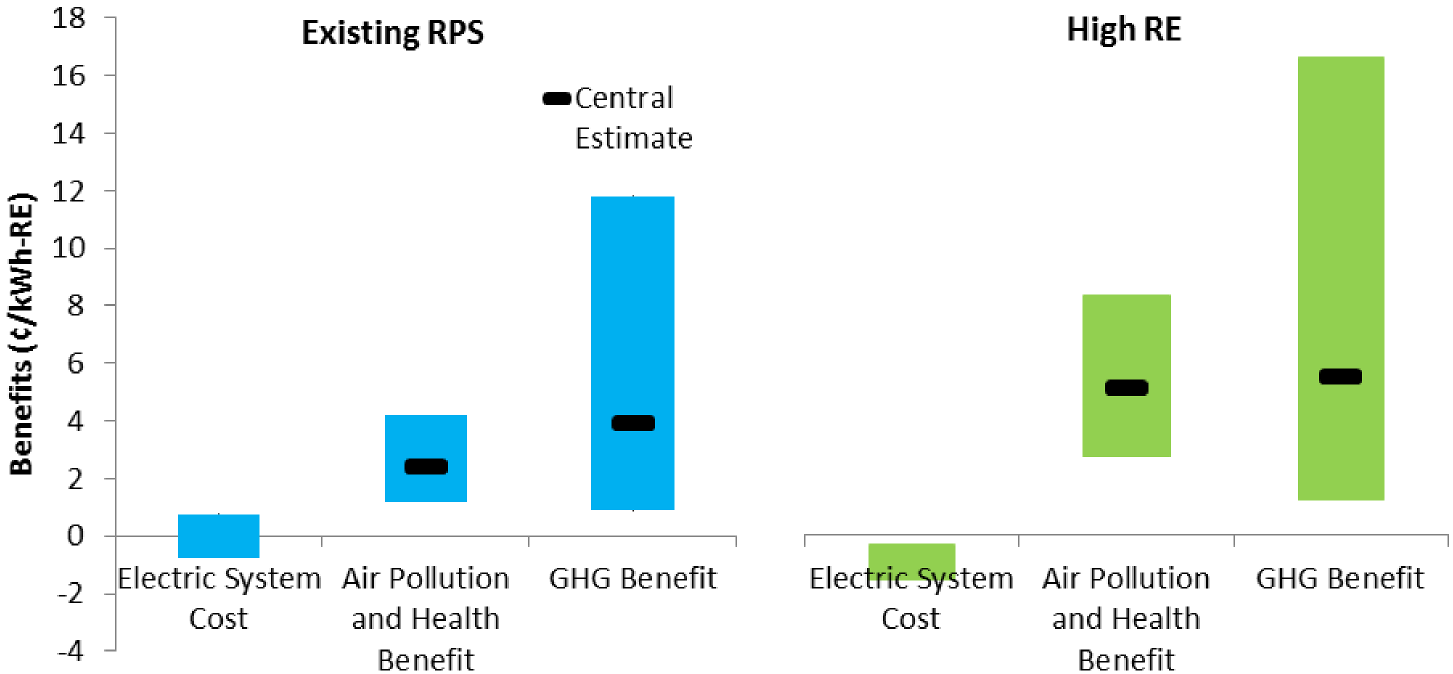
| | | EXISTING RPS | | HIGH RE | |
|---|---|---|---|---|---|
| RENEWABLE ENERGY IN 2050 | | increased by ↑ 122 GW \| 296 TWh | | increased by ↑ 331 GW \| 765 TWh | |
| COSTS | ELECTRIC SYSTEM COSTS | range from -0.7% to 0.8% | equivalent to +/–$31 billion *estimates span +/- 0.75¢/kWh-RE* | range from 0.6% to 4.5% | equivalent to $23 billion–$194 billion *estimates span 0.26-1.5¢/kWh-RE* |
| COSTS | ELECTRICITY PRICES | range from -2.4 cents/kWh to 1 cent/kWH | | range from -1.9 cents/kWh to 4.2 cents/kWH | |
| BENEFITS | SULFUR DIOXIDE | reduced by ↓ 6% \| 2.1 million metric tons $SO_2$ | | reduced by ↓ 29% \| 11.1 million metric tons $SO_2$ | |
| BENEFITS | NITROGEN OXIDES | reduced by ↓ 6% \| 2.5 million metric tons $NO_x$ | equivalent to $97 billion (2.4¢/kWh-RE) *estimates span $48 billion-$175 billion (1.2-4.2¢/kWh-RE)* | reduced by ↓ 29% \| 12.8 million metric tons $NO_x$ | equivalent to $558 billion (5.0¢/kWh-RE) *estimates span $303 billion-$917 billion; 2.7-8.2¢/kWh-RE* |
| BENEFITS | PARTICULATE MATTER 2.5 | reduced by ↓ 5% \| 0.3 million metric tons $PM_{2.5}$ | | reduced by ↓ 29% \| 1.8 million metric tons $PM_{2.5}$ | |
| BENEFITS | GREENHOUSE GAS EMISSIONS | reduced by ↓ 6% \| 4.7 billion metric tons $CO_2e$ | equivalent to $161 billion (3.9¢/kWh-RE) *estimates span $37 billion-$487 billion (0.9-11.8¢/kWh-RE)* | reduced by ↓ 23% \| 18.1 billion metric tons $CO_2e$ | equivalent to $599 billion (5.4¢/kWh-RE) *estimates span $132 billion-$1,821 billion (1.2-16.3¢/kWh-RE)* |
| BENEFITS | WATER USE | reduced by ↓ 4% consumption \| 3% withdrawal | | reduced by ↓ 18% consumption \| 18% withdrawal | |
| IMPACTS | NATURAL GAS | reduced by ↓ 35 quads (3.3%) | equivalent to $78 billion impact 1.9¢/kWh-RE | reduced by ↓ 46 quads (4.3%) | equivalent to $99 billion impact 0.9¢/kWh-RE |
| IMPACTS | RE JOB NEEDS | increase in ↑ 19% RE-employment | equivalent to 4.7 million RE job-years | increase in ↑ 47% RE-employment | equivalent to 11.5 million RE job-years |

- Relying on a well-vetted set of methods, the study evaluates the costs, benefits, and other impacts of renewable energy used to meet future RPS demand growth—from current state RPSs as well as under a high RE scenario in which most states adopt aggressive targets—over the 2015-2050 period
- We find 296 TWh (122 GW) of new RE generation is needed to meet Existing RPSs; 765 TWh (331 GW) is needed under the High RE scenario
- Incremental RE generation offsets fossil generation leading to environmental benefits (air pollution, GHG, water) and other impacts

# Comparison of Costs and Monetized Benefits




- When comparing the costs and monetized benefits, we find that the benefits exceed the costs, even when considering the highest cost and lowest benefit outcomes
  - Existing RPS: Costs are <0.75 cents/kWh-RE vs. >1.2 cents/kWh-RE air pollution and >0.9 cents/kWh-RE GHG benefits
  - High RE: Costs are <1.5 cents/kWh RE vs. >2.7 cents/kWh-RE air pollution and >1.2 cents/kWh-RE GHG benefits
- Additional benefits occur from water savings, which could not be readily monetized; other impacts associated with gross RE workforce needs and natural gas consumers are also quantified
- Important to recognize that RPS policies may not be the least-cost means of achieving these benefits; see “limitations” noted earlier and described in full report

# For more information...

Report, summary fact-sheet, and PPT briefing are all available:

- http://www.nrel.gov/docs/fy17osti/67455.pdf
- https://emp.lbl.gov/publications/prospective-analysis-costs-benefits

Related reports, data, and materials are also available:

- http://www.nrel.gov/analysis/rps.html
- http://rps.lbl.gov

Report primary coordinating authors:


- Galen Barbose glbarbose@lbl.gov
- Lori Bird lori.bird@nrel.gov
- Jenny Heeter jenny.heeter@nrel.gov
- Trieu Mai trieu.mai@nrel.gov
- Ryan Wiser rhwiser@lbl.gov