State-Federal RPS Collaborative Webinar

Impacts of Federal Tax Credit Extensions on Renewable Deployment and Power Sector Emissions

Hosted by
Warren Leon, Executive Director, CESA

March 18, 2016

CleanEnergy States Alliance

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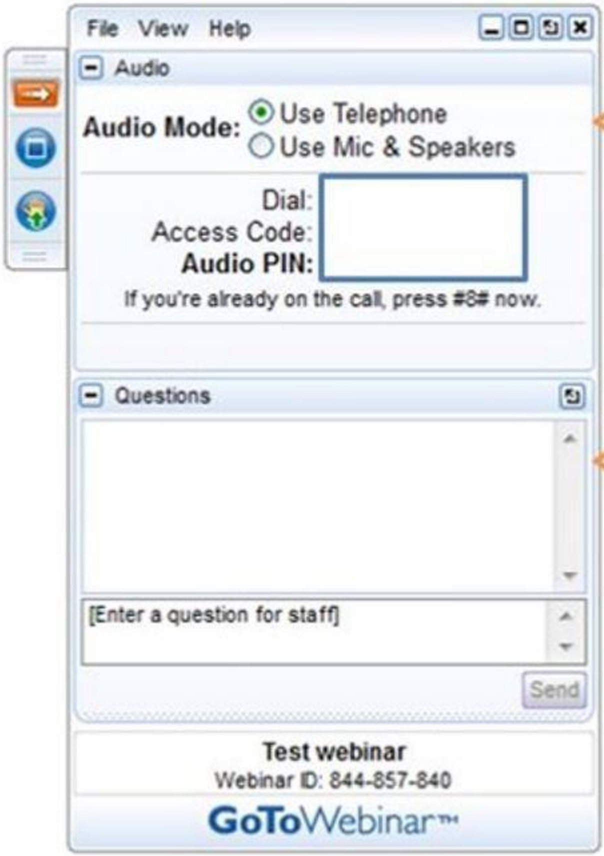

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State-Federal RPS Collaborative

- With funding from the Energy Foundation and the US Department of Energy, CESA facilitates the **Collaborative**.
- Includes **state RPS administrators**, **federal agency representatives**, and other stakeholders.
- Advances dialogue and learning about RPS programs by **examining the challenges and potential solutions** for successful implementation of state RPS programs, including **identification of best practices**.
- To sign up for the Collaborative listserv to get the **monthly newsletter** and announcements of **upcoming events**, see: www.cesa.org/projects/state-federal-rps-collaborative

Today's Guest Speaker

Trieu Mai, Energy Engineer, Energy Forecasting and Modeling Group in the Strategic Energy Analysis Center, National Renewable Energy Laboratory (NREL)

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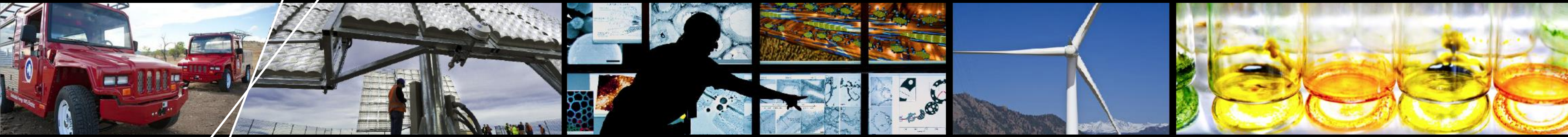
Impacts of Federal Tax Credit Extensions on Renewable Deployment and Power Sector Emissions



Presenter and author: Trieu Mai

Co-authors: Wesley Cole, Eric Lantz, Cara Marcy, Ben Sigrin

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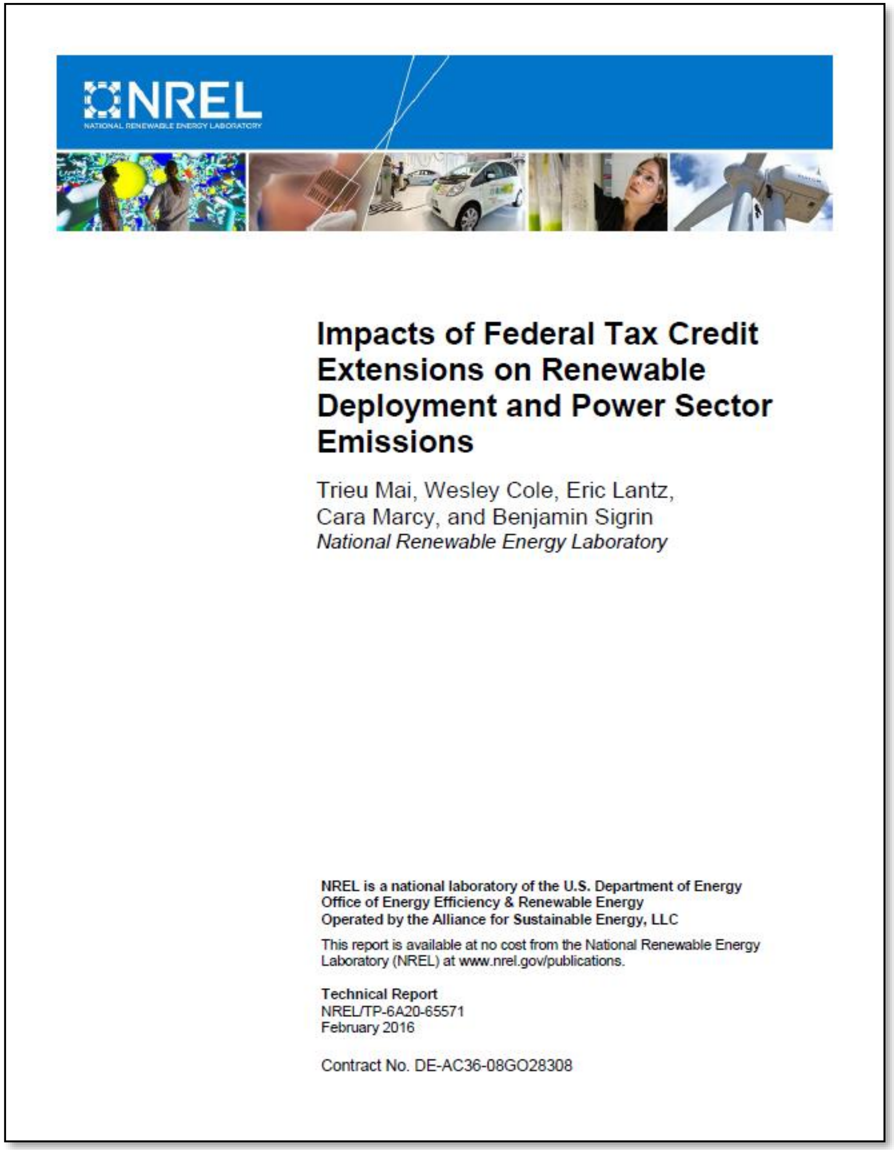
Presentation Overview

- **Federal RE tax credit policy background & status**
- **Study objectives**
- **Modeling methods and assumptions**
- **Results**
  - Impacts to RE deployment
  - Impacts to Power Sector CO_2 Emissions
- **Conclusions**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National Renewable Energy Laboratory

NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC

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Acknowledgments and team

- **Project funded by DOE EERE Strategic Programs, Solar Energy Technologies, and Wind and Water Power Technologies Offices**

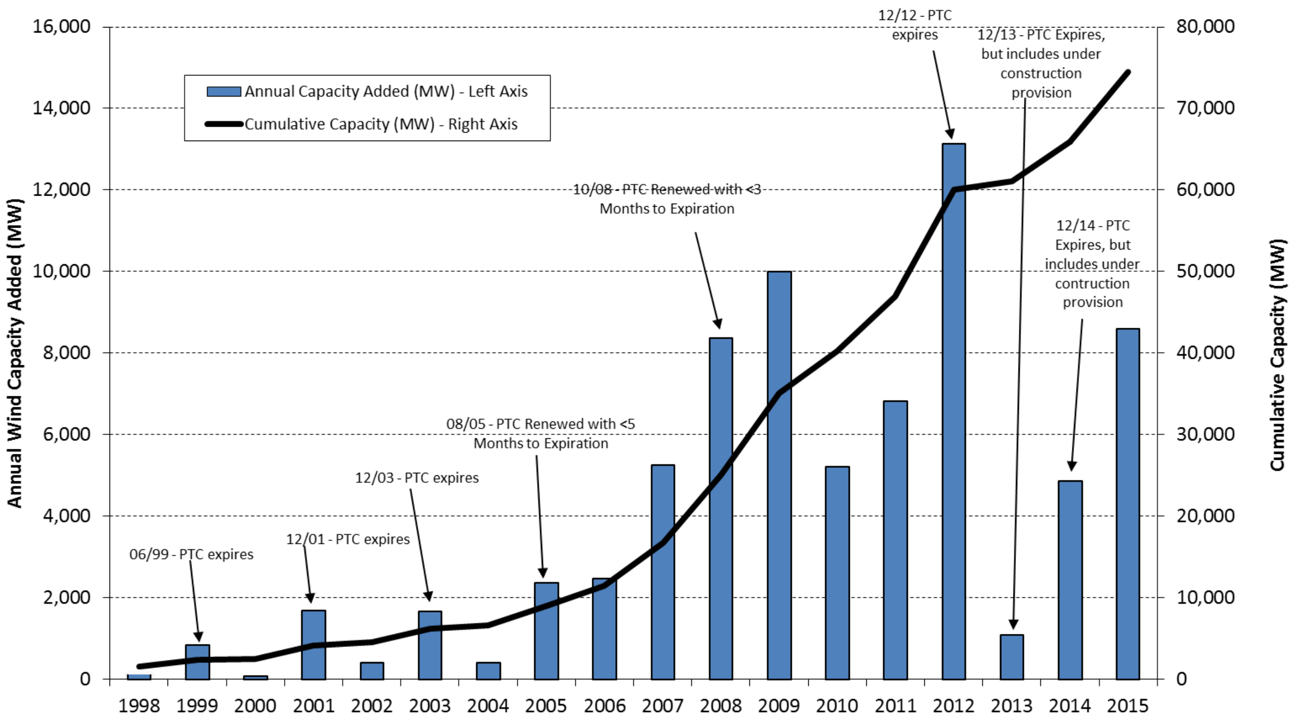
- **Executed by NREL analysis research team: Mai, Cole, Lantz, Marcy*, Sigrin**

  ** Cara Marcy is a PMF on assignment at NREL from the Energy Information Administration*

- **Recent addition to a broader policy analysis research portfolio from NREL's Strategic Energy Analysis Center and our collaborators**
  - Interdisciplinary team of renewable energy and policy analysts, economists, engineers, and energy modelers
  - Key topics: federal incentive policy, state RPS, carbon policies (e.g., Clean Power Plan), RE grid integration

Federal RE tax credit policy - background

- **The wind PTC and solar ITC were first enacted as part of the *Energy Policy Acts of 1992* and *2005*, respectively, and have expired, been extended, modified, and renewed numerous times**
- **<u>Before</u> the passage of the *Consolidated Appropriations Act of 2016* in December 2015:**
    - The wind PTC expired as of December 31, 2014, but with the “commenced construction provision”
    - The 30% solar ITC was set to decline after 2016



Federal RE tax credit policy – current status

New Policy		2015	2016	2017	2018	2019	2020	2021	Future
Wind PTC		Full	Full	80%	60%	40%	0%	0%	0%
Solar ITC	Utility	30%	30%	30%	30%	30%	26%	22%	10%
Solar ITC	Commercial/Third-Party-Owned	30%	30%	30%	30%	30%	26%	22%	10%
Solar ITC	Residential Host-Owned	30%	30%	30%	30%	30%	26%	22%	0%
Prior Policy		**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Wind PTC		0%	0%	0%	0%	0%	0%	0%	0%
Solar ITC	Utility	30%	30%	10%	10%	10%	10%	10%	10%
Solar ITC	Commercial/Third-Party-Owned	30%	30%	10%	10%	10%	10%	10%	10%
Solar ITC	Residential Host-Owned	30%	30%	0%	0%	0%	0%	0%	0%

The New Policy schedules reflect “commenced-construction” dates for all categories except Solar ITC Residential Host-Owned for which “placed-in-service” dates are shown. The Prior Policy schedules reflect “placed-in-service” dates for all categories except or the Wind PTC which had a “commenced-construction” deadline of December 31, 2014. The “Full” (100%) wind PTC value is 2.3¢/kWh for electricity production over the first ten years.

- **The new policy extends the wind PTC through 2019 and solar ITC through 2021, but with lower value during the last 2-3 years**
- **It includes the commenced-construction provision for business projects; residential tax credit requirements remain as placed-in-service**
- **PTCs for biomass, geothermal, and hydropower were extended through 2016 (with commenced-construction provision) and ITC in lieu of PTC option is also available for qualifying technologies (e.g., offshore wind)**

Study Objectives

This study explores two key questions:

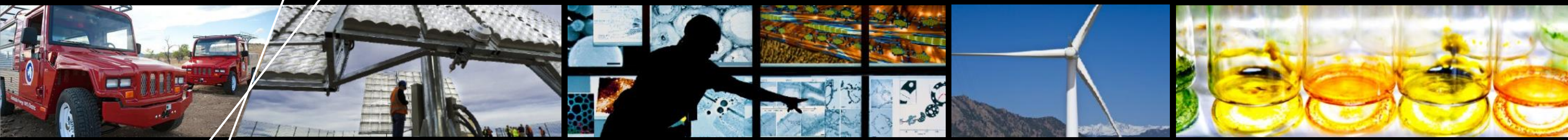
1. ***How might RE deployment in the contiguous United States change with the federal tax credit extensions?***
2. ***How might this change in RE deployment impact carbon dioxide (CO_2) emissions in the power sector?***

The focused scope of the study does not include a broader set of potential impacts, including to: taxpayers and electricity ratepayers; air pollution, land use, and environmental quality; clean energy policy compliance costs; and grid operations and electricity markets. As such, this analysis does not represent a comprehensive cost-benefit assessment of the tax credit extensions.

Key Findings

- **Under a range of natural gas price assumptions, scenarios with RE tax credit extensions show greater renewable investments through the early 2020s than scenarios without extensions**
  - The tax credit extensions are estimated to drive a net peak increase of 48-53 GW in installed renewable generation capacity in the early 2020s
  - Longer-term impacts are less certain and can depend on natural gas prices; longer lasting impacts are found with low gas prices
  - Solar and wind are estimated to experience the most growth and are most impacted by the tax credit extensions

- **The tax credit extension-driven acceleration in renewable energy capacity development can reduce fossil fuel-based generation and lower electric sector CO_2 emissions**
  - Cumulative (2016-2030) CO_2 emissions reductions range from 540 MMT (base gas price) to 1420 MMT (low gas price)



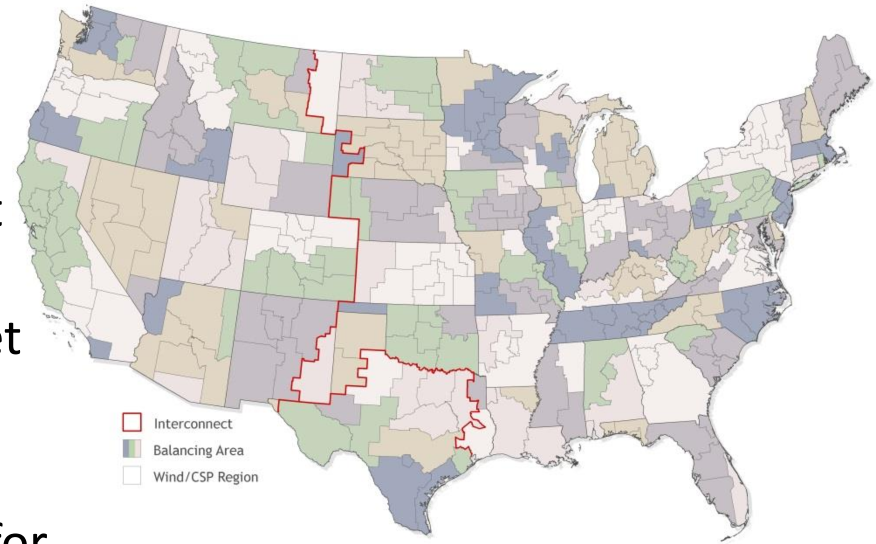
Methods and Assumptions

NREL Regional Energy Deployment System (ReEDS) and Distributed Solar (dSolar) models

ReEDS is a spatially and temporally resolved capacity expansion model for the contiguous United States. It is designed to:

(1) explore optimal scenarios under different economic, technology, and policy assumptions – ensuring all scenarios meet load balancing, reliability, and physical requirements.

(2) consider issues of particular importance for RE deployment, including through high spatial resolution.



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

ReEDS models a full suite of utility-scale generation technologies and dSolar, a consumer adoption model, is used to model the U.S. rooftop PV market.

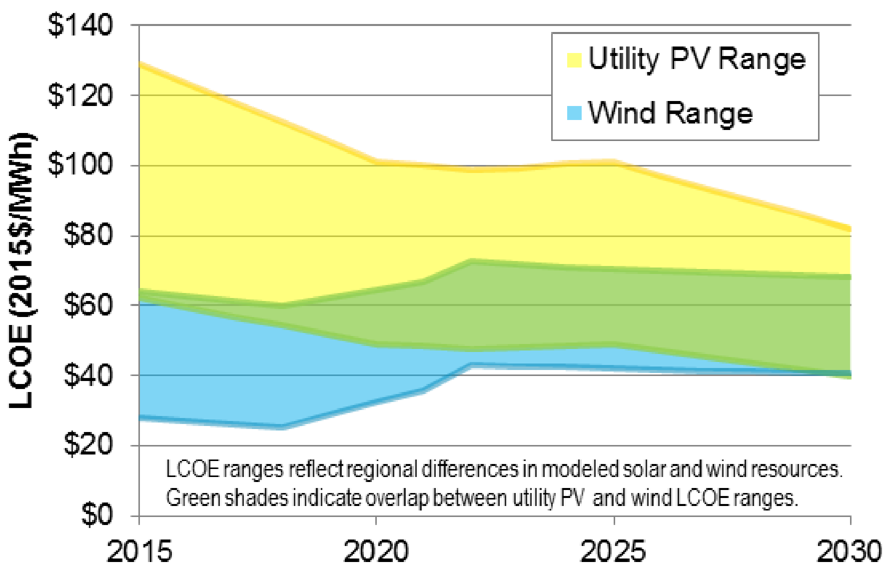
Select studies: Wind Vision (2015), SunShot Vision (2012), Renewable Electricity Futures (2012), *Implications of a PTC Extension on U.S. Deployment* (2014), *Considering the Role of Solar Generation under Rate-based Targets in the EPA's Proposed Clean Power Plan* (2015)

Key assumptions and data sources

- **RE technology cost and performance assumptions: NREL 2015 Annual Technology Baseline central case**
  http://www.nrel.gov/analysis/data_tech_baseline.html

- **Non-RE and biopower assumptions: EIA Annual Energy Outlook (AEO) 2015 Reference case**

- **Demand growth and fuel prices: AEO 2015**



Existing policies included only

- **ReEDS: major energy policies as of January 1, 2016 were modeled, including**
  - State Renewable Portfolio Standards
  - Regional carbon emissions policies (e.g., RGGI, CA AB32)
  - EPA Clean Power Plan
    - Mass-based compliance with new source complement targets for each state
    - Full credit trading between states
  - Federal RE tax credits vary by scenario (next slide)

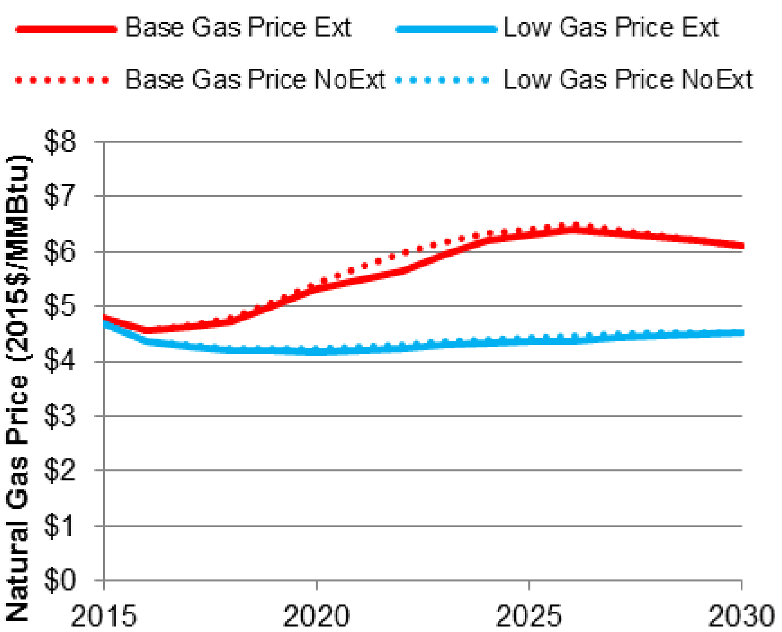
- **dSolar: Net-energy metering policies as of October 1, 2015 were modeled**

The analysis focuses on the impacts of tax credit extensions, and while other policies interact with tax credit policy, this analysis does not reflect a comprehensive assessment of these other policies nor all possible interactions.

Scenario framework

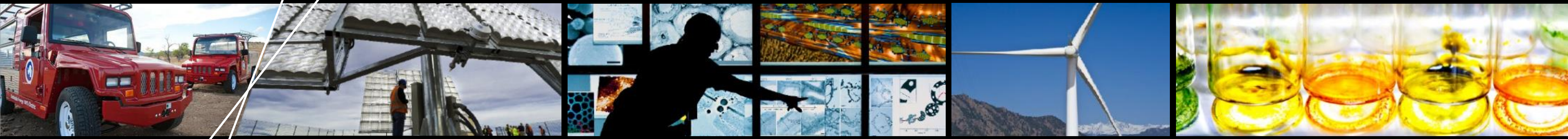
	RE Tax Credits	Natural Gas Price (AEO 2015)
Base Gas Price Ext	Extension	Reference
Base Gas Price NoExt	No Extension	Reference
Low Gas Price Ext	Extension	High Oil & Gas Resource
Low Gas Price NoExt	No Extension	High Oil & Gas Resource

- **Impacts of tax credit extensions are based on differences between "Ext" and "NoExt" scenarios**
  - Incremental RE = Ext – NoExt
  - Avoided CO_2 = NoExt – Ext
- **No other sensitivities are modeled**



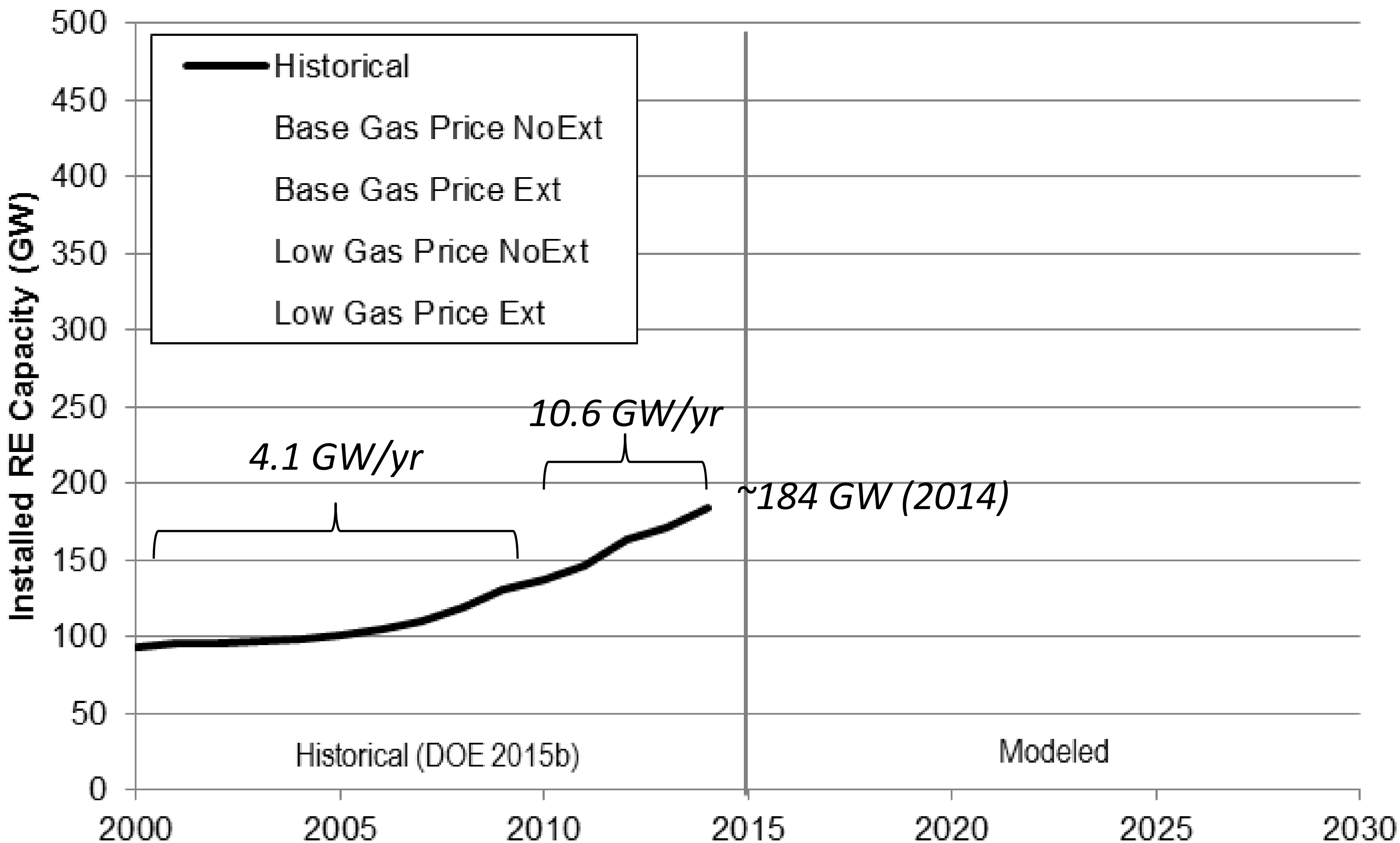
Modeling limitations and caveats

System-wide optimization	• Does not reflect local decision-making, or non-economic choices • Not all uncertainties and parameter distributions considered
Foresight and behavior	• Policy foresight not modeled • “rush to build” in anticipation of declining credits not modeled
Project Pipeline	• Not all planned or under construction projects included
Manufacturing, supply chain, and siting	• Potential project delays for new generation or transmission not reflected in ReEDS
Financing interactions	• Financial parameters reflect long-term averages • Not all financing interactions with tax credits captured
Technology learning	• Technology improvement assumptions are exogenous • Omission of learning might understate the impact of tax credits
Limited scope and sensitivities	• Narrow focus on impacts to RE deployment and emissions • Only natural gas price sensitivities modeled



Results: Impacts to RE deployment

RE growth has accelerated over the past 5-10 years

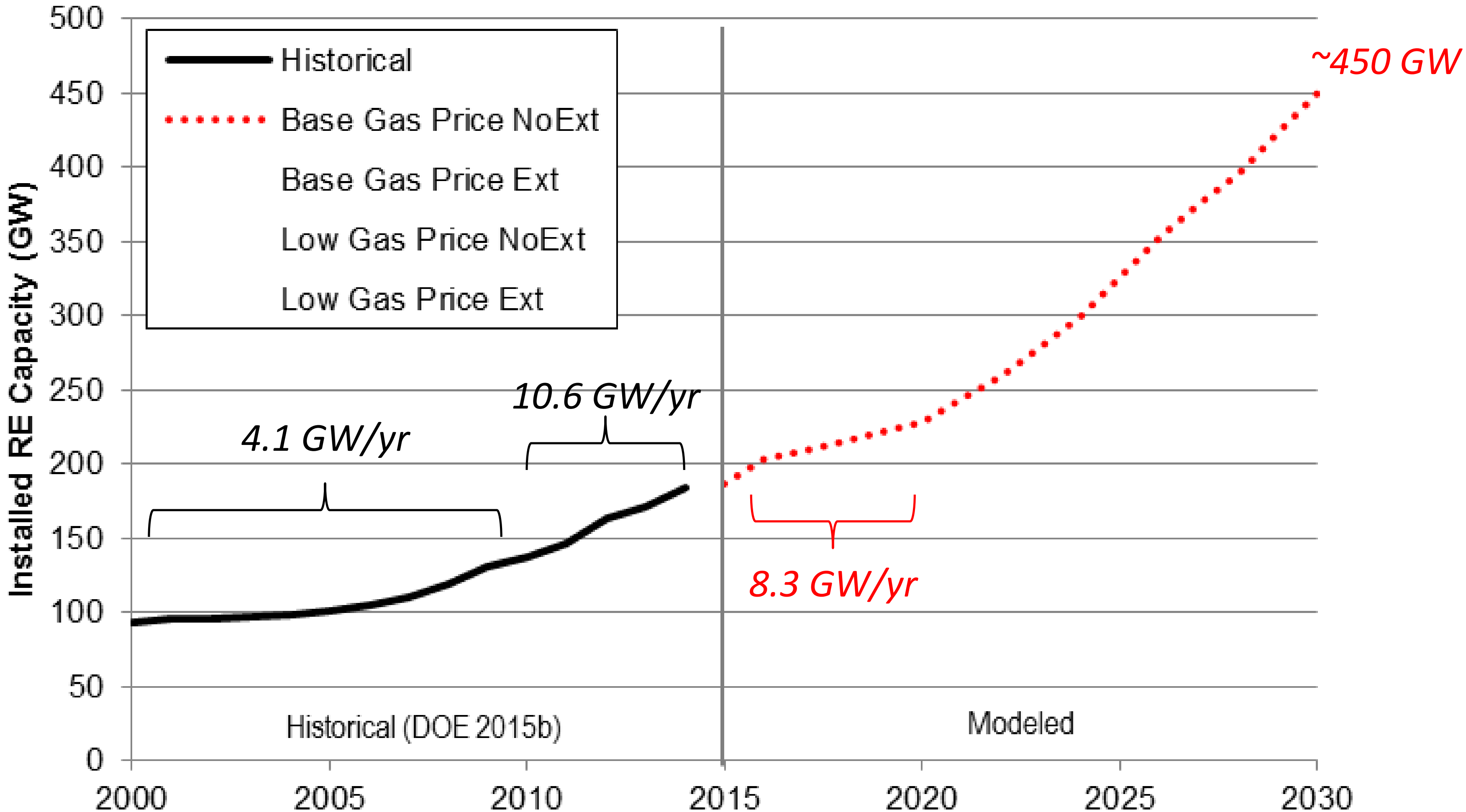


RE = biomass, geothermal, hydropower, solar, and wind

RE additions totaled 12.8 GW in 2014 and 17.6 GW in 2012

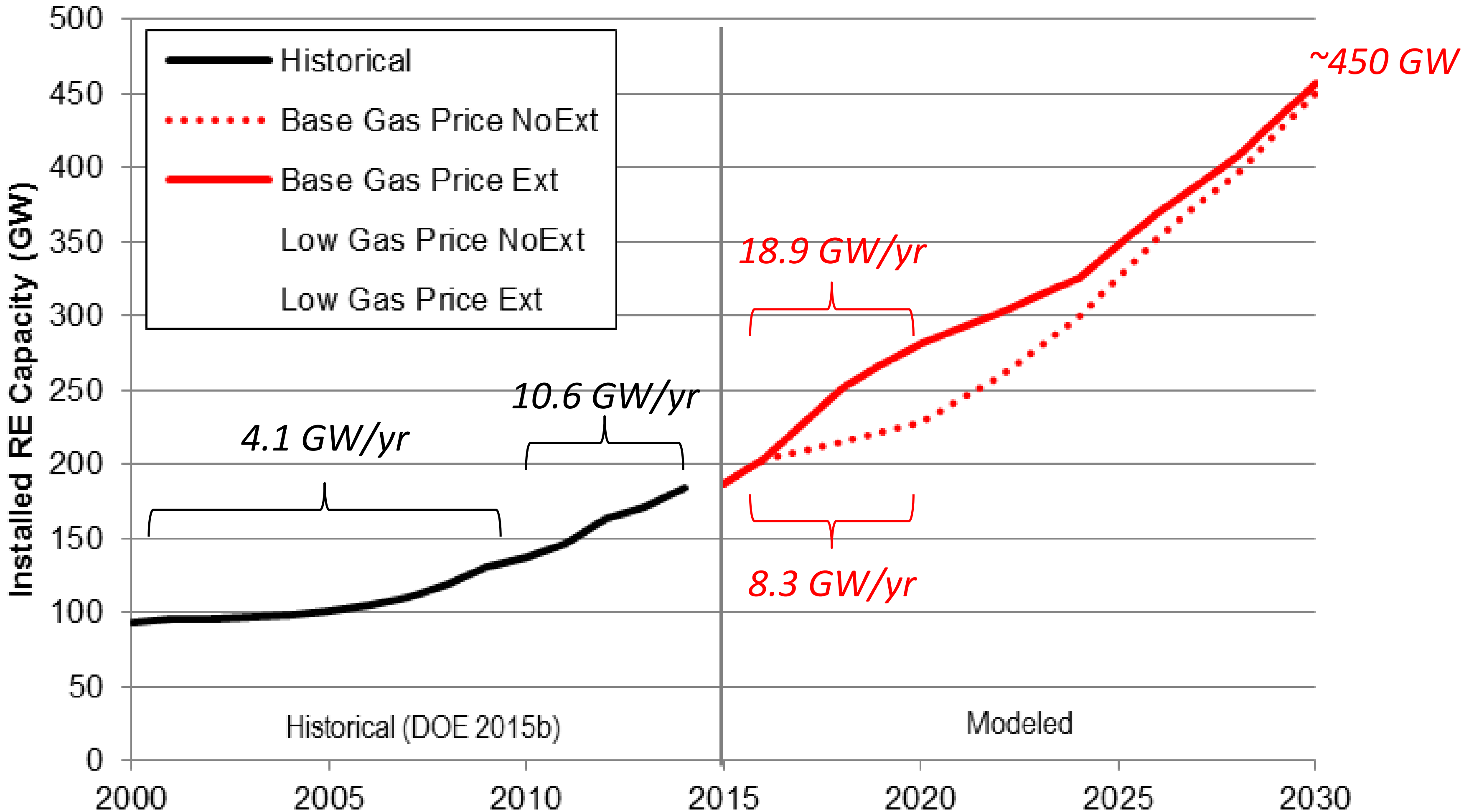
(2015 numbers not available at time of analysis)

Base gas prices – Absent tax credit extensions RE growth is estimated to slow during the next 5 years



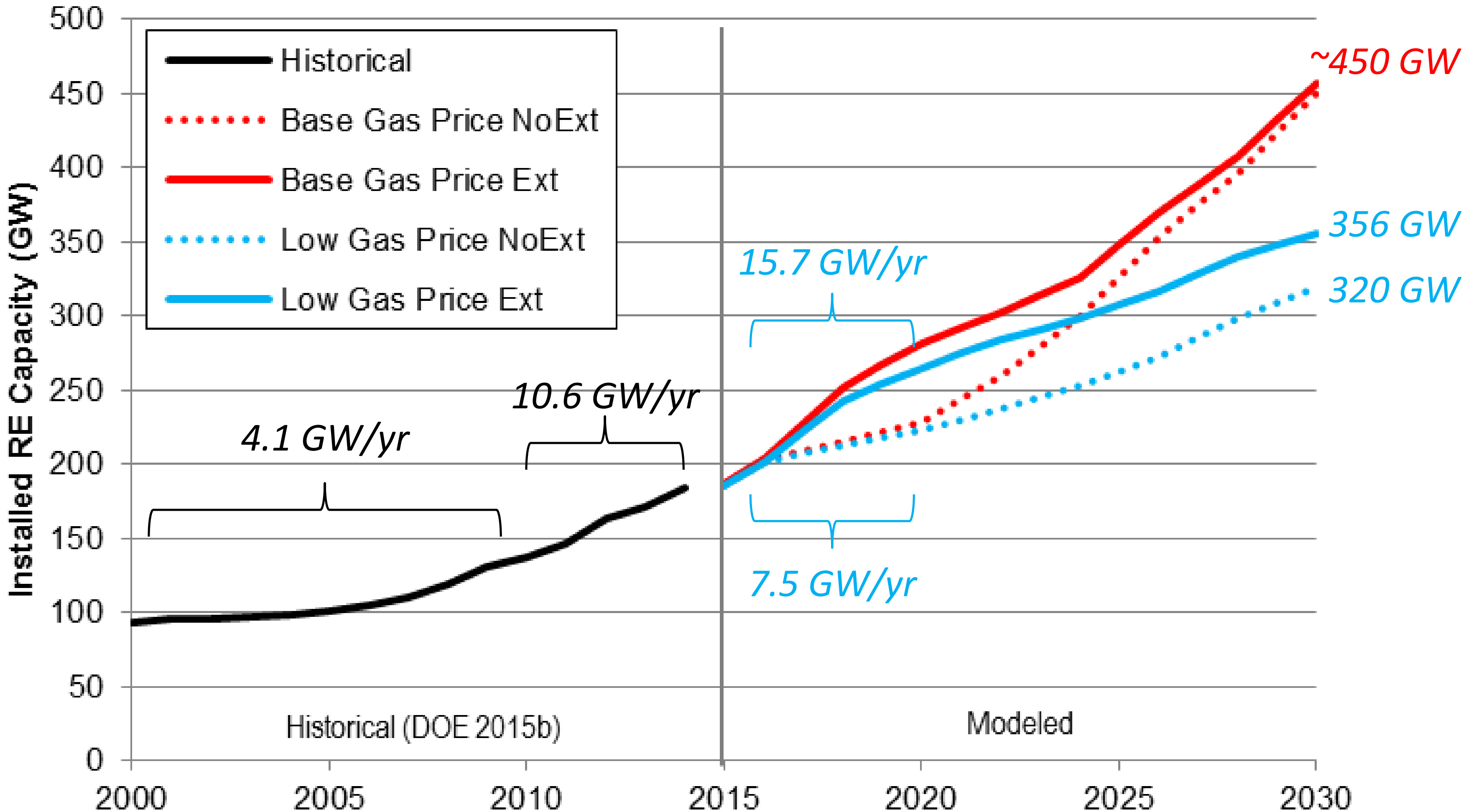
But RE growth increases beyond historical rates during the 2020s due to a combination of (1) decreasing RE costs, (2) increasing NG prices, and (3) policy demand, e.g. CPP, for clean energy

Base gas prices – Tax credit extensions can boost near-term RE deployment: 53 GW incremental RE in 2022



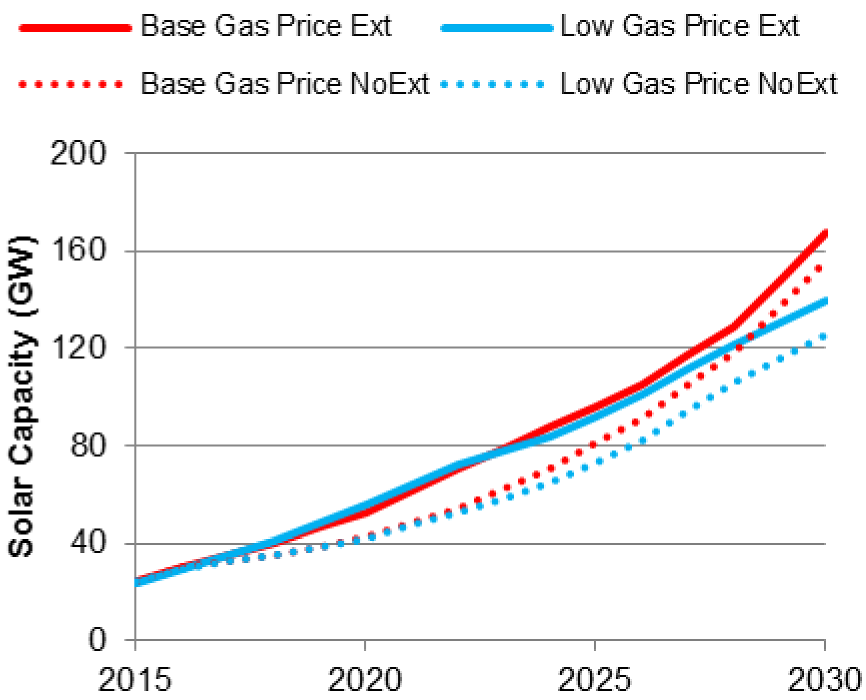
But the impacts of the extensions decline after 2020; cumulative installed capacity in 2030 is nearly identical between the extension and no-extension scenarios

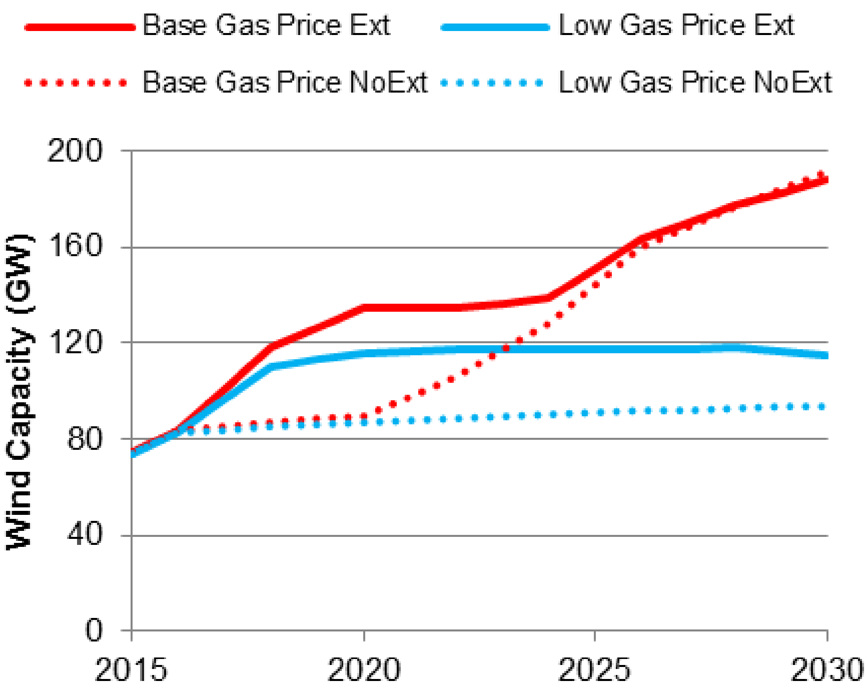
Low gas prices – Tax credit extensions also yield similar (48 GW) incremental RE but with lower deployment



And the impacts of the tax credit extensions to RE deployment are longer lasting

Tax credit extensions primarily impact new solar and wind capacity additions

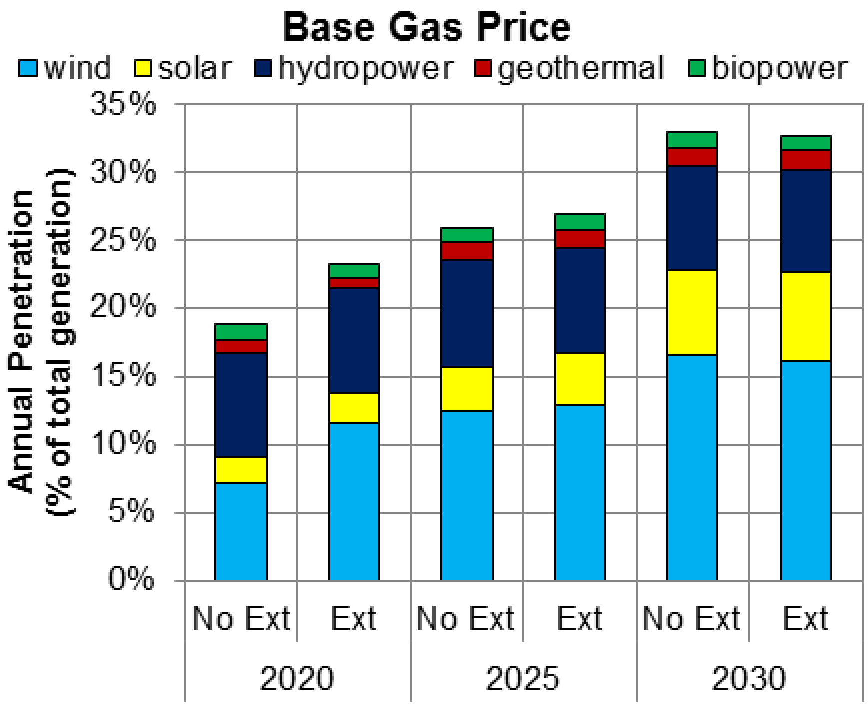


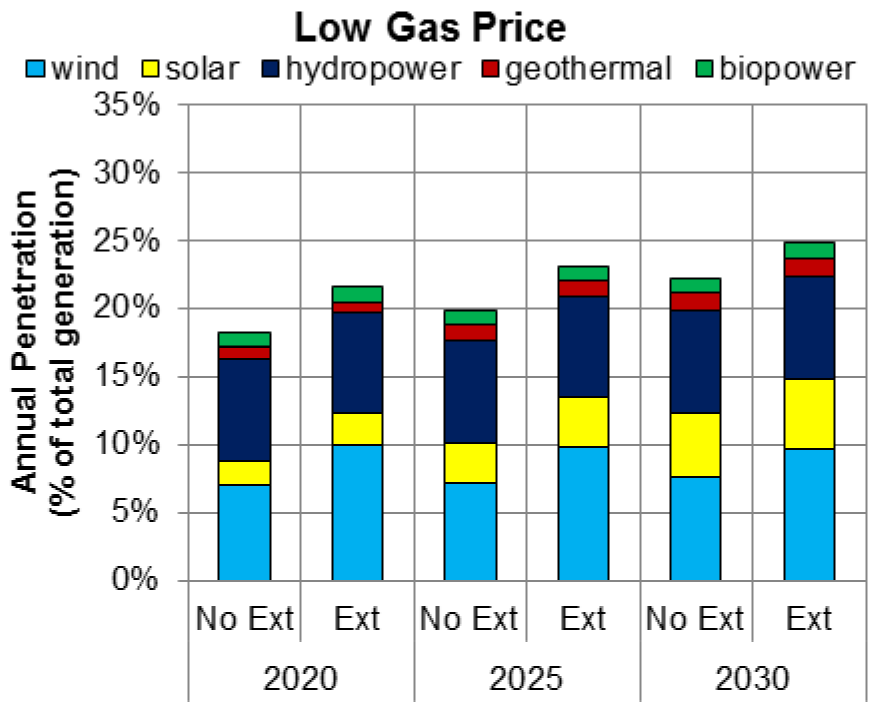


- **Solar**
  - Growth in solar is somewhat consistent over time and between scenarios
  - Tax credit-driven incremental solar capacity is greatest during 2022-2024 at 16-20 GW

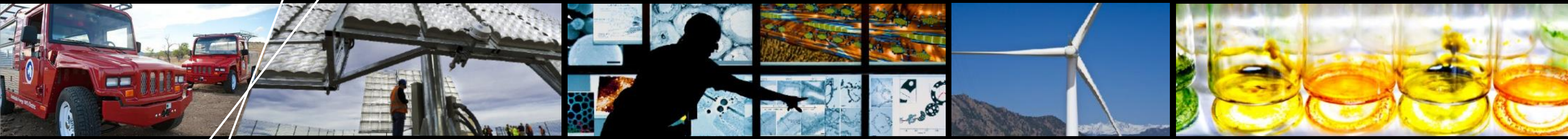
- **Wind**
  - Wind growth is more sensitive to tax credits in the near term and natural gas prices in the longer term
  - Tax credits drive 45 GW and 29 GW of incremental cumulative 2020 wind installed capacity under the Base Gas Price and Low Gas Price scenarios, respectively

Tax credit extensions can help accelerate RE penetration



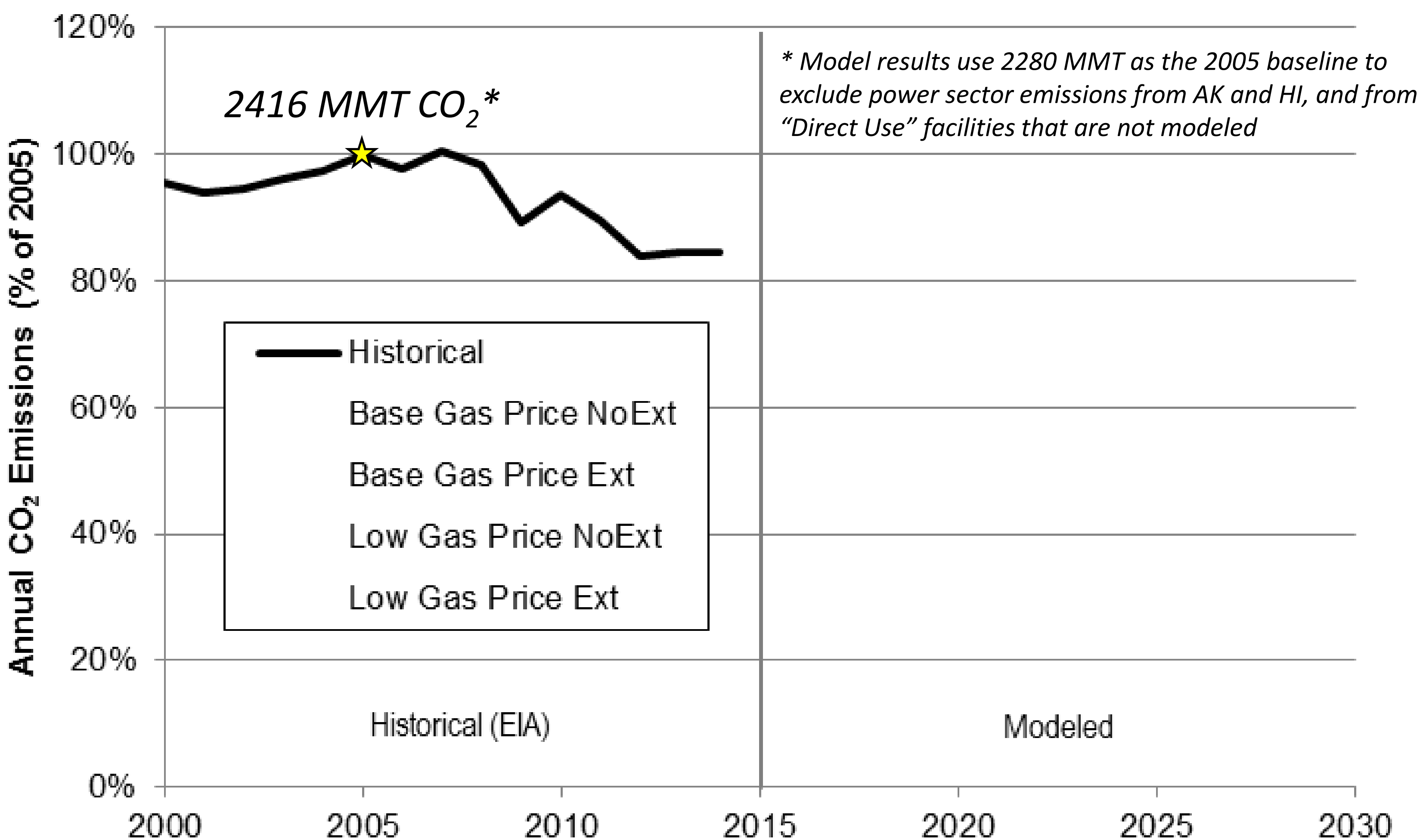


- **Base Gas Price – RE penetration reaches 33% (23% wind & solar) by 2030**
- **Low Gas Price – RE penetration grows more slowly than in the Base Gas Prices cases, but tax credits drive incremental benefit to RE penetration through 2030 (25% vs. 22%)**
- **Wind and hydropower comprise the largest generation shares in all years and scenarios; solar and wind experience the greatest growth in market share**



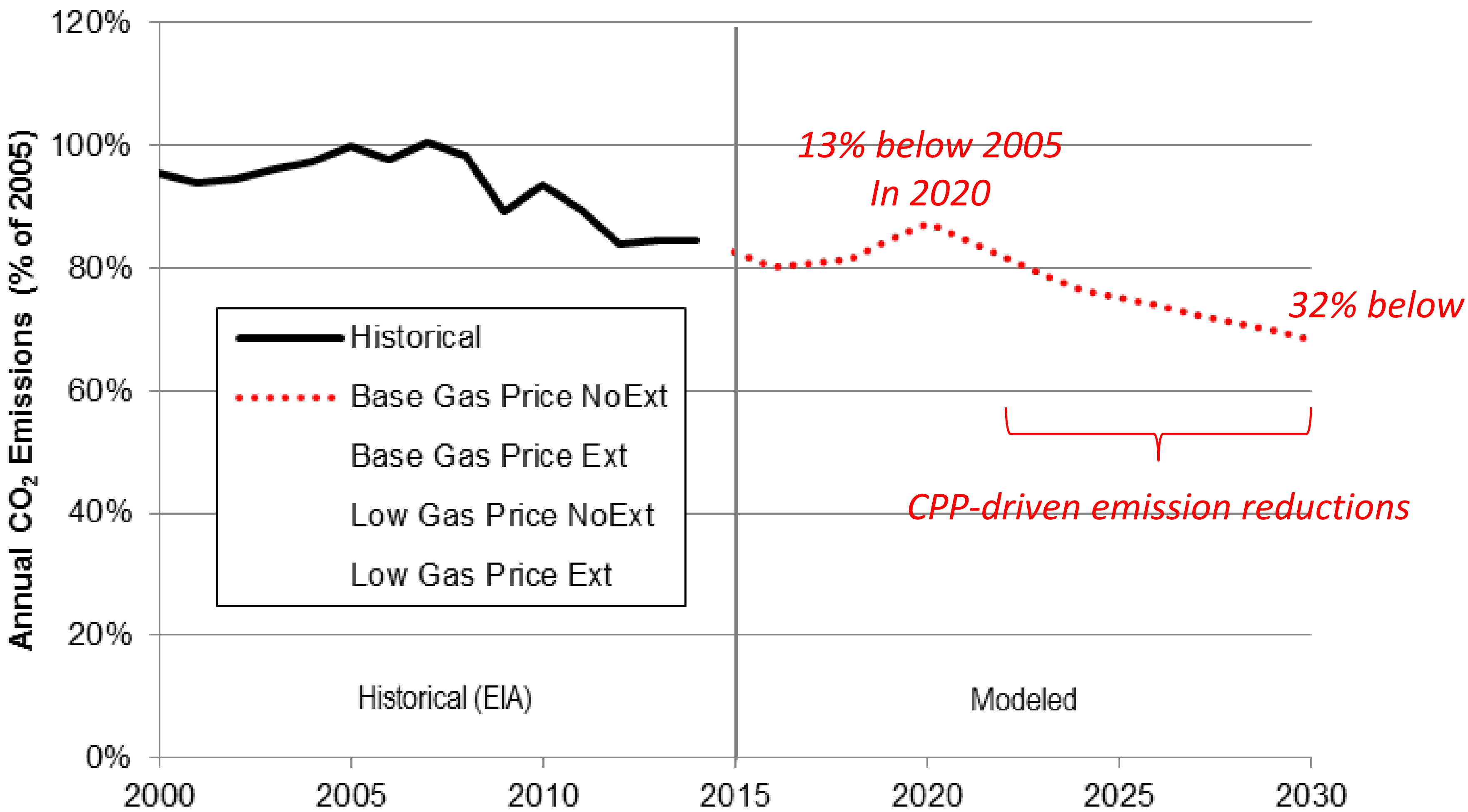
Results: Impacts to Power Sector CO_2 Emissions

Power sector emissions have trended downward in recent years



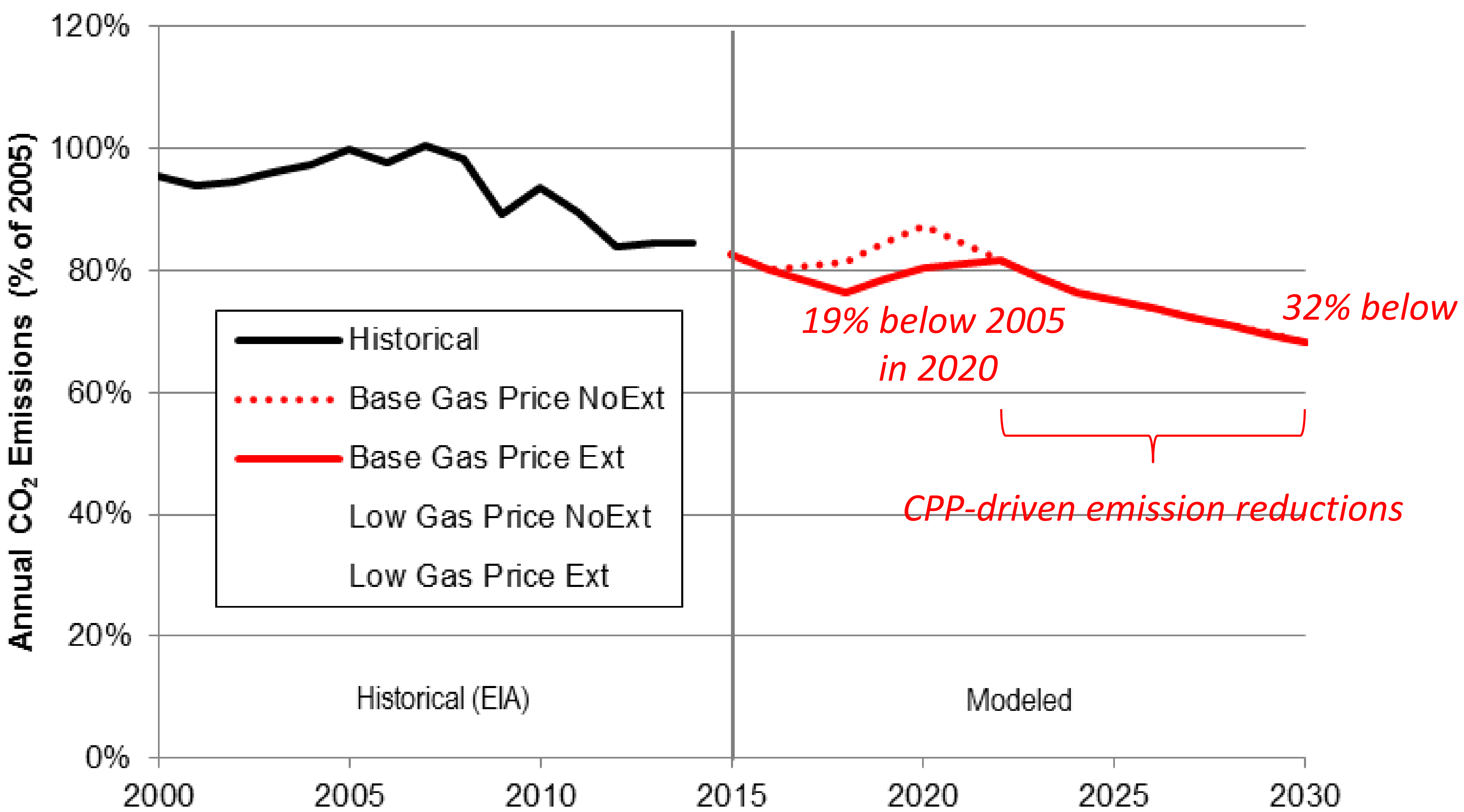
The downward trend is a result of (1) coal-to-gas switching, (2) increased RE and EE deployment, and (4) the great recession

Base gas prices – Absent tax credit extensions power sector emissions rise and peak in 2020



But longer-term trends show declining emissions driven primarily by the CPP
Annual emissions reach 32% below 2005 levels by 2030

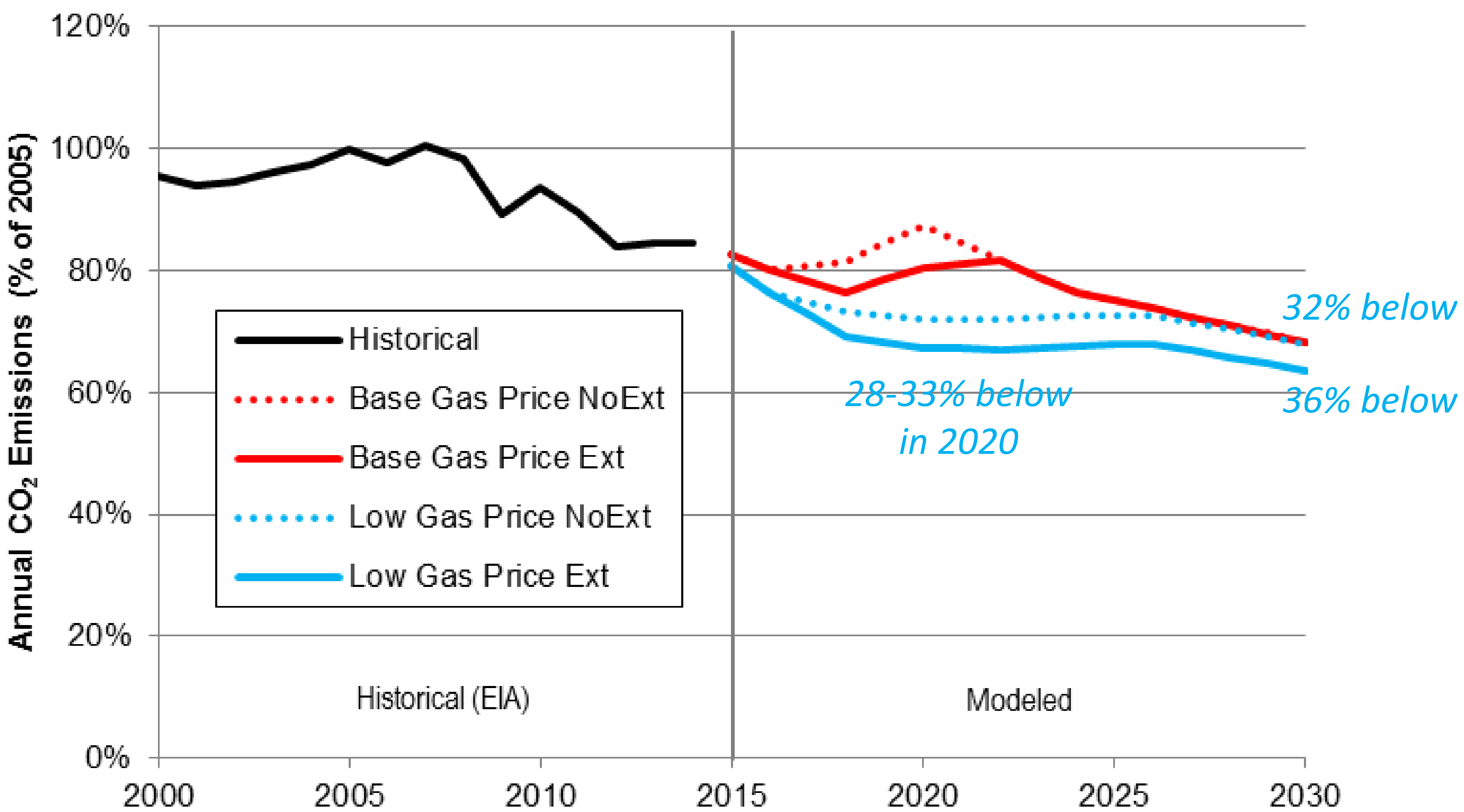
Base gas prices – With tax credit extensions flat or reduced emissions are observed in the near-term



But longer-term emission trends (2022-2030) are driven primarily by the CPP

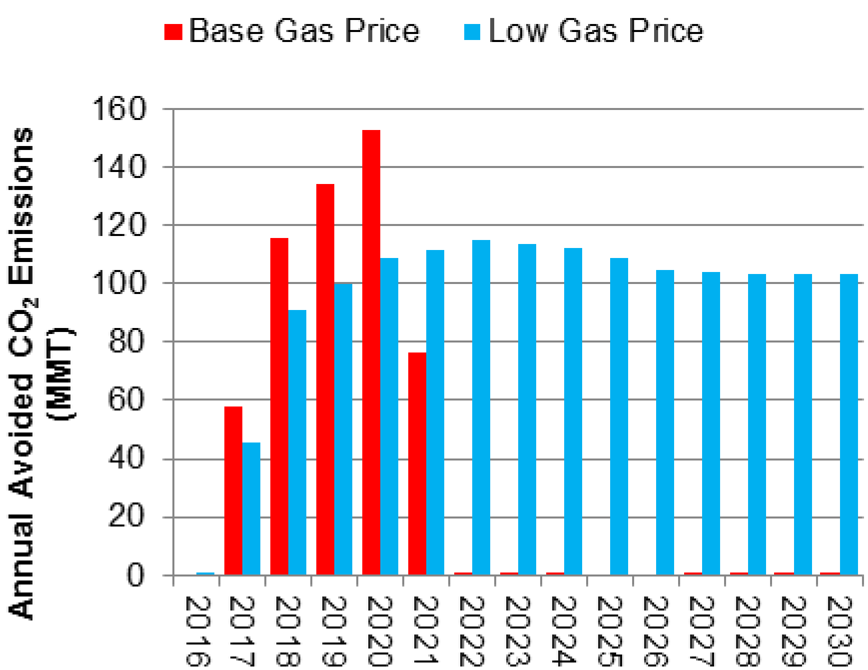
Similar to the no-extension scenario, annual emissions reach 32% below 2005 levels by 2030

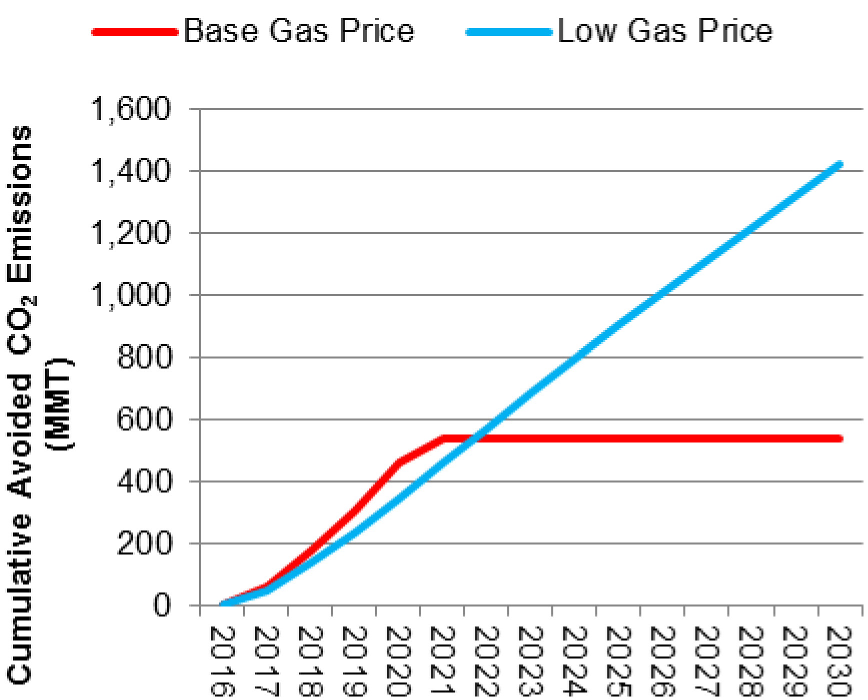
Low gas prices result in rapid emissions reductions due primarily to continued coal-to-gas switching



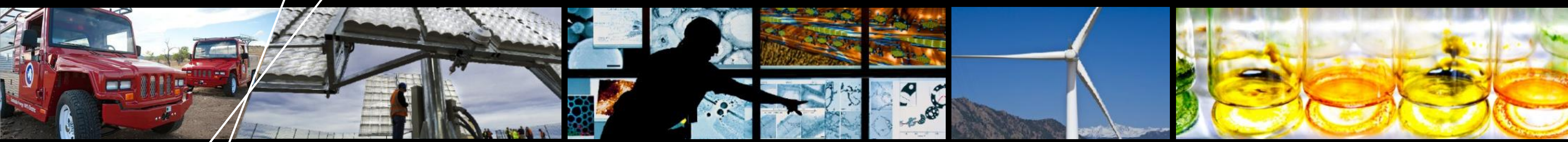
RE tax credit extensions help drive even lower emissions and with longer lasting avoided emissions
Under low gas prices, incremental RE displaces a greater share of coal compared with base gas prices

Annual avoided emissions peak at 110-150 MMT CO_2 Cumulative avoided emissions total 540-1420 MMT CO_2





- **Under base gas prices, nearly all avoided emissions occur before 2022 and cumulative (2016-2030) emissions total 540 MMT CO_2**
- **Under low gas prices, peak annual avoided emissions are lower but tax credit-driven emissions reductions last through 2030 (1420 MMT avoided CO_2)**
- **Emissions benefits of the tax credits can be sensitive to CPP compliance scenario**



Conclusions and future work

Key Findings

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Thank you

Report available at:

http://www.nrel.gov/docs/fy16osti/65571.pdf

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Thank you for attending our webinar

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