Net Metering and Market Feedback Loops:
Exploring the Impact of Retail Rate Design on Distributed PV Deployment

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National Summit on Smart Grid and Climate Change
Washington, DC
October 2015

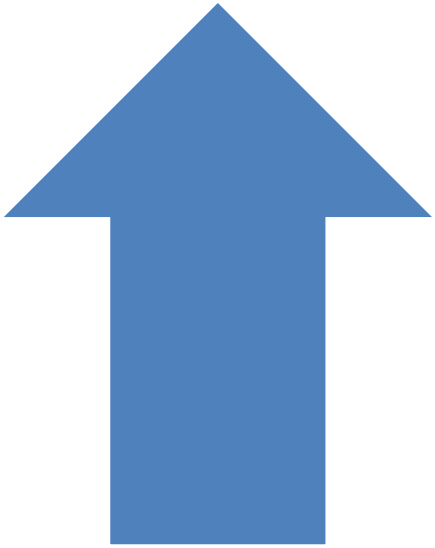
This work was funded by the Solar Energy Technologies Office within the Office of Energy Efficiency and Renewable Energy at the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

SunShot U.S. Department of Energy

Context and Motivation

- Rapid growth of distributed PV, supported in part by net metering with favorable (volumetric) retail rates
- Concerns about financial impacts of distributed PV on utilities and ratepayers due, in part, to possible under-collection of utility fixed infrastructure costs
- Revisions to rate design and net metering among the measures considered to address concerns: impacts PV-customer contribution to fixed costs, but also value of PV to host customers and overall PV deployment

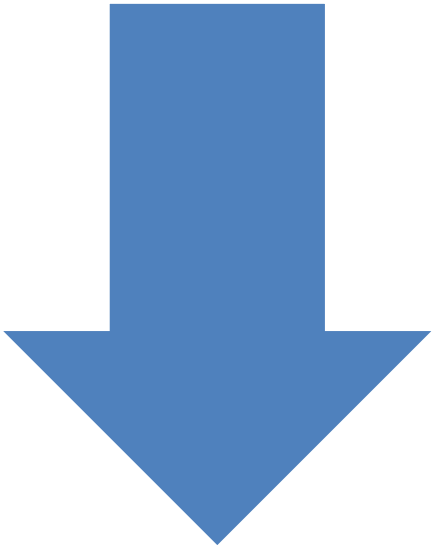
Issues Impacted by Two Feedbacks Between PV Deployment and Retail Electricity Rates



Fixed Cost Recovery

Compounding the concern with fixed cost recovery is that, with PV deployment, fixed utility costs are potentially spread over a shrinking base of sales, increasing retail prices and further accelerating PV deployment

"Utility Death Spiral"



Time Varying Rates

Less-commonly noted opposing feedback: with PV deployment, peak price periods shift to evening hours, reducing PV bill savings for customers on time-varying rates and dampening PV deployment

Related to the "Duck Curve"

Objectives and Contribution

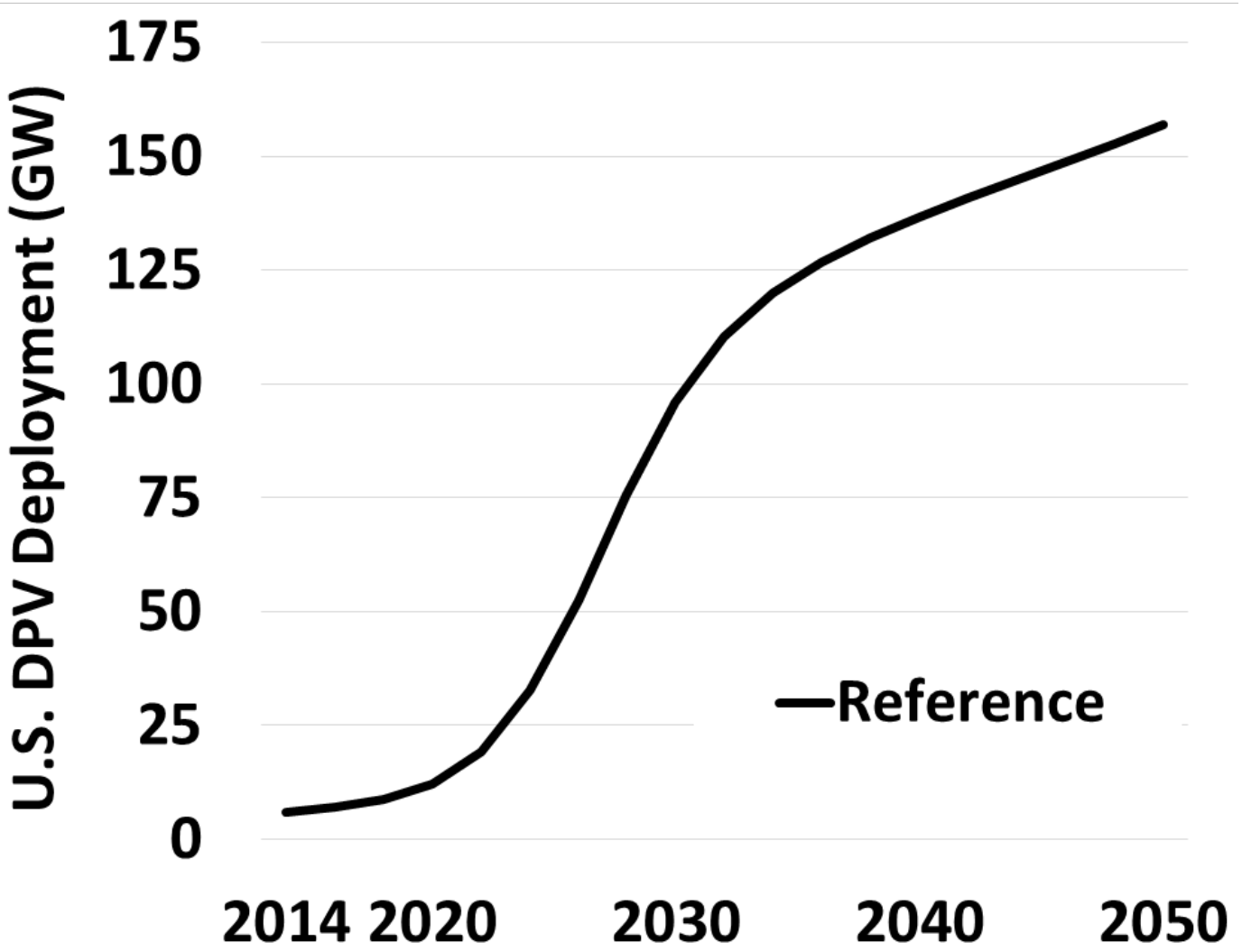
Examine impact of changes in retail rate structures and PV compensation on U.S. distributed PV deployment…*one of many factors policymakers might consider during rate design decisions*

Quantify degree and conditions under which the two feedback mechanisms accelerate or dampen future PV deployment…*in contrast to current conceptual discussions that focus largely on just one of the two feedbacks*

Methods: PV Deployment Modeling

- Apply NREL's Solar Deployment System (SolarDS) model
  - Simulates distributed PV adoption in each state through 2050, based on assessment of customer economics of PV
  - Model updated, and then augmented to incorporate the two feedback mechanisms between PV adoption & retail rates
- Analyze subset of possible rate design & PV compensation options
  - Reference (current mix of flat, time-varying, demand charges), fixed customer charges ($10 & $50/month), partial net metering (net excess compensated at lower rate), time-varying rates for all customers
- Important model caveats
  - Not equipped to asses impacts of PV-storage on customer defection or altered demand ➔ future work
  - Best-used for long-term national deployment assessments: not optimized for near-term or utility- and state-level analysis

In Reference Scenario with Net Metering, DG PV Deployment Increases to 157 GW by 2050



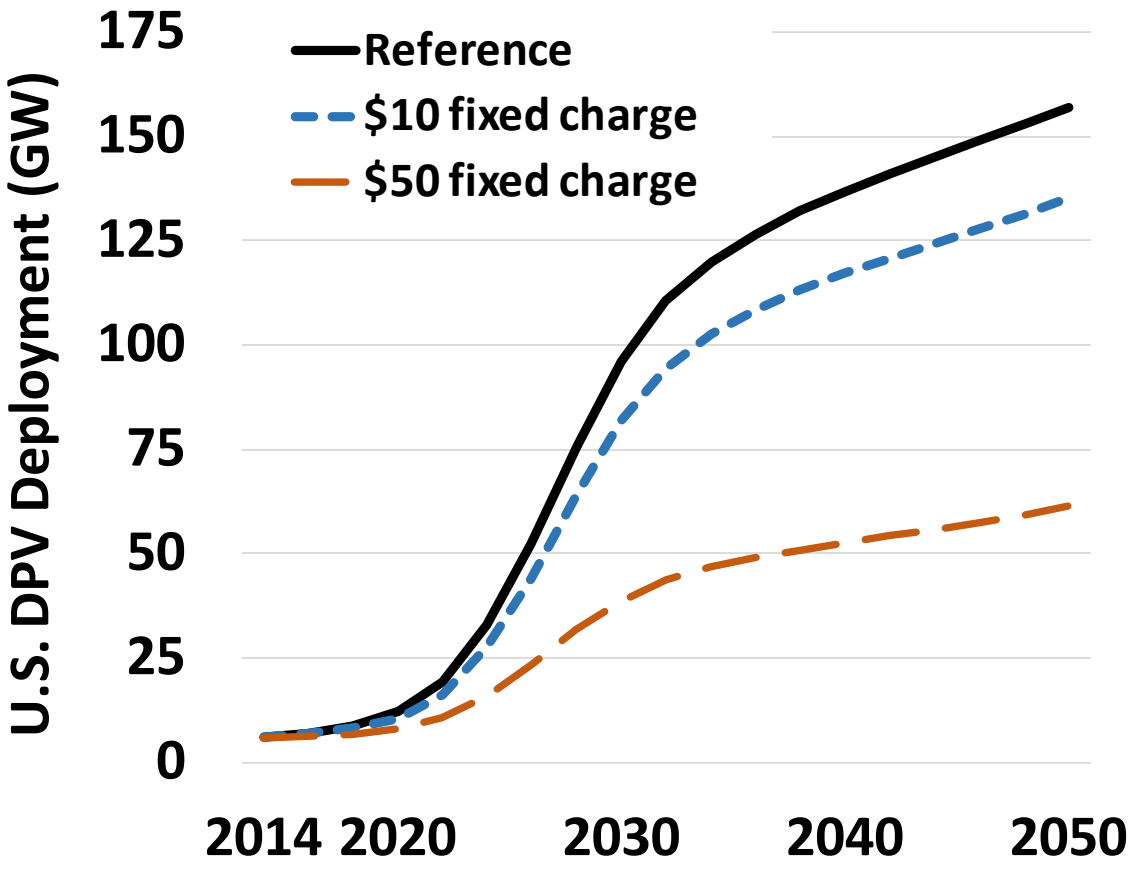
Equivalent to 3% of total load in 2030, 4% in 2050

Note: Analysis focuses on distributed PV deployment; utility-scale PV adds to these figures

PV Deployment Is Highly Sensitive to Rate Designs and PV Compensation Mechanisms

Residential fixed monthly charges can substantially reduce PV deployment

$50 monthly charge is especially damaging to PV deployment

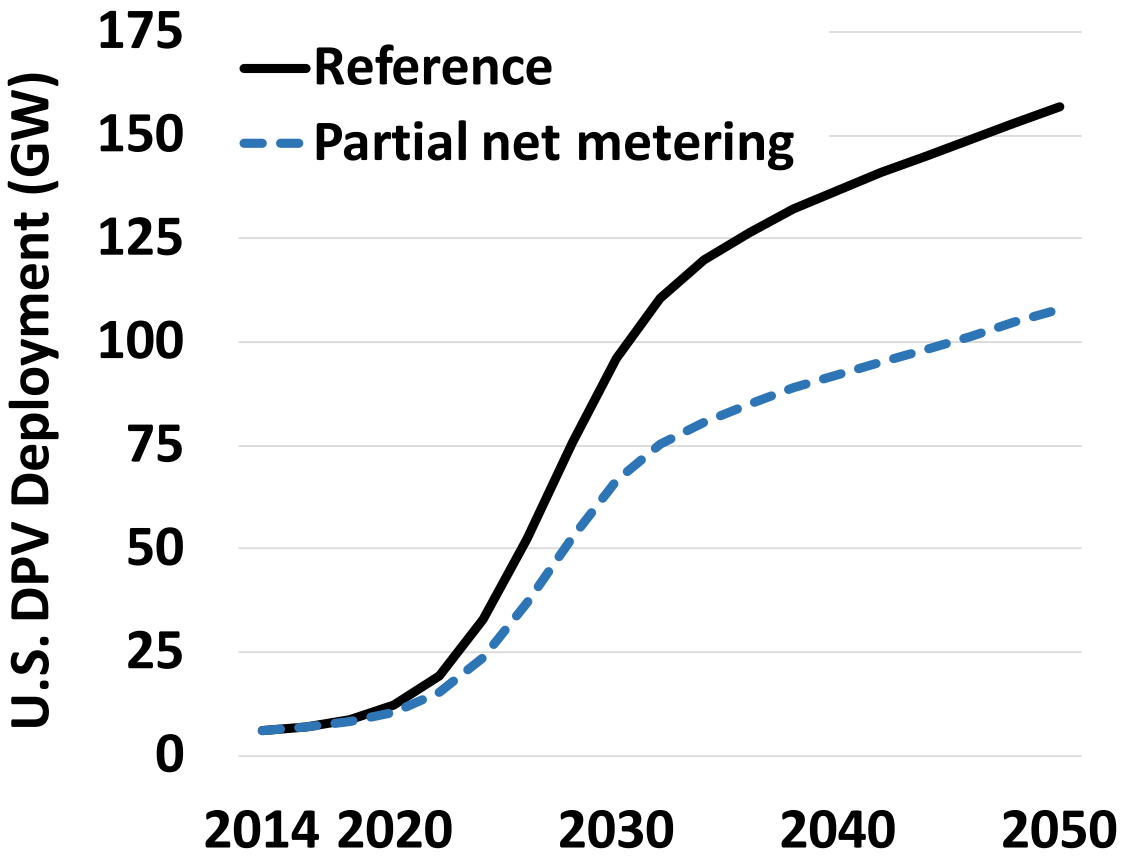


PV ~15% lower in 2050 with $10/month fixed charge, ~60% lower with $50/month charge

PV Deployment Is Highly Sensitive to Rate Designs and PV Compensation Mechanisms

Removing full net metering and compensating hourly net-excess generation at a rate consistent with avoided utility costs (not social costs) decreases deployment

Calculated avoided utility costs are lower than retail rates

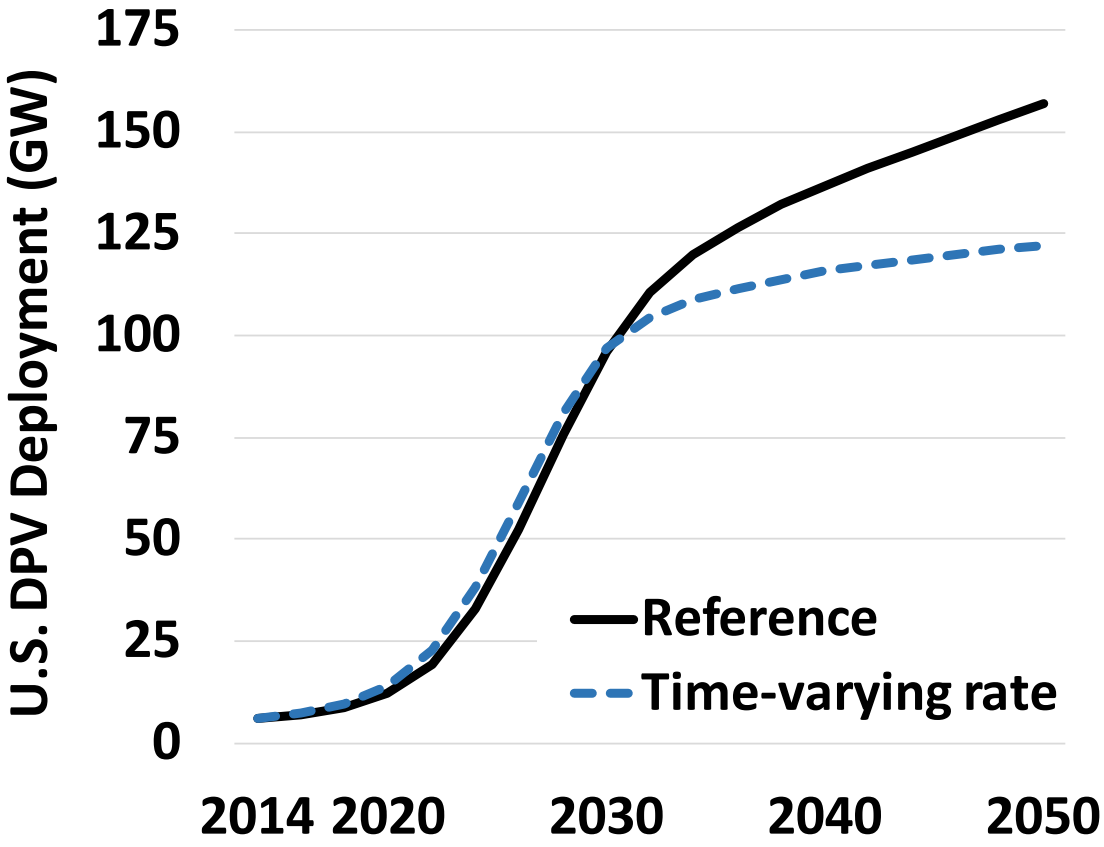


PV ~30% lower in 2050 with "partial" net metering

PV Deployment Is Highly Sensitive to Rate Designs and PV Compensation Mechanisms

Converting all customers to time-varying retail rates results in varying deployment results over time

Results in increased PV deployment in the near term, but decreased deployment in the longer term

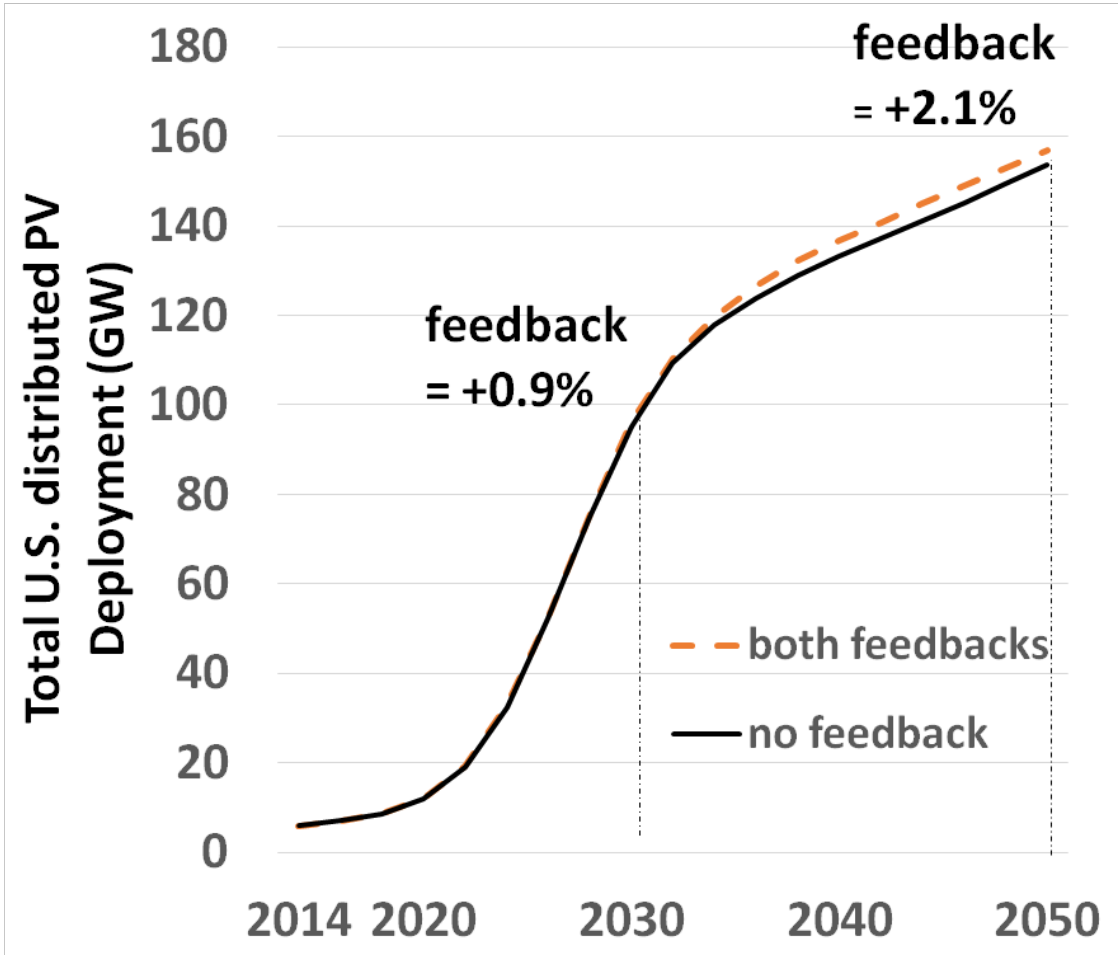


PV ~22% lower in 2050 under time-varying rate scenario, but ~18% higher in 2022

Aggregate Impact of Two Feedbacks at the National Level Is Modest in Reference Scenario

Combined impact of two feedbacks never increases cumulative PV deployment by more than 3% over the no feedback case (in reference scenario)

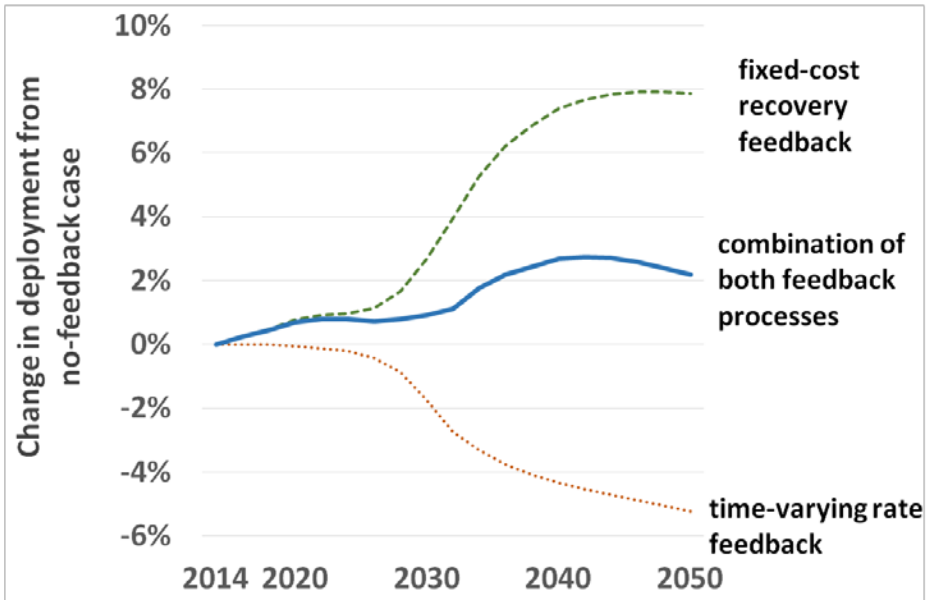
By 2030, the combined impact of the two feedbacks increases deployment by 0.9%; by 2050, increases by 2.1%

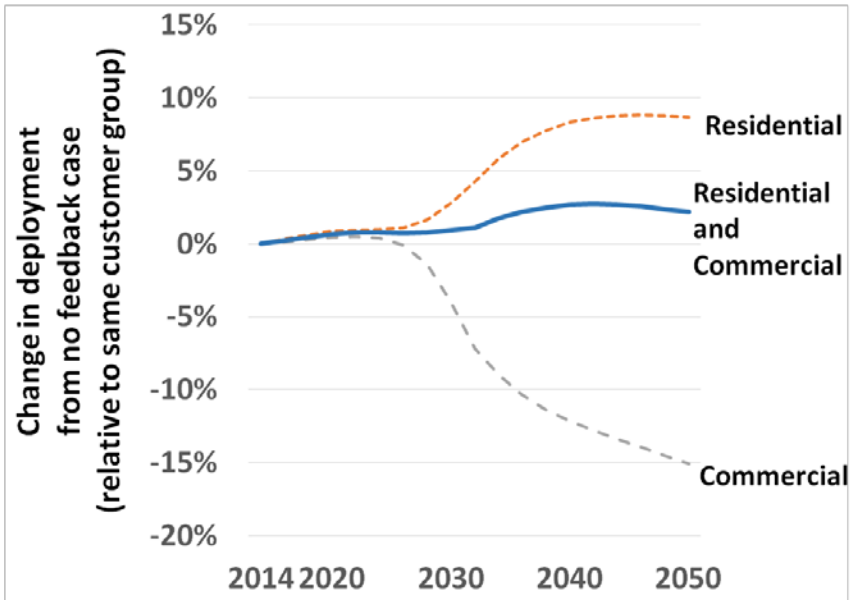


Two Feedback Mechanisms Largely Offset Each Other at National Level in Reference Scenario

Fixed-cost recovery feedback: increases PV deployment +8% in 2050, relative to no feedback case (residential customers)

Time-varying rate feedback: decreases PV deployment -5% in 2050, relative to no feedback case (commercial customers)





With move towards time-varying rates, PV deployment feedback effects likely to be in the *negative* direction

Conclusions

Retail rate design and PV compensation approaches can have dramatic impacts on distributed PV deployment

- Increasing fixed customer charges or implementing alternatives to full net metering could significantly slow distributed PV deployment
- ***Note:*** *Policymakers must weigh these impacts against many other considerations when making rate design decisions*

Concerns about fixed-cost recovery feedback effect (aka, "utility death spiral") as it relates to PV may be overstated

- Current debates tend to miss the opposing time-varying rate feedback
- Combined feedback is small and, with expected move towards time-varying rates, may result in dampening (not accelerating) deployment
- ***Note****: does not imply that concerns about fixed-cost recovery are misplaced, only that a sizable "feedback loop" is not evident; note also that analysis does not consider PV-storage or non-PV load impacts*