THE TRIPLE EFFECT:

Unraveling the joint impact of electric vehicles, solar panels, and work-from-home patterns on household electricity costs

National Renewable Energy Laboratory, 15013 Denver West Parkway, Golden, Colorado 80401

Nicole Viz[1,2]
Shivam Sharda[1]
Venu M. Garikapati[1]
Katelyn Stenger[1]
Konstadinos G. Goulias[3]
Christopher Hoehne[1]
Elisabeth A. Graffy[4]

[1]National Renewable Energy Laboratory
[2]University of Illinois at Urbana Champaign
[3]University of California Santa Barbara
[4]Pacific Northwest National Laboratory

NREL/PO-5400-87672

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INTRODUCTION & MOTIVATION

The past two decades have seen the introduction of new technologies and paradigms, such as **electric vehicles (EVs), solar photovoltaics (PVs), and increased work-from-home (WFH) patterns**, all of which impact overall household energy consumption and cost. Currently...

3% of cars sales consist of EVs

8% of homeowners have solar panels installed

31% of households report having at least one member WFH

Over the last decade, the average residential electricity bill has risen by about 27%

Could the adoption of **cross-sectoral sustainable technologies** offset the rising household energy burden? Do we have the necessary **tools and models** to assess the impacts of these emerging phenomena on **household energy burden**?

Research Objective

1. Can bundled adoption of EVs and PVs **offset rising household energy burden** and help increase financial savings from a technology?
2. To what extent does Staying at home (SAH) contribute to a **rise in consumer energy consumption and costs**, and can bundled adoption of EVs and PVs help offset such costs?
3. What are the potential **economic and policy levers** that could mitigate rising household electricity costs?

RESIDENTIAL ENERGY CONSUMPTION SURVEY

The RECS 2020 dataset provided a much-needed update on pandemic-era trends and behaviors and inform representative data to use for studies on energy consumption, behavior, and costs.

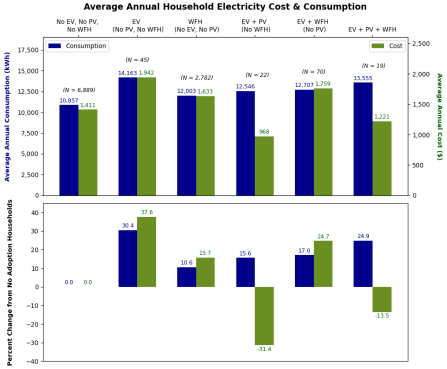

Figure 1. Average annual electricity cost (green) and consumption (blue) by household type and percentage change with respect to "no adoption" households

Compared to no-technology adoption households:

EV+PV households: ↓ 31% less expensive ↑ 16% more consumption	**EV+WFH households:** ↑ 24% more expensive ↑ 17% more consumption
EV+PV+WFH households: ↓ 13% less expensive ↑ 25% more consumption	*Could modeling consumption alone (without cost) lead to incomplete conclusions?*

INTEGRATED EV-PV-WFH MODELING FRAMEWORK

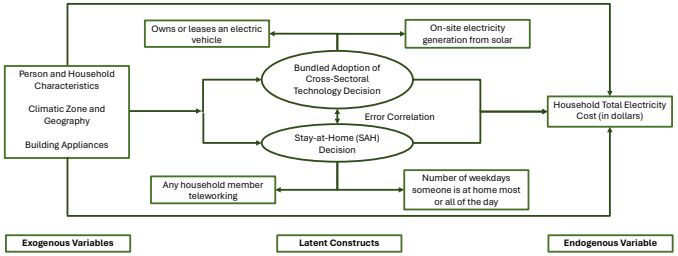

Figure 2. Structural equations modeling (SEM) framework for EVs, PVs, and WFH

MODEL ESTIMATION RESULTS

What factors influence these **latent constructs**, and how? Likewise, how do these constructs (and other factors) influence household's electricity costs?

Bundled Adoption:

- ↑ **High income (> $100k)**
- ↑ **High education attainment**
- ↑ **Located in the west**
- ↓ **Female**
- ↓ **Unemployed**

Stay-at-Home Decisions (SAH):

- ↑ **Female**
- ↑ **High education attainment**
- ↑ **Located in hot climate**
- ↓ **Low income (< $15k)**
- ↓ **Unemployed**

Annual Household Electricity Cost:

- ↑ **Stay-at-home (SAH)**
- ↑ **High income (> $75k)**
- ↑ **Single family household**
- ↑ **> 3000 square feet**
- ↓ **Bundled adoption of EV-PV**
- ↓ **Older in age (> 55 years)**
- ↓ **Renting**
- ↓ **Located in cold climate**
- ↓ **Located in the west**
- ↓ **< 600 square feet**

Bundled adoption had a stronger influence on electricity costs than **SAH**. In other words, the *increase* in electricity cost associated with SAH is significantly smaller than the *reduction* in cost associated with joint adoption of EVs and PVs.

DISCUSSION & CONCLUSIONS

RECS data revealed households that own EVs, PVs, and engage WFH observed a **13.5% decline in their electricity bills**, despite a **25% increase in electricity consumption**

Bundled adoption of cross-sectoral technology is found to reduce household electricity cost significantly

Co-adoption of sustainable **building and transport technologies** might appease **energy burden** for households while also **reducing a household's overall energy footprint.**

FUTURE CONSIDERATIONS

This study doesn't consider **household energy storage with PVs** that might counteract peak hour pricing and further reduce household electricity costs (RECS doesn't include any data on them).

Additionally, it might be interesting to investigate the effect of *working* from home individually as opposed to *staying* at home.

Future efforts will incorporate the influence of capital costs, rebates or tax incentives pertaining to the adoption of these technologies.

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Nicole.Viz@nrel.gov
Shivam.Sharda@nrel.gov