Triple Effect Economics: How do electric vehicles, solar photovoltaics, and work-from-home transform household electricity cost?

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6. Results
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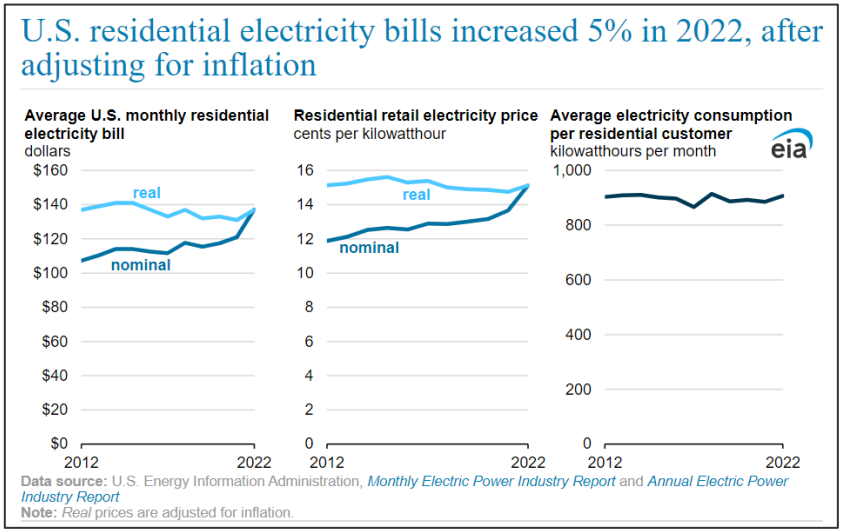
Increasing Energy (Cost) Burden on Households

*"In year 2022, **largest annual increase** in average residential electricity spending since EIA began calculating it in 1984"*



Bloomberg.com
https://www.bloomberg.com/news/articles/2022-09-13/...

US Electricity Bills Rise Most in 41 Years as Inflation ...

Web Sep 13, 2022 · US **Electricity Bills** Rise Most in 41 Years as Inflation Endures - Bloomberg Green New **Energy** US Power Prices Rise Most in 41 Years as Inflation Endures **Electricity** ...

NPR
https://www.npr.org/2022/09/13/1122371879

Soaring electricity bills are the latest inflation flashpoint

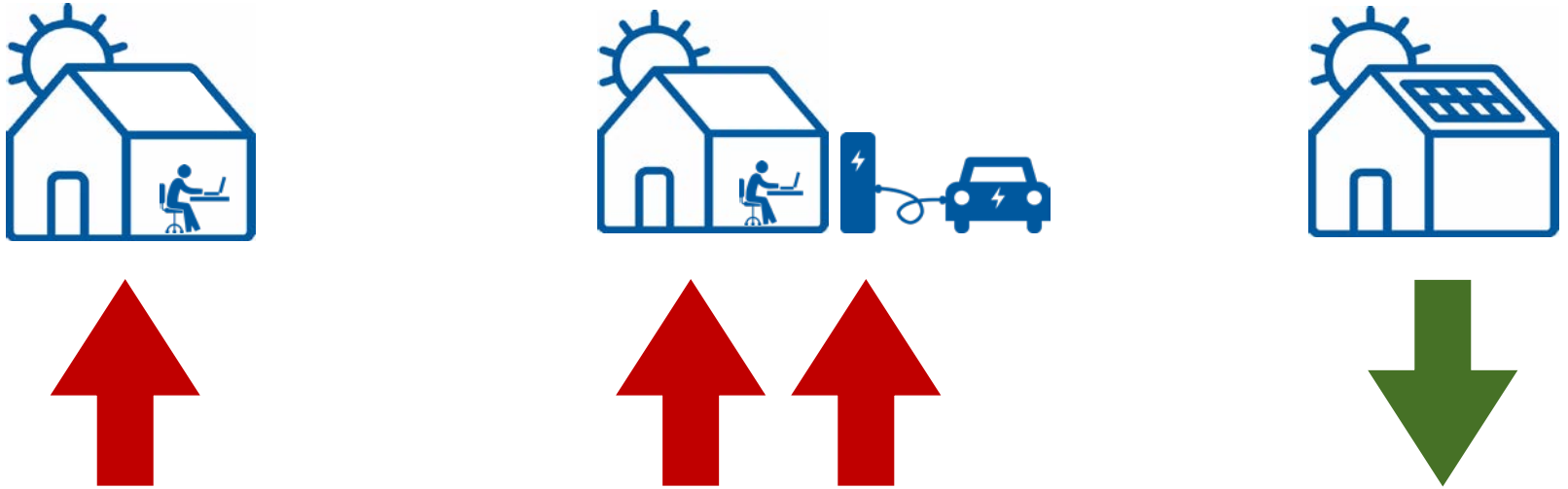
Web Sep 13, 2022 · **Electricity** prices have jumped 15.8% in the last year, largely as a result of high-priced natural gas, which is used to generate nearly 40% of the nation's power. The **rising** price of power has...

The Wall Street Journal
https://www.wsj.com/articles/why-your-electric...

Why Your Electric Bill Is Soaring—and Likely to Go Higher

Web Mar 14, 2022 · Clark Hodgin for The Wall Street Journal By Katherine Blunt Updated March 14, 2022 11:55 am ET Text U.S. **electricity** customers are facing some of the largest **bills** ...

Can Adoption of New Technologies Ease Household Electricity Cost?



"We cannot manage what we do not measure"

A household might not have the tools necessary to understand how (or if) the adoption of sustainable technologies and WFH really benefits them financially

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 **stay-at-home** 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 (RECS)

- Year : Late 2020 and early 2021 (released in 2023)
- Sample: National Level
- Sample Size: 10,170 respondents
- Exogenous Variables:
  - (a) Socio-Demographic Characteristics
  - (b) Climatic Zone, Geography, and Building Appliances
  - (c) Technology Ownership and Stay-at-Home decision
- Endogenous Variables: Total annual electricity cost (in $)

Because the year **2020** experienced **the peak of WFH**, this dataset presents an opportunity to understand the co-benefits of EV-PV adoption along with WFH on energy burden

Cost & Consumption Trends

Compared to no-technology adoption households :

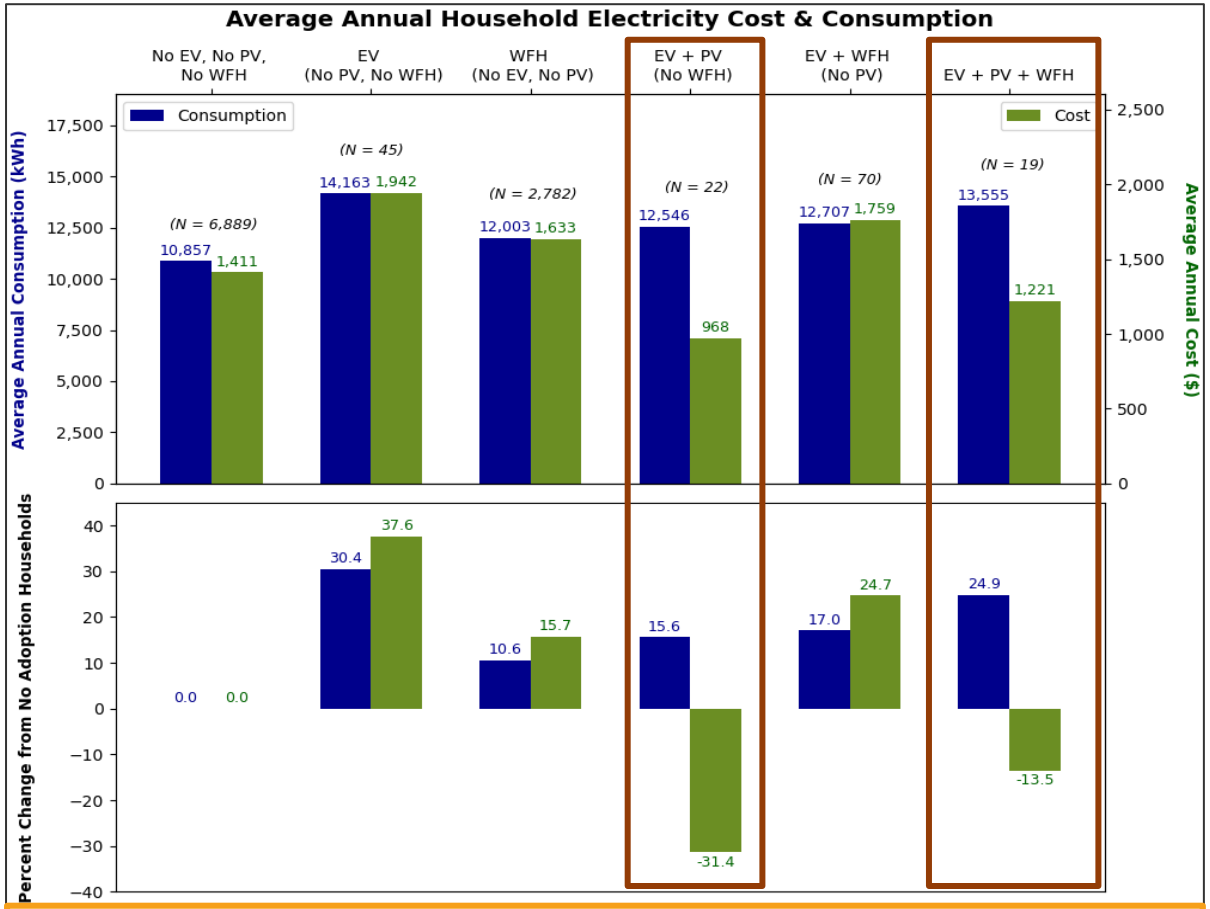
EV+PV households:
31% decrease in cost
16% increase in consumption

EV+WFH households :
24% increase in cost
17% increase in consumption

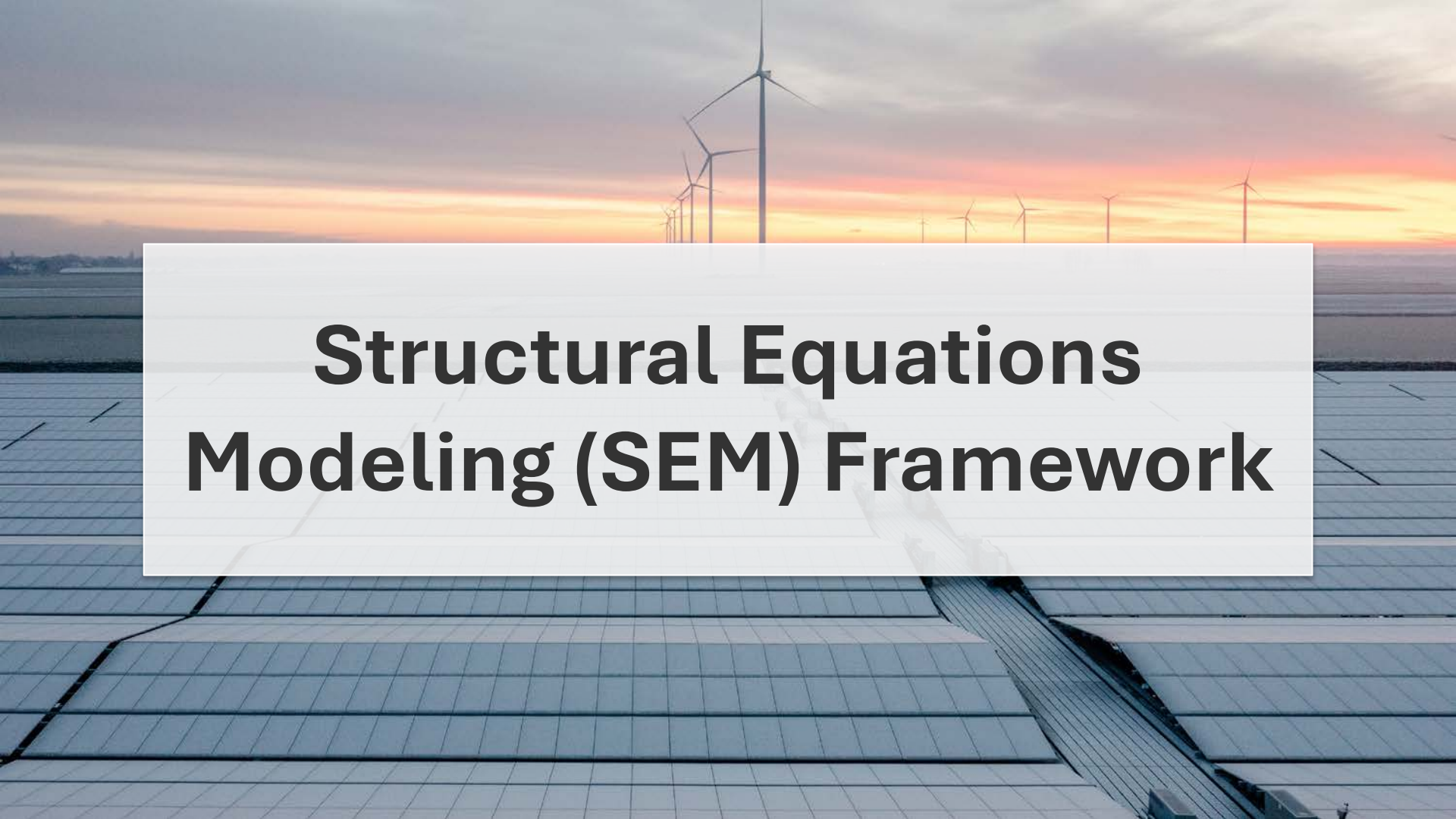
EV+PV+WFH households:
13% decrease in cost
25% increase in consumption

Note: The research study explicitly consider reported electricity cost and does not include **capital and operational costs** for PVs and EVs

2022 Residential Energy Consumption Survey (N=10,189 respondents)

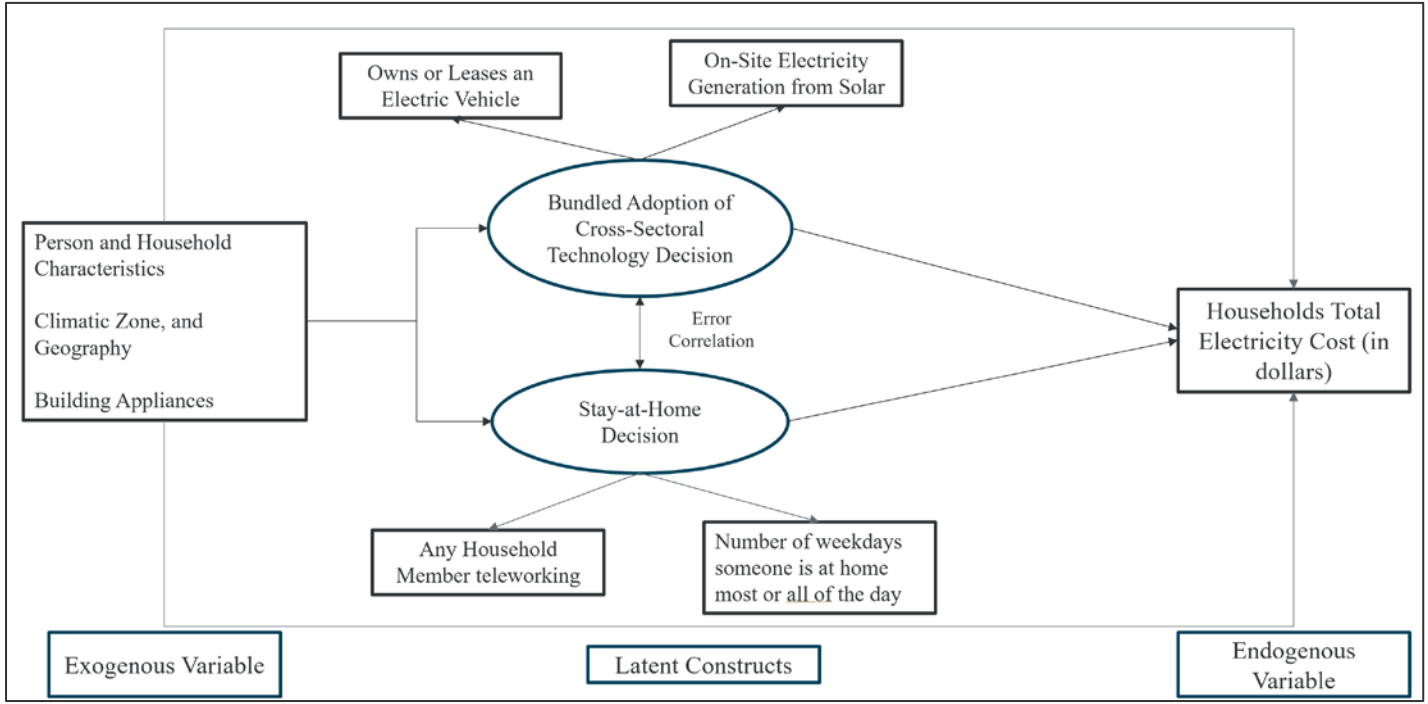


Could modeling consumption (and not cost) alone lead to incomplete conclusions?



Structural Equations Modeling (SEM) Framework

Integrated EV-PV-WFH Modeling Framework



Measurement Model for **Latent Factors:**

$$L_j^* = w_j \alpha_j + \eta_j$$

Structural Equation Model for **Observed Endogenous Variables:**

$$y_i = x_i \beta_i + L^* \gamma_i + \varepsilon_i$$

What factors influence latent constructs?

Bundled Adoption:

- High income (> $100k)
- High education attainment
- Located in the West region

- Female
- Unemployed

Stay-at-Home Decisions:

- Female
- High education attainment
- Located in hot climate

- Low income (< $15k)
- Unemployed

High income and highly educated households have higher proclivity to bundle adopt and stay-at-home. Exploring equitable cross-sectoral adoption policies might accelerate economy wide decarbonization goals

What factors influence electricity cost?

- **Stay-at-home (SAH)**
- High income (> $75k)
- Single family household
- > 3000 square feet
- Electric heating fuel

- **Bundled adoption of EV-PV**
- Older in age (> 55 years)
- Renting
- Located in cold climate
- Located in the west
- < 600 square feet

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 (cost) burden for households, while also **"reducing a households overall energy footprint"**

Conclusions & Future Considerations

Conclusions

- This study presents a **comprehensive understanding** of how different technologies and behaviors might impact electricity cost
- RECS data revealed households that own EVs, PVs, and engage in WFH observed a **13.5% decline in their electricity bills**, despite a 25% increase in electricity consumption
- The model results indicated that **bundled adoption reduces the electricity cost** significantly compared to stay-at-home decisions
- **Cross-sectoral modeling** of technologies can help balance supply and demand, managing peak loads, and improve energy systems resiliency & efficiency

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).

It might be interesting to explore the individual impact of WFH.

The study ignores the influence of any **rebates or tax incentives**, as well as **capital costs** on the adoption of these technologies.

Consideration of **operating cost** benefit of EVs relative to the cost saving from no longer needing to fuel a comparable **gasoline vehicle** should be explored

Thank you!

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