SUSTAINABLE SOLAR EDUCATION PROJECT

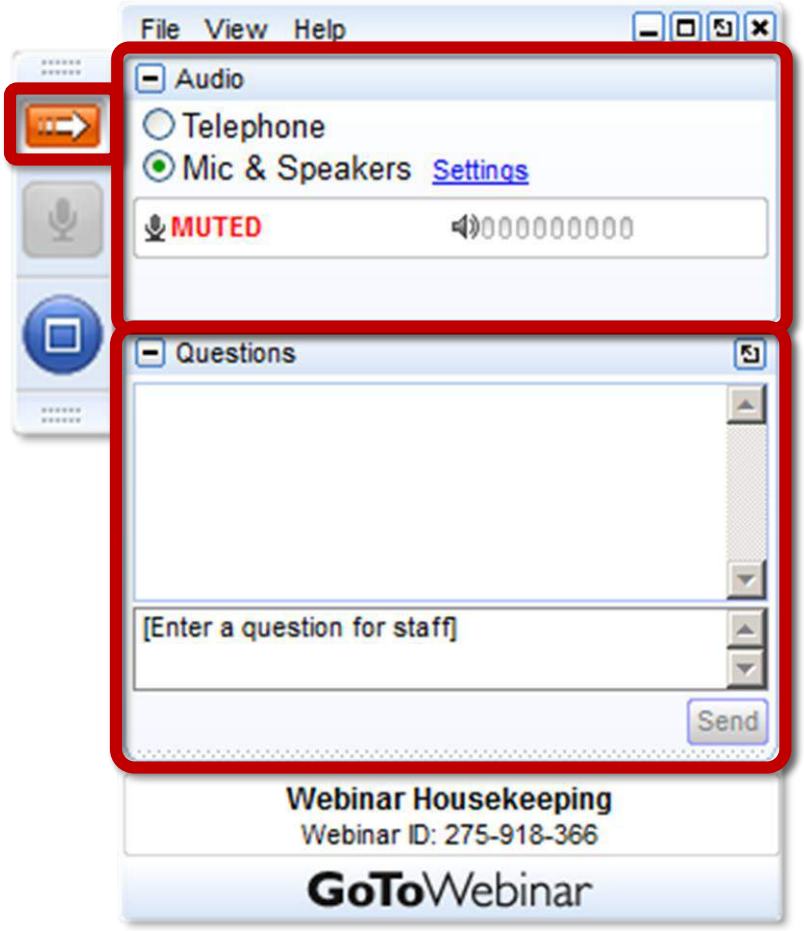
Electricity Affordability Metrics for the U.S.

June 14, 2018

SOLAR ENERGY TECHNOLOGIES OFFICE
U.S. Department Of Energy

CleanEnergy States Alliance

Housekeeping



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BPU New Jersey's cleanenergy njcleanenergy.com program

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SMUD Powering forward. Together.

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Sustainable Solar Education Project

A project to provide information to state and municipal officials on strategies to ensure distributed solar

- Remains consumer friendly
- Benefits low- and moderate-income households

The project is managed by the Clean Energy States Alliance (CESA) and is funded through the U.S. Department of Energy Solar Energy Technologies Office.

SOLAR ENERGY TECHNOLOGIES OFFICE
U.S. Department Of Energy

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Sustainable Solar Education Project Resources

The project offers a variety of free resources on solar equitability and consumer protection:


CleanEnergy States Alliance

SUSTAINABLE SOLAR EDUCATION PROJECT

NEWSLETTER

Sustainable Solar Education Project Webinars

MAY 2017

Bringing the Benefits of Solar to Low-Income Customers

Thursday, May 18th, 1-2 pm ET

CESA will conduct a webinar on low-income solar program and policy design. The webinar will be based on a recently released CESA guide authored by Bentham Paulos titled Bringing the Benefits of Solar to Low-Income Consumers. The guide identifies successful and promising approaches, offers factors policymakers should consider, and provides policy and program design recommendations for bringing the benefits of solar to low-income consumers. Register here.

Crowd Financing Solar for Nonprofits Serving Low-Income Communities

Thursday, May 25, 1-2 pm ET

Nonprofit community service providers that serve low-income communities have faced challenges in financing solar for their own facilities. One answer that has emerged is crowdfunding, in which many individuals each provide a small amount of money for a project. Crowdfunding can involve donations, or it can involve investments, in which the individuals who participate expect a financial return. In this webinar, Andreas Karelas, Executive Director of RE-volv, and Todd Bluechel, Vice President of Marketing and Sales at CollectiveSun, will present two models that rely on crowdfunding to enable nonprofits to adopt solar. Register here.

Community Solar for Low- and Moderate-Income Consumers

Thursday, June 1, 1-2 pm ET

Because community solar can be made accessible to renters and can include flexible terms, it holds promise for spreading the benefits of solar to low- and moderate-income (LMI) consumers. In this webinar, Kelly Roache, Senior Program Manager at Solstice, and David Miller, Senior Vice President at Alpine Bank,

The Sustainable Solar Education Project provides information and educational resources to state and municipal officials on strategies to ensure distributed solar electricity remains consumer friendly and benefits low- and moderate-income households. The project is managed by the Clean Energy States Alliance (CESA) and is funded through the U.S. Department of Energy SunShot Initiative's Solar Training and Education for Professionals program.

The Sustainable Solar Education Project Newsletter reports on issues related to solar equitability and consumer protection.

For more information about the Sustainable Solar Education Project, please visit our website.

cesa.org/projects/sustainable-solar

CleanEnergy States Alliance

- **Guides**
- **Webinars**
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Electricity Affordability Metrics for the U.S.
Webinar Panelists

Monisha Shah

National Renewable Energy Laboratory

David Anderson

Pacific Northwest National Laboratory

Nate Hausman

Clean Energy States Alliance

(Moderator)

GMLC Foundational Metrics Analysis: Electricity Affordability

June 14, 2018, Webinar

Clean Energy States Alliance

Dave Anderson (Pacific Northwest National Lab)

GMLC1.1: Metrics Analysis

High Level Summary

Project Objectives

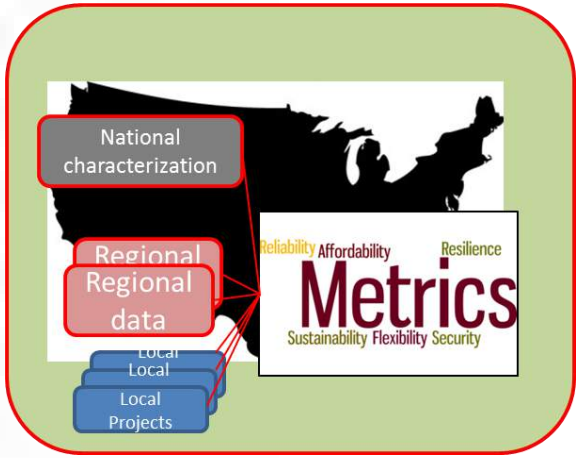
- Work directly with *strategic* stakeholders
- to confirm the usefulness of *new and enhanced existing* metrics
- that will guide grid modernization efforts
- to maintain and improve:
  - **Reliability,**
  - **Resilience,**
  - **Flexibility,**
  - **Sustainability,**
  - **Affordability, and**
  - **Security.**

Value Proposition

- ✓ Ensuring that all stakeholders understand how grid modernization investments will affect and benefit them
- ✓ Audiences: grid modernization technology developers and investors; utility and ISO technology adopters or sponsors; federal, state, and municipal regulatory or oversight authorities; **and electricity consumers** (i.e., the ratepayers**)**

Expected Outcomes

- ✓ Definition, Validation, and Adoption of metrics and analysis approaches by leading industry stakeholders and regional partners
- ✓ Better alignment of DOE R&D priorities with stakeholder and public-interest objectives



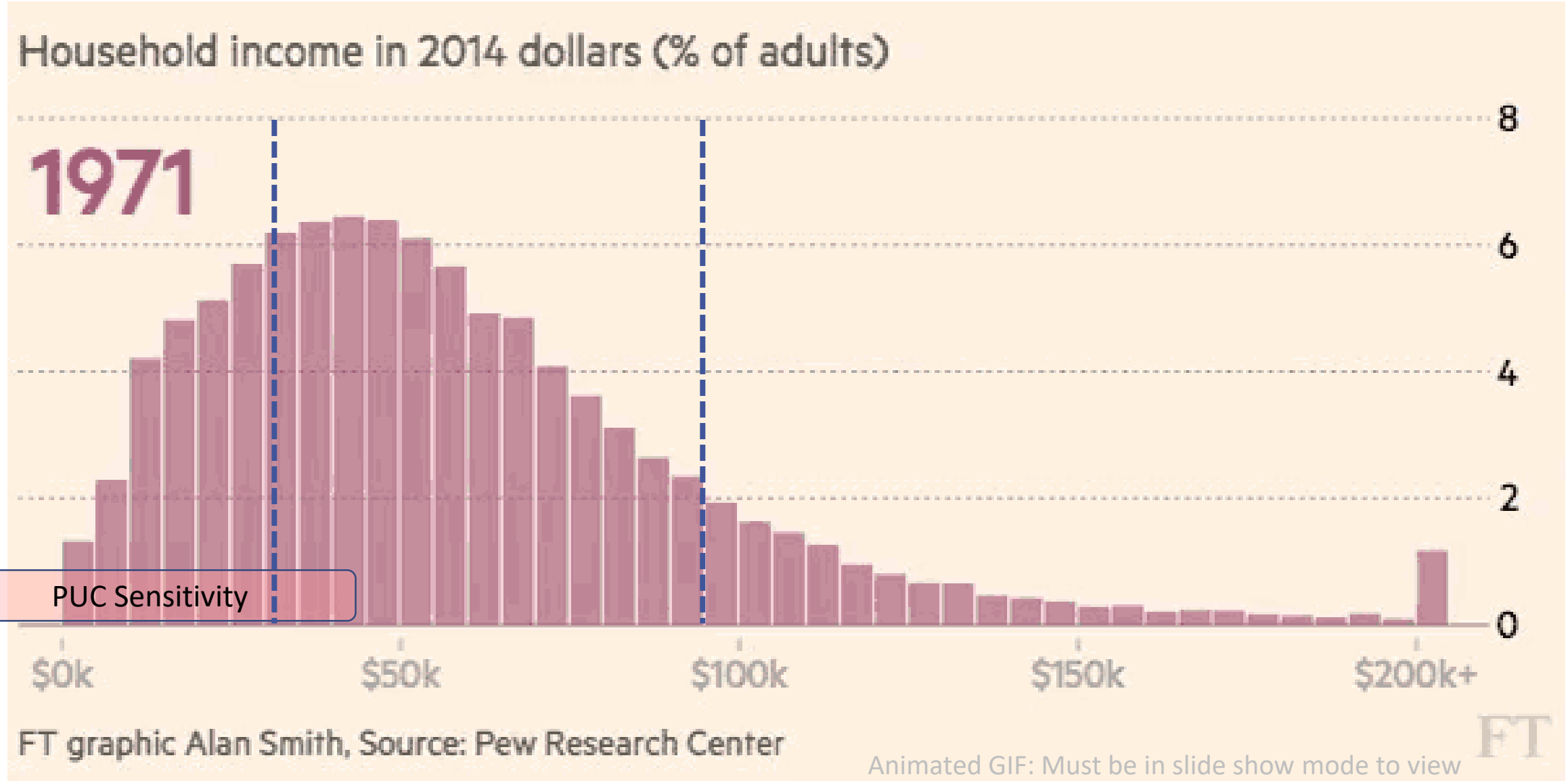
Outline:

- How DOE is defining affordability
- Macroeconomic indicators of affordability
- Affordability metrics derived from customer cost burden
- Data and calculation methods
- Demo of affordability metrics mapping visualization tool
- Next steps

Definition:

- The foundational basis for modern grid architecture specification defines affordability as a system quality that "*ensures system costs and needs are balanced with the ability of users to pay*" (Taft and Becker-Dippmann 2014).
- Most established metrics have been developed to determine cost-effectiveness or to answer the question "*will a specific investment pay off, subject to return on investment criteria*?"
- Emerging metrics determine the electricity service cost burden affecting end-use customers or to answer the question "*what portion of customers' income or revenue is required to pay for affordable electricity service*?"

Electricity Affordability – Cost burden of electric service



PUC Sensitivity

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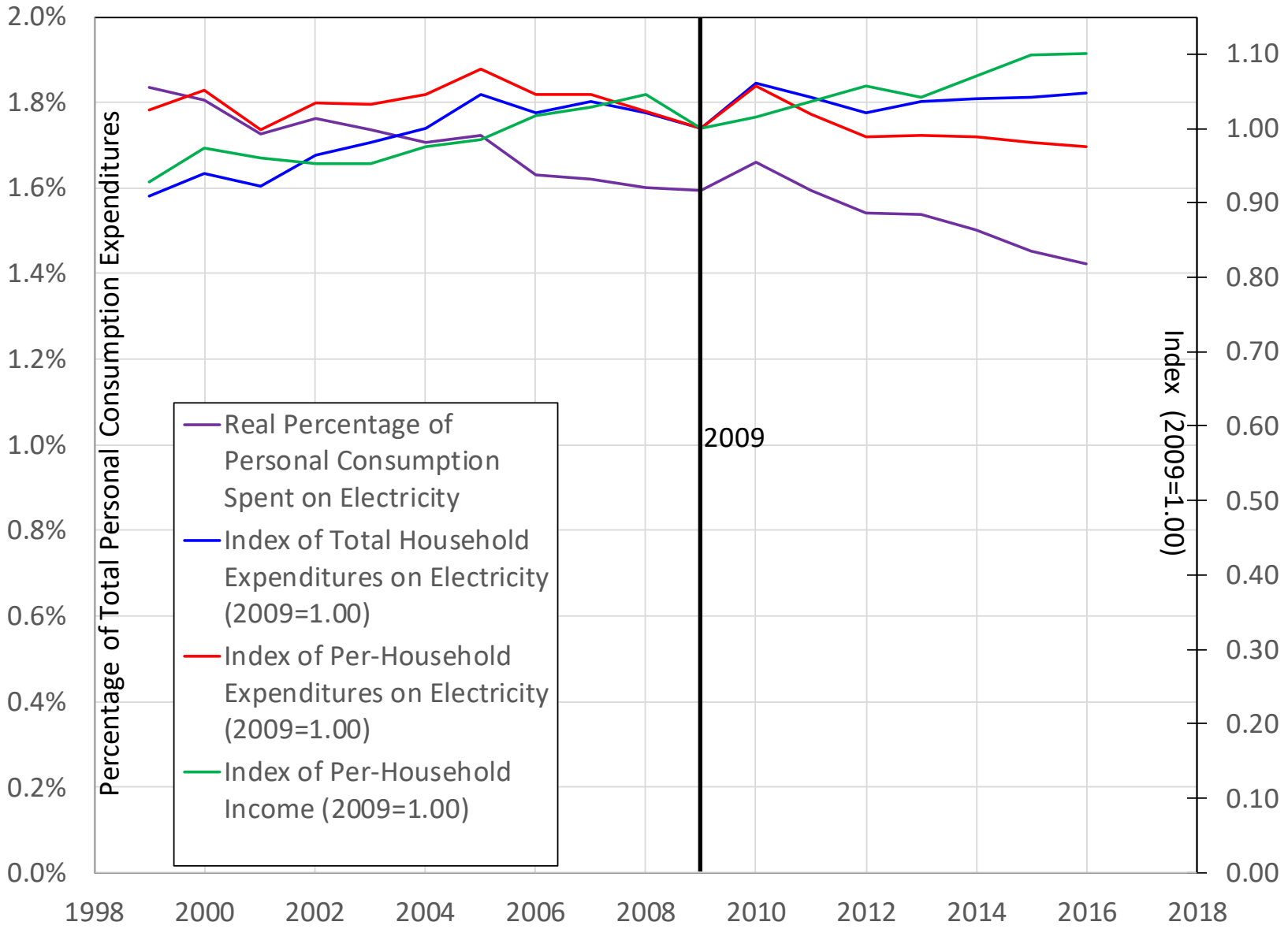
Macro Indicators of Affordability



Real HH incomes are rising, while expenditures on electricity are flat or slightly declining. Thus, the real percentage of income spent on electricity is declining. Electricity is becoming more affordable in the baseline.

Derived from Dept. of Commerce, Bureau of Economic Analysis, National Income and Product Accounts components of GDP and Federal Reserve Data

Customer Cost Burden

$$Household\ electricity\ cost\ burden = \frac{Residence\ Net\ Electric\ Bill}{Household\ Income}$$

$$Business\ electricity\ cost\ burden = \frac{Enterprise\ Net\ Electric\ Bill}{Gross\ revenue}$$

Customer Affordability Gap

$$Household\ Electricity\ Affordability\ Gap = \frac{Electricity\ Cost\ Burden}{Affordability\ Threshold}$$

- Affordability Threshold: Portion of household income *deemed* to be affordable. Cost burdens greater than this threshold are unaffordable (e.g. gap > 1, then the customer household faces unaffordable electricity costs).
- Literature varies widely on the appropriate threshold to use. Cases are made for thresholds ranging from 2 to 11 percent or higher.
- A rule of thumb of 3% is often used.
- Reminder: GMLC only considering *electricity* costs, not all *energy* costs.

Data

- American Community Survey (Census): Annually updated household income distribution from national to census block group granularity for 16 income bins.
- EIA Form 861m: Monthly revenue, kWh sales, and number of customers served by class, by utility.
- EIA Form 861: Service territory definitions (county-level) by utility updated annually.
- Use of monthly data overcomes the masking of some unaffordability that occurs when using annual averages.
- Annual Census income distribution is simply converted to monthly.
- For counties not covered by the Form 861 data, State average customer costs are applied.

Calculations

For any geography (g):

$$Households\ with\ Unaffordable\ Electricty_{month} = \sum_{bin=1}^{16} \frac{\left(\left(\frac{Utility\ Residential\ Revenue}{Number\ of\ customers}\right)_g}{Monthly\ household\ income_g}\right)}{Affordability\ Threshold}$$

$$Effective\ Rates_{month} = \sum_{utilities=1}^{n} \left(\frac{Utility\ Residential\ Revenue_g}{Residential\ kWh\ Sales_g}\right)$$

$$Customer\ Costs_{month} = \sum_{utilities=1}^{n} \left(\frac{Utility\ Residential\ Revenue_g}{Number\ of\ customers_g}\right)$$

Mapping the Results

- Implemented in Excel with plans to convert to R with Shiny for web deployment
- VBA code updates the map based on menu selections
- Looking for review and input on the value and usefulness of this information
- Tool demo…

Some Caveats

- No accounting for influence of nonelectric fuels or self-generated.
- Cooling season likely to be more reliable than heating season for the case of dominant nonelectric heating.
- Monthly metrics reflect revenues from customers on equal payment plans, which may understate actual cost burdens in peak usage months may overstate in low-usage months.

Next Steps…

- Actively seeking utility partners to test the use of their anonymized billing data against our use of public data for specific service areas or states.
- Updating documentation of affordability metrics.
- Attempting to extend the approach to commercial and industrial customers.
- Webifying the mapping tool.

Contact Information

SUSTAINABLE SOLAR EDUCATION PROJECT

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Upcoming Webinars

The Future of Electrification and What It Means for Clean Energy

Tuesday, June 26, 1-2pm ET

Resilient Power in Practice: Lessons Learned from the Field

Wednesday, June 27, 2-3pm ET

State Programs for Clean Energy in Local Jurisdictions: Examples from New York and Oregon

Wednesday, July 11, 1-2pm ET

Using Solar to Reduce Peak Loads: Evaluating Rhode Island's Distributed Solar Pilot

Thursday, July 12, 1-2pm ET

Read more and register at www.cesa.org/webinars