RESIDENTIAL ENERGY CONSUMPTION SURVEY (RECS) 2020

I. OVERVIEW

- The only nationwide source of energy related characteristics, consumption, and expenditures for U.S. homes
- The *first time* that estimates will be available for all 50 states and DC
- **Measures characteristics that contribute to energy consumption** in U.S. households
- **A 3-phase study**
    1. Collects data from ***U.S. households***
       (Household Survey) - Voluntary
        a. ***Physical characteristics of the home***
           e.g. roofing material, the number of windows
        b. ***Energy use behaviors***
           e.g. the frequency of microwave use
    2. Collects data from ***energy suppliers*** for that housing unit
       (Energy Supplier Survey, ESS) - Mandatory
        a. **Fuel *consumption***
           e.g. the amount of cubic feet of gas that the home used
        b. **Fuel *expenditures***
           e.g. gas cost
    3. Run complex statistical models using combined data to produce
       ➜ **Produce consumption & expenditure estimates for heating, cooling, refrigeration, and other end uses** in all housing units occupied as a primary residence in the U.S.

RESOURCES

- **RECS Dataset** (Go to: Microdata > Data files > CSV)
- **RECS 2020 Household Survey (in full):**
    - **RECS 2020 Household Questionnaire**
    - 2020 RECS Propane (Bottled Gas or LPG) Usage Form
    - 2020 RECS Electricity Usage Form
    - 2020 RECS Natural Gas Usage Form
    - 2020 RECS Fuel Oil and Kerosene Usage Form
- **RECS Terminology/Glossary**
    - **Housing unit:**
      Either 1) a *single*-family home, 2) a unit in a *multifamily* building, or 3) a *mobile* home.

II. DATA COLLECTION

Survey design

- **Timeframe**:
    - Examines billing data for 2-years (March 2019 - February 2021) but
    - Billing and fuel delivery data were annualized to the calendar year 2020
- **Survey method**: *self-administered** questionnaire via 1) the web or 2) mail/paper
    - Prior to 2020 RECS:
        - a) in-person interviews or a b) mix of in person and self-administered modes (computer-assisted personal interviews).
    - The advantages of eliminating interviews:
        1. Could increase the sample size
        2. Change to an *unclustered* sample design
           ➜ because it is no longer needed to assign interviewers to households based on geographic proximity, for efficiency and cost-effectiveness
- **Topics covered:**
    1) *The respondent's home* (e.g. housing type, construction year , size of home)
    2) *Appliances* (e.g. the number, size, and age of each appliance)
    3) *Electronics* (e.g. the number, size, type, and usage, hours of usage of TVs/PCs/Cellphones etc; whether and how many people in the household are teleworking/engaging in distance learning)
    4) *Space heating* (e.g. main & secondary heating equipment, its source of energy, age etc)
    5) *Air conditioning* (e.g.main & secondary cooling equipment, age, number of equipment…)
    6) *Thermostats and temperatures* (e.g. typical temperature during the winter and summer)
    7) *Water heating* (e.g. location of the main water heating equipment, size and age of the main water heater, source of fuel)
    8) *Lighting* (e.g. % of each lightbulb types inside the home, the number of lightbulbs that are turned on for short/medium-term/long-term during the day)
    9) *Energy bill*s (e.g. the person responsible for paying the bills, whether the bill includes costs for energy usage for non-household purposes)
    10) *Household characteristics* (e.g. gender, age, employment status, education level, income, ethnic/racial minority status, number of household members and their approximate age)
    11) *Energy assistance* (e.g. receipt of shut off notice for an energy bill, challenges in maintaining heating and cooling in the home)
    12) *Energy supplier information* (e.g. name of electricity, natural gas, propane, fuel oil providers; account number of the respondent)

Sampling

- **Target population:**
  all a) *occupied* housing units in b) the 50 states & DC* that are used as c) *primary residences*
- **Sample:** Homes that are occupied **as a primary residence**
  - Excludes *vacant homes, secondary homes* (e.g. *seasonal housing units), group quarters (*e.g. *dormitories, nursing homes, prisons, military barracks),* and *common areas in apartment buildings*.
  - Includes housing units located on military installations
- **Sampling methods to ensure representation of the target population**:
  (1) Selection of eligible housing units:
  - Housing units were sampled using an Address-Based Sample (ABS) design
    - Unclustered sampling
    - Selected from a list of residential addresses, based on the U.S. Postal Service's (USPS) Computerized Delivery Sequence file of active mail delivery points (which covers 99.6% of eligible RECS addresses in the U.S.),
    - Non-residential addresses were removed
    - Also accounted for non-deliverable and drop-point addresses

  (2) Weighted adjustments:
  - The weights (= the number of households in the population that the observation represents) accounted for
    a) different probabilities of selection,
    b) survey response rates, and
    c) the U.S. Census Bureau housing unit estimates
    - **The sum of all weights** (RECS 2020) **= total number of primary, occupied housing units in 2020, in the U.S** (Census Bureau data)
- **Sample size:**
  1) 2020 RECS Household survey
     - 18,496 households (72% via web questionnaire; 27.2% via paper questionnaire)
     - Response rate: Unweighted, 38.6%; Weighted, 37.9%
       - Lower compared to 2015 (unweighted, 51.2% ; weighted, 50.8%), due to self-administered survey design
         - In-person surveys (e.g. RECS 2015) tend to have higher response rates, because interviewers can build rapport with the respondents
  2) 2020 RECS Energy Supplier survey
     - 2,500+ electricity, natural gas, fuel oil, and propane suppliers
     - Response rate: 92%
     - Coverage rate: 84%

IMPROVEMENTS TO THE RECS 2020 vs. 2015

- Given the COVID19 pandemic, questions about the following were added:
    - teleworking
    - Whether anyone in the household was participating in K-12 distance learning or online college courses
- Additional questions on emerging technologies and usage behavior,
    - Household solar capacity and installation
    - Electric vehicle ownership and charging behavior
    - Smart speakers

III. DATA CLEANING

- **Handling of missing data**: missing values were replaced with an observed response from a "similar" unit (hot-deck imputation)
    - Number of variables that were imputed: 263
    - Median imputation rate of the variables: 3%
- **Quality checks:**
    - Identified incorrect data formats
    - erroneous data entry,
    - inconsistencies across bills,
    - outliers
    - corrected inconsistencies between the ESS data and the HS responses.

IV. CAVEATS TO KEEP IN MIND WHEN INTEGRATING OTHER DATASETS

- RECS is best suited for comparison across different characteristics of homes within the residential sector

- RECS is not appropriate for comparing EIA (Energy Information Administration)'s other residential energy data
    - Because the scope of RECS is limited to homes occupied as a primary residence
    - As a result, RECS estimates are not comparable with sector-level totals defined in other EIA products

- RECS *square footage estimates* (which includes 1) the main living area, 2) attic, 3) basement, and 4) garage) may not be appropriate for comparison with data sources that consider only *furnished* or *livable space*.
- Avoid comparing or aggregating *square footage* data across different years of RECS
    - Due to changes in data collection and estimation methods for 2020 RECS

OFFICIAL DOCUMENTATION

- Housing Characteristics Overview of 2020 RECS
- RECS 2020 - Household Characteristics Technical Documentation Summary
- RECS 2020 - Codebook
- RECS 2020 - Consumption and Expenditures Documentation
- RECS 2020 - Square Footage Data Collection and Estimation Methodology
- RECS 2020 - Using Microdata to Compute Estimates & Relative Standard Errors

V. PUBLICATIONS

Kaza, Nikhil. 2010. "Understanding the Spectrum of Residential Energy Consumption: A Quantile Regression Approach." *Energy Policy*, Energy Efficiency Policies and Strategies with regular papers., 38 (11): 6574–85. https://doi.org/10.1016/j.enpol.2010.06.028.

Mohr, Tanga McDaniel. 2018. "Fuel Poverty in the US: Evidence Using the 2009 Residential Energy Consumption Survey." *Energy Economics* 74 (August): 360–69. https://doi.org/10.1016/j.eneco.2018.06.007.

Wang, Qiang, Mei-Po Kwan, Jie Fan, and Jian Lin. 2021. "Racial Disparities in Energy Poverty in the United States." *Renewable and Sustainable Energy Reviews* 137 (March): 110620. https://doi.org/10.1016/j.rser.2020.110620.