

TASK 2: ENERGY BURDEN ANALYSIS & GIS MAPPING

MAY 24TH, 2021 | DHCD

PROJECT TEAM

2



Philip Agee, PhD
Principal Investigator
Assistant Professor
Virginia Tech

Expertise:

- Human-building Interaction
- Humidity control
- Human Factors Engineering

Lead: Task(s) 1 & 3



Xinghua Gao, PhD
CO-PI
Assistant Professor
Virginia Tech

Expertise:

- Machine learning
- Internet of things
- Cyber-physical systems



Mel Jones, MS, MURP
CO-PI
Research Scientist
VCHR
Virginia Tech

Expertise:

- Housing affordability
- Economics
- Housing data

Lead: Task 2



Andrew McCoy, PhD
CO-PI
Director, VCHR
Beliveau Professor
Virginia Tech

Expertise:

- Housing innovation
- Production cost analysis
- Housing technologies



Armin Yeganeh, PhD
CO-PI
Postdoctoral Assoc.
Virginia Tech

Expertise:

- Affordable housing
- Building systems



Sarin Adhikari, PhD
Consultant
Research Economist
VCU

Expertise:

- Formal modeling
- GIS



Ivan Seun, PhD
Consultant
Associate Professor
VCU

Expertise:

- Applications of GIS
- Data visualization

DEFINITIONS

3

Historically Economically Disadvantaged Communities: (i) a community in which a majority of the population are people of color or (ii) a low-income geographic area. "Low-income geographic area" means any locality, or community within a locality, that has a median household income that is not greater than 80 percent of the local median household income, or any area in the Commonwealth designated as a qualified opportunity zone by the U.S. Secretary of the Treasury via his/her delegation of authority to the Internal Revenue Service (Virginia Clean Economy Act, 2020)

HUD Income Levels: extremely low income (less than 30% of AMI); very low income (30-50% AMI); low income (50-80% AMI); moderate income (80-100% AMI) (US HUD, 2021)

Energy burden: the percentage of gross household income spent on energy costs (U.S. Dept of Energy, 2021)

Public Use Microdata Area (PUMA): geography unit for ACS Public Use Microdata Sample (PUMS); Census designated are with no less than 100,000 people

Census Tract: Census designated sub-county geography designed to an average of 4,000 people

Block Group: clusters of blocks within the same census tract

Block: Statistical areas bounded by visible features such as roads, streams, and railroad tracks, and by non-visible boundaries such as property lines, city, township, school district, county limits and short line-of-sight extensions of roads

OBJECTIVE

4

Conduct analysis that allows DHCD to plan for HIEE investments in places with high levels of energy burden and promotes equity by investing in housing for people who are disproportionately impacted by energy cost-burdens and who experience effects of racism and segregation (systematic or otherwise) that have resulted in housing-related disadvantages.

Steps:

- 1) Preliminary data analysis
- 2) Decide approach & methodology
- 5) Create database
- 6) Map database
- 7) Configure and develop web interface

American Community Survey Public Use Microdata (PUMS):

Geography: Public Use Microdata Area, regions including no fewer than 100,000 people.

In densely populated areas they are sub-county regions (i.e. Fairfax County and Loudoun County each include multiple PUMAs, while the entire New River Valley constitutes a single PUMA)

PUBLIC USE MICRODATA SAMPLE (PUMS)

6

Preliminary Data Analysis:

- **Estimate number of energy-burdened households in each PUMA**
 - Energy-burden will be categorized based on the distribution of energy costs a percentage of household income in Virginia
 - Those with the greatest energy burden have extremely low incomes and high energy costs and thereby may be housing cost-burdened by energy costs alone (VCHR 2016)
 - 25% (30.6 million) of US households pay more than 6% of income on energy bills and 13% (15.9 million) of U.S. households pay more than 10% of income on energy (ACEEE 2020)
- **Identify households types that are disproportionately energy budened**
 - Income (AMI level, poverty, other income thresholds as desired)
 - Race and ethnicity of householder
 - Family composition
 - Household size
 - Other housing problems (housing cost-burden, overcrowding)
- **Identify building types in which households are disproportionately energy burdened**
 - Single family (attached, detached, mobile/manufactured), multifamily (small, medium, large)
 - Year built
 - Fuel source

Reliability will restrict estimates for small populations in some regions

- i.e. there are too few minority households in some counties and regions to accurately estimate the the extremely low income households experiencing cost-burden by individual each race or ethnic group, requiring aggregation to include all minority households

ANALYTICAL OUTPUTS AND TECHNIQUES

8

Identify the socioeconomic and housing characteristics of households with energy cost burdens→ use this information to develop criterion for Census Tracts of interest

Possible Outputs

Simple Tract Criterion (in or out)

Index (high/low indicated level of priority)

Composite Index (allows us to incorporate other already existing indices) e.g.

- Home-heating energy poverty risk
- Proximity to health hazards
- Historic red lining
- Walkability
- Job opportunity indices

SUPPORTING ANALYTICAL TECHNIQUES

9

Implicit to each output is the requirement to identify criteria/characteristics that are important to allocation/direction of investment and whether they should be considered together or separately

Empirical analysis can support those decisions, however other considerations will need to be decided by DHCD & stakeholders

- Correlation to identify closely related characteristics and proxies
- Regression to identify top predictors of energy cost burden
- Group decision making process

OTHER SUPPORTING DATA

10

Using other supporting data (i.e. AHS, NHPD, local parcel and assessment data, block level ACS data where reliable, DHCD administrative data) it may be possible to apply the index at the block group or block level in jurisdiction where high-quality data is available.

- ❑ Option to demonstrate these possibilities in places where VCHR/CURA already have data compiled
- ❑ Option to assemble data in PUMA regions that have high levels of energy cost burden

MAPPING

11

- Census block is anticipated to be lowest level of geography for general mapping
- Depending on the detail of the criteria mapping detail may need to be stratified based on population density (urban, suburban, exurban and rural).
 - Greatest detail is only reliability available in the most densely populated places.
- **Overlays to explore:**
 - Home-heating energy poverty risk
 - Proximity to health hazards
 - Historic red lining
 - Walkability
 - Job opportunity indices