

# Statewide Variations in Energy Efficiency Rebates: A Comparative Analysis

*Suchismita Bhattacharjee, University of Oklahoma*  
*Georg Reichard, Virginia Tech*

## ABSTRACT

A systematic review of energy efficiency incentives that were available to homeowners was conducted across all 50 states. This review revealed that incentive portfolios vary largely with regard to the number of available incentives, the various types of incentives, the individual amounts that are made available, and the targeted equipment.

Of the \$ 1.27 billion in total residential incentive budgets, this study reviewed the portfolios of energy efficiency incentives available to homeowners only. Data regarding these incentives has been directly collected from program sponsors and has been broken down to the individual equipment level, categorizing different equipment options, available energy sources, and the final amount of the rebates based on specified performance.

The study identified a total of 748 individual energy efficiency incentives that were available in 2012 to the various homeowners across the 50 states. Expanding on the original 9 technology groups (e.g. Appliances, HVAC, etc.) within the DSIRE structure, the individual rebate programs were broken down into 42 specific technologies (e.g. Dishwasher, Boiler, Light Bulbs, etc.) and their sub-options, resulting in a granularity of 60 target technologies.

Utility Rebate Programs were found to be the most common type of incentive program offered across all the states. An analysis of the incentives revealed that the amount of available rebates to move the installed equipment base towards higher efficiency varies widely from state to state. The study also showed that states incorporate quite different approaches in terms of targeted energy resources, consumption technologies, and distribution mechanisms reaching the individual households.

## Introduction

Energy efficiency rebate programs have been implemented to create the necessary conditions to accelerate the development and the deployment of energy efficient equipment, and to make people use energy more efficiently (i.e., get the maximum output from minimum input of energy). The objectives has been fulfilled through the deployment of specific financing mechanism, which are typically loan, rebate, or grant programs (World Energy Council 2008). Over the past 30 years several energy efficiency incentives have been implemented across the U.S., and were guided mainly by three drivers. The first driver consisted of a wave of policies that followed the economic concerns resulting from the oil embargos of the 1970s. Another driver was the environmental concerns that started in the early 1970s due to urban smog and acid rain and later in the more global context of climate change. The third driver relates to increasing energy prices since those times (Norberg-Bohm 2000).

This paper presents the results of a comparative analysis of different energy efficiency incentives and programs implemented across the 50 individual United States. The outcome of

this analysis will assist the understanding of the various dynamics of currently implemented program portfolios and their underlying policies.

## **Rationale**

This study was carried out to fill several gaps in the research on customer incentives for energy efficiency. First, since the majority of the existing literature in this area is survey-based, this study focused on content and available socioeconomic information in order to gain an in-depth understanding of how energy efficiency incentives that have been implemented directly relate to state and local constituents (Austin et al. 2009; Frondel and Schmidt 2005; Lee and Yik 2004; Wiser et al. 2005). Second, there have been few analyses of energy efficiency incentives implemented at the state level, although several studies have analyzed the effectiveness of energy efficiency incentives at the national or international level (Alberini and Segerson 2002; Banerjee and Solomon 2003; Mahlia et al. 2004; Schiellerup 2002; Sutherland 2003). Third, this study will provide information to social scientists, such as political scientists and sociologists, to better understand the requirements of the energy efficiency incentives in different states. Finally, much of the available research has been conducted in larger and typically more progressive states, such as California and New York (Wiser et al. 1998), but there has never been a study across all 50 states that specifically went to the level of equipment detail as carried out in this effort

## **Research Scope and Procedure**

The research team developed a new database system to allow for detailed probing of research queries related to specific features and technologies of energy efficiency incentives that target residential buildings across the 50 states. Incentive data for this relational database system was parsed by harvesting detailed technology information posted on rebate forms of individual programs. The starting list of identification of possible incentives was a subset of the DSIRE (Database of State Incentives for Renewable Energy) (DSIRE 2012) records. DSIRE records provided a summary and typology with links back to the funding source. The information on technological data, systems options, and the required criteria are not captured in DSIRE and thus not available for analysis on a systematic level. To develop the database system the researchers went to each original source and analyzed available specifications in terms of taxonomy to identify the required information to be captured into the new database schema, which then was searchable against specific technologies, equipment specifications, energy sources, rebate amounts, rebate terms and conditions, as well as targeted households and population data. This deep level of data mining on an individual program and incentive levels had not been done before.

The method employed for this study as presented in this paper was content analysis, which permitted the authors to develop a better understanding of energy efficiency incentive portfolios and analyze energy efficiency incentives listed under each state. It is a useful technique to sort qualitative data and categorize them in a more methodological and systematic manner (Berelson 1971; Stemler 2001; Weber 1985). The overall research process employed by this method is described in Figure 2.

The scope of this study is restricted to incentives available in the year 2012. While the distribution of incentive programs will have changed since then, as some incentive programs exhaust their funding and other new incentives have been created, the results represent a valid

snapshot of portfolios, which now can be compared to consumption and census data that are made available through the Energy Information Administration (EIA).

Technology / Options		E-Source	Amount	Terms
	<b>Heat Pumps</b> • Source: Geothermal	• Electric	3000.00 \$	• <b>Max. Amount</b> Max. \$ = 3000
	<b>Photovoltaics</b>	• Electric • Solar	1000.00 \$	• <b>Max. Amount</b> Max. \$ = 1000 Comment: per project
None (id=13493)	Water Heaters <input type="checkbox"/> Condensing <input type="checkbox"/> Heat Pump <input type="checkbox"/> Indirect <input type="checkbox"/> Pool/Spa Heater <input type="checkbox"/> Power Vented <input type="checkbox"/> Tankless <input checked="" type="checkbox"/> Tank	<input type="checkbox"/> Electric <input type="checkbox"/> Natural Gas <input type="checkbox"/> Oil <input type="checkbox"/> Propane Gas <input checked="" type="checkbox"/> Solar	500.00 \$	Select Term to add: • <b>Max. Amount</b> Max. \$ = 500
<a href="http://energy.maryland.gov/Residential/cleanenergygrants/index.html">http://energy.maryland.gov/Residential/cleanenergygrants/index.html</a>				
Text to track: Solar Water Heating    10-100 sq. ft.    \$500/project				
<a href="http://energy.maryland.gov/Residential/cleanenergygrants/documents/FY13ResidentialApplication.pdf">http://energy.maryland.gov/Residential/cleanenergygrants/documents/FY13ResidentialApplication.pdf</a>				

Figure 1. Example of a form for capturing individual technologies supported through an incentive program.

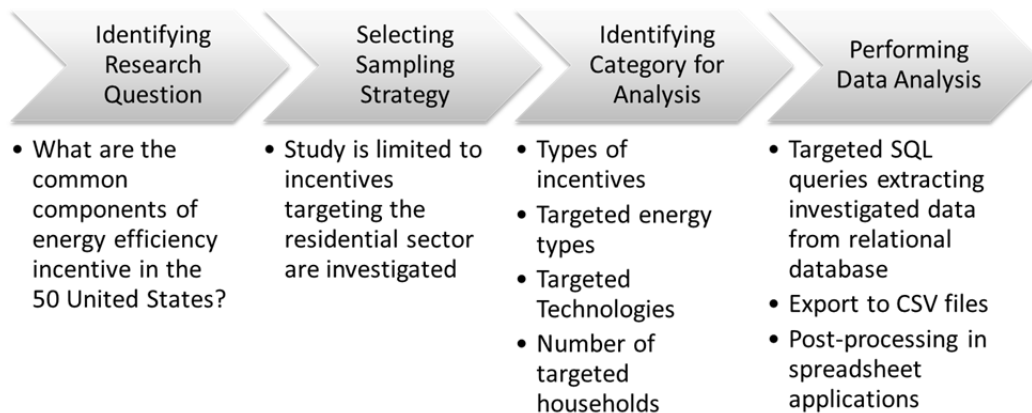


Figure 2. Questions and steps in content analysis.

## Results

### Type of Incentives

The study identified a total of 748 individual active energy efficiency incentives targeting different technologies that were available to the various homeowners in individual states across the U.S in 2012. These energy efficiency incentives were categorized as 11 different types based on their objectives, which are namely, Utility Rebate Programs (URP), State Rebate Programs (SRP), Local Rebate Programs (LRP), Utility Grant Programs (UGP), State Grant Programs (SGP), Utility Loan Programs (ULP), State Loan Programs (SLP), Local Loan Programs (LLP),

Green Building Incentives (GBI), Manufacturer Rebate Programs (MRP), and Non-Profit Rebate Programs (NpRP).

- *Rebate Programs* offered by utility companies, state or local governments, manufacturers, and non-profit organizations provide a financial incentive in form of a partial reimbursement to promote the application of energy efficiency measures or installation of renewable energy systems.
- *Grant Programs*, which are mostly offered by utility companies or state governments, can offer a variety of support mechanisms to encourage the use and development energy efficiency improvements or renewable energy systems. Most of the time these programs support the funding of a broad range of projects, or focus on particular technologies, like photo voltaic systems, but some also support research and development, or commercialization efforts.
- Unlike Rebate or Grant Programs, *Loan Programs* typically provide financing mechanisms for the purchase of renewable energy or energy efficiency systems or equipment.

*Utility Rebate Programs* were the most common among the different incentive types. Seven of the 50 states had 30 or more active URPs. Minnesota was leading this list, followed by Indiana, Florida, Washington, California, Michigan, and Texas as shown in Figure 3.

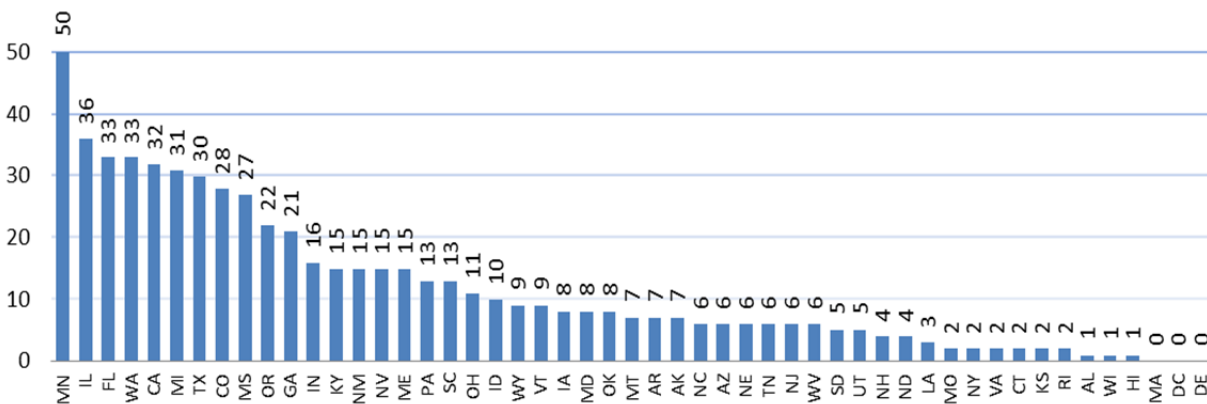


Figure 3. Number of utility rebate program by state.

Though available much less frequently, *State Rebate Programs* were the second most common among the different types of active incentives. Wisconsin was leading this list with 4 active SRPs followed by Maine, Maryland, New Jersey, Oregon, Virginia, and Vermont, which had 3 active SRPs each. *Local Rebate Programs* were only found in few states, with the highest occurrences in Colorado, followed by California and Florida. Figure 4a & 4b graphically represents the distribution of the number of active SRPs and LRPs in each of the 50 states. A single *Manufacturer Rebate Program* was found in Utah. The only active *Non-profit Rebate Program* was in Virginia.

In addition to the various Rebate Programs, several Loan Programs have also emerged in the past years. *Utility Loan Programs* were most common in Georgia and California, *State Loan*

Programs were mostly found in California and Pennsylvania. Figure 5a & 5b shows the distribution of the number of ULPs and SLPs implemented across the 50 states.

The only states that have implemented any kind of *Utility Grant Program* were Colorado and New Jersey, and Massachusetts was the only state where a *State Grant Program* was found. North Carolina finally, was the only state with an active *Green Building Incentive* called the “Progress Energy Carolinas - CFL Rebate Program”.

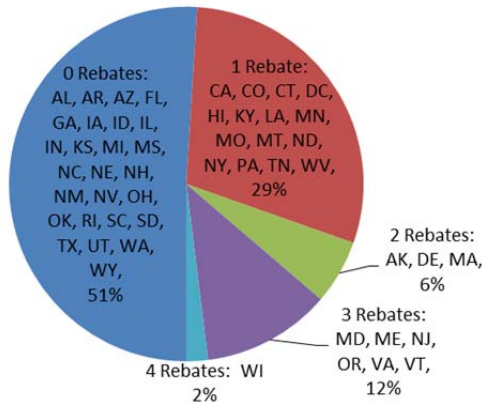


Figure 4a. Number of state rebate programs/state.

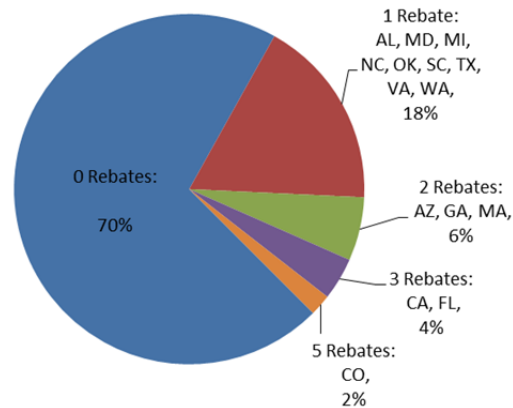


Figure 4b. Number of local rebate programs/state.

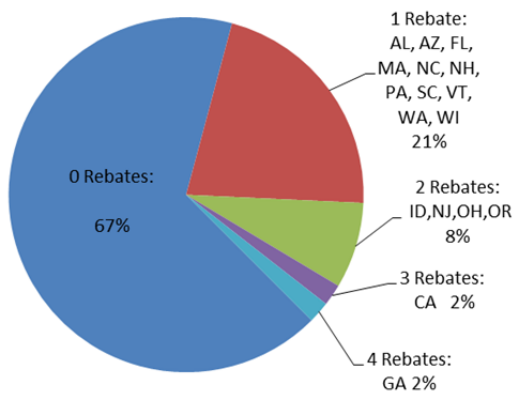


Figure 5a. Number of utility loan programs/state.

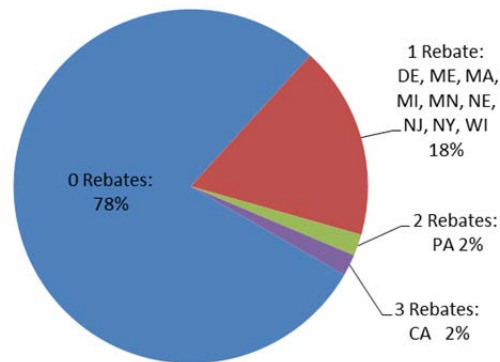


Figure 5b. Number of state loan programs/state.

### Type of Targeted Energy Resources

The second area of analysis explored the type of energy resources targeted by each of the energy efficiency incentives implemented across the 50 states. The different types of targeted resources were electricity, natural gas, propane gas, heating oil, solar, and wind. By far the most frequently targeted energy resource type is electricity, followed by natural gas, and then solar power. Figure 6 and 7 show the number of active rebates targeting electrical equipment and natural gas equipment by state. States that are not included in these figures did not have any active incentives targeting the particular energy resource.

A considerable amount of money is spent at the state level to improve the use of renewable energy systems, where solar energy systems have been identified as the main focus of the researched active incentives. Florida was the leading state with a maximum number of 19 incentives focusing on an improvement of solar energy system utilization, followed by Texas, Georgia, Pennsylvania, and others as shown in Figure 8. Once again, states that are not represented in Figure 8 did not have any active solar energy rebate programs in place. The least frequent targeted energy resource type was wind power. Among all the 50 states, Wisconsin was the only state having an active incentive that provided financial assistance or cash back rebates for the installation of wind energy system.

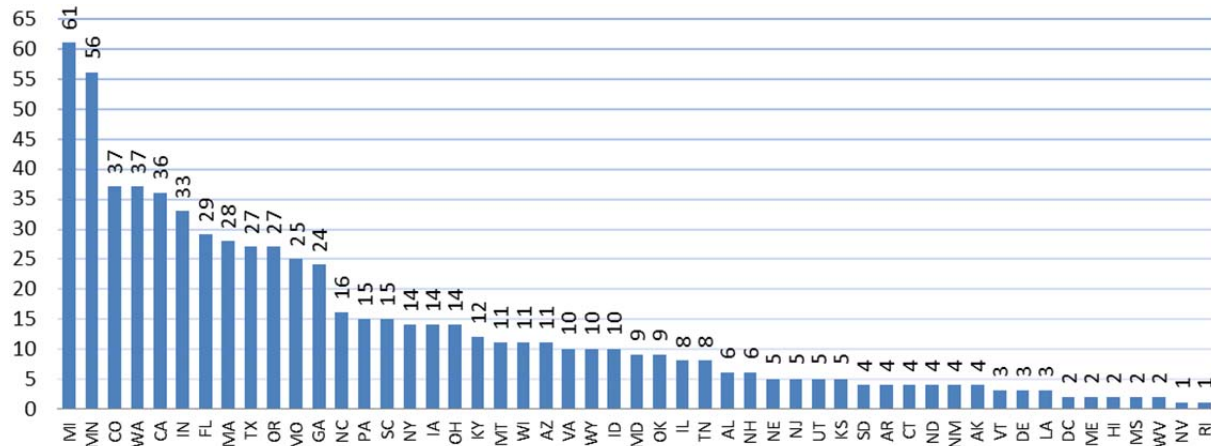


Figure 6. Number of incentives targeting electrical equipment, by state.

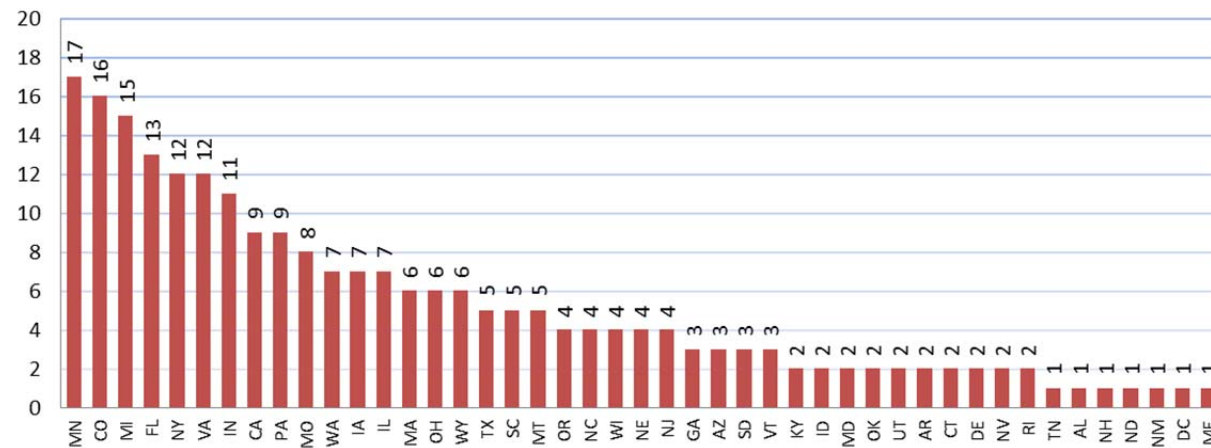


Figure 7. Number of incentives targeting natural gas equipment by state.

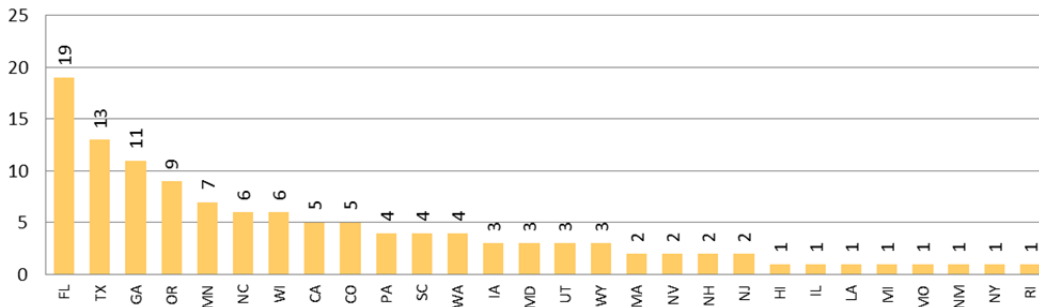


Figure 8. Number of incentives targeting solar energy system per state.

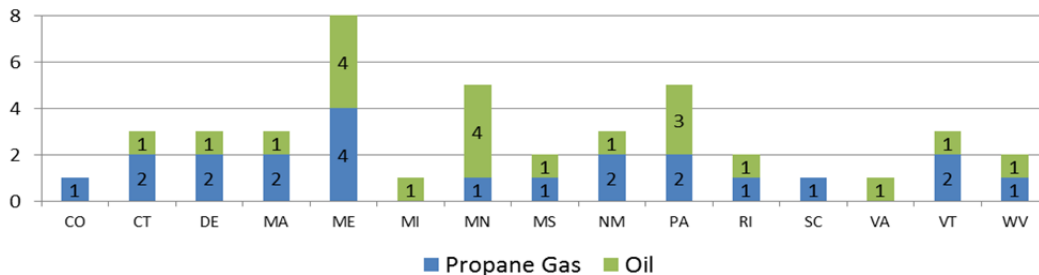


Figure 9. Number of incentives targeting propane gas, and oil per state.

### Type of Targeted Technologies

The third area of analysis of this study investigated the different types of technologies that were targeted by each of the energy efficiency incentives across the 50 states (Table I). HVAC systems and hot water systems were the most frequently targeted system technologies followed by whole building and building enclosure systems measures, and then lighting systems. For household appliances, kitchen and laundry items were the most frequently targeted technologies throughout the different energy efficiency incentives. Power (co-)generation solutions were the least frequently targeted technologies.

Energy efficiency incentives targeting HVAC systems were then further broken down based on the type of HVAC system intervention. Figure 10a shows the percentage of incentives targeting the various types of HVAC system technologies. It should be noted that heat pumps were the most widely targeted HVAC systems. The various power generation incentives were also further broken down based on the type of energy production as shown in Figure 10b. It can be seen that 56% of all incentives targeting power generation were focusing on photovoltaic systems.

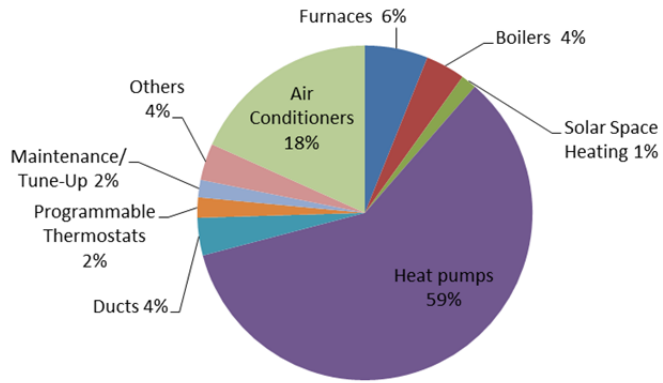


Figure 10a. Percentage of HVAC incentives targeting different type of HVAC system.

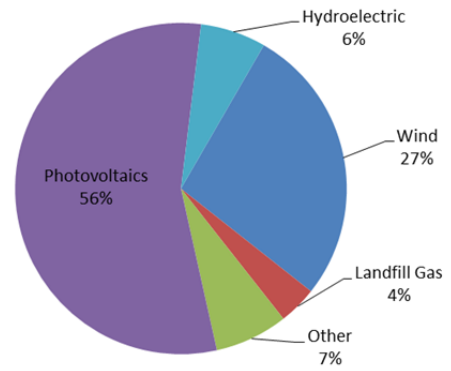


Figure 10b. Percentage of energy resource types of power generation incentives.



Table 1. Technology types targeted by energy efficiency incentives

States	Light Sys.	HW Sys.	HVAC Sys.	Bldg. Meas.	Bldg. Encl.	Ktch. Appl.	Lndr. Appl.	Power Gen.	Other
Alaska	1	1		2		1	1		
Alabama		6	6	3	3	1	1		
Arkansas	2	3	5	3	1				
Arizona		3	9	4	8	2	1		
California	11	20	29	7	26	24	20	2	18
Colorado	3	29	30	3	14	26	23	2	2
Connecticut	1	3	4	2	2	2	2		
DC		1	1		1	1	1		
Delaware		2	2	2	1	1	1		
Florida	4	26	28	8	21	17	18	4	1
Georgia	1	16	13	8	5	3	1	5	1
Hawaii		1	1			2	2		
Iowa	8	10	11	5	5	9	9	1	1
Idaho	3	6	9	2	6	7	7		
Illinois	4	7	8	2	6	4	2	1	
Indiana	2	23	31	5	5	15	2		
Kansas		1	3		1				
Kentucky	1	4	14	7	12				
Louisiana	2	1	2	2	2				
Massachusetts		10	19	7	10	13	9		2
Maryland	4	5	7	8	5	6	6	1	1
Maine		1	2	3	1	1	1		
Michigan	23	28	31	5	9	25	23		20
Minnesota	32	25	46	8	12	39	34	2	2
Missouri	2	13	25	11	8	11	9	1	
Mississippi		2	2						
Montana	1	4	7	2	3	6	5		2
North Carolina	1	12	15	1	3	5	4		
North Dakota		3	3		2	2	1		1
Nebraska		3	7	1	5	1	1		
New Hampshire	3	3	6	6	2	4	4		2
New Jersey		2	7	4	4	1	1	1	
New Mexico		3	3	1	2	4	1		
Nevada		3	2	1	1	1	1		1
New York		12	12	2	6	4			1
Ohio	3	4	12	4	4	2	1		3
Oklahoma	1	5	11	1	4	1	2		

States	Light Sys.	HW Sys.	HVAC Sys.	Bldg. Meas.	Bldg. Encl.	Ktch. Appl.	Lndr. Appl.	Power Gen.	Other
Oregon	6	21	23	6	18	16	19	1	
Pennsylvania	6	11	12	6	5	8	5	1	1
Rhode Island	1	1	2	2	1	1			1
South Carolina	1	10	14	2	4	2		1	1
South Dakota		5	5		3				1
Tennessee		6	7	1	1				
Texas	2	18	23	8	15	6	6	3	1
Utah	1	4	3	3	2	2	3	1	
Virginia		10	14	5	8	3	3		
Vermont	2	2	5	3	1	1	2		1
Washington	8	24	27	8	25	24	24	1	
Wisconsin	4	8	8	10	6	5	4	3	
West Virginia	1	1	2		1	1	1		
Wyoming	1	8	8	4	4	2	3	1	
	<b>146</b>	<b>430</b>	<b>576</b>	<b>188</b>	<b>294</b>	<b>312</b>	<b>264</b>	<b>32</b>	<b>64</b>

### Households Reached by Incentives

The fourth area of analysis explored the number of households targeted by the various energy efficiency incentives implemented across the 50 states, in order to understand program coverage.

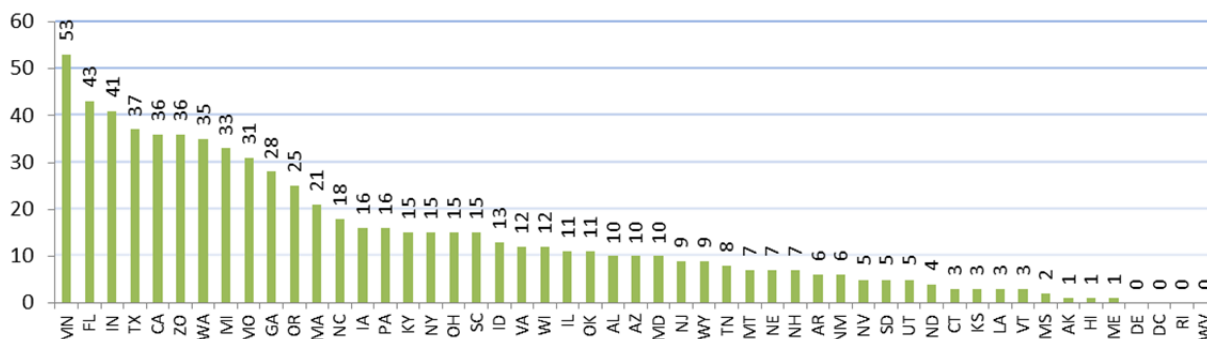


Figure 11. Number of incentives in each state targeting only part of the state population.

The majority of energy efficiency incentives in most states are targeting only part of the state. States typically have just one or two state-wide energy efficiency incentives. Delaware is the only state that has as many as 4 active incentives, all of which are targeting the entire state, as compared to Florida, which has 43 active incentives, but all of which are targeting only a part of the state. The incentive that reaches out to the highest number of households in Florida targets only 52% of total households in the state. Minnesota has the largest number of active incentives with two of those incentives targeting the whole state and rest 53 incentives are targeting only a part of the state. Rhode Island has 2 active incentives, which actually target 3 different states at

the same time. Other states following Minnesota and Florida that have a large number of active incentives targeting part of the state were Indiana, Tennessee, Texas, California, Colorado, Washington, Michigan, and Missouri as shown in Figure 11.

Figure 12 provides information on the percentage of households that are reached by regional incentives. In Connecticut we identified a regional incentive program that reaches out to almost all households. Connecticut has 3 active incentives targeting only part of the state, out of which one incentive reaches 98.9% of the total number of household in the state. There are 12 other states with regional incentives that reach at least 75% of the total state household.

Figure 13 shows the states with active incentives targeting the entire state and their respective state-wide incentive numbers. 31 states had at least one, some states even up to four active incentives that target the entire state.

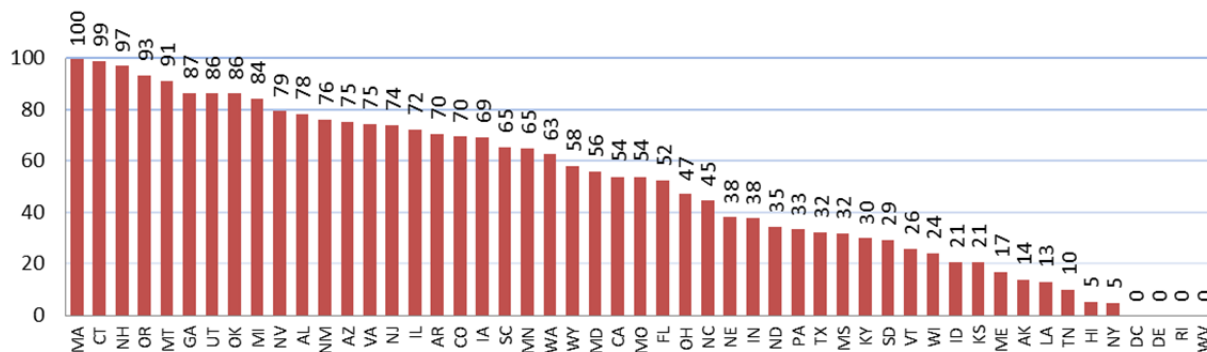


Figure 12. Maximum percentage of households covered by a single incentive targeting only part of each state.

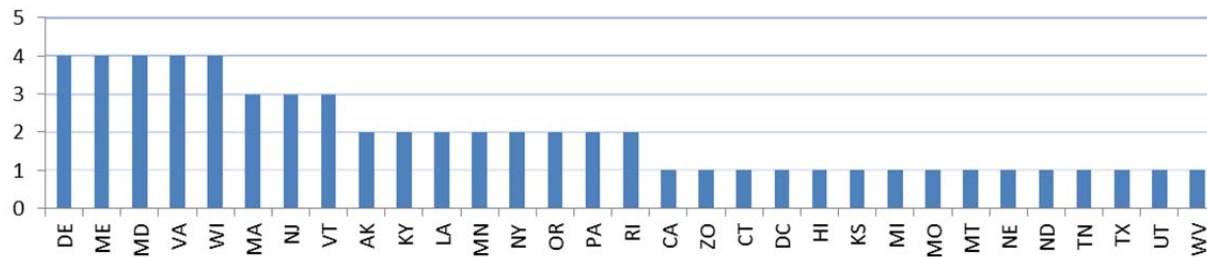


Figure 13. Number of incentives per state targeting the entire state.

## Conclusion

The use of financial incentives, including rebates, to promote a reduction of energy consumption has become increasingly widespread across the 50 states. Each of the 50 states has at least one or more type of individual rebate programs implemented. A detailed analysis at the program and technology level based on a newly developed database parsed from reviewing source data of programs across 50 states has been undertaken in this study. The findings of this study indicated that state policymakers recognize the need for financial incentives to support homeowners in decision-making when they purchase appliances and energy-using equipment. In this national review of incentive programs the following conclusions were found.

## **Distribution by Program Type**

The most commonly observed incentives were Utility Rebate Programs and State Rebate Programs. Utility Rebate Programs have become more prevalent due to their dual function of reducing overall household energy consumption, while at the same time reducing peak demand loads in the power grid, which in turn would require utility companies to increase production capacity and its highly expensive related infrastructure. Manufacturer Rebate Programs, though less commonly used across the U.S., also have their own benefits. They encourage homeowners to invest in energy efficient equipment or retrofit projects through reduced initial cost, which in turn shortens the respective pay-back periods while accelerating the market transformation.

## **Distribution by Energy Resource**

Around 62% of the active incentives and rebates across all 50 states target electrical equipment followed by another 21% targeting natural gas equipment. In additional 10% of all the active incentives promote the adoption of solar energy systems. Based on the figures published in the '*Household Site Fuel Consumption Data 2009 in the U.S.*' published through the U.S. Energy Information Administration, the total consumption of electrical and natural gas is 4.388 and 4.694 quadrillion Btu respectively (EIA 2009b). One reason for the much higher number of active energy efficiency incentives targeting electrical equipment than natural gas equipment may be the stressed power grid infrastructure of electrical power generation and distribution, which can be successfully targeted by a reduction of electrical peak consumption. Currently only 28 out of 50 states in U.S. have at least one active incentive focusing on solar energy. Considering the fast depletion of non-renewable energy resources, it is important that individual state governments as well as local governments implement more incentives and rebates to assist in the reduction of consumption of non-renewable energy and the installation of more renewable energy sources.

## **Distribution by Equipment and Technology**

This study also analyzed the focus of targeted technologies by the different active incentives across the U.S. According to the '*Household Site End-Use Consumption Data 2009 in the U.S.*' 48% of the total household energy usage accounts for space heating and cooling (EIA 2009a). This consumption number matches the findings of this study, where the combined incentives targeting the heating and cooling needs represent 46% of all incentives (25% HVAC systems, 13% building enclosure improvements, and 8% whole building measures). This study also found that 19% of the active incentives across the U.S. focus on hot water heating, which very much relates to the share of 18% of total household energy usage due to water heating published by the EIA (EIA 2009a).

## **Demographic Distribution of Incentive Programs**

Finally, this study analyzed the coverage of the rebate programs by estimating the number of households reached by the various active incentive programs. Fewer than 10% (60 out of a total 748) of the active incentive programs that were available to the individual households of the 50 states targeted the entire population of a state. Most of the incentive programs only reach the households in parts of a state, which can create quite significant regional differences in

the number of available rebates. The actual relevance of the number of available rebates on any change in per capita energy consumption is a relationship that was not addressed in this study and thus will require further investigation.

## Significance

Due to the time consuming process of database development, data mining, and data parsing, this study builds on data available from 2012. With ARA funding and its associated funding channels into state and utility programs coming to an end the landscape of incentive programs is changing again. Nevertheless, the results of this in-depth analysis along with the possible future research queries that can be run against the developed data structure, allow for a variety of future studies, comparing incentive effectiveness and portfolios with efficiency data researched through other studies, such as those published by EIA or ACEEE.

## References

- Alberini, A., and Segerson K. 2002. "Assessing voluntary programs to improve environmental quality " *Environmental and Resource Economics*, 22(1-2): 157-184.
- Austin, C. M., Pande A., and Mahone D. Year. "A study of international appliance standards enforcement strategies " *Proceedings of 2009 International Energy Program Evaluation Conference*, Portland, Oregon, US.
- Banerjee, A., and Solomon B. D. 2003. "Eco-labeling for energy efficiency and sustainability: a meta-evaluation of US programs." *Energy Policy*, 31(2): 109-123.
- Berelson, B. 1971. *Content analysis in communication research*, New York, US: Hafner.
- DSIRE. 2012. "Database of State Incentives for Renewables & Efficiency ". NC State University: Raleigh, North Carolina, US.
- EIA. 2009a. "Household Site End-Use Consumption Data 2009 in US", Energy Information Administration.
- EIA. 2009b. "Household Site Fuel Consumption Data 2009 in US", Energy Information Administration.
- Frondel, M., and Schmidt C. M. 2005. "Evaluating environmental programs: the perspective of modern evaluation research." *Ecological Economics*, 55(4): 515-526.
- Lee, W. L., and Yik F. W. H. 2004. "Regulatory and voluntary approaches for enhancing building energy efficiency." *Progress in Energy and Combustion Science*, 30(5): 477-499.
- Mahlia, T. M. I., Masjuki H. H., Saidur R., and Amalina M. A. 2004. "Cost-benefit analysis of implementing minimum energy efficiency standards for household refrigerator-freezers in Malaysia." *Energy Policy*, 32(16): 1819-1824.

- Norberg-Bohm, V. 2000. "Creating incentives for environmentally enhancing technological change: lessons from 30 years of U.S. energy technology policy." *Technological Forecasting and Social Change* 65: 125-148.
- Schiellerup, P. 2002. "An examination of the effectiveness of the EU minimum standard on cold appliances: the British case." *Energy Policy*, 30(4): 327-332.
- Stemler, S. 2001. "An overview of content analysis" *Practical Assessment, Research & Evaluation*.
- Sutherland, R. J. 2003. "The high costs of federal energy efficiency standards for residential appliances." *Cato Policy Analysis*, 504.
- Weber, R. P. 1985. *Basic content analysis*, Beverly Hills, California, US: Sage Publications.
- Wiser, R., Pickle S., and Goldman C. 1998. "Renewable energy policy and electricity restructuring: a California case study." *Energy Policy*, 26(6): 465-475.
- Wiser, R., Porter K., and Grace R. 2005. "Evaluating experience with renewables portfolio standards in the United States " *Mitigation and Adaptation Strategies for Global Change*, 10(2): 237-263.
- World Energy Council. 2008. *Energy efficiency policies around the world: review and evaluation*. London, UK.