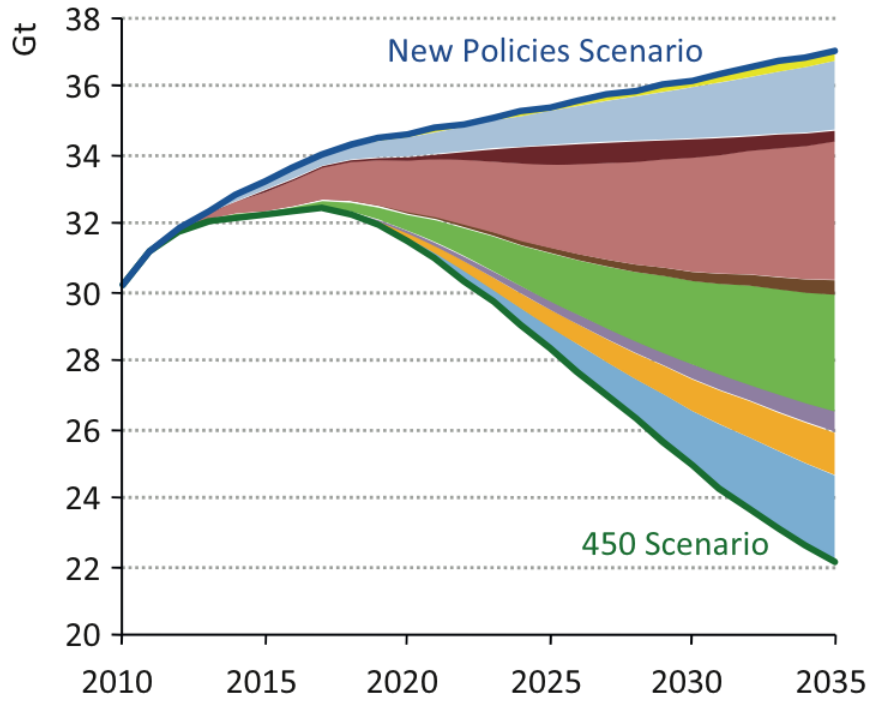
CEGA Evidence to Action
UC Berkeley
April 2013

Energy Efficiency in Mexico

Veronica Irastorza
Center for Environmental Public Policy
Goldman School of Public Policy

According to the IEA about 70% of the potential CO2 abatement in 2020 comes from energy efficiency



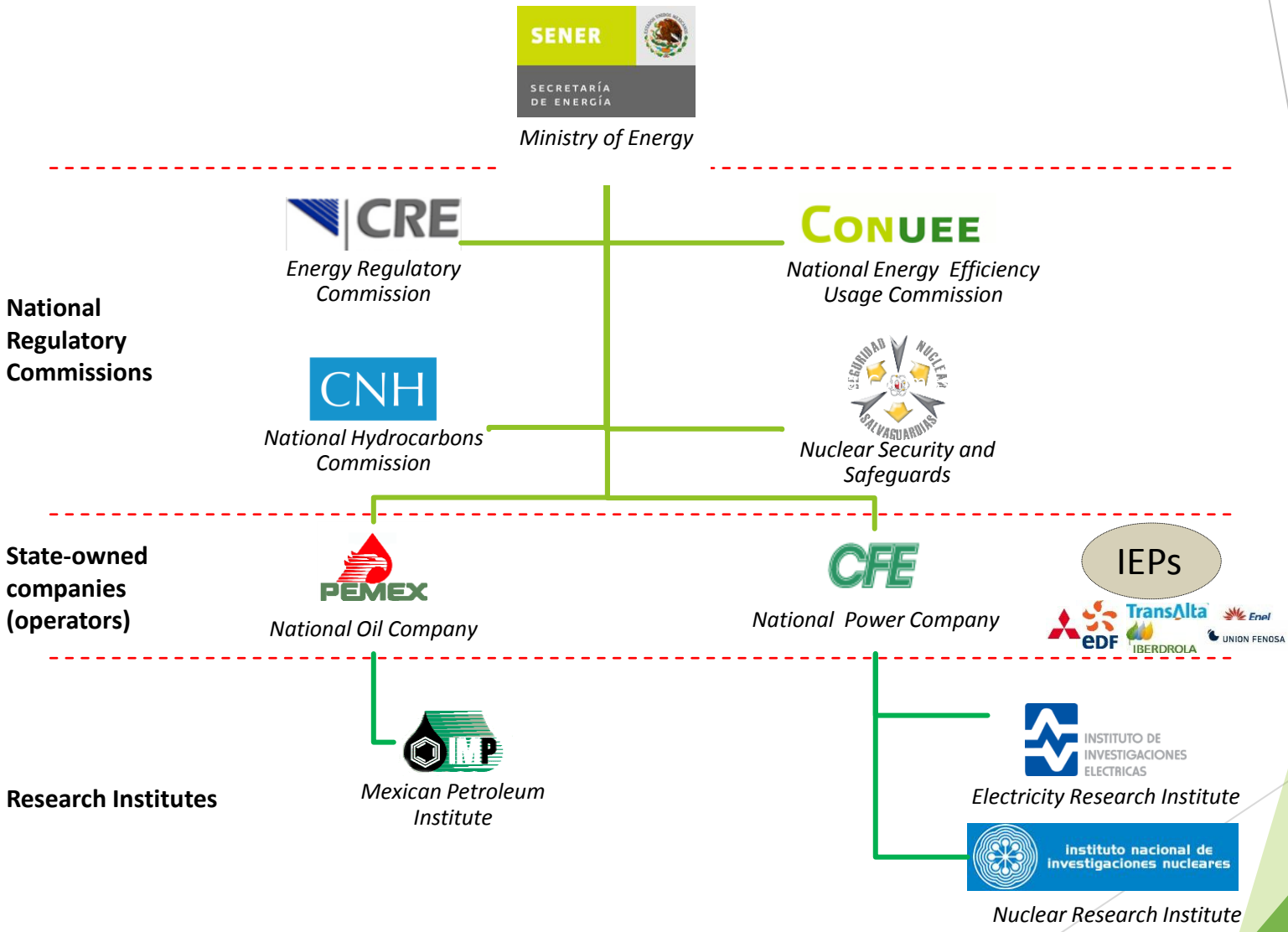
CO_2 abatement	2020	2035
Activity	2%	2%
End-use efficiency	18%	13%
Power plant efficiency	3%	2%
Electricity savings	50%	27%
Fuel and technology switching in end-uses	2%	3%
Renewables	15%	23%
Biofuels	2%	4%
Nuclear	5%	8%
CCS	4%	17%
Total (Gt CO_2)	**3.1**	**15.0**

Source: International Energy Agency, World Energy Outlook, 2011

Developing countries are key

- Also according to IEA, most of the growth in energy demand is expected from developing countries.
- Growth in energy consumption in non-OECD countries 85% vs 18% in OECD countries.
- To support a global population of 9.5 billion in 2050 with average standard of living equivalent to the current US lifestyle would require 16 times the current use (Brown et at, Jan 2011)

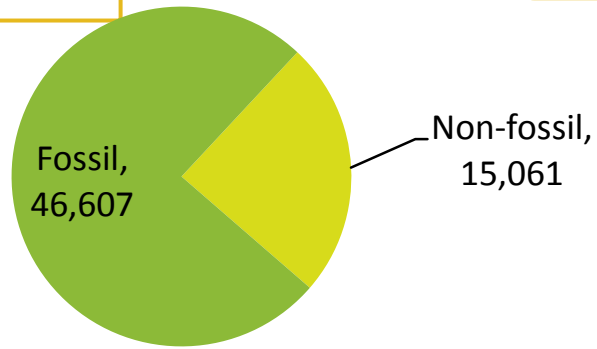
Structure of the Mexican Energy Sector



Electricity

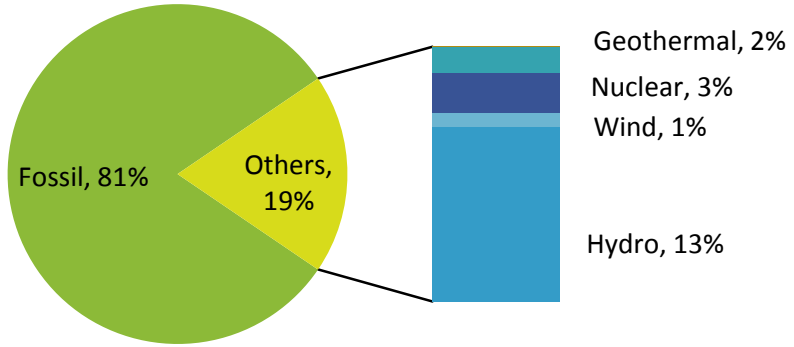
Installed generation capacity 2011
(MW)

25% of the installed capacity is from non-fosil fuels



Capacity: 61,770 MW

Electricity generation 2011
(GWh)



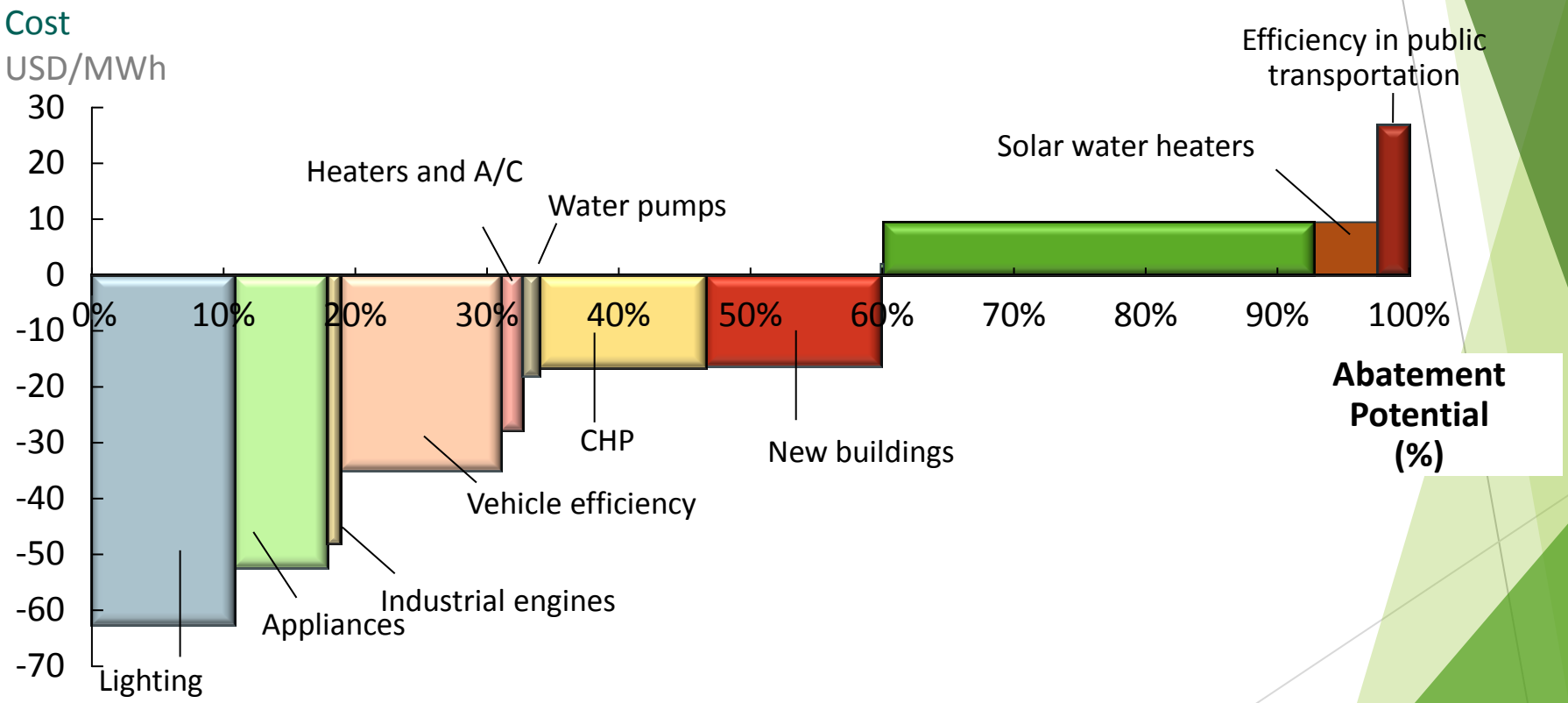
Generation: 291,673 GWh

Source: SENER with CRE, CFE and ANES data.

Energy Efficiency

- Mexico has been moving towards EE through aggressive programs and standards.
- The challenge in Mexico (and many countries) is to end poverty and keep the energy demand low
- There are limited resources that need to be used in the most efficient way
- To prioritize EE support, the Mexican government used a CO2 abatement cost curve

Mexico's Abatement Cost Curve, 2030



Source: SENER (McKinsey and Co.)

Incandescent Light bulb replacement program “Luz Sustentable”

Country	Population (millions)	Time Period	Substituted lamps
Uganda	33.4	2006	800 thousand
Cuba	11.5	2006-2007	9 millons
Spain	40.5	2009-2010	9.4 millons
Mexico	112	2011-2012	45.8 millions

Incandescent Light bulb replacement program “Luz Sustentable”

- Each participant saved $120 USD on their electricity bill.
- The government saved $850,000 USD on avoided subsidies
- Environmental benefits avoided GHG emissions equivalent to take out 600,000 cars.

EE Standard for Lightbulbs

This standard phased out inefficient lightbulbs:

Type	Sales prohibited by
100 watts and up	December 2011
75 watts	December 2012
40 y 60 watts	December 2013

Appliance replacement program “Cambia a tu viejo”

- 1,884,062 old appliances replaced as of Dec 31, 2012.
- Mr. Lucas Davis will discuss this program

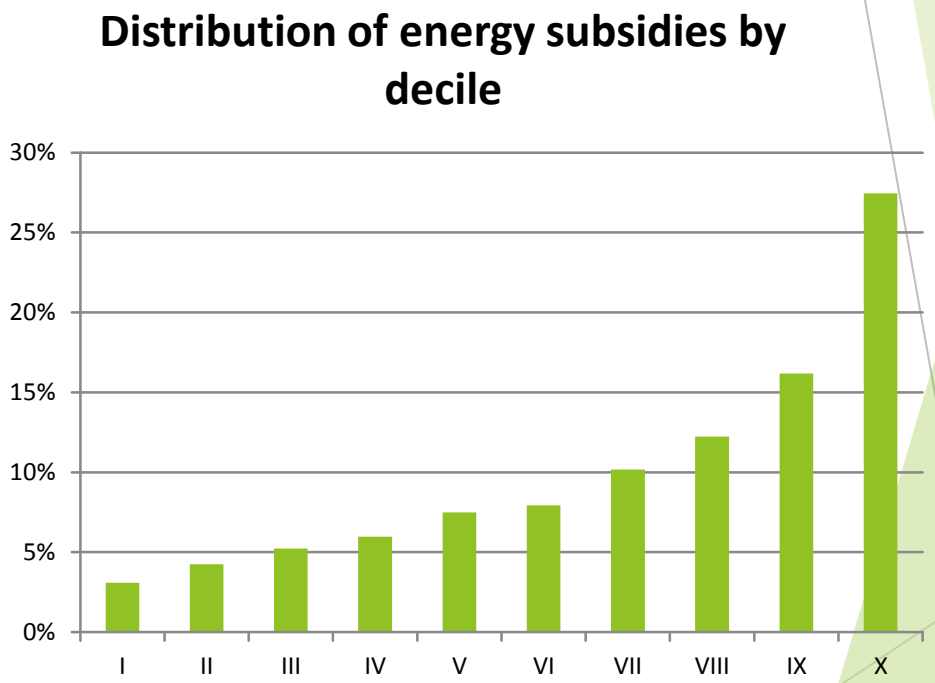
Energy Subsidies

- While doing important EE efforts, the Mexican government gives subsidies to electricity, gasoline and LP Gas.

- Not the best energy pricing signals!

Regressive subsidies

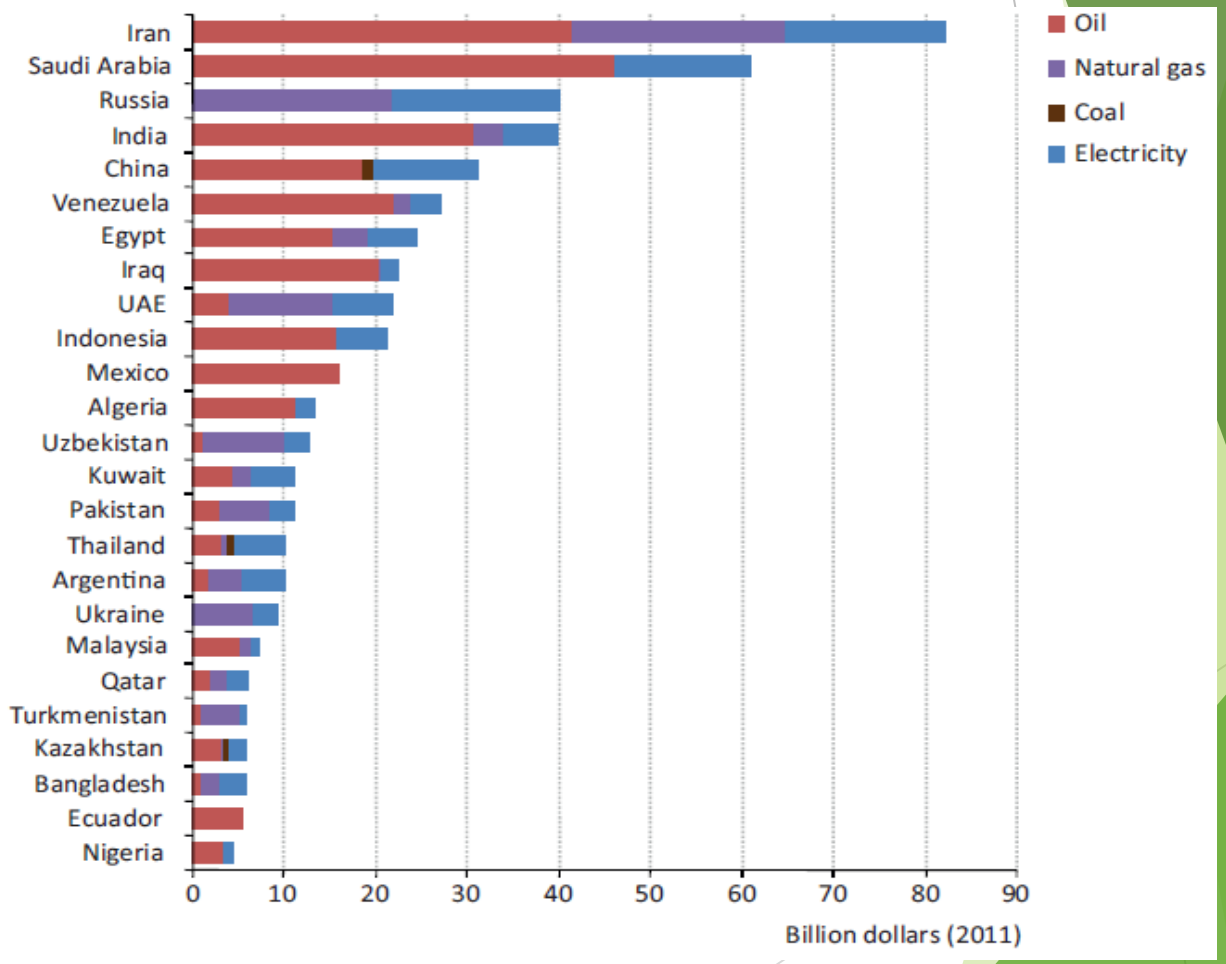
- In 2008, energy subsidies were 10 times more than the cost of Oportunidades and, in 2010, 4 times the cost of all the poverty programs together.
- Gasoline: More than 16,000 million dollars in subsidies in 2012.
- Residential electricity rates cover only 43% of the cost on average (2011). Agricultural rates cover only 31%
- Electric Subsidies to households: 7,000 million dollars in 2011



Source: CIDE

Mexico is not alone

Subsidies for petroleum products, electricity, natural gas and coal reached $480 billion in 2011 (0.7% of global GDP) (IMF, Jan 2013)



Source: International Energy Agency, World Energy Outlook, 2011

What does Mexico need to do?

- Transparent and targeted subsidies.
- Keep investing on energy efficiency, but
- Strengthen the evaluations on energy efficiency programs and standards to get the most bank for the buck

Muchas gracias

Veronica Irastorza

Visiting Scholar

Center for Environmental Public Policy

Goldman School of Public Policy

virastorza@berkeley.edu

Behavioral Response to an Appliance Replacement Program in Mexico

Lucas Davis

Haas School of Business, UC Berkeley

Energy Institute at Haas

CEGA

April 25, 2013

Introduction

Total energy consumption worldwide is forecast to increase 54% by 2030 (EIA, 2012).

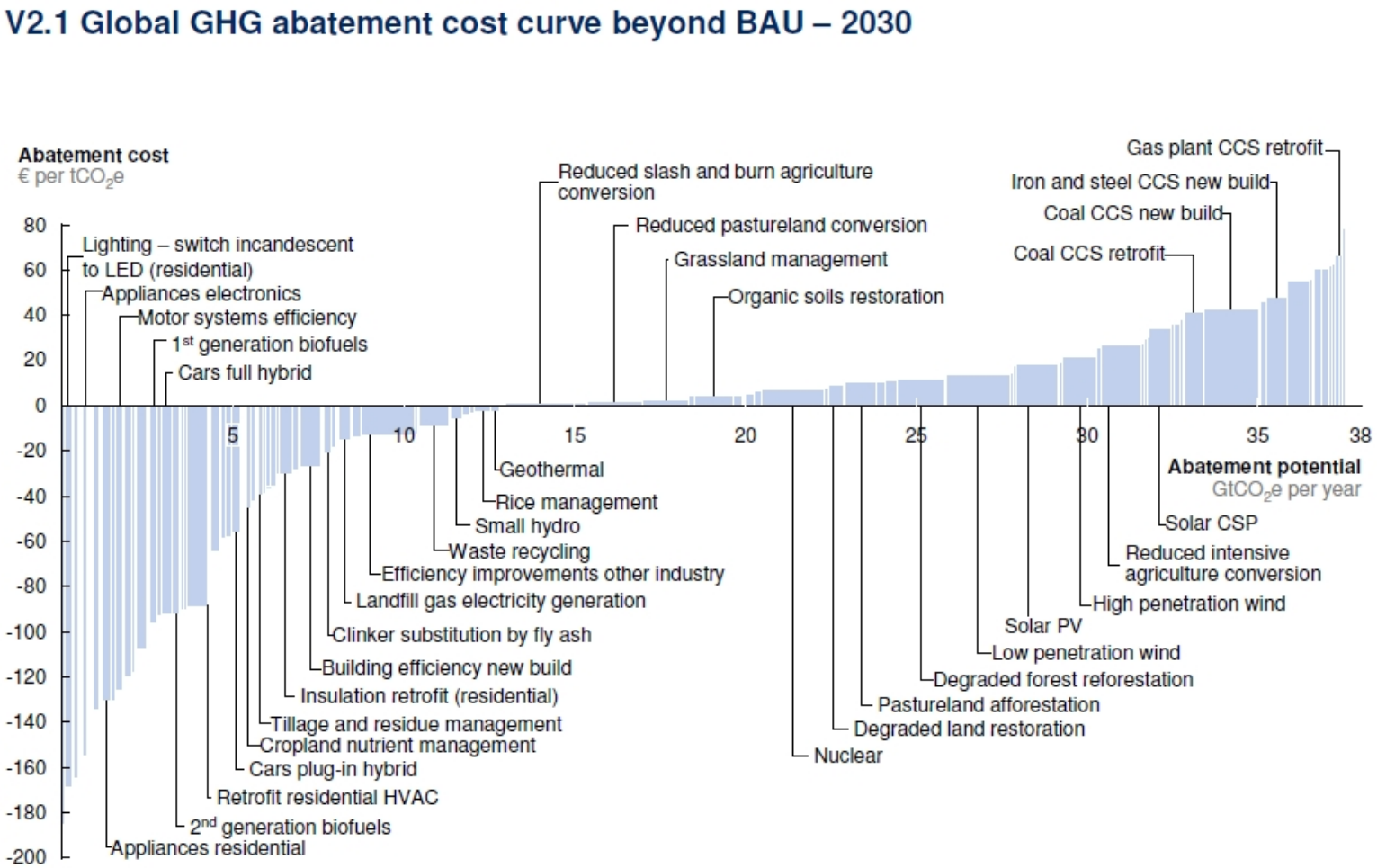
- Most of this growth is forecast to occur in developing countries.
- Meeting this increase in demand will be an immense challenge.

Most economists would like to see a carbon tax, or cap-and-trade program.

Although there has been some progress, most emissions remain unpriced.

Instead, what is receiving much attention is energy-efficiency.

The McKinsey Curve

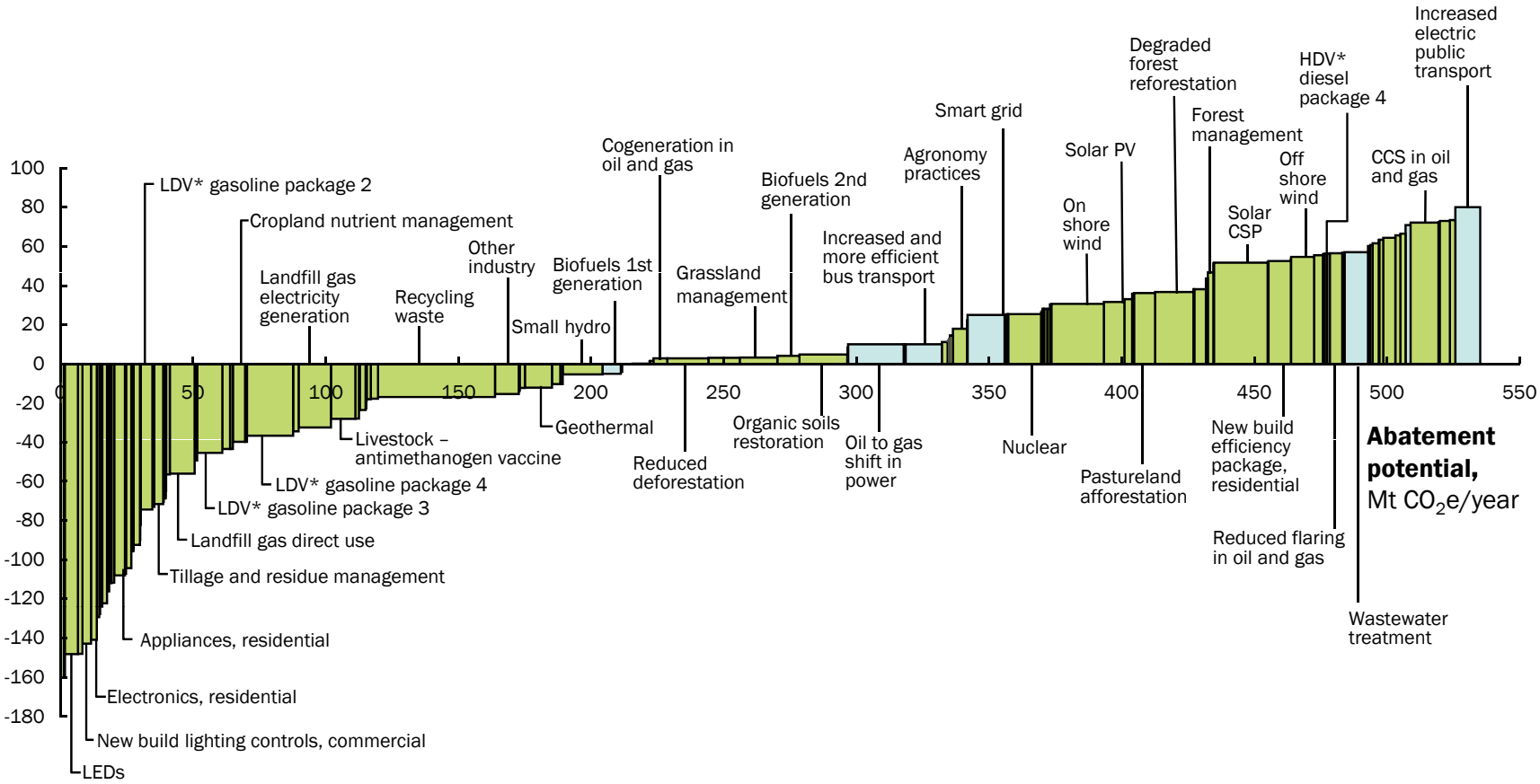


Source: McKinsey and Company, "Pathways to a Low-Carbon Economy", 2010

The McKinsey Curve for Mexico

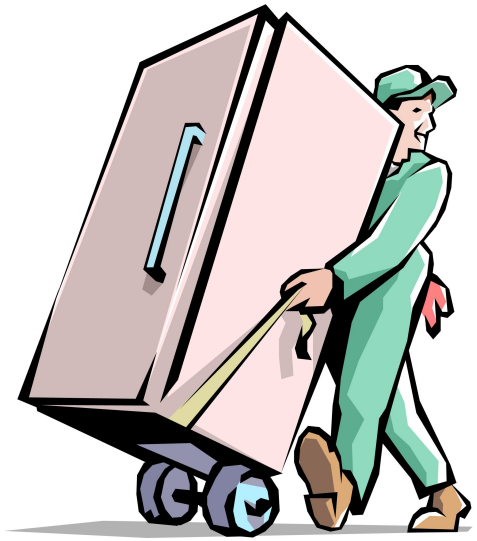
Exhibit 4. National carbon abatement cost curve for Mexico

GHG abatement cost curve for Mexico in 2030
Cost, US$/t CO_2e



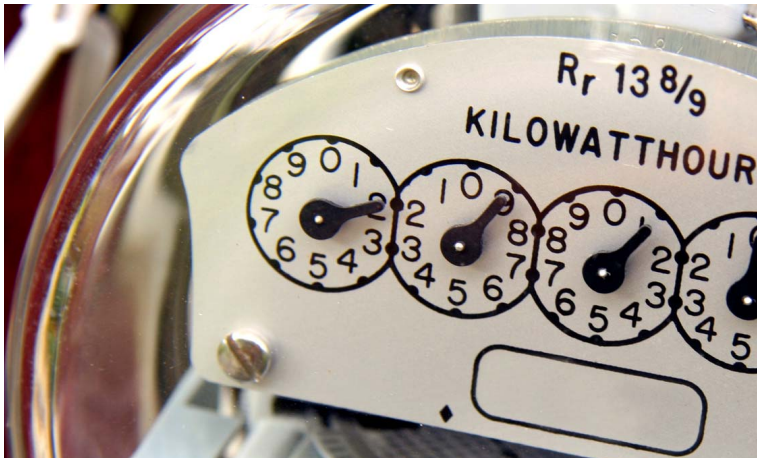
Source: McKinsey and Company, "Low-Carbon Growth: A Potential Path for Mexico", 2009

Program Details



- Nationwide program March 2009 - December 2012
- 1.5 million refrigerators and air-conditioners replaced
- Old appliances had to be 10+ years old
- New appliance must exceed 2002 standard by 5%
- Direct cash subsidies of $30, $110, or $170

Dataset



Household-level electric billing records

- Two-year panel from May 2009 through April 2011
- Bimonthly billing information for 26 million households

Program data about recipients of energy-efficiency subsidies

- About 1 million participants
- Includes date of replacement, appliance type, subsidy amount

Participation Behavior

How does participation change with subsidy amounts?

Our Research Approach

Regression Discontinuity (RD)

Compare behavior just on either side of eligibility thresholds.

Observationally-equivalent households offered different subsidy amounts.

Participation Behavior

How does participation change with subsidy amounts?

Our Research Approach

Regression Discontinuity (RD)

Compare behavior just on either side of eligibility thresholds.

Observationally-equivalent households offered different subsidy amounts.

Participation Behavior

How does participation change with subsidy amounts?

Our Research Approach

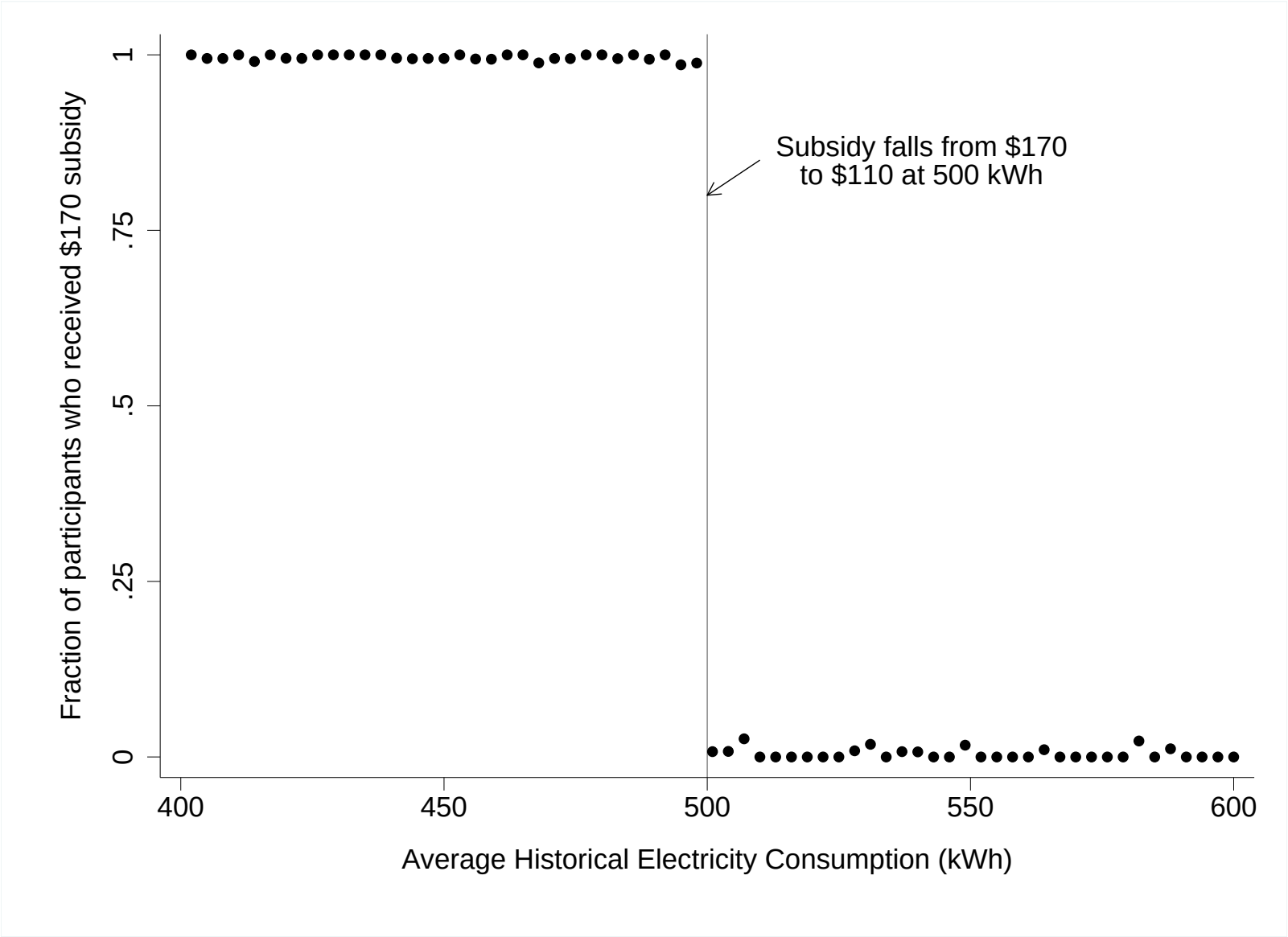
Regression Discontinuity (RD)

Compare behavior just on either side of eligibility thresholds.

Observationally-equivalent households offered different subsidy amounts.

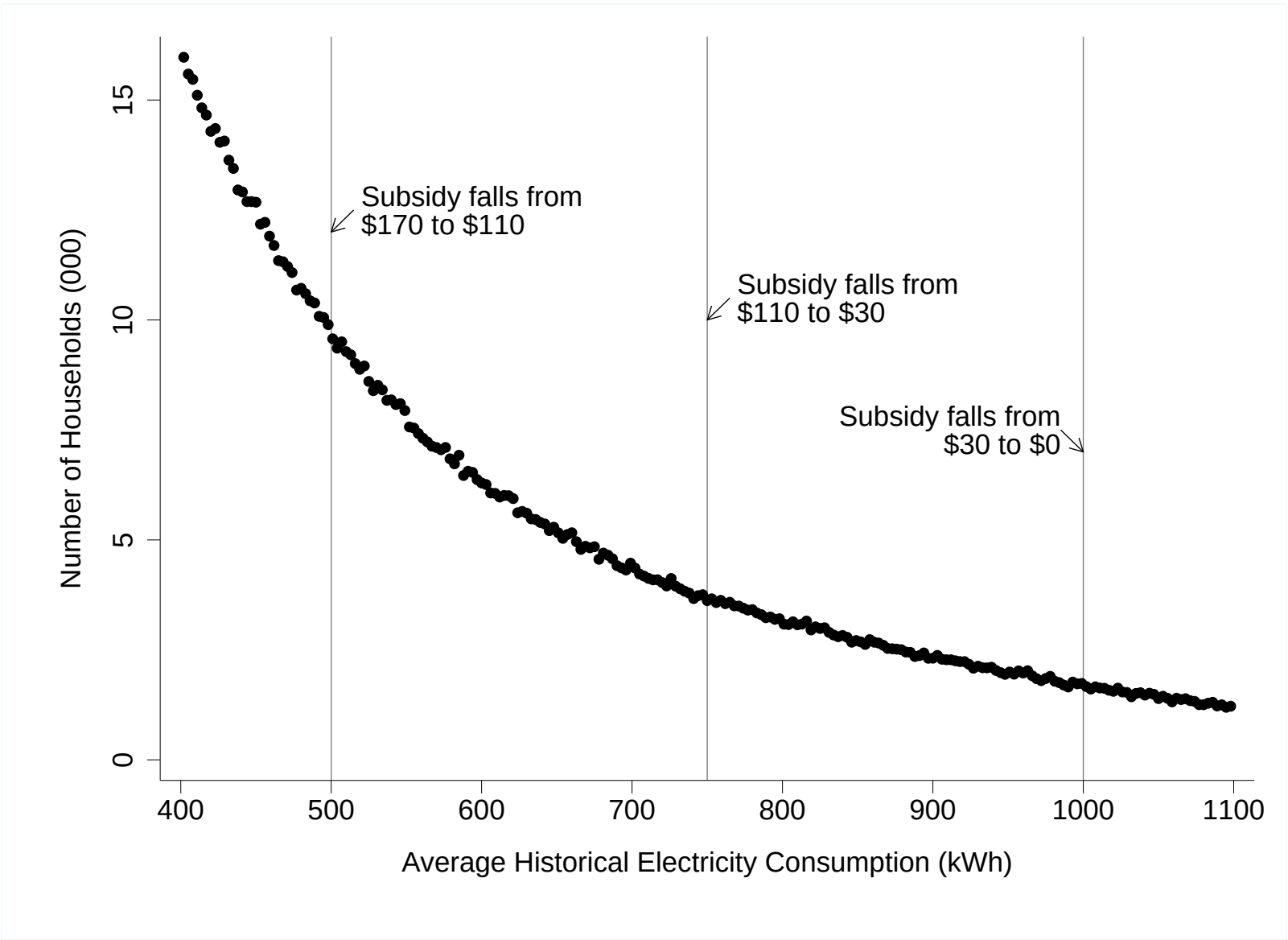
Figure 2: The Discontinuity

Air Conditioners, 500 kWh



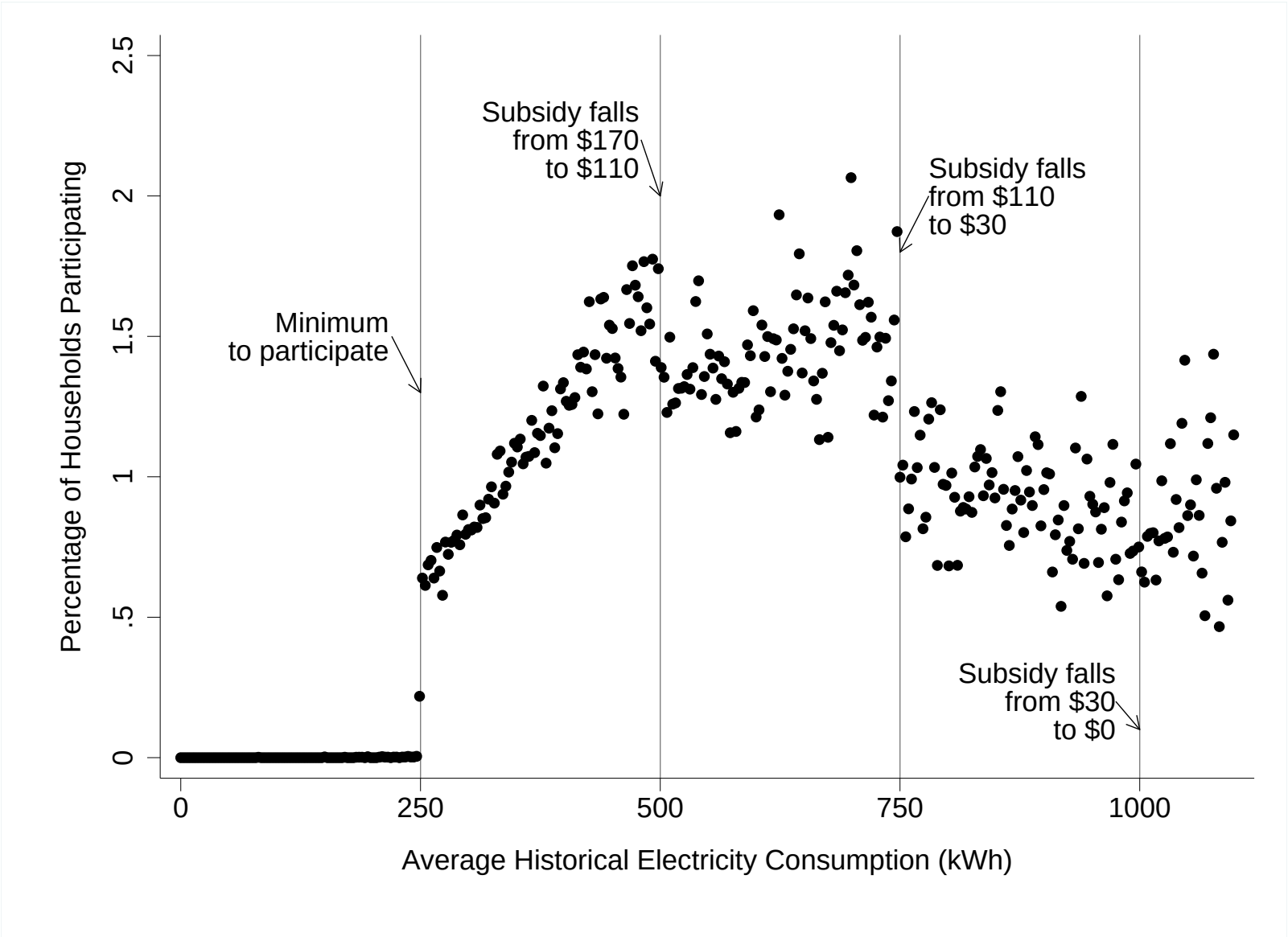
Source: Boomhower and Davis (2013).

Figure 3: Could Households Manipulate Eligibility?



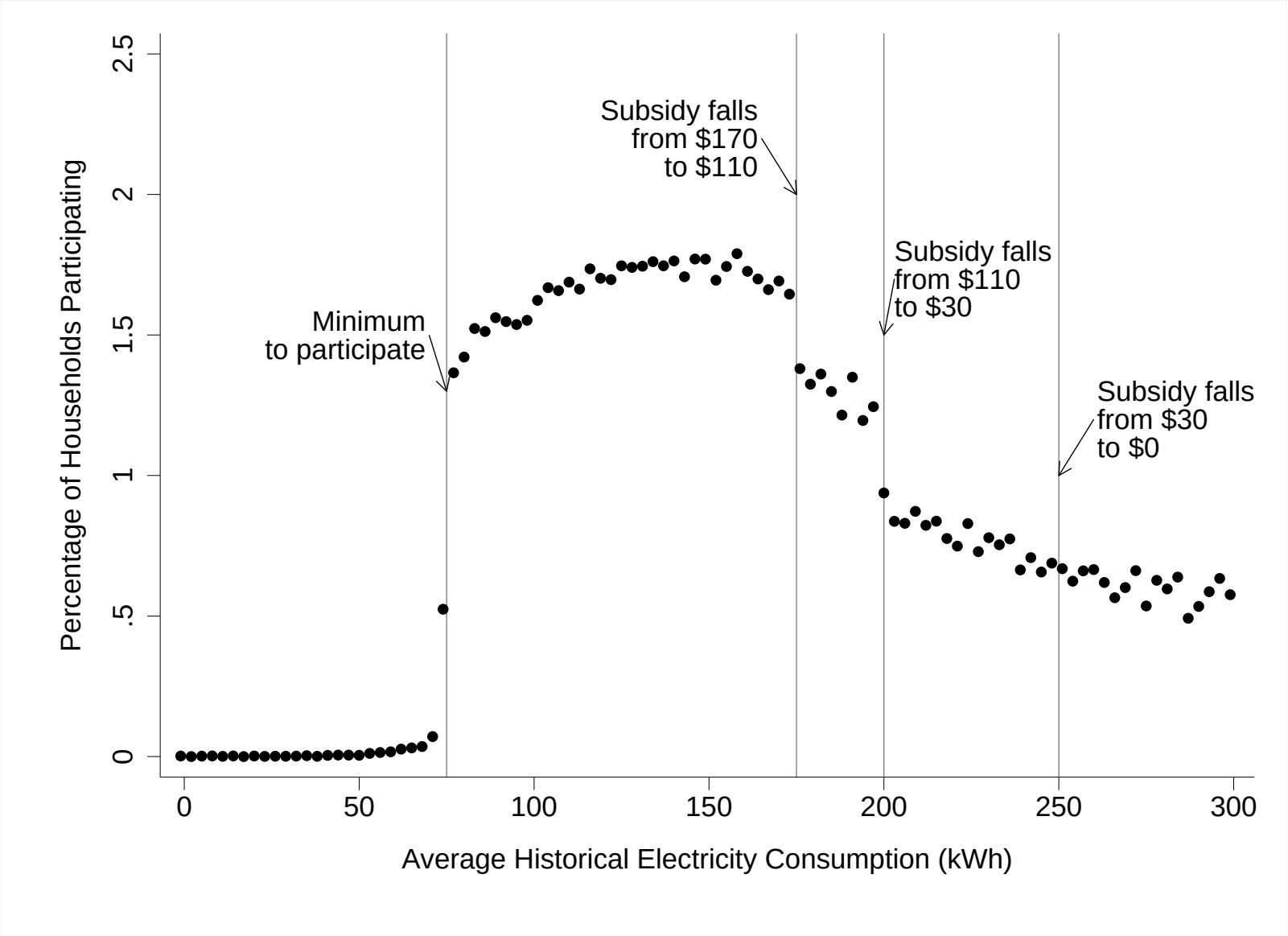
Source: Boomhower and Davis (2013).

Figure 4: Program Participation, Air Conditioners



Source: Boomhower and Davis (2013).

Figure 4: Program Participation, Refrigerators



Source: Boomhower and Davis (2013).

Energy Savings

How much energy did participants save?

How could the programs have been designed to save more?

Our Research Approach

Compare electricity consumption before and after appliance replacement.

Incorporate control groups matched to participants based on location.

Energy Savings

How much energy did participants save?

How could the programs have been designed to save more?

Our Research Approach

Compare electricity consumption before and after appliance replacement.

Incorporate control groups matched to participants based on location.

Energy Savings

How much energy did participants save?

How could the programs have been designed to save more?

Our Research Approach

Compare electricity consumption before and after appliance replacement.

Incorporate control groups matched to participants based on location.

Engineering Estimates of Savings

Residential Refrigeration

Without project assumptions

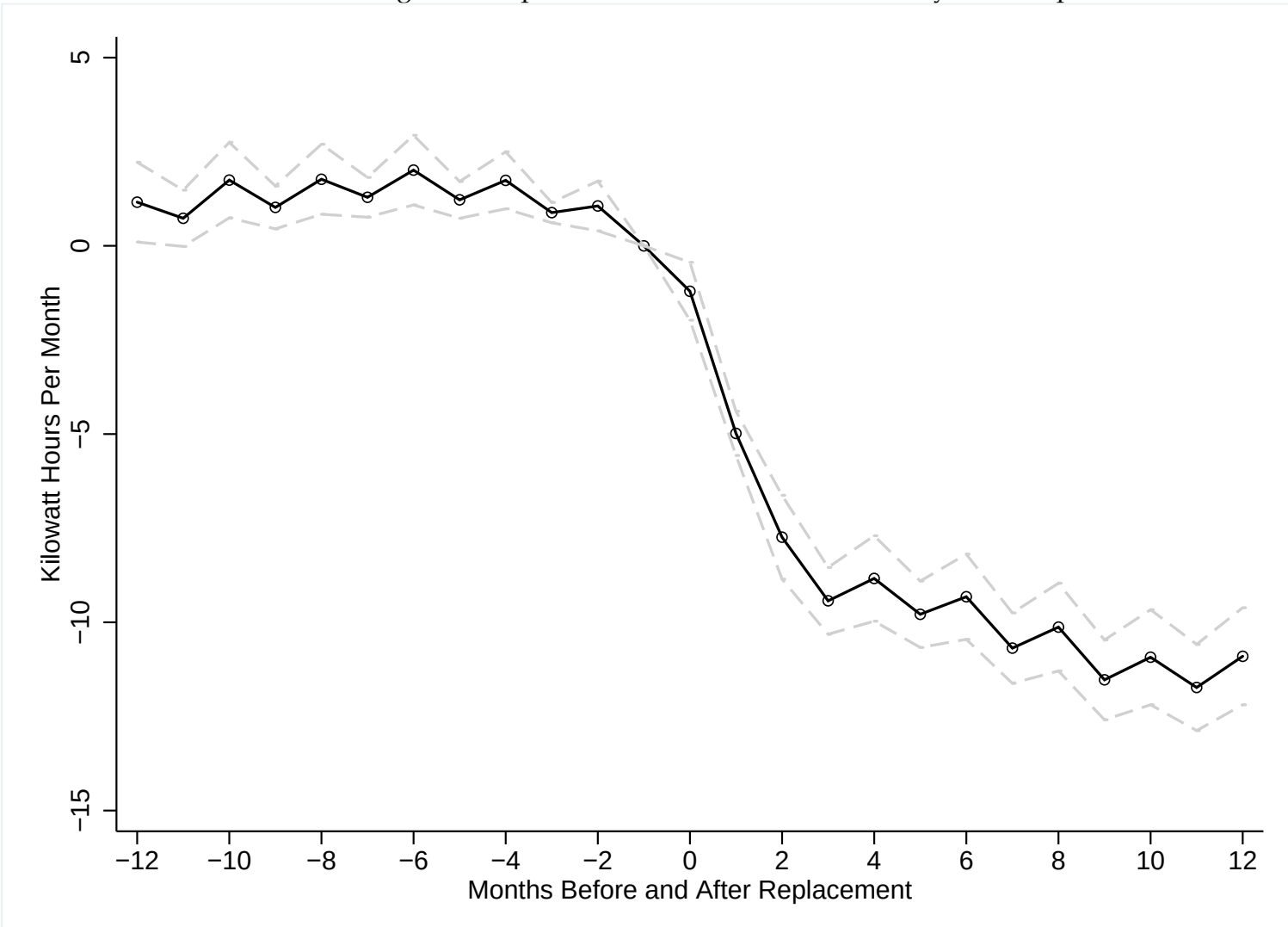
- Energy consumption: 0.850 MWh/year (older refrigerators have higher consumption, of about 1.050 MWh/year, but a large number comply with the 1996 standard)

With project assumptions

- Energy consumption: 0.369 MWh/year

Source: World Bank, "Low-Carbon Development for Mexico', 2009

FIGURE 3
The Effect of Refrigerator Replacement on Household Electricity Consumption



Source: Davis, Fuchs, and Gertler (2012)

FIGURE 5A
The Effect of Refrigerator Replacement by Month of Year

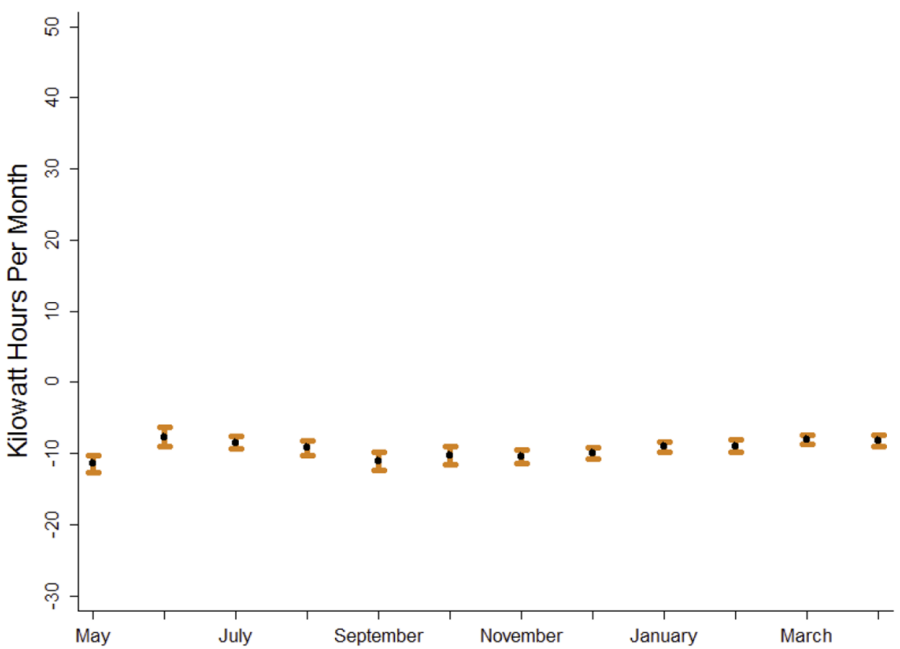
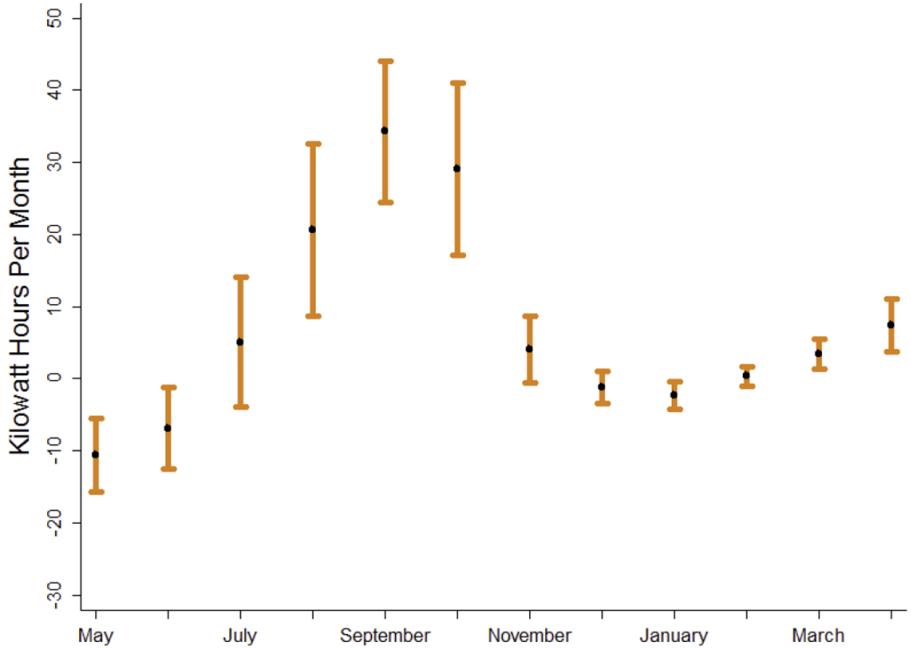


FIGURE 5B
The Effect of Air Conditioner Replacement by Month of Year



Source: Davis, Fuchs, and Gertler (2012).

Interpretation

What is going on?

- Households increased utilization of air-conditioners.
- New appliances tended to be larger and have more features.
- Old appliances tended to be close to the minimum age threshold.

Summary

These studies provide some of the most direct evidence to date on EE subsidies.

Participation

- Most households would have participated even with much lower subsidy amounts.
- So smaller subsidies would have been considerably more cost-effective.

Energy Savings

- Refrigerator replacement saves considerably less energy than expected.
- Air-conditioner replacement appears to actually increase energy consumption.

Urgent Need for More Research

We should be performing analyses like this of all EE programs.

- What about energy-efficient lighting, and other rapidly improving technologies?
- What about other forms of deployment (e.g. standards versus subsidies)?

High-quality microdata is critical.

- These data must be collected and made publicly available.
- "In god we trust, everyone else bring data."

Thank You!

Comments Welcome

ldavis@haas.berkeley.edu