# Behavioral Issues in Environmental and Energy Economics

Lecture 13

ARE 264

March 1, 2022

# Preparing for lecture 14

- bCourses item on WTP (before your read Allcott and Kessler)
- Bring a laptop for evals
- Be ready to discuss Myers, Puller and West
- Be ready to discuss Moscona paper

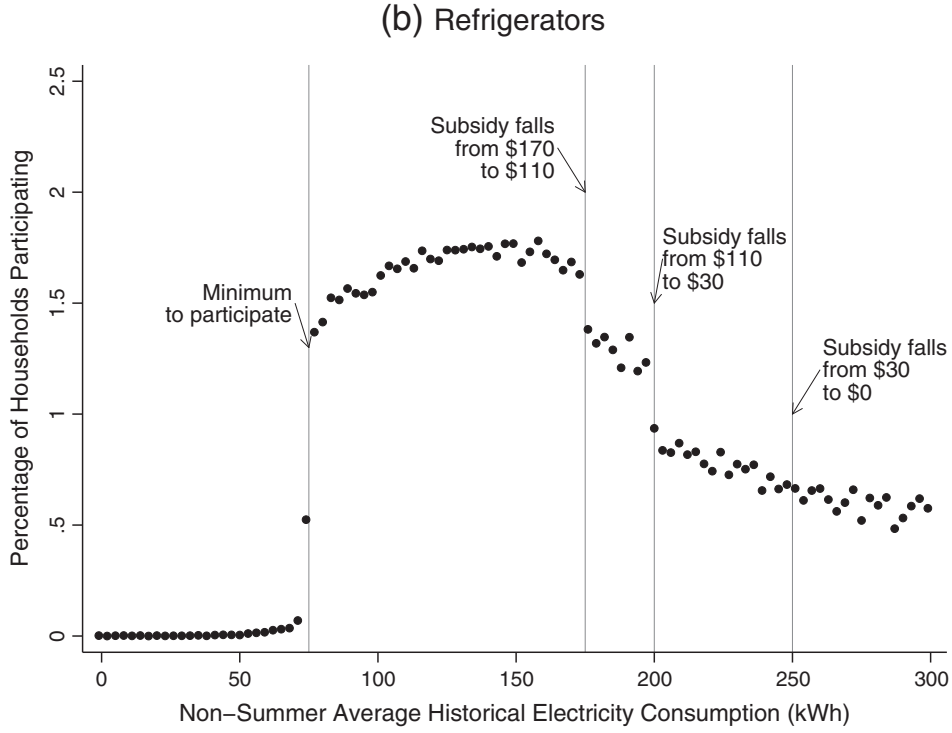



**Fig. 5.** Program participation.

Source: Boomhower and Davis (2014)

- If you have this figure, how do you build a paper?

- Boomhower and Davis (2014) consider how fiscal interactions affect interpretation of inframarginal recipients of green subsidy

- Setup: consumers choose whether or not to adopt energy efficient action
- Adoption yields social marginal benefit

- Question: how do fiscal distortions affect the welfare impact of a green subsidy?

# Recap

- Other market failures
  - Market power
  - Non-marginal cost pricing
  - Co-benefits
  - Behavioral frictions
  - Leakage

- Any of these issues can alter optimal policy to deviate from the Pigouvian prescription
  - Can alter second-best tax rate
  - May cause you to prefer different policy instrument
  - Usually, two problems requires two solutions

- We will spend 2 lectures discussing a range of topics in the intersection of behavioral economics and energy/environmental economics

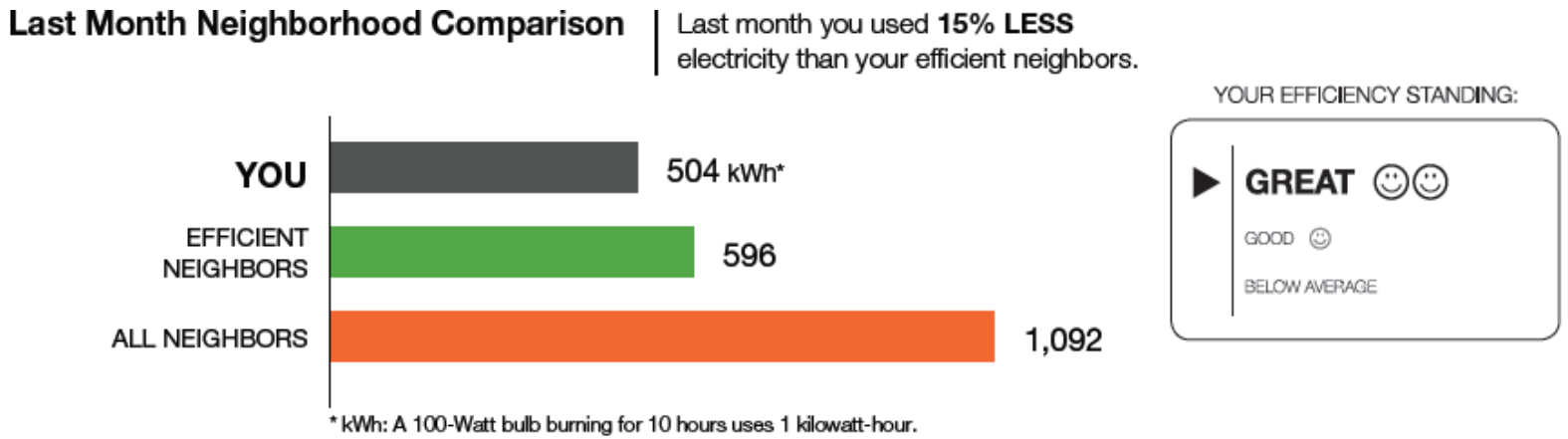
- Main themes will include
  - Nudges
  - Information provision
  - The energy efficiency gap

- Our focus today is on talking about these issues and then asking what questions they raise for research
- We will talk more about example solutions and approaches next lecture

# Outline

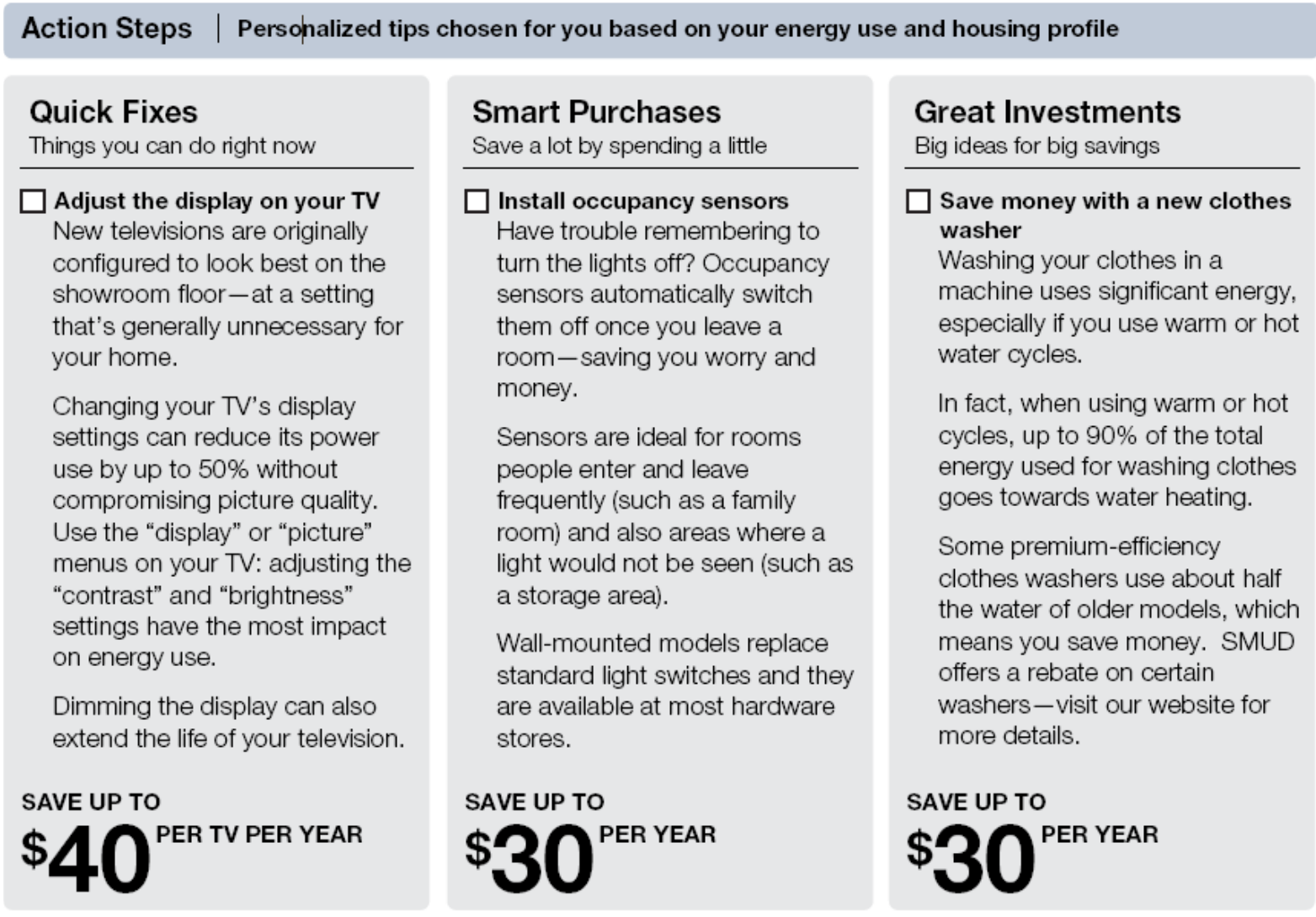
1. **Nudges: implications for research**
   - Nudges raise fundamental questions about welfare interpretation, as well as questions about effectiveness and stability of effects
2. **Information provision: implications for research**
   - With limited rationality, we care not just about providing information, but also how it is provided
3. **Energy efficiency gap: implications for research**
   - Is the gap real or an illusion, and how does that impact policy implications?
4. **How do we model an internality and an externality?**
   - AMT (2014) derives second-best formulas
   - One point to emphasize is the value of targeting around behavioral biases

# Allcott (2009 J Pub E): Social norms




Allcott (2009)

- OPOWER: company conducts randomized control trials
- Some people get comparison rating (smiley faces), others do not
- Compare electricity consumption among those with comparison information and those without
- Overall, estimate a 2% reduction in electricity usage, equivalent to a $\approx$ 20% increase in price



**Action Steps** | Personalized tips chosen for you based on your energy use and housing profile

## Quick Fixes
Things you can do right now

☐ **Adjust the display on your TV**
New televisions are originally configured to look best on the showroom floor—at a setting that's generally unnecessary for your home.

Changing your TV's display settings can reduce its power use by up to 50% without compromising picture quality. Use the "display" or "picture" menus on your TV: adjusting the "contrast" and "brightness" settings have the most impact on energy use.

Dimming the display can also extend the life of your television.

**SAVE UP TO**
**$40 PER TV PER YEAR**

## Smart Purchases
Save a lot by spending a little

☐ **Install occupancy sensors**
Have trouble remembering to turn the lights off? Occupancy sensors automatically switch them off once you leave a room—saving you worry and money.

Sensors are ideal for rooms people enter and leave frequently (such as a family room) and also areas where a light would not be seen (such as a storage area).

Wall-mounted models replace standard light switches and they are available at most hardware stores.

**SAVE UP TO**
**$30 PER YEAR**

## Great Investments
Big ideas for big savings

☐ **Save money with a new clothes washer**
Washing your clothes in a machine uses significant energy, especially if you use warm or hot water cycles.

In fact, when using warm or hot cycles, up to 90% of the total energy used for washing clothes goes towards water heating.

Some premium-efficiency clothes washers use about half the water of older models, which means you save money. SMUD offers a rebate on certain washers—visit our website for more details.

**SAVE UP TO**
**$30 PER YEAR**

Allcott (2009)

- How to interpret: information? social pressure?
- What are policy implications?

# Interpreting the OPower effect

- Common to interpret such peer comparisons as a "nudge"
- A nudge is a situation in which the choice set/prices are not changed, but the environment or framing is changed
- Idea is that rational actor will be unaffected—a nudge that has an effect is proof against homo economicus
  - Default effects are another example (Fowlie, Wolfram, Spurlock, Todd, Baylis and Cappers 2017)

- Welfare effects of nudges generally ambiguous
  - Did reports make people happy? sad?
  - Did people incur significant utility costs to avoid guilt?

- Is this information or "peer effects"? Results consistent with information, or with social pressure (or both)

# Questions inspired by smiley faces

- Are nudges persistent, or more fleeting than price effects?
- What are the welfare implications of nudges?
- If nudges have effects, how do we design optimal nudges?
- Are nudges mostly providing information, or operating around biases?

# For next lecture

- How would you design a study to determine the **welfare effects** of nudges?

- Let's use OPower as an example context. Can you think of a study design to assess the welfare impact of OPower?

1. What are the different ways in which a nudge might affect welfare?
2. What are the different ways that we normally (i.e., not for nudges) assess welfare?
3. What is a research design that would allow us to measure the welfare effects of a nudge?

# Outline

1. **Nudges: implications for research**
   - Nudges raise fundamental questions about welfare interpretation, as well as questions about effectiveness and stability of effects
2. **Information provision: implications for research**
   - With limited rationality, we care not just about providing information, but also how it is provided
3. **Energy efficiency gap: implications for research**
   - Is the gap real or an illusion, and how does that impact policy implications?
4. **How do we model an internality and an externality?**
   - AMT (2014) derives second-best formulas
   - One point to emphasize is the value of targeting around behavioral biases

# Labels, information and choice

- Below are 5 changes in MPG
- Rank them: 1 is the change that saves the most, 2 saves the second most, etc.

| | US units | Metric |
|---|---|---|
| 1. | 16 MPG to 20 MPG | 6.7 km/L to 8.4 km/L |
| 2. | 18 MPG to 28 MPG | 7.6 km/L to 11.8 km/L |
| 3. | 22 MPG to 24 MPG | 9.3 km/L to 10.1 km/L |
| 4. | 34 MPG to 50 MPG | 14.3 km/L to 21.1 km/L |
| 5. | 42 MPG to 48 MPG | 17.7 km/L to 20.2 km/L |

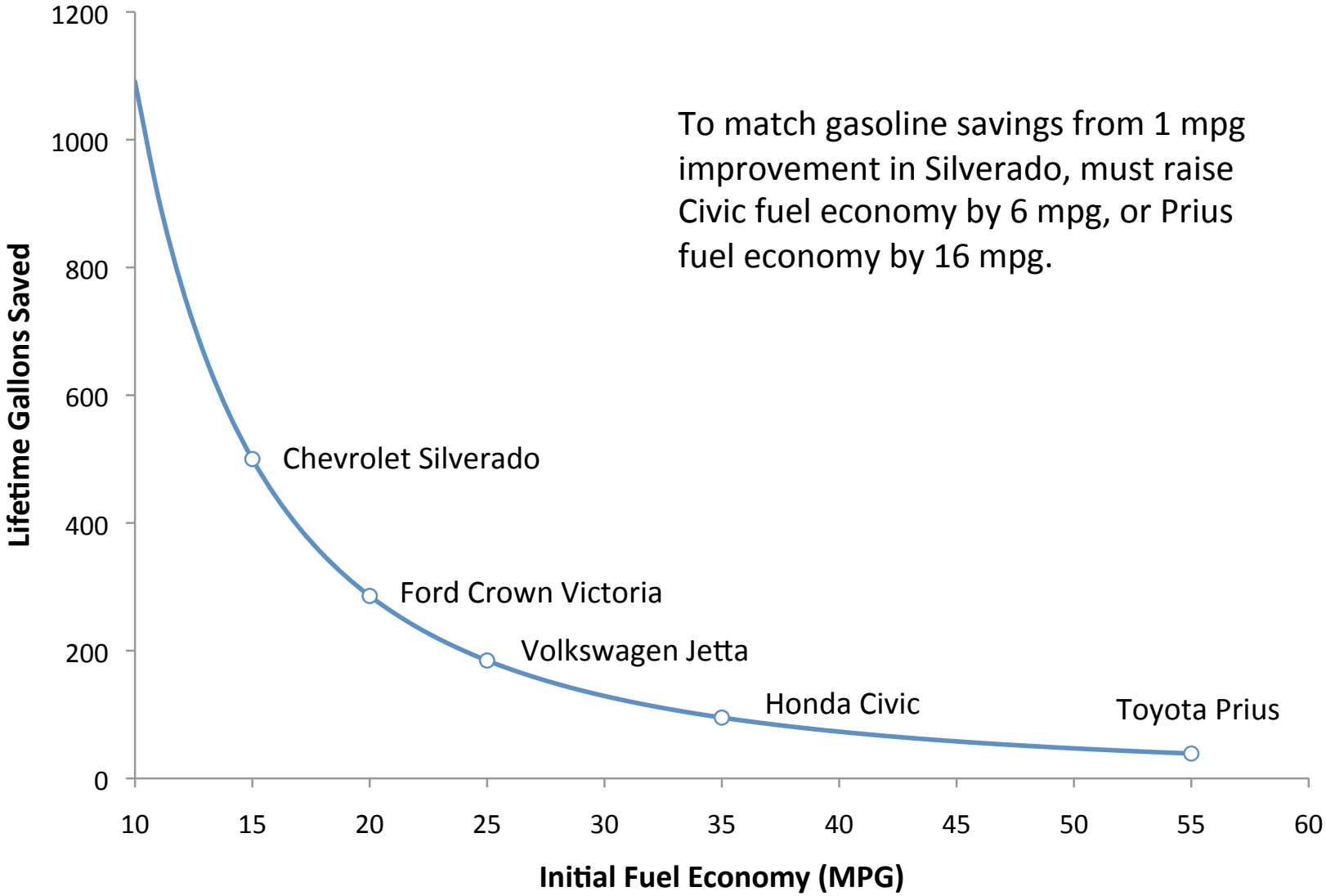
These are the examples used in a lab test in Larrick and Sol (2008).

Lab Results versus Correct Rankings

| Change | Actual Rank | L&S | Savings 10,000 miles |
|---|---|---|---|
| 16 to 20 | 2 | 3.73 | 125.0 |
| 18 to 28 | 1 | 1.95 | 198.4 |
| 22 to 24 | 4 | 4.86 | 37.9 |
| 34 to 50 | 3 | 1.18 | 94.1 |
| 42 to 48 | 5 | 3.29 | 29.8 |

- People estimate that actual savings are largest when the change in MPG is largest
- But, MPG is nonlinearly related to gasoline savings, because $g = \frac{m}{MPG} \Rightarrow \frac{\partial g}{\partial MPG} = \frac{-m}{MPG^2}$
- This systematic mistake called **MPG illusion**

# Lifetime gallons saved by 1 mpg increase in fuel economy




Source: Sallee (2011)

# Questions inspired by MPG illusion

- Are people making major mistakes because they lack information?
- Or, is information available, but it is difficult to process?
- How should we best provide information?

## Economic model of rational actor called *homo economicus*

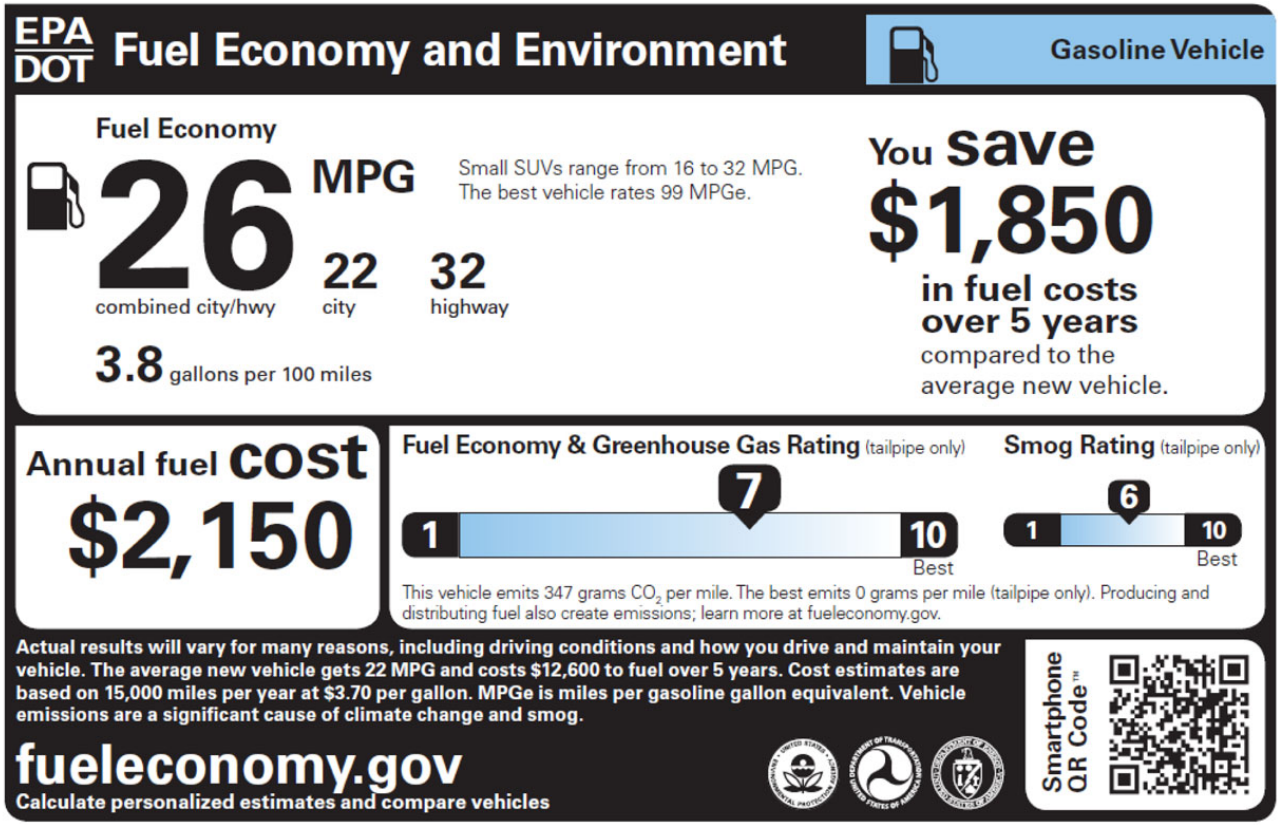
- Rational
- Self-interested
- Atomistic

- My version of homo economicus assumes that they costly process information that they have available, but they may not have all available information

- In behavioral economics, we are fundamentally interested in how people make mistakes. I find it useful to separate mistakes made by homo economicus and those made by homo sapiens

- I suggest that it useful to think of homo economicus and homo sapiens as Spock and Captain Kirk, respectively
  - Spock (rational man, *homo economicus*) may make mistakes because he does not have all information
  - Kirk (emotional, subject to bias, *homo sapiens*) may make mistakes because of a failure to be rational, even given available information

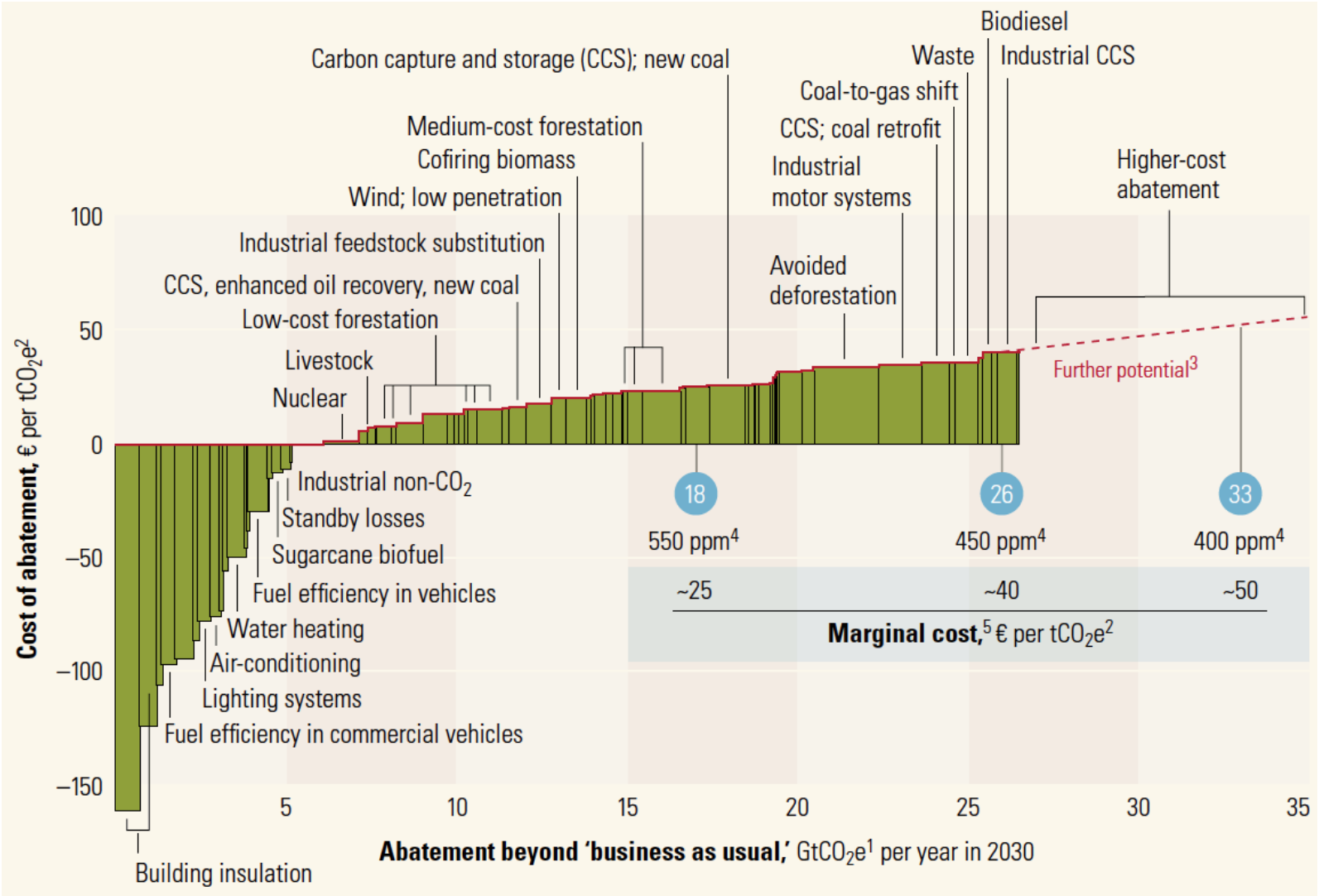
- The reason to make this distinction is to think about whether these two types of mistakes differ in their policy implications
  - If Spock makes mistakes, the solution is to **just provide more information**
  - If Kirk makes mistakes, the solution might involve use pricing incentives, or nudges, or try to **present information differently**, or to make decisions for him (paternalism)




- MPG illusion is a human (Kirk) problem
- The EPA now includes GPM in small font (this is not what marketing experts advised!)
- Do you think this solves the problem?

# Outline

1. **Nudges: implications for research**
   - Nudges raise fundamental questions about welfare interpretation, as well as questions about effectiveness and stability of effects
2. **Information provision: implications for research**
   - With limited rationality, we care not just about providing information, but also how it is provided
3. **Energy efficiency gap: implications for research**
   - Is the gap real or an illusion, and how does that impact policy implications?
4. **How do we model an internality and an externality?**
   - AMT (2014) derives second-best formulas
   - One point to emphasize is the value of targeting around behavioral biases




A McKinsey cost curve

- The **energy efficiency paradox** or **energy efficiency gap** is the observation that apparently negative cost energy efficiency technologies often enjoy low take up in the market

- Prominent interpretations of gap
  1. Principal-agent problems (split incentives, or landlord-tenant problem)
  2. Consumer undervaluation
  3. Engineers are wrong
     - Savings do not occur
     - Other attributes not being held constant (e.g., CFLs suck)

- Note: this list is incomplete; it is my sense of how the issue is most commonly discussed, rather than a comprehensive set of possibilities

**Table 1 EPA's Estimated 2017-2025 Model Year Lifetime Discounted Costs, Benefits, and Net Benefits assuming the 3% discount rate SCC Value[a,b,c,d] (Billions of 2010 dollars)**

| Lifetime Present Value[c] – 3% Discount Rate | |
|---|---|
| Program Costs | $150 |
| Fuel Savings | $475 |
| Benefits | $126 |
| Net Benefits[d] | $451 |

- Main results of EPA's regulatory impact analysis (RIA) of 2017-2025 CAFE standards
- Benefits here means externality
- Costs based on "engineering" estimates of technology deployment

- Punchline: private benefits greatly exceed costs: so why doesn't market do this without policy?
- Note also that private benefits are very large compared to externalities, but this is true mechanically if private costs are larger than social costs!

# Questions from energy efficiency gap

- Is there an energy efficiency gap?
  - Do consumers undervalue energy efficiency?
  - Do energy efficiency technologies deliver predicted gains?
  - Do split incentives stall efficient adoption?
  - Are there other causes of a gap (e.g., supply side failures)?

- If there is a gap, what are the implications for policy?
  - Should corrective tax be changed (i.e., amend Pigouvian prescription)?
  - Does gap imply we prefer a non-price instrument?
  - Does the root cause of a gap determine the policy response?
  - How can we target policies to correct the gap?
  - If there is a gap, why don't market forces lead innovator to profitable solution?

# Outline

1. **Nudges: implications for research**
   - Nudges raise fundamental questions about welfare interpretation, as well as questions about effectiveness and stability of effects
2. **Information provision: implications for research**
   - With limited rationality, we care not just about providing information, but also how it is provided
3. **Energy efficiency gap: implications for research**
   - Is the gap real or an illusion, and how does that impact policy implications?
4. **How do we model an internality and an externality?**
   - AMT (2014) derives second-best formulas
   - One point to emphasize is the value of targeting around behavioral biases

- A common interpretation of the energy efficiency gap is that consumers undervalue energy efficiency, but the empirical evidence is mixed

- Let's suppose that consumers do undervalue energy efficiency

- What does that imply for policies that aim to correct energy externalities, so there is an externality and a behavioral failure at the same time?

- One useful treatment is found in Allcott, Mullainathan and Taubinsky (JPubE 2014) "Energy policy with externalities and internalities"
- Another is Farhi and Gabaix "Optimal taxation with behavioral agents"

# Allcott, Mullanaithan and Taubinsky

- Model binary choice; unit demand for durable; efficient or inefficient
- Durable consumes $e_I$ or $e_E < e_I$ energy per unit of utilization $m$
- Payoff: $u(m) + \epsilon_j + Y - p_g e_j m - p_j$
- $\epsilon_j$ are taste shocks that generate heterogeneity (not in utilization); let $\epsilon$ be difference
- Define $V(\xi)$ as "gross utility gain" from efficient product; excluding heterogeneity, this is payoff for $E$ and $I$ assuming optimized $m$; $\xi = (e_E, e_I, p_g)$
- Consumer will choose efficiency iff

$$V(\xi) + \epsilon > p_E - p_I$$

# Allcott, Mullanaithan and Taubinsky

- Model bias by saying consumer's choice is:

$$\Gamma(V, \xi)V(\xi) + \epsilon > p_E - p_I$$

- Distinguish decision utility and experienced utility
- $\Gamma$ is the "valuation weight"

- Key elements of model:
  - Two market failures: externality and internality
  - Homogeneous externality; heterogeneous internality
  - Utilization margin
- What do these features imply?

- Two market failures and two margins implies two policies are required
- Allow both a tax on energy (gas tax) and a subsidy to efficiency (subsidy for high mpg cars)

- Note: because of heterogeneity, never get first best

- How will tax on energy ($\tau_g$) related to Pigouvian benchmark?
- Proposition 1:

$$\tau_g^* = \phi + \frac{\mathcal{I}_{\tau_g} D_{\tau_g}}{-Q_{\tau_g}}$$

- $\phi$ is marginal externality
- $\mathcal{I}_{\tau_g}$ is the average "marginal" internality (think Diamond)
- $D_{\tau_g}$ is derivative of market share of efficient product
- $Q_{\tau_g}$ is derivative of total energy consumed

## $\tau_g^* > \phi$ under mild assumptions

- Suppose there two types: rationals and myopics
- Raising $\tau_g$ above $\phi$ distorts choice of rationals, even as it helps myopics
- How do we know $\tau_g^* > \phi$?
- Gains to myopics is "first-order" because they are distorted (i.e., pre-existing distortion), whereas initial distortion to rationals is infinitesimal
  - Close analog to O'Donoghue and Rabin

$$\tau_g^* = \phi + \frac{\mathcal{I}_{\tau_g} D_{\tau_g}}{-Q_{\tau_g}}$$

- Who do you think will be marginal?
- As in Diamond model, policy depends on elasticity-weighted average internality
- If myopics ignore price signal, this will be small

$\Rightarrow$ Targeting is key

- Consider gas tax, plus subsidy for efficient product ($\tau_e$)
- Proposition 2:

$$\tau_g^* - \phi \propto \mathcal{I}_{\tau_g} - \mathcal{I}_{\tau_e}$$

$$\tau_e^* \propto \mathcal{I}_{\tau_e} - \mathcal{I}_{\tau_g} \frac{Q_{\tau_e} D_{\tau_g}}{Q_{\tau_g} D_{\tau_e}}$$

- Energy tax exceeds Pigou if it is a better way to target the internality
- Efficiency subsidy depends on how well it targets myopics

# Targeting

- The problem with price instruments is that they will (generally) affect everyone
- But, with internality, not everyone should be given incentive

- Information, nudges may be much better at targeting than prices/regulation
- Note: this is directly analogous to Diamond model of heterogeneous externalities

# Outline

1. **Nudges: implications for research**
   - Nudges raise fundamental questions about welfare interpretation, as well as questions about effectiveness and stability of effects
2. **Information provision: implications for research**
   - With limited rationality, we care not just about providing information, but also how it is provided
3. **Energy efficiency gap: implications for research**
   - Is the gap real or an illusion, and how does that impact policy implications?
4. **How do we model an internality and an externality?**
   - AMT (2014) derives second-best formulas
   - One point to emphasize is the value of targeting around behavioral biases