

Behavior and Energy Efficiency (More Questions than Answers)

James L Sweeney

Professor, Management Science and Engineering

Director, Precourt Energy Efficiency Center

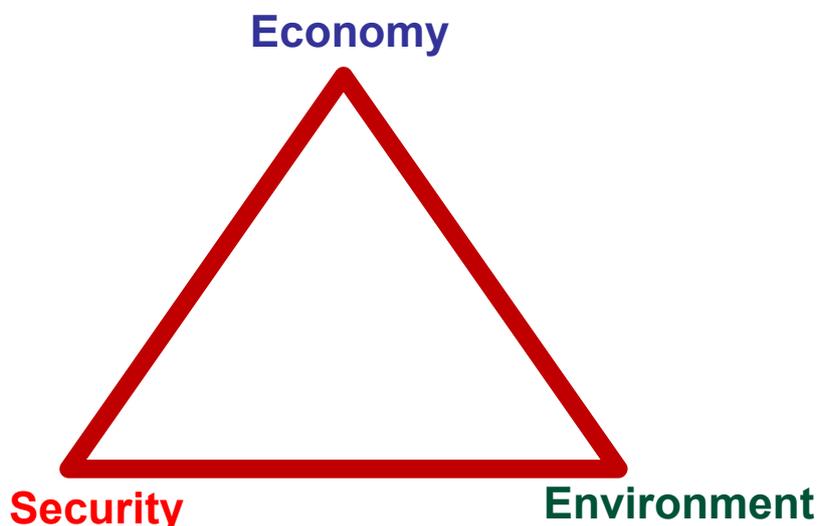
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What Goals Guide Japanese Energy Policy?

- What are, or should be, the goals for Japan or other Asian countries?
 - In US, energy policy triangle
 - In Japan, same issues? What are tradeoffs?



2

What is Technical Energy Use Reduction Potential?

- What is the technical potential to reduce energy use in a way that appropriately balances the goals?
- How far is Japan from that potential?
 - Consumers? Industry? Commercial Buildings? Transportation? City Infrastructure?
- How costly might it be to reduce energy use – if you can motivate people to do so?
- Is there a readily accessible database on energy use patterns in Japan that can be easily used by researchers through Japan?
 - For example, see Energy Information Administration web pages: www.eia.gov/consumption/

Does “Energy Efficiency Gap” Exist in Japan?

- “Energy efficiency gap” exists IF:
 - Consumers and businesses use more energy than is optimal in their own self interest
- Why can “energy efficiency gap” exist?
 - Poor information about electricity rates and use
 - Electricity does not have obvious price tags
 - Limited feedback from use to cost
 - Limited information at point of equipment purchase
 - Low salience of energy issues for households
 - Small fraction of income ; many small decisions; poor information for decision making
 - Poor information about co-benefits of energy efficiency
 - E.g., Natural lighting increases productivity
- Is “energy efficiency gap” important problem in Japan?

How Can Metering and Feedback be Used?

- **Feedback (immediate information linked to decisions)**
 - Smart meters, sensors, energy information devices
 - How can one provide feedback to consumers that will motivate consumers to cost-effectively reduce electricity and natural gas use?
 - Do you need active disaggregated feedback?
 - How do you make the response long term, rather than just lasting over a few months?
 - Some video games keep players coming back for years.
 - Are there any lessons from those games?
 - How can dopamine response be triggered?

What Information Leads to Large Response?

- **Some feedback on impacts other than personal financial costs may be more effective than on financial costs.**
 - Residential field experiment in Los Angeles gave feedback on environmental harms, in particular external health impacts of electricity consumption (Magali Delmas)
- **Can comparison of energy use with other people in similar homes motivate energy use reductions, for those who use large amounts of energy?**
 - In US: OPower mailings (Hunt Allcott research)
 - Single mailing: very low persistence
 - Monthly or quarterly mailings over long period: Persistent reductions

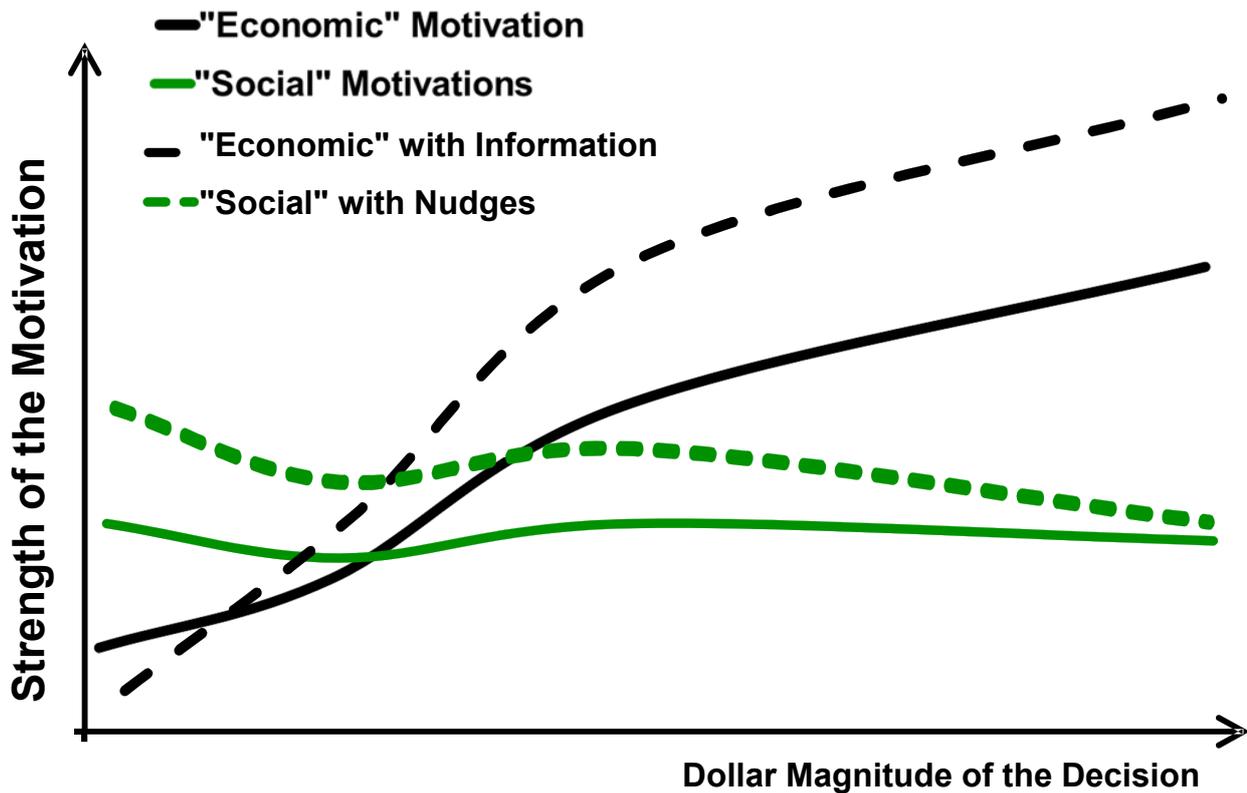
Can Social Norms be Effective in Japan?

- **Social norms**
 - Can social media be harnessed for comparisons of energy use among people?
 - Can social value of not wasting be communicated and harnessed?
 - Can energy reduction competitions be structured among friends? Can these be effective?
 - How would you motivate people to initiate such competitions.

Economic Information versus Social Nudges

- For low financial cost, economic information may not motivate change.
- For large financial cost, economic information may be crucial for energy use decisions.
- Social nudges may work across the entire spectrum
- For what ranges of outcomes does economic information provide best motivation and for what range will social nudges provide best motivation?
- Under what circumstances will financial information undercut social nudges?

Conceptually: Social vs Economic Motivations



Can New Business Models Be Created?

- **New Business Models**
 - **Shared benefits from energy efficiency contracts**
 - Measurement and validation hard
 - Difficult to create enough trust – two way problem.
 - **Distributed renewables can be rented to homeowner, rather than sold.**
 - **Organizations can finance energy efficiency capital improvements. Repayment obligation legally and credibly remains with property, if property sold.**
 - In US: PACE program (Property Assessed Clean Energy). Repayment through property taxes
 - Other programs repaid through utility bills.

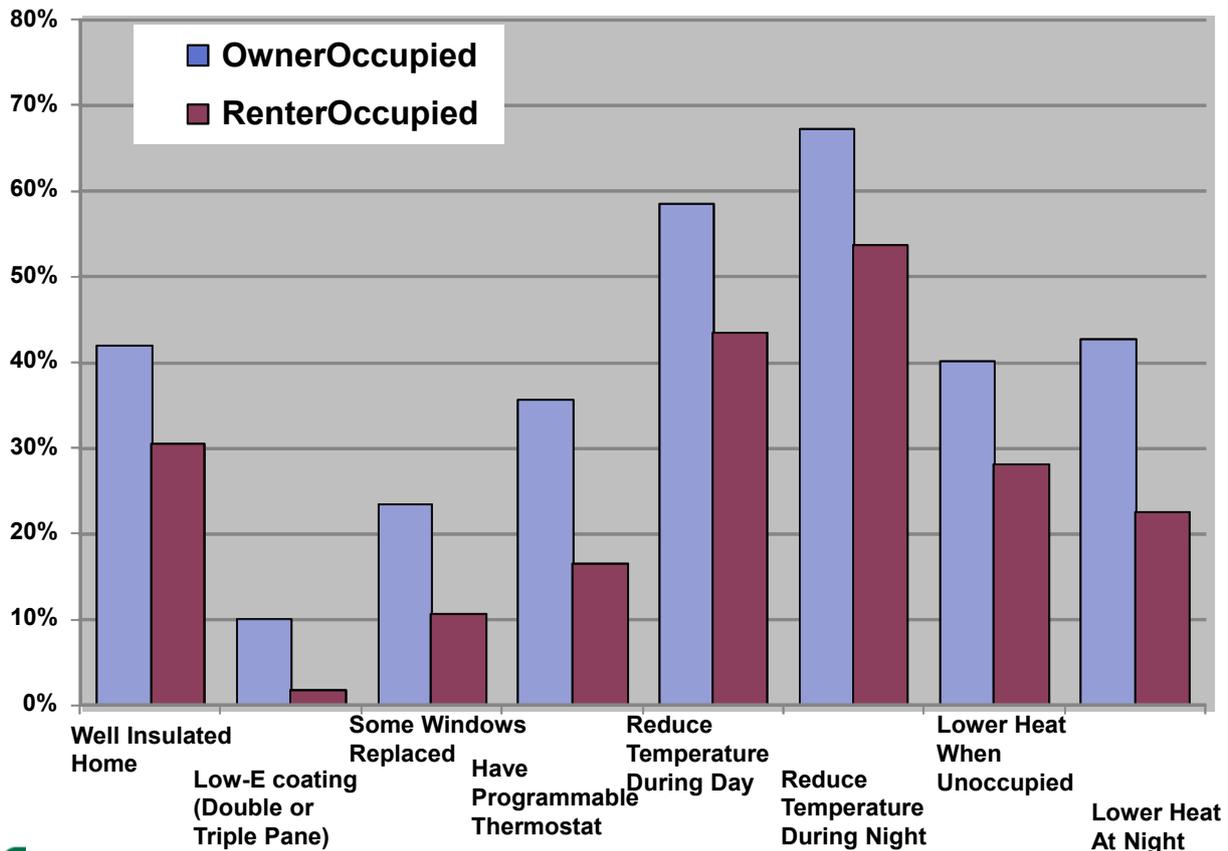
Can Japan Design Stochastic Rewards?

- **Stochastic Rewards**
 - Balaji Prabhakar congestion experiment with Infosys in Bangalore, India. Goal: incentives for Infosys commuters to travel at uncongested times
 - Infosys employees given one chance for one month extra salary if they took bus one half hour before rush hour, two chances for one hour earlier.
 - Expected value (value multiplied by probability) per half-hour-early trip was 20 rupees – 40 US cents.
 - Roughly 15% of employees decided to come one-half hour or one hour early.
 - Similar system, but much smaller rewards, used to change commuting times to Stanford
 - Can stochastic reward systems be designed in Japan?

Are Split Incentive Problems Important in Japan?

- **Split Incentive (Principal/agent) problems**
 - Rental housing
 - Television set top box provided with cable service

US Homes With Efficient Technologies or Behaviors



Source: Calculated from the 2005 RECS survey, by Anant Sudarshan

Can split incentive problem be solved with good information?

- Commercial or residential building performance rating and rating disclosure.
 - Mandatory disclosure laws in California enforced at time of major financial transaction
- Green Building Certificates
 - LEED certification
- Or are regulations needed?
 - Building codes
 - Appliance efficiency standards

Do Implicit Incentive Systems in Companies Lead to Overuse of Energy?

- Corporation organization – energy as overhead
 - Managerial incentives: what you don't measure you don't manage. Typically no incentive to manage overhead items.
 - Could internal information systems provide effective internal controls?
- How can companies create social nudges for energy efficiency?
 - “Energy Citizens”

When Electricity Markets are Liberalized, Will Utilities have Incentive for Energy Efficiency?

- In some of US there is decoupling of net revenue from sales. Less sales does not decrease profits.
 - True-up annually of rates.
 - Reduced sales implies under-recovery of fixed costs; Under-recovery account; rate increase for next year
 - Increased sales implies over recovery; Over-recovery account; rate decrease for next year
- Can go further
 - Allow earnings on successful energy efficiency programs. How large should incentive be?
 - Earnings based on net benefit: electricity cost savings net of program and capital costs
- What systems could work under electricity markets to be liberalized in Japan?

What are Tradeoffs in Rate Structure Design?

- Time-independent pricing in typical retail rates
 - Dynamic pricing
 - Several degrees of dynamic pricing possible
 - Risk-reward tradeoffs

	Economic Efficiency (Net Expected Economic Value)	Risk to Customer
Flat Pricing	↓	↓
Seasonal Pricing		
Time of Use Pricing		
Critical Peak Pricing		
Dynamic Pricing		
Dynamic Pricing with hedging contracts		↑

Can Insights be Derived from Other Areas?

- Medical practice in the US includes dealing with behavioral choices that have health consequences
 - Eating behavior
 - Exercise
 - Stress management
 - Smoking, drinking
- Many of these involve low saliency activities.
- Cross-fertilization from the medical field could be very valuable.
 - Case study: reduction of smoking in US over time
- Marketing and Advertising
 - Much social science research underlies practices

Are Rebound Effects Important?

- **Increases in efficiency of energy use have direct effect: reduce energy use. But reduced cost of energy-using services leads to behavioral response: people use more of these services and thus more energy.**
- **Is behavioral response large enough to eliminate or greatly reduce direct effect?**
- **If so, how can one design policies to overcome that issue?**

How Big are Rebound Effects?

- **Substitution: people may use more energy services because efficiency of energy-using services increases**
 - **E.g.: More efficient air conditioners motivate people to cool their homes more**
 - **Small to modest for most household applications (~10-30%); Smaller with fixed cycles (e.g. refrigerators)**
 - **How large in industry?**
- **Re-spending effect: money saved with energy efficiency is spent to buy other goods, thus increasing energy use.**
 - **Effect may be from 5% to 15% of the savings, after substitution effect is accounted for.**
- **Other effects: Probably insignificant**
- **Net energy reduction of energy efficiency: Most likely 60% to 85% of direct reduction**