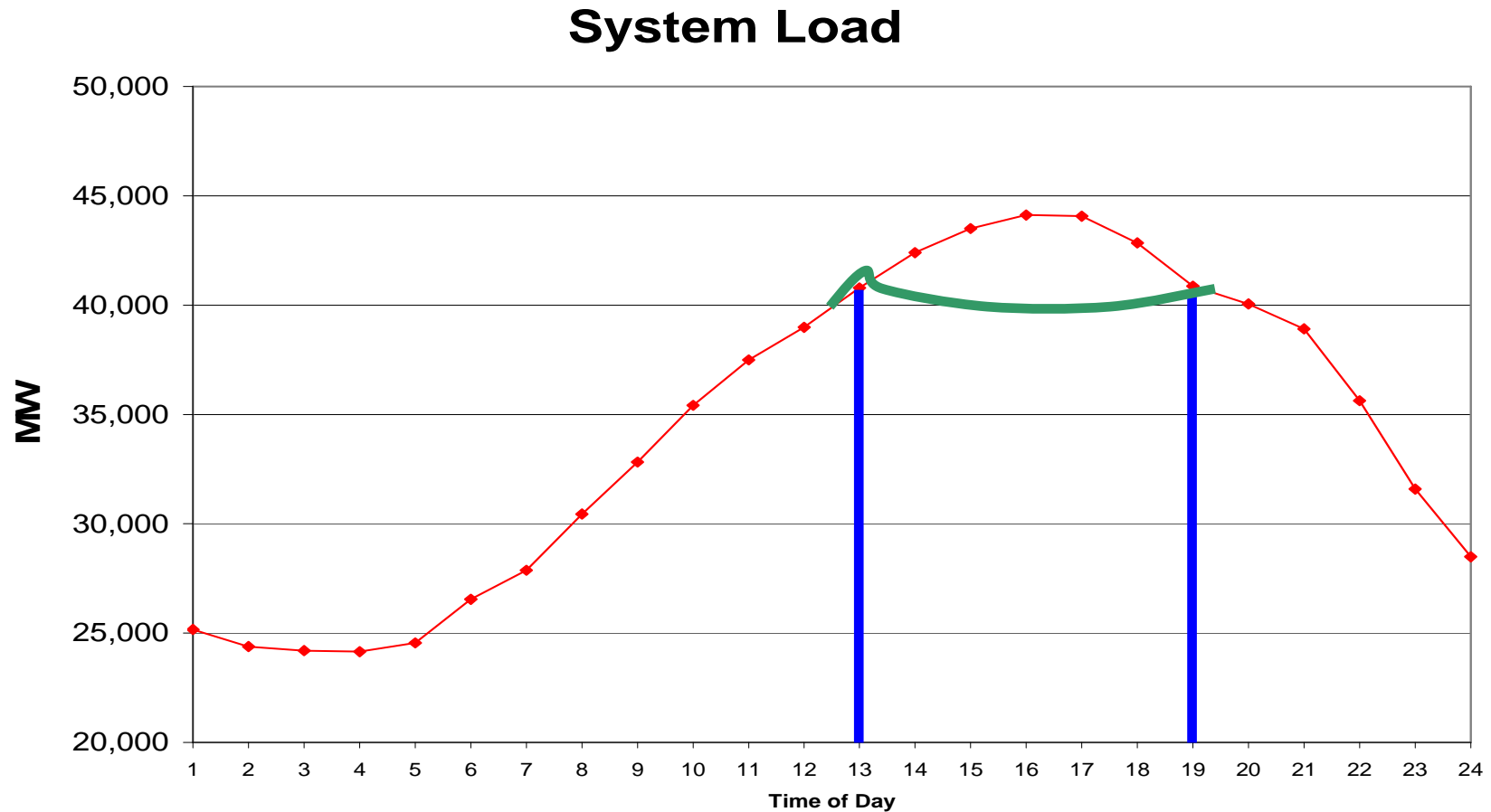


Demand Response:
Time-differentiating **technologies**, **rates**,
programs, **metrics** and **customer behavior**

Joy Morgenstern
California Public Utilities Commission

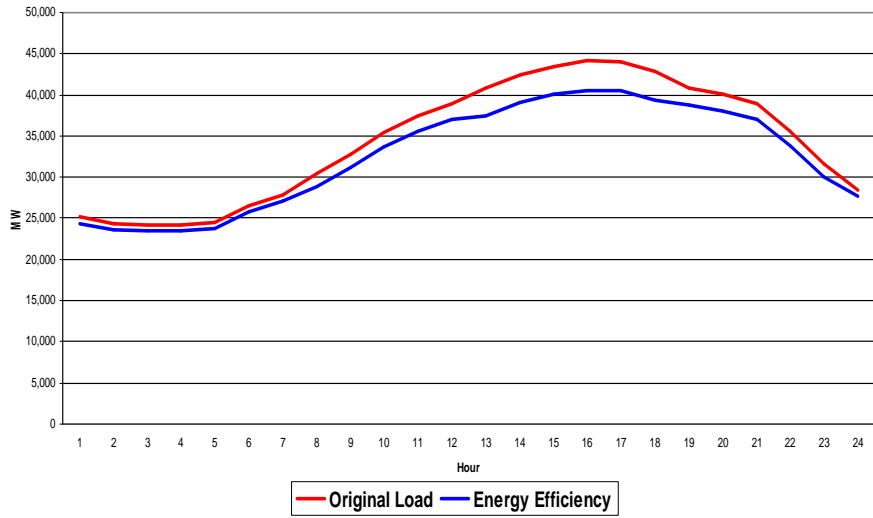


When do we use electricity?

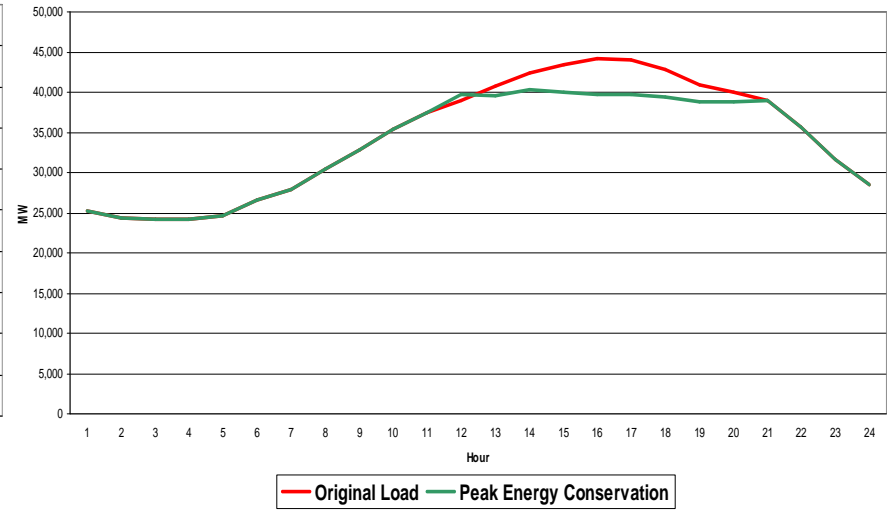


*California ISO system load, typical summer day

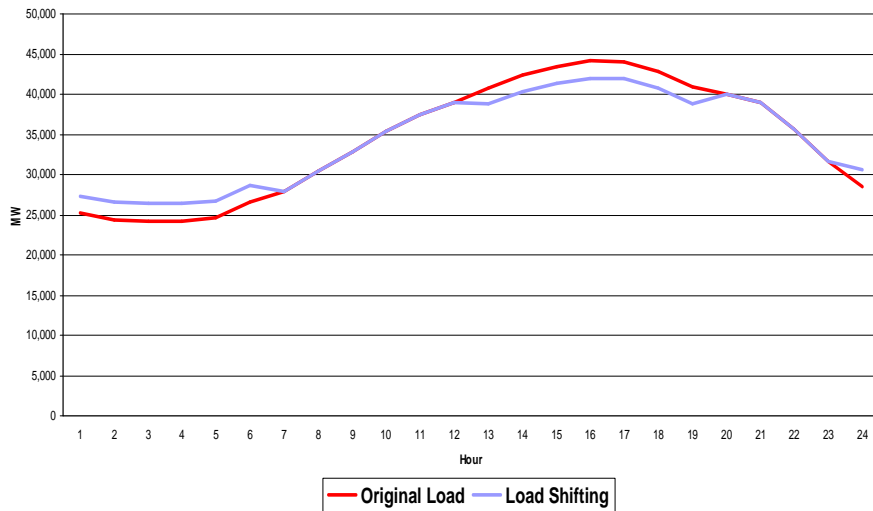
Energy Efficiency Impact on Load



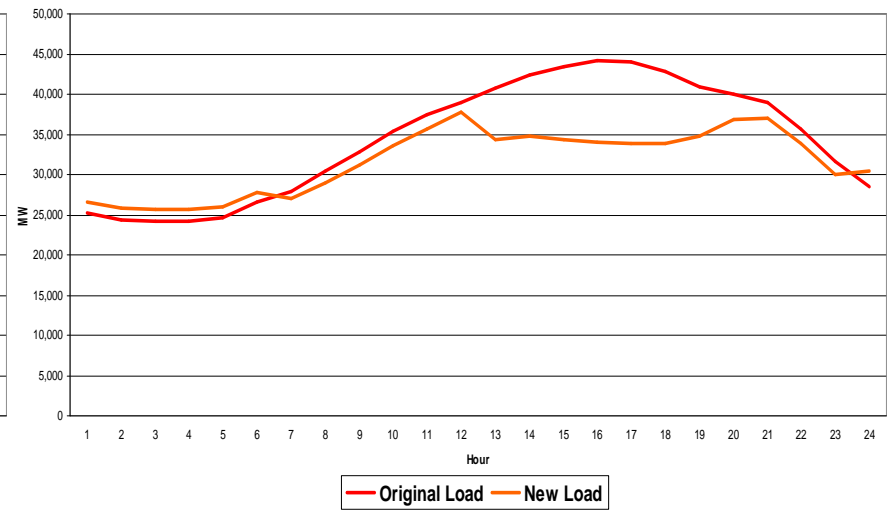
Peak Energy Conservation Impact on Load



Load Shifting Impact on Load



Total Impact on Load



Technologies

Smart Meters

Interval Meters

PCTs

Home Area Networks

Auto DR

Rates

Dynamic Rates

Time of Use Rates

Real Time Pricing

Critical Peak Pricing

Programs

Direct Load Control

Critical Peak Pricing

Traditional Interruptibles

Aggregator Contracts

Metrics

Program Evaluation

Load Impact Protocols

Cost-effectiveness protocols

Customer Behavior

?

Why we need time-differentiating technologies, rates, programs, metrics and customer behavior:

EE focuses on saving kWh, DR on saving kW, and both result in fewer power plants, fuel consumption, and emissions (including GHG).

Both reduction in energy consumption (energy efficiency) and reduction in energy demand (demand response) are required to make the grid more economically efficient and reduce its environmental impact.

Understanding customer behavior is necessary to:

- Improve demand response efforts and save more energy
- Measure and understand demand response program effectiveness
- Develop and distribute effective demand reduction technologies

Technologies

Smart Meters

Interval Meters

PCTs

Home Area Networks

Auto DR

Rates

Dynamic Rates

Time of Use Rates

Real Time Pricing

Critical Peak Pricing

Programs

Direct Load Control

Critical Peak Pricing

Traditional Interruptibles

Aggregator Contracts

Metrics

Program Evaluation

Load Impact Protocols

Cost-effectiveness protocols

The *Standard Practice Manual* (SPM)

- Developed to measure the cost-effectiveness of **Energy Efficiency** programs
- Use four tests to measure cost-effectiveness from four perspectives:
 - *Society*: The Total Resource Cost (TRC) test
 - *Program Administrator*: The Program Administrator (PAC) test
 - *Ratepayers*: The Ratepayer Impact Measure (RIM) test
 - *Participant*: The Participant Test

Cost-effectiveness tests for Demand Response

(based on the SPM)

INPUT:	TEST:	TRC (Society)	PAC (Utility)	RIM (Ratepayers)	Participant
Administrative costs		COST	COST	COST	
Avoided costs of supplying electricity		BENEFIT	BENEFIT	BENEFIT	
Bill increases					COST
Bill reductions					BENEFIT
Capital costs to participant		COST			COST
Environmental Benefits		BENEFIT			
Incentives paid			COST	COST	BENEFIT
Increased supply costs		COST	COST	COST	
Market benefits		BENEFIT	BENEFIT	BENEFIT	
Participant non-monetary benefits					BENEFIT
Revenue gain from increased sales				BENEFIT	
Revenue loss from decreased sales				COST	
Transaction costs to participant		COST			COST
Value of service lost		COST			COST

Shaded rows indicate those costs and benefits which are not listed in the SPM but have been added to the Demand Response draft protocols.

SPM tests that include customer perspectives

Participant Test

Benefits = Bill Reductions + Incentives Paid + Non-monetary benefits

Costs = Capital costs + Transaction costs + Value of service lost

Total Resource Cost Test

Benefits = Avoided cost of supplying electricity + Environmental benefits + Market benefits + Non-monetary benefits

Costs = Administrative costs + Capital costs + Increased supply costs + Transaction costs + Value of service lost

The old approach

Participant Test

Benefits = Bill Reductions + Incentives Paid + Non-monetary benefits
Costs = Capital costs + Transaction costs + Value of service lost

Total Resource Cost Test

Benefits = Avoided cost of supplying electricity + Environmental benefits +
Market benefits + Non-monetary benefits
Costs = Administrative costs + Capital costs + Increased supply costs +
Transaction costs + Value of service lost

Know: Part. Test Benefits > Costs; Ignore Bill Reductions, Increased supply costs

Assume: Part. Benefits ≈ Costs; Non-monetary, Market benefits negligible

Therefore: Capital costs + Transaction costs + Value of service lost ≈ Incentives Paid

Total Resource Cost Test

Benefits = Avoided cost of supplying electricity + Environmental benefits
Costs = Administrative costs + Incentives Paid

How accurate is the old approach?

Total Resource Cost Test (new)

Benefits = Avoided cost of supplying electricity + Environmental benefits + Market benefits + Non-monetary benefits

Costs = Administrative costs + Capital costs + Transaction costs + Value of service lost

Total Resource Cost Test (old)

Benefits = Avoided cost of supplying electricity + Environmental benefits

Costs = Administrative costs + Incentives Paid

However:

Participant Benefits > Participant Costs, so Incentives Paid are not a good proxy for customer costs

Non-monetary benefits \neq 0

Market benefits \neq 0

Environmental benefits include only a small GHG adder

*The current approach **overestimates** the costs and **underestimates** the benefits, hence severely underestimating benefit/cost ratios.*

Hard-to-quantify cost and benefits

Environmental Benefits

Market Benefits

Non-monetary benefits

Help the environment
Reduce carbon footprint
Better public image
Better energy management
Prevent blackouts

In other words, the benefits of changing customer behavior.

Transaction costs

Opportunity costs associated with education, equipment installation, program applications, energy audits, etc. *In other words, the costs of changing customer behavior.*

Value of service lost

Productivity losses and comfort costs.

Influence	Example	How can it be influenced?
Actual value of service lost	decreased production	Subsidies, high prices, bill protection, better technology
Perceived value of service lost	decreased comfort	"
Ownership/control	homeowner/renter; company large enough to employ system manager	Legislation/regulation
Decision-making authority/flexibility	customers differ in their decision-making procedures.	Marketing, incentives/rebates
Ability to respond	type of industry or processes; medical conditions	Incentives/rebates
Resistance to change	finds changing behavior expensive or difficult	Extremely high prices might have an impact.
Risk sensitivity	enrolling in program may result in higher bills; investing in new equipment may not	Incentives/rebates, bill protection
Awareness of program	customer does not know about or understand program	Marketing
Awareness of rate structure	customer understanding of bill	Marketing; changes in rate structure
Relative discount rate	poorer people have higher discount rates	Incentives/rebates, low income programs
Availability of capital	poorer people have low availability of capital; middle income people and small businesses may be reluctant to make large investments for long term payoffs.	Incentives/rebates, low income programs
(lack of) Price sensitivity	some people don't care about the price of energy	Use of OPT-OUT rather than OPT-IN
Trust	some people do not trust utilities and/or government agencies	Marketing
Environmental values	customers who respond to environmental incentives rather than, or in addition to, price incentives	Marketing
Awareness of environmental issues	customers who might respond to environmental incentives	Marketing; other educational materials/efforts
Civic/corporate responsibility	some people feel it is their responsibility to reduce peak demand, especially during emergencies	Marketing

Value of service lost

Transaction Costs

Non-monetary benefits

Time-differentiating **technologies**, **rates**, **programs**, **metrics** and **customer behavior** save energy and money, decrease GHG and other emissions, and make the grid more efficient.

Joy Morgenstern

California Public Utilities Commission

jym@cpuc.ca.gov

(415) 703-1900