Principles of Modern Rate Design:

Pricing Options Where Advanced Metering Infrastructure Has Not Been Fully Deployed

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RAP Publications on Rate Design

- RAP has published several papers on rate design:
  - Charging for Distribution Utility Services: Issues in Rate Design
  - Revenue Regulation and Decoupling: A Guide to Theory and Application
  - Rate Structures for Customers with Onsite Generation: Practice and Innovation
  - Pricing Do's and Don'ts
  - Standby Rates for Customer-Sited Resources: Issues, Considerations and the Elements of Model Tariffs
- In the 2011- 2013 **Global Best Practices** Series:
  - **Time-Varying and Dynamic Rate Design (Faruqui)**
  - **Rate Design Where Advanced Metering Infrastructure Has Not Been Fully Deployed (Lazar)**
- This paper is a companion to the second, and looks at what can be done **without** AMI.

What Does This Rate Design Say?

Eat more ice cream!

Some Basic Rate Design Terminology

- **Customer Charge**: A monthly charge that applies independent of consumption. Also called a Basic Charge, Standing Charge, Meter Charge.
- **Energy Charge:** A price per kWh; may be in more than one time period, or more than one block.
- **Demand Charge:** A monthly fee based on the highest instantaneous usage rate (usually highest hour) during the month or year.

Residential Rate Types From Simple to Complex

- **Flat Rate:** Uniform rate per kWh for all usage.
- **Inclining Block:** two or more blocks of usage, with incremental usage at a higher price.
- **TOU:** Two or more **T**ime **O**f **U**se periods, with higher prices during higher-cost periods.
- **TOU with Inclining Block**: A TOU rate that includes a lower price for lower levels of usage.
- **Critical Peak:** A TOU price that has a much higher price for a limited number of hours. [Requires AMI]
- **Real-Time Price (RTP):** A price that changes frequently with market conditions. [Requires AMI]

Current Trend: Seeking Higher Customer Charges

Utilities across the country are seeking higher monthly fixed (basic) charges.

San Diego G&E (Proposed): $38.42

Customer Charges: Largest US Utilities		
Pacific Gas & Electric Co	CA	None
So Cal Edison	CA	$ 0.87
Public Service E&G	NJ	$ 2.43
Detroit Edison Co	MI	$ 6.00
Virginia Electric Power	VA	$ 7.00
Florida Power & Light Co	FL	$ 7.24
Georgia Power Co	GA	$ 9.00
Commonwealth Edison Co	IL	$ 15.06
Consolidated Edison	NY	$ 15.76

These utilities serve one in six Americans.

What's Wrong With High Customer Charges?

- Few costs are really "fixed."
- Reduces the per-kWh rate, which encourages consumption.
- Punitive to apartment dwellers and urban residents.
- Other options for revenue stability available, including decoupling.

The Most Common Residential Rate Design: Inclining Block

- Globally, the most common residential rate design was the inclining block rate.
- Most have zero or very low customer charges.
- Goals include:
  - Allocation of limited low-cost resources
  - Recognition of declining load factor as usage increases
  - Encouragement of conservation
  - Providing for essential needs at affordable cost
  - Benefit to low-income consumers

How an Inclining Block Rate Affects Most Consumption

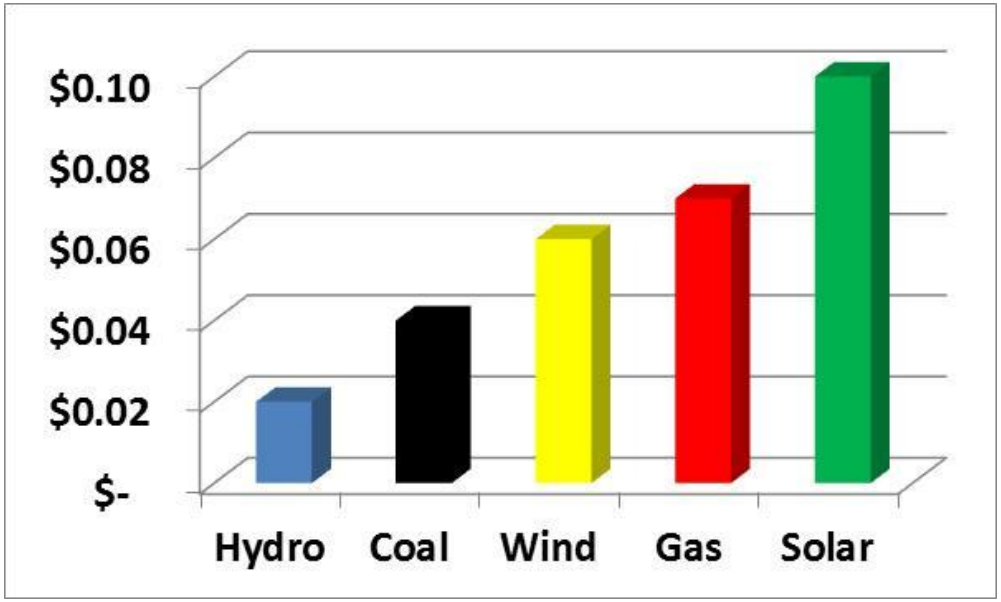
	Bills	kWh Usage by Customers Ending in Block	% of Sales to Customer Using More than Block	Total Block Sales Including Sales to Customers Exceeding Block Limit	% of Sales In Block
0 - 250	154,281	22,705,353	92%	118,791,853	42%
250 - 500	176,985	64,370,066	69%	71,964,066	25%
500 - 750	94,209	57,617,207	49%	38,800,707	14%
750 - 1,000	49,741	42,864,074	34%	21,411,074	8%
>1,000	63,411	95,831,158	0%	32,420,158	11%
	538,627	283,387,858		283,387,858	

Effect on Usage of Alternative Rate Designs

	Flat Rate	Inclining Block Rate	High Customer Charge
Customer Charge	$ -	$ -	$ 25.00
First 250 kWh	$ 0.15	$ 0.1160	$ 0.1025
Over 250 kwh	$ 0.15	$ 0.1740	$ 0.1025
Usage Change With Elasticity of -0.2		**-2.6%**	**+6.3%**

Cost-Based Inclining Block Rate Based on Resource Types

- Start with typical cost of resources
- Determine how much of each the utility has available for the class
- Set blocks to recover costs



Block	kWh	Energy	Delivery	**Total**
Hydro	250	$ 0.02	$ 0.06	**$ 0.08**
Coal	251 - 750	$ 0.04	$ 0.06	**$ 0.10**
New Supply	>750	$ 0.10	$ 0.06	**$ 0.16**

Cost-Based Inclining Block Rate Based on Load Factor

- Determine Load Factor of Each Usage Block
- Apply a typical Commercial rate:
  $10/kW/month + $.08/kWh
- Compute Block Rates

Primary Usage	kWh	Load Factor	Demand	Energy	Total
Lights/Appliances	**400**	70%	$ 0.020	$ 0.08	**$ 0.100**
Water Heat	**401- 800**	40%	$ 0.035	$ 0.08	**$ 0.115**
Space Conditioning	**>800**	20%	$ 0.069	$ 0.08	**$ 0.149**

California

- California IOUs have steeply inclining block rates with low customer charges, as do some POUs.
- Baselines reflect housing type and climate zone.
- CPUC is examining possible changes, including mandatory TOU.

Palo Alto

Customer Charge		None
First 300 kWh		$0.0954
Next 300 kWh		$0.1302
Over 600 kWh		$0.1740

PG&E

Customer Charge		None
Baseline Usage		$0.1323
101% - 130%		$0.1504
131% - 200%		$0.3111
Over 200 %		$0.3511

SCE

Customer Charge		$0.91
Baseline Usage		$0.1295
101% - 130%		$0.1607
131% - 200%		$0.2719
Over 200%		$0.3110

Baseline = 270 - 1,200 kWh/month

Examples from Other Countries

Country	Blocks	Customer Charge	Head Block	Tail Block
China	3	None	$.087	$.136
India	6	None	$.03	$.128
Mexico	4	None	$.056	$.225
Hungary	2	$0.87	$.208	$.215

Seasonal Rate: Summer or Winter Peaking

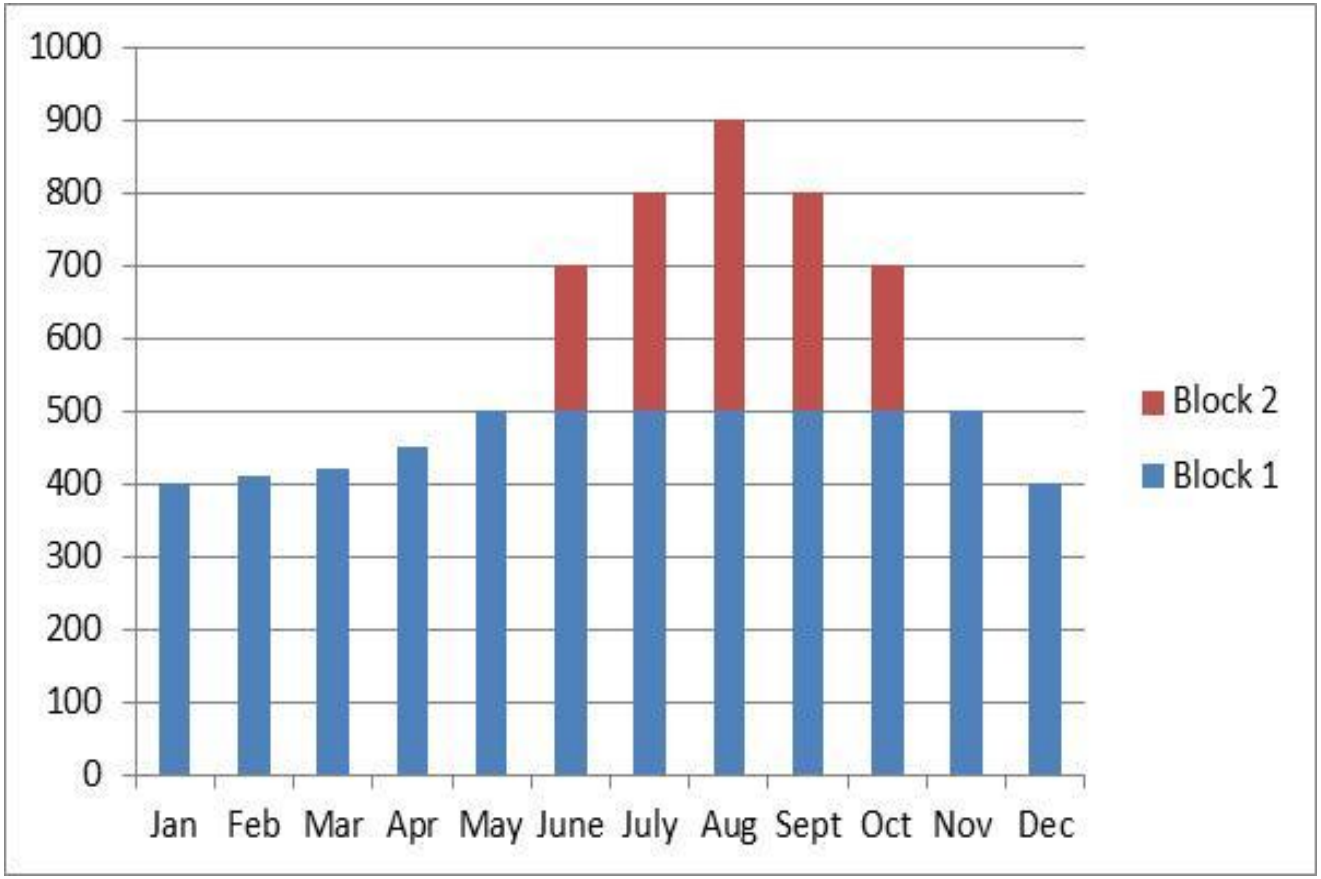
- Seasonal rate reflects higher costs in the peak season.
- Most of the US is summer peaking, but some is winter peaking.

Madison Gas and Electric, Wisconsin

		Summer	Winter
Basic Charge		$ 10.00	$ 10.00
Per kWh		$ 0.152	$ 0.14

Newfoundland Power			
		Summer	Winter
Per kWh		$0.0965	$0.1190

An Inclining Block Rate CAN BE a Seasonal Rate



Inclining block rate can be designed so that most customers see the second block only in the peak season.

Arizona Public Service Seasonal + Inclining Block

- Arizona has a very distinct summer daytime peak, driven by air conditioning load
- Load-Factor Based Inclining Block Rate
- Optional TOU Rate Available

Arizona Public Service Company Standard Plan (Optional TOU Available)			
		Winter	Summer
0 - 400 kWh		$ 0.0942	$ 0.0969
401 - 800 kWh		$ 0.0942	$ 0.1382
801 - 3,000 kWh		$ 0.0942	$ 0.1617
Over 3,000 kWh		$ 0.0942	$ 0.1726

Fixed Period TOU Rates

- Many utilities have introduced fixed-period TOU rates.
- These require interval meters, but not AMI.

Green Mountain Power	Standard Rate	Optional TOU Rate
Customer Charge:	$11.21	$16.10
Off-Peak	$.14669	$.11343
On-Peak	$.14669	$.25522

Fixed-Period TOU Rates With Inclining Block Design

- TOU and Inclining Block features can be combined, by implementing a fixed $/kWh discount (or surcharge) below (above) the baseline level.

Customer Charge	$5.00
Off-Peak	$.10
On-Peak	$.20
Baseline Credit, First 500 kWh	($.04)

Other Alternatives to High Customer Charges

Utility	Approach
Manitoba Hydro	Customer Charge Linked to Panel Size
Fort Collins (optional rate)	Residential Demand Charge $/kW
Indonesia, France, Italy	Subscription to a demand level

Peak Load Management Without AMI

- Many utilities have peak interruption programs controlled by the utility.
- Midwest coops often REQUIRE that electric water heaters be under utility control.

Southern California Edison
Summer Discount Plan

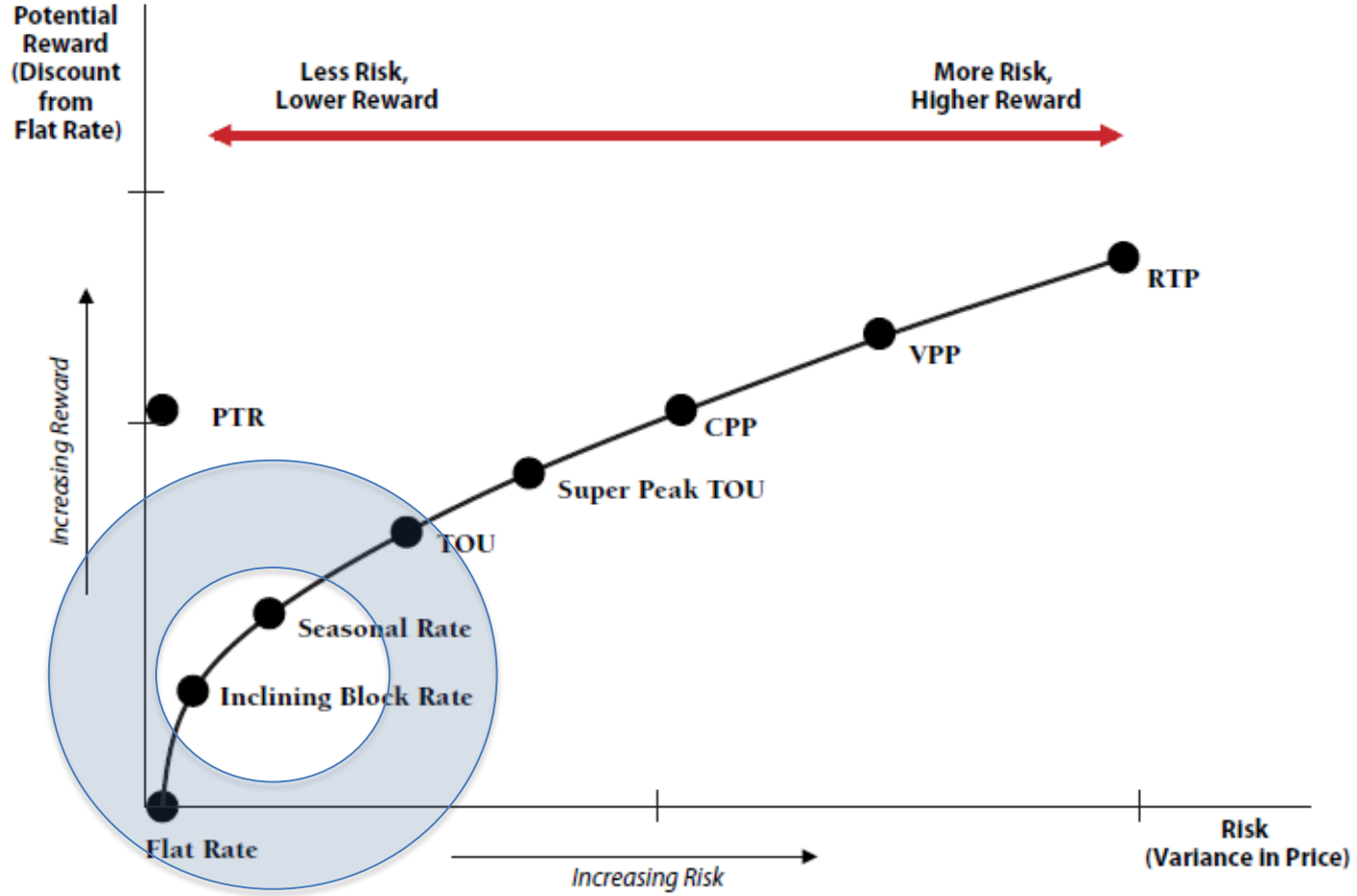
Summer Discount Plan: Maximum Savings/Maximum Comfort

	Maximum Savings *Off continuously up to 6 hours*	**Maximum Comfort** *Off 15 out of every 30 minutes for up to 6 hours*
Unlimited *(Any # of interruptions per summer)*	**$200**	**$50**
Limited *(Up to 15 interruptions per summer)*	**$100**	**$25**

Peak Reduction vs. Energy Reduction

- Inclining block rates produce the most overall reduction in energy usage.
- Time-varying prices produce peak load reduction, but may or may not reduce total energy use.
- More complex rates work best with technology enablement.

Peak Load Benefits of Different Residential Rate Designs



Peak Demand Benefits of an Inclining Block Rate Design

TOU Rate				Inclining Block Rate	
Customer Charge		$ 5.00		Customer Charge	$ 5.00
Off-Peak		$ 0.08		First 500 kWh	$ 0.08
On-Peak		**$ 0.15**		Additional kwh	**$ 0.15**

- TOU rate sets on-peak at $.15
- IBR sets rates for ALL usage over 500 kWh at $.15
- ~80% of usage in peak months is by customers using over 500 kWh/month
- **Therefore this IBR will achieve about 80% of the peak load benefits of this TOU rate.**

Jim's Preferred Residential Rate Design (Note: requires AMI)

Simple enough to understand, but with attention to critical peak hours.

Customer Charge	$5.00	Billing and Collection ONLY
First 500 kWh	$.08	Cost of Older Resources / High load factor uses
Over 500 kWh	$.16	Cost of New Resources / Low load factor uses
Critical Peak Surcharge	$.50	Max: 4 hours/day, 15 days/year

Commercial and Industrial Rates Covered in the Publication

- **Commercial**
  - TOU rates
  - Rolling baseline rates
  - AMI not a barrier for larger customers
- **Industrial**
  - AMI not a barrier
  - TOU and Real-Time Pricing alternatives
  - Rolling baseline rates

Other Topics Covered in the Publication

- Treatment of emission costs in rates
- Tariff vs. Market-Based Pricing for restructured regions
- New customer connection charges
- Pricing for small power producers
- Low-Income energy assistance rates
- Prepayment

Key Themes
For Modern Rate Design

- **Focus on long-run marginal costs, including transmission, distribution, and environmental costs.**
- **Recover costs in usage sensitive elements of the rate design.**
- **Consider some sort of dynamic price as an optional service.**
- **Empower consumers to respond effectively.**
- **Manage utility revenue stability concerns separately.**

Bill Simplification

Which Pricing Approach is More Useful to You as a Consumer?

Crude Oil		$2.237
Tanker to Refinery		$0.114
Refinery Capital		$0.213
Refinery Operating		$0.235
Product Pipeline		$0.113
Terminal Rack		$0.023
Truck to MiniMart		$0.114
Mini-Mart Profit		$0.217
State Taxes		$0.349
Federal Taxes		$0.184

So Why Do We Confuse Electric Consumers?

Your Usage:		1,266 kWh		
Base Rate		Rate	Usage	Amount
First 500 kWh		$ 0.04000	500	$ 20.00
Next 500 kWh		$ 0.06000	500	$ 30.00
Over 1,000 kwh		$ 0.08000	266	$ 21.28
Fuel Adjustment Charge		$ 0.03456	1,266	$ 43.75
Infrastructure Tracker		$ 0.00789	1,266	$ 9.99
Decoupling Adjustment		$ (0.00057)	1,266	$ (0.72)
Conservation Program Charge		$ 0.00123	1,266	$ 1.56
Nuclear Decommissioning		$ 0.00037	1,266	$ 0.47
Subtotal:				$ 126.33
State Tax		5%		$ 6.32
City Tax		6%		$ 7.96
Total Due				$ 140.60

When This is What It Really Means

EFFECTIVE RATE INCLUDING ALL ADJUSTMENTS					
First 500 kWh			$ 0.09291	500	$ 46.46
Next 500 kWh			$ 0.11517	500	$ 57.59
Over 1,000 kwh			$ 0.13743	266	$ 36.56
					$ 140.60

SIMPLIFY WHAT YOU PUT ON THE BILL!

Recommended Publications

This Presentation: ***Rate Design Where Advanced Metering Infrastructure Has Not Been Fully Deployed***
http://www.raponline.org/document/download/id/6516

Companion Publication: Time-Varying and Dynamic Rate Design
http://www.raponline.org/document/download/id/5131

Pricing Do's and Don'ts: Designing Retail Rates as if Efficiency Counts
http://www.raponline.org/document/download/id/939

Charging for Distribution Utility Services: Issues in Rate Design
http://www.raponline.org/document/download/id/412

Customer Incentives for Energy Efficiency Through Electric and Natural Gas Rate Design
http://www.epa.gov/cleanenergy/documents/suca/rate_design.pdf

About RAP

The Regulatory Assistance Project (RAP) is a global, non-profit team of experts that focuses on the long-term economic and environmental sustainability of the power and natural gas sectors. RAP has deep expertise in regulatory and market policies that:

- Promote economic efficiency
- Protect the environment
- Ensure system reliability
- Allocate system benefits fairly among all consumers

Learn more about RAP at www.raponline.org

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