Recovering Smart Grid Costs In Electricity Rates

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About Jim Lazar

- Consulting Economist specializing in utility rates and resource planning.
- Expert witness in more than 100 regulatory proceedings before federal, state, local regulators.
- Author of several books and guides on issues relating to regulation.
- Senior Advisor with Regulatory Assistance Project, providing training and technical assistance to utility regulators worldwide.
- Rate consultant to BWP since 2000.

What Are The Costs of Smart Grid?

- **Capital Costs:**
  - Smart meters
  - Data collection network (wifi grid in Burbank)
  - Distribution system controls
  - Meter data management system (hardware and software)
- **Operating Costs:**
  - Software development, implementation and training
  - Hardware maintenance (meters, wifi)
  - Customer service (education)

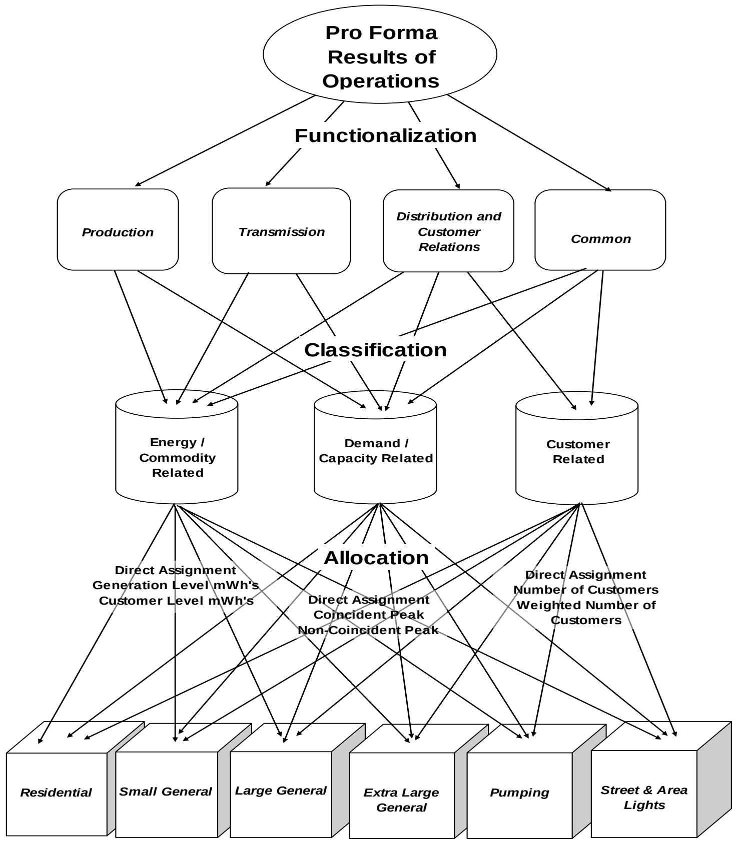
What Are The Benefits of Smart Grid?

- Reduced O&M Expense for meter reading
- Remote shut-off and turn-on
- Reliability Improvement:
- Distribution Automation
- Peak load reduction through Time of Use and Critical Peak Pricing
- Loss reduction: Voltage Control and Power Factor Correction
- Loss Reduction:Phase balancing on the fly

How Would Costs of This Type Be Recovered "Normally?"

- In a traditional cost of service study, costs are:
- Functionalized
  - Prod, Trans, Dist, Common
- Classified
  - Demand, Energy, Customer
- Allocated
  - Residential, Commercial, Industrial

ELECTRIC COST OF SERVICE STUDY FLOWCHART



Pro Forma Results of Operations by Customer Group

Functionalization and Classification Should Track Benefits

- Smart Meters do more than conventional meters.
- The system works together to provide system benefits.
- Capital (smart meters) is substituting for operating (meter readers, station meters, load research meters, and more)
- Investment in computers and software are up sharply.
- Distribution system controls reduce peak capacity requirements and reduce energy losses.

Treating Smart Grid Grants

Smart grid grants have been used for both capital investment in hardware, investment in software, and staffing costs during the transition.

- Net the grants out of the amount of plant booked to plant in service.
- Net the amount spent from grants on training and startup from O&M expense

Benefits: O&M Expense

- Cost savings in meter operations and transportation expense are significant.
- These are offset by higher capital costs and data management costs

Meter Operations Impact Metrics	% Change in Improvement
Change in meter operations cost	-13% to -77%
Change in vehicle miles driven, vehicle fuel consumption, and CO_2 emissions	-12% to -59%

Source: USDOE, 2012

Benefits: Peak Demand

Project Elements	OG&E	MMLD	SVE
Number of customers	6,000 residential customers	500 residential customers	600 mostly residential customers
Time-based rate(s)	Time-of-use and variable peak pricing with critical peak pricing components	Critical peak pricing	Critical peak pricing
Customer systems	In-home displays, programmable communicating thermostats, web portals	Web portals	Web portals
Peak demand reduction during critical peak events	Up to 30%	37%	Up to 25%
Customer acceptance	Positive experience, many reduced electricity bills	Positive experience, but did not use the web portals often	Interested in continued participation, many reduced electricity bills

Table ES-1. Summary of the Initial Results (Summer 2011)

Source: USDOE, 2012

Benefits: Reliability

Reliability Indices	Description	Range of Percent Changes
SAIFI	System Average Interruption Frequency Index (outages)	-11% to -49%
MAIFI	Momentary Average Interruption Frequency Index (interruptions)	-13% to -35%
SAIDI	System Average Interruption Duration Index (minutes)	+4% to -56%
CAIDI	Customer Average Interruption Duration Index (minutes)	+29% to -15%

Table ES-1. Changes in Reliability Indices from Automated Feeder Switching

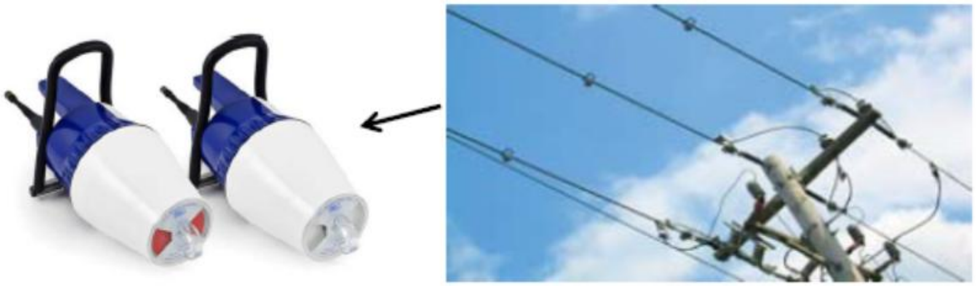


Figure 3. Example Remote Fault Indicator

Source: USDOE, 2012

Benefits: Voltage Control

Multiple Elements

- Lower peak demand
- Lower losses
- Lower O&M costs
- Less Expensive Distribution Upgrades

Improvement Area	Impacts	Primary Benefits
Better voltage control	Lower real power (MW) peak demand from CVR	Reduce capacity payments and/or defer capacity additions/upgrades
	Lower real power (MWh) consumption from CVR	Reduce fuel consumption with lower greenhouse gas and polluting emissions
Better VAR control	Lower reactive power (MVAR) peak demand	Reduce capacity payments and/or defer capacity additions/upgrades
	Lower line losses (MW)	Reduce fuel consumption and environmental emissions
Better operations and maintenance	Fewer service trips	Reduce O&M cost and vehicle emissions
Better integration of distributed energy resources	Acceptable voltage profiles over a wider range of generation and load conditions	Less expensive distribution system upgrades

So, What's The Problem?

- Traditional metering, meter reading, and billing costs are treated as 100% customer-related in cost of service studies.
- Traditional distribution system components are often treated as 100% demand-related in cost of service studies.
- Now we have new categories of equipment performing multiple functions to manage peak demand, reduce line losses, improve reliability, and provide metering functions.
- Cost allocation and rate design must adapt.

The Methods For Classification and Allocation Must Change

Smart Grid Element	Pre-Smart Grid Element	"Traditional" FERC Account	Traditional Classification		Smart Grid Classification
Smart Meters	Meters	370	Customer		Demand / Energy / Customer
Distribution Control Devices	Station Equipment	362	Demand		Demand / Energy
Data Collection System	Meter Readers	902	Customer		Demand / Energy / Customer
Meter Data Management Syste	General Plant	391 - 397	Subtotal PTDC		Demand / Energy / Customer
Smart Grid Managers	Customer Accounts Supervision	901	Customer		Demand / Energy
Energy Storage Devices (Batteries; Ice Bear)	Installations on Customer Premises	371	Customer		Demand / Energy

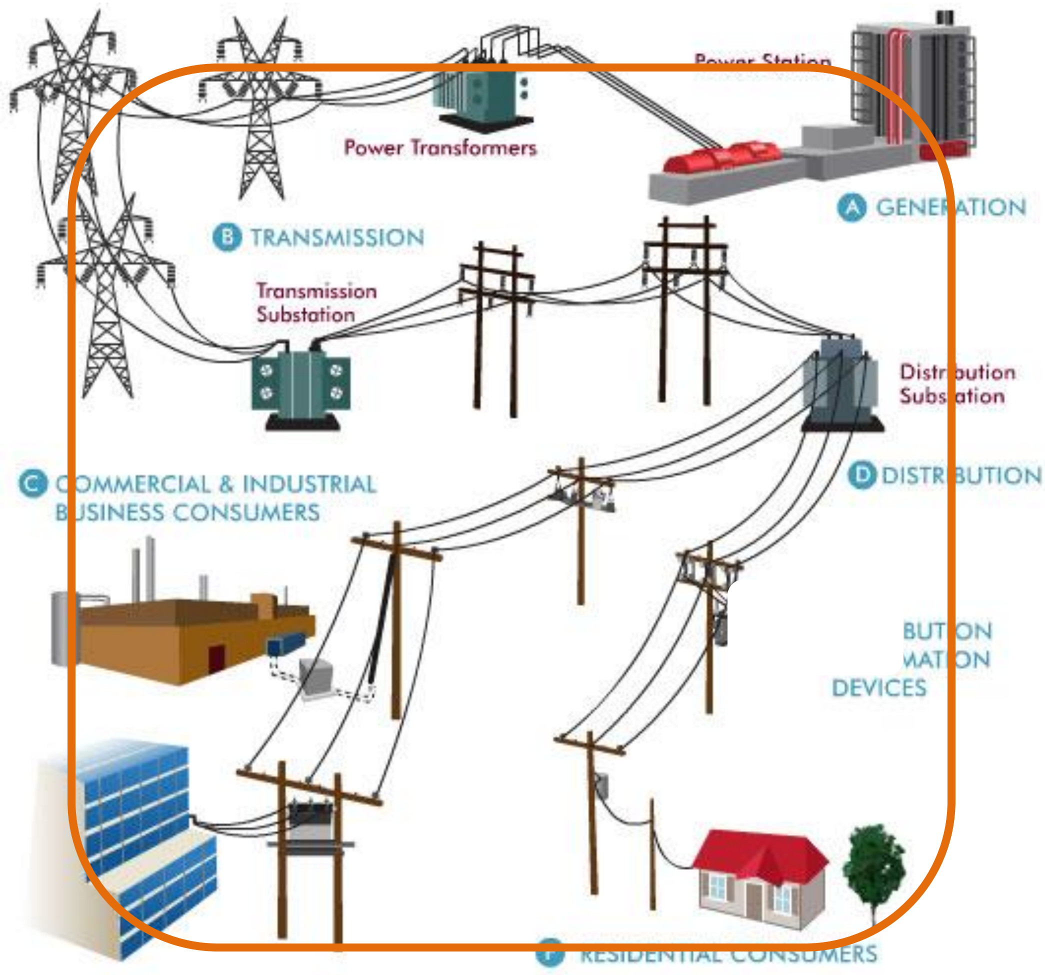
Including Costs In Rate Design

- If benefits are > costs, then all rate elements should be moderated by smart grid investments.
- This means that the savings should be apportioned between customer charges, demand charges, and energy charges.
- If the end-result is an increase in customer charges, and decreases in other rate elements, then not all customers will benefit from smart grid investments.
- There are probably some customers (very small users) for whom smart meter investments are uneconomic, but there is a benefit to system uniformity.

Example of a Service That Smart Grid Makes Possible

- Rooftop PV is a rapidly expanding resource for utilities.
- It creates challenges for operations, and challenges for revenues.
- Smart grid lets us know where the loads are, where the resources are, and adapt the distribution system in real-time to optimize for losses and reliability.
- Net metering is perceived by utilities to be a subsidy.
- A new rate design may be appropriate for PV customers.

Net-Metering Is An Infant-Industry Subsidy



Traditional bundled utility rates pay for all costs of the system.

Power supply
Transmission
Distribution
Customer Service
Billing and Collection

Typically (and ideally) only billing and collection are recovered $/customer.

Which means all other costs are $/kW or $/kWh

Current Net-Metering Rate Design (BWP)

			Rate	1,000 kWh Customer	
				Usage	Bill
Customer Service Charge			$ 4.87	1	$ 4.87
First 250 kwh			$ 0.11	250	$ 28.60
Next 500 kwh			$ 0.15	500	$ 76.40
Over 750 kWh			$ 0.17	250	$ 43.58
		Total:		1000	$ 153.45

Without PV System

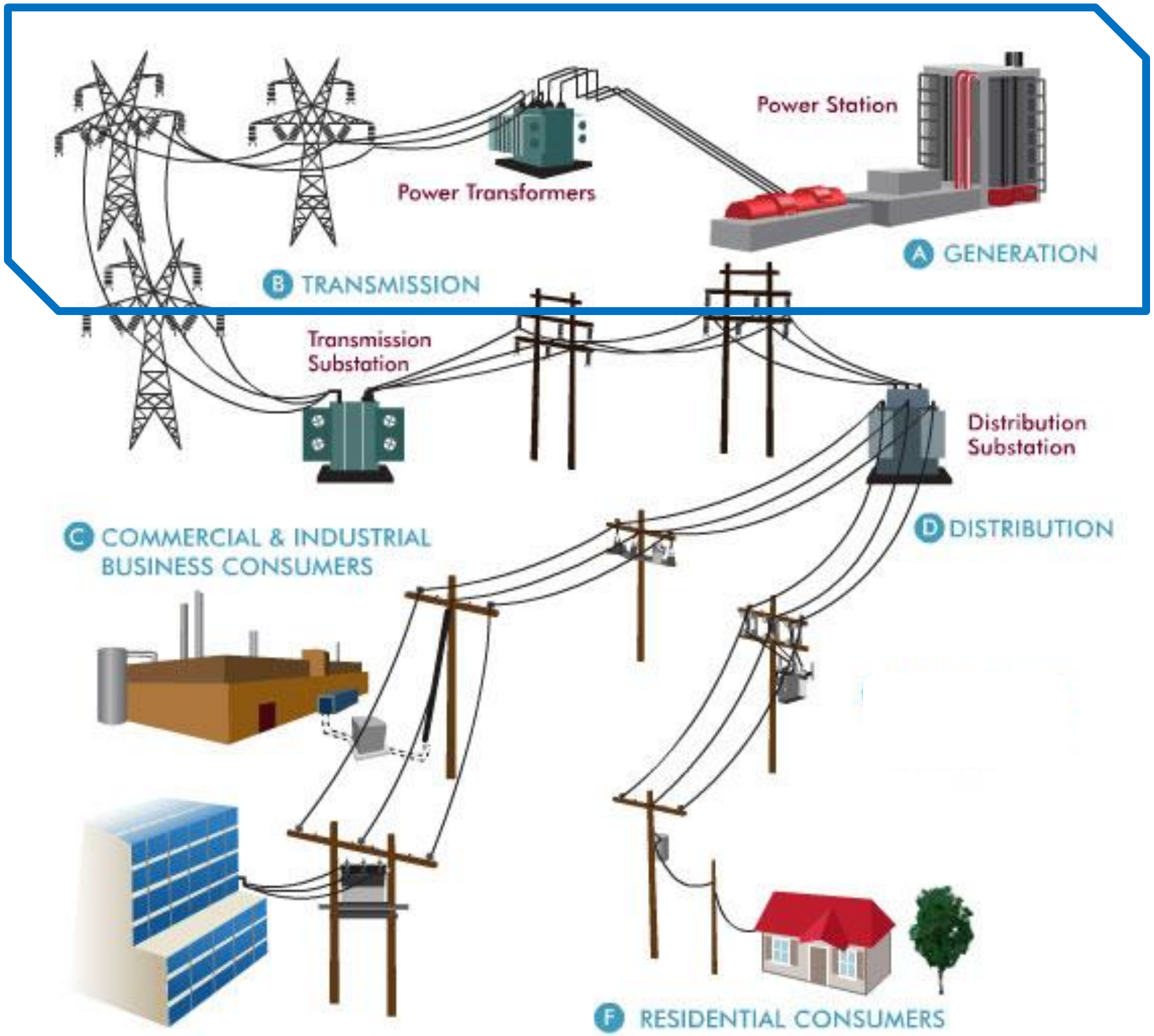
			Rate	1,000 kWh Customer	
				Usage	Bill
Customer Service Charge			$ 4.87	1	$ 4.87
First 250 kwh			$ 0.11	0	$ -
Next 500 kwh			$ 0.15	0	$ -
Over 750 kWh			$ 0.17	0	$ -
		Total:		0	$ 4.87

With PV System producing 1,000 kWh

Bi-Directional Pricing Charges All Customers For What They Use

- Customers using exclusively grid power pay for production, transmission, network distribution, local distribution, and customer service.
- Self-generation customers pay for the full grid for their consumption from the grid, and also pay for local distribution when they are surplus, to help pay for finding customers for their excess power.

Bulk Power Supply Costs



Production and High-Voltage Transmission

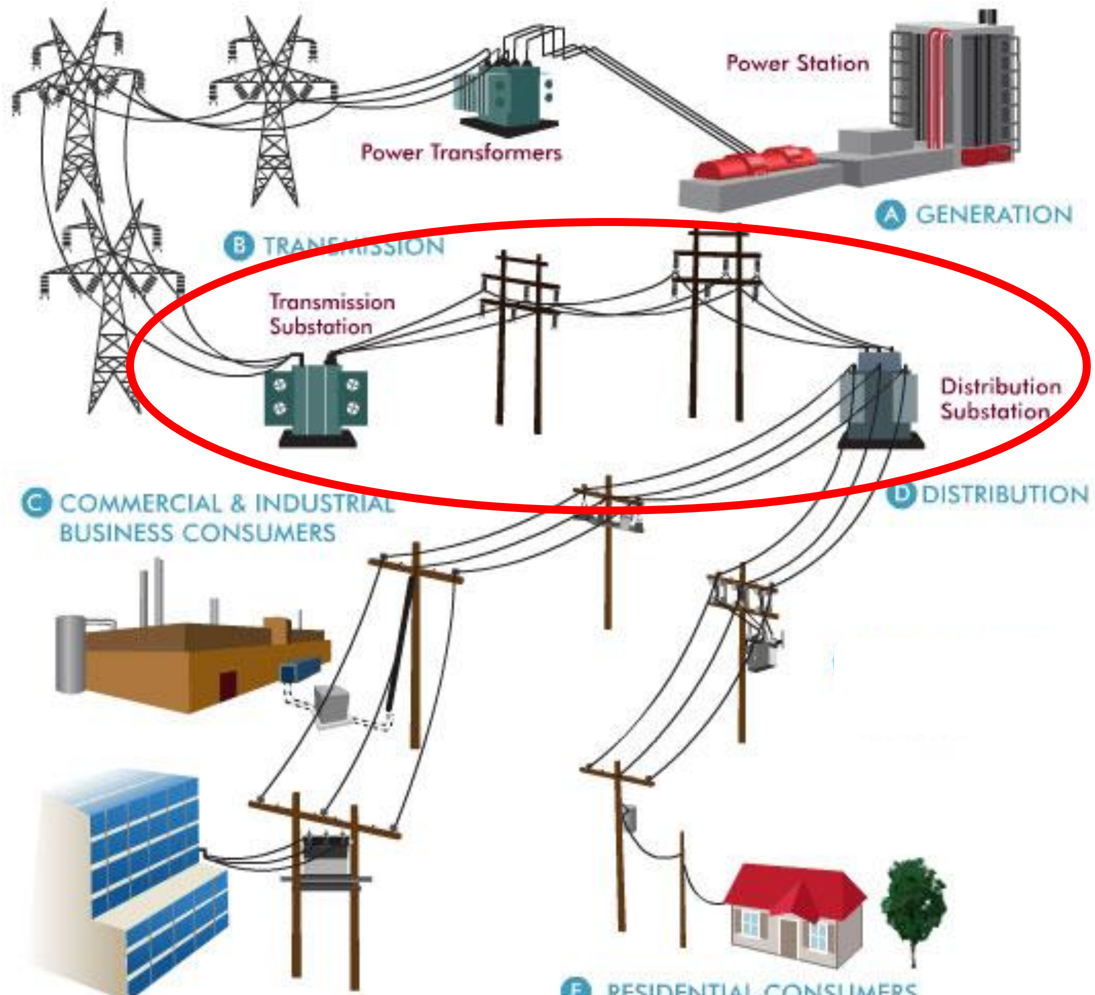
Common to all customers using grid power.

Recover on a Demand/Energy / TOU / Seasonal / Real-Time basis (different discussion)

On-Peak: $ .12/kWh
Mid-Peak: $ .08/kWh
Off-Peak: $ .05/kWh

Critical Peak: $.50/kWh

Network Sub-transmission and Distribution Costs



Common to all customers taking grid power.

34kV, 69kV, 115 kV

Ends at distribution substation

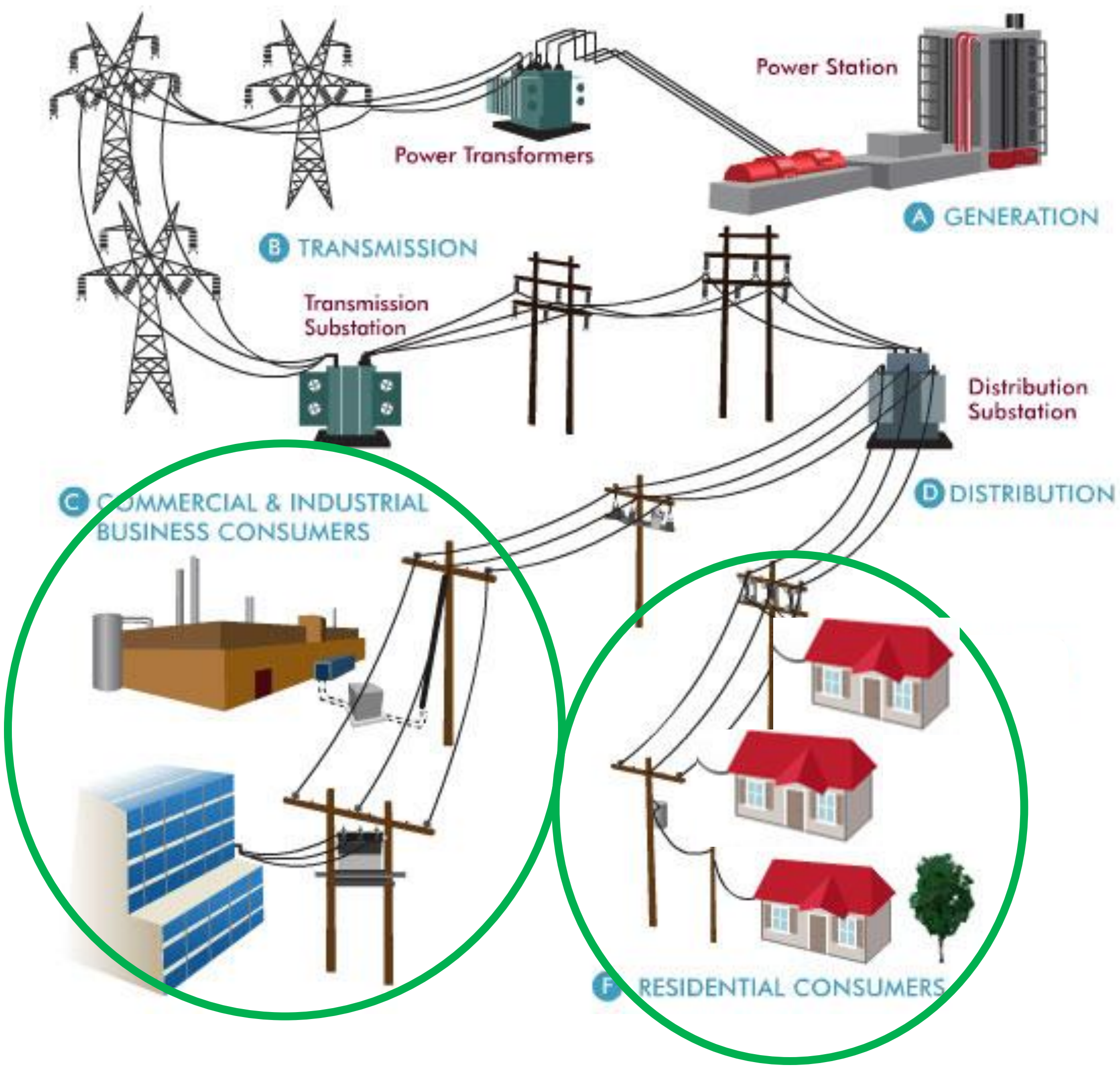
Incurred to meet energy requirements

Sized to meet peak demand

Recover on a demand and energy basis from all customers

Demand-Metered: $4/kW/mo
Energy-Metered: $.01/kWh

Local Distribution Costs



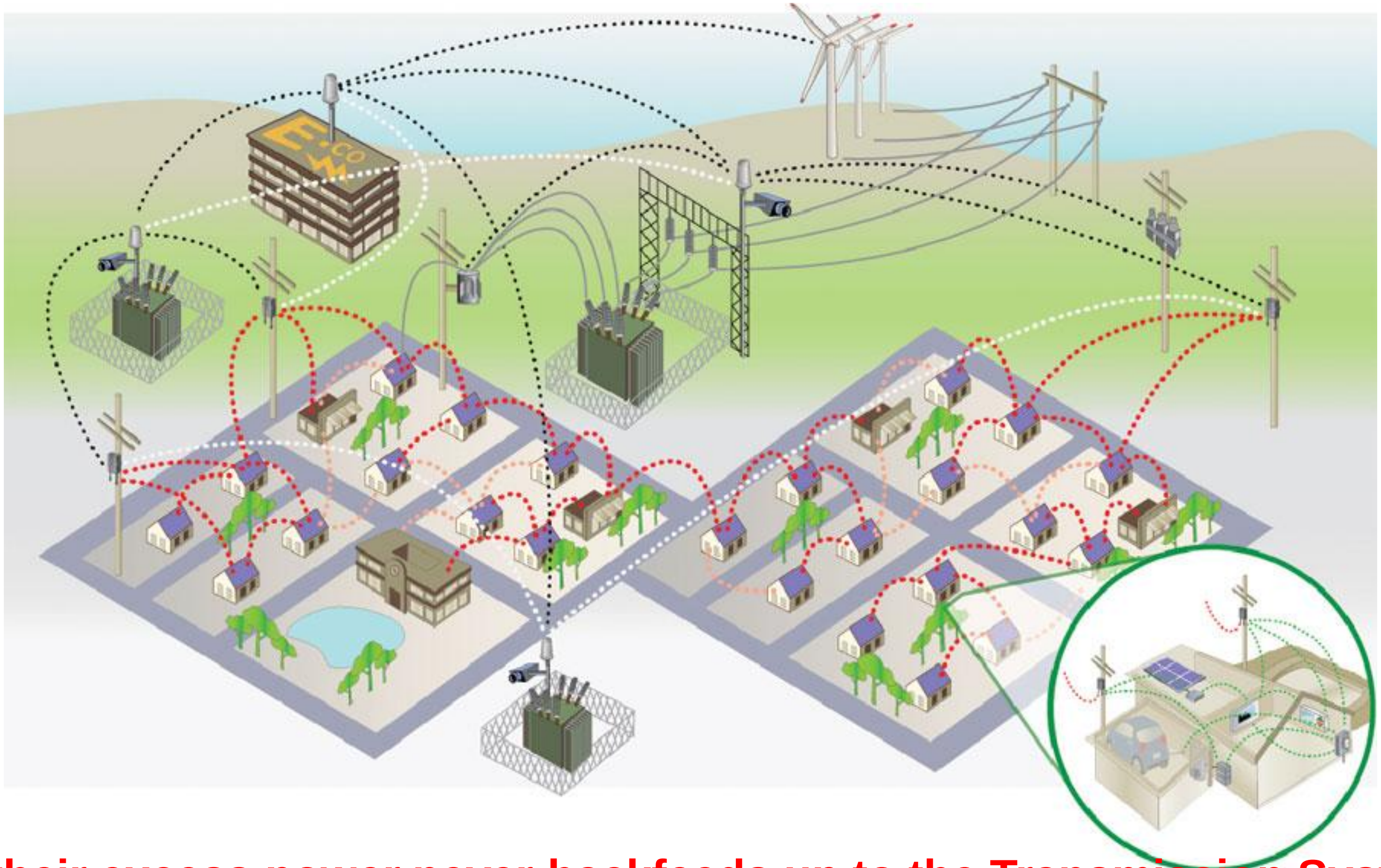
Localized networks that serve only customers in the immediate area.

Some higher-voltage C&I customers take directly from distribution substation, and do not use these costs (and should not pay for these costs)

Local distribution costs recovered bi-directionally from all users.

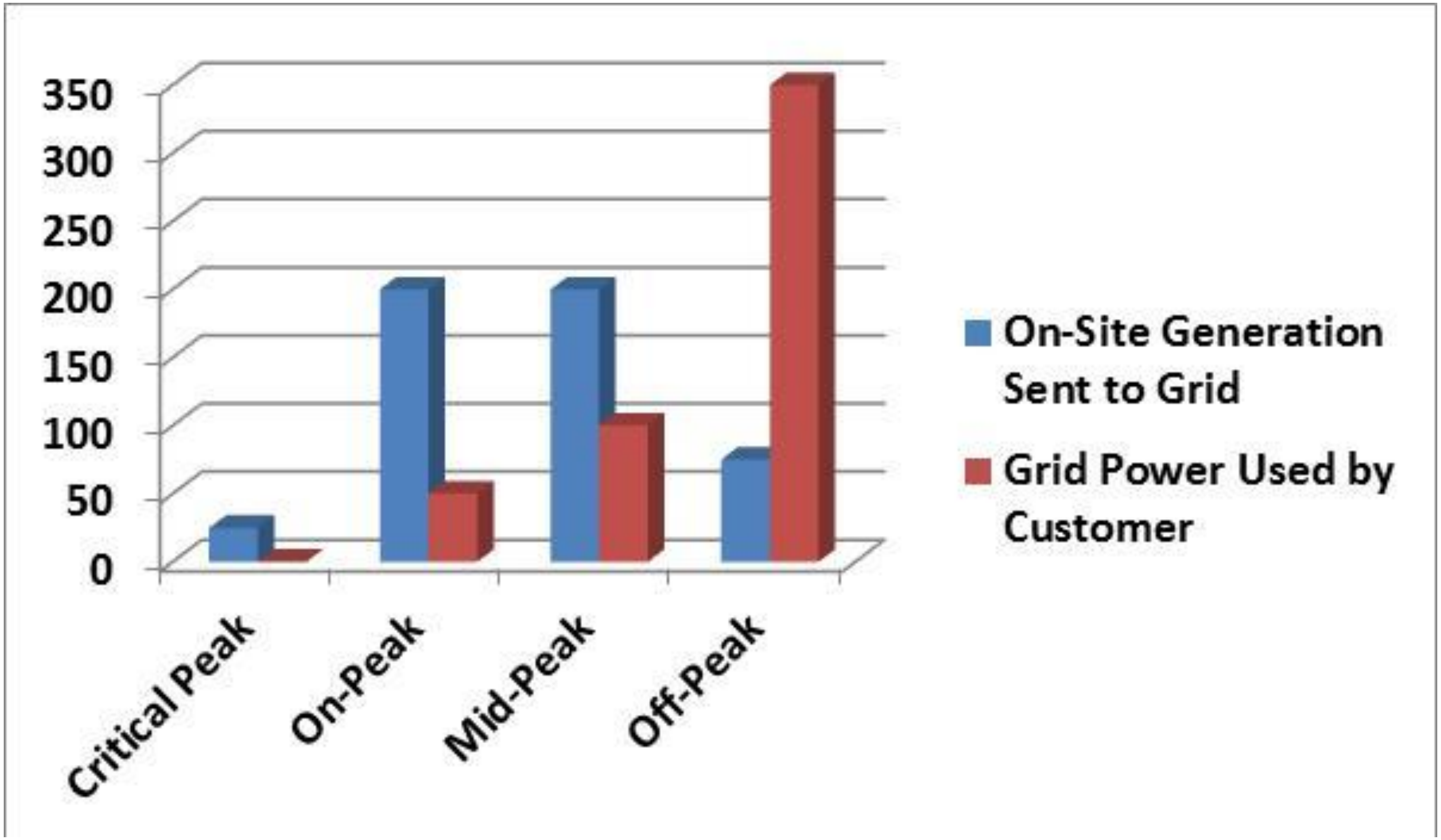
$.02/kWh either direction

Argument: PV customers need a grid and should help pay for it.



But their excess power __never__ backfeeds up to the Transmission System. It stays within the local distribution system. So, only charge them for LOCAL DISTRIBUTION for power they upload to the grid.

Argument: PV customers provide valuable on-peak power to the grid.



So, pay them a TOU price for the power they provide, and charge them a TOU price for the power they use.

Effect of Bi-Directional Pricing

- Step 1: Break down the usage between that produced on-site, and that taken from or sent to the grid.

		Total Usage	Total On-Site Generation	On-Site Generation Used On-Site	On-Site Generation Sent to Grid	Grid Power Used by Customer
Critical Peak		50	75	50	25	0
On-Peak		150	300	100	200	50
Mid-Peak		300	400	200	200	100
Off-Peak		500	225	150	75	350
Total		1,000	1,000	500	500	500

Effect of Bi-Directional Pricing

- Step 2: Apply a Time of Use Rate, with unbundling of Network Distribution from Local Distribution

Customer Service Charge	$	4.87
Power Supply Charge		
Critical Peak	$	0.50
On-Peak	$	0.12
Mid-Peak	$	0.08
Off-Peak	$	0.05
Network Distribution	$	0.01
Local Distribution	$	0.02

Effect of Bi-Directional Pricing

- Step 3: Compute Customer Bill

		Credit for PV	Charge for Grid Power
Customer Service Charge	$ 4.87		$ 4.87
Power Supply Charge			
Critical Peak	$ 0.50	$ (12.50)	$ -
On-Peak	$ 0.12	$ (24.00)	$ 6.00
Mid-Peak	$ 0.08	$ (16.00)	$ 8.00
Off-Peak	$ 0.05	$ (3.75)	$ 17.50
Network Distribution	$ 0.01		$ 5.00
Local Distribution	$ 0.02	$ 10.00	$ 10.00
Subtotal:		$ (46.25)	$ 51.37
Total:			**$ 5.12**
Total Payment for Distribution:			$ 29.87
Net Cost for Power:			$ (24.75)

The bi-directional rate enabled by smart grid investment allows a cost-based rate for energy and delivery.

Customer bill about the same.

But paying $30/month for distribution service.

Cost Recovery For Smart Grid Bottom Line

- Smart grid investments are made primarily to provide demand and energy savings.
- Smart grid cost recovery should follow the benefits – meaning classification and allocation on an energy and demand basis.
- Smart grid investment enables an alternative to traditional pricing that can be devised to be compensatory to both PV customers for the value of power they deliver to the system, **and** recover distribution system costs from PV customers.

Suggested Publications

- **Effect of Smart Metering on Electricity Prices**, European Parliament, 2012
  http://www.lbst.de/ressources/docs2012/EP-11_EFFECT-OF-SMART-METERING-ON-ELECTRITY-PRICES_PE-475-093_LQ.pdf
- **Operations and Maintenance Savings from Advanced Metering Infrastructure - Initial Results**
- **Reliability Improvements from the Application of Distribution Automation Technologies - Initial Results**
- **Demand Reductions from the Application of Advanced Metering Infrastructure, Pricing Programs, and Customer-Based Systems - Initial Results**
- **Application of Automated Controls for Voltage and Reactive Power Management - Initial Results**

http://www.smartgrid.gov/library

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

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