IEE Releases: The Benefits of Smart Meters

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"Smart" meters or AMI (advanced metering infrastructure) enable multiple operational & customer benefits. This study quantifies "***net benefits***" for a range of utility types.*

- Smart meter benefit flows to customers include five categories:
  - Access to information on energy use; updated daily
  - Direct load control 2.0 where shifted load is now measurable and verifiable
  - System wide availability of a peak time rebate (customers stay on current rate but receive incentive to shift load during certain hours on very high priced days)
  - Ability to opt into a critical peak pricing program
  - Ability to charge electric vehicle with a time varying rate
- To illustrate range of benefits, analysis includes 4 "prototype" utilities – South, Central, East and West – with real world load shapes and 1 million customers.
  - Differences include generation mix, capacity and T & D costs, current meters, costs
- Benefits and costs of smart meters
  - Incremental to programs that can be implemented without AMI
  - Developed from a societal perspective, not simply an individual customer's bill savings

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This study was conducted by ***The Brattle Group***. IEE and Brattle thank Cheryl Hindes of BGE and the AEIC load research committee for making real world load shapes available for this study.

IEE study assesses the net benefits of operational improvements from smart meters as well as new energy management options for customers over 20 year time horizon

Value streams	Cost metrics		Benefit metrics							
	Installation costs	O&M costs	Avoided metering costs	Value of outage avoidance	Remote connect and disconnect	Avoided generation capacity costs	Avoided T&D costs	Avoided energy costs	Avoided CO2 costs	Avoided gasoline costs
AMI										
Web portal										
IHD										
DLC with M&V										
PTR										
PTR with enhanced PCT										
CPP										
CPP with enhanced PCT										
EV										

Note: Grey cells are not measured.

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Study includes 4 “prototype” utilities with varying characteristics.

Input	Utility			
	South	Central	East	West
Participation schedule	1	1	2	2
AMI installation cost ($/meter)	334	231	177	212
Avoided meter reading cost ($/meter)	24	12	7	6
Cost of generation capacity ($/kW-year)	50	50	50	50
Cost of transmission & distribution capacity ($/kW-year)	10	10	10	10
Energy price: critical peak ($/MWh)	120	180	240	300
Energy price: peak ($/MWh)	60	70	80	90
Energy price: off-peak ($/MWh)	20	30	40	50
Carbon dioxide emissions rate: peak and critical peak (tons/MWh)	0.57	0.57	0.57	0.57
Carbon dioxide emissions rate: off-peak (tons/MWh)	1.12	0.28	0.57	0.57
Maximum annual peak demand, per customer (kW)	3.88	4.58	2.08	1.84
Demand forecast (annual growth rate)	1.2%	1.0%	0.8%	0.6%

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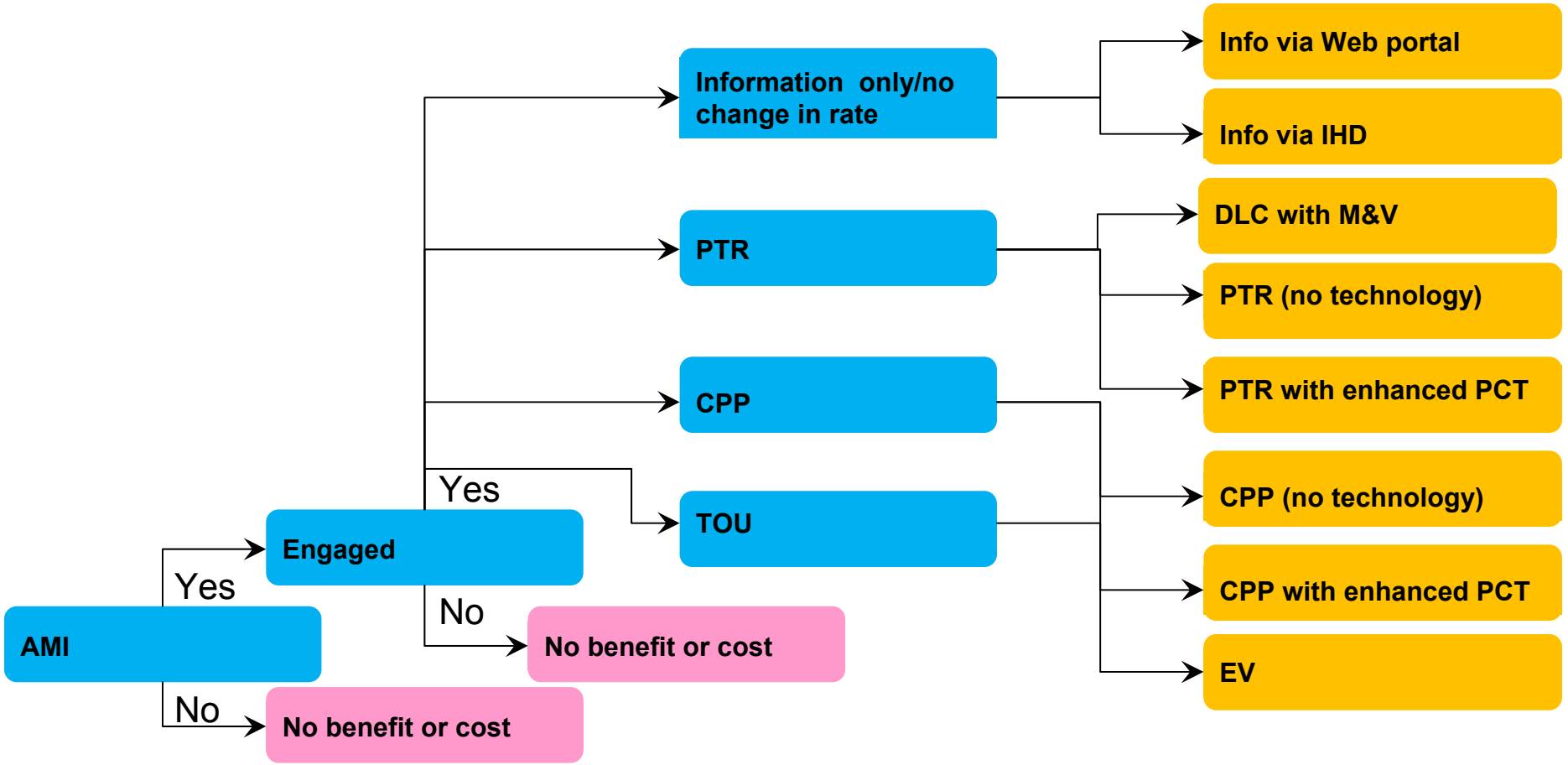
Notes:

For utilities East and West , we assume AMR is in place.

Customer load shapes vary by utility.

Power generation mix varies by utility.

In addition to providing operational benefits to the customer and the grid, smart meters enable new energy management options for customers.

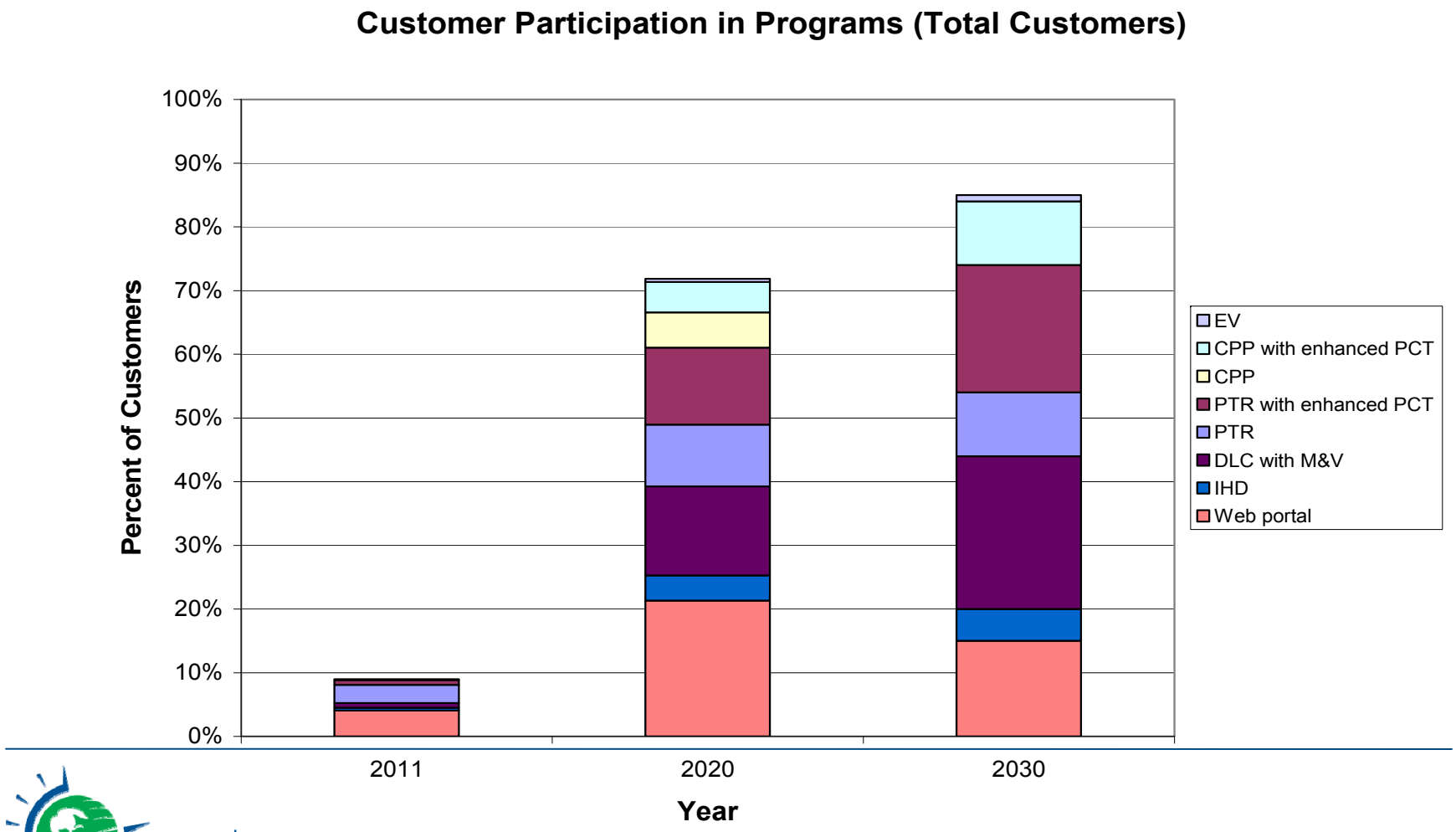


Once AMI deployed, all customers have access to web portal information.

The key question is how many customers will participate in these energy management options/programs!

- As smart meters are deployed nationwide, utilities are experimenting and making different options available to customers under different time frames. Two scenarios are included to capture a range of options.
  1. Some customers participate in an information only option and others participate in smart rate options including PTR, CPP, direct load control, and EVs with a time varying rate.
  2. An "opt out" peak time rebate is available to all customers and some customers "opt in" to other rate based programs including CPP, direct load control, and EVs with a time varying rate. An information only option is not available.

Scenario 1: Some customers participate in an information only option and others participate in smart rate options including PTR, CPP, direct load control, and EVs with a time varying rate.



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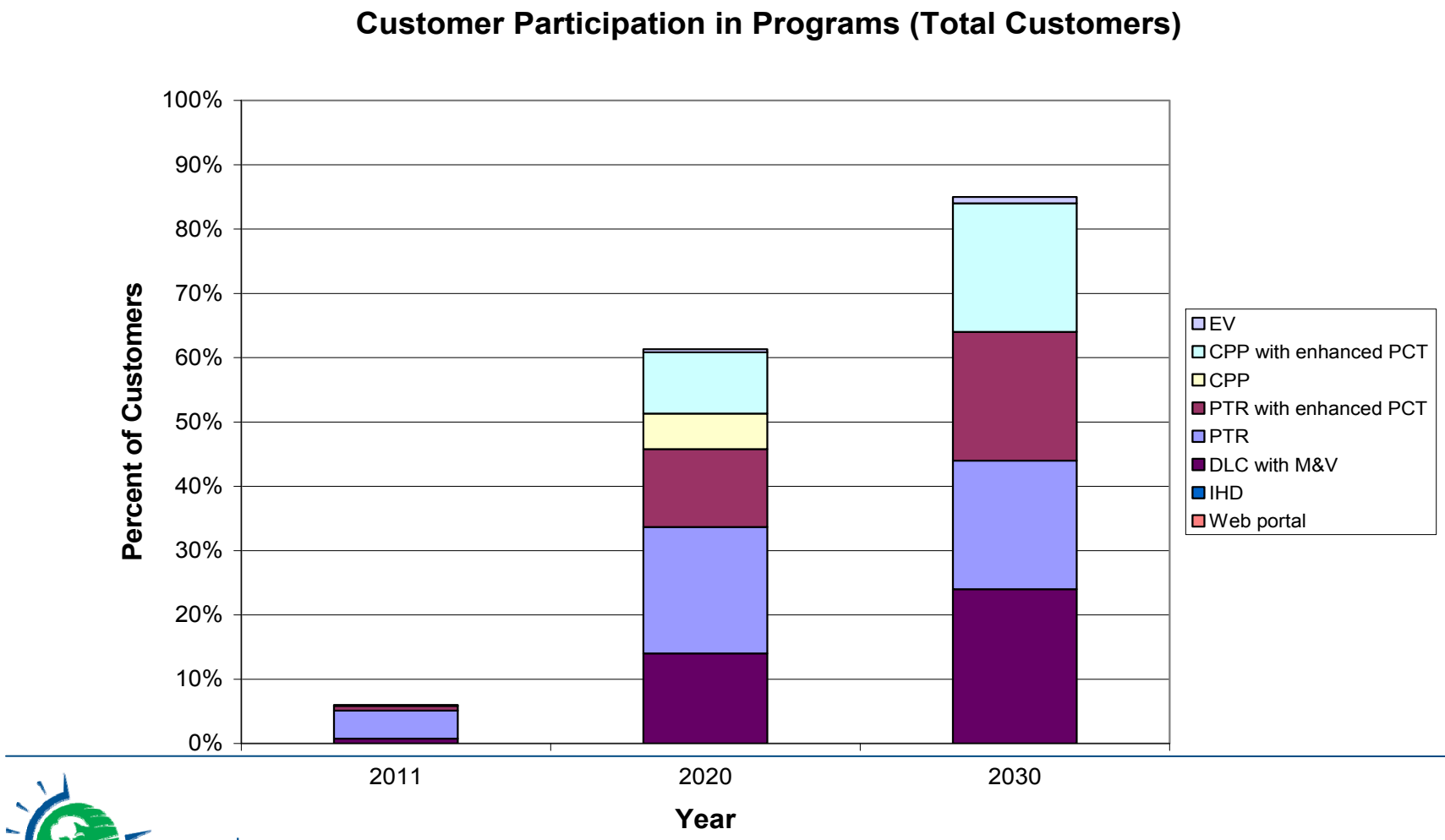
Scenario 2: An “opt out” peak time rebate is available to all customers and some customers “opt in” to other rate based programs including CPP, direct load control, and EVs with a time varying rate. An information only option is not available.



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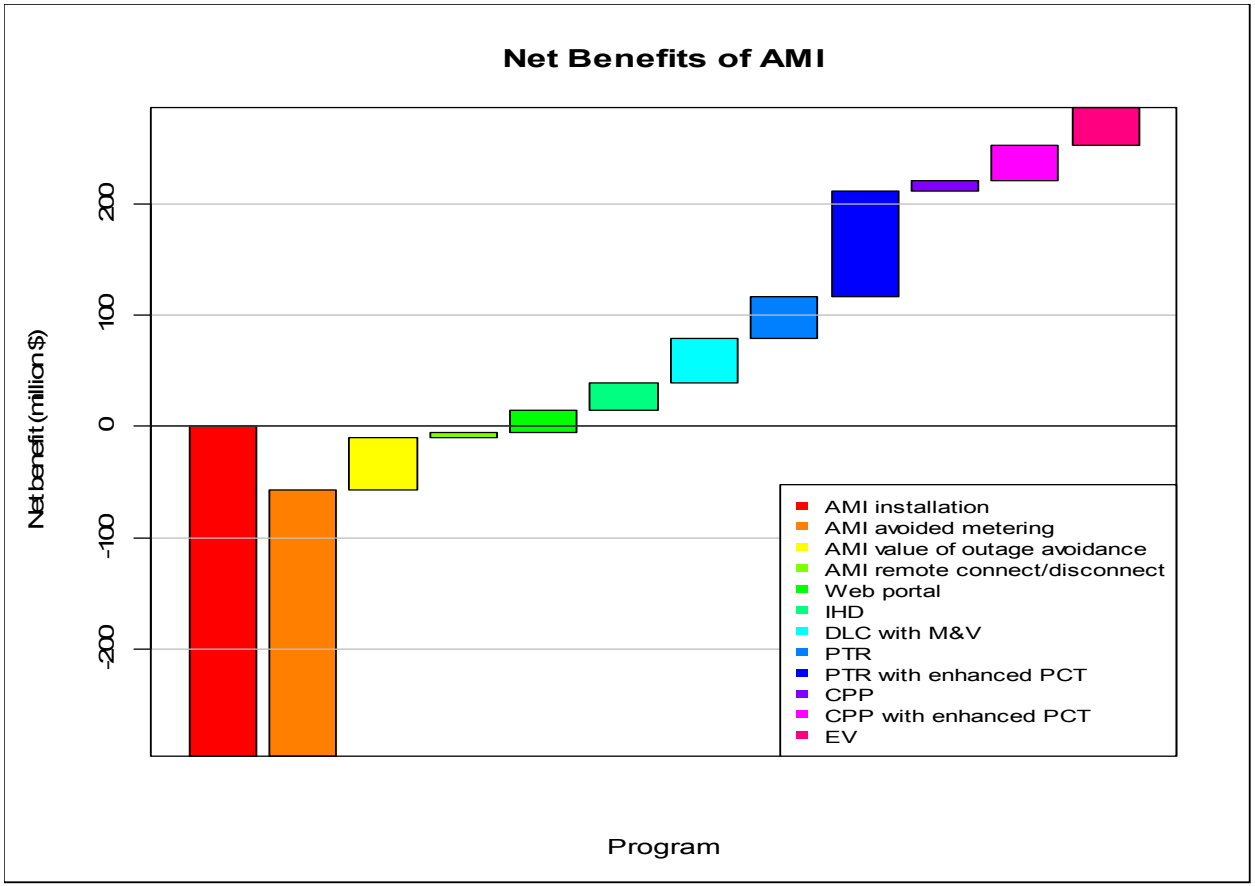
Utility South: This utility's AMI costs are mostly covered by the operational benefits (avoided meter reading, outage detection, and remote connects/disconnects); information programs alone are enough to make net benefits positive.



Utility South: Components of costs and benefits. Very small operational gap. Overall benefit cost ratio is 1.8.

Total NPV Costs, Benefits, and Net Benefits (2011 - 2030)

Value streams	Total Cost	Total Benefit	Net Benefit
AMI installation	296,308,794		-296,308,794
AMI avoided metering		239,566,601	239,566,601
AMI value of outage avoidance		46,994,501	46,994,501
AMI remote connect/disconnect		4,252,307	4,252,307
Web portal		20,199,137	20,199,137
IHD	4,519,641	29,255,040	24,735,399
DLC with M&V		40,073,210	40,073,210
PTR		37,166,507	37,166,507
PTR with enhanced PCT	27,714,414	122,906,813	95,192,399
CPP		10,070,015	10,070,015
CPP with enhanced PCT	11,726,433	43,216,970	31,490,537
EV	32,679,492	66,153,857	33,474,365
Total	**372,948,774**	**659,854,958**	**286,906,185**

Operational gap	**5,495,384**
Operational gap, percent	**2%**

Benefit cost ratio	**1.7693**

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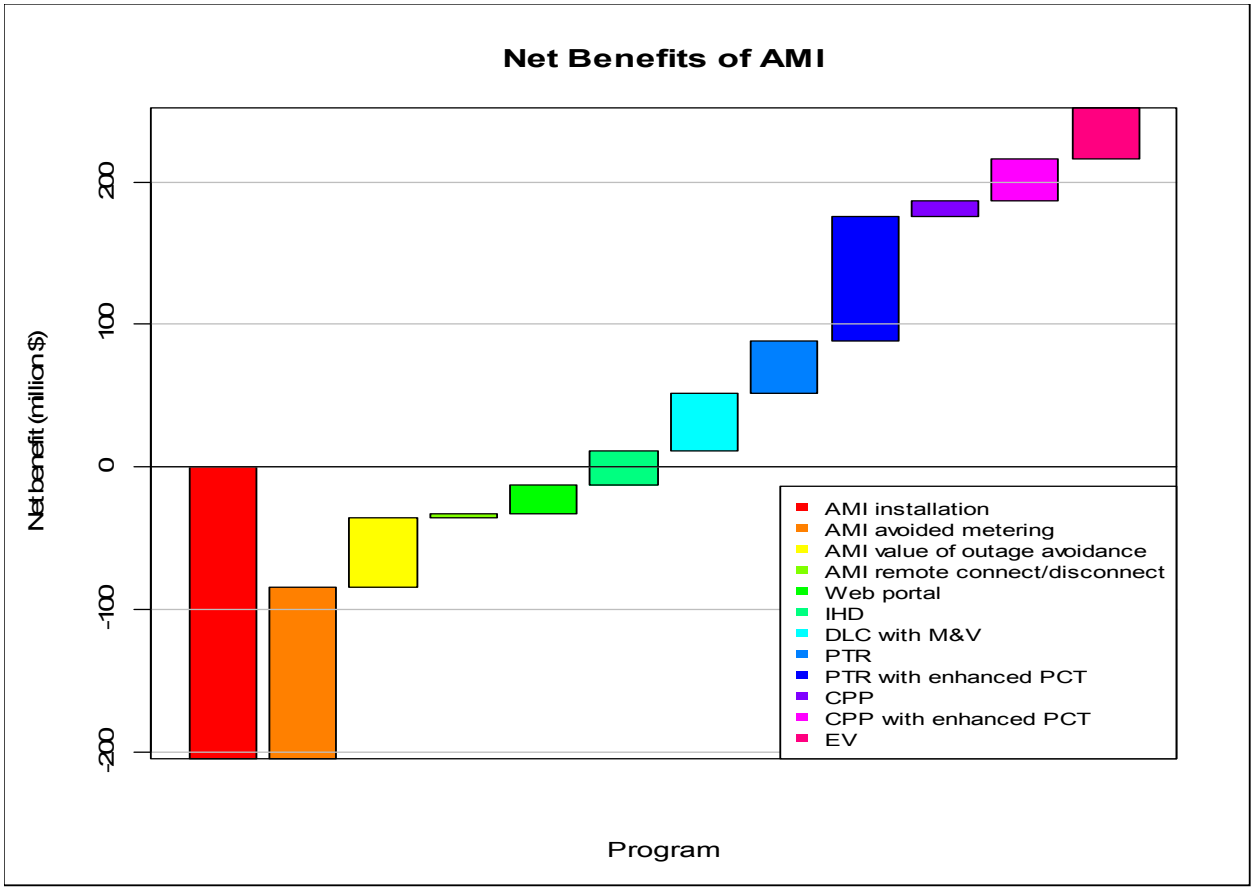
Utility Central: This utility's AMI costs are mostly covered by the operational benefits. information programs alone are enough to make net benefits positive.



Utility Central: Components of costs and benefits; operational benefits lower but still high. Overall benefit cost ratio is 1.9.

Total NPV Costs, Benefits, and Net Benefits (2011 - 2030)

Value streams	Total Cost	Total Benefit	Net Benefit
AMI installation	204,613,390		-204,613,390
AMI avoided metering		119,783,300	119,783,300
AMI value of outage avoidance		49,314,447	49,314,447
AMI remote connect/disconnect		2,255,919	2,255,919
Web portal		20,662,247	20,662,247
IHD	4,519,641	28,315,546	23,795,905
DLC with M&V		40,397,501	40,397,501
PTR		37,230,985	37,230,985
PTR with enhanced PCT	27,714,414	114,701,889	86,987,475
CPP		10,930,419	10,930,419
CPP with enhanced PCT	11,726,433	41,457,650	29,731,217
EV	32,679,492	68,106,735	35,427,243
Total	**281,253,371**	**533,156,638**	**251,903,267**

Operational gap	**33,259,724**
Operational gap, percent	**16%**

Benefit cost ratio	**1.8956**

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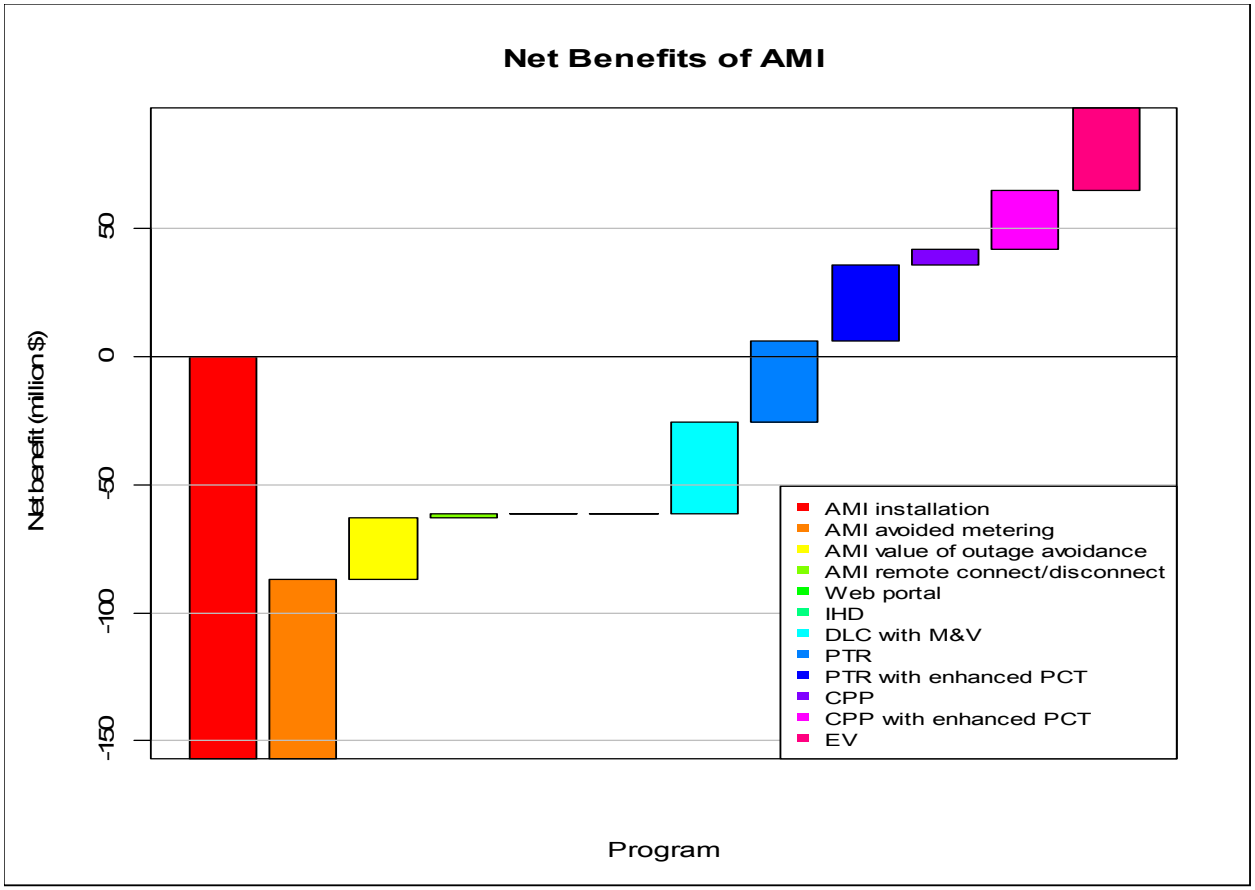
Utility East: Much larger operational gap because utility has AMR in place. Both DLC with M&V and PTR programs help close the gap between AMI costs and benefits.



Utility East: Components of costs and benefits. Operational benefits much lower than South and Central. Overall benefit cost ratio is 1.4 with addition of customer options/programs.

Total NPV Costs, Benefits, and Net Benefits (2011 - 2030)

Value streams	Total Cost	Total Benefit	Net Benefit
AMI installation	156,700,657		-156,700,657
AMI avoided metering		69,873,592	69,873,592
AMI value of outage avoidance		24,056,757	24,056,757
AMI remote connect/disconnect		1,424,090	1,424,090
Web portal		0	0
IHD	0	0	0
DLC with M&V		35,913,213	35,913,213
PTR		31,328,910	31,328,910
PTR with enhanced PCT	27,714,414	57,640,550	29,926,136
CPP		5,995,614	5,995,614
CPP with enhanced PCT	23,364,084	46,625,431	23,261,347
EV	32,679,492	64,585,337	31,905,845
Total	**240,458,647**	**337,443,494**	**96,984,847**

Operational gap	**61,346,218**
Operational gap, percent	**39%**

Benefit cost ratio	**1.4033**

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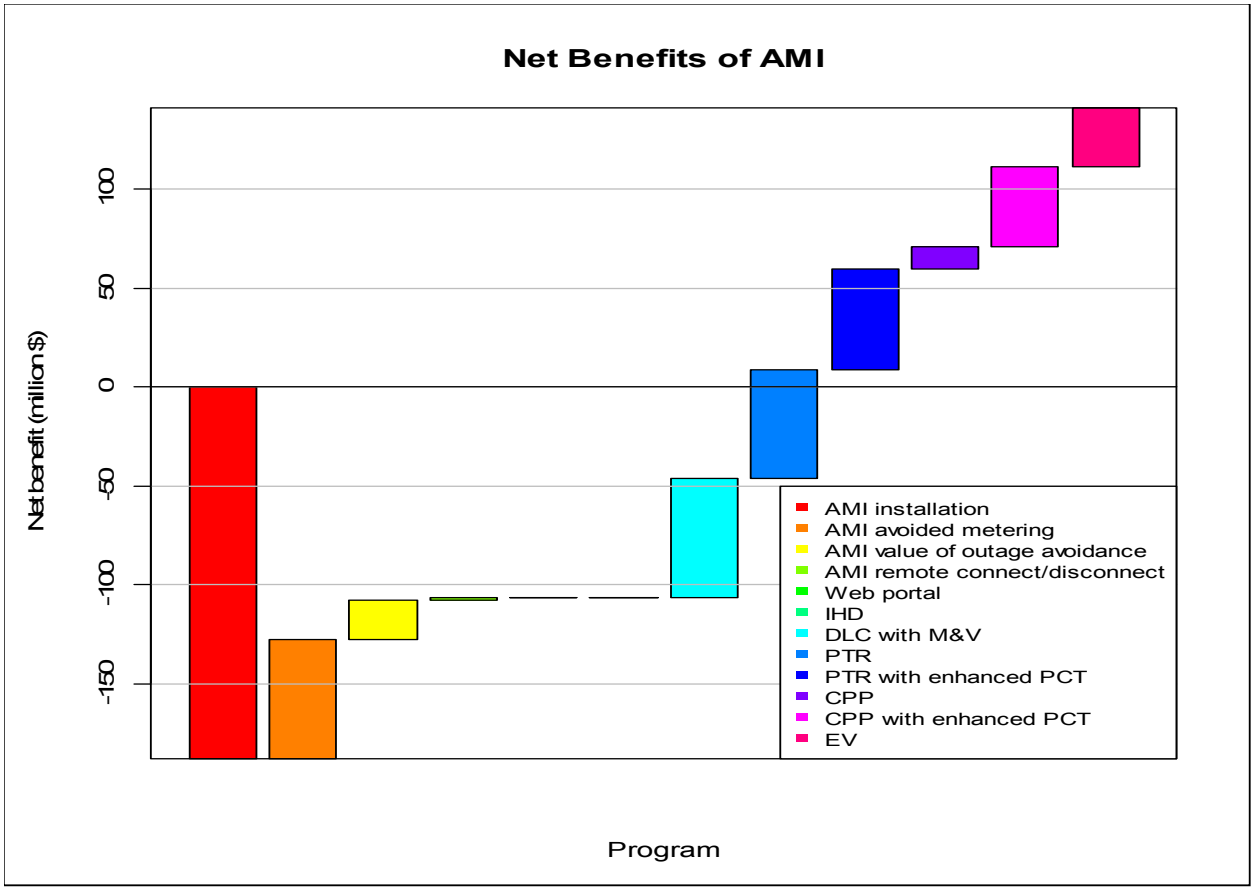
Utility West: Largest operational gap because utility has AMR in place. Both DLC with M&V and PTR programs help close the gap between AMI costs and benefits.



Utility West: Components of costs and benefits. Operational benefits are the lowest of the four utilities. Overall benefit cost ratio is 1.5 with addition of customer options/programs.

Total NPV Costs, Benefits, and Net Benefits (2011 - 2030)

Value streams	Total Cost	Total Benefit	Net Benefit
AMI installation	187,721,976		-187,721,976
AMI avoided metering		59,891,650	59,891,650
AMI value of outage avoidance		19,759,280	19,759,280
AMI remote connect/disconnect		1,257,725	1,257,725
Web portal		0	0
IHD	0	0	0
DLC with M&V		60,737,609	60,737,609
PTR		54,598,358	54,598,358
PTR with enhanced PCT	27,714,414	78,998,937	51,284,523
CPP		11,568,973	11,568,973
CPP with enhanced PCT	23,364,084	63,333,472	39,969,389
EV	32,679,492	62,545,025	29,865,533
Total	**271,479,966**	**412,691,030**	**141,211,064**

Operational gap	**106,813,321**
Operational gap, percent	**57%**

Benefit cost ratio	**1.5202**

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Offering customers options to manage energy create value and produce benefits to customers and society.

- In this analysis, we purposely examined a range of utilities with different characteristics.
  - In all cases, the benefits of smart meters exceeded the costs.
  - Overall, the NPV of net benefits of smart meters ranged from $96 (East) to $287 (South) million for the 20 year period.
- Beyond operational benefits, smart meters allow utilities to offer a range of options to engage customers in managing energy. Such programs
  - Result in savings to the customer.
  - Add significantly to the net benefits of smart meters thereby creating overall economic value for society

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