Transitions to Smart Grid, a.k.a. Modernizing Distribution Systems: Major Factors Affecting Cost Effectiveness

Synapse Energy Economics, Inc.

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Rick Hornby

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Overview & Conclusions

1. Overview –

   A. These transitions should be considered part of each utility's normal capital expenditures. The distribution systems of all U.S. electric utilities are already "smart" to varying degrees. Advances in communication and computer technologies are driving utility proposals to transition to even "smarter" distribution systems.

   B. Proposed scale and pace of proposed transition is enormous. The few large utilities with transitions now underway are finding them to be difficult and complex. These transitions pose serious challenges for the Country's more than 3,000 electric utilities, 90% of whom serve less than 50,000 retail customers.

2. Conclusions –

   A. Many proposed transitions are not supported by demonstrations of either need (i.e. reliable service) or cost-effectiveness (i.e., reasonable rates). A few proposals appear to be cost-effective, many do not.

   B. Cost-effectiveness of proposed projects depends on a few key categories of costs and savings. The key costs are for communication and back office system infrastructure. The key savings are in distribution operating expenses; generation and T&D capacity costs and in annual electric energy costs.

   C. Many utilities are recovering or proposing to recover the costs of these transitions via surcharges or trackers that place most if not all of the risk on ratepayers.

Overview & Conclusions

- Suggested Reading
  - ___, *Illinois Statewide Smart Grid Collaborative: Collaborative Report*, September 30, 2010
  - Presentation by Scott Hempling to FERC - NARUC Smart Grid Collaborative, November 14, 2010
- Reason for caution – Despite over 10 years of studies and installation of 16 million smart meters there is still much uncertainty regarding demand response, efficiency and distributed generation benefits.

1. Utilities are Proposing Transitions to Smarter Distribution Systems

A. The distribution systems of all US electric utilities are already "smart" to varying degrees. Advances in communication and computer technologies are driving utility proposals to transition to even "smarter" distribution systems.

– The distribution systems of all US electric utilities are already "smart" to varying degrees. Most utilities currently record 15 minute interval usage of large C&I customers and can notify those customers of hourly prices and impending critical peak periods.

– Advances in computer and communication technologies are driving utilities to make their distribution systems even smarter by extending this functionality to residential and small commercial customers. Eventual modernization is inevitable - look at changes in other residential services since 1990 – cable TV, cell phones, email, internet applications.

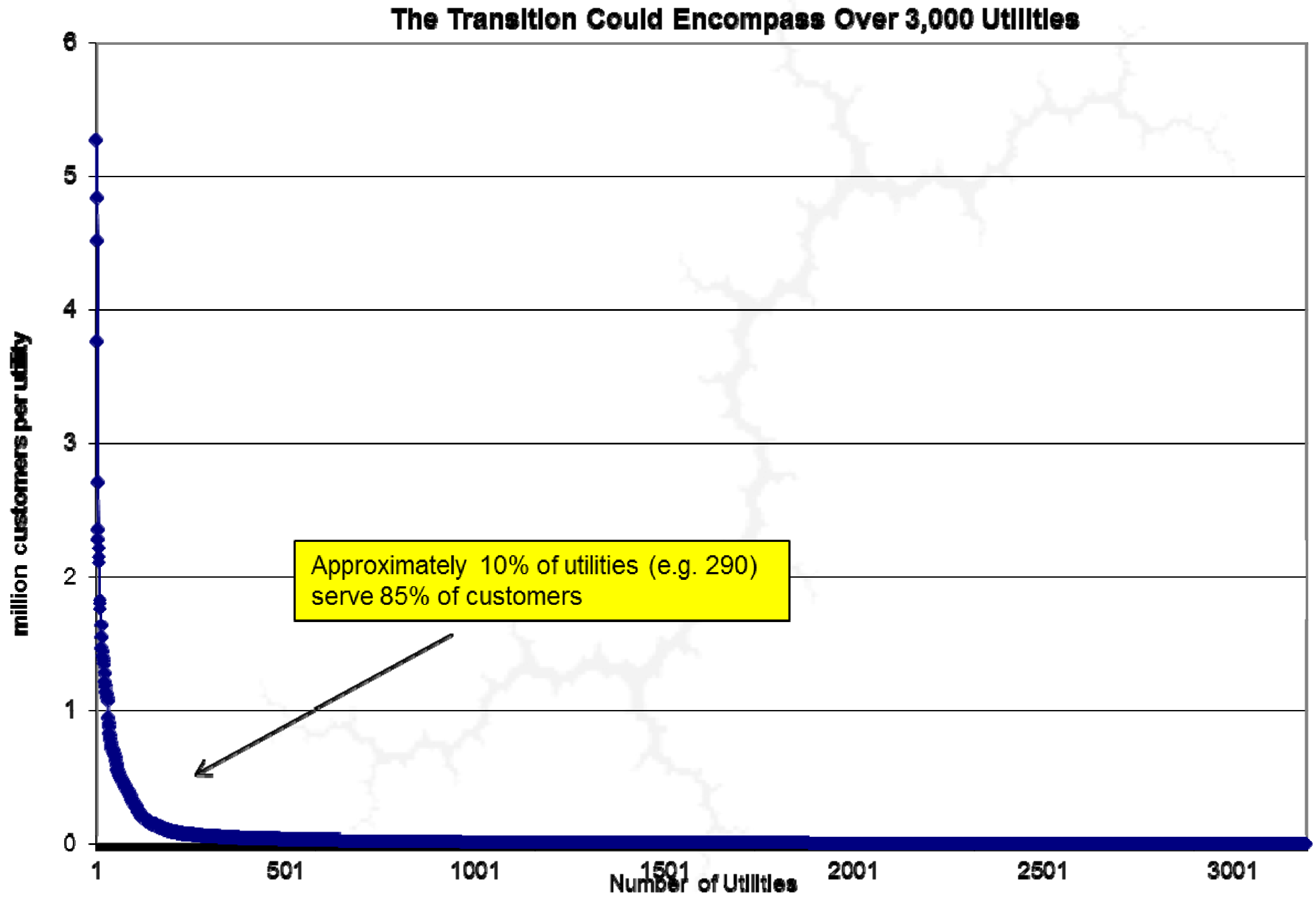
– Some utilities have made, and continue to make, incremental investments in new technologies such as communication systems, distribution automation, advanced meters as part of their routine capital expenditures (e.g. ENEL in Italy).

1. Utilities are Proposing Transitions to Smarter Distribution Systems

B. Proposed scale and pace of transition is enormous

- The U.S. has approximately 3,200 electric utilities at the state level, serving 140 million retail customers. Of those
  - a few are very large, e.g. 30 utilities serving 1 million or more customers
  - The vast majority are quite small, 90 percent serve less than 50,000 customers
- Comprehensive Investments in smart grid projects are typically more complex and comprehensive than incremental investments in individual smart grid technologies.
  - Moving to smart meters increases data communication and processing by orders of magnitude. Usage data increases from 1 data point per residential customer per month to approximately 3,0000 data points per residential customer per month. In addition, systems will have the capability to send hourly price signals to every customer
  - These increases require major transitions in communication, data processing, billing and customer interface systems
  - To maximize savings these transitions must be implemented on a system-wide basis within a short time period, typically 3 to 5 years.

1. Utilities are Proposing Transitions to Smarter Distribution Systems



2. What is a Reasonable Pace and Cost for Transition Proposals

At what pace, and cost, is it reasonable for U.S. electric utilities to make those investments?

• We have reviewed various utility smart grid filings in NJ, ME, DC, MD, PA, NV,TX, CA, IL. These reviews are either through direct participation in proceedings or review of utility filings and/or regulatory commission orders in those proceedings.

•Results of review

- All projects are based upon numerous assumptions that are uncertain. These include assumptions regarding actual costs and performance of new technologies on a system-wide basis over time, value of avoided capacity, customer participation in and response to dynamic pricing, customer engagement in and response to feedback, cyber-security and obsolescence.
- A few proposed projects appear cost-effective, particularly with ARRA grants (e.g., MD - BG&E, NV – NV Power, MD – PEPCO)
- Many projects have not presented business cases which clearly demonstrate cost-effectiveness

2. What is a Reasonable Pace and Cost for Transition Proposals

A. Many proposed Transitions are not supported by demonstrations of either need (i.e. reliable service) or cost-effectiveness (i.e., reasonable rates).

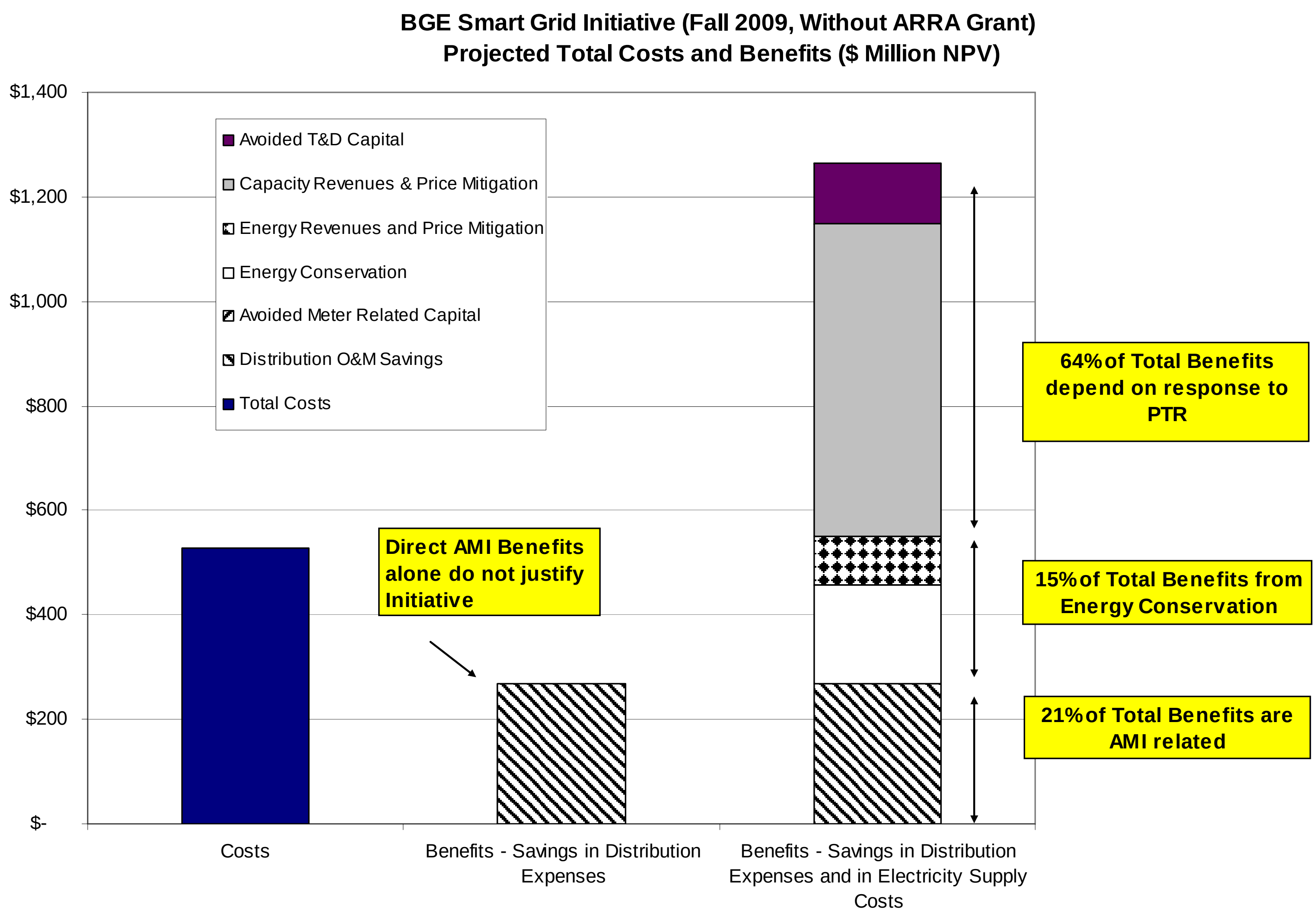
- A proposal is cost-effective if the Net Present Value (NPV) of its projected savings are greater than the NPV of its projected revenue requirements, i.e. a benefit to cost ratio greater than 1.

- Considerable variation in the cost-effectiveness of proposed projects. Some proposals appear to be cost-effective, many do not. For example:

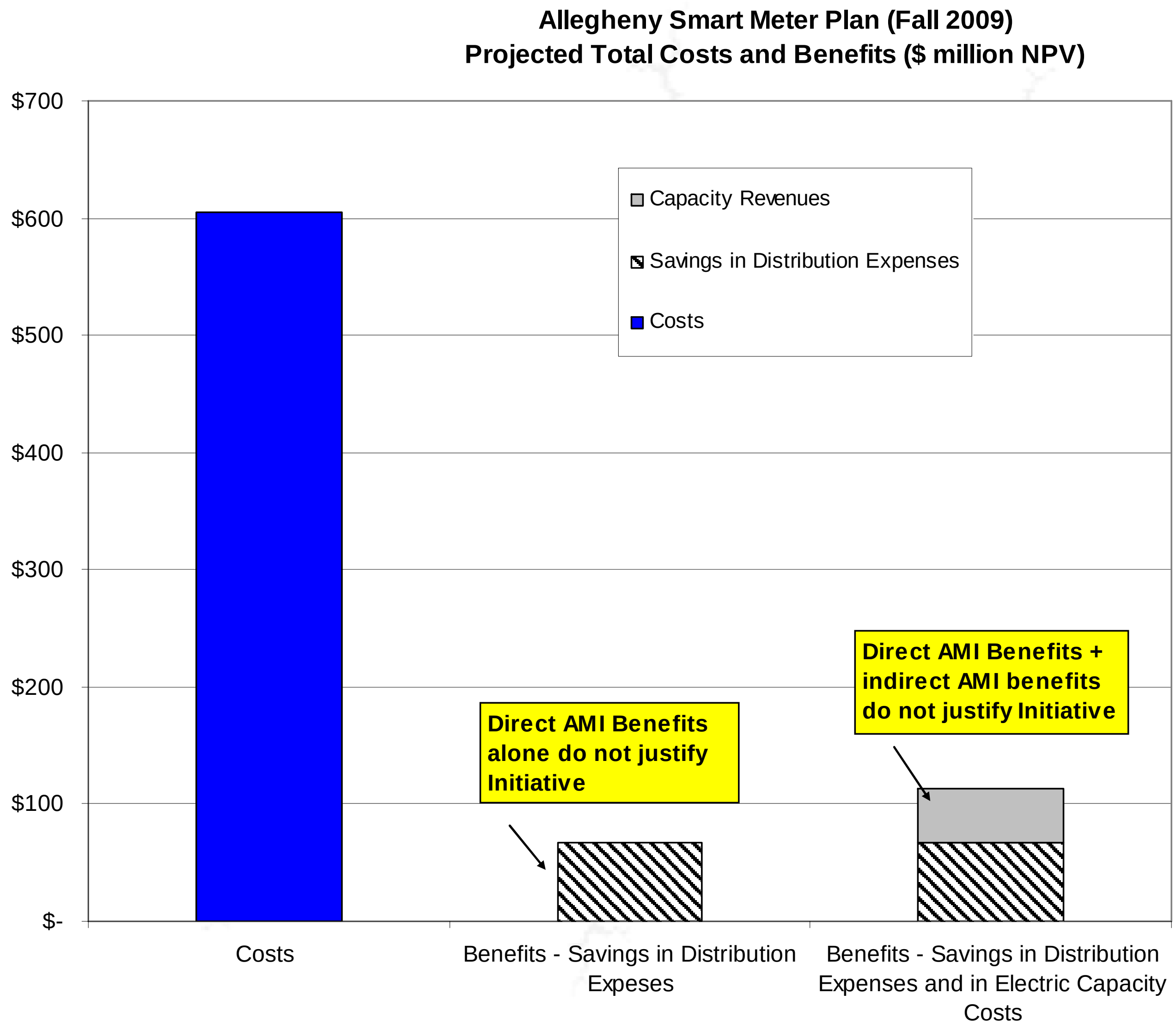
  – parties to the BG&E proceeding in MD generally agreed that the NPV of the project's expected savings would exceed the NPV of its revenue requirements, although they disagreed on the magnitude of that excess.

  – parties to the Allegheny Power proceeding in PA did not agree that the NPV of the project's expected savings would exceed the NPV of its revenue requirements. The Company itself did not even forecast savings in excess of costs

Cost - Effective



Not Cost - Effective



2. What is a Reasonable Pace and Cost for Transition Proposals

B. Cost-effectiveness depends on a few key categories of costs and savings.

- projected costs
  - communication system
  - back office hardware and software

- projected savings
  - in distribution operating expenses
  - projected savings in generation, transmission, and distribution capacity costs
  - Projected savings in annual electric energy use

COSTS Affecting Cost-effectiveness

The major costs of a smart grid project of any utility can be grouped into 3 major categories, i.e. - Smart meters, Communication network and Back Office Systems)

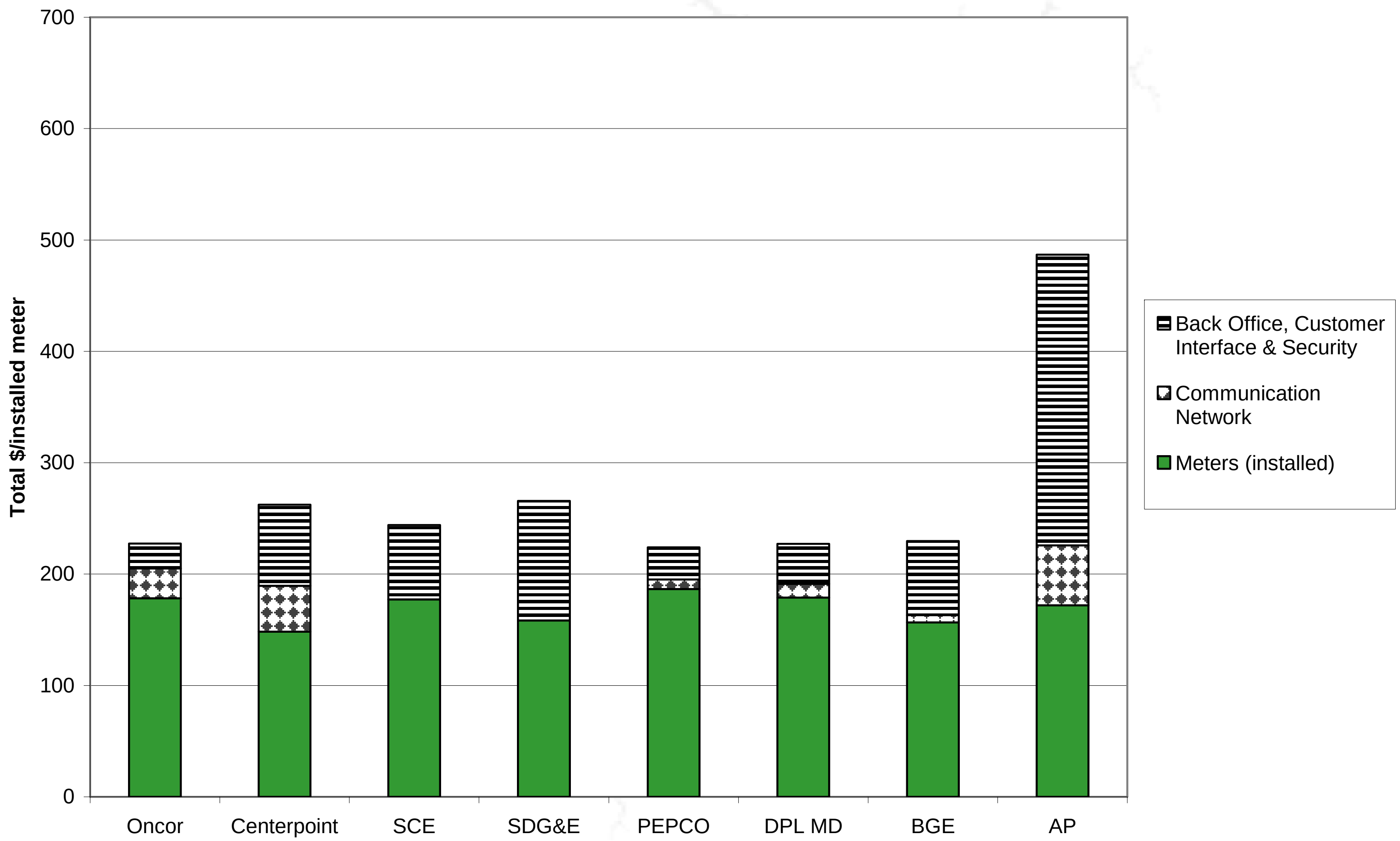
One can compare the costs of smart grid projects of various utilities at a high level by expressing either the total capital costs of those projects or, even better, their annual revenue requirements on a unit or per installed meter basis. For example, total capital costs of project divided by number of installed meters = capital cost per installed meter.

Our analyses of several unit capital cost comparisons indicate:

- Little variation in the smart meter component. That component is typically in the range of $200 per installed meter.
- Considerable variation in the Communication and Back Office System components. Those components may range from *$50 to $300 per installed meter*. That range is due to the scope of the transition at the particular utility as well as the size of the utility.

COSTS Affecting Cost-effectiveness

Capital Costs of Smart Meter Infrastructure Projects Expressed in $ per installed meter



COSTS Affecting Cost-effectiveness

Variation in the unit cost of Communication and Back Office Systems is primarily due to 3 major factors

i. Age and capacity of existing communication and back office systems. If a utility's existing Communication and Back Office Systems are relatively new and have adequate capacity, the utility can transition without large investments. If a utility's existing Communication and Back Office Systems are relatively obsolete and/or do not have adequate capacity, the utility may require large investments.

ii. Geography / customer density of service territory, i.e. urban vs. Rural . The type and cost of communication technology a utility uses to serves rural areas tends to differ from those it uses to serve urban areas.

iii. Number of customers in service territory. The costs of Back Office Systems seem to be relatively similar for large and small utilities, i.e. the costs of those systems do not "scale" with the size of the utility. As a result, a small utility will incur almost the same Back Office Systems as a large utility but will have to recover those costs over fewer customers.

BENEFITS Affecting Cost-effectiveness

The major projected quantitative benefits of a smart grid project of any utility can be grouped into 3 major categories of projected savings

i. **Distribution operating expenses.** (Actual savings can be verified ex post.)

ii. **Generation, transmission and/or distribution capacity costs.** (Direct savings due to reductions in demand enabled by smart grid technology, indirect savings due to reduction in marginal cost of capacity resulting from lower demand. Some actual savings may be difficult to verify ex post.)

iii. **Annual electric energy supply costs.** (Direct savings due to reductions in energy use enabled by smart grid technology, indirect savings due to reduction in marginal cost of energy resulting from lower energy use. Some actual savings may be difficult to verify ex post.)

In addition, many utilities describe non-quantified benefits including improved reliability of distribution service, enabling of plug-in hybrid electric vehicles (PHEV) and enabling of distributed generation.

Our analyses indicate considerable variation between utility smart grid projects in each of those four categories of benefits

BENEFITS Affecting Cost-effectiveness

i. Projected savings in distribution operating expenses

- Reductions in annual operation and maintenance expenses. Major categories are:
  - Meter reading
  - Revenue protection (reduction in theft)
  - Distribution & local transmission planning
  - Credit & Collections (reductions in uncollectibles)
  - Billing
  - Meter operations

- Magnitude of these reductions depends on how “smart” the existing distribution system already is. For example, a utility that has already invested in automated meter reading will not see large savings in meter reading expenses from the installation of smart meters.

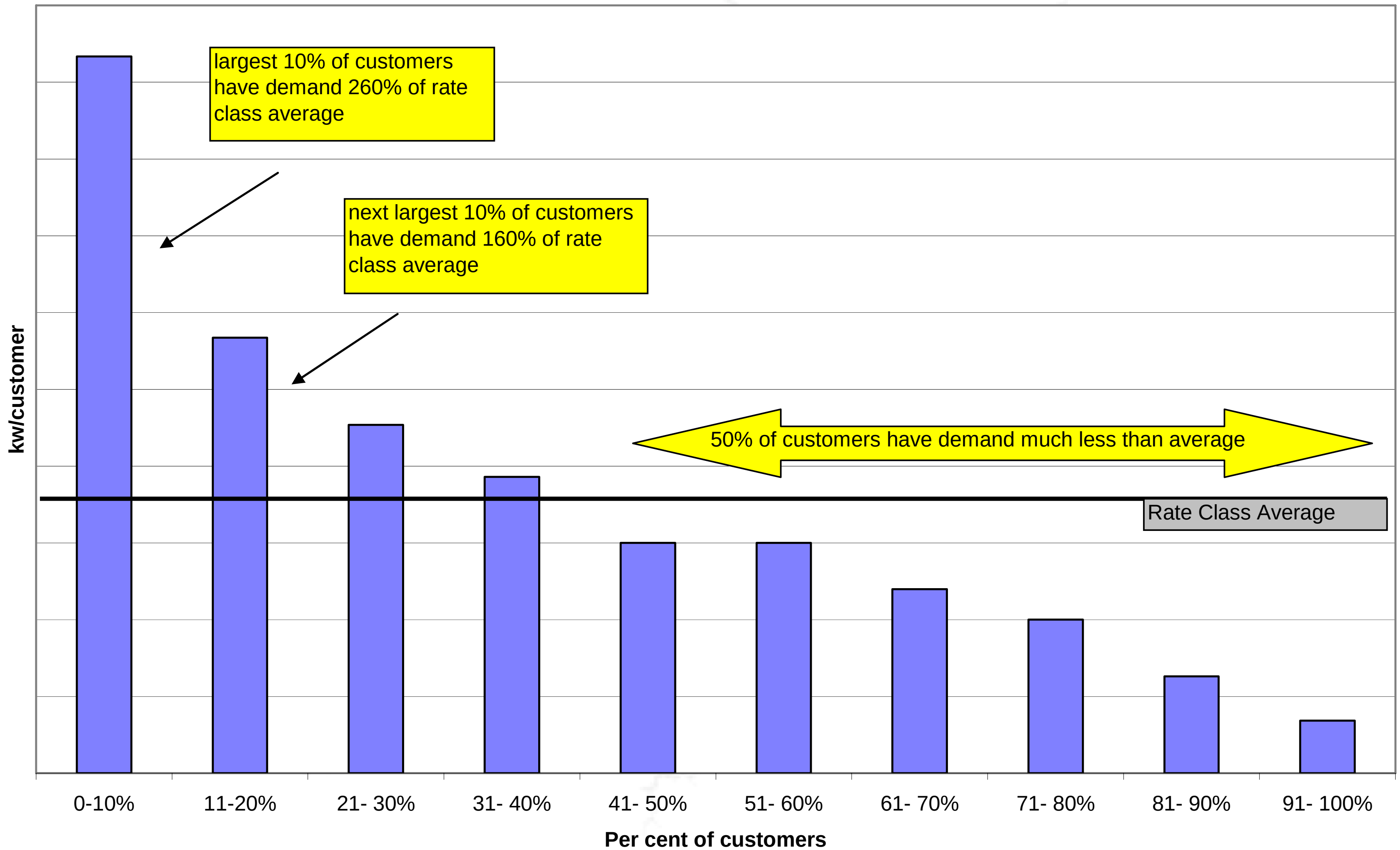
BENEFITS Affecting Cost-effectiveness

ii. Projected savings in generation, transmission and distribution capacity costs

- Reductions in capacity costs require sustained reductions in customer demand
- Utilities are projecting reductions in demand in response to dynamic pricing enabled by smart grid technology (Reductions in demand through direct load control are excluded because utilities can achieve these without smart meters).
- The projected savings in capacity costs assume that reductions in demand will be achieved by paying participants incentive based on high values of for avoided demand indefinitely. Incentives are usually based on avoided the cost of a new gas fired CT), typically $60 to $100 per kW-year. In fact, analyses of long-term demand and supply may indicate that avoided demand may only be valuable for a few years, if it is valuable at all, because the region has or will soon have adequate capacity through 2020 (e.g. recent NERC report.)
- The projected savings in capacity costs assume that a significant percentage (e.g. 20%) of residential customers will voluntarily reduce their demand in response to dynamic prices every year over the planning horizon. There is considerable uncertainty regarding these projections. Actual rates of residential participation in the few jurisdictions which offer various pricing (e.g. TOU, RTP, DP) range from 1 to 5% with participation of 20% to 30% being the exception. One reason for the low participation is the wide distribution of usage per residential customer. As illustrated in the next slide, a small % of customers have very high usage while many customers have much lower usage.

Percentage of Residential Customers Who Will Respond to Dynamic Pricing is Uncertain

Illustrative distribution of kw/customer in residential rate class (NJ utility)



BENEFITS Affecting Cost-effectiveness

iii. Projected savings in electric energy supply costs

- Utilities are projecting reductions in annual electricity use in response to customized feedback on their usage (i.e., the "nudge" factor).

- Achieving reductions in electricity use from residential customers via customized feedback is relatively new. Feedback can be, and is being, provided using monthly usage data from existing meters as well as hourly usage data from new smart meters. *It is not yet clear whether feedback based on hourly usage data from new smart meters, dynamic pricing and web portals leads to materially greater reductions than feedback from monthly usage data, nor that any such reductions are sustainable over time.*

  - _____. *Residential Electricity Use Feedback: A Research Synthesis and Economic Framework.* EPRI, Palo Alto, CA: 2009. 1016844 (*Feedback Research Synthesis)*. Available at http://www.opower.com)

  - Ehrhardt-Martinez et al., *"Advanced Metering Initiatives and Residential Feedback Programs,"* ACEEE, Washington, D.C., June 2010

BENEFITS Affecting Cost-effectiveness

Non-quantified benefits

- The value of improved reliability of distribution service will depend on the reliability of the existing distribution system. If existing reliability is high, the value of an improvement may be low.

- There is little, if any, evidence or analysis demonstrating that a smart grid will cause the percentage of residential customers installing DG to be materially higher. There is considerable uncertainty regarding the percentage of residential customers who will actually purchase PHEVs over the next 10 to 15 years. If only a small percentage of customers actually install DG or purchase PHEVS, it may be more cost-effective to initially provide only those customers with smart meters rather than replacing all meters of all customers over the next few years.

2. What is a Reasonable Pace and Cost for Transition Proposals

C. Many utilities are recovering or proposing to recover the costs of these transitions via surcharges or trackers that place most if not all of the risk on ratepayers.

- Surcharges or Trackers
  - California
  - Maine
  - Massachusetts
  - Ohio
  - Oklahoma
  - Oregon
  - Texas
  - Vermont
  - Wisconsin
- Base Rates
  - Arizona (APS)
  - Delaware (Delmarva)
  - Indiana (Duke Energy, AEP)
  - Maryland (BGE)
  - Michigan (CE, DTE)
  - Nevada (NV Energy)

• Some information from Rob Wilhite, KEMA Consulting, presentation dated September 17, 2010 available at http://www.smartgridtoday.com/cost_recovery.pdf

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Recent Orders Regarding Cost Recovery

- In June 2010, Ohio PSC approved FirstEnergy application **without** approving cost recovery mechanism. As a result FirstEnergy suspended SmartGrid pilot (Docket 09-1820-EC-ATA)

- In June 2010, MD PSC rejected initial BG&E application, but approved revised application that modified cost recovery mechanism (Orders 83410 & 83531, Case No. 9208)

- October 2010, Illinois Appellate Court overturned ICC's ruling of cost recovery mechanism for ComEdison (Illinois Appellate Court Docket 1-08-3313)

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Contact Information

Rick Hornby

Senior Consultant

Synapse Energy Economics

(617) 661-3248, ext. 243

rhornby@synapse-energy.com

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