Charge-to-Group – WG 4

Interim Status Report

EPS Working Group IV

November 5, 2007

WG 4 – Emerging Technologies, Demand Response, Peak Load Reduction

- Electricity and Natural Gas Energy Efficiency and Usage Reduction
  - District Energy/District Steam?
- **Usage measured in (kWh)** and Demand (kW)
- End-user Sector and T&D

WG 4 – Sequence of Efforts

- Compile a catalog of Market Activity for both Emerging Technologies and Demand Response
- Identify Gaps and possible barriers or hurdles for usage or continued growth in NY
- Compile Recommendations, with sensitivity to integration of Proposed with Existing
- Forecast Costs, Benefits, and Beneficiaries

WG 4 – Ground Rules

- Broad Format
  - not exclusive to any one company or market sector
- Where diverse opinions exist, express Majority and Minority viewpoints

Emerging Technologies and Practices

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WG 4 – Inspiration

- … 15 by 15 will address the rising tide of young people leaving New York by fueling a job-rich clean power industry that is driven by the race to meet our target. Think of all the high-paying jobs that will be needed to retrofit power plants, homes and office buildings so they can be more efficient; the jobs that will be needed to develop innovative efficiency and clean energy technologies … (Governor Eliot Spitzer, *"15 by 15" A Clean Energy Strategy for New York*, April 19, 2007, page 6)
- … more efficient use of energy has the potential to foster economic development and job growth by encouraging in-state technology advances to deliver energy efficiency programs to consumers… An EPS should be designed ultimately to reduce customer bills, stimulate State economic development, and create jobs for New Yorkers... Consider and prioritize end-user efficiency programs, market transformation approaches, research and development… (Case 07-M-0548, *Proceeding on Motion of the Commission Regarding an Energy Efficiency Portfolio Standard*, Order Instituting Proceeding, Issued and Effective May 16, 2007, pages 3, 6, 7)
- Increase investments and cooperation in energy-technology innovation to develop the new systems and practices that are needed to avoid the most damaging consequences of climate change. Current levels of public and private investment in energy technology research, development, demonstration, and pre-commercial deployment are not even close to commensurate with the size of the challenge and the extent of the opportunities (United Nations Foundation and The Scientific Research Society, *Confronting Climate Change: Full Report*, February 27, 2007, page xvii)

WG 4 – Emerging Techs Definition

- Define Emerging Technologies (ETs) based on Major Characteristics (as opposed to compiling a Stagnant List - open to all ideas)

- Can be a Widget or a Business Practice
  - Example: Retro-commissioning

WG 4 – Major Characteristics of ETs

- May Not yet be Commercially Mature
- Have Technical, Business, and Market Risks
- Enables Energy Efficiency
- Potential to reach Commercialization by 2015
- Applicable for use in NYS
- Efforts to advance Emerging Technologies cannot appropriately be assessed using a traditional Total Resource Cost (TRC) test

WG 4 – Examples of Some ETs

Advanced Lighting	On-Site Generation	Heating & Cooling	Energy Storage	Sensors & Controls	Improved Combustion & Heat Transfer
■ LEDs ■ Daylighting ■ etc.	■ PV ■ MicroCHP ■ Microturbine ■ Fuel Cell ■ etc.	■ Solar DHW ■ Geothermal Heat Pump ■ Residential condensing water heater for DHW ■ etc.	■ Advanced Batteries ■ Flywheel ■ Ultracapacitor ■ etc.	■ Advanced Meters ■ Load shed ballast ■ Occusmart occupancy sensor ■ etc.	■ Superboiler ■ Partial oxidation gas turbine ■ Ultra-low NOx supplemental firing ■ Metal forging heat transfer ■ Advanced glass melting ■ etc.

WG 4 – Specific ET Example: Occusmart Sensor

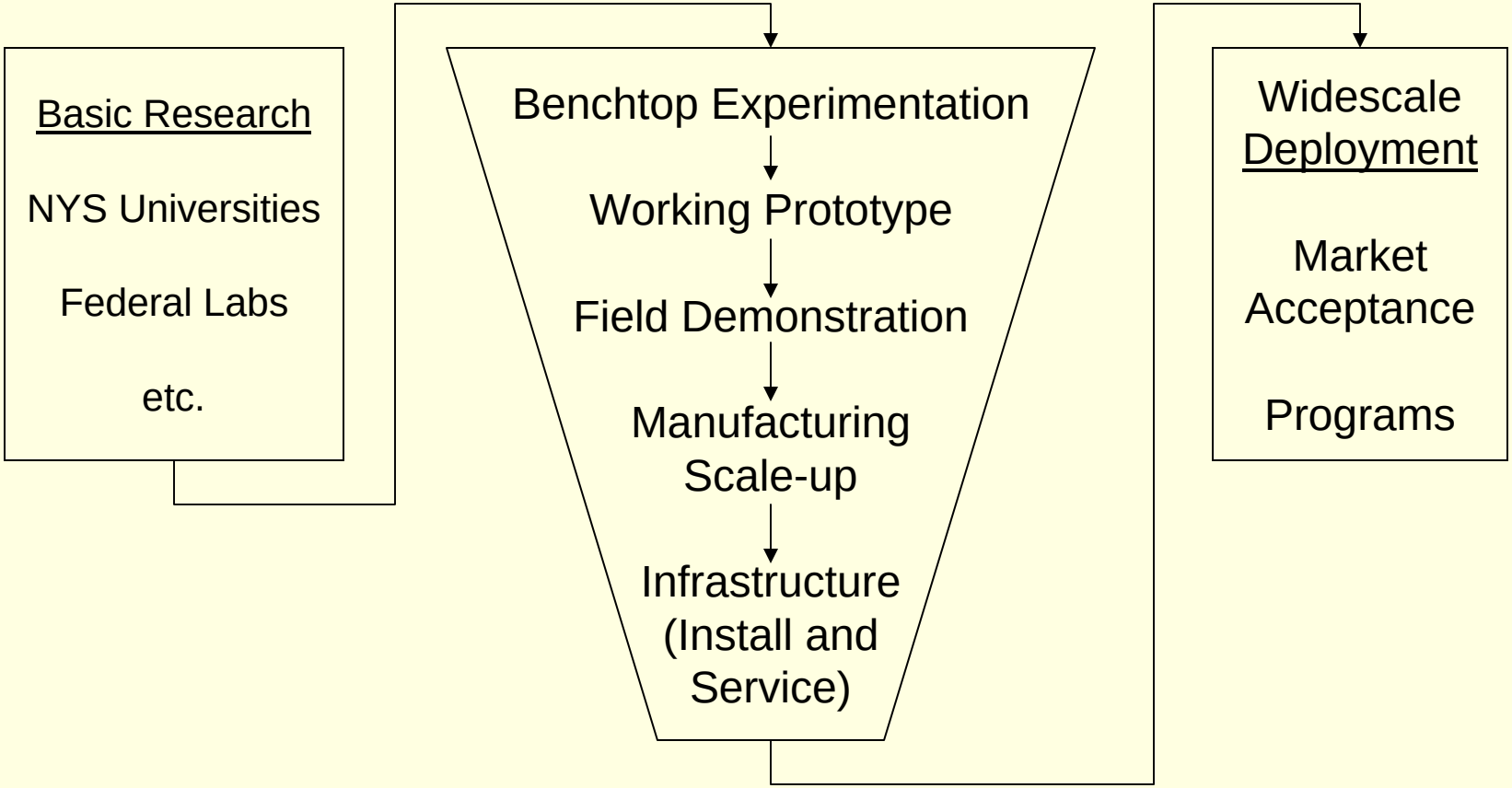
- Traditional occupancy sensors turn lights Entirely Off, or 100% brightness On
- Hallway and stairwell lights in multistory buildings are typically 100% On for 24/365
  - Stairwells occupied 1 – 3% hours per year
- A newly invented sensor automatically toggles lights between dim (33%) and 100%
- Potential savings 50,000 kWh/yr per building

- “Simple idea - I could have invented that”

WG 4 – ETs Need Support

- Long Timeframes for new products
- Business and Technical Risks and Funding
- Lack of consumer awareness/confidence
- Avoid large “lost opportunities” associated with timing of decision/relative cost of measure (new construction -vs- retrofits)
- Collateral and non-energy benefits
- Could Spur Economic Development in NYS
- Promise of a better tomorrow (new amenities)

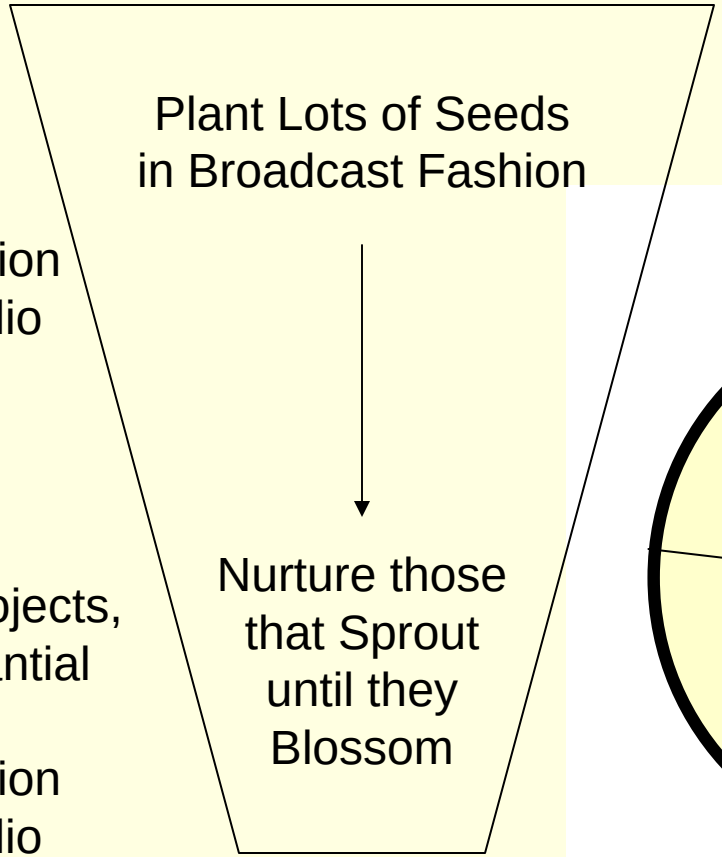
WG 4 – Pathway from Concept-to-Commercialization



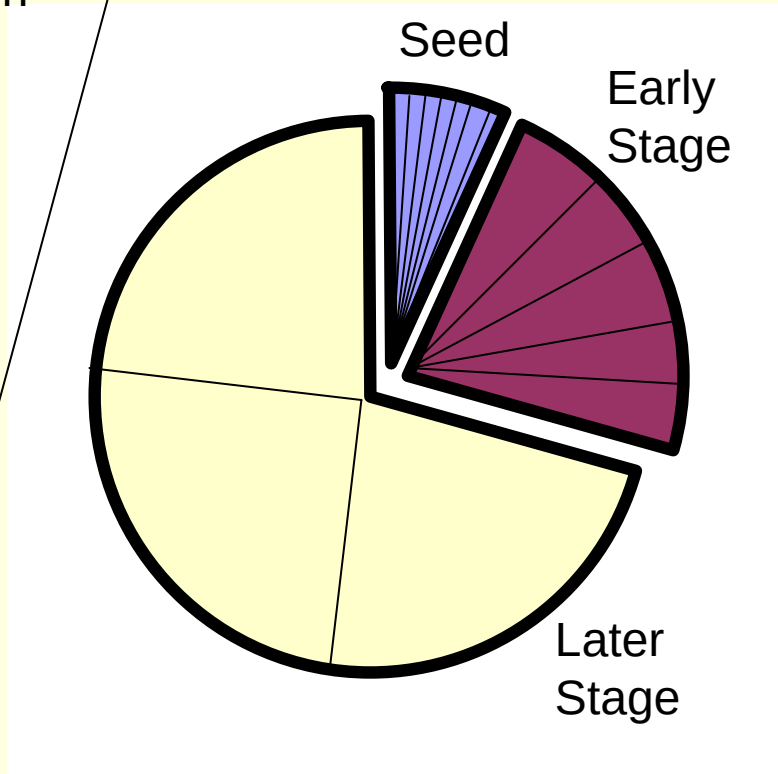
WG 4 – Options Theory

<u>"Seed" funding</u>
Large number
of projects, each
at very-low dollars:
Sums to Minor Fraction
of Investment Portfolio

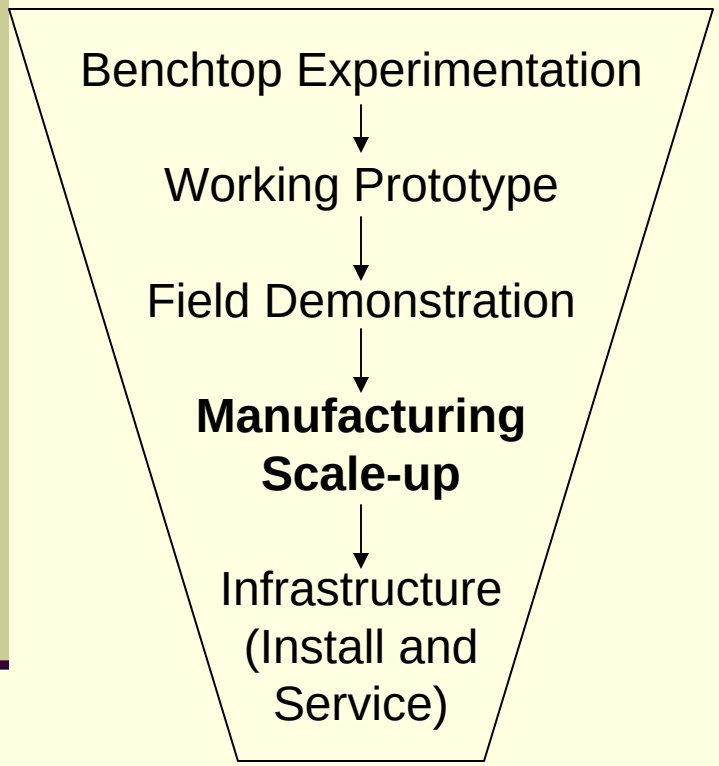
"Later-stage"
<u>Venture funding</u>
Fewer number of projects,
each at more-substantial
dollars:
Sums to Major Fraction
of Investment Portfolio



"Portfolio"
Approach



WG 4 – Hurdles - Example



- Attempting to identify Generic Hurdles associated with each various stage experienced by inventor/entrepreneur
- Example (Manufacturing Scale-up) "Chicken and Egg Scenario"
  - Need large sales-volume for mfg scale-up, but
  - Need mfg scale-up to reduce costs to attract large sales-volume
- Successful Model:
  - Question – How to get a job without experience, and how to get experience without a job?
  - Answer – College Co-op and Internship!

WG 4 – Catalog of Some Hurdles

- DG/Grid Integration
  - Net Metering
  - Interconnection
  - Standby Rates
  - Codes Issues
- Workforce Training for Installation & Maintenance Technicians
- Bi-directional Communication Infrastructure and Common Protocols

WG 4 – Next Step: Recommendations

- There may be more than one way to overcome a particular hurdle
- If multiple pathways are identified, will strive to list in priority order and note reasoning
- Or, may need a combination of actions in concert to overcome a hurdle

Demand Response / Peak Load Reduction

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Working Group Process – Brainstorm and Discussion

- Initial discussion of goals and objectives and overall methodology
- Assess the lay of the land
  - Identification of current programs
  - Identify barriers in New York's current programs and markets
- Brainstorm ways to overcome barriers
- Brainstorm new opportunities that have not yet been pursued

Working Group Process – Collection of Ideas into Straw Man

- Ideas from the first two meetings were collected to form a straw man proposal of recommendations for future opportunities
- Discussion of straw man led to more mature ideas
- Experts on each topic were tasked with developing a more detailed proposal of how to achieve demand reductions within that topic area

Working Group Process – The Path Forward

- Proposals on each topic are being collected and complied into draft recommendations
- Draft recommendations will be vetted to the group for discussion and revision
- Recommendations will be revised to best represent the consensus of the group
- A final report, including recommendations will be presented on December 5th.

Ideas Under Discussion

1. Advanced Metering Infrastructure (AMI) Deployment
2. Controllable End Use Technology R&D and Deployment
3. Smart Grid (More efficient overall grid management)
4. Resolution of Metered Data Access Issues
5. Use of Current DR Customers and Technology for EE
6. Increased Deployment of Current Programs
7. Long Term Contracts for Load Reductions
8. Expanded Use of Current DR Resources

Other forums exist for some topics – We don't want to reinvent the wheel, but rather use the expertise of this group to inform other groups

1. Advanced Metering Infrastructure (AMI)

- Mass deployment of AMI gains economy of scale and will serve as a critical backbone in better grid management
- AMI is market ready now – deployment should not be delayed, if shown to be cost effective
  - Technology will always evolve, can we wait for the evolution to be complete?
  - Care should be taken to “future proof” the technology
- Cost Benefit Analysis should be carefully conducted to ensure cost effectiveness while the benefits of all cost effective measures are captured

AMI Special Considerations

- Future Proof Technology
  - Include Demand Response Capability
  - Standardized, Open Protocol Communications for both meter communication and DR signals
  - Advancement of controllable end-use technology
- Maximize Benefits
  - Carefully consider all the ways to use DR resources (capacity, energy, synchronous reserves, etc.)
  - Create rates that stimulate changes in behavior (hourly or critical peak pricing)
  - Create a regulatory environment that motivates utilities to consider demand side resources on equal footing with supply side (revenue decoupling discussions currently underway)

2. Controllable End-Use Technologies

- While the backbone of AMI is being created, demand responsive end-use technology (appliances, air conditioners, etc.) should be advanced through R&D and deployment efforts
- AMI can provide a valuable communication gateway to control appliances
- Standardized communication is necessary to allow for mass deployment across utility territories
- Establish an “Energy Star” type label for high efficiency, controllable appliances ie. “Green Grid” labeled appliances

3. Smart Grid

- Combine AMI, Controllable Appliances, and actionable information to use for better grid management
- Utilities and grid operators can collect near real time data to better monitor grid performance
- Data can be analyzed to determine corrective actions
- Corrective Actions can be implemented using the communication and controls backbone
  - Demand Response, Power Factor Correction, Voltage Adjustment, etc.
  - Near real time data can accelerate NYISO settlement procedures saving interest payments associated with settlement delays

4. Resolution of Metered Data Access Issues

- Currently, access to metered data is not uniform throughout New York State, and is not direct to meters
- Demand Response requires an interval meter
- Currently, most DR providers install interval meters, even if one is already in place
- This allows them access to data, but is a redundancy that could be avoided
- New York should investigate meter security with the intended outcome of allowing customers and DR Providers direct meter access, as security permits
- New York should consider specific time requirements on utility pulse initiator installations

5. Use of Current DR Customers & Technology for Efficiency

- DR customers tend to be energy savvy and have interval meters and sometimes advanced controls
- Existing customer base could be utilized
- Controls could be used to improve daily energy efficiency
- Interval Meters could be used to assist with Measurement and Verification
- Hourly pricing customers also have interval meters and should be pursued for DR & EE opportunities
- M&V and payment structures must be carefully considered

6. Increased Deployment of Current Programs

- New York has some of the most successful programs in the country. Any new programs developed should not supplant current programs.
- It is recommended that current programs be continued with efforts to increase activity
- Increased activity can come from increased funding, increased outreach and reduction of identified barriers

7. Long Term Contracts for Load Reductions

- Long term contracts will help grow New York's infrastructure of DR Providers
  - Long term contracts provide price stability that allows providers to safely scale up
- RFPs could be issued to secure long term load reduction contracts at fixed prices
- If forward capacity markets are developed, consideration should be given to Energy Efficiency

8. Expanded Use of Current DR Resources – Synchronous Reserves

- Some DR resources have technology that allows for very quick response time
- These resources could be dispatched (and compensated) as synchronous reserves
- NYISO is developing a program for this, but current metering requirements are prohibitive to all but the largest resources
- An evolution of this program could include smaller resources

8. Expanded Use of Current DR Resources – Emissions Reduction

- Non-Generation based DR resources could be dispatched for emissions reduction
- Ozone alerts are issued by DEC and could be a trigger point to call DR resources to reduce power plant emissions
- Reduction in reliance on peaking powers plants leverages large emissions reduction
- The monetary value of these emissions reductions could be studied and offered as payment to DR resources
- Could help bring New York closer to ozone attainment

DR's Contribution to 15x15

- It is clear that Demand Response is a part of EPS, although unclear how it's contribution will be measured
- It is this group's recommendation that:
  - A kW based goal be established
  - It be made explicit the role that demand response is to play in 15x15

Next Steps

- Refine discussion items into formal Recommendations
- Some discussion items may not materialize into recommendations
- It is not expected that all recommendations will be implemented. All should be studied, and implemented if determined feasible.
- All DR recommendations should be subject to careful consideration including benefit/cost screenings before being implemented

Transmission & Distribution System Optimization

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Transmission & Distribution (T&D) Optimization by Managing Losses

- Effective Management of T&D System Losses Offer Significant Energy Savings Opportunities
- Reactive Power is a Significant Contributor to T&D System Losses
- Reactive Power Management is a Long-standing, Good Utility Practice, Typically Done With Capacitors
- Effects of Reactive Power Not Bounded by Points of Demarcation Between Transmission (i.e., Bulk Power Grid), Sub-Transmission, & Distribution Systems

Reactive Power More Effectively & Economically Managed at its Source

- Textbook Example of How a Customer Can Improve Distribution System Losses by ~31%

Background

Loss factor is defined as the ratio of the average losses over a specified period of time to the peak losses during that same period.
While it is relatively easy to determine **Load Factor**, it is difficult to determine **Loss Factor** because average system losess cannot be easily determined.
The reason for this is, in part, due to the fact that system losses vary as the square of the current.

As would be expected, **Loss Factor** varies as some function of **Load Factor**. The following empirical relationship between **Load Factor (LdF)** and **Loss Factor (LsF)** has been determined to be a relatively good approximation for calculations on a distribution system having a typical load cycle:

LsF = 0.15*LdF + 0.85*LdF*LdF

The cost of conductor losses per year = LsF*(kW Loss at peak load) * (cost per kWH) * 8760

Benefit of Capactor banks on Distribution feeders (Example):

A 10 mile, 13.8kV utility line with an impedance of (0.2 + j 0.6) ohm/mile serves an industrial customer with a peak load of 8 MVA at 0.8 Power Factor (PF) and a 0.6 Load Factor. The customer has just purchased a 3 MVAR bank of capacitors.

Losses without the cap banks:

Per phase peak current value =	334.6958	Amp
Loss Factor = Average loss/Peak loss =	0.396	
Avg. Losses = I2 R * Loss Factor =	88.72086	kW per Phase
Toal Annual Losses =	2,331.58	MWH per year

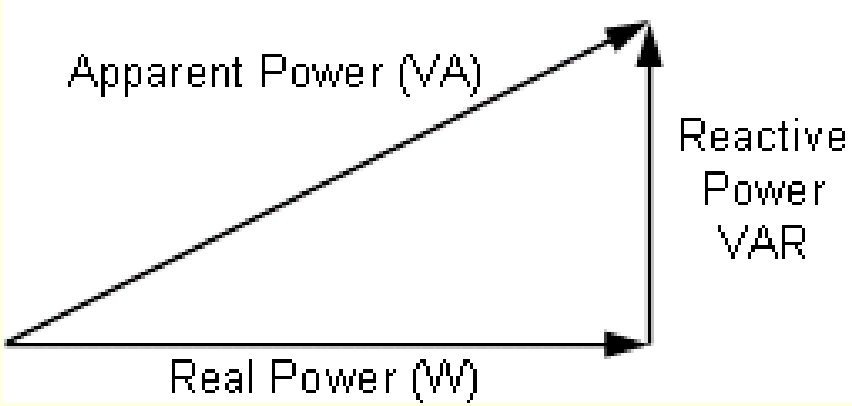
Losses with the cap banks:

0.8 PF means power angle of :	0.643501		
8 MVA at 0.8 PF = Real Power/Reactive Power =	6.4 MW	/	4.8 MVAR
with 3 MVAR, the industrial load becomes =	6.4 MW	/	1.8 MVAR
that is, the new load to the Distribution system =	6.648308	MVA	
Per phase peak current value =	278.1451	Amp	
Loss Factor = same as without the cap bank =	0.396		
Avg. Losses = I2 R * Loss Factor =	61.27284	kW per Phase	
Toal Annual Losses =	1,610.25	MWH per year	

Total Annual Losses Saving = 30.94%

Managing Reactive Power at its Source

- Current/Available Metering Could be Leveraged to Incent Investment in Reactive Power Correction
- Reactive Power Typically Measured by Power Factor



Power Factor = Real / Apparent

- Retail Rate Structures that Contain Compelling Provisions for End-Users to Maintain Minimum Power Factors is Would Encourage Awareness & Action

Affects of Reactive Power Not Isolated Across the Power Grid

- As Previously Stated, Effects of Reactive Power Not Bounded by Points of Demarcation Between Transmission (i.e., bulk power grid), Sub-Transmission, & Distribution systems
- Ineffective Reactive Power Management Not Only Results in Increased Energy Consumption from T&D System Losses, But Also Affects Reliability
- Poor Reactive Power Management at Sub-Transmission & Distribution System Levels are Parasitic on Measures Undertaken at Bulk Power System Level, Affecting Transfer Capability (i.e., ability to move energy through the State)

Affects of Reactive Power Not Isolated Across the Power Grid

- Enforceable Standards for Interconnections Between Transmission, Sub-Transmission, Distribution Systems, and End-Users Could Ensure Consistent Application of Good Utility Practices & Energy Efficiency
- T&D Systems are not Sufficiently Monitored or Automated to Recognize or Correct Power Factor as System Conditions Changes with Energy Use
- SmartGrid Technologies Could Provide the Metering, Communication, & Automated Control Capabilities to Manage Reactive Power in a More Dynamic Fashion

Other T&D System Opportunities for Energy Efficiency

- Investment in Superconductivity Could Result in Further Reductions of T&D System Losses by Reducing the Resistance of Conductors
- Effective Reactive Power Management Could Also provide Opportunities to Manage System Voltages More Efficiently
- Voltage Affects Energy Usage As Follows:

  Watts = Voltage x Current
- For Example, Voltage at a Distribution Substation May be "Pumped-Out" at a Level Equivalent to 120 Volts at the End-User Level Just to Deliver 110 Volts to the Customer.
- Managing System Losses Such That Voltage at the Substation Can be Reduced to 115 Volts Results in a 5% Energy Reduction