

Scope of Commercial Analysis

- **About 50 measure bundles**
 - Commercial Buildings (square feet by segment)
 - High Rise Residential (New for 7 Plan)
 - Appliances (number of units)
 - Processes (flow rates or population based measures)
- **Many measure permutations ~ 300**
 - By building type, climate zone, vintage, heating system
 - By decision event (New, Retrofit, Natural Replacement)
 - Multiple efficiency tiers

Methodology (Units)

- **Units driven by building segment floor space**
 - Load forecast model provides SF by year by segment
 - SF driven by employment
- **A few measure bundles are population driven:**
 - Wastewater & Water Supply
 - Computers, package refrigeration
 - Streetlight & infrastructure
- **Units estimates tied to load forecast**

Building Type
Assembly
Food Service
Grocery
Hospitals
Lodging
Office
Other
Residential Care
Retail
Schools
Universities
Warehouse

Data Sources

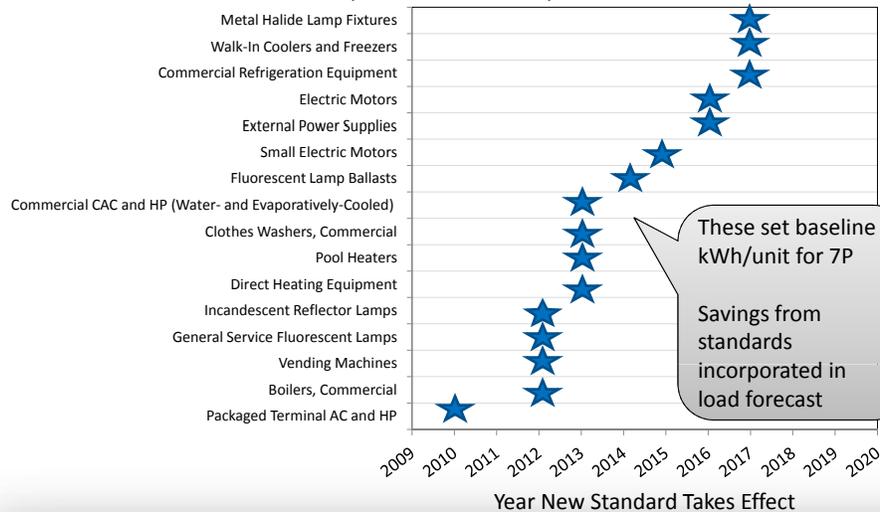
- **Building-configuration dependent**
 - New CBSA for characteristics & saturations
 - Sales data & market trend analysis
- **Equipment regulated by Federal standards**
 - Federal rulemakings, sales data
- **Equipment or process-driven**
 - EPA, State Agencies, Surveys, CPA's, NEEA, AWWA, whatever we can get

Commercial Building Stock Assessment (CBSA)

- Database of PNW commercial building characteristics
- Conducted 2012 – 2014
- Random sample
- About 850 sites
 - 464 site-level data points on each
 - Lighting detail by space type within
 - Over 80 HVAC detail variables
- Characteristics data due end September
- Billing data less complete (need help)
- Higher estimate of floor area? (up >20%)



New Federal Efficiency Standards (Commercial)



Lighting Standards Updates

(Three? in 7P Baseline, remainder as Potential)

Product Covered	Initial Legislation	Updated DOE Standard Expected	Potential Effective Date
Candelabra & Intermediate Base Incandescent Lamps	None	2015	2018
Ceiling Fans and Ceiling Fan Light Kits	EPACT 2005	2016	2019
Compact Fluorescent Lamps	EPACT 2005	2017	2020
Fluorescent Lamp Ballasts	NAECA 1988 1988	2018	2021
General Service Fluorescent Lamps	EPACT 1992	2014	2017
General Service Lamps: Incandescents plus CFLs, GSLED, GSOLED	None	2017	2020
HID Lamps	EPACT 1992	2015	2018
Incandescent Reflector Lamps	EPACT 1992	2014	2017
Incandescent Reflector Lamps (includes certain BR and Other Exempted IRLs)	EPACT 1992	2014	2017
Metal Halide Lamp Fixtures	EISA 2007	2019	2022

Other Standards Updates

Many Will Provide Data for Savings Potential

Product Covered	Initial Legislation	Updated DOE Standard Expected	Potential Effective Date
Automatic Commercial Ice Makers	EPACT 2005	2015	2018
Boilers, Commercial	EPACT 1992	2015	2018
Clothes Washers, Commercial	EPACT 2005	2015	2018
Commercial CAC and HP (65,000 Btu/hr to 760,000 Btu/hr)	EPACT 1992	2016	2019
Commercial CAC and HP (<65,000 Btu/hr)	EPACT 1992	2015	2018
Commercial CAC and HP (Water- and Evaporatively-Cooled)	EPACT 1992	2018	2021
Commercial Refrigeration Equipment	EPACT 2005	2022	2025
Commercial Water Heaters	EPACT 1992	2016	2019
Compressors	EPACT 1992	2016	2021
Electric Motors	EPACT 1992	2022	2025
Fans and Blowers	EPACT 1992	2016	2021
Furnaces, Commercial Warm Air	EPACT 1992	2016	2019
Packaged Terminal AC and HP	EPACT 1992	2015	2018
Pre-Rinse Spray Valves	EPACT 2005	Initiating a Rulemaking	TBD
Pumps, Commercial and Industrial	EPACT 1992	2015	2018
Single Package Vertical Air Conditioners and Heat Pumps	EPACT 1992	2015	2018
Small Electric Motors	EPACT 1992	2016	2021
Vending Machines	EPACT 2005	2016	2019
Walk-In Coolers and Freezers	EISA 2007	2022	2025
Water-Source Heat Pumps	EPACT 1992	2016	2018

238 Measures in 6P

Appendix E: Conservation Supply Curve Development Sixth Power Plan

Table E-10: Commercial Sector Measure Bundles

Measure Bundle	End Use	Number of Measures in Bundle	Measure Description	Technical Potential in MW by Year 2020			
				New	Replacement	Retrofit	Total
Lighting Power Density	Lighting	54	Lamp, ballast and fixture improvements to lighting power density	51	254	38	443
Daylighting with Skylights	Lighting	6	Skylights with lighting controls	16	0	0	16
Daylighting with Windows	Lighting	6	Photometer electronic controls	3	12	0	15
Lighting Controls Interior	Lighting	6	Occupancy controls for areas not required by code such as open office, warehouse aisle, classrooms	6	85	8	99
Exit Signs	Lighting	2	LED and electrochromic "Exit" signs	0	0	0	0
Premium HVAC Equipment	HVAC	4	HVAC equipment more efficient than applicable code or standard practice	8	31	0	39
Variable Speed Chiller	HVAC	2	Variable speed chillers	1	14	0	15
Control Commission Complex HVAC	HVAC	20	Commissioning on HVAC systems in buildings with complex HVAC systems	10	0	0	104
Package Roof Top Optimization and Repair	HVAC	5	Suite of measures and control strategies for buildings served by package roof top HVAC units	4	8	16	29
Low Pressure Distribution Complex HVAC	HVAC	2	Dedicated Outside Air or Underfloor Air distribution systems in buildings with complex HVAC systems	6	0	0	6
Demand Control Ventilation	HVAC	5	Fan control strategies, COV and Fresh Strategy DOAS with heat recovery in simple HVAC systems	4	4	14	22
ECM Motors on Variable Air Volume Boxes	HVAC	2	Electrically-Commutated Motors on Variable Air Volume Boxes	3	9	0	12
Evaporative Assist Cooling	HVAC	0	Evaporative Assist Cooling	0	0	0	0
Windows	HVAC	30	Windows and glazing more efficient than code or standard practice	3	8	22	33
Roof Insulation	HVAC	2	Add insulation during re-roofing	0	3	0	3
Duct Sealing and Repair	HVAC	0	Sealing and repair of ductwork in unconditioned spaces	0	0	0	0
Efficient Fans, pumps and drives	HVAC	0	Variable speed fans, pumps and drives, pump and fan system efficiencies and demand control	0	0	0	0
Exterior Building Lighting	Ext Lighting	4	Efficient signage, walkway, area and decorative exterior lighting, such as LED	0	67	0	67
Integrated Building Design	Mult	13	Multiple measures applied in integrated design practice	61	0	0	61
Street and Roadway Lighting	Ext Lighting	2	Efficient street and roadway lighting, LED and induction	8	42	0	51
Parking Lighting	Ext Lighting	2	Efficient parking lot and garage lighting and controls	1	36	0	38
LED Traffic Lights	Ext Lighting	1	LED traffic signals	0	0	0	0
Signage	Ext Lighting	1	LED advertising signs	0	5	0	5
Municipal Sewage Treatment	Process	10	Suite of measures for sewage treatment	0	0	27	27
Municipal Water Supply	Process	5	Suite of measures for water supply systems	0	0	13	13
Network PC Power Management	Process	1	Control of a networked computer's advanced energy management systems	0	0	40	40
Packaged Refrigeration Equipment	Process	0	Efficient refrigerators and freezers, beverage merchandisers, ice makers and vending machines	0	0	52	52
Commercial Clothes Washers	Process	0	Clotheswashers more efficient than federal standard	0	0	0	0
Cooking Equipment	Process	0	Efficient cooking equipment such as hot food holders, grills, toasters and steam tables	0	0	0	0
Office Equipment	Process	2	Efficient Desktop PC and Efficient Monitor	0	0	0	0
Computer Servers and IT	Process	2	Consolidation & virtualization & upgrade of servers in embedded server rooms in buildings	0	0	88	88
OCV Restaurant Hood	Process	1	Demand control ventilation systems for large restaurant hoods	0	0	4	4
OCV Parking Garage	Process	1	Demand control ventilation systems for parking garages	0	0	0	0
Grocery Refrigeration Bundles	Process	12	Grocery store refrigeration measures	0	0	68	68
Plug Load Sensor	Process	1	Occupancy controls for task lighting and other ancillary loads in offices	0	0	0	0
Premium Flame Hood	Process	1	Efficient flame hoods in labs	0	0	2	2
Pre-Rinse Spray Wash	Process	1	Low-flow pre-rinse spray valves for restaurant kitchens, cafeterias, and food-serving	0	0	2	2
Total		238		258	662	462	1382

Key Measures from Sixth Plan All Being Updated

- **Lighting**
 - **Building LPD improvements**
 - CBSA on saturation & baseline
 - Federal standards & codes
 - Cost, Efficacy & Availability of SSL
 - **Lighting Controls**
 - **Street Lighting**
 - *Need data on adoption to date*
 - **Daylighting**
 - **Exterior building lighting**
 - Much better data in new CBSA
 - **Parking lot lighting**



6P Key Measures, Cont

- HVAC – Update with CBSA data, standards
 - Rooftop system optimization
 - Premium HVAC Equipment
 - Chillers, heat pumps, advanced rooftop systems
 - Demand Controlled Ventilation
 - ECM on VAV systems
- *Need better measured end-use data (heating, cooling & ventilation loads)*



6P Key Measures, Cont

- Wastewater Treatment and Water Supply
 - EPA database of wastewater systems
 - ETO project data
 - AWWA data
- *Additional consumption (kWh/MGD) and savings data in kWh/MGD would improve estimates*
- *What has already been done?*
- *Are Water Supply Measures being adopted?*



6P Key Measures, Cont

- Refrigeration – Grocery & Packaged
 - Grocery store update based on program data and CBSA
 - Packaged equipment analysis update from Federal standards
- Integrated Building Design - New
 - ***Apply to Existing Building Renovation Market?***
- Envelope
 - CBSA on existing glazing & heating system
 - Windows
 - Roof
- Cooking equipment
 - Update with new RTF values

Measure Expansion or Expanded Savings

- Solid State Lighting
 - Vast expansion of options compared to 6P
 - All form factors now in play, all applications
 - ***Freeze cost & efficacy improvements at projected 2017***
- Lighting Controls
 - Luminaire level, self commissioning, smart
 - ***Highly variable savings: Need better data on savings reductions across applications***

New Measures: Commercial New or Expanded Applications

1. Data Centers: Embedded & Dedicated
2. Compressed Air Systems
3. Chiller retrofits
4. Advanced Roof Top HVAC
5. Evaporative Assist Roof Top HVAC*
6. HPWH, Showerhead, gravity flow heat exchanger
7. Water Cooler Controls
8. Switch Reluctance Motors, Motor Rewind
9. Clothes Washers, Freezers, Refrigerators (from RTF)
10. School Weatherization (from RTF)
11. Smart Plug Strips*
12. Demand Control Ventilation for Garages
13. Pool Pumps



New Measures: Commercial New Technology or Practice

1. Strategic Energy Management in Commercial BIG
2. Glazing: Secondary Window, Dynamic Windows BIG?
3. Integrated Circulating Pump ECM & Drive
4. Block Heater Controls for Engine Generator Sets Mid
5. AC Heat Recovery for Water Heating Small ?
6. Web-enabled t-stats* Small
7. Variable Capacity Heat Pump and VRF*
8. CO2 Heat Pump*
9. Heat Pump Clothes Dryer* Mid

* Fuzzy: May drop

High Priority New Measures

- **Strategic Energy Management in Commercial**
 - Sixth plan at least partially covered this
 - Should be strong potential here
 - Data from NEEA and ETO
 - *What market segments applicable?*
- **Data Centers**
 - Embedded & Dedicated
 - Sub-contract
 - CBSA data set on embedded
- **Compressed Air Systems**
 - Not just industrial any more
- **Circulating Pump ECM & Drive**
 - Data from federal standards analysis plus CBSA



High Priority New/Update

- **Glazing**
 - Secondary glazing systems (inside) (R-1 to R-7) (half the cost)
 - Dynamic windows (PNL)
- **Advanced Roof Top HVAC**
 - Aiming at fan energy
 - BPA seeing savings in 50% range
 - Catalyst & others



Lower Priority New/Update

- **Water heating**
 - Gravity flow heat exchanger (MF)
 - Showerhead, HPWH
- **Parking Garage Ventilation Controls, VSD**
- **High Rise Multi-Family**
 - New RBSA Data
 - Appliances & Lighting part of Residential Analysis
 - Possible Multi-Family Measures
 - Windows
 - Common Area HVAC
 - Central Water Heating HPWH



Measures to Drop

- **HVAC Controls Commissioning & Optimization**
 - Incorporate into Commercial SEM
- **Sign Lighting?**
 - May have transformed to SSL
- **Roof Insulation on Re-Roof**
- **Heated and Cooled Office Chair?**



Summary of Issues and Data Needs: Commercial

- **CBSA**
 - *Billing data less complete (need help)*
 - *Higher estimate of floor area? (up >20%)*
- **HVAC Measures**
 - *Need better measured end-use data (heating, cooling & ventilation loads)*
- **Water/Wastewater**
 - *Additional consumption (kWh/MGD) and savings data in kWh/MGD*
 - *Are Water Supply Measures being adopted?*
- **Lighting**
 - *Freeze cost & efficacy improvements at projected 2017*
 - *Controls: Need better data on savings reductions across applications*
- **Integrated Building Design - New**
 - *Apply to Existing Building Renovation Market?*
- **Strategic Energy Management**
 - *What markets to include?*
- **Advice on New Measures**
 - *Any data and or advice on the proposed new measures?*

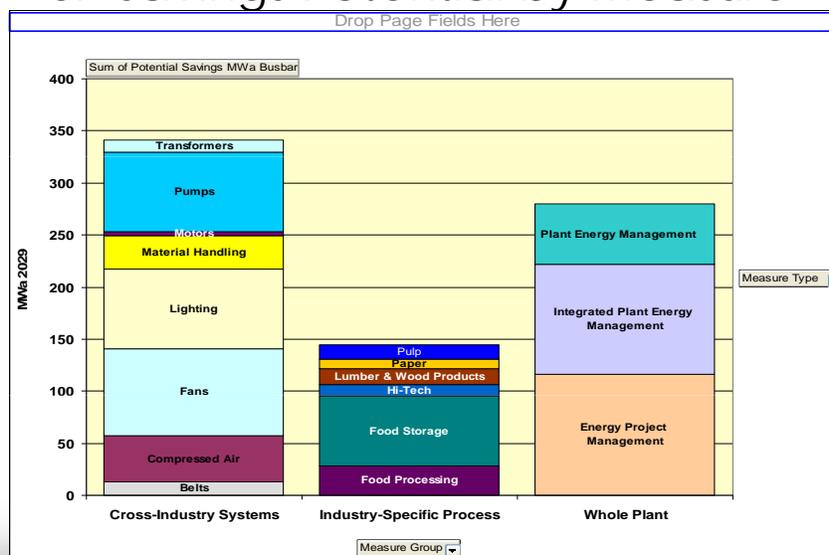
Industrial Sector



What Was in Sixth Plan?

- Doubled potential compared with Fifth Plan
- 63 Measures applied to 19 PNW Industries
- Nearly 800 aMW potential
- Most less than \$50/MWh
- A top-down methodology
 - End use shares of electric load
 - Percent savings by measure by end use
 - Fraction incomplete
 - Measure interactions

6P Savings Potential by Measure



Seventh Plan Approach: Same Measures, Update End Use

- New IFSA data on end use shares
- New IFSA data on saturation of measures
- **Where IFSA data are missing, revert to 6P estimates**
- Remove accomplishments per regional reports
 - 130 aMW as of 2012
- Update costs and/or savings information based on program data & recent evaluations
- Include a few new measures
- Break out stone/clay/glass as new sub-industry

Next Federal Efficiency Standards (Industrial)

Product Covered	Initial Legislation	Updated DOE Standard Expected	Potential Effective Date
Compressors	EPACT 1992	2016	2021
Electric Motors	EPACT 1992	2022	2025
Fans and Blowers	EPACT 1992	2016	2021
Pumps, Commercial and Industrial	EPACT 1992	2015	2018

May provide data for costs & savings of new measure. But may be end of 2014.

Industrial Facility Site Assessment

- Sponsored by Northwest Energy Efficiency Alliance
- Began in March 2013; NEEA reviewing draft report
- The primary goal of the IFSA was obtain end-use energy consumption data for the Northwest industrial sector.
- The IFSA intent to provide:
 - Representative accounting of PNW energy use
 - Comprehensive analysis of energy use & management
- The IFSA is the first study of its kind to collect comprehensive information on this level
- ***Site count less than expected***

Key Measure & Practices

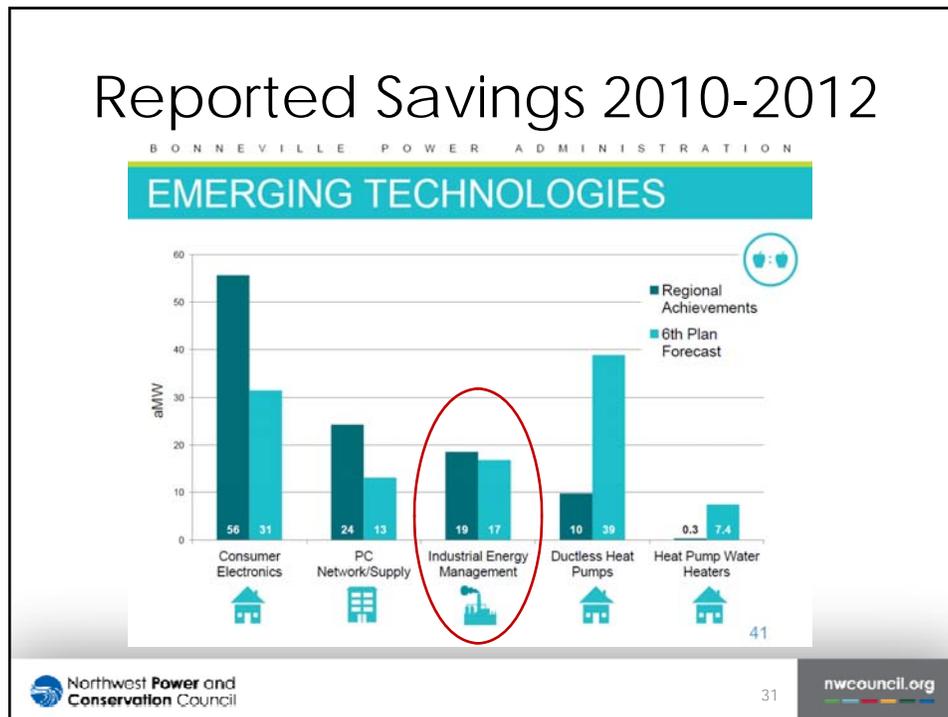
- Air Compressor Demand Reduction
- Air Compressor Equipment
- Air Compressor Management
- HighBay Lighting
- Lighting Controls
- Motors: Efficient Rewind VSD Controls
- Motor Management Program
- Fan Efficient Centrifugal
- Food: Fans and Blowers
- Other: Fans and Blowers
- Fan ASD Control
- Premium Pump
- Pump ASD Control
- Transformers
- Synchronous Belts
- Food: Cooling and Storage
- Food: Refrig Storage O&M
- Metal: New Arc Furnace
- Paper: Medium Consistency Pump
- Mech Pulp: Refiner Replacement
- Mech Pulp: Premium Process
- Mech Pulp: Refiner Plate Improvement
- Kraft Pulp: Effluent Treatment System
- Kraft Pulp: Efficient Agitator
- Paper: Efficient Pulp Screen
- Paper: Premium Fan
- Paper: Material Handling
- Wood: Replace Pneumatic Conveyor
- Wood: Hydraulic Press
- Cold Storage Retrofit
- Cold Storage Tuneup
- Fruit Storage Refer Retrofit
- CS Retrofit -- CO2 Scrub
- CS Retrofit -- Membrane
- Fruit Storage Tuneup
- Groc Dist Retrofit & Tuneup
- Generic O&M

Proposed Measure Changes 7P

- **Drop Transformers** 
 - Little beyond new federal standards
 - Next round of transformer standards 2022
- **Revise Industrial Energy Management**
- **Review Refrigeration Potential & Ramp Rates**
- **Update Lighting Baseline**

Industrial Energy Management

- **Was introduced in Sixth Plan – three levels**
 - Energy Project Management (level 1)
 - Plant Energy Management (level 2)
 - Integrated Plant Energy Management (level 3)
- **Significant program adoption & savings 2010-2012**
 - BPA & ETO early leaders
 - Now significant regional experience
 - Measurement tools improving
 - Delivery infrastructure developing



Industrial Energy Management Seventh Plan

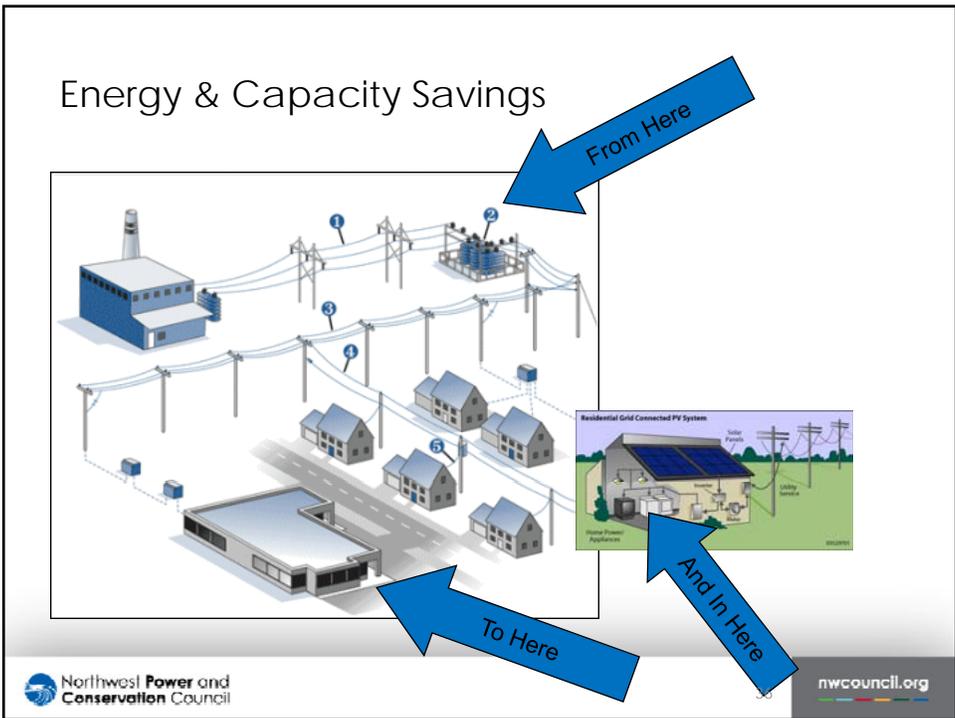
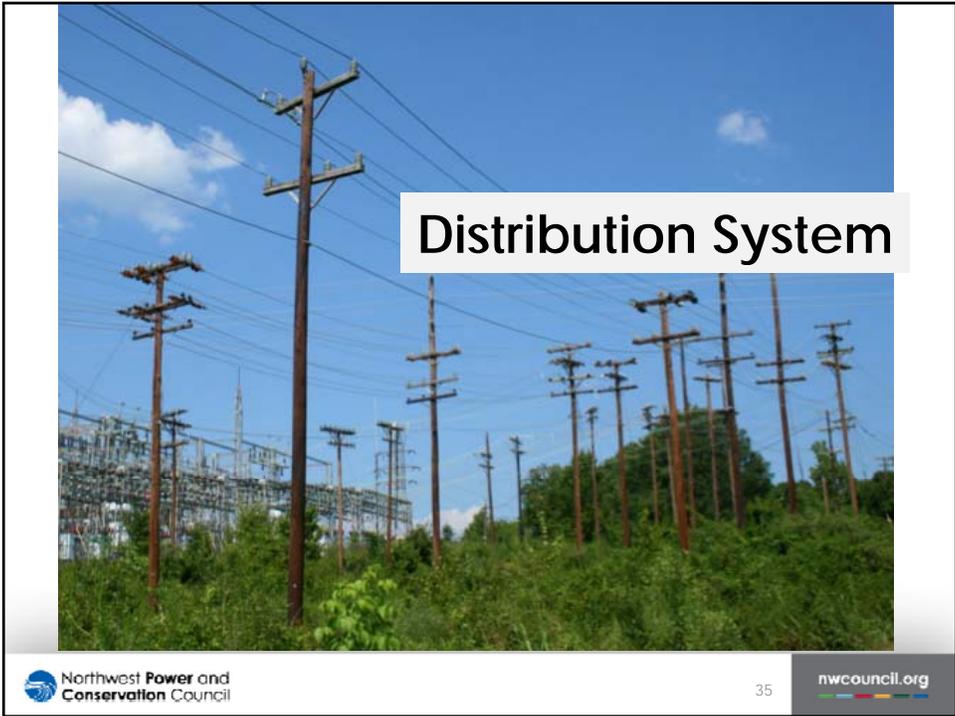
- Keep the measure set
- Align approach with program experience & recommendations of NEEA Strategic Energy Management (SEM) Collaborative
 - ***How to represent levels of adoption & applicability***
- Update costs, savings from program data & evaluations
 - ***Review and update measure life?***
- Harvest data from IFSA
- ***More utility program data needed***

New Measures: Industrial

1. Switched Reluctance Motors
2. Microwave Sterilization & Pasteurization Technologies
3. Efficient Power Supplies
4. Integrated Motor/Pump/Drive or Fan/Pump/Drive
5. CO2 Heat Pumps

Summary of Issues and Data Needs: Industrial

- Where IFSA data are missing, revert to 6P estimates
- Industrial Strategic Energy Management
 - How to represent levels of adoption & applicability
 - More utility program data needed
- New Measures
 - Missing any?
 - Need to develop costs and savings



Methodology

- **The Distribution System efficiency measures were new in the Sixth Plan (~400 aMW potential)**
 - But they were also in the First Power Plan in 1981
- **Based on NEEA Distribution System Efficiency Initiative 2008 (4-year study)**
- **Dominated by Conservation Voltage Reduction (CVR)**

Distribution System Measures

- **1 - Reduce system voltage w/ LDC voltage control method**
- **2 - Light system improvements (var mgmt, phase load balancing, and feeder load balancing)**
- **3 - Major system improvements (voltage regulators on 1 of 4 substations, and select reconductoring on 1 of every 2 substations)**
- **4 - EOL voltage control method**

Updating Distribution Efficiency

- What's been done last five years (mixed bag)
- Review evaluations PNW & USA
- Review costs from recent applications & update
- Review/update achievable fraction & ramp rates

Summary of Issues and Data Needs: Distribution System

- **Achievable Fraction and Ramp Rates**
 - How much is happening outside the conservation program arena?
 - Institutional barriers?
- **Physical limitations or differences among utilities?**