Peak Shaving Using Conservation Voltage Reduction

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COO, Pee Dee Electric Cooperative

NISC Gridposium, May 13, 2011

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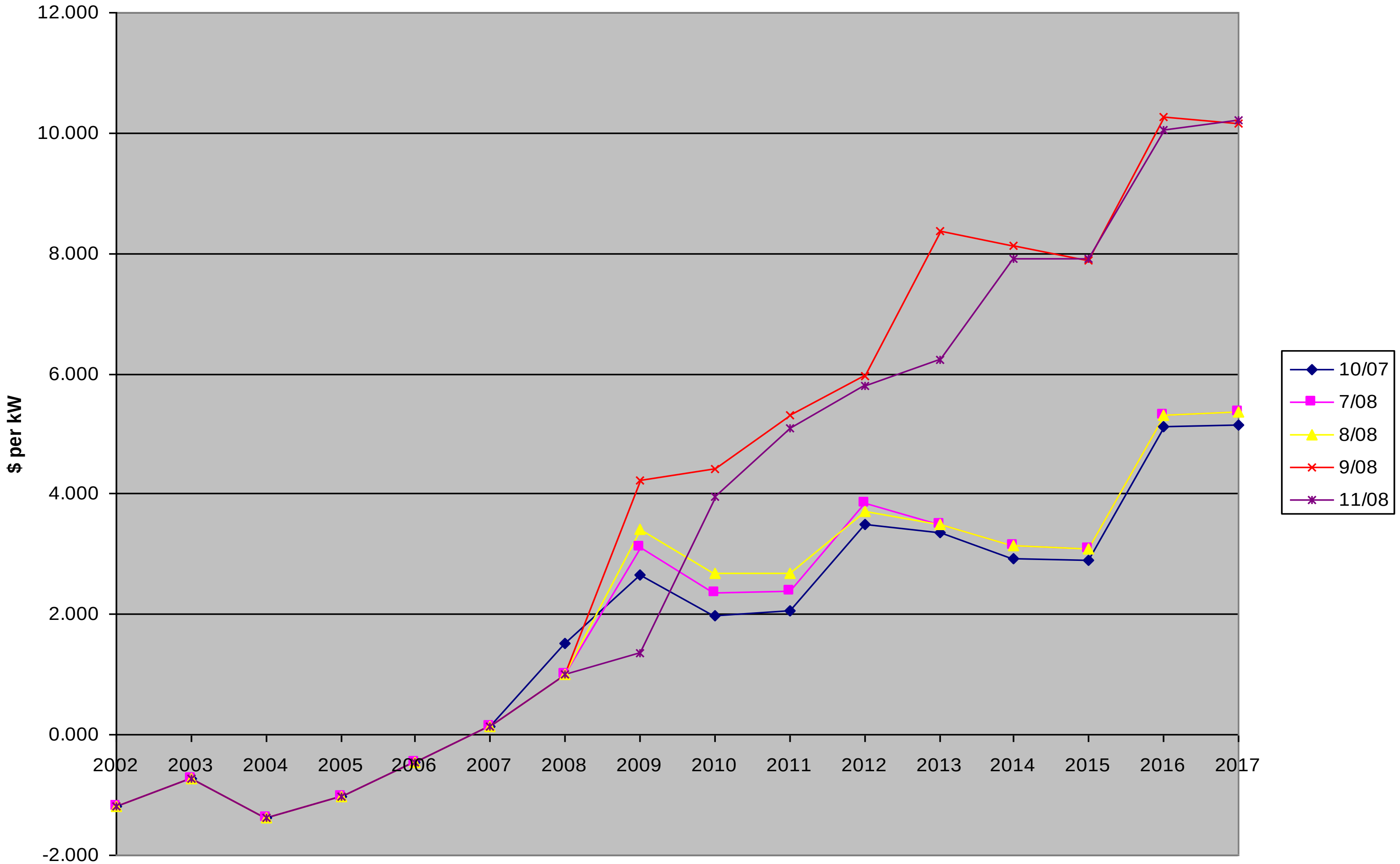
How We Are Billed

- 12 individual 60-minute coincident peak demands
- Everyone on rate is held accountable for their contribution when the system was peaking – not necessarily their own peak
- Calendar Month
- 20 SC Distribution Cooperatives – do not generate

Demand Adjusters – History and Forecasts



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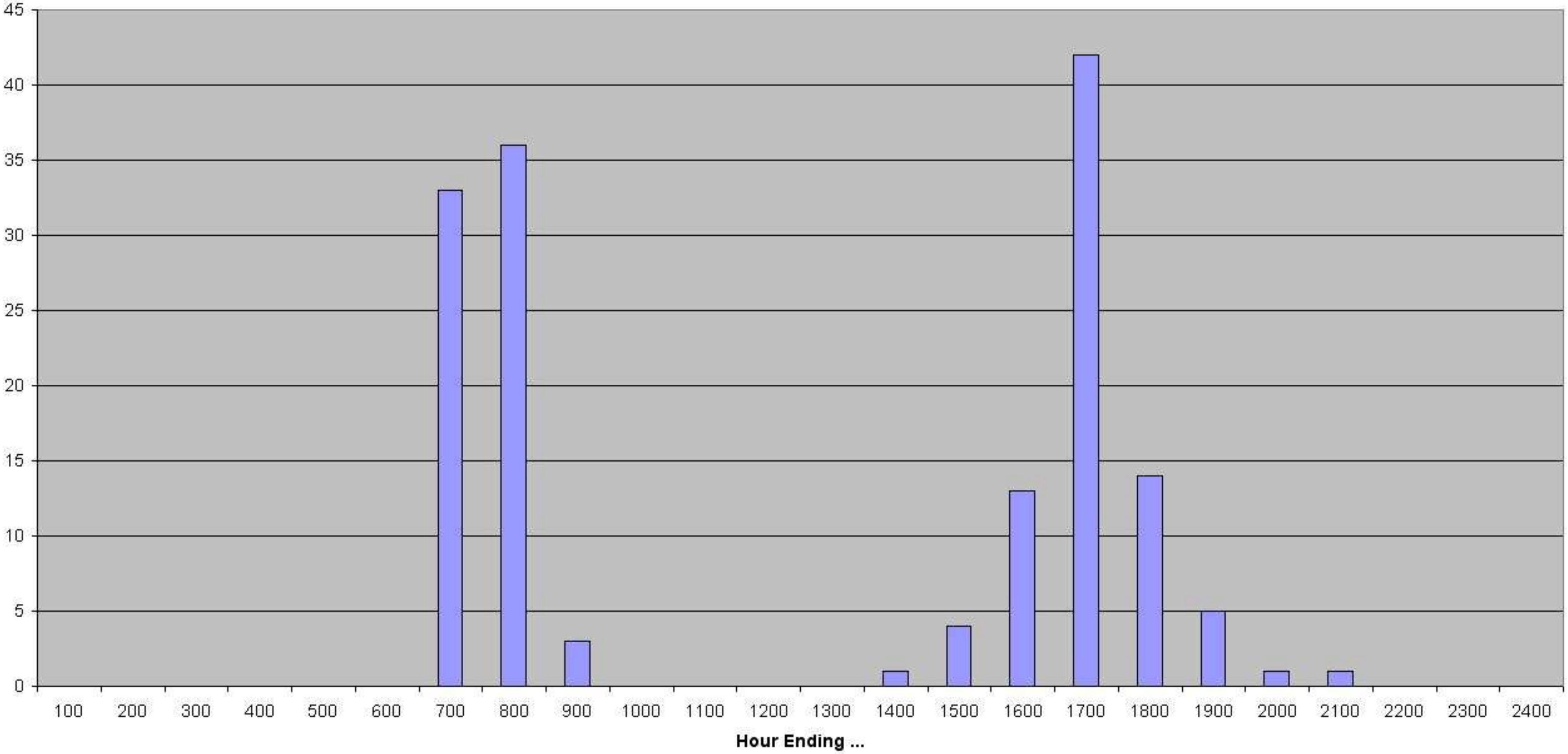
Voltage Regulation

- If it wasn't cost effective before, might be now
- Need to analyze technical and man-power requirements
- Must also consider tolerable voltage ranges

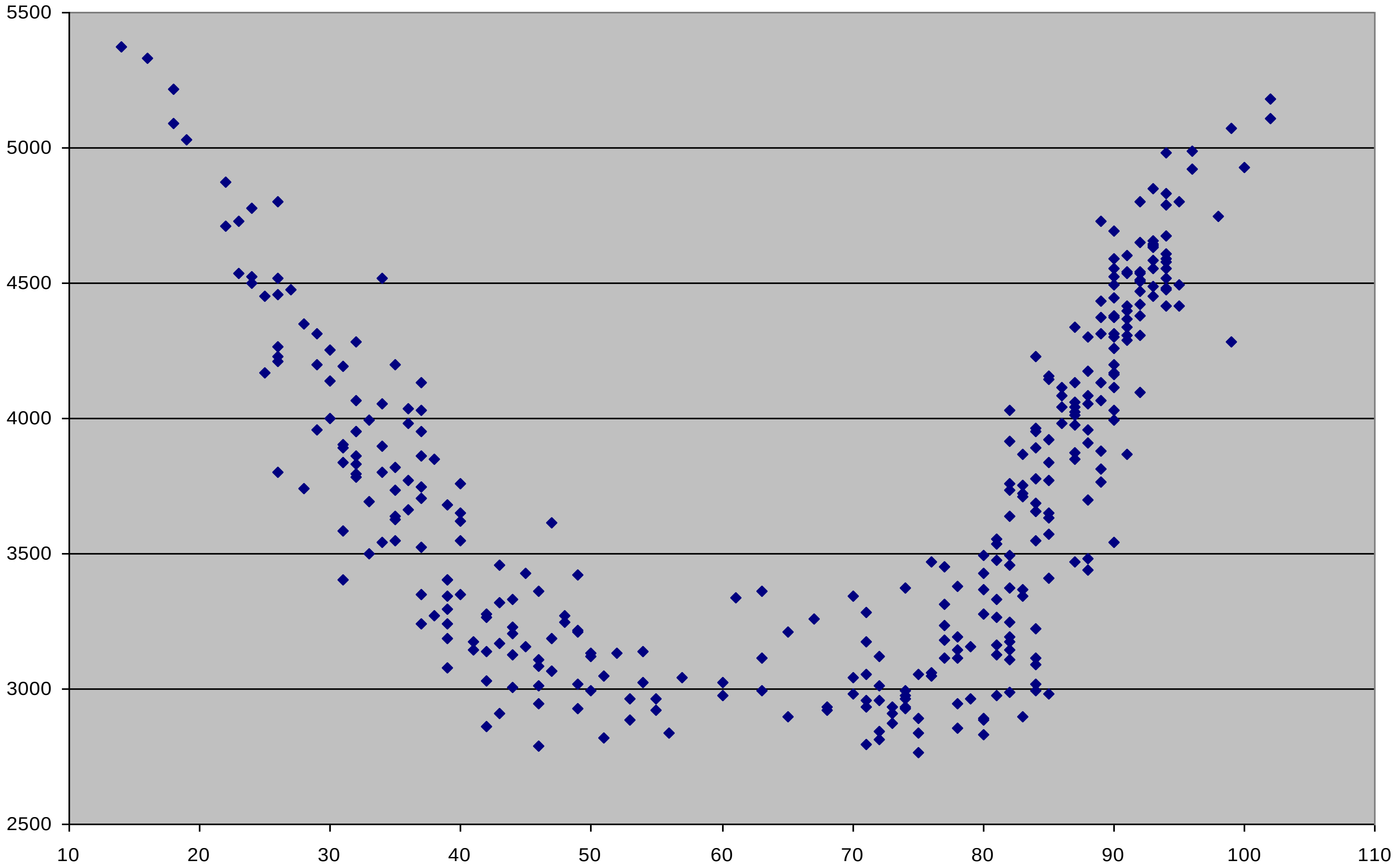
Specific to PDEC

- Leaning more toward feeder regulation
- Very few downline regulators
- Targets for load control (130 MW)
- First day of month
- Temperature in Florence
- 5-person team (SCADA from Home)
- Very few capacitors in system

Historical Peak Hours



System Load versus Florence Temperature



Two Basic Types of Loads

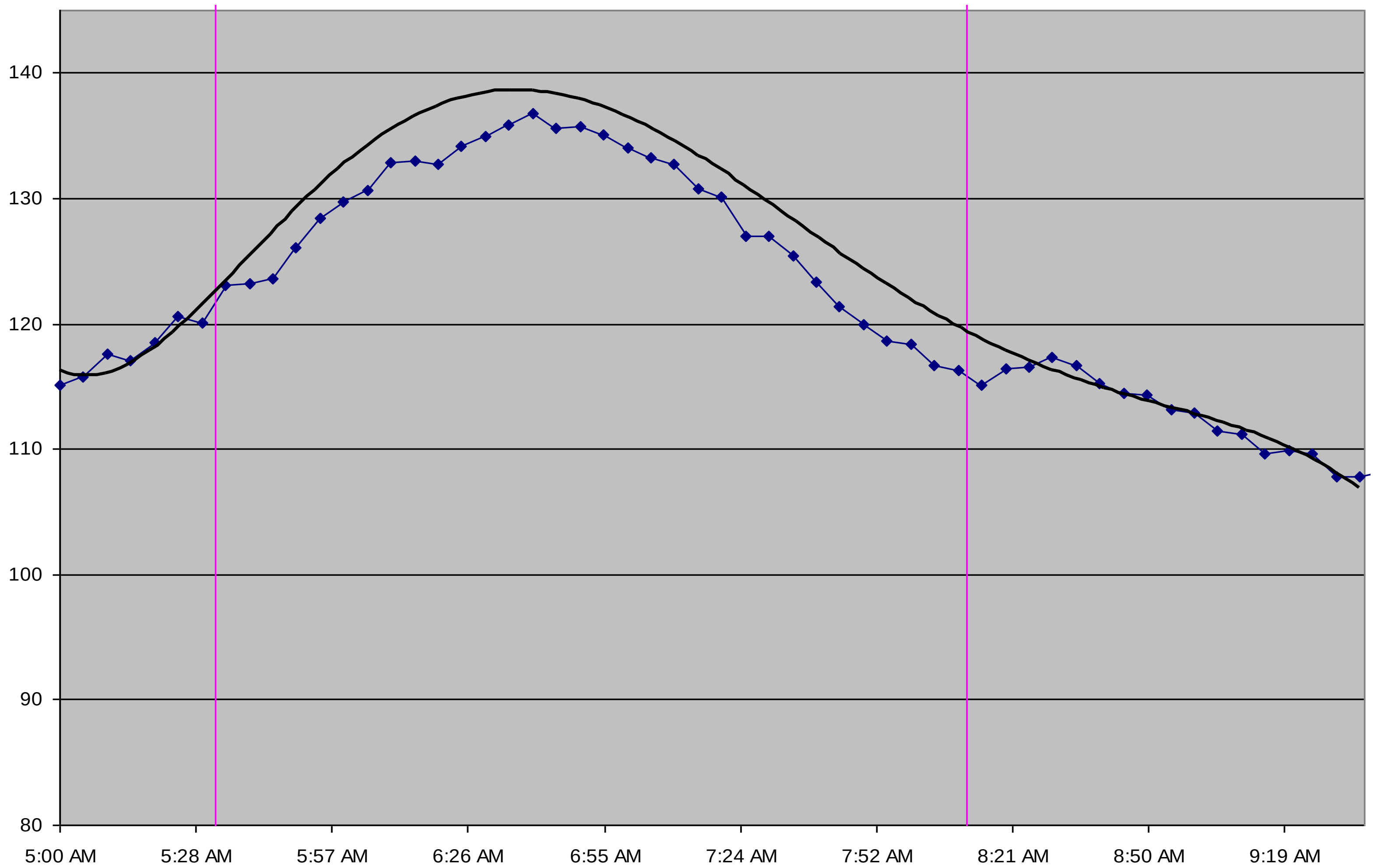
- **Constant Power Loads:**
- Motor Driven – motors, AC, heat pumps, etc.
- Fluorescent Lighting
- Electronic Devices
- Decrease voltage => Increase current

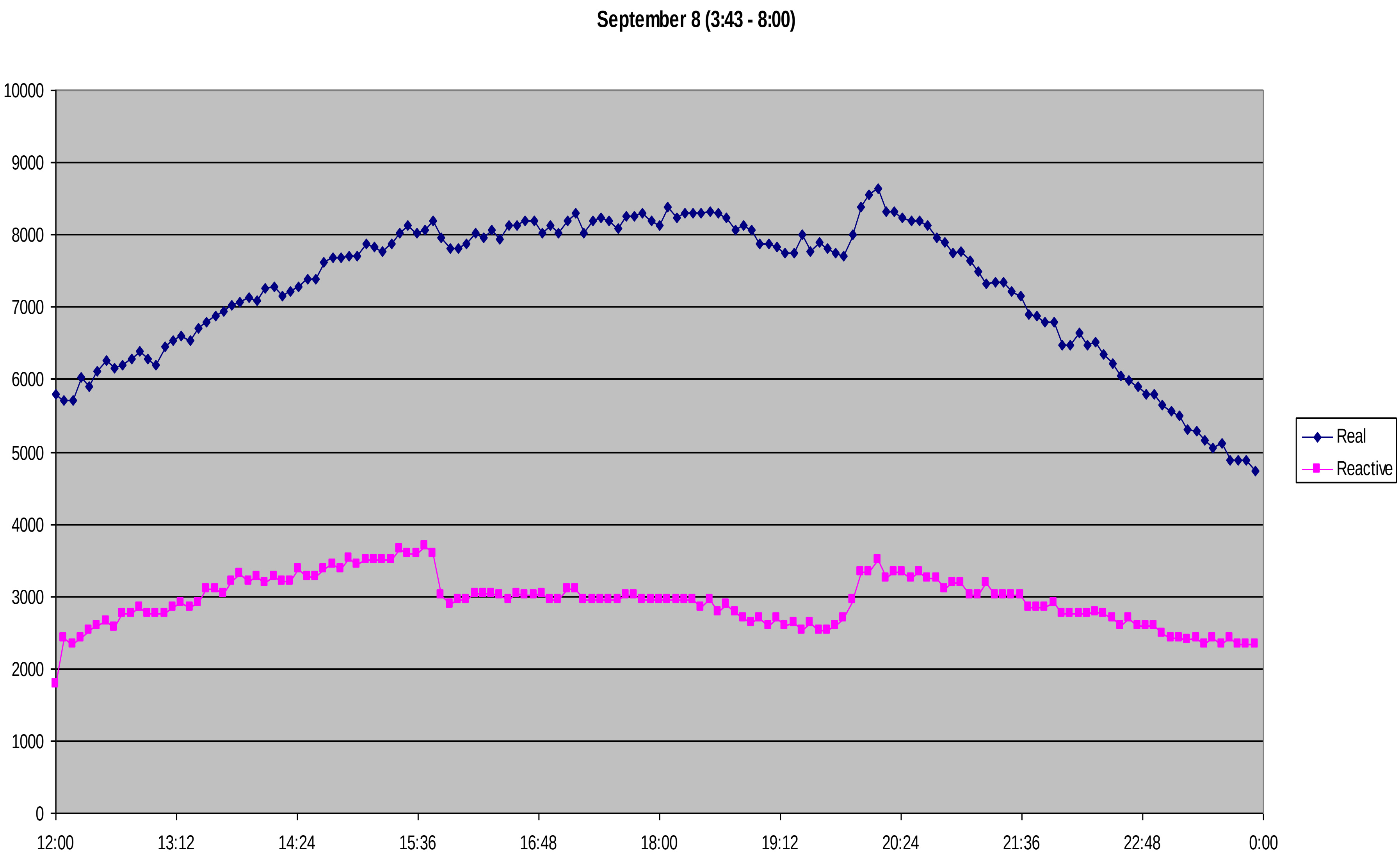
- **Constant Impedance Loads:**
- Electric Resistance Heating
- Water Heaters
- Incandescent Lighting
- Some office equipment and small machinery
- Appliances such as oven/range, clothes dryer
- Power Reduces with Voltage

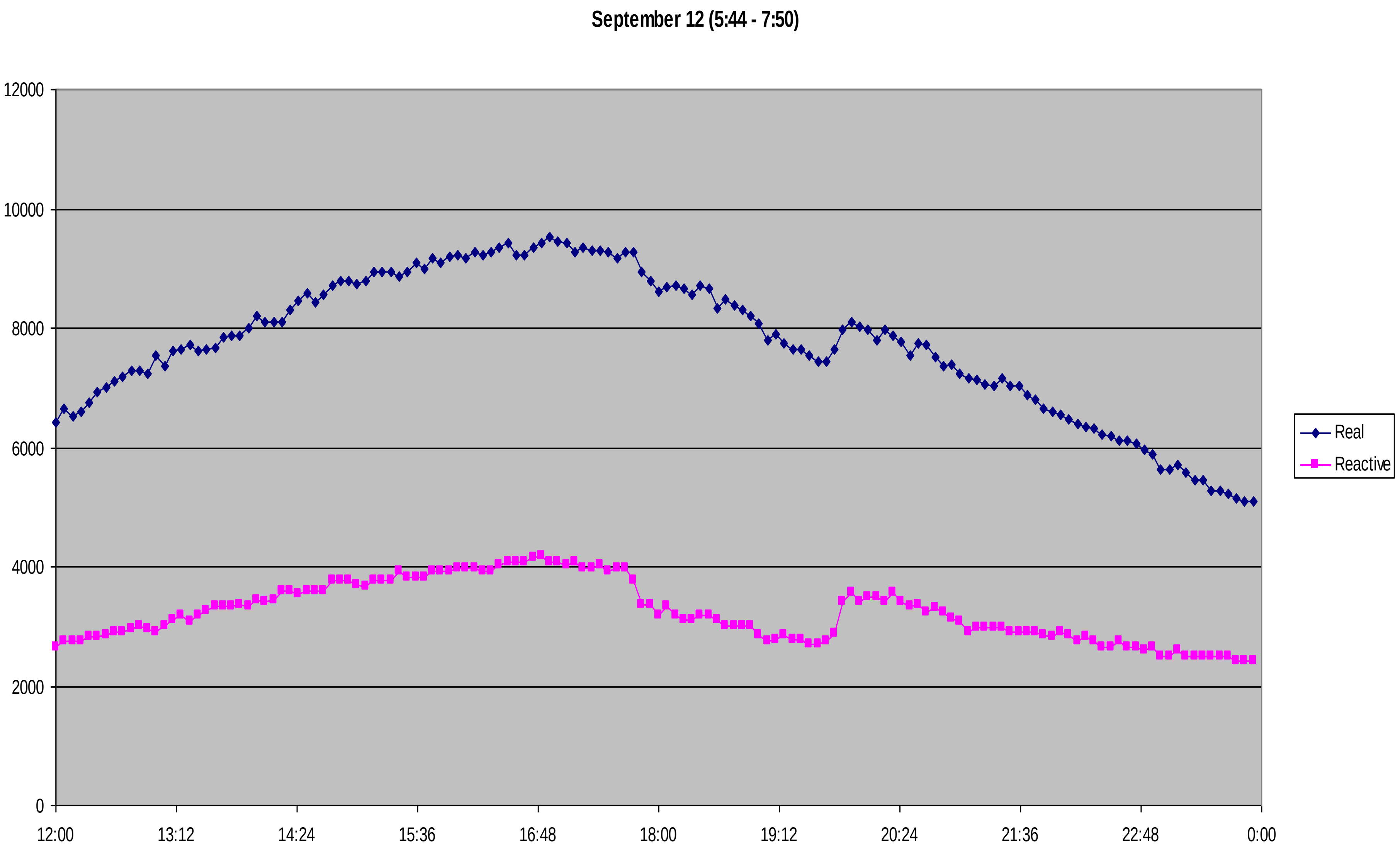
Simplified Calculations

- Constant Power: P = constant, P=IV (reduce voltage by 3%, current must increase by approximately 3%). No demand savings.
- Constant impedance: Z = constant, P=IV, Z=V/I (reduce voltage by 3%, current must reduce by 3% => Power reduces by almost 6%). Demand reduction = voltage reduction squared.

Typical Winter Morning




September 8 (3:43 - 8:00)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
12:00
13:12
14:24
15:36
16:48
18:00
19:12
20:24
21:36
22:48
0:00
Real
Reactive



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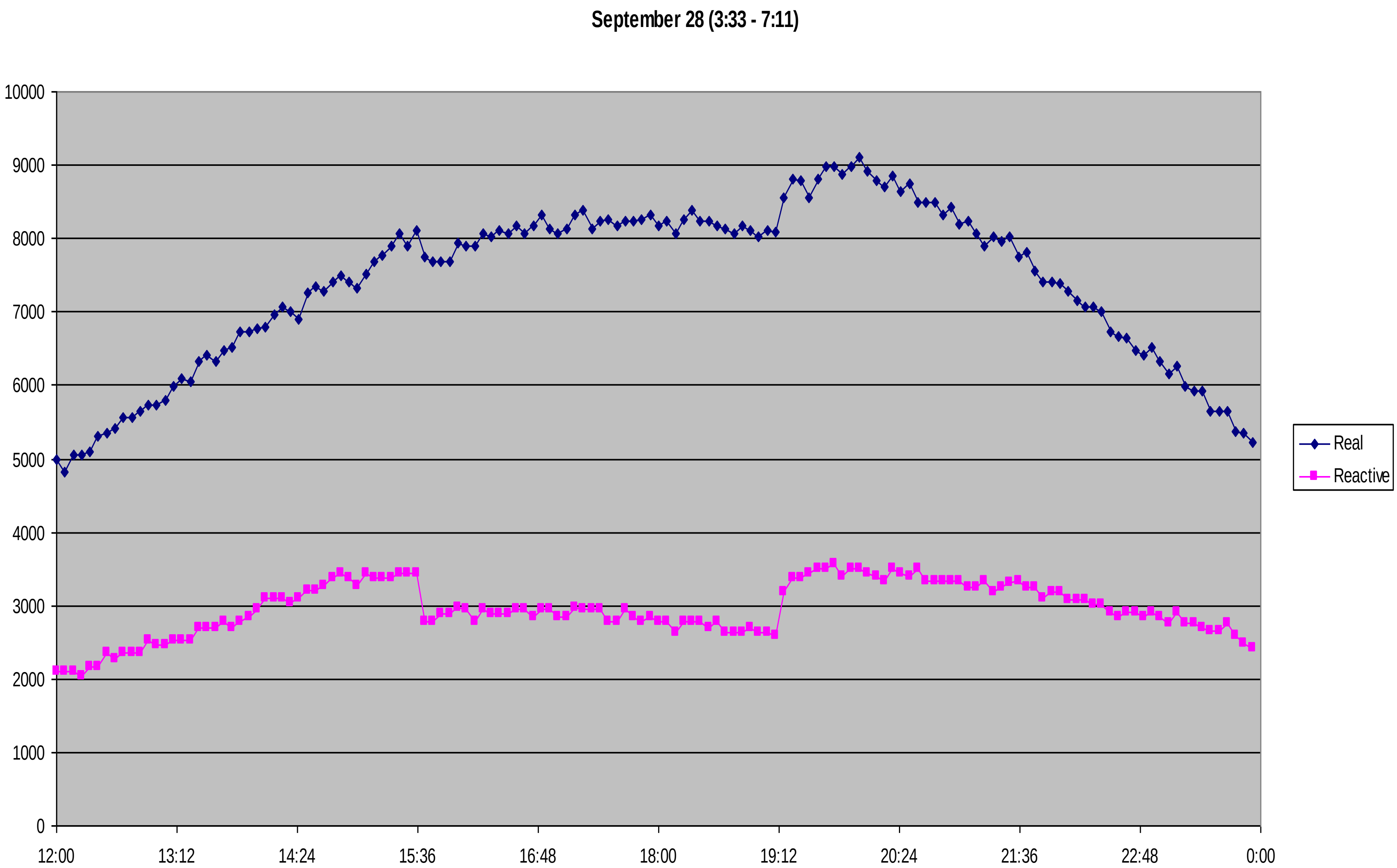

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Sample Month – Net Savings

- Estimated Demand Reduced: 3119.9 kW
- Percent Voltage Reduction: 2.59%
- "Profit" per kWh: 5.3 mills
- Cost of control per hour: $165.35
- Savings during peak: $37,884
- Time we were in control: 21 hours
- Net Savings: $34,412

Perhaps Three Load Models

- Constant Power – demand does not vary with voltage
- Constant Impedance – demand varies in proportion with the square of voltage
- Constant Current – demand varies directly in proportion with voltage

CVR – Not Just for Saving

- Peak Shaving to Avoid Building Generation
- Emergency Feeds, Bypass, etc.
- Losses Reduction
- May be used to meet "non-renewable reduction" requirements

Questions???

- Contact Information:

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