Grid Operations and Why They Matter for Air Quality – Part 2

MARAMA Training

The Regulatory Assistance Project (RAP)®
www.raponline.org

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Goals for Today

• Reinforce ideas from 1st training
• Provide an overview of the changing electricity system and effects on air quality
• Provide examples of connections to your air quality work
• Raise ideas for collaborating with your Utility Commissioners and Energy Office
• Discussion, Q and A
Topics for Today

- Role of energy efficiency and distributed energy
- Role of renewables in improving air quality
- EPA tools for determining health benefits from clean alternatives
- Electrification principles and examples
- Importance of Rate Design
- Opportunities for cross-agency collaboration
The “New” Grid (not so simple)

Illustrative modern electric system

- **Smart appliances**: Can shut off in response to frequency fluctuations.
- **Processors**: Execute special protection schemes in microseconds.
- **Demand management**: Use can be shifted to off-peak times to save money.
- **Sensors**: Detect fluctuations and disturbances, and can signal for areas to be isolated.
- **Storage**: Energy generated at off-peak times could be stored in batteries for later use.
- **Generators**: Energy from small generators and solar panels can reduce overall demand on the grid.

Electric Sector Emissions

But NOx Remains Important

Maryland Example – Ozone Peak Day Partnership and EGU Data Requirements
Energy Efficiency
Put Efficiency First
Energy Efficiency Improves Air Quality

- Complying with Public Health Standards
- Complying with Visibility Standards
- Developing Implementation Plans
- Demonstrating “permanent, quantifiable, surplus, enforceable” reductions
RAP’s “Layer Cake” Approach

Source: https://www.raponline.org/knowledge-center/recognizing-the-full-value-of-energy-efficiency/
Poll Question
Energy Savings → Emission Reductions

- Savings determined by AVERT Region
- AVERT
  - Predicts magnitude & location of emission reductions in
  - Outputs compatible with air quality models
Arkansas DEQ Method for Energy Efficiency Accounting

- Projected Energy Savings for 2018 – 2028 Haze Planning Period
- Modeled Emission Reductions using AVERT

Arkansas is the 1st in the nation to include EE in Regional Haze planning!
EPA’s health benefits per kilowatt-hour (BPK) values

Use to quickly estimate the monetary value of health benefits from reductions in fine particulate matter (PM$_{2.5}$) due to energy efficiency (EE) and renewable energy (RE)

- Free
- Easy to use
- Peer-reviewed

BPK values (¢/kWh) are available for:

- 10 regions of the United States
- Solar, wind, uniform and peak EE

Technical report provides details on methodology and appropriate uses
EPA used existing tools and expert input to develop the BPK values.

### Scenarios
- **Wind**
  - 100 MW
- **Solar**
  - 100 MW
- **Uniform EE**
  - 500 GWh
- **Peak EE**
  - 200 GWh
  - (12-6 pm weekdays)

### Estimate
- Changes in electricity generation
- Changes in emissions of NO\(_x\), SO\(_2\), and primary PM\(_{2.5}\)

### Estimate air quality changes
- (primary and secondary PM\(_{2.5}\))
- Dollar value of public health benefits

### Regional factors (¢/kWh) for estimating the monetized health benefits of kWh saved through EE or generated through RE
Efficiency and renewables provide air quality and health benefits

- **EE and RE deliver health and environmental benefits** by avoiding fossil-fired power plant emissions, which improves air quality and enhances public health.

- State and local governments, and others are increasingly looking to quantify and document the **air quality and health benefits** of EE and RE, driven by:
  - **Policymaker and planner** interests in addressing local air quality and health concerns
  - **Energy regulators** seeking comprehensive assessments of costs and benefits of energy choices
  - **Green banking and EE/RE industries** looking to demonstrate public health benefits of investments
How Health Benefits Improve the Outlook for Renewables

Figure 5. Values for public health benefits from 100 MW of new renewable energy in two regions

Utility Procurement: Consider Health Impacts in Avoided Cost

[Graph showing cost distribution with categories: Capital, O&M, Fuel, Health]
Utility Dispatch

Avoided Cost

Avoided Cost

Fuel  O&M

Fuel  O&M  Health
Poll Question
Beneficial Electrification (BE) - Three Conditions

1. Saves Customers Money Over Long-Term
2. Reduces Environmental Impacts
3. Enables Better Grid Management
As the Grid Gets Cleaner, Electric Options Become More Beneficial

- Electric Resistance Water Heater

Emissions

Time (years)
Understand Emissions Effects of Changes in Load
Just Some Flexible Load Makes a Big Difference
EV Charging Opportunity

- 1,000 miles/month @ 25 mph average = 40 hours
- Driven: 40 hours/month
- Charging: 40 hours/month
- Parked: 680 hours/month

**Challenge**: Find 40 low-cost, low emission hours out of 680 hours that vehicle is parked each month.
Electric Vehicles Are A Lot Like Water Heaters
Really!

**Electric Vehicle**
- 3.3 – 6.6 kW
- 2,000 – 4,000 kWh/year
- Can avoid morning and early evening peak charging
- Batteries likely equal a full day’s supply

**Water Heater**
- 4.4 – 5.5 kW
- 2,000 – 4,000 kWh/year
- Can avoid morning and early evening peak charging
- Tank usually supplies a full day’s supply
# Emission Comparison

<table>
<thead>
<tr>
<th>Oil Water Heater</th>
<th>Heat Pump WH</th>
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<tbody>
<tr>
<td>150 gallons oil/year</td>
<td>1,500 kWh/year</td>
</tr>
<tr>
<td>22 lb CO$_2$/gallon</td>
<td>50% Gas 50% Coal</td>
</tr>
<tr>
<td>3,300 lb CO$_2$/year</td>
<td>1,400 lb CO$_2$/MWh</td>
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<tr>
<td></td>
<td>2,100 lb CO$_2$/year</td>
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</table>
“Fueling” EVs

100,000 EVs =

116 MW of wind
(37% capacity factor)

154 MW of solar
(27% capacity factor)

52 MW of natural gas
(80% capacity factor)
Measure Life Matters
A Few Words about Rate Design
Final Thoughts

• The “new” grid offers opportunities
• Efficiency should come first and can be part of a SIP
• Solar and wind are frequently less expensive than fossil generation and provide health benefits
• Electrification means innovation and opportunities
• Distributed Energy offers opportunities to improve air quality
• Collaboration is key to benefiting from those opportunities
Resources

- 2020 PJM emissions report
- RAP and ADEQ Arkansas presentation
- Recognizing the Full Value of Energy Efficiency
- Health benefits by the Kilowatt Hour
- EPA AVERT
- BPK EPA website
- RAP Beneficial Electrification reports - four
- Teaching the Duck to Fly
About RAP

The Regulatory Assistance Project (RAP)® is an independent, non-partisan, non-governmental organization dedicated to accelerating the transition to a clean, reliable, and efficient energy future.

Learn more about our work at raponline.org

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Value of Flexibility for Integrating Renewable Energy

Avoid Home Charging during these hours

Workplace Charging

Source: California ISO
# Illustrative Smart Rate Design

<table>
<thead>
<tr>
<th></th>
<th>Residential</th>
<th>Medium C&amp;I</th>
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<tbody>
<tr>
<td>Customer Charge ($/mo.)</td>
<td>$4</td>
<td>$20</td>
</tr>
<tr>
<td>Site Infrastructure ($/kW)</td>
<td>$1</td>
<td>$2</td>
</tr>
<tr>
<td>Off-peak (cents per kWh)</td>
<td>7 cents</td>
<td>5 cents</td>
</tr>
<tr>
<td>Mid-peak (cents/kWh)</td>
<td>9 cents</td>
<td>8 cents</td>
</tr>
<tr>
<td>On-peak (cents/kWh)</td>
<td>14 cents</td>
<td>13 cents</td>
</tr>
<tr>
<td>Critical peak (cents/kWh)</td>
<td>75 cents</td>
<td>75 cents</td>
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</tbody>
</table>
First year impacts:
- 7.5% drop in peak demand
- 65% of customers benefited
- 67% of low-income customers benefited

Fort Collins Utilities Residential TOU Rates - Mandatory

<table>
<thead>
<tr>
<th>Residential TOD</th>
<th>Charges-E125</th>
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<tbody>
<tr>
<td>Fixed Charge</td>
<td>$8.59 /Mo</td>
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<tr>
<td>Non-Summer (Jan-Apr &amp; Oct-Dec)</td>
<td></td>
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<tr>
<td>Off-Peak</td>
<td>$0.0719 /kWh</td>
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<tr>
<td>On-Peak (5 - 9 pm) M - F</td>
<td>$0.2242 /kWh</td>
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<tr>
<td>Over 700 kWh tier</td>
<td>$0.0246 /kWh</td>
</tr>
<tr>
<td>Summer (May - Sept)</td>
<td></td>
</tr>
<tr>
<td>Off-Peak</td>
<td>$0.0719 /kWh</td>
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<tr>
<td>On-Peak (2 - 7 pm) M - F</td>
<td>$0.2624 /kWh</td>
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<tr>
<td>Over 700 kWh tier</td>
<td>$0.0246 /kWh</td>
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