RESOURCES (DUKE)
Resources Overview

- Load Shapes

- Resources categories:
  - Dispatchable supply side
  - Variable supply side
  - Demand side
  - Distributed generation
Resources – Summer & Winter Load Shapes

How a generation portfolio serves a daily load

MW

[Graph showing load, solar, wind, peaking, intermediate, and baseload over a 24-hour period.]
Resources Categories

- Dispatchable supply side
  - Nuclear, coal, combined cycle (CC)/ combustion turbine (CT)
  - Biomass, reservoir hydro, batteries, combined heat & power (CHP)
- Variable supply side
  - Solar & wind
  - Run of river hydro
- Demand side
  - Energy Efficiency
  - Demand Response
- Distributed Generation
**Resources – Dispatchable Supply Side**

**Overnight Capital Cost ($/kW) (2013$)**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Overnight Capital Cost ($/kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual Unit Nuclear</td>
<td>$5,000 (2013$)</td>
</tr>
<tr>
<td>Advanced CC with CCS</td>
<td>$1,000 (2013$)</td>
</tr>
<tr>
<td>Advanced CC</td>
<td>$2,000 (2013$)</td>
</tr>
<tr>
<td>Advanced CT</td>
<td>$3,000 (2013$)</td>
</tr>
<tr>
<td>Biomass</td>
<td>$4,000 (2013$)</td>
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</tbody>
</table>

CCS: Carbon Capture and Sequestration or Carbon Capture and Storage  
CC: Combined Cycle  
CT: Combustion Turbine

Resources – Variable Supply Side

Overnight Capital Cost ($/kW) (2013$)

- Photovoltaic
- Onshore Wind
- Conventional Hydroelectric

Resources – Demand Side (Energy Efficiency)

Resource Description

- EE is not a single resource but rather a collection of hundreds of different measures such as lighting, appliances or motors.

- Typically,
  - EE is incorporated into the load forecast implicitly.
  - EE levels are frequently described in terms of
    - Technical potential
    - Economic potential
    - Achievable potential

- There are various methods to model DSM/EE
  - Indiana Utilities will address this within their IRP Stakeholder Meetings.
Resource Description

- EE can be incented by the utility, but frequently requires an action by the customer
- Participation is less than what purely economic behavior would suggest
Resources – Demand Side (Demand Response)

Resource Description

Demand Response (DR) is a resource used to reduce peak load by one of these options:

- Customers agreeing to load curtailment in exchange for an option, e.g. Air Conditioning Load Management (ACLM) or industrial curtailment
- Calling upon customer-owned generation
- Utility modifies system operating parameters, e.g. Conservation Voltage Reduction or Volt/VAR Optimization
Resources – Demand Side (Demand Response)

Benefits
- Capacity value in RTO market
- Opportunity for customers to lower bill in exchange for agreeing to load curtailment
- Useful in peak shaving or shifting
- May include EE benefits too

Challenges
- Unique Evaluation Measurement & Verification (EM&V) requirements
- Higher use of DR may drive customers away from program
- Incremental DR capacity gets increasing expensive
  - Higher payments are needed to incent new participants and that higher rate also gets paid to all participants and drives up the cost of incremental DR
Resources – Distributed Generation

Resource Description: Distributed Generation are resources connected on distribution circuits. Examples include solar, wind, combined heat and power (CHP), and energy storage.

Benefits
- Avoided line losses/T&D expenses
- Less “chunky” resource additions
- Potential customer specific reliability improvements
- Customer choices
- Reduced emissions

Challenges
- System operations
  - Dispatch-ability
  - Intermittency
- Interconnection issues
- Loss of economies of scale