Virtual Power Plants:
Mobilizing Demand-Side Resources to Support Renewables Goals

National Fund for Environmental Protection and Water Management
Warsaw, Poland

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What is a VPP?

• A VPP is a bundle of demand-side programs designed to yield load reductions in amounts, timing, and durations that very closely resemble—and are as predictable and substantial as—a conventional power plant.

• Demand-side resources include:
  o Energy efficiency (EE)
  o Demand response/load management (DR/LM)
  o Customer-sited clean distributed generation (DG)
Why VPP?

The VPP concept grew out of the recognition that:

• Financing, building, and producing a revenue stream to pay for conventional power plants (CPPs) is commonplace.
  • China does this easily for 100 GW/year.

• If a VPP with output (savings) comparable to the output of a CPP had comparable financing and revenue security, its cost would be 1/3 that of a CPP (or even less).
  • China has more than 150 GWs of VPPs readily available—equal to roughly 15% of the country’s installed capacity.

• The VPP concept created new opportunities to overcome barriers to demand-side resources and to realize their potential.
  • The Asian Development Bank (ADB) is financing $200 million of VPPs in two Chinese provinces.
Definitions

• **Energy Efficiency**
  • Long-lived improvements in the efficiency with which end-uses (motors, appliances, industrial processes, buildings) use energy, in this case electrical energy

• **Demand Response and Load Management**
  • Short-lived (minutes, hours) reductions in demand through curtailments in load
    • Demand response: Voluntary end-user curtailments in response to price signals
    • Load management: Curtailments administered by the electric company or system operator; typically, end-users are paid for the reductions they provide

• **Distributed Generation**
  • Typically, small-scale generation facilities on end-user premises (“behind the meter”) that reduce end-user demand for grid-supplied electricity
Benefits of VPPs

- Reduce the need for additional generation
- Delay the need for new transmission and distribution lines
- Help meet renewable energy goals
Benefits of VPPs

• They reduce the overall need for generation
  – Make it easier to meet renewable energy targets
  – Improve system reliability
    • E.g., in the Northeast and mid-Atlantic states, EE and DR/LM successfully compete against generation and transmission options to provide reliability resources
  – Can provide (through DR/LM) real-time ancillary services (ramping, frequency regulation) to enable better integration of intermittent renewables into the grid
    • At various stages of implementation in the US, EU, and China
• They avoid the environmental impacts of generation
“Energy Efficiency Power Plant” (EPP) in China

An EPP is a bundle of energy efficiency programs whose savings resemble the output of a coal-fired CPP. EPPs are being “built” in six provinces. A new program calls for EPPs to be built in 100 cities over the next four years, to total 10 GW.

<table>
<thead>
<tr>
<th></th>
<th>CPP</th>
<th>EPP</th>
</tr>
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<tbody>
<tr>
<td>Capacity</td>
<td>300 MW</td>
<td>300 MW</td>
</tr>
<tr>
<td>Annual MWh produced/saved</td>
<td>1.5 million</td>
<td>1.5 million</td>
</tr>
<tr>
<td>Fuel Use/kWh</td>
<td>340 grams coal</td>
<td>0 grams</td>
</tr>
<tr>
<td>SO2 emissions/kWh</td>
<td>4 grams</td>
<td>0 grams</td>
</tr>
<tr>
<td>Average cost/kWh</td>
<td>35-40 fen (0.18 PLN – 0.21 PLN)</td>
<td>15 fen (.08 PLN)</td>
</tr>
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Potential VPP Models for Poland

• In China, we developed a number of different models for implementing VPPs including:
  • Comprehensive integration of VPPs into power sector planning, investment, and operations, with costs collected in electricity prices
  • Earmarked government funds with centralized planning and administration
  • Loan-based models supported by commercial and other (e.g., ADB) financing
• There are a variety of VPP delivery mechanisms:
  • Distribution companies
  • Retail suppliers
  • Third-party contractors
Potential VPP Models for Poland

- Poland’s conditions provide even more interesting opportunities:
  - Integration with Thermo-Modernization Fund and National Fund for Environmental Protection and Water Management (NFOŚiGW);
  - Adapting the white certificate scheme commencing in 2013 to ongoing VPP construction;
  - Reforming the power markets to allow VPPs to compete with CPPs;
  - Using revenue from the EU Emissions Trading Scheme (ETS) to build VPPs;
  - Adapting green certificates and additional incentives for distributed renewable resources under the proposed amendments to the renewable energy law; and
  - Incorporating VPPs into Poland’s national energy strategy, which calls for consideration of both supply- and demand-side resources.
Complementary Policies to Consider

• To reduce barriers to deployment of renewables:
  • A **net metering** policy would help fund customer-side distributed renewable energy through electricity bills;
  • A **multiplier** can be applied to the renewable energy credits that distributed resources are eligible to earn, granting them 1.x (a number greater than 1) renewable energy credits per kWh generated.

• To reduce barriers to deployment of VPPs:
  • **Better integration of demand-side resources into Poland’s national energy plan**, recognizing them as a low-cost power system resource;
  • A revenue-setting policy that would **decouple utility profits from sales**, thereby removing the financial disincentive to support VPPs of the distribution companies;
  • Possible performance incentives for the successful deployment of cost-effective VPPs; and
  • **A standard EM&V protocol** that accurately measures energy savings.
About RAP

The Regulatory Assistance Project (RAP) is a global, non-profit team of experts that focuses on the long-term economic and environmental sustainability of the power and natural gas sectors. RAP has deep expertise in regulatory and market policies that:

- Promote economic efficiency
- Protect the environment
- Ensure system reliability
- Allocate system benefits fairly among all consumers

Learn more about RAP at www.raponline.org

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Case Study, California

- VPPs must be built by the privately-owned electric distribution companies
  - The electric utilities must design and implement a **portfolio of energy efficiency and demand response programs** in order to meet MW and GWh savings goals.
  - The goals are established through an integrated planning process (called Long-Term Procurement Planning) aimed at **meeting energy needs with a least-cost mix of demand- and supply-side options**.
  - The utilities must procure cost-effective demand-side solutions **before** pursuing new supply-side options.
Case Study, California

- Utility-funded programs are, in effect, EPPs:
  - They are funded through retail prices, just like CPPs;
  - They have a stable source of funding that supports broad-reaching programs;
  - There is a programmatic approach to meeting EE goals;
  - There are sound standards for evaluation, measurement and verification (EM&V) to accurately quantify savings; and
  - Efficiency programs are driven by key policies that set concrete goals and standards for EE, ensure full utility participation, and remove the disincentive for utilities to invest in EE.
Case Study, South Korea

• VPPs are designed and delivered by the national government
  • They are funded by the Ministry of Commerce, Industry, and Energy (MOCIE)
  • Funds are administered by Government-owned Korean Energy Management Corporation (KEMCO)
Case Study, South Korea

- **KEMCO administers EE investment & oversees virtually every aspect of the nation’s efficiency and renewable energy activities:**
  - Develops policy tools
  - Conducts efficiency audits for customers
  - Undertakes research and development
  - Provides technical assistance, rebates, incentives, and financing

- **Some activities are undertaken in conjunction with partners, such as utilities and energy service companies.**