RAP Energy solutions for a changing world

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

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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:
  - Energy efficiency (EE)
  - Demand response/load management (DR/LM)
  - Customer-sited clean distributed generation (DG)

Why VPP?

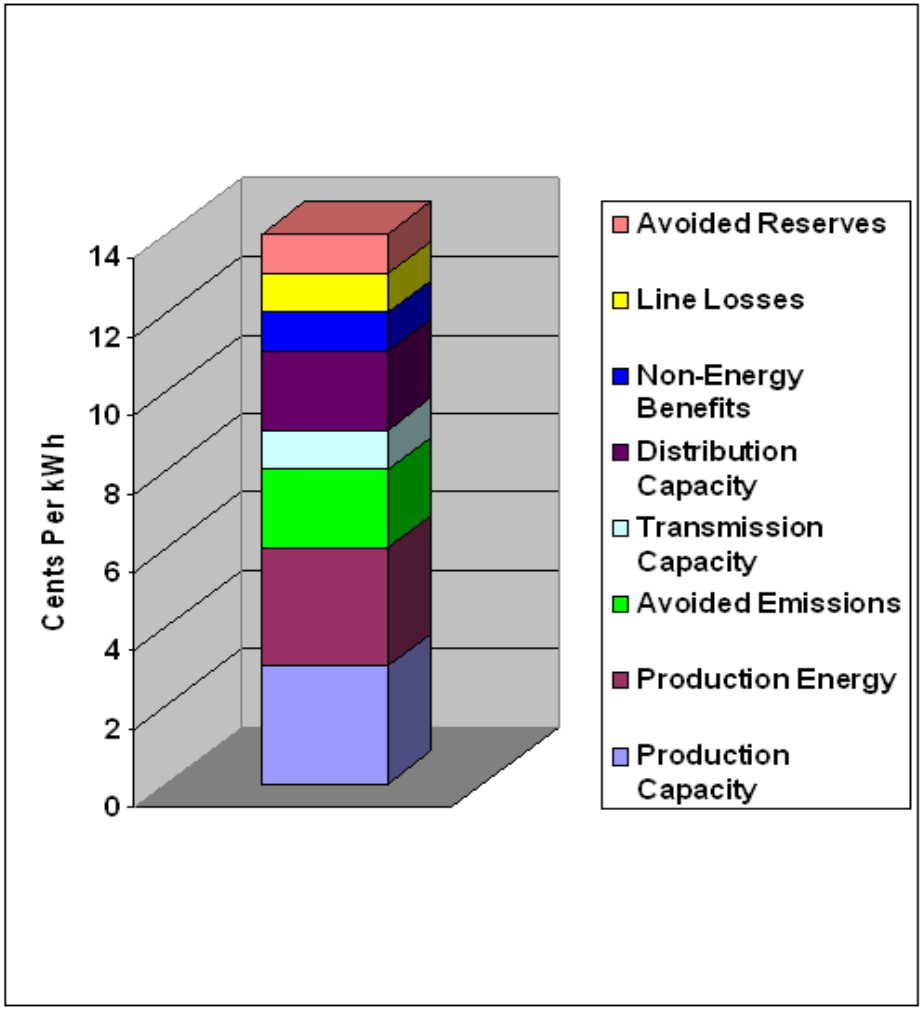
The VPP concept grew out of the recognition that:

- 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.

	CPP	**EPP**
Capacity	300 MW	300 MW
Annual MWh produced/saved	1.5 million	1.5 million
Fuel Use/kWh	340 grams coal	0 grams
SO2 emissions/kWh	4 grams	0 grams
Average cost/kWh	**35-40 fen (0.18 PLN – 0.21 PLN)**	**15 fen (.08 PLN)**

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.