

Roof-top Solar and Demand Alignment

November 16, 2011

Eran Mahrer

Renewables and Resource Program Planning, Director



Profile of Arizona Public Service

- Arizona's largest utility
- Serves about ½ of Arizona's population
- 5th largest service territory in the US
- Peak demand over 7,000 MWs
- Average growth rate of 3-5% per year
- Energy demand expected to double in 25 yrs
- Owns and operates about 5,000 miles of transmission lines



Regulatory standards still drive program development

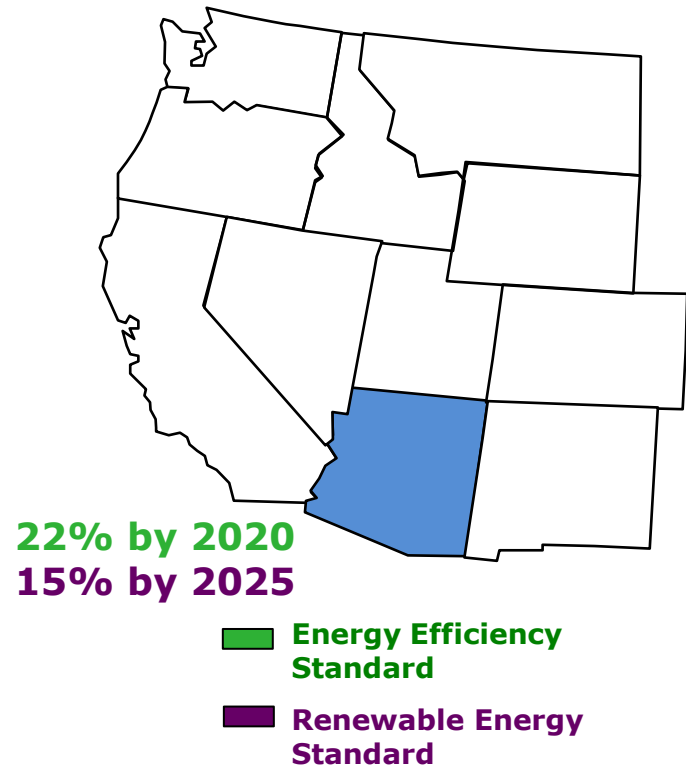
26.5% of retail sales will be met through DE, EE by 2025

Distributed Energy

- Renewables: Standard calls for 15% of retail sales by 2025
- 30% of same to be distributed = **4.5%** by 2025
- Nine technologies included, including solar
- Flagstaff Pilot, Schools and Governments – APS ownership programs

Energy Efficiency (DSM)

- Standard calls for **22%** of retail sales by 2020
- 15 non-residential and residential EE programs
- C&I and residential DR initiatives – rates, DLC, etc.



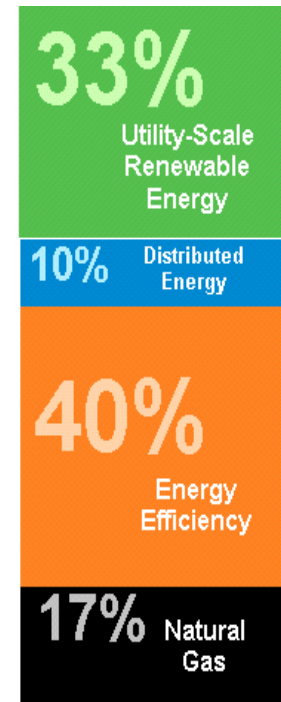
Customer-sited resources will contribute 50 percent APS growth in energy sources

DE and DSM are key components of the APS resource plan

DE within the APS portfolio

- Primarily roof-top PV and solar water heating
 - Planning for 335 MW PV of capacity by 2025
 - Some distribution feeders projected to have over 60 percent energy derived from customer-sited resources
 - Intermittency and other technical challenges expected on parts of the distribution system

APS Energy Growth Sources 2011 - 2025

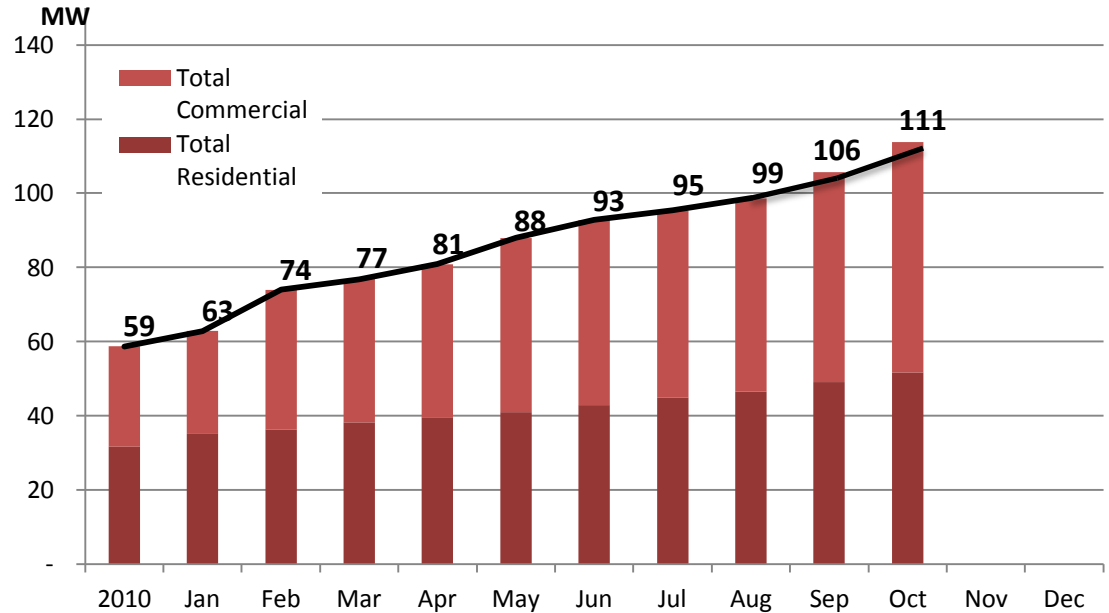


Partnering with Customers

Demand for PV is strong, and currently constrained by incentive availability



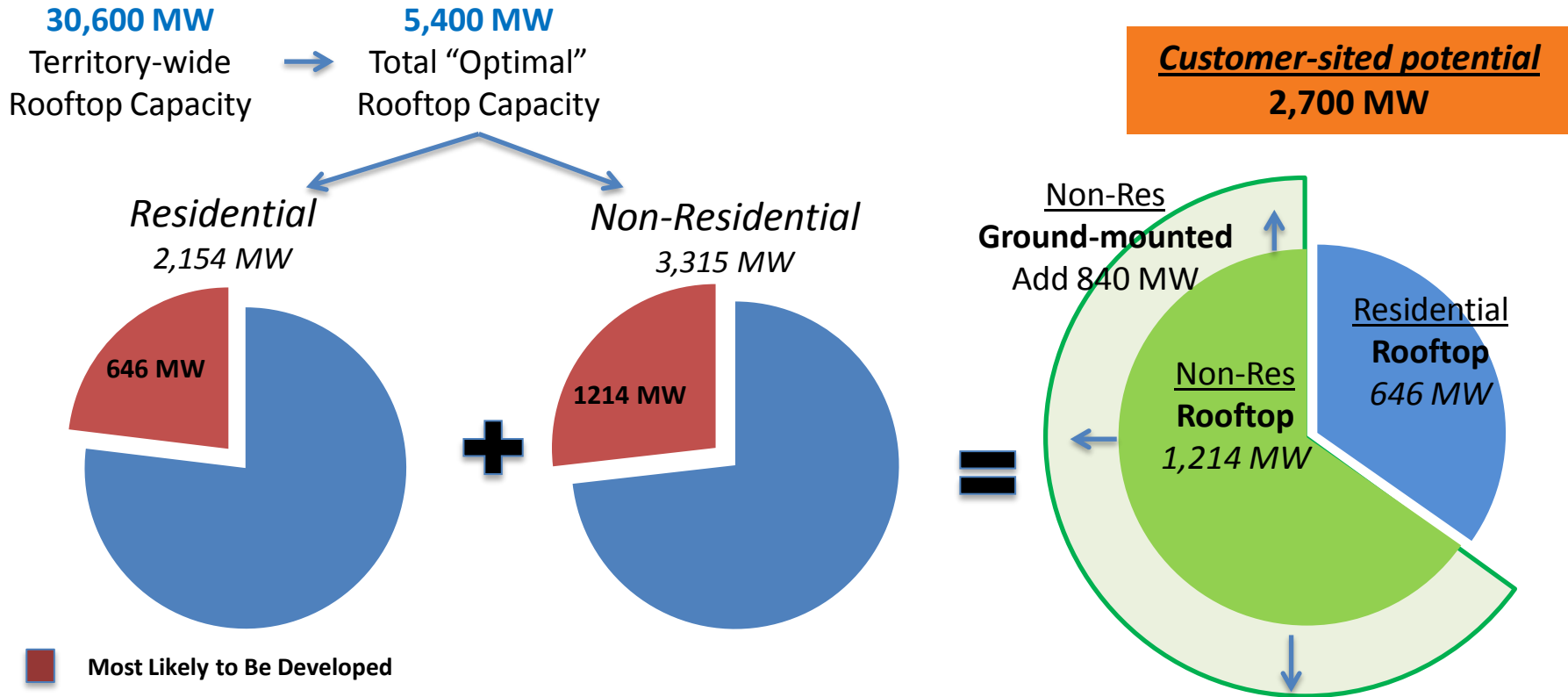
Installed DE Cumulative Capacity



Over 16,000 APS customers have installed solar

Potential for PV in as a distributed resource far exceeds currently forecast adoption rates

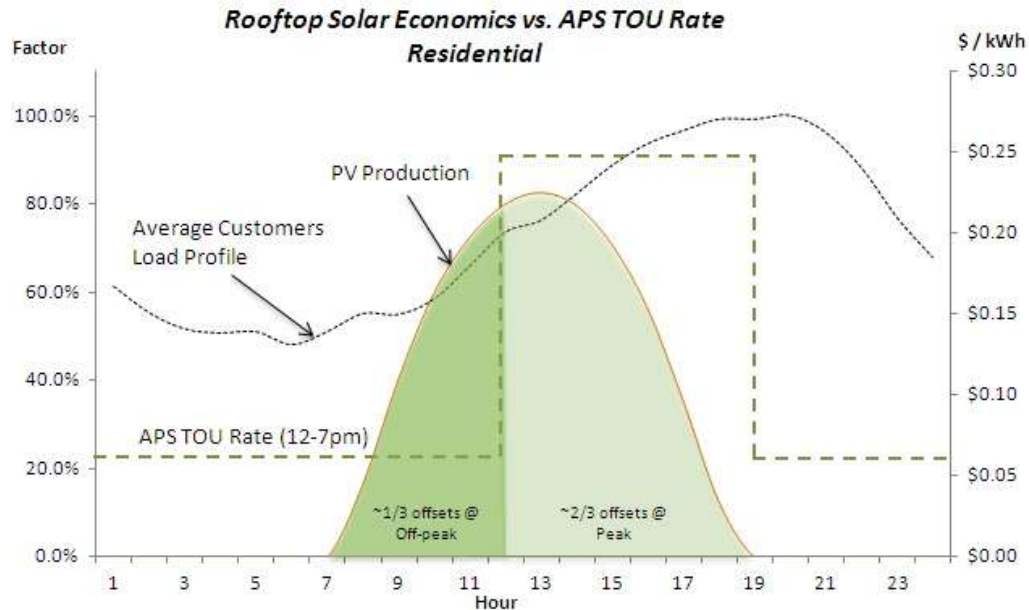
Over 5,400 MW of optimally oriented DE rooftop potential exists on APS territory...



2,700 GW are likely to be develop...the RES target in 2025 requires 1,030 MW DE

Rate related value to customers is not aligned with costs

Current residential customer savings from solar installs is \$0.165/kWh



Annual Weight Price (S + W) \$0.14 + \$0.02 = **\$0.16**

APS Rates (Summer: May-Oct)

Residential TOU, ET-2 (12pm-7pm)

	On-Peak	Off-Peak
Summer Rates	\$0.24445	\$0.06126
x PV Annual Production Weight	<u>33%</u>	<u>22%</u>
Summer Weighted Price	\$0.08	\$0.01

APS Rates (Winter: Jan-Apr, Nov-Dec)

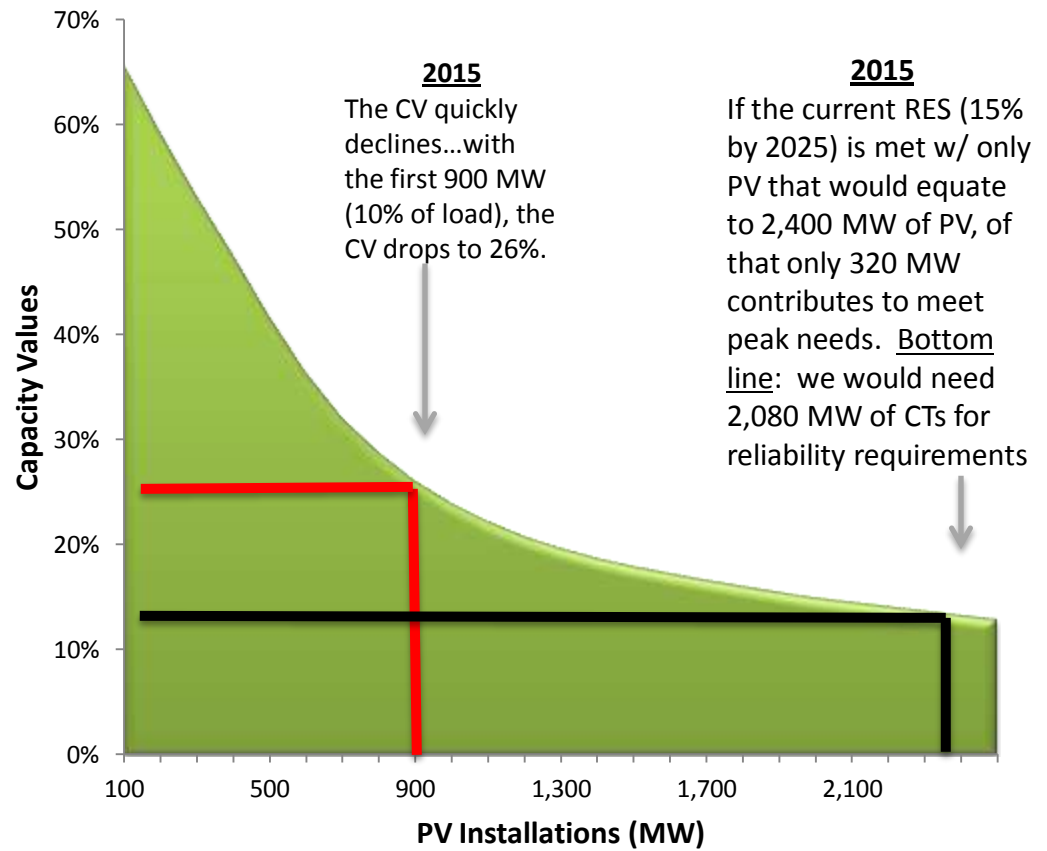
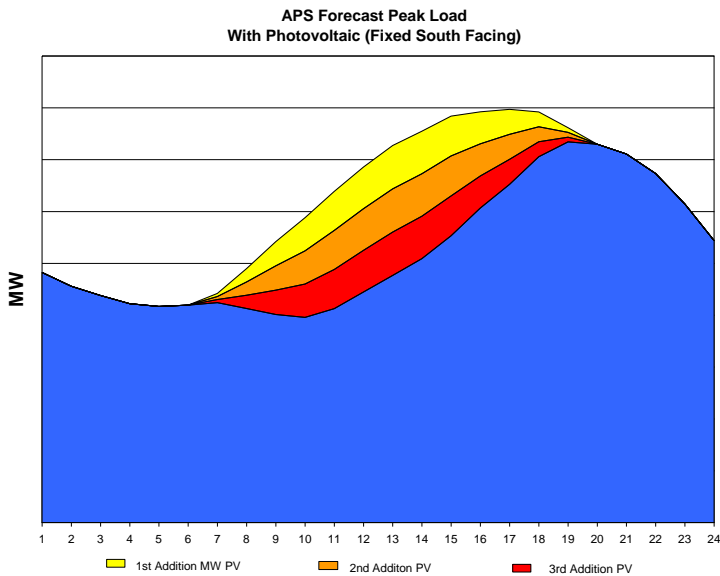
Residential TOU, ET-2 (12pm-7pm)

	On-Peak	Off-Peak
Winter Rates	\$0.19825	\$0.06124
x PV Annual Production Weight	<u>32%</u>	<u>13%</u>
Winter Weighted Price	\$0.06	\$0.01

Unmanaged, PV capacity value declines as more is deployed

The peak capacity value of PV decreases as penetration increases...

TODAY	
Solar PV-Single Axis	70%
Solar PV Fixed Position	50%



Leveraging Demand Response to Retain PV Capacity Impact

APS Demand Response study demonstrated value and sensitivities of direct load control

Managed at the “system” level DR maximum potential of 5% of APS peak demand

- DR maximum potential of **2 - 5%** of peak demand
 - Suggested **140-350 MW** of peak load reduction
 - Snapback and missing 4th Peak Day contribute to range
 - Base case defined as **6 hours/event, 15 events (6x15)** dispatch scenario
- **70-80% capacity value** for DR

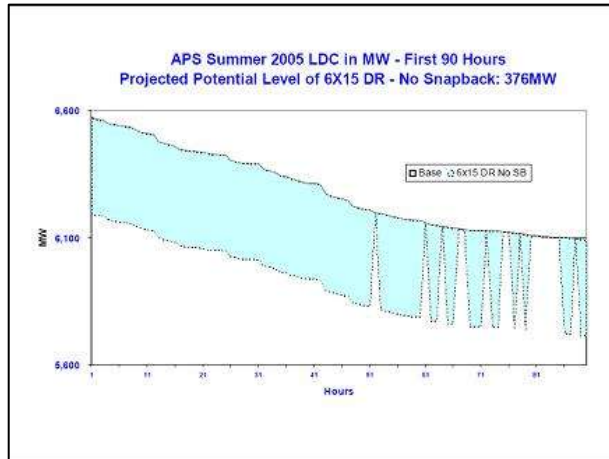
Also performed a Cost-benefit analysis on 8 Residential and C&I programs

(Total Resource Cost Test (TRCT) and Program Administrator tests (PAC))

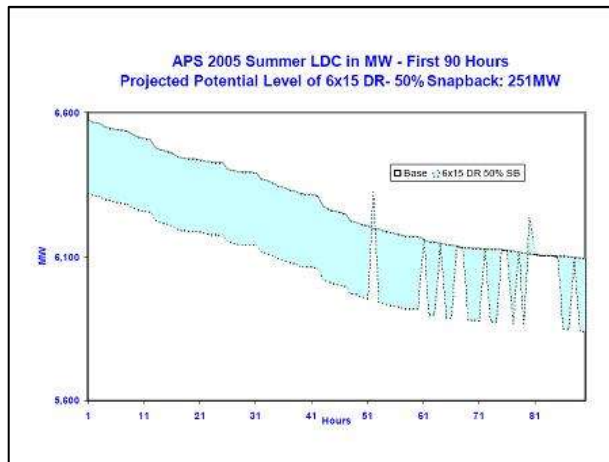
Avg Acceptable Callable Level of DR as a % of Peak	
<u>Scenario</u>	<u>MW Impact</u>
6x15 Base Case	6.8%
With 50% Snapback	5.0%
Missing 4th Peak Day	1.9%
Missing 4 th Peak+50% Snapback	1.9%

Managing on-site load based on system signals may not maximize value

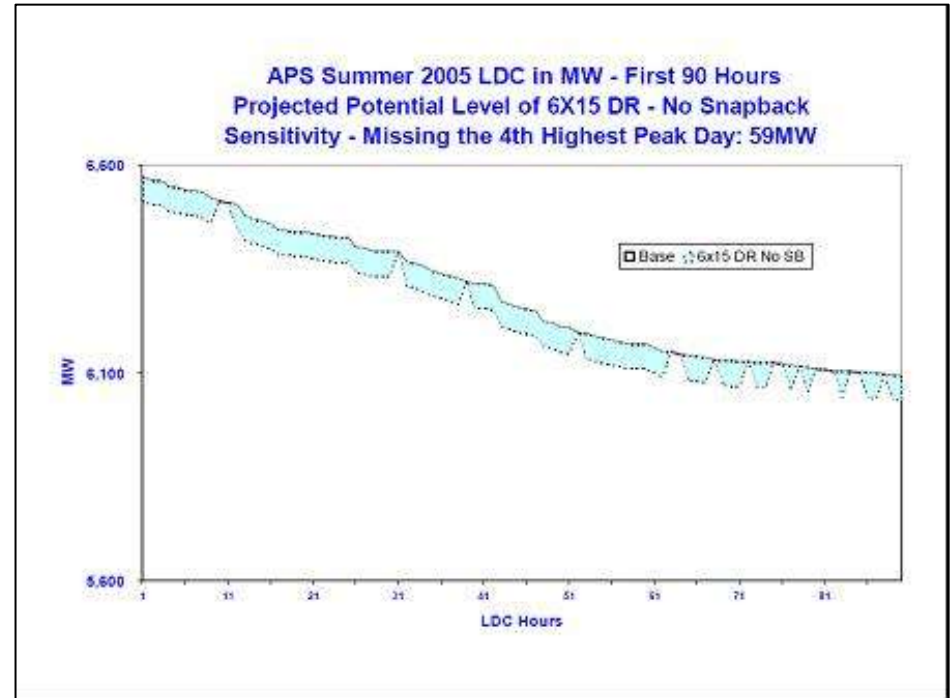
Missing the 4th peak day reduces DR potential to 2%



Baseline Scenario



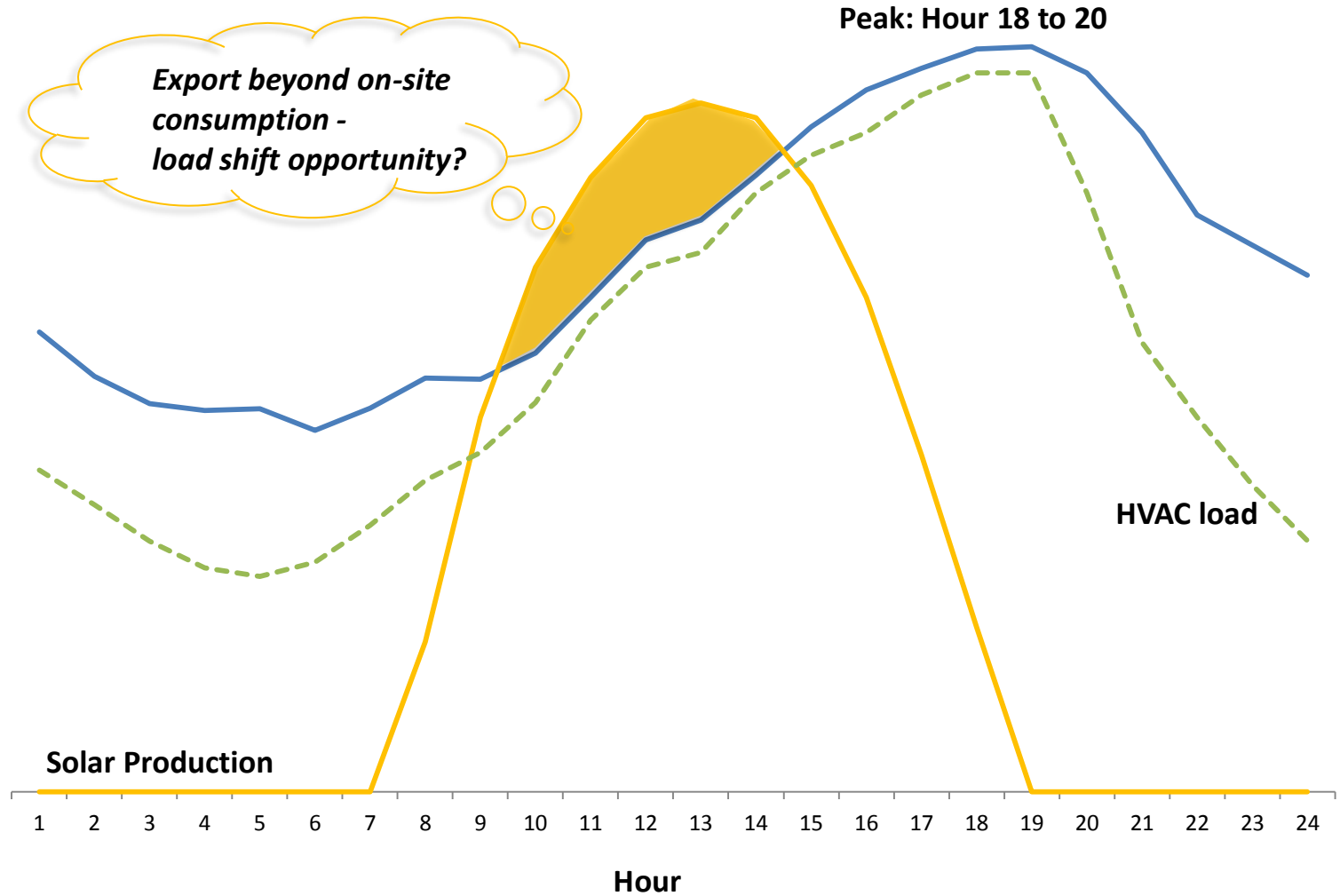
50% Snapback



Missing 4th Highest Peak Day Scenario

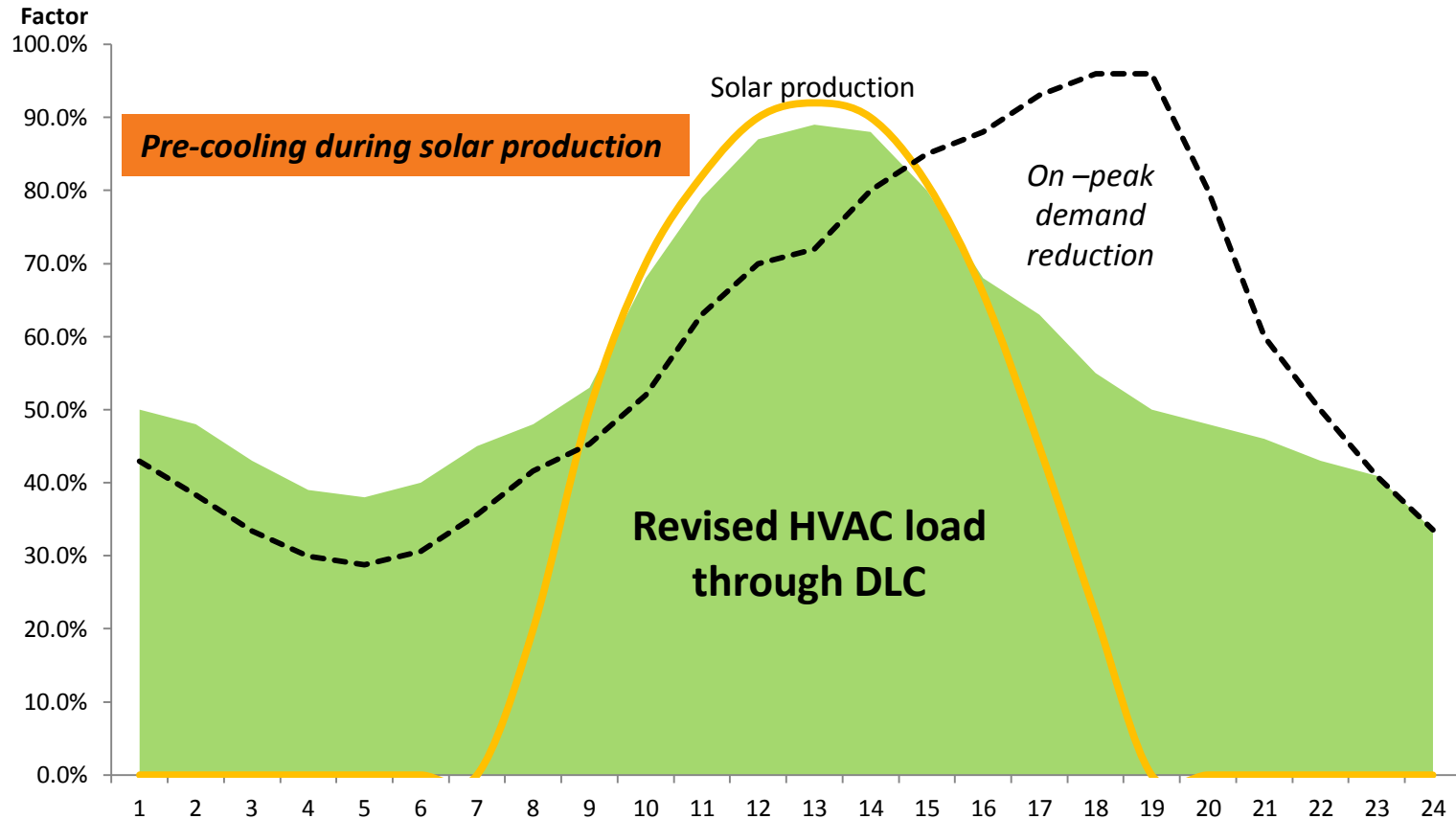
- 6x15 dispatch
- No snapback
- With 50% snapback, still 1.9% potential reduction

Can load management “into solar” increase capacity value and mitigate system impacts?



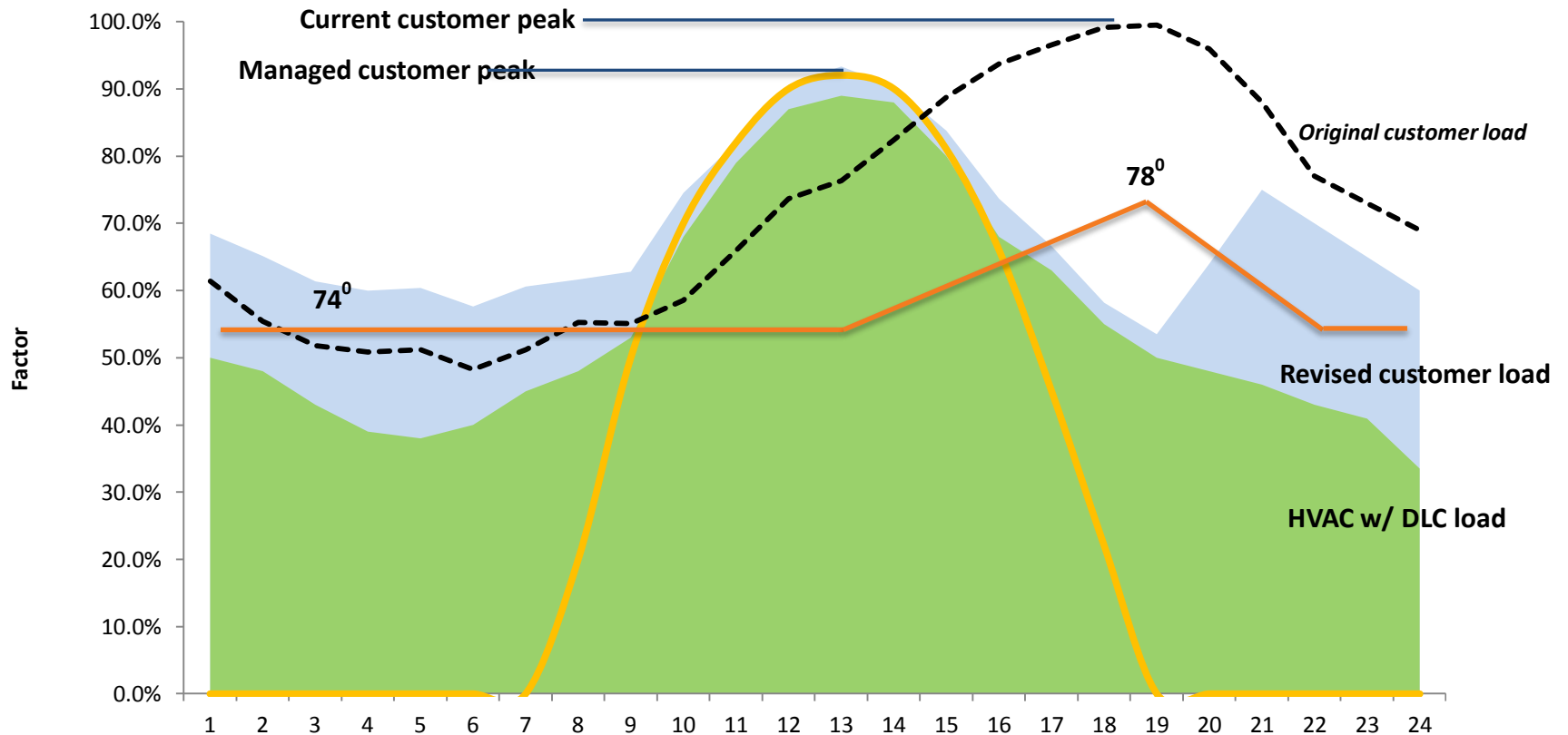
Can direct load management can ensure consumption aligned with production?

Direct load control communication through PV inverters?



HVAC loading is naturally aligned with PV

On-site triggers support maximizing the value of load control...



...and are naturally aligned with PV production

APS proposed Integrated Pilot and smart-grid communication platform

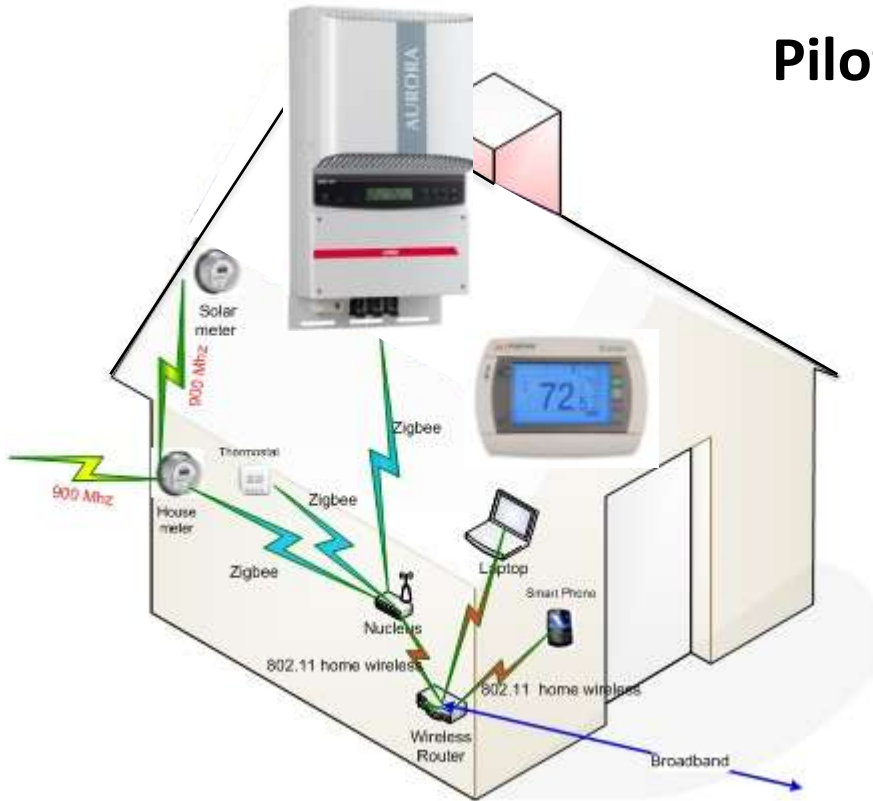
APS-owned “smart” inverter provides near real-time PV production data...

Pilot provides opportunity for managed consumption

- APS owns “operates” the PV inverter
- Inverter communicates to GE Nucleus (through Zigbee)
 - Communication capability with smart phone, PC and in-home display
- APS bills shows actual PV system production and gross consumption

Current: allows customer to manage their thermostat aligned with solar production
Future: thermostat sync'd with PV production

- Opportunity for future Volt/Var, real-time pricing, remote connect/ disconnect, and low-voltage sage ride through



...to in-home display, smart phone, and PC