



High DSM/DG Case: Approach for DG Estimates

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Background



- **E3 is working with LBNL and RAP to prepare DG resource estimates for the SPSC's High DSM/DG Case**
- **Today's presentation discusses the methodology and results of the DG resource market penetration estimates**
- **Estimates developed for PV and CHP only**
 - **Unable to find good information about potential for other resource types**
 - **PV and CHP are a reasonable stand-in for other technologies for measuring the impact on interregional transmission flows**



DISTRIBUTED GENERATION: SOLAR PV

Interconnection Potential



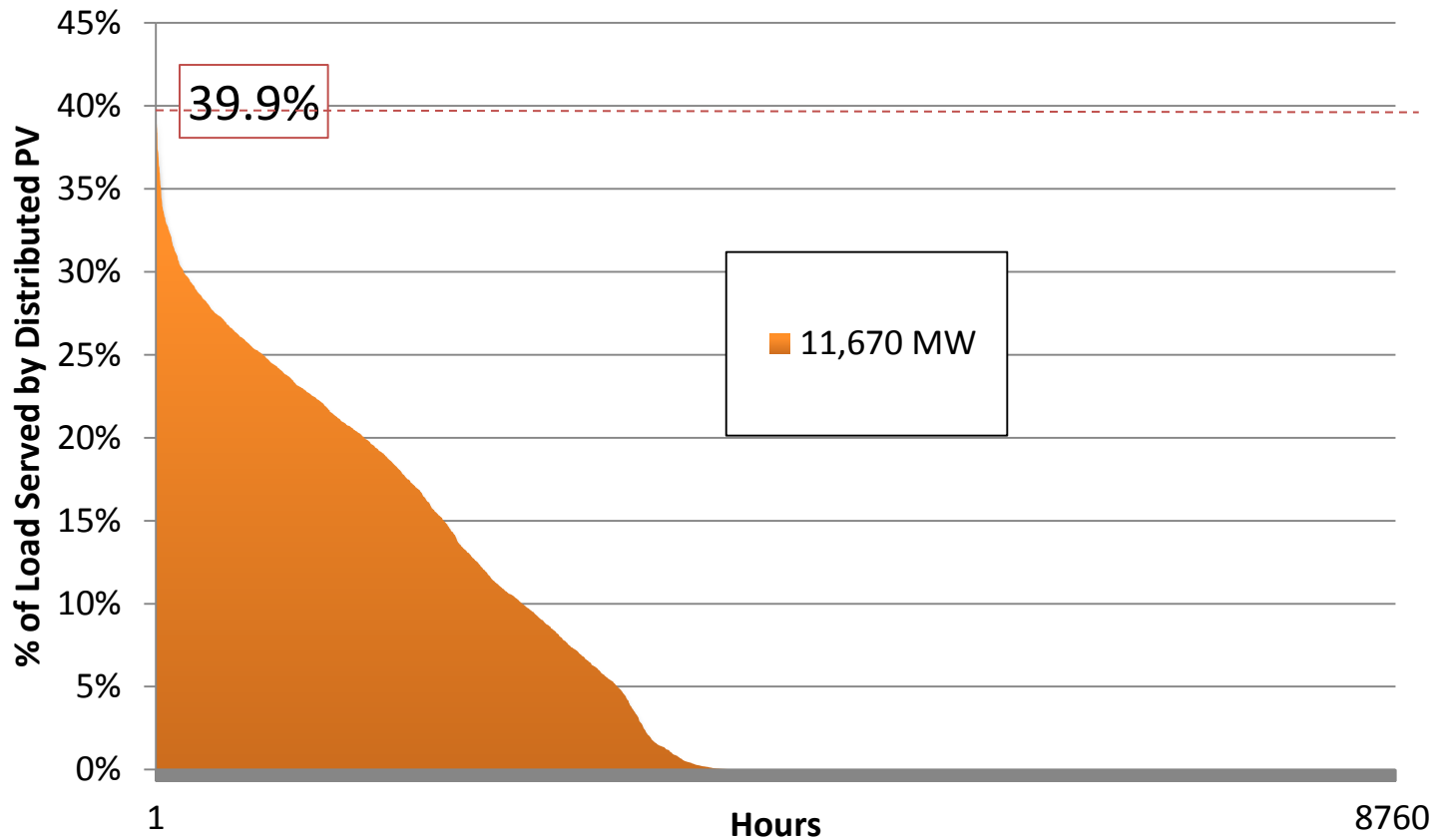
- **Leveraged DG interconnection work done by E3 for the state of California in Phase 3 of the California Solar Initiative (CSI) to estimate Interconnection Potential**
- **“Interconnection potential” assumed to be a meaningful constraint on high PV deployment in the near term**
- **Phase 3 estimated “easy” interconnection potential of small, local DG based on a resource potential estimate, screened by estimates of market penetration and adoption**
 - **DG applications up to 30% of peak substation load assumed to be “easy” to interconnection**
- **Estimated 11,670 MW of easy interconnection potential in California:**
 - **Similar in scale to Governor Brown’s 12,000 MW DG goal**
 - **Also similar to California Long Term Planning Proceeding PV in Environmentally Constrained Case (12,100 MW of DG PV)**

Solar PV Methodology cont.

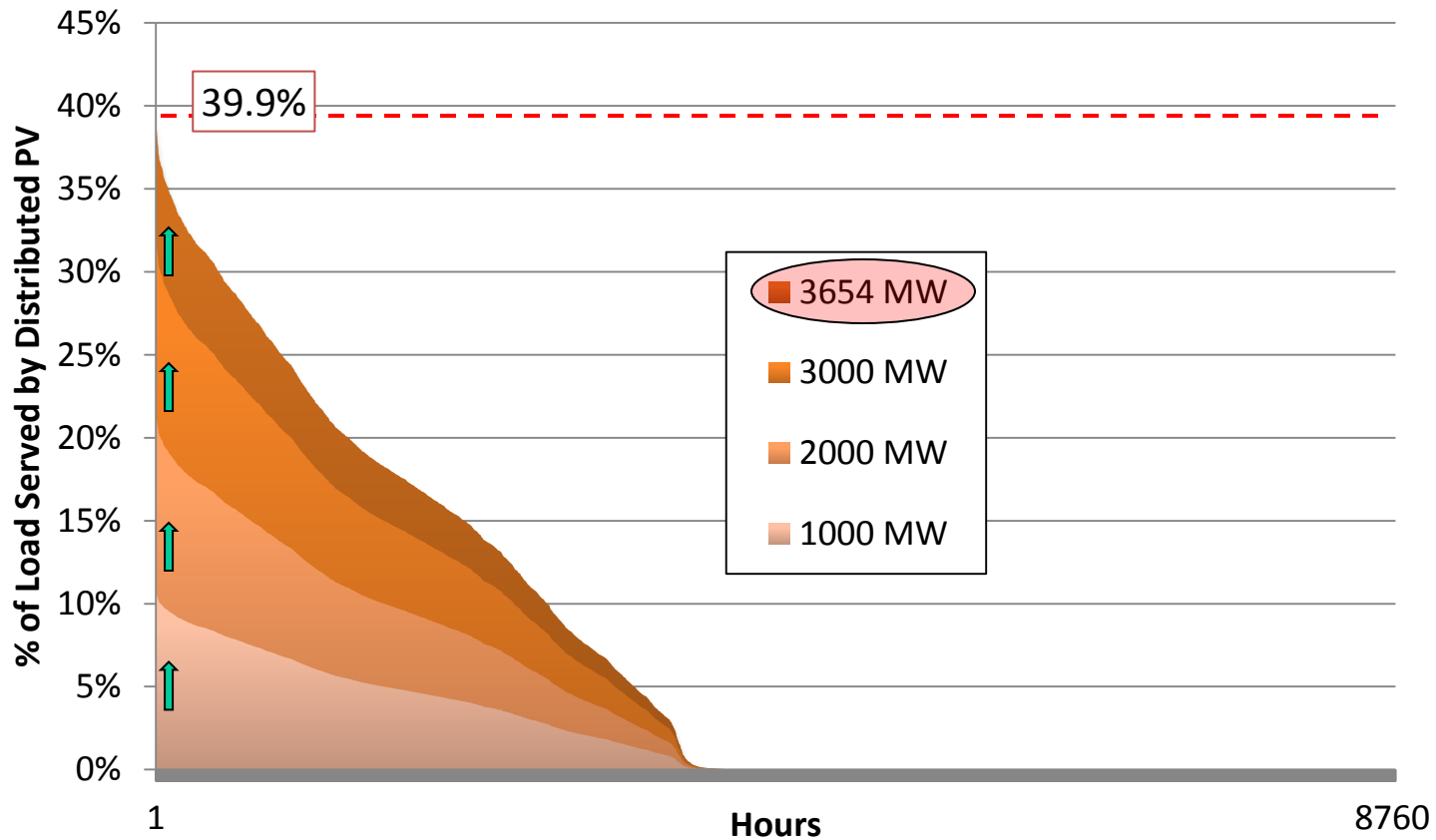


- **Scaled interconnection potential by the maximum % load served by PV in any state:**
 - Used 8760 load shapes by state and province
 - Used example solar PV shapes from NREL's System Advisor Model (SAM) for each state and province
 - Scaled the MW of DG PV so that the maximum % of load served by PV in any hour was the same as the maximum served by 11,670 MW of PV in California
- **Methodology accounts for:**
 - Variable solar resource quality
 - Different load types (winter vs. summer peak)
 - Coincidence of PV output and peak load

California PV Duration Curve



Interconnection Potential Scaling: Arizona



Interconnection Potential Estimates



- **Scaling interconnection potential based on California results in ~40,000 MW WECC-wide**
- **High amount of interconnection potential in northern jurisdictions**
- **Used additional scaling factors to reflect less favorable economics for northern latitudes**

State	2022 State Interconnection Potential (CPUC) (MW)
Alberta	5,013
Arizona	3,654
British Columbia	2,813
California	11,670
Colorado	2,820
Idaho	1,107
Mexico	397
Montana	620
Nevada	1,451
New Mexico	795
Oregon	2,480
Texas	286
Utah	1,370
Washington	4,360
Wyoming	1,015
Total	39,851

Solar PV Values



State	2022 State Interconnection Potential (CPUC) (MW)	Scaling Factor	Final PV Value (MW)
Alberta	5,013	10%	500
Arizona	3,654	100%	3,650
British Columbia	2,813	25%	700
California	11,670	100%	11,670
Colorado	2,820	75%	2,120
Idaho	1,107	50%	550
Mexico	397	75%	300
Montana	620	25%	160
Nevada	1,451	75%	1,090
New Mexico	795	75%	600
Oregon	2,480	50%	1,240
Texas	286	75%	210
Utah	1,370	50%	690
Washington	4,360	25%	1,090
Wyoming	1,015	50%	510
Total	39,851		25,080

Solar PV Characteristics



- **Solar PV performance will vary based on system type and location**
 - Assume resource breakdown from CSI study (21% commercial rooftop, 35% residential rooftop, 44% ground-mounted)
 - Assume that PV can be distributed among nodes in proportion to load (use CPUC case for California)
 - Recommend developing PV output profile for each major load center
- **Need to understand what fraction of DG is behind-the-meter in order to estimate the impact on retail sales**
 - Needed to calculate resources needed for RPS requirements
 - Assume that 100% of residential rooftop, 50% of commercial rooftop, and 10% of ground-mounted systems are behind-the-meter
 - Works out to roughly 50% of systems behind-the-meter



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Technical Potential Sources



- **Western Governor's Association:** *CHP White Paper*
 - Prepared in support of the Clean and Diversified Energy Advisory Committee (CDEAC)
 - Gives estimates of existing and potential CHP capacity by state
- **DOE/EIA:** *The Market and Technical Potential for Combined Heat and Power in the Commercial/Institutional Sector*
 - Existing capacity and technical potential estimate of CHP in the Commercial/Institutional Sector prepared in 2000
 - Conducted a similar report for industrial sector but results not broken down by state
- **EEA/ORNL:** *CHP Market Potential in the Western States*
 - Technical and economic market potential for six Western states
- **PacifiCorp:** *Assessment of Long-Term, System-Wide Potential for Demand-Side and Other Supplemental Resources*
 - Technical and achievable potential for states in their territory
- **ICF International:** *Combined Heat and Power Market Assessment (California only)*

CHP Potential



- **Scaled technical potential downward to reflect a more realistic scenario**
 - Scaled down WGA CDEAC technical potential numbers by 33%
 - Increases WECC CHP capacity by 8,125 MW
 - Close to California PUC “stretch” goal of 3,742 MW
 - Assumed 50% behind-the-meter (per CA PUC LTPP proceeding)

State	WGA CDEAC 2015 Potential	Scaling Factor	Additions by 2022 (MW)	Behind-The-Meter	Wholesale
Arizona	1,801	33%	600	300	300
California	10,945	33%	3,600	1,800	1,800
Colorado	1,578	33%	525	263	263
Idaho	1,142	33%	375	188	188
Montana	470	33%	150	75	75
Nevada	834	33%	275	138	138
New Mexico	649	33%	225	113	113
Oregon	1,862	33%	625	313	313
Texas	62	33%	25	12	12
Utah	1,267	33%	425	213	213
Washington	3,189	33%	1,050	525	525
Wyoming	747	33%	250	125	125
<i>Total</i>	<i>24,546</i>		<i>8,125</i>	<i>4,063</i>	<i>4,063</i>



NEXT STEPS

Next Steps



- **Locate DG resources on grid**
 - For California, use details from Long Term Procurement Planning proceeding
 - Outside of California, assume that PV can be distributed among nodes in proportion to load
 - Outside of California, assume that CHP can be distributed among nodes in proportion to industrial load
- **Develop DG output profiles for use in Promod**
- **Recommend an effort to identify existing DG resources in order to enhance performance of production simulations**
 - TEPPC case only identifies 1300 MW out of the approx. 14,000 MW of CHP in the WECC
 - Less important for flows, but could matter for studies where operating flexibility is important (e.g., renewables integration)



Energy+Environmental Economics

Thank You!

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