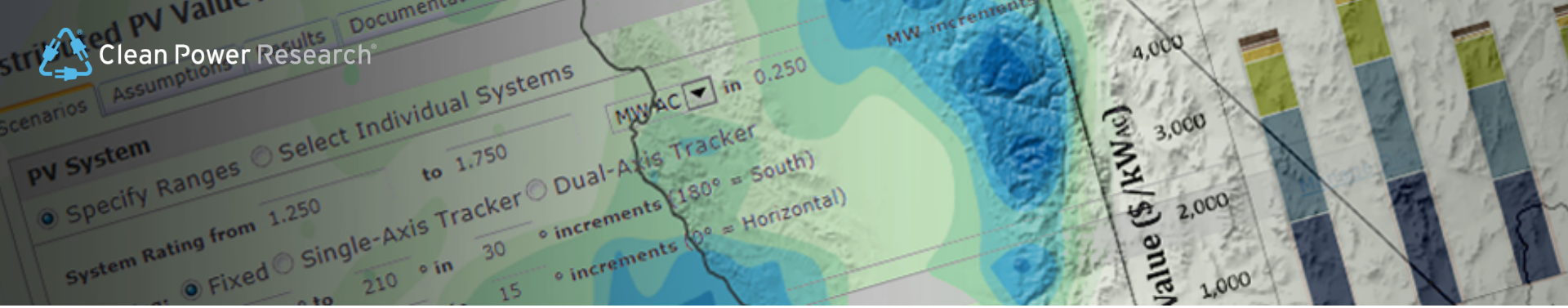
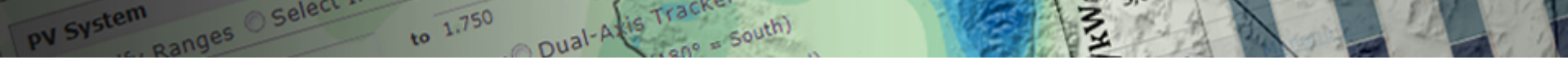


Distributed Solar Valuation: Cooperatives and Municipal Utilities

January 29, 2016

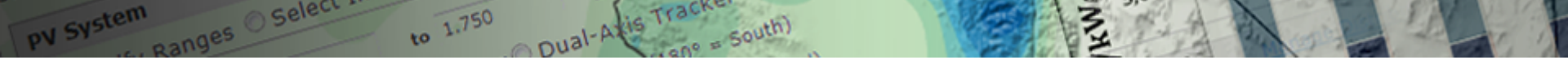
Prepared by:

Ben Norris
Clean Power Research



Clean Power Research Solar Valuation and Fleet Modeling Studies

Utilities	Energy Agencies	Renewables Organizations
Austin Energy CEPCI Duke Energy Nevada Power Portland General Electric SDG&E (USD) Tacoma Power “Utility X” We Energies	California PUC Minn. Dept. of Commerce Maine PUC NYSERDA Ontario Ministry of Energy	IREC MSEIA Solar San Antonio Utah Clean Energy “Organization Z” AEEI

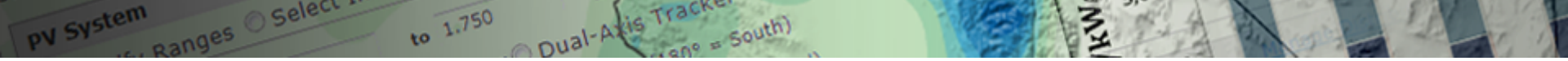


Why Calculate the Value of Solar?

- Determine whether net energy metering (NEM) rates are fair
  - Is there cross-subsidization to (or by) solar customers?
  - Is it necessary to add fixed, demand, or minimum charges to pay for infrastructure?
- Develop a value-based compensation
  - “Pay what it’s worth”

Example: Possible Benefits of Solar

Utility costs		Examples	Benefit of solar
Energy costs		Fuel, plant O&M, wholesale power purchases	Reduces all of these costs
Capacity costs		Plant capacity, transmission lines, substations, distribution lines	Can reduce these, depending upon how well solar generation matches the corresponding load profile
Fixed costs		Metering, line maintenance, billing, customer service	Generally, no impact

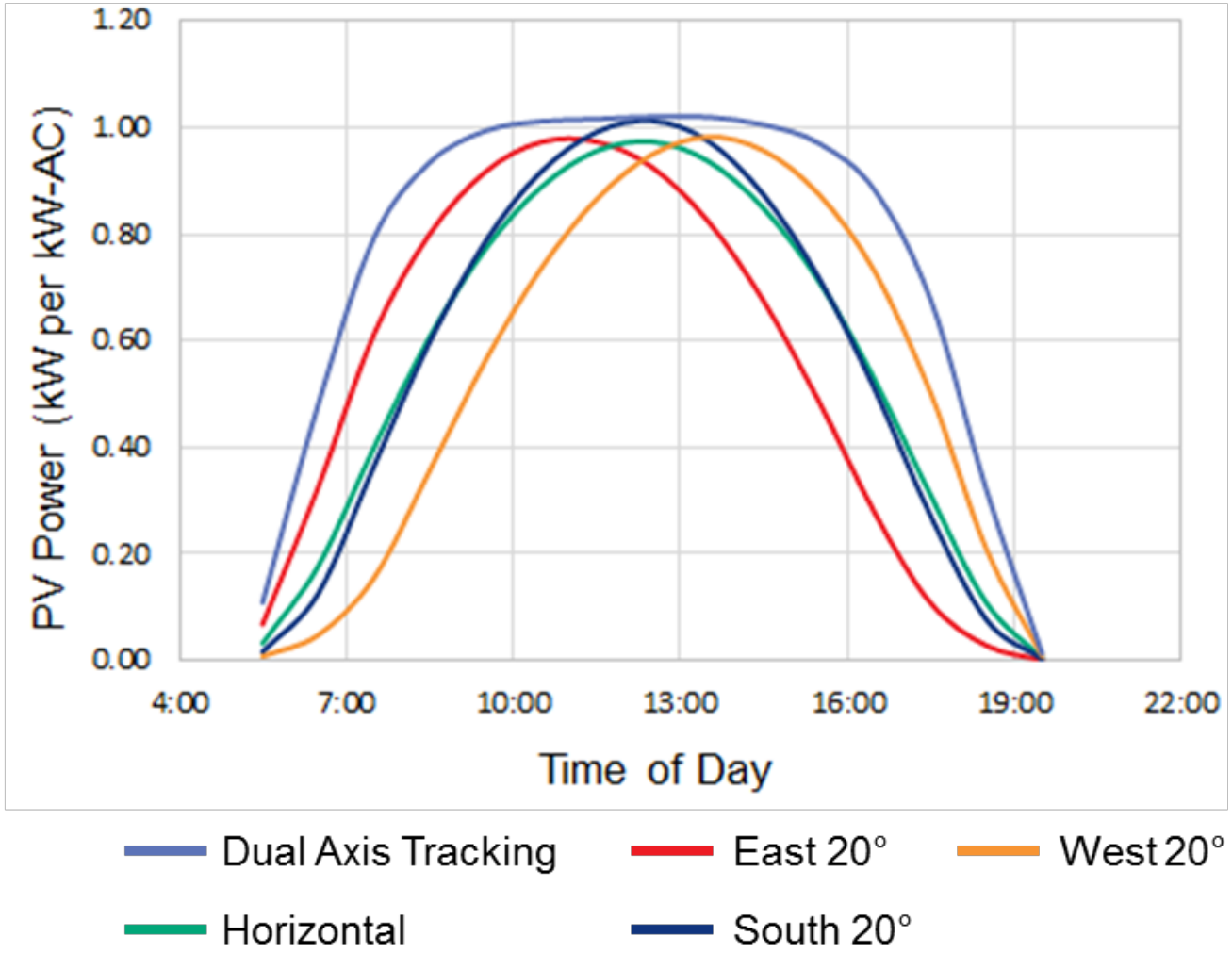


Example Calculation

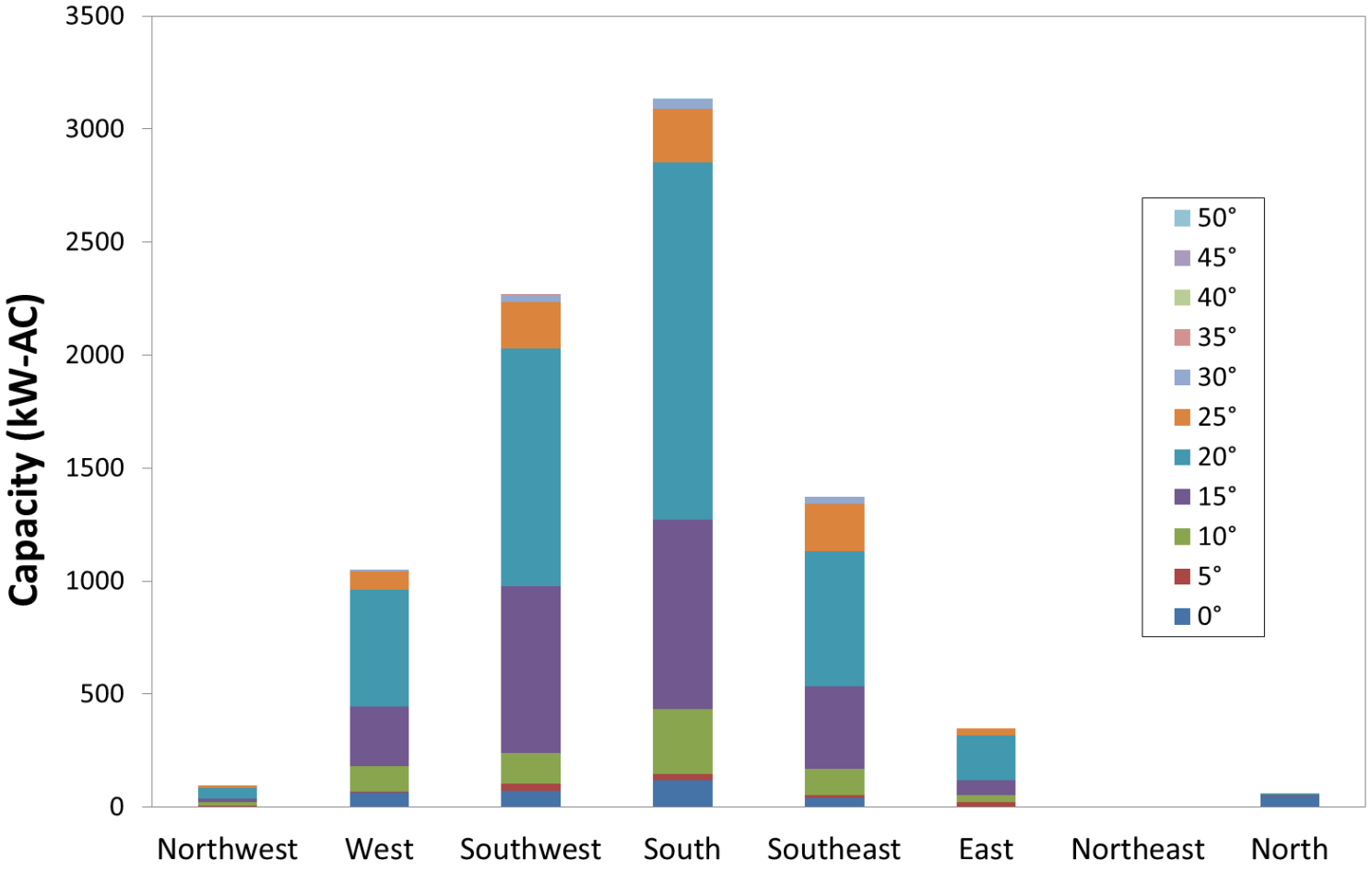
Categories selected for Illustration

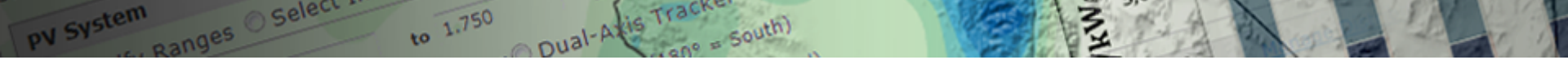
		Gross Value		Load Match Factor		Loss Savings Factor		Distributed PV Value
		A	×	B	×	(1+C)	=	D
		($/kWh)		(%)		(%)		($/kWh)
Demand Savings	Non-coincident Demand	V1		L1		S1		D1
	Coincident Demand	V2		L2		S2		D2
	Summer Demand	V3		L3		S3		D3
Energy Savings	Supplier Energy Charges	V4				S4		D4
	Renewable Energy Credit	V5						D5
Added Costs	Incremental Metering	V6						D6
	Incremental Billing	V7						D7
	Voltage Regulation	V8						D8
Societal Benefits	Social Cost of Carbon	V9						D9
	Municipal Jobs	V10						D10
								Value

PV Profile by System Orientation



Capacity “Buckets” by Orientation
(Illustrative)



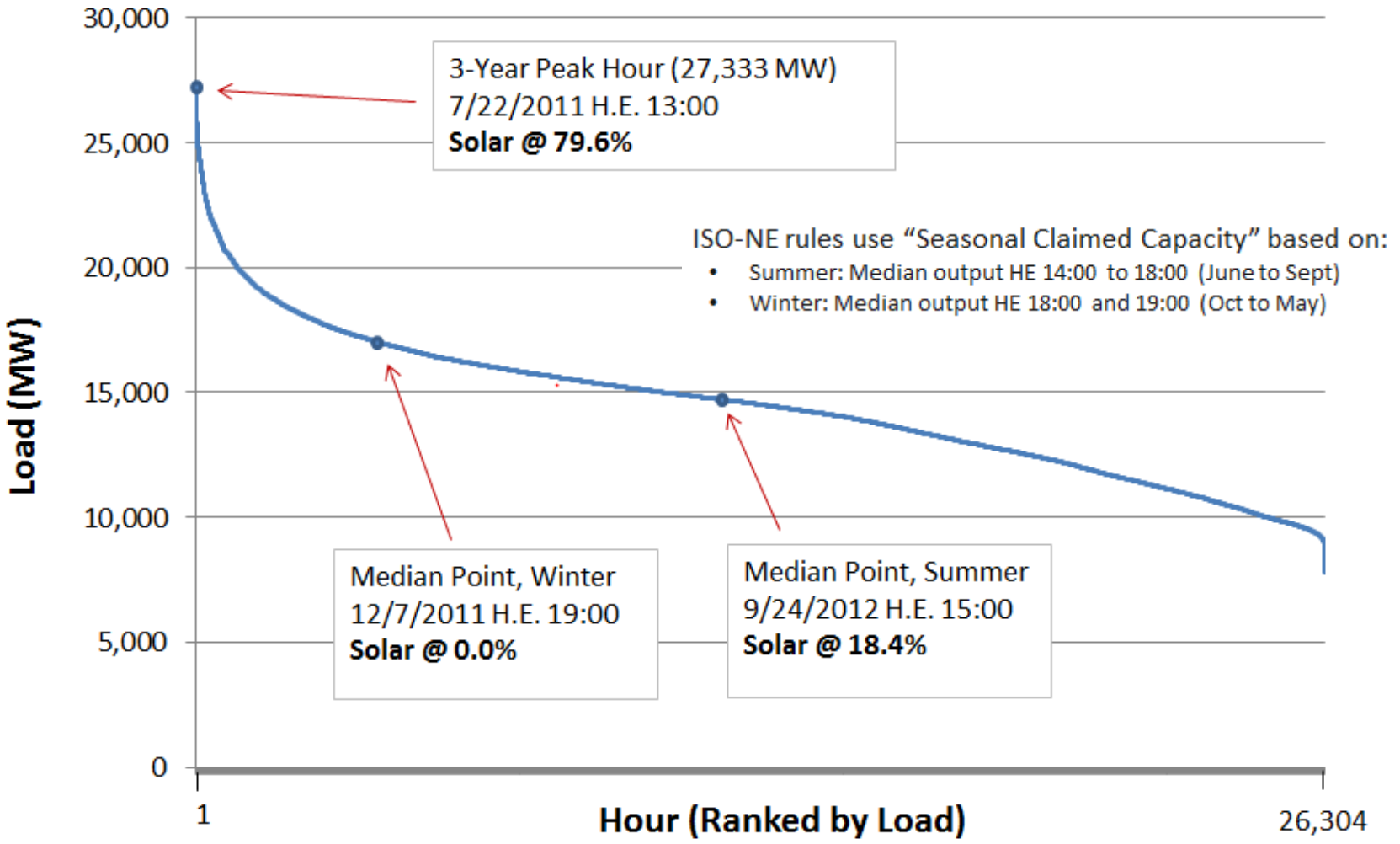


Determining Solar Production

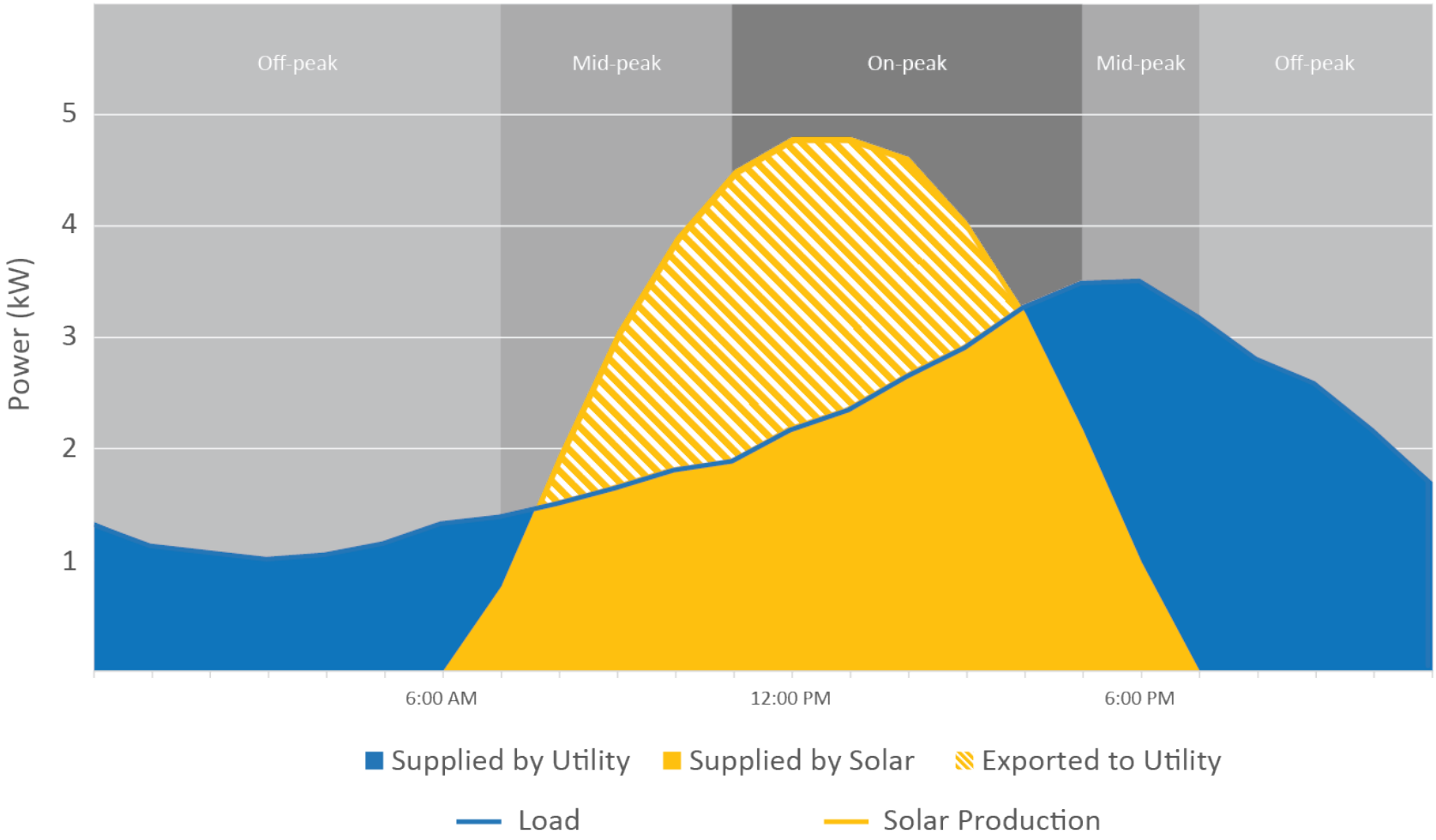
- Option 1 – Simulate
  - Simulate hourly solar “fleet” output for sample year(s)
  - Use actual utility loads to determine match factors
  - Calculate value applied to all distributed PV resources
- Option 2 – Measure
  - Use interval meter readings to calculate energy and capacity benefits using same methodology
  - Calculate value applied to individual distributed PV resource

Illustration of Effective Capacity Calculation

Maine PV Fleet, ISO New England "Seasonal Claimed Capacity" Method

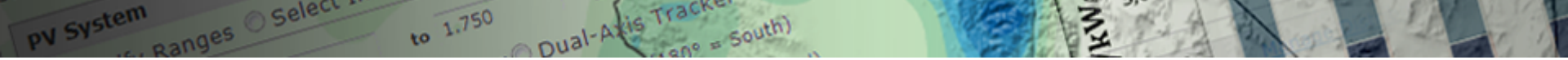


Valuation May be on All Solar Production or Export Only



Available Methodologies

Cost	Possible Methodologies
Demand Savings	• Include avoidable charges from wholesale schedule • Calculate (or measure) hourly solar production • Determine demand reduction and savings
Energy Savings	• Use MISO nodal energy prices; or • Utility owned generation (fuel costs, heat rates)
Added Costs	• Quantify incremental metering and billing costs • Do not include costs paid by solar customers • Count against other savings
Societal Benefits	• Depends on benefits selected • These benefits are typically paid by all customers



Project Goal: Valuation Methodologies for Cooperatives and Municipals

- Work with 2 or 3 utilities who will
  - provide wholesale schedules
  - review the draft methodology
- Interested?
  - Contact Ben Norris, *ben@cleanpower.com*