Maine Distributed Solar Valuation Study

E2 Tech Forum on Renewable Energy Incentives

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Maine Public Utilities Commission
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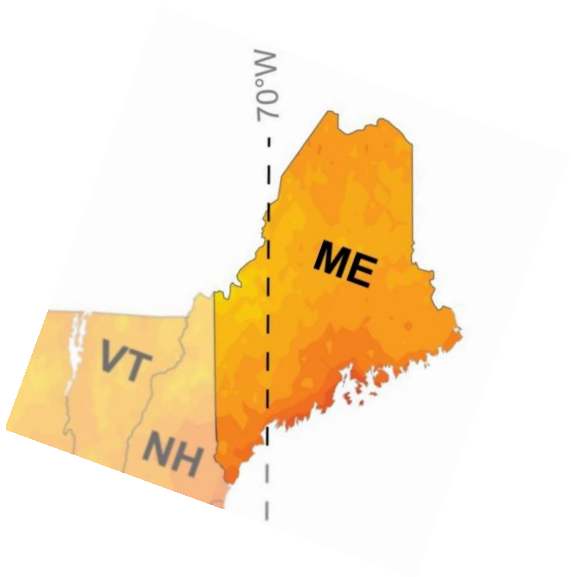
The Value of Solar Energy In Maine

- Why we did the VoS Study
- Methodology and Results
- Key Take Aways
- Next Steps



Legislation and Project Background

- Maine passed legislation* in April 2014 that found that solar energy constitutes a valuable indigenous and renewable resource in Maine and that the development of the State's solar generation potential could make a contribution to State's general welfare.

- The legislation set several goals including ensuring that solar meaningfully contributes to the generation capacity in Maine through increased private investment, contributes to reducing imported energy, mitigates transmission and distribution investments, benefits all ratepayers regardless of income, increases the adoption of solar and increases jobs in the solar industry.

- In addition, the legislation charged the Maine Public Utilities Commission (PUC) to determine the value of distributed solar energy generation in the State based on statutory criteria and other factors.

- Goal of Study to develop a methodology, use the methodology to conduct a value assessment, and prepare report on this and on options for increasing deployment of distributed solar generation for the Maine Legislature.

*An Act to Support Solar Energy Development in Maine, P.L Chapter 562 (April 24, 2014) (codified at 35-A M.R.S. §§ 3471-3473)

Process

- June 2014- Issued a Notice of Inquiry to begin to gather input on the study's structure and process
- August 2014- Consultants engaged and Staff began stakeholder outreach
  - Study stakeholders included T & D Utilities, Office of the Public Advocate, the Solar Industry, Environmental Advocates and the City of South Portland.
- October – December 2014- Stakeholder workshop on Methodology, circulation and comments on draft
- February 2015- Final Methodology and Draft Report delivered to Staff
- March 1, 2015- Final Report delivered to Legislature
- March 23, 2015- Stakeholder's Webinar on Final Report

Statutory Criteria

- By statute, the methodology must, at a minimum, account for
  - the value of the energy,
  - market price effects for energy production,
  - the value of its delivery,
  - the value of generation capacity,
  - the value of transmission capacity,
  - transmission and distribution line losses; and
  - the societal value of the reduced environmental impacts of the energy.

- The methodology may also utilize “known and measurable evidence of the cost or benefit of solar operation to utility ratepayers and incorporate other values into the method, including credit for systems installed at high-value locations on the electric grid, or other factors.”

Roadmap

Value Component	Basis	Legislative Guidance
Energy Supply		
Avoided Energy Cost	Avoided wholesale market purchases	Required (energy)
Avoided Generation Capacity Cost	Avoided cost of capacity in Forward Capacity Market	Required (generation capacity)
Avoided Reserve Capacity Cost	Capital cost of generation to meet planning margins and ensure reliability	Required (generation capacity)
Avoided Natural Gas Pipeline Cost	Cost of natural gas pipeline capacity needed to serve generation plants.	Allowed (ratepayer)
Solar Integration Cost	Added cost to follow system load with variable solar	Required (generation capacity)
Transmission Delivery Service		
Avoided Transmission Capacity Cost	Capital cost of transmission	Required (transmission capacity)
Distribution Delivery Service		
Avoided Distribution Capacity Cost	Capital cost of distribution	Required (delivery)
Voltage Regulation	Capital cost of distribution voltage regulation	Required (delivery)
Environmental		
Net Social Cost of Carbon	Externality cost	Required (environmental)
Net Social Cost of SO2	Externality cost	Required (environmental)
Net Social Cost of NOx	Externality cost	Required (environmental)
Other		
Market Price Response	Ratepayer benefit of reduced market prices	Allowed (ratepayer)
Avoided Fuel Price Uncertainty	Avoided risk of future volatility in fuel prices	Allowed (ratepayer)

Roadmap

		Gross Value		Load Match Factor		Loss Savings Factor		Distributed PV Value
		A	×	B	×	(1+C)	=	D
		($/kWh)		(%)		(%)		($/kWh)
Energy Supply		Avoided Energy Cost	C1			LSF-Energy		V1
		Avoided Gen. Capacity Cost	C2	ELCC		LSF-ELCC		V2
		Avoided Res. Gen. Capacity Cost	C3	ELCC		LSF-ELCC		V3
		Avoided NG Pipeline Cost	C4			LSF-Energy		V4
		(Solar Integration Cost)	(C5)			LSF-Energy		(V5)
Transmission Delivery Service		Avoided Trans. Capacity Cost	C6	ELCC		LSF-ELCC		V6
Distribution Delivery Service		Avoided Dist. Capacity Cost	C7	PLR		LSF-Dist		V7
		Voltage Regulation	C8					V8
Environmental		Net Social Cost of Carbon	C9			LSF-Energy		V9
		Net Social Cost of SO_2	C10			LSF-Energy		V10
		Net Social Cost of NO_x	C11			LSF-Energy		V11
Other		Market Price Response	C12			LSF-Energy		V12
		Avoided Fuel Price Uncertainty	C13			LSF-Energy		V13
								Total

ELCC (Electricity Load Carrying Capability)- effective capacity for DG solar that can be allocated to certain avoided costs.

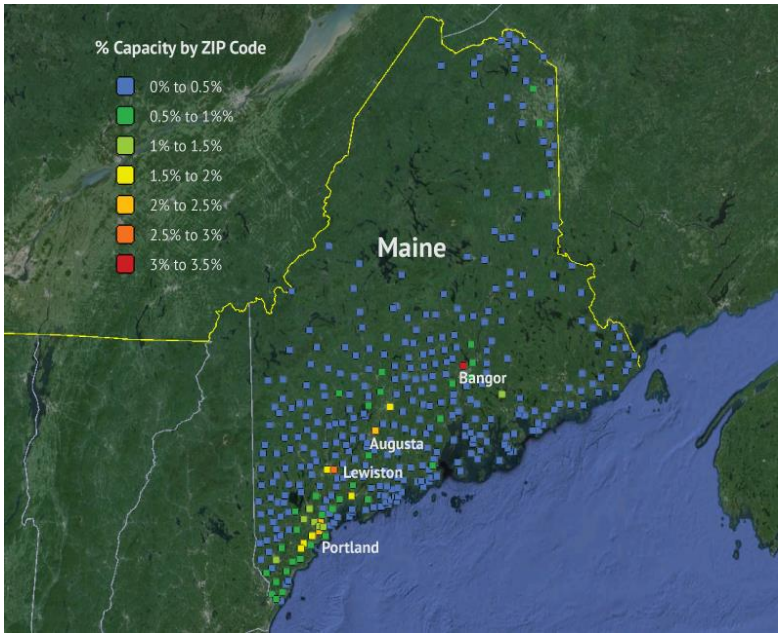
PLR (Peak Load Reduction)- The ability of DG solar to shift (and reduce) the peak load during the analysis period.

Couple Notes. . .

- Only looked at Solar at the Distributed Generation scale i.e. < 500 kW.
- Value in this context includes a wide range of market related, societal and potential benefits.
- Relationship between Value and Cost was not considered i.e. How much would one need to pay to obtain that value?
- Avoided Cost is traditionally associated with vertically integrated utilities , those which generate, transmit and deliver electricity. In Maine T & D Utilities don't serve load so the avoided cost could attributed to the electricity market, the T & D utilities, ratepayers or society at large.
- Methodology should be replicable and improve as recalculated over time and data sets improve.

Solar Fleet

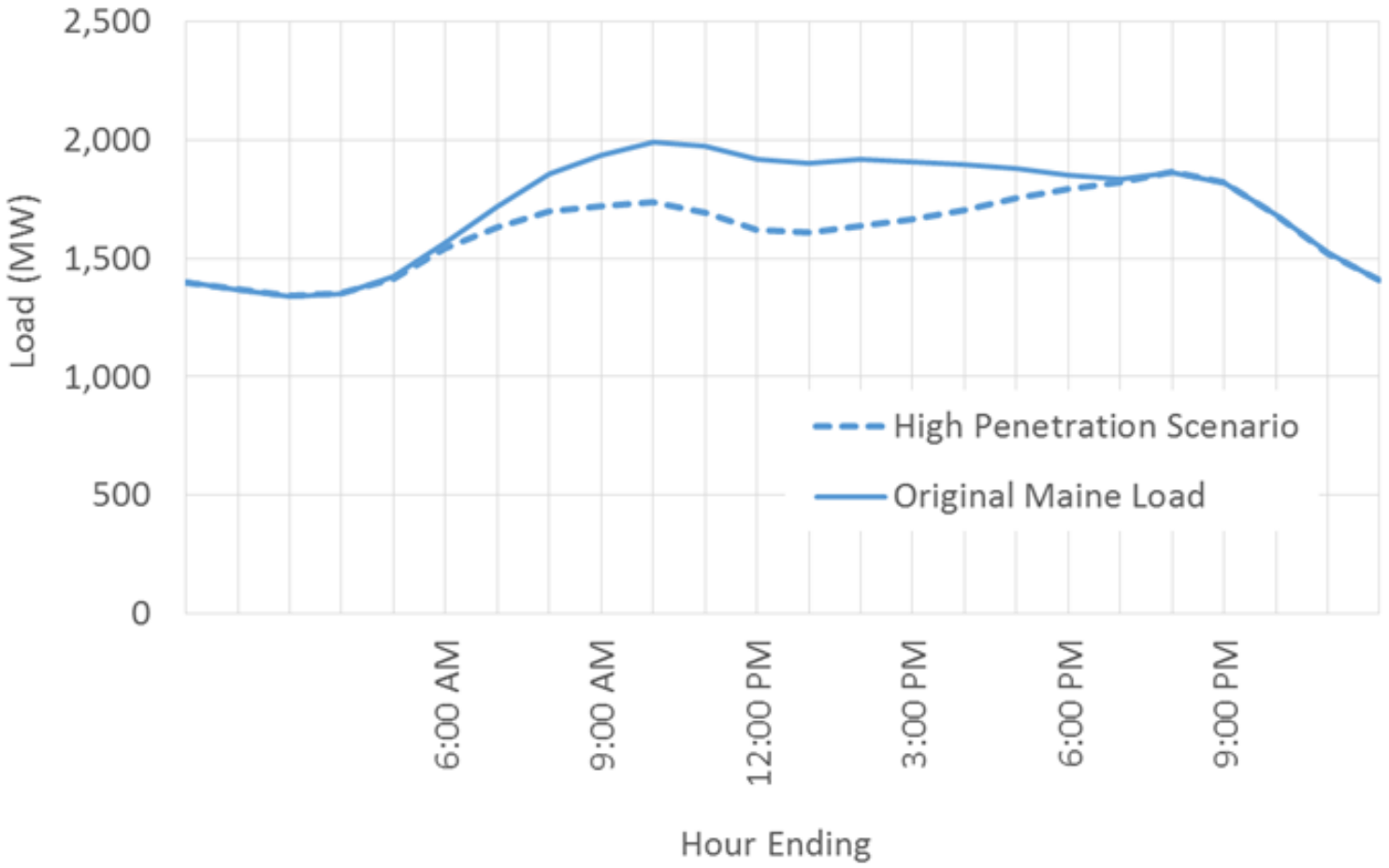
- **Base Case fleet** –All systems : NY, CT, MA.
- **Residential fleet** – Based on 1,284 residential systems in Upstate NY.
- **Non-Residential fleet** – Based on 2,842 non-residential systems in NY, CT, MA.
- **Max Energy fleet -** Based on configuration in Portland having max energy. Configuration replicated in each zip code, but population weighted.
- **Max Capacity fleet –** Portland at Max ELCC



- Simulation period = 1/1/2011 (hour 1) through 12/31/2013 (hour 24).
- For each system-hour:
  - Used ambient temperature & factors from system location.
  - Calculated sun position and incidence angle to PV module.
  - Modeled PV production (DC), losses, and output to grid (AC).
  - No calculation for shade or snow cover

High Penetration Scenario (ME Load Zone)

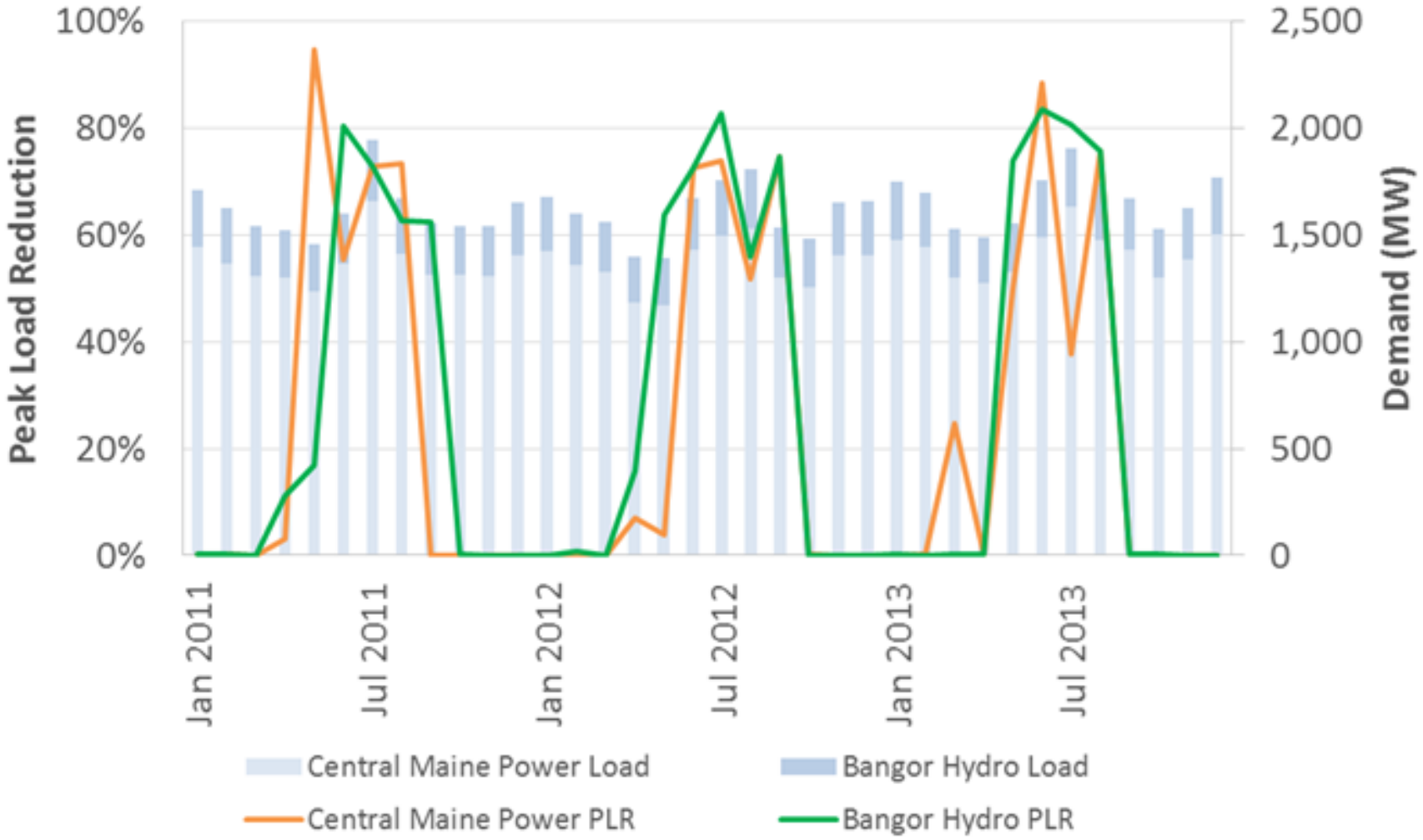
July 22, 2011



Monthly Peak Load Reductions

CMP Average Monthly PLR is 23.9%

For every 1kW of installed PV capacity peak is reduced by PLR of that kW



First Year Results CMP Service Territory

First Year

		Distributed Value ($/kWh)
Energy Supply	Avoided Energy Cost	$0.061
	Avoided Gen. Capacity Cost	$0.015
	Avoided Res. Gen. Capacity Cost	$0.002
	Avoided NG Pipeline Cost	
	Solar Integration Cost	-$0.002
Transmission Delivery	Avoided Trans. Capacity Cost	$0.014
Distribution Delivery	Avoided Dist. Capacity Cost	
	Voltage Regulation	
Environmental	Net Social Cost of Carbon	$0.021
	Net Social Cost of SO_2	$0.051
	Net Social Cost of NO_x	$0.011
Other	Market Price Response	$0.009
	Avoided Fuel Price Uncertainty	$0.000
		$0.182

Avoided Market Costs
$0.090

Societal Benefits
$0.092

Key Take Aways

- Distributed Solar has a Benefit to the Electricity System in the State of Maine
- Installed Solar capacity is growing and is currently around 11.7 MW (.59 % penetration)
- Calculations show little variation between integrated and restructured electricity markets; however, attributing avoided cost more complex.
- Robustness of New England market allowed more granular analysis than had been possible before (MN, TX, AZ). We have markets for a lot of this stuff.
- BUT not all. . . For example ELCC NOT Equal to the measure ISO currently uses for calculating value in the Forward Capacity Market so it includes both market based and societal value.

Potential Present Value of Long Term Performance (CMP)

25 Year Levelized

		Gross Value	Load Match Factor	Loss Savings Factor	Distr. PV Value	
		A ×	B ×	(1+C) =	D	
		($/kWh)	(%)	(%)	($/kWh)	
Energy Supply	Avoided Energy Cost	$0.076		6.2%	$0.081	Avoided Market Costs
	Avoided Gen. Capacity Cost	$0.068	54.4%	9.3%	$0.040	
	Avoided Res. Gen. Capacity Cost	$0.009	54.4%	9.3%	$0.005	$0.138
	Avoided NG Pipeline Cost					
	Solar Integration Cost	($0.005)		6.2%	($0.005)	
Transmission Delivery Service	Avoided Trans. Capacity Cost	$0.063	23.9%	9.3%	$0.016	
Distribution Delivery Service	Avoided Dist. Capacity Cost					
	Voltage Regulation					
Environmental	Net Social Cost of Carbon	$0.020		6.2%	$0.021	Societal Benefits
	Net Social Cost of SO_2	$0.058		6.2%	$0.062	$0.199
	Net Social Cost of NO_x	$0.012		6.2%	$0.013	
Other	Market Price Response	$0.062		6.2%	$0.066	
	Avoided Fuel Price Uncertainty	$0.035		6.2%	$0.037	
					$0.337	

Room for Improvement

- Wind Integration Study used as placeholder for Solar integration costs.
- SO2 and NOx emission quantities possibly overstated (AVERT Tool includes NY).
- Solar fleet analysis could be more robust.
- Better data of distribution system impacts (no avoided distribution benefit because no system-wide load growth).

Implementation Options

Market Preparation	• Addresses institutional barriers, market access • *Examples*: Interconnection, net metering, allow 3rd-party ownership
Market Creation	• Addresses investor uncertainty, lack of existing markets, public understanding • *Examples*: Mandates, Renewable Portfolio Standards
Market Expansion	• Addresses technology first cost, investment uncertainty • *Examples*: Incentives (e.g. tax, rebates, grants, FIT)
Market Transformation	• Addresses long-term reliance on incentives, market sustainability and competitiveness • *Examples*: Green Bank, soft cost reduction, grid modernization

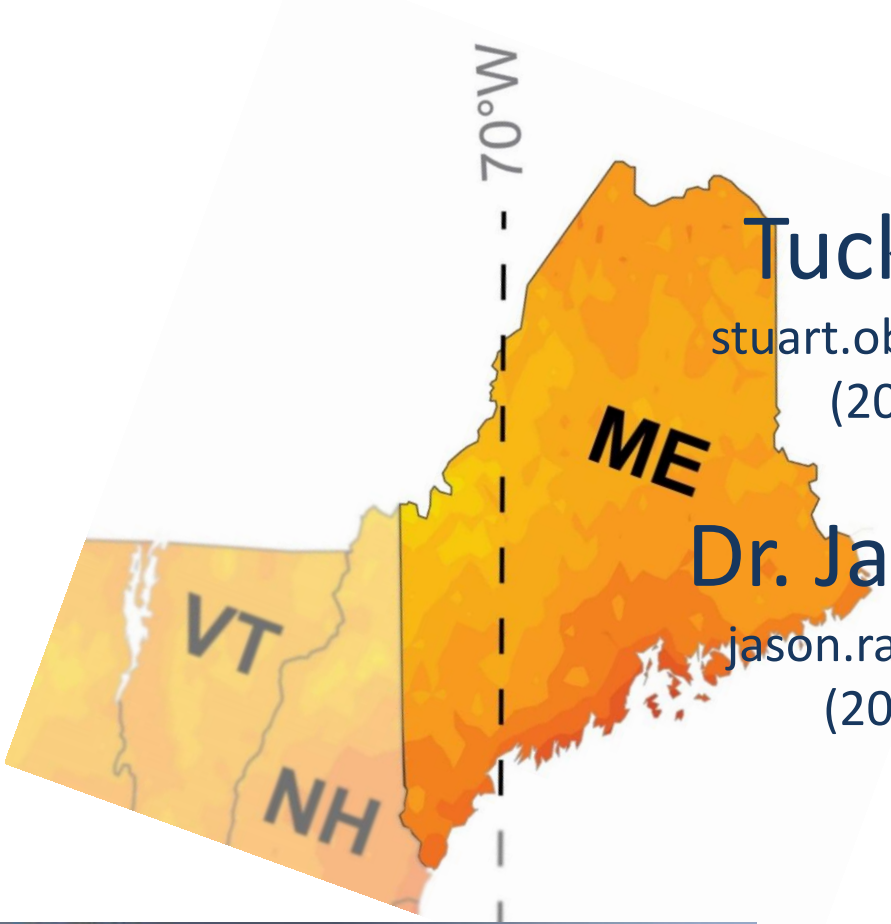
Next Steps

- Presentation to Legislature on April 1, 2015.
- Commission will be issuing an addendum with some clarification and data comparisons in the coming days.
- Hopefully, work will be updated periodically going forward.
- Potential use in the Commission's Non-transmission Alternative analysis and for other technologies.

Special Thanks to the Study Team

- Ben Norris, Clean Power Research
- Bob Grace, Sustainable Energy Advantage
- Karl Rabago, Pace University
- Richard Perez
- Mitch Tannenbaum, Acting GC @ PUC
- Jason Rauch, Utility Analyst @ PUC

Questions ?



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