Distributed Generation and Electric Grid Capacity

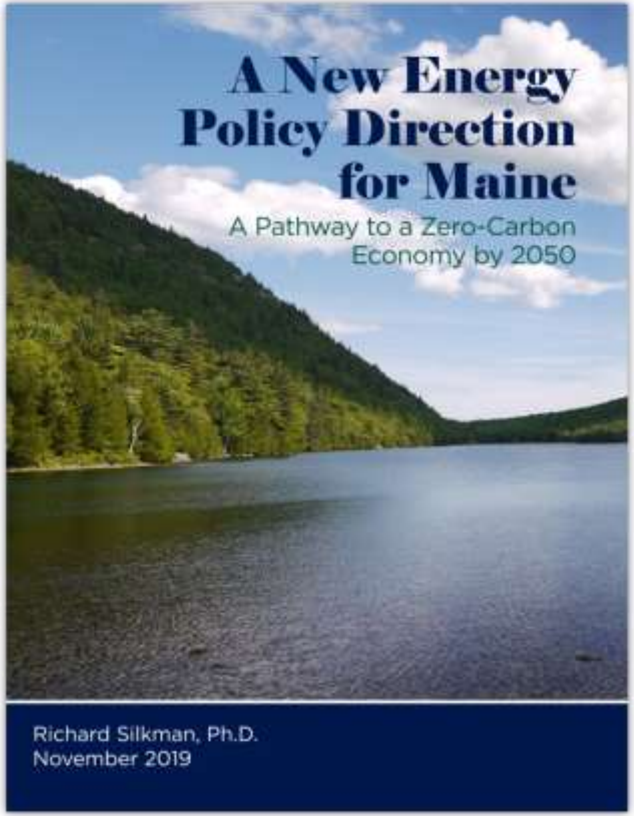
Presentation to the Distributed Generation Stakeholder Group

Dr. Richard Silkman, CEO

Competitive Energy SERVICES

October 14, 2021

Pathway to a Zero-Carbon Economy by 2050



Most of you are familiar with the results of my work charting a path to a zero-carbon economy by 2050:

- Beneficial Electrification will Increase Electricity use from 12 TWh to 40 TWh and Peak Demands from 2 GW to 10 GW
- Decarbonizing the Grid will require 7,500 MW of Solar PV, 3,000 MW of On-Shore Wind and 5,000 MW of Off-Shore Wind plus 250,000 MWh of Battery Storage
- The Transition can be done without increasing real spending on energy – maintain energy spending at roughly 10% of Total Income
- Investment of $2 billion a year in renewable generation capacity and T&D grid upgrades

Portland Region Study

Rethinking Electric Grid Design to Meet Beneficial Electrification and Enhanced Distributed Generation

A Portland Area Case Study

GRIDSOLAR

GridSolar, LLC
May 2020

You are probably not familiar with the work we have done in the Portland Region:

- Filed in Docket 2011-00138
- Available at https://www.competitive-energy.com/rethinking-electrical-grid-design

Investigate the Impacts of Beneficial Electrification and Distributed Generation on the Transmission and Distribution Grid – A Case Study

- Portland Region – Freeport to Saco – West to Gorham
- Unit of Analysis – Each Building in the Portland Region – 72,426 Residential, 6,167 Commercial and 1,008 Industrial
- Energy Use – Current Electricity Use, Transportation, Space Heating, Commercial and Industrial Processes
- Distributed Generation – Roof-Top Solar

Portland Region Study – Beneficial Electrification

Load Type	Total Energy (MWh)	Maximum Demand (MW)	Capacity Factor %
Current Electricity Use (RNS)	1,680,233	271	71%
Total heating	1,140,843	738	18%
Residential AC	110,542	132	10%
Total C&I Process Use	583,248	123	54%
Total EV Charging	613,343	145	48%
Total Loads	**4,128,208**	**1,086**	**43%**

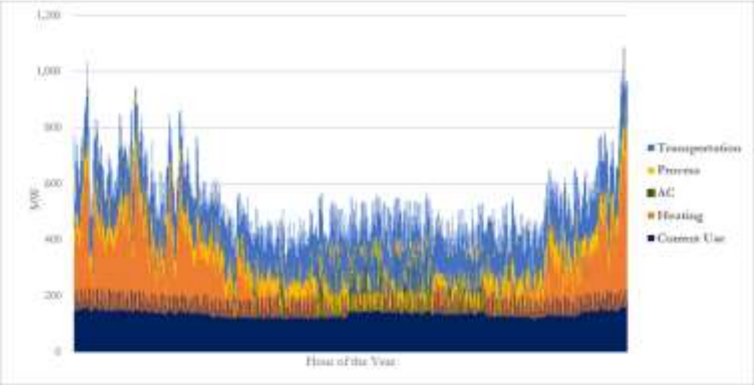
Note:

Maximum Demand for each load type is annual peak non-coincident demand

Maximum Demand for Total Loads is annual peak coincident demand

Full Beneficial Electrification :

- A 250% increase in Total Electricity Consumed
- A four-fold increase in peak load

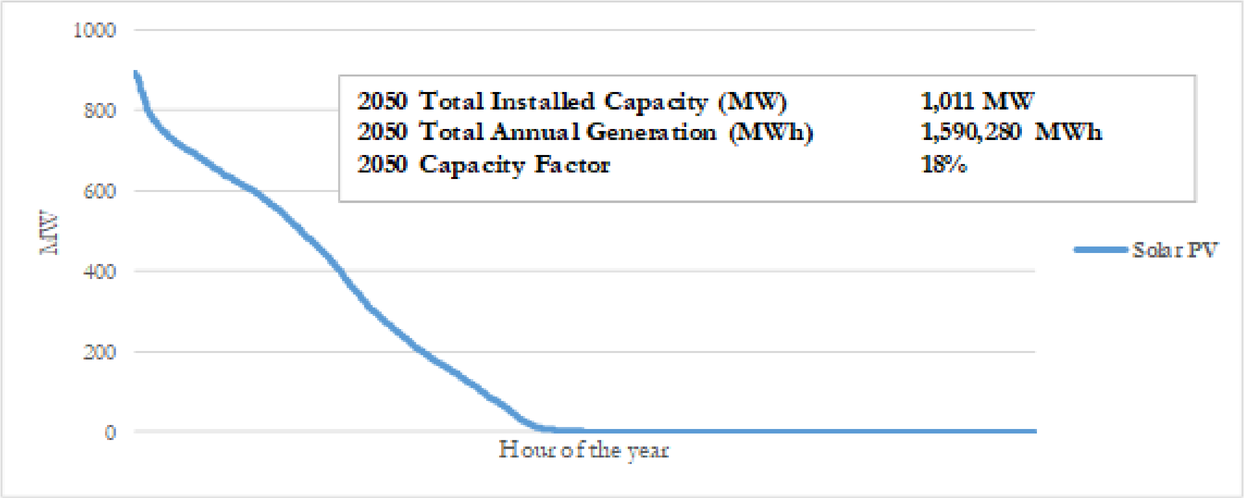


Full Beneficial Electrification :

- Shift from Relatively high-load factor with moderate Summer Peak
- To much lower load-factor with pronounced Winter Peak

Portland Region Study – Distributed Generation

TOTAL - All Buildings					
Total Bldg. Footprint	Sq.Ft.	195,538,885	195,538,885	195,538,885	195,538,885
Number of Solar Panels	No.	0	30,894	926,826	2,808,565
Maximum Hourly Generation	MW	0.00	9.83	295.02	894.00
Pct Of Rooftop Covered	%	0.00%	0.29%	8.81%	26.70%
Annual Solar Generation	MWh	0	17,493	524,792	1,590,280



Maximum Solar Build-out Roof-Top Only

1.6 TWh of annual generation represents 13.3% of total electricity use today; roughly 4% of the 40 TWh in 2050.

The Portland Region represents about 10% of all Buildings in Maine

Does not include any Ground-Mounted or canopy solar projects

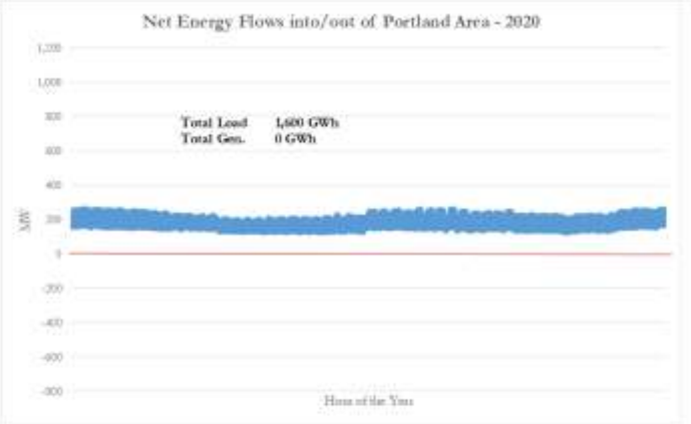
First Important Finding

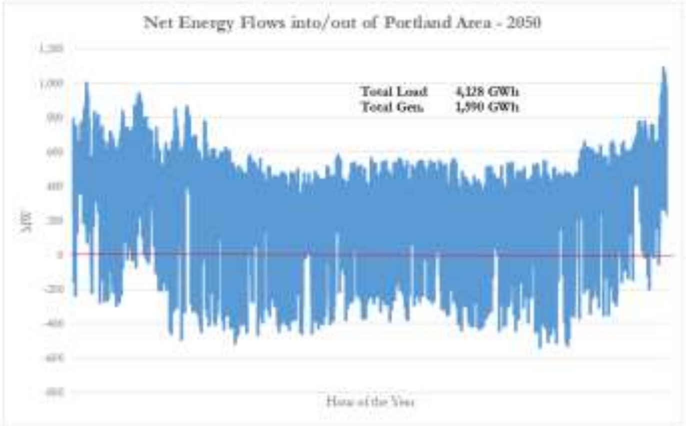
By 2050, Distributed Solar PV Generation will vastly exceed the 7% of total Electricity Use in Maine – even after factoring in the significant increases in electricity use resulting from Beneficial Electrification.

- If only 20% of feasible rooftop space statewide is developed (which is about 5% of total rooftop surface), total generation will be 3.2 TWh or 8% of 2050 load of 40 TWh
- If only 50% of LD 1711 projects are developed, total generation will be 1.4 TWh or 3.5% of 2050 load of 40 TWh

Assuming that achieving the 7% share has any technical or economic validity in and of itself, Maine will get there with no further directed state policy initiatives.

Can the Electric Transmission Grid Deliver?





The answer is an unambiguous "NO – Not even close."

At the Transmission Level:

The need to import close to 1,100 MW into the Portland Region will require a major build-out of the Transmission System:

- 66 miles of new overhead 345 kV lines
- 18 miles of new undersea 345 kV cables
- 84 miles of new 115 kV lines
- 225 miles of new 34.5 kV lines
- 3 new 345 kV substations to support landings of two, 1 GW offshore wind generation facilities in the Gulf of Maine and the aggregation of large-scale solar PV generation to the west
- 4 new 345/115 kV substations with auto-transformers
- 25 new 115/34.5 substations

Transmission Upgrades – Estimated Costs (2020$)

Table 8-6 Summary – Estimated Cost of Transmission/Subtransmission Upgrades - 2050

Estimated Transmission/Subtransmission Costs			Cost
345 kV System	No.	Miles	(millions$)
New 345 kV Substations	3		$318.12
345 kV Line - Overhead		66	$424.96
345 kV line - Undersea		18	$231.80
Subtotal			$974.88
115 kV System			
New 115 kV Substations	4		$218.32
345 kV Line - Overhead		84	$293.49
345 kV line - Undersea		1	$8.42
Subtotal			$520.23
34.5 kV System			
New 115 kV/34.5 kV Substations	25		$556.97
34.5 kV Line - Overhead		225	$492.05
34.5 kV line - Undersea		0	$0.00
Subtotal			$1,049.03
Total Transmission/Subtransmission			**$2,544.13**

The estimated costs to build out a grid that will allow for the import of 1,100 MW of into the Portland Region and meet N-1-1 reliability is roughly $2.5 billion in 2020$.

Transmission Upgrades – Land Requirements

Table 8-7 Land-Use Consequences of Electric Grid Build-Out

Transmission Lines		Width (ft.)	Length (miles)	Area (acres)
345 kV Lines		150	66	1,200
115 kV Lines		100	84	1,018
34.5 kV Lines		50	225	1,364
Subtotal				3,582
	No.	**Width (ft.)**	**Length (ft.)**	**Area (acres)**
Substations				
345 kV Lines	3	1,200	1,700	140
115 kV Lines	4	450	450	19
115 kV/34.5 kV	25	200	200	23
Subtotal				182
Total Land Area				3,764

Notes:

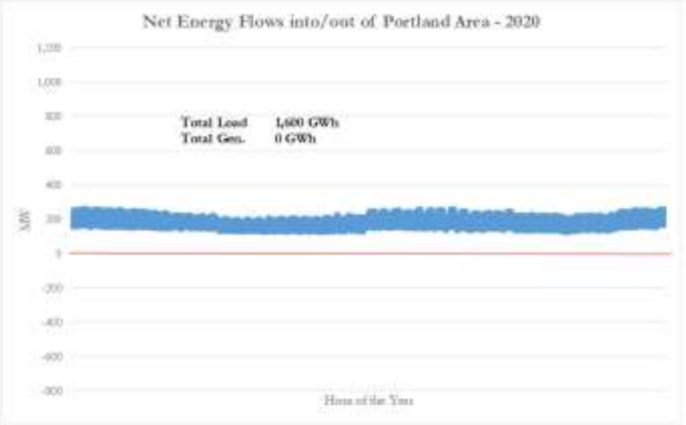
Buffer Factors - Set Backs for Substations:

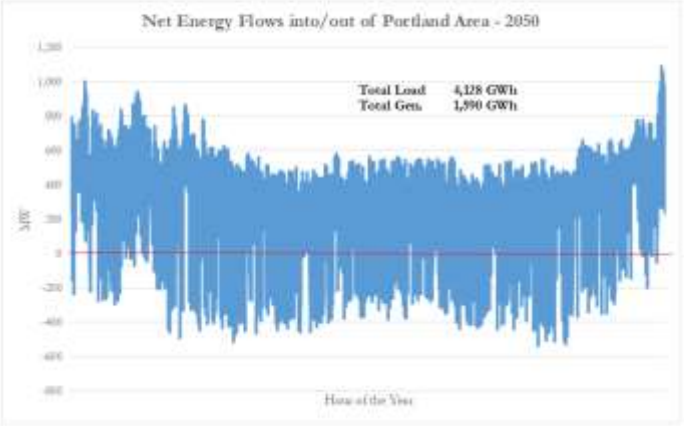
345 kV	Feet	200
115 kV	Feet	150
34.5 kV	Feet	100

Interstate 295/95	(ft.)	(miles)	(acres)
Freeport to Scarborough	200	40	970

The estimated land-use/corridor requirements (given current construction standards) for these transmission upgrades is the equivalent of four new I-295/95 highways through the Region.

Can the Electric Distribution Grid Deliver?





The answer is an unambiguous "NO – Not even close."

At the Distribution Level:

- Load exceeds the carrying capacities of the majority of the Region's 96 distribution circuits
- All but 4 of these 96 distribution circuits experience reverse power flows during some hours of the year
- Loads exceed the high load rating of 75% of substation transformers, most by well over 100%.

Distribution Grid reconfiguration will require limited new circuit miles and some reconductoring of circuits to increase capacity.

The primary upgrades will be (i) a doubling of the number of distribution substations (34.5/12.5 kV) and (ii) the accommodation of reverse power flows on all circuits

Electric Distribution Grid Reconfiguration

The KEY finding is that "Electricity Density" – the amount of electricity used within a specific geographic area - increases significantly as a result of Beneficial Electrification.

- This means that the number of distribution substations must increase, these substations will be closer geographically to each other, and circuit lengths will be shorter.
- This will make it less expensive to loop-feed much of the distribution grid.
- This will reduce the "islanding problem" and increase significantly reliability by reducing the number of the most common causes of outages – trees, squirrels and drivers.

Conclusions

- Beneficial Electrification will require a major expansion of Transmission Grids and redesign of Distribution Grids.
- The investments needed are driven by load – these are reliability upgrades driven by federal and state policies designed to reach zero-carbon.
- Aside from interconnection facilities, grid upgrades to interconnect renewable generation (whether utility-scale or DG) are very minor to the extent there are any at all.

Concluding Thought

Until we eliminate the artificial, archaic, and absurd dichotomy in FERC's Generator Interconnection, Transmission Planning and Cost Allocation Processes and in Maine PUC rules (Chapter 324 and Chapter 395) between grid upgrades required to interconnect generation and grid upgrades required to ensure reliability, progress on meeting federal and state goals with respect to decarbonizing the electric grid through the development of renewable generation will be slow, at best.

[Call Your attention to FERC ANOPR – Docket No. RM21-17-000]

THANK YOU

Competitive Energy SERVICES

Creating A Clean, Affordable, Equitable and Resilient Energy Future For the Commonwealth

DOER
Massachusetts Department of Energy Resources

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENERGY RESOURCES
Patrick Woodcock, Commissioner

Solar Massachusetts Renewable Target (SMART) Program Overview

Maine Distributed Generation Working Group

Eric Steltzer
Director, Renewable and Alternative Energy Division

October 14, 2021

Basic Features of the SMART Program

Solar Massachusetts Renewable Target (SMART) program

- Chapter 75 of the Acts of 2016 directed DOER to create a new solar incentive program to replace the Solar Carve-out II Program (SREC II)
- SMART launched on November 26, 2018
  - Initial goal was to incentivize 1,600 MW AC of solar development, though this was expanded to 3,200MW AC
- A voluntary tariff program with a declining block structure
- Base Compensation Rates to qualified generators is fixed for the tariff term
  - 10-year duration for small projects (less than or equal to 25 kW AC)
  - 20-year duration for large projects (25 kW AC to 5,000 kW AC).
- Compensation structure differentiated between behind-the-meter and standalone facilities
- Several types of Compensation Rate Adders to eligible facilities
  - For example, program provides incentives for solar over parking lots, offtake agreements with public entity, or installation of solar trackers
- Projects have 12 months to be mechanically complete, though several different extension types are available

Capacity Block Sizes – 1,600MW AC

Total Capacity Available per Capacity Block (MW AC)									
Distribution Company	**Block 1**	**Block 2**	**Block 3**	**Block 4**	**Block 5**	**Block 6**	**Block 7**	**Block 8**	**Total**
Fitchburg Gas & Electric d/b/a Unitil	3.9	3.9	3.9	3.9	Not Applicable				15.8
Massachusetts Electric d/b/a National Grid	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	720.2
Nantucket Electric d/b/a National Grid	3.0	3.0	Not Applicable						6.0
NSTAR d/b/a Eversource Energy	91.5	91.5	91.5	91.5	91.5	91.5	91.5	91.5	732.1
WMECO d/b/a Eversource Energy	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	125.9
Total Capacity	**204.2**	**204.2**	**201.2**	**201.2**	**197.3**	**197.3**	**197.3**	**197.3**	**1600.0**

- Capacity available in each service territory was determined by multiplying 1,600 MW by each distribution company's percentage share of total statewide distribution load in 2016
- Unitil and Nantucket Electric have each elected to have fewer than eight blocks, as permitted by regulation
- Each block has a minimum of 20% and a maximum of 35% of capacity set-aside for projects <=25 kW AC
- Capacity selected under the initial competitive procurement is deducted from the capacity available under Block 1 for each distribution company
- More information can be found in DOER's Guideline on Capacity Blocks, Base Compensation Rates, and Compensation Rate Adders

Block 1 Base Compensation Rates

Electric Distribution Company	Generation Unit Capacity	Term Length	Block 1 Compensation Rate
Fitchburg Gas & Electric d/b/a Unitil Massachusetts Electric d/b/a National Grid	Low income less than or equal to 25 kW AC	10-year	$0.35795
	Less than or equal to 25 kW AC	10-year	$0.31126
	Greater than 25 kW AC to 250 kW AC	20-year	$0.23345
	Greater than 250 kW AC to 500 kW AC	20-year	$0.19454
	Greater than 500 kW AC to 1,000 kW AC	20-year	$0.17119
	Greater than 1,000 kW AC to 5,000 kW AC	20-year	$0.15563
Nantucket Electric d/b/a National Grid NSTAR Electric d/b/a Eversource Energy	Low income less than or equal to 25 kW AC	10-year	$0.39100
	Less than or equal to 25 kW AC	10-year	$0.34000
	Greater than 25 kW AC to 250 kW AC	20-year	$0.25500
	Greater than 250 kW AC to 500 kW AC	20-year	$0.21250
	Greater than 500 kW AC to 1,000 kW AC	20-year	$0.18700
	Greater than 1,000 kW AC to 5,000 kW AC	20-year	$0.17000
WMECO d/b/a Eversource Energy	Low income less than or equal to 25 kW AC	10-year	$0.32862
	Less than or equal to 25 kW AC	10-year	$0.28576
	Greater than 25 kW AC to 250 kW AC	20-year	$0.21432
	Greater than 250 kW AC to 500 kW AC	20-year	$0.17860
	Greater than 500 kW AC to 1,000 kW AC	20-year	$0.15717
	Greater than 1,000 kW AC to 5,000 kW AC	20-year	$0.14288

- Block 1 prices established through one-time competitive procurement
- For initial 1,600MW, Massachusetts Electric and Eversource decline by 4% per Capacity Block. Unitil and Nantucket Electric decline at higher rates due to less capacity blocks
- More information can be found in DOER's [Guideline on Capacity Blocks, Base Compensation Rates, and Compensation Rate Adders]

Compensation Rate Adders

- There are five categories of Compensation Rate Adders
  - ➢ Location Based Adders
  - ➢ Off-taker Based Adders
  - ➢ Energy Storage Adder
  - ➢ Solar Tracking Adder
  - ➢ Pollinator Adder
- Systems larger than 25 kW AC may qualify for one adder from each category
- Systems less than or equal to 25 kW AC may only qualify for the Energy Storage adder
- More details on the eligibility criteria for certain adders can found in the following DOER Guidelines
  - ➢ *Definition of Agricultural Solar Tariff Generation Units Guideline*
  - ➢ *Definition of Brownfield Guideline*
  - ➢ *Energy Storage Adder Guideline*
  - ➢ *Low Income Generation Units Guideline*
  - ➢ *SQ and Capacity Block Reservation Guideline*
- These Guidelines are published at:

  https://www.mass.gov/service-details/development-of-the-solar-massachusetts-renewable-target-smart-program

Adder Values

Location Based Adders	
Type	**Adder Value ($/kWh)**
Agricultural	$0.06
Building Mounted	$0.02
Brownfield	$0.03
Floating Solar	$0.03
Landfill	$0.04
Solar Canopy	$0.06

Energy Storage Adder	
Type	**Adder Value ($/kWh)**
Storage + PV	Variable

Off-taker Based Adders	
Type	**Adder Value ($/kWh)**
Community Shared Solar (CSS)	$0.05
Low Income Property Owner	$0.03
Low Income CSS	$0.06
Public Entity	$0.04

Other Adders	
Type	**Adder Value ($/kWh)**
Solar Tracking	$0.01
Pollinator	$0.0025

- Offtake Adder values decline by 4% as adder tranches are filled
- Each adder tranche is 80MW, except CSS
- First adder tranche for CSS is 80MW and subsequent adder tranches are 60MW
- To provide price protection to certain systems, the program has set asides withing capacity blocks for small systems, low income systems, and mid-size systems.
- More information on adder values and future tranche sizes can be found in DOER's Guideline on Capacity Blocks, Base Compensation Rates, and Compensation Rate Adders

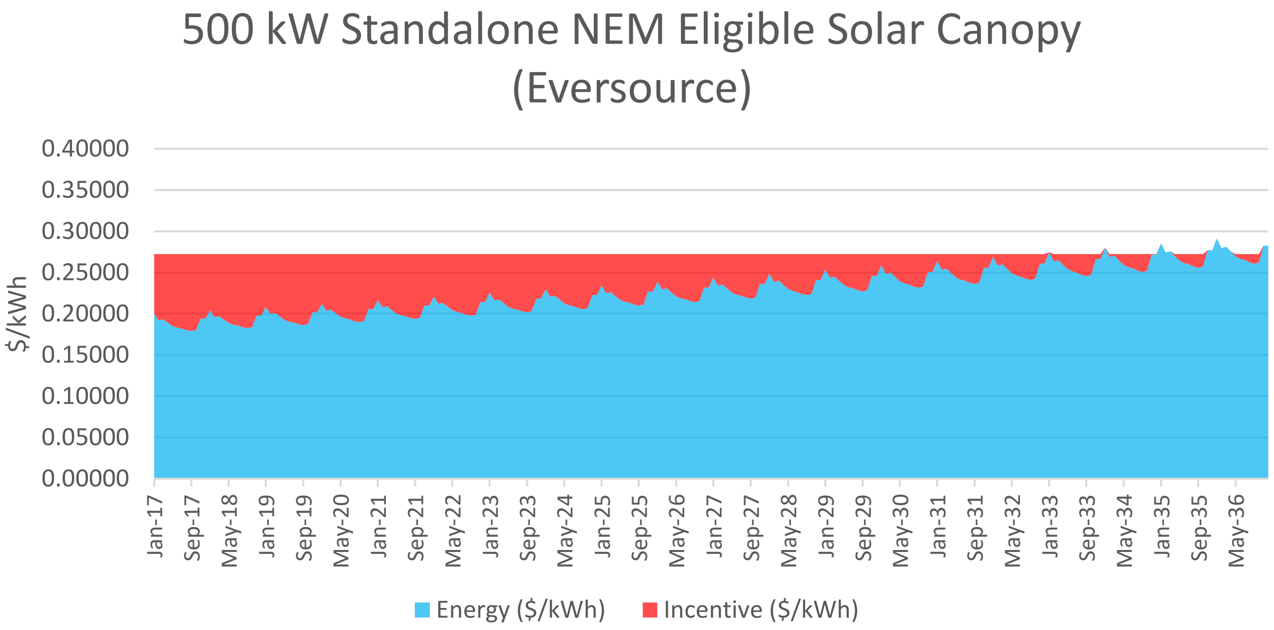
Land Use Categories

- All systems are categorized according to land use
  - Category 1: No Greenfield Subtractor
  - Category 2: Greenfield Subtractor of $0.0005/acre impacted
  - Category 3: Greenfield Subtractor of $0.001/acre impacted
  - In April 2020, Greenfield Subtractors were increased 2.5x
- Area impacted determined by the square footage of the PV panels
- Category is determined based on multiple factors such as, but not necessarily limited to the following:
  - Is the system located on Important Agricultural Farmland?
  - What is the size of the system?
  - Is the system ground mounted?
  - What is the existing condition of the land?
  - What is the zoning of the land?
- More information can be found in DOER's *Guideline on Land Use, Siting and Project Segmentation*

Land Use Categories

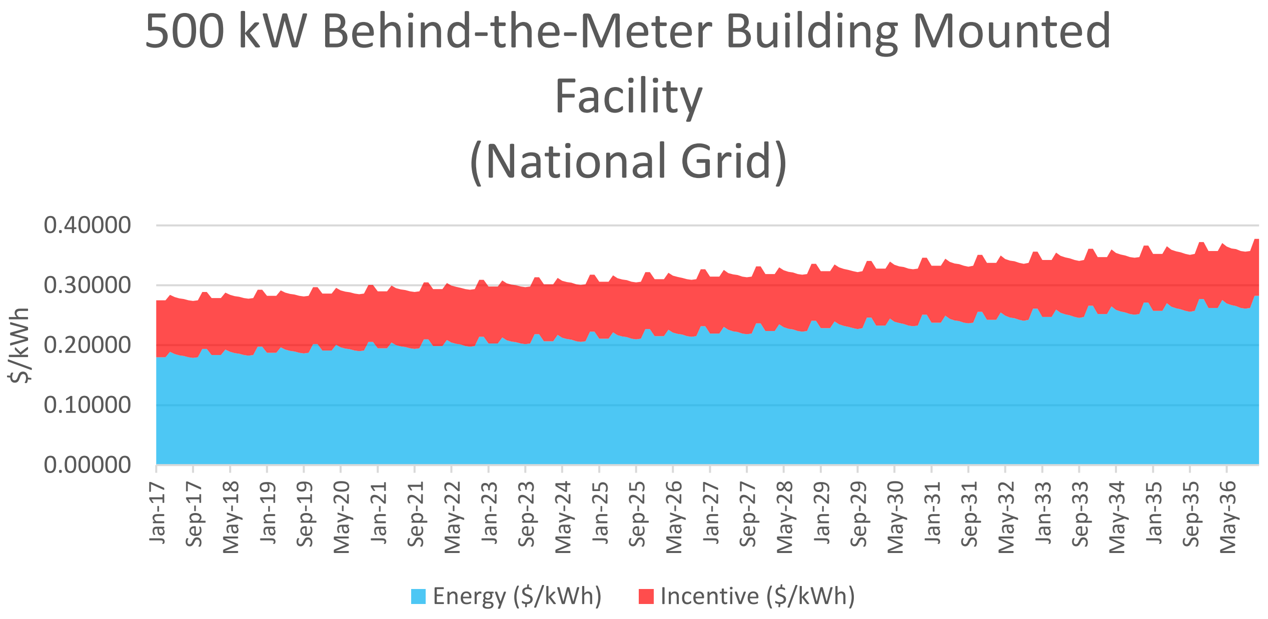
- Projects located in ineligible land uses shall not be eligible to qualify. These include land uses include:
  - Protected Open Space
  - Wetlands
  - Historic Resources on State Register
  - Specifications for Priority Habitat, Core Habitat and Critical Natural Landscape
- More information can be found in DOER's *Guideline on Land Use, Siting and Project Segmentation*

Base Compensation Rate – Standalone



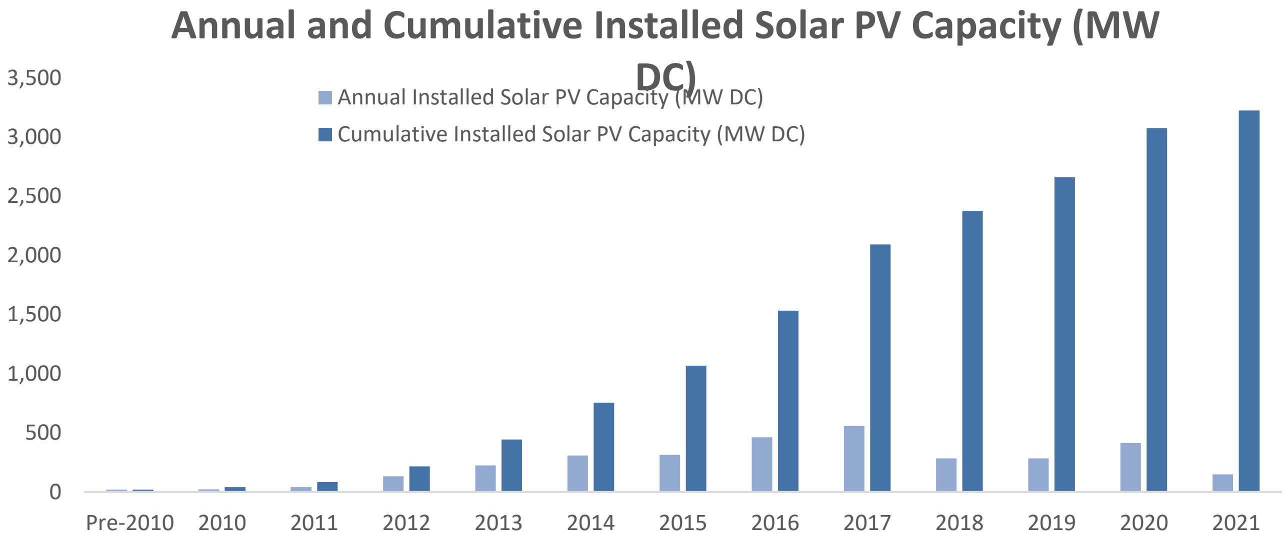
Note: Graph is illustrative of how payments would be determined and does not necessarily reflect actual values.

Base Compensation Rate – Behind the Meter



Note: Graph is illustrative of how payments would be determined and does not necessarily reflect actual values

MA Solar Trends – Capacity Installed



- Through SREC, SRECII and SMART, Massachusetts has installed over 3,000 MW of solar
- Under SMART, there have been over 40,000 applications, representing 1,500MW AC of solar, of which 700+MW AC has been installed

2021 Key Issues

SMART – COVID Impacts

COVID delays

- April 2020, a blanket extension of 6 months was offered to all projects submitted prior to July 1, 2020
- June 2020, extended the COVID extension to projects that applied before December 31 2020
- Delays predominantly due to:
  - Equipment delays, labor constraints, site access restrictions
- DOER continues to evaluate these delays and has streamlined guidance to assist applicants requesting extension due to COVID

SMART – Interconnection

Investigation into DER Planning and Cost Allocation for Interconnection

- Several Affected System Operator (ASO) studies have been completed to assess ability to interconnected Distributed Energy Resources (DER). There is a prolonged interconnection queue for many projects
- The ASO studies, and subsequent group studies, are identifying significant upgrade costs
- Department of Public Utilities (DPU) has opened a docket (20-75) in October 2020 to investigate interconnection
- DPU issues a straw proposal for:
  1) Distributed Energy Resource Planning
  2) Assignment and Recovery of Costs for the Interconnection of Distributed Generation
- Distribution Companies filed system planning proposals
- Next steps:
  1) Implement stakeholder process to advance short-term progress on DER planning while creating working group to advance longer-term objectives
  2) Awaiting DPU order on proposed plan following information requests

SMART – Consumer Protection

Consumer Protection and Low Income Guidelines

- Guidelines initially released in May 2020 and established:
  - Requirement for Low Income Customers to receive net savings
  - Audit procedure and a three strikes policy
- Summer 2021, DOER undertook an audit of Low Income Solar Tariff Generation Units (systems under 25kw AC) and focused on third party owned systems. DOER is in the process of finalizing the audit
- DOER continue to engage with stakeholders and industry to ensure low income customers are receiving a benefit

SMART – Dual Use Agriculture

Agricultural Solar Tariff Generation Units

- Solar projects designed to allow agricultural activity to be maintained under the solar
- Dual Use Agriculture is encouraged underneath the SMART program, receiving an adder of $0.06/kwh
- Projects must undergo a rigorous review to be qualified
- Draft guidelines issued last week propose the following:
  - Sets goal of 80MW AC
  - Increases size to 5MW AC
  - DC:AC ratio of 2:1, with a cap of 7,500MW AC
  - Requires new farms to be operational for 3 years
  - Clarifies waiver for crop changes, droughts, etc.
- Public Comments due October 27th

DOER Massachusetts Department of Energy Resources

Dual Agriculture Solar – Massachusetts

- Total of 12 projects, representing 23.5 MW AC of solar
- Agricultural activity includes livestock, cranberries, row crops and hay

Land Use and Siting

- 20GW of solar sited in Massachusetts is needed to meet our goal of net zero by 2050
- Where should all this solar be sited?
- Massachusetts will be undertaking a technical potential for solar study in 2021-2022

Thank you

Public Comment

Break until 2:30p.m.

MODELING 80% CLEAN ELECTRICITY BY 2030:

Growing distributed solar and storage is key to achieving the President's vision of 80% clean electricity by 2030

October 2021

What did we do?

Using an advanced grid model, we asked the question:

How do we build a grid that can achieve President Biden’s clean energy goals at the lowest cost?

80% clean electricity and 50% economy-wide reductions by 2030 + 95% economy-wide reductions and 100% economy-wide electrification by 2050

Snapshot of our Modeling:

Growing distributed solar and storage is key to achieving the President's vision of 80% clean electricity by 2030

Least Cost Clean Energy Transition plan:

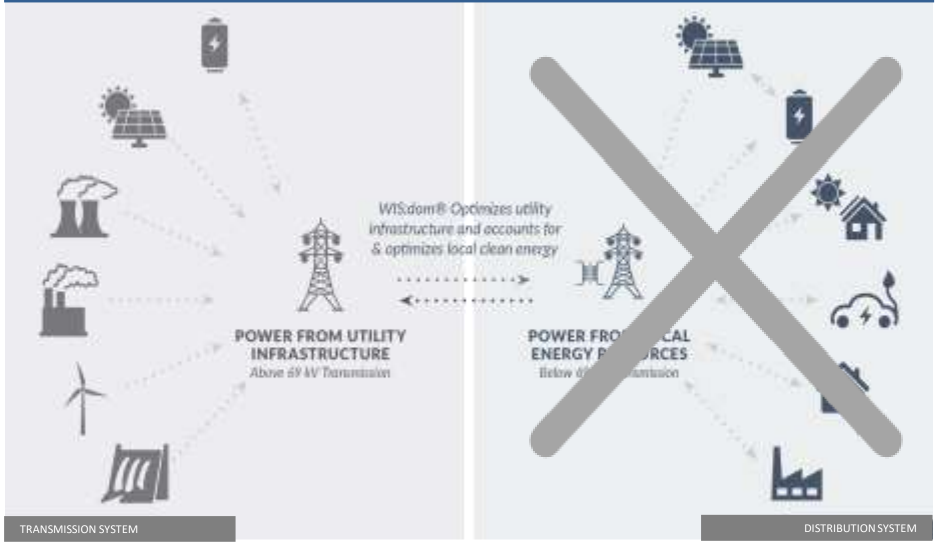
- Results in a minimum of **103 GW of distributed solar** and **137 GW of distributed storage** capacity
- Enables **579 GW of utility-scale solar** and **442 GW of wind**
- Saves **$109 billion** by 2030 over the utility-scale-only approach
- Adds **1.2 million local solar and storage jobs** by 2030
- Directing 50% of local solar capacity to low- and moderate-income (LMI) households could lower the energy burden for **8-15 million LMI households**
- Same conclusion as other studies (DOE Solar Future Study, SEIA's 30x30 analysis, Local Solar Roadmap, etc.): distributed generation must grow between **2 - 4x faster** than in the previous decade (2010 to 2020)

Problem: Utility Planning Models Were Designed For 19th Century Electric Grids and Policy Goals, Running on 20th Century Computers

- Utility planning historical assumes demand and builds large central station generation to fit, with a myopic focus on short-term costs, and considers transmission and distributed resources as an afterthought or static input.

- **These models are used in resources plans and rate setting, but have many flaws:**
  - **Data sets are limited and large-scale** - hourly time slices, no high-resolution climate and weather forecasts, T&D costs are rarely considered or treated with plug-in numbers
  - **Not really system planning but instead, central station planning** - not all resources are considered dynamically and don't account for total system costs and benefits (like T&D costs and savings)
  - **Doesn't consider DERs as a resource** - DERs are static inputs at most
  - **Long-term social and environmental impacts addressed only superficially**

Utility planning only considers transmission resources and ignores the costs and benefits of distribution level resources like community and rooftop solar



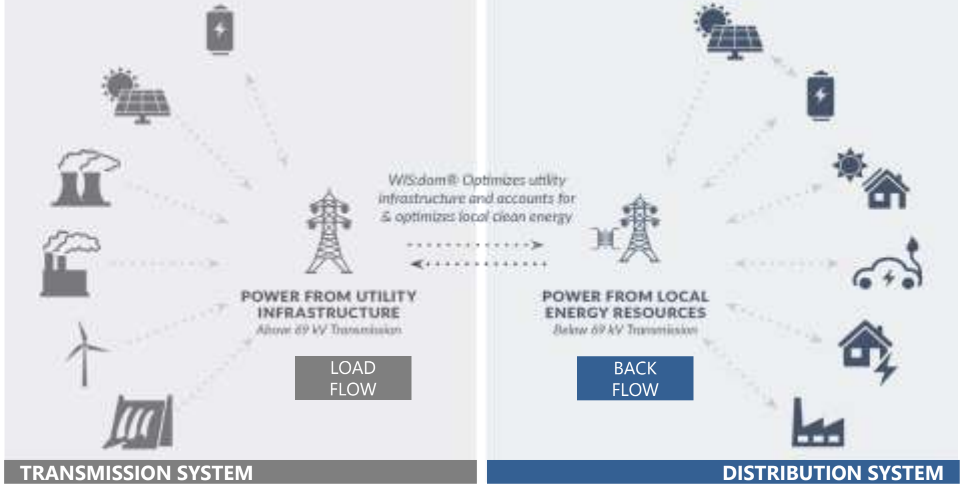
Solution: 21st Century Total System Planning Modeling

1. MORE & BETTER DATA PROCESSING

2. TOTAL SYSTEM and POLICY PLANNING COORDINATION

3. LOCAL CLEAN ENERGY INTEGRATION & OPTIMIZATION

WIS:dom optimizes utility infrastructure (left) + integrates all resource options including local energy produced on the distribution grid (right)



What Did We Ask the Model to Map Out?

Optimized Local Solar + Storage

80% CLEAN ELECTRICITY BY 2030
+
50% ECONOMY-WIDE REDUCTIONS BY 2030
+
95% ECONOMY-WIDE REDUCTIONS BY 2050
+
ECONOMY-WIDE ELECTRIFICATION BY 2050
+
DER OPTIMIZATION
+
LOCAL SOLAR + STORAGE CONSIDERED AS RESOURCE

The model considers distribution infrastructure requirements and determines that leveraging local solar + storage deployment to serve local load and/or reduce peak load, could lessen the need for some of the distribution infrastructure as well as forgoing additional utility-scale generation and transmission buildout. Model looks at CONUS only.

Constrained DER

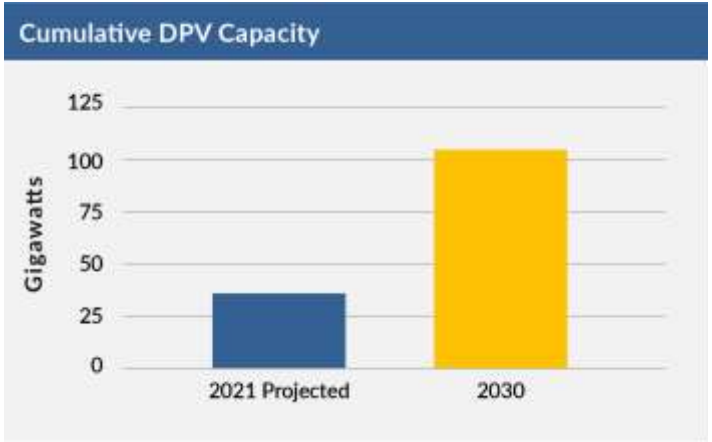
80% CLEAN ELECTRICITY BY 2030
+
50% ECONOMY-WIDE REDUCTIONS BY 2030
+
95% ECONOMY-WIDE REDUCTIONS BY 2050
+
ECONOMY-WIDE ELECTRIFICATION BY 2050
+
NO DER OPTIMIZATION
+
NO NEW LOCAL SOLAR + STORAGE PAST 2021

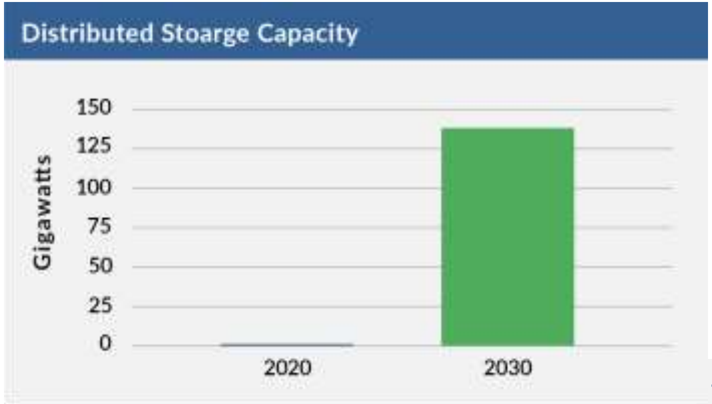
Model assumes zero additional growth of local solar and storage past 2021 and only considers and weighs cost impacts from a central transmission-level grid perspective. Changes to, and upgrade costs for, distribution infrastructure are not considered, they are merely additional costs computed after a solution is found. Model looks at CONUS only.

Local Solar + Storage Capacity Key Takeaways

- The U.S. must deploy a minimum of 103 gigawatts (GW) of distributed, local solar power (including residential, commercial and community) by 2030 to achieve least cost - that's over 65 GW of new distributed solar in the next eight years.

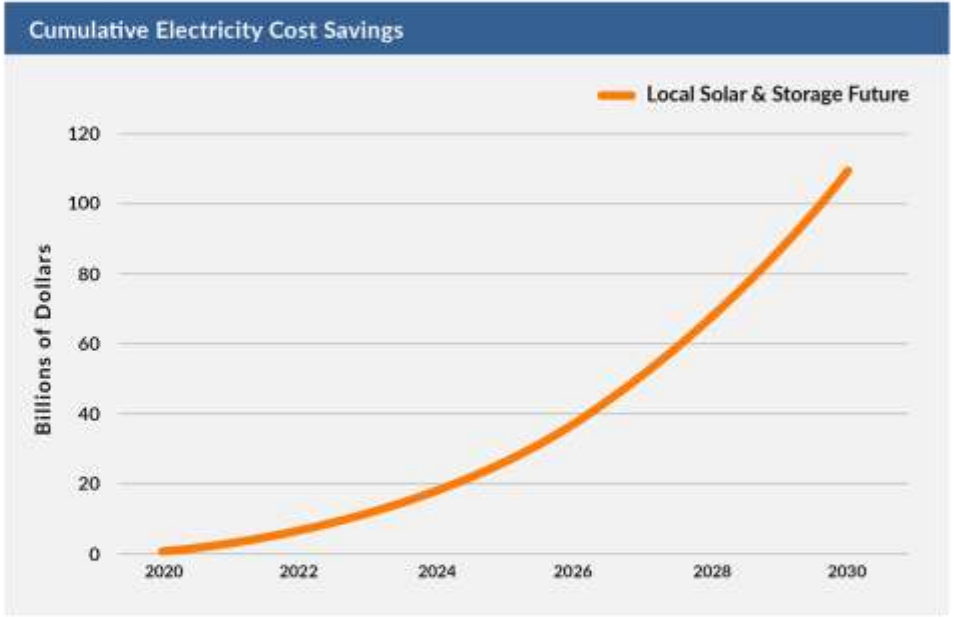
- We must also add 137 GW of distributed storage to optimize the power generation and improve resilience. Together local solar and storage enable future savings and support deployment of large-scale renewables.





Scaling Local Solar + Storage Saves Ratepayers $109.6 billion by 2030 vs. Utility-Scale Only Approach

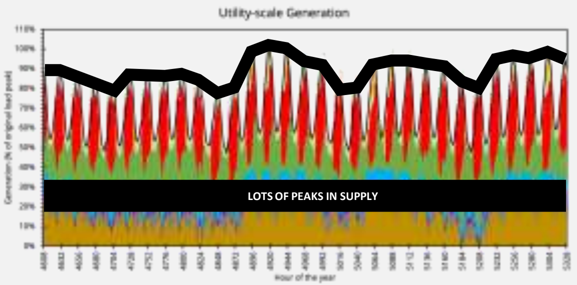
+ Initial investments in utility-scale and distribution level grid infrastructure and capacity drive huge long-term savings relative to traditional electricity grid system planning.
+ The savings captured in this chart include only monetary grid costs and benefits, it doesn't include indirect societal benefits.
+ Savings would be greater if we achieve advanced technology/price targets.

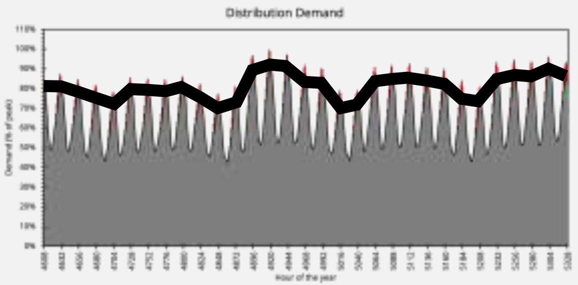


Local Solar + Storage Smooths the Load

UTILITY-SCALE GENERATION ⟷ DISTRIBUTION DEMAND

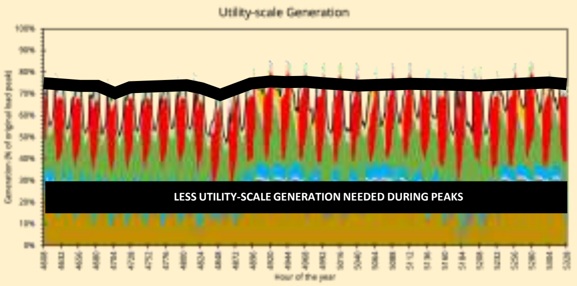
Utility-SCale Only
(summer month in sample state)

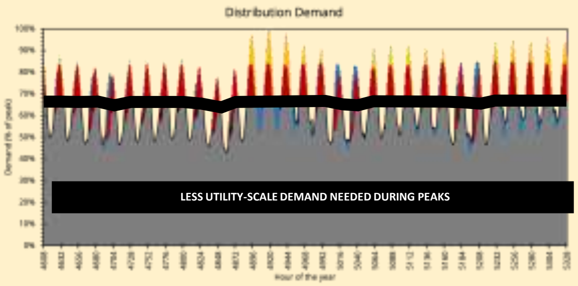




- Demand is sharp and spiked, and supply ramps up and down to meet peaks
- More firming capacity and peaker plants are required to meet demand at times of the day when customers are using the most electricity
- Distributed solar + storage have minimal impacts on "shaping load" and meeting system needs

Optimized DER
(summer month in sample state)



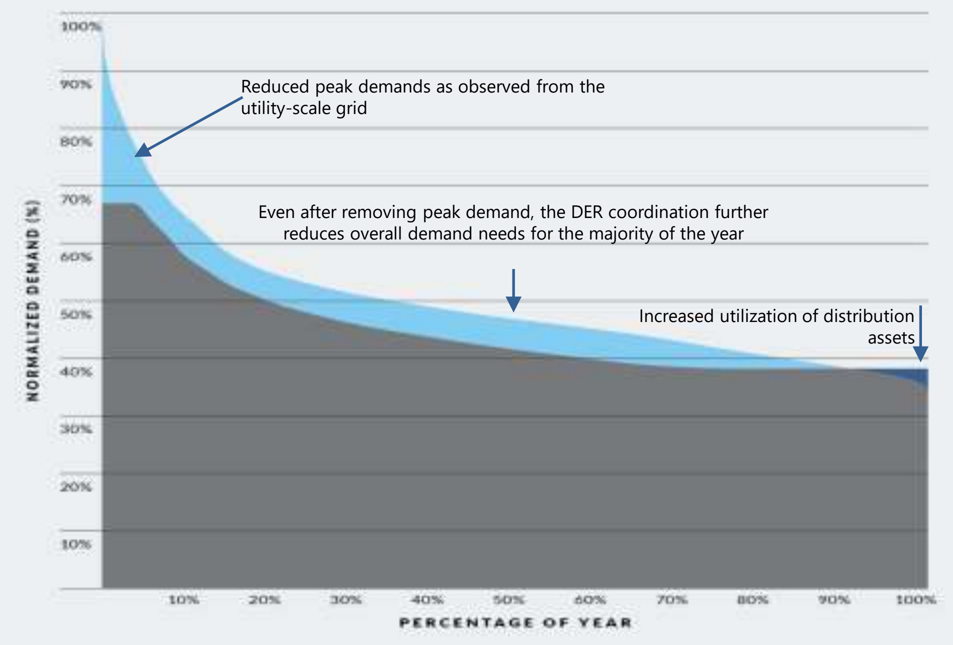


- Demand is smooth because local solar + storage can be deployed at peak times and reshapes load from the perspective of the utility grid
- Permanently eases stress on system during critical peak hours & reduces how much bulk-scale power is needed to serve the distribution grid
- Less bulk power = less money on expensive peaker plants and firming capacity thus overbuilding the system

Local Solar + Storage Shapes the Load

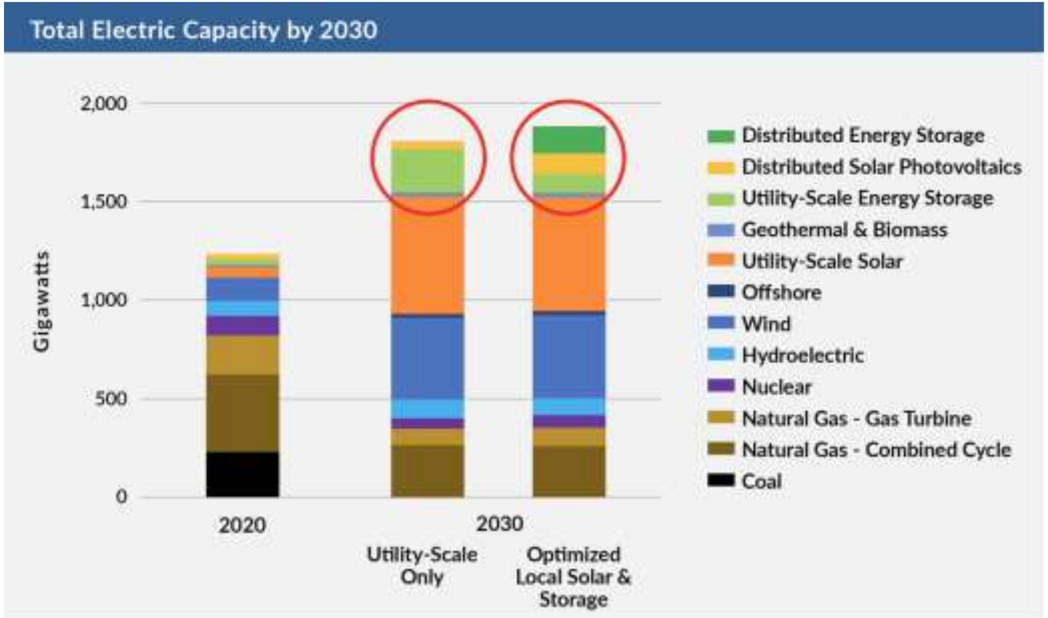
- The entire grid is really only needed a few hours of the year, driving higher costs for everyone with a utility-scale model. Right-sized local solar + storage shaves the peak and saves money across 80% of the hours in the year.
- Local solar + storage shapes the load seen by utility-scale resources, getting more value for bulk-sized variable renewables and other generation.
- The result is more local solar + storage reduces net demand and smooths overall demand to enable access to lowest cost utility-scale generation – more utility wind and solar and less fossil firming capacity.

DER-Improved Load Duration Curve (example state)



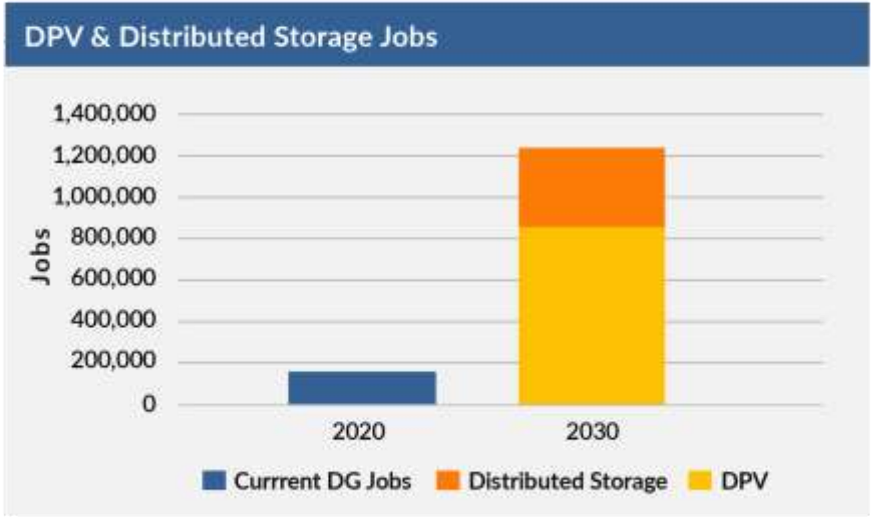
Installed Capacity in 2030

+ Local solar + storage is essential to meeting capacity and generation needs by 2030 in the most cost-effective manner
+ Local solar + storage enable and improve the economics of utility-scale solar and wind (over 50% of capacity and generation across all scenarios).
+ By 2030, there is nearly 579 GW of utility-scale solar and over 442 GW of utility-scale wind installed.
+ **TAKEAWAY:** Local solar + storage make large amounts of least-cost utility-scale solar and wind work.



Local Solar + Storage Add 1,200,000 jobs by 2030

+ Local solar + storage add 861,000 local solar and 374,000 local storage jobs.
  - These include direct and indirect jobs, but do not include induced jobs (*e.g.*, the ripple effect of direct economic impacts).
+ Local solar creates more jobs on a per MW basis than does utility-scale electricity generation.
  - This difference is largely a result of more construction and operations jobs from distributed energy facilities.
  - DPV has an average job/MW-ac ratio of 8.4 compared to UPV's job/MW-ac ratio of 3.4.*



*Actual ratios are state-specific and are tied to basic assumptions from NREL's JEDI and the IMPLAN modeling tools, adjusted further by actual jobs numbers provided in the Solar Foundation's annual solar jobs report.

Snapshot of our Modeling:

Growing distributed solar and storage is key to achieving the President's vision of 80% clean electricity by 2030

Least Cost Clean Energy Transition plan:

- Results in a minimum of **103 GW of distributed solar** and **137 GW of distributed storage** capacity
- Enables **579 GW of utility-scale solar** and **442 GW of wind**
- Saves **$109 billion** by 2030 over the utility-scale-only approach
- Adds **1.2 million local solar and storage jobs** by 2030
- Directing 50% of local solar capacity to low- and moderate-income (LMI) households could lower the energy burden for **8-15 million LMI households**
- Same conclusion as other studies (DOE Solar Future Study, SEIA's 30x30 analysis, Local Solar Roadmap, etc.): distributed generation must grow between **2 - 4x faster** than in the previous decade (2010 to 2020)

Key Takeaways: Local Solar + Storage is Critical to Achieving Climate and Equity Goals at the Lowest Cost

What we knew before:

+ American customers want local solar + storage
+ Local solar + storage allows us to target benefits of clean energy more equitably through increased access and jobs
+ Local solar on the grid today provides meaningful benefits to the electric grid

What we know now:

+ Growing local solar + storage benefits the entire system and all ratepayers by reducing and smoothing electric demand
+ This is NOT the time to slow the development and deployment of local solar + storage
+ We must grow local solar 2 - 4x faster than in the previous decade

What else can Local Solar + Storage Do?

+ Assure we achieve the President's Justice40 goals
+ Provide an insurance policy for development constraints for ~1 TW of utility-scale and transmission deployments
+ Increase grid resilience
+ Grow clean economy jobs
+ Reach climate goals faster

Policymakers Must Double-Down on the Growth of Local Solar + Storage

- **Action in Washington :**
  - Congress should (1) extend and expand the solar investment tax credit (storage and ITX costs, direct pay, bonus credit for community solar projects serving at least 50% LMI); (2) create $10B in grant funding opportunities for rooftop and community solar, and (3) support distributed energy resources in the Clean Electricity Performance Program (CEPP).
  - A broad coalition of advocates representing civil rights, indigenous, environment, equity, rural, and business organizations have released a comprehensive policy roadmap on how Congress can ensure the equitable and just deployment of renewable energy through policies that support expanding local rooftop and community solar power for all.
- **Action in States:**
  - Establish clear and consistent policies to grow local solar + storage today and integrate and optimize local solar + storage into state energy planning.

Thanks!

Learn more at www.localsolarforall.org

October 2021

Modernizing the Rooftop Solar Transaction

Solar Choice Metering Tariffs

Lon Huber – VP Rate Design & Strategic Solutions

2021

DUKE ENERGY®

SC Solar Choice – Outcomes

UTILITY DIVE

Duke-solar industry breakthrough settlement aims to end rooftop solar cost shift debates

Successor tariff deal reshapes solar with dynamic rates, demand response requirements

1. Utilized Collaborative Stakeholder Process to produce a durable and equitable policy outcome

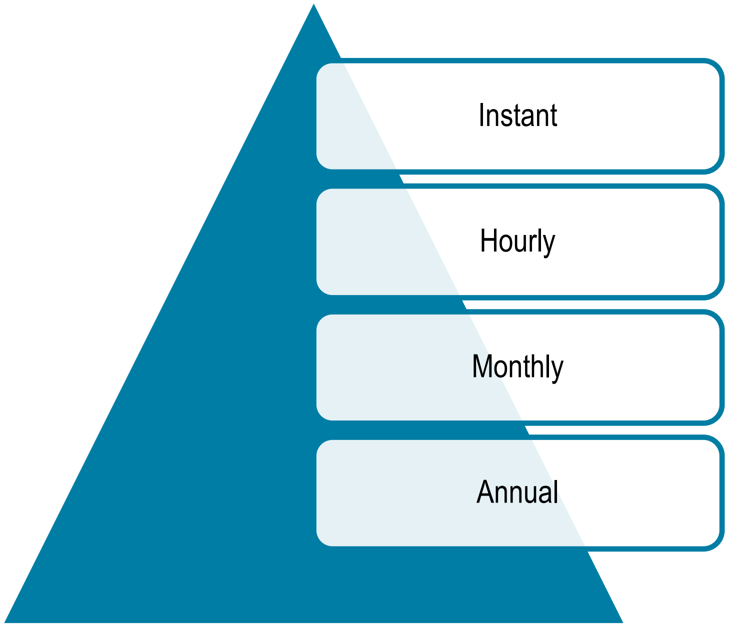
2. Developed a SC Solar Choice program that balances the needs of participants (i.e. NEM customers) and non-participants (particularly low-income, residential customers)

Settlement Agreement Parties

Parties:

- Duke Energy Carolinas & Duke Energy Progress
- Vote Solar
- North Carolina Sustainable Energy Association
- Sunrun Inc.
- Solar Energy Industries Association
- Alder Energy
- Southern Environmental Law Center on behalf of:
  - South Carolina Coastal Conservation League
  - Upstate Forever
  - Southern Alliance for Clean Energy

Netting Periods



"No netting" – every kWh served to the customer is billed

- Example: 700 kWh is imported to customer; 400 kWh is exported from customer→ the utility bills for 700 kWh served

Exports and Imports can be netted across any time period

- Example: 700 kWh imports, 400 kWh exports, 100 kWh excess exports carryover from previous month → 200 kWh billed
- Excess exports set to zero once per year

Key Elements of the Proposed Settlement

Dynamic Critical Peak Pricing (CPP) to reflect costs on highest-cost days

Controllable Smart thermostats and a platform to add more dispatchable devices

Dynamic & Temporal Price Signals
to better reflect the cost to serve

Demand Response
to flexibly reduce peaks

Time-of-use Netting
with excess credited at avoided cost monthly

Recovery
of appropriate costs

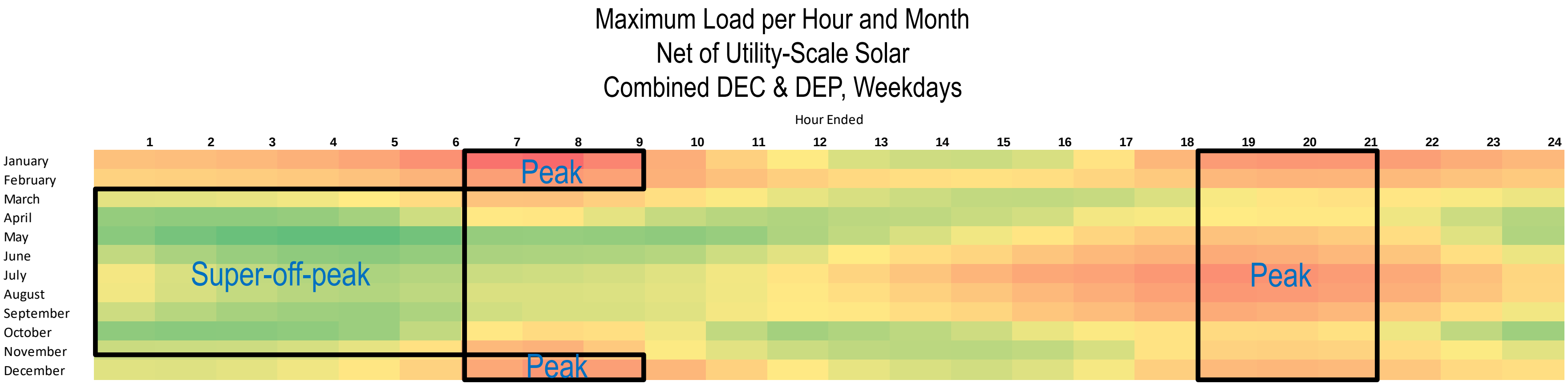
More closely reflects temporal value of solar generation than current policy

Non-Bypassable Riders – recovers public programs

$30 Minimum Bill – recovers Duke's estimated customer and distribution costs

Refreshing TOU Periods

- Updated TOU Periods to target highest cost and loss of load risk hours
- Utilized forecasts for 2025 to ensure design is ahead of the curve
- Shorter 3-hour peak periods enable customers to better respond to price signals
- Aligns DEC and DEP TOU periods



Time of Use and Dynamic Prices

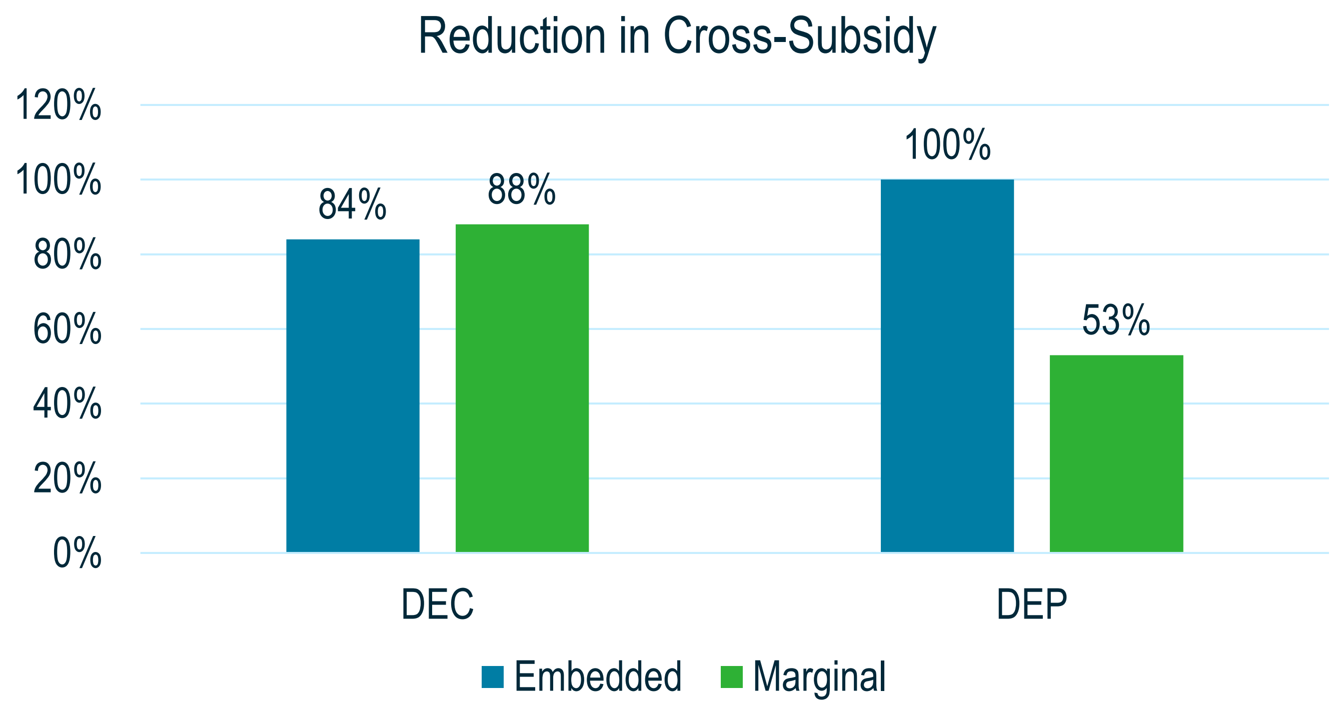
	Price w/o Riders* (c/kWh)	
	DEC	DEP
Peak	15.4444	16.140
Off-Peak	9.0270	9.805
Super-Off-Peak	6.2952	7.294
Critical Peak	25	25

*includes fuel as included in the 2017 COSS

Non-Participant Protections

Address Potential Cost Shifting to Non-Participants	Protects Against
TOU & CPP	✓ Inter- and Intra-day arbitrage between high- and low-cost periods
Grid Access Fee	✓ Very large system sizes
Monthly Netting	✓ Seasonal Arbitrage
Non-Bypassables	✓ Non-collection of Public Benefit Costs
$30 Minimum Bill	✓ Non-collection of Customer and Some Distribution Costs

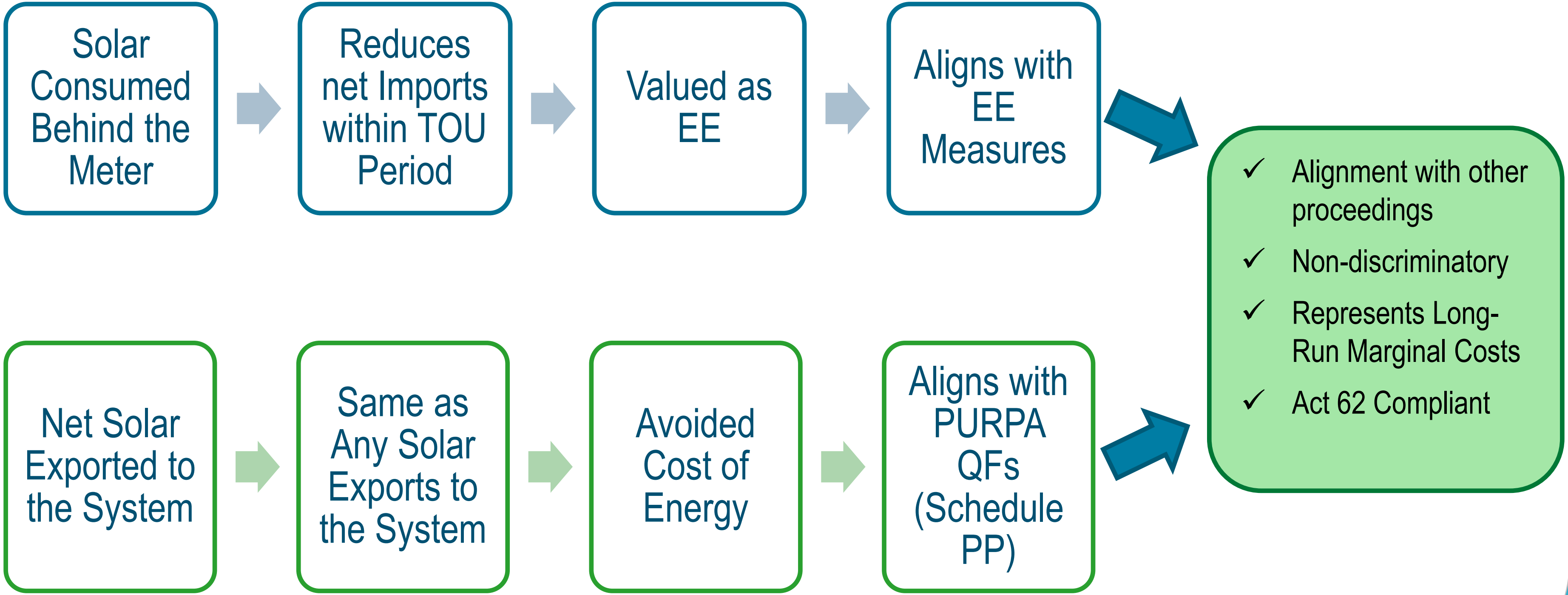
Settlement Reduction in Cross-Subsidy



Introducing Solar +

- Enables synergistic system benefits by linking solar to controllable peak demand reducing devices – with a focus on winter peak
  - Smart thermostats 
  - Battery storage (future state) 
  - Other connectable devices that bring a reliable reduction of at least 1 kW
- When eligible devices are paired with Solar, the adopter becomes qualified for an EE incentive of ~$0.36/Watt
  - Solar reduces system energy needs + DR reduces system capacity needs = Comprehensive System Benefits
  - Must pass cost effectiveness tests
  - Incurs same treatment as today's EE measures

Value of Solar



Transition For Existing Customers

- At their transfer year (2025 Act 236, 2029 Act 62), existing NEM solar customers will be given the option to switch to the CPP TOU rate.

- If they elect not to be on that rate:
  - They can stay on the standard residential tariff but any volumetric price increase after their transfer year will be placed in a non-bypassable, non-volumetric charge based on their system size for the remaining life of the system.
  - This will also include monthly netting with net excess energy credited at the avoided cost rate.
  - The solar customer will also be assessed a minimum bill set at $10 more than the Basic Facilities Charge at that time.