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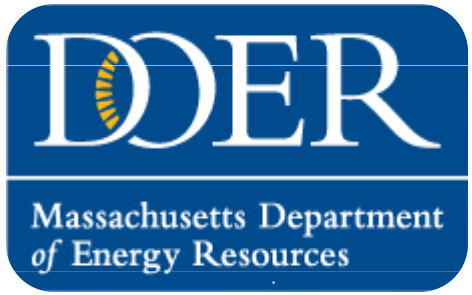


COMMONWEALTH OF MASSACHUSETTS

Deval L. Patrick, Governor
Richard K. Sullivan, Jr., Secretary
Mark Sylvia, Commissioner

Shedding Light on Solar PV and Incentives

LSPA Renewable Energy Conference

Boxborough, MA

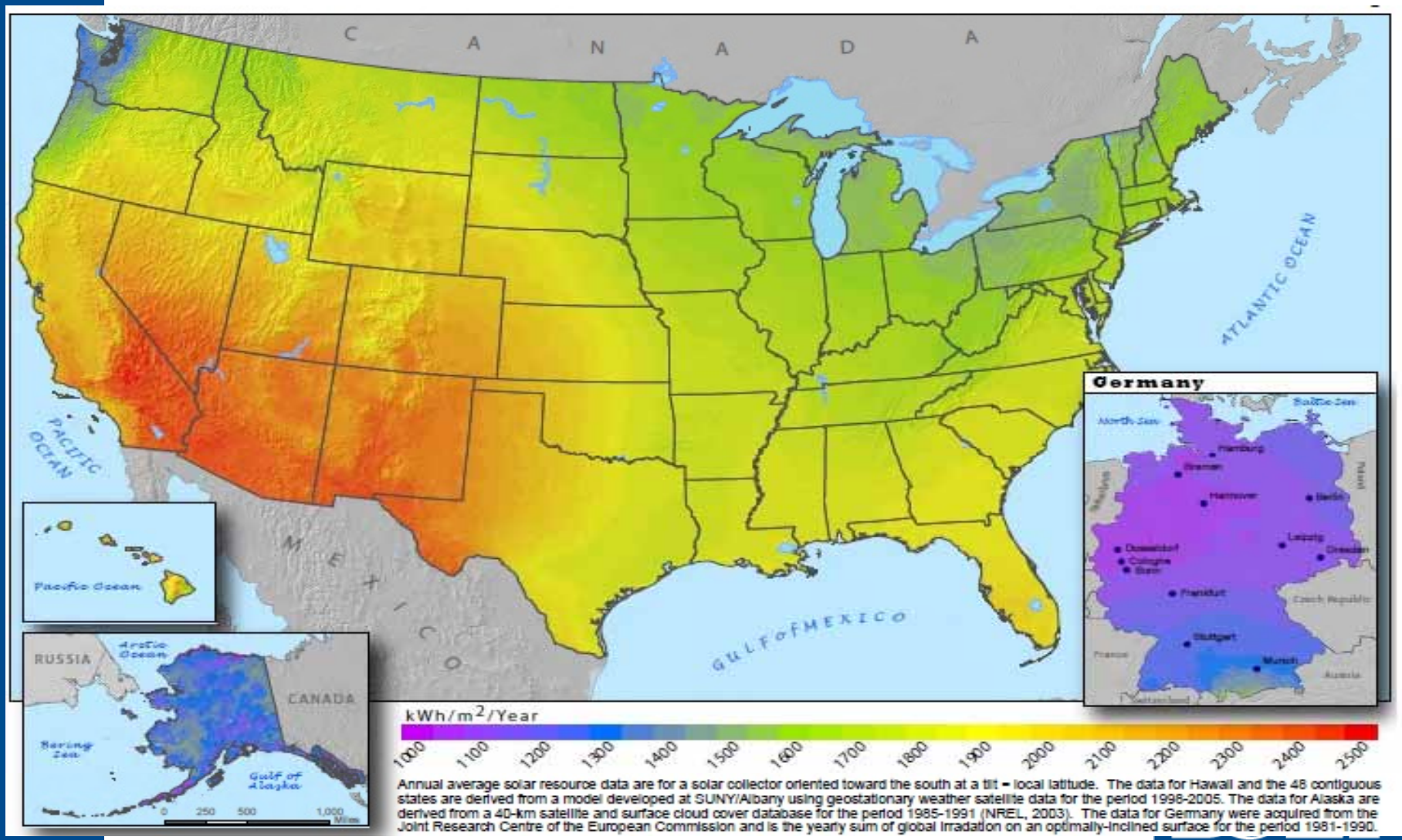
November 7, 2012

Natalie Andrews
Renewable Energy Program Coordinator

Outline

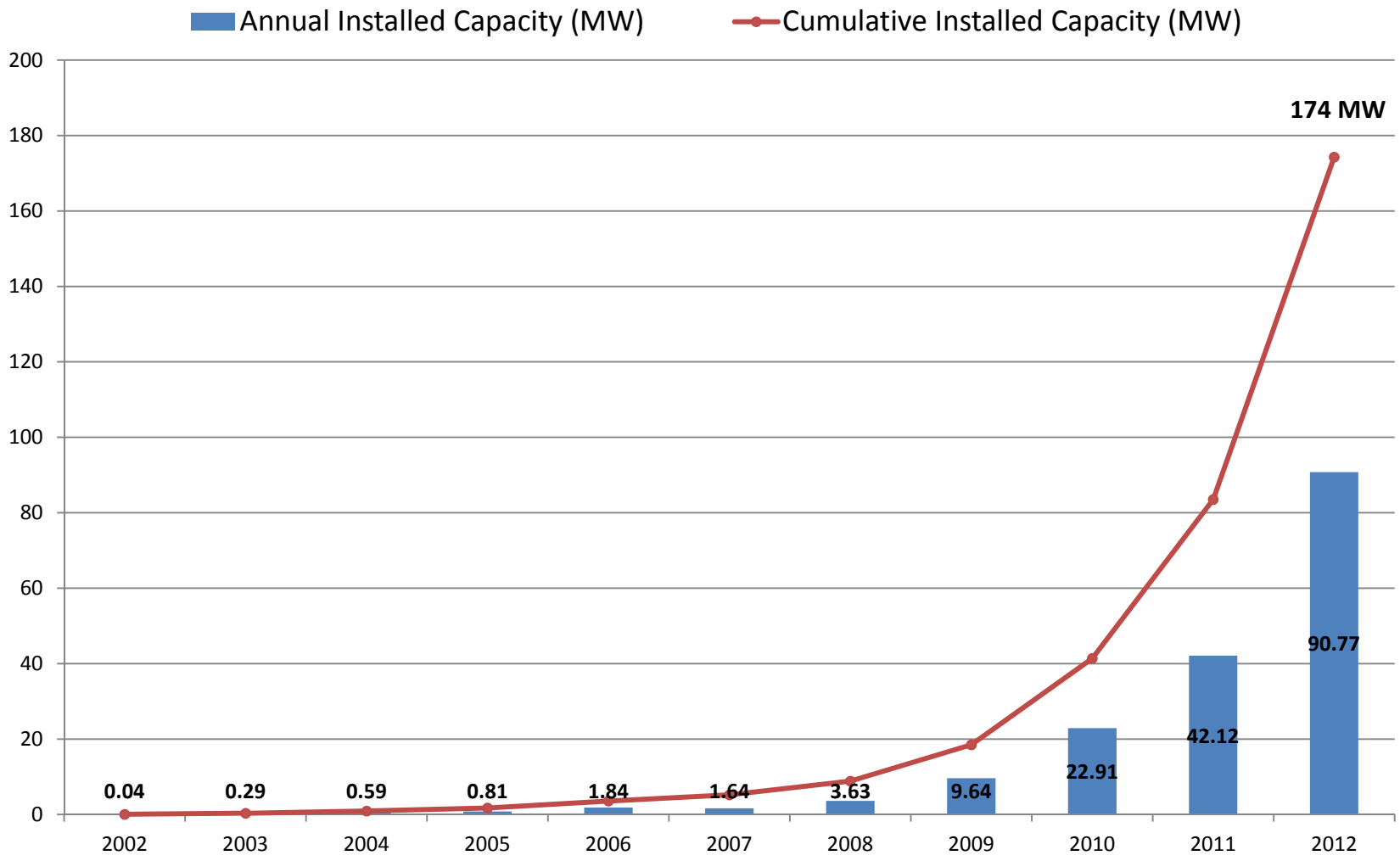
- Solar technology and siting
- Learn about Renewable Portfolio Standard Programs
- Learn how the solar PV market has grown in MA since 2007
- Understand variety of incentive programs and policies currently supporting solar development in MA
- Update on the current status of the market

Is there enough sun in MA?



Annual average solar resource data are for a solar collector oriented toward the south at a tilt = local latitude. The data for Hawaii and the 48 contiguous states are derived from a model developed at SUNY/Albany using geostationary weather satellite data for the period 1998-2005. The data for Alaska are derived from a 40-km satellite and surface cloud cover database for the period 1985-1991 (NREL, 2003). The data for Germany were acquired from the Joint Research Centre of the European Commission and is the yearly sum of global irradiation on an optimally-inclined surface for the period 1981-1990.

Installed Solar Capacity in Massachusetts (as of 11/1/12)



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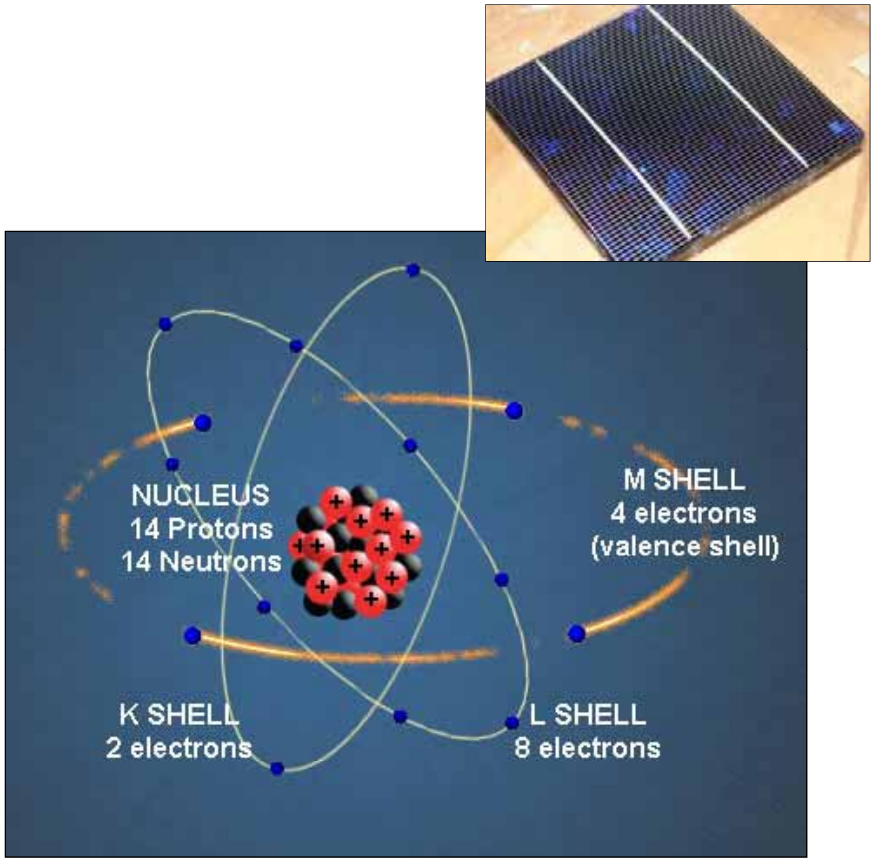
How does Solar PV Work?

- Absorbed sunlight dislodges electrons in a semiconductor
- Electric field forces free electrons to flow in certain direction (current)



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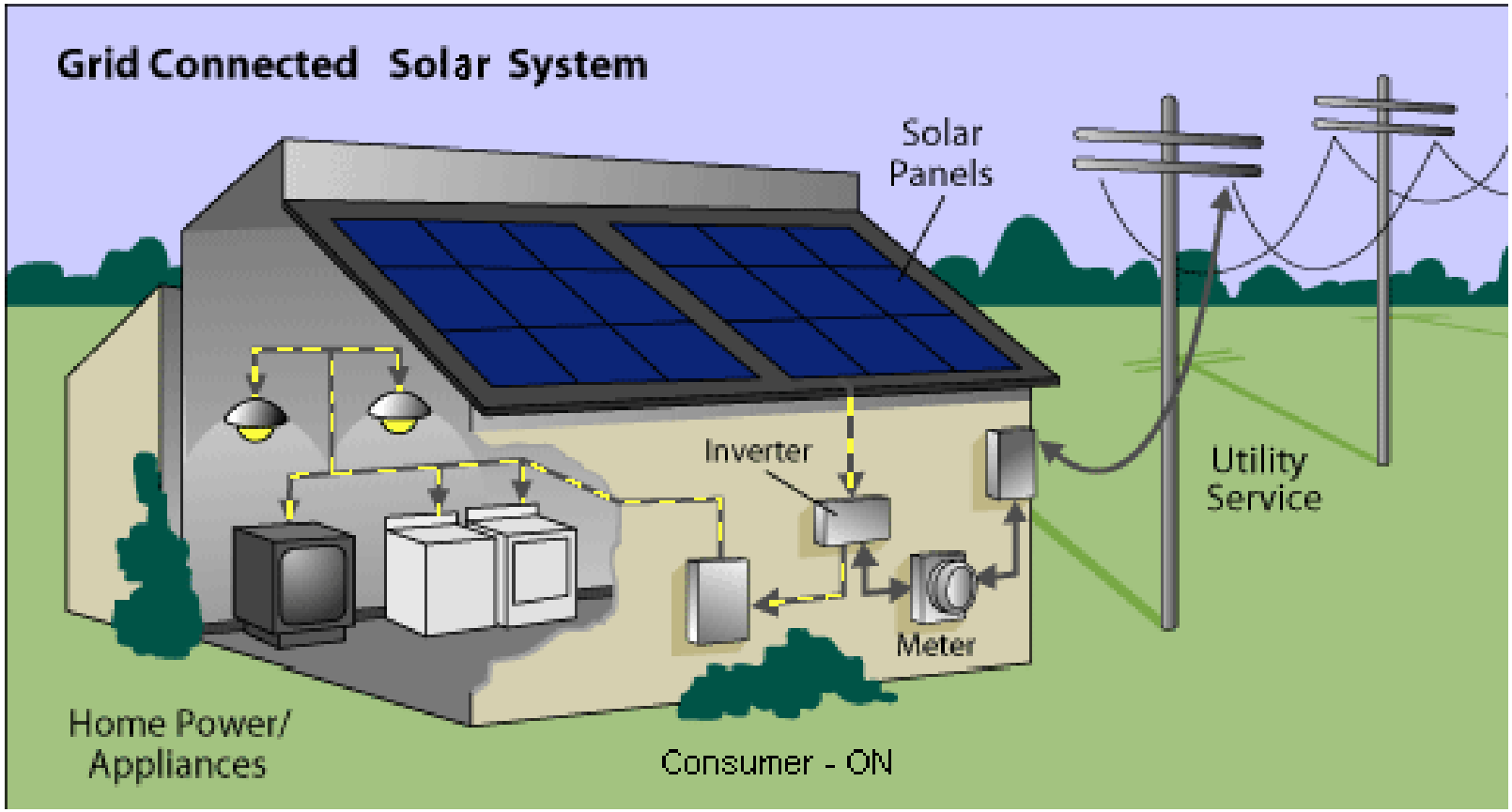
How does solar PV work?



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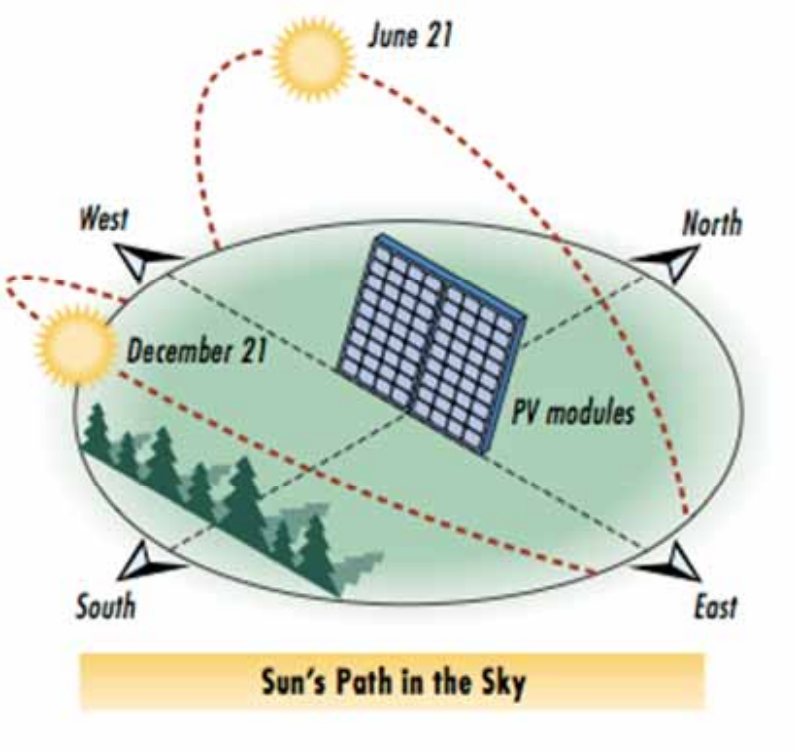
What makes a good site

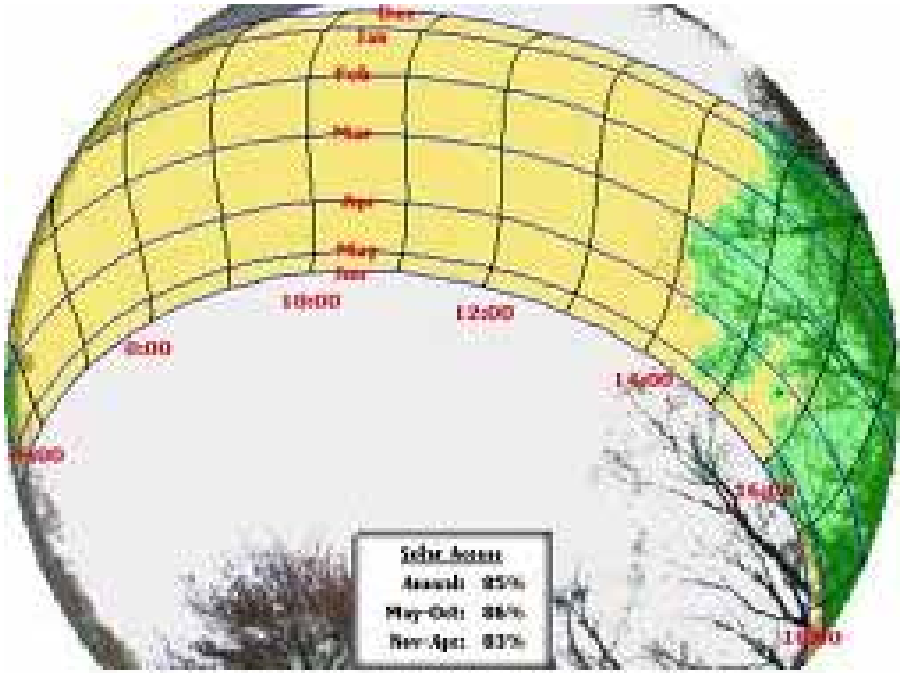
- Orientation
  - Southerly exposure
- Tilt
  - Ideal 36 degrees
- No shading
  - Trees, rows
- Trackers

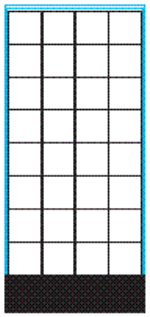


http://energy.ltgovernors.com/solar-energy-pv-systems-self-generation-make-your-own-power.html

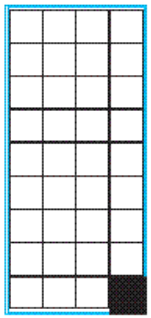
Shading of Solar PV Systems

- Shading can significantly reduce the output of a system
- An analysis should be performed for each project





Example of full-cell shading that can reduce PV module power to zero

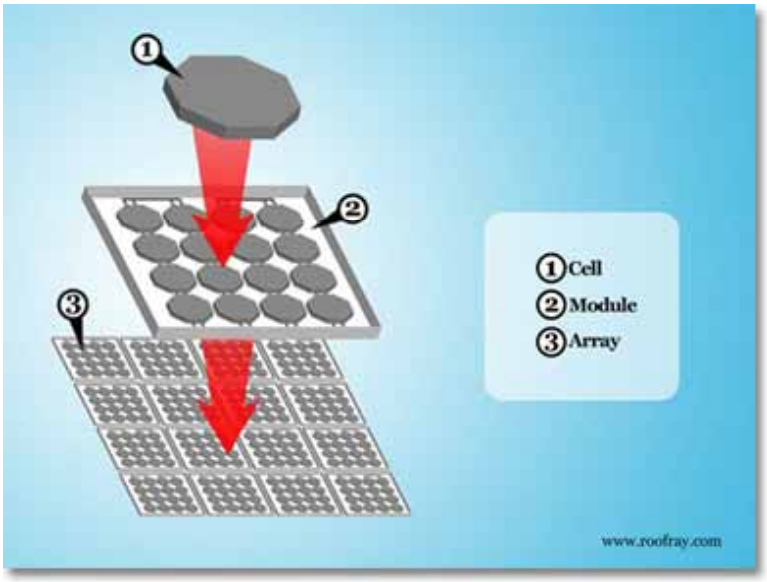


Example of full-cell shading that can reduce PV module power by ½

Common Solar PV Terms

Racking

Cell < Module < Panel < Array



Inverter

kW, MW, kWh

DAS

Annual Solar PV production in MA: Size of array (kW) x 8760 hours/year x 0.13 capacity factor

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Key Characteristics of Project Success

- Interconnection
- Ability to secure all permits
- Financial backing of developer
- Ability to secure financing
- Understanding of municipality's property tax evaluation
- Contracts for sale of electricity and SRECs

Ownership Models

- Power Purchase Agreement (PPA)
- Credit Purchase Agreement (CPA)
- Outright purchase
- Land lease

Project Economics

- 1 MW sample project
- Installed cost $4 million
- Over 4-5 acres of land
- Town sees revenue ~$5,000- $8,000 in property taxes
- Solar developer/owner 10-12% return

What is a Renewable Portfolio Standard?

- State program requiring a certain percentage of the in-state load served by Load Serving Entities (LSEs) come from renewables
- LSEs meet their yearly obligations by procuring Renewable Energy Certificates (RECs)
- One REC = 1 MWh
- Obligation typically expressed as percent of total load

Example:

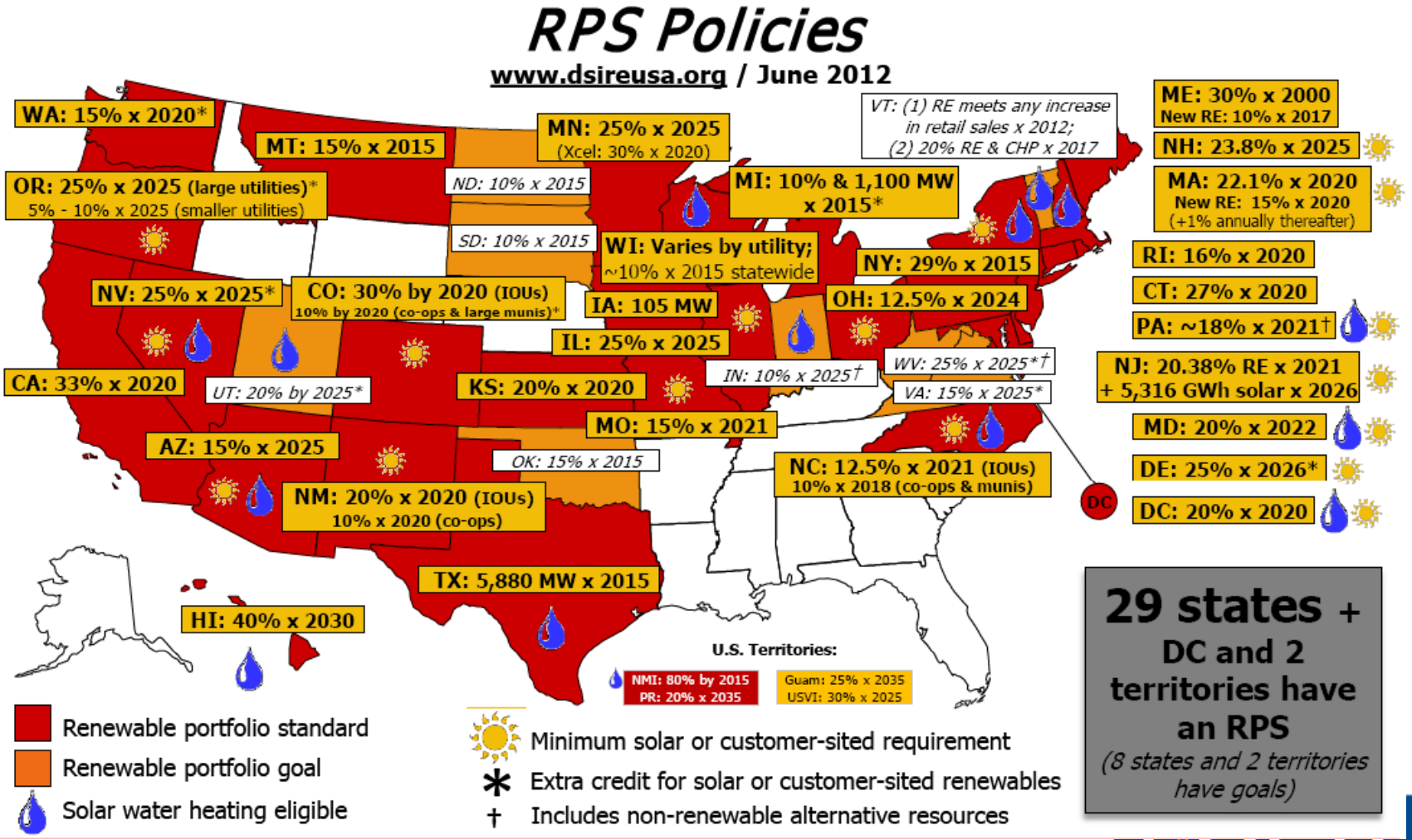
Utility serves 1,000,000 MWh of load in 2010 and had an obligation to procure 5% of that through the purchase of RECs

1,000,000 MWh x 0.05 = 50,000 MWh (number of RECs they must procure)

REC Pricing

- Market driven
- State usually sets two variables:
  - Minimum Standard
  - Alternative Compliance Payment (ACP) Rate
- Minimum Standard refers to yearly percentage obligations placed upon compliance entities
- ACP rate is the price LSEs must pay for every MWh they are short of meeting their obligation

RPS Programs Nationally



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MA RPS Class I Program

- Established in 1997, first year of compliance in 2003
- Eligible technologies include solar PV, solar thermal electric, wind, ocean thermal, wave or tidal energy, fuel cells, landfill methane gas, small hydro, low-emission biomass, marine or hydrokinetic energy, and geothermal electric
- Generation Units from New England and adjacent control areas (i.e. New York and maritime Canadian provinces) may qualify
- Minimum Standard of 7% in 2012
- Set to increase by 1% each year going forward

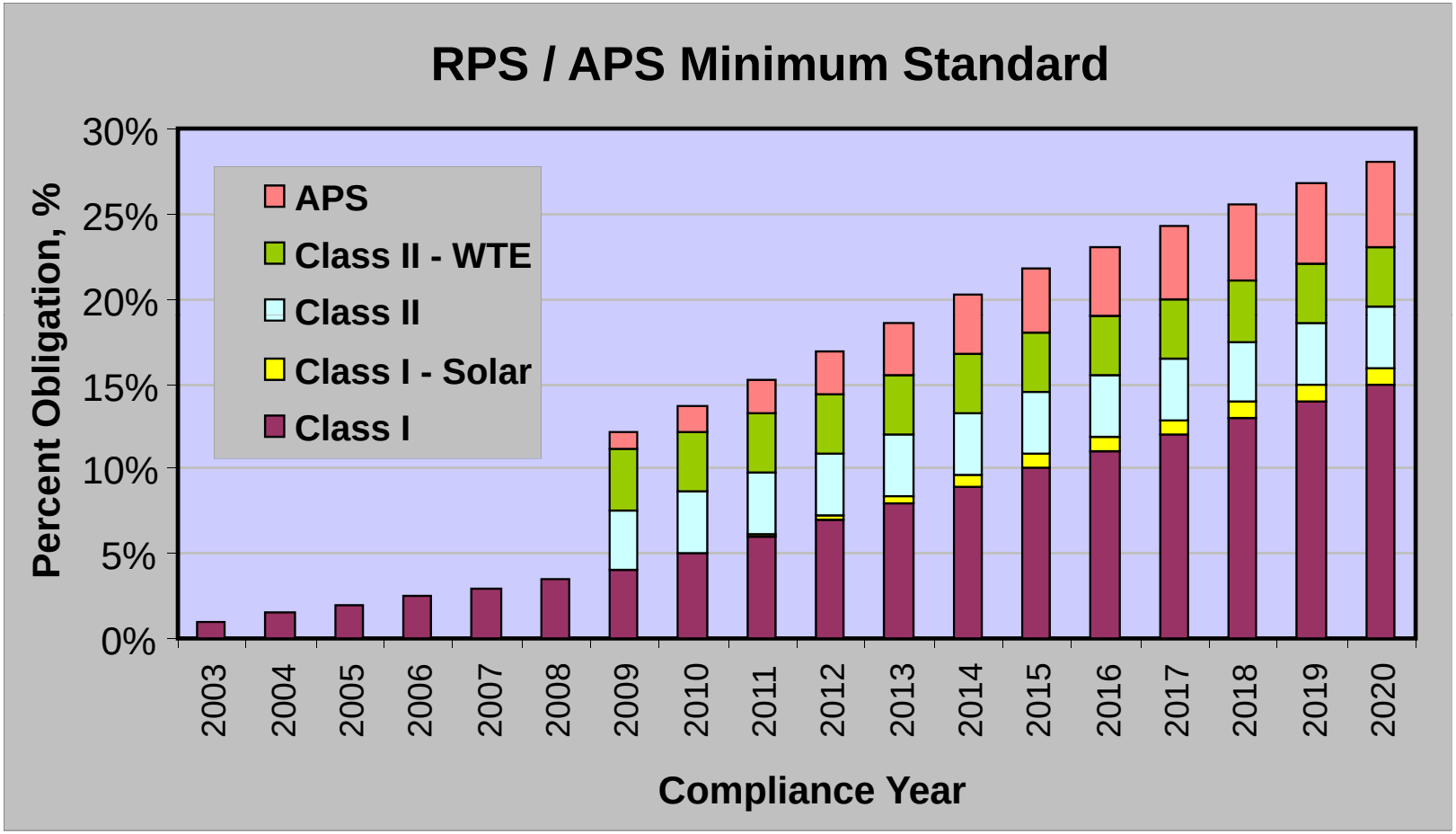
MA RPS/APS Programs

- In 2008, 3 new classes were added to the RPS
  - Class II Renewable Energy for facilities in operation prior to 1998 (mostly small hydro, LFG, and biomass)
  - Class II Waste-to-Energy for waste-to-energy facilities located in MA
  - Alternative Portfolio Standard (primarily CHP projects)
- In 2010, a Solar Carve-Out was added to Class I
- Obligation is part of the Class I total, but has different market parameters and qualification process

Summary of MA Renewable Energy Portfolio Standard (RPS) Programs

RPS Class	Sub Class	Technology	Minimum Standard	2012 ACP Rate, $/MWh
Class I		Wind, LFG, Biomass, Solar, Small Hydro, AD, etc.	7% in 2012, increases 1%/year	$64.02; increases with CPI
	Solar Carve-Out	Solar PV; 6 MW or less, in MA	set by formula to grow installed capacity to 400 MW	$550; reduced annually according to 10-year schedule
Class II	Renewable	same as Class I	3.6%, stays constant	$26.28; increases with CPI
	Waste Energy	Waste to Energy Plants, in MA	3.5%, stays constant	$10.51; increases with CPI
APS		CHP in MA, flywheels, storage, etc.	2.5% in 2012; increases to 5% in 2020	$21.02; increases with CPI

Cumulative Obligations of RPS / APS* Programs



*Alternative Energy Portfolio Standard (APS)

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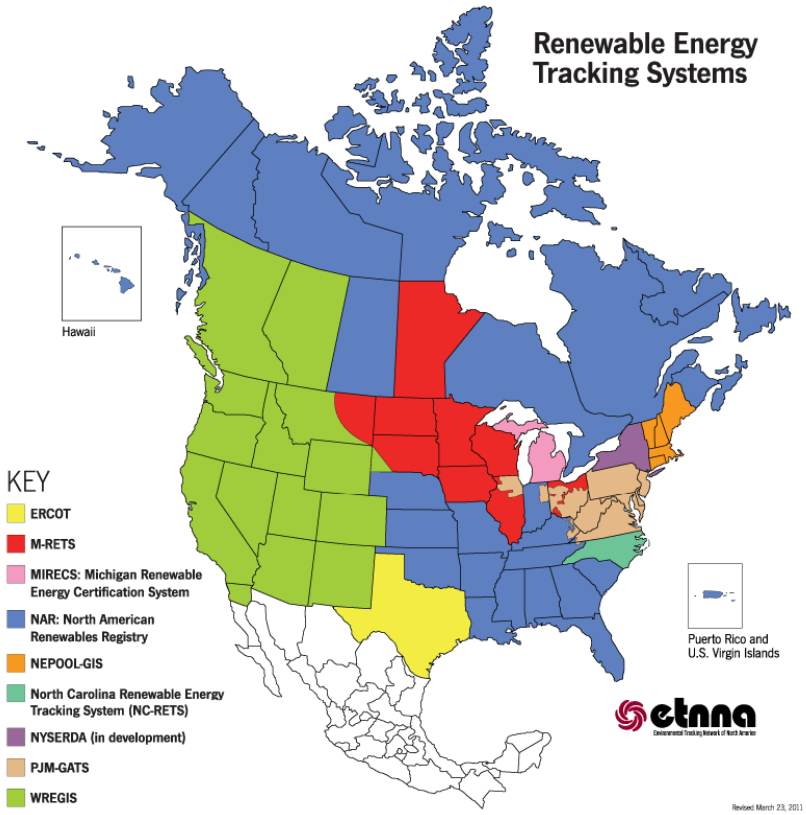
NEPOOL GIS

- NEPOOL GIS is the tracking system for all New England certificates
- Includes renewable and non-renewable resources
- Renewable generators flagged as RPS eligible by DOER, resulting in creation of RECs
- Generation of certificates occurs quarterly
- Q1 generation occurring between 1/1 and 3/31 results in certificates being created on 7/15



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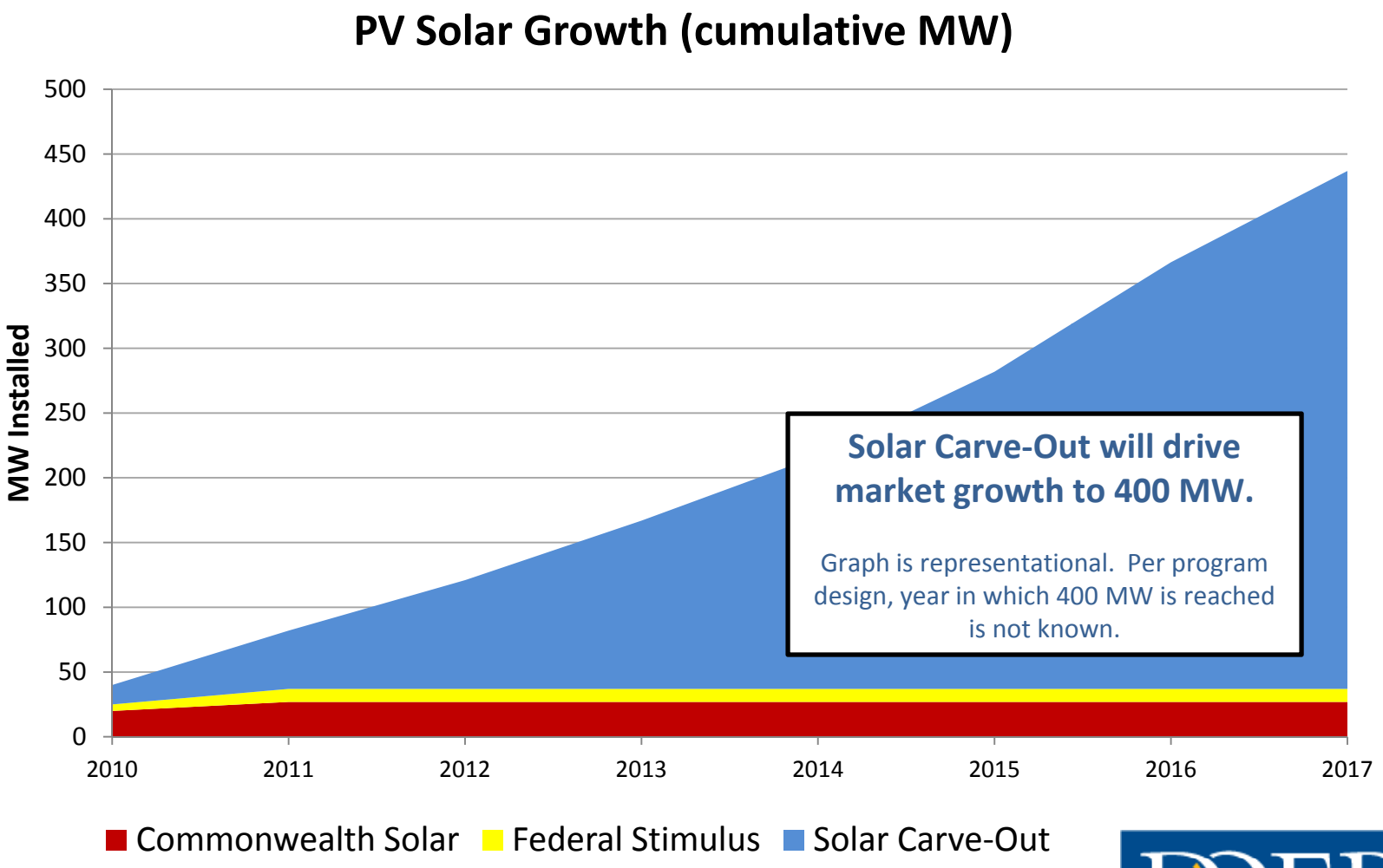
Massachusetts Solar Development Strategies (Pre Solar Carve-out)

- Governor Patrick's goal – 250 MW by 2017
- Commonwealth Solar (Rebates) – initiated Dec. 2007
  - Rebate Program: $68 million, 27 MW
  - Successfully achieved and completed Oct. 2009
  - Created robust PV development sector in MA
- Commonwealth Solar II (Rebates) managed by the MassCEC for small (<15kW) systems has maintained residential PV market
- Federal Stimulus/ARRA funds used by DOER to support over 10 MW of PV at state/municipal facilities.
- Green Communities Act allowed for limited Distribution Utility ownership of PV Generation (approximately 9 MW installed under this provision)

RPS Solar Carve-Out



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RPS Solar Carve-Out Program Design Basics: Generation and Minting

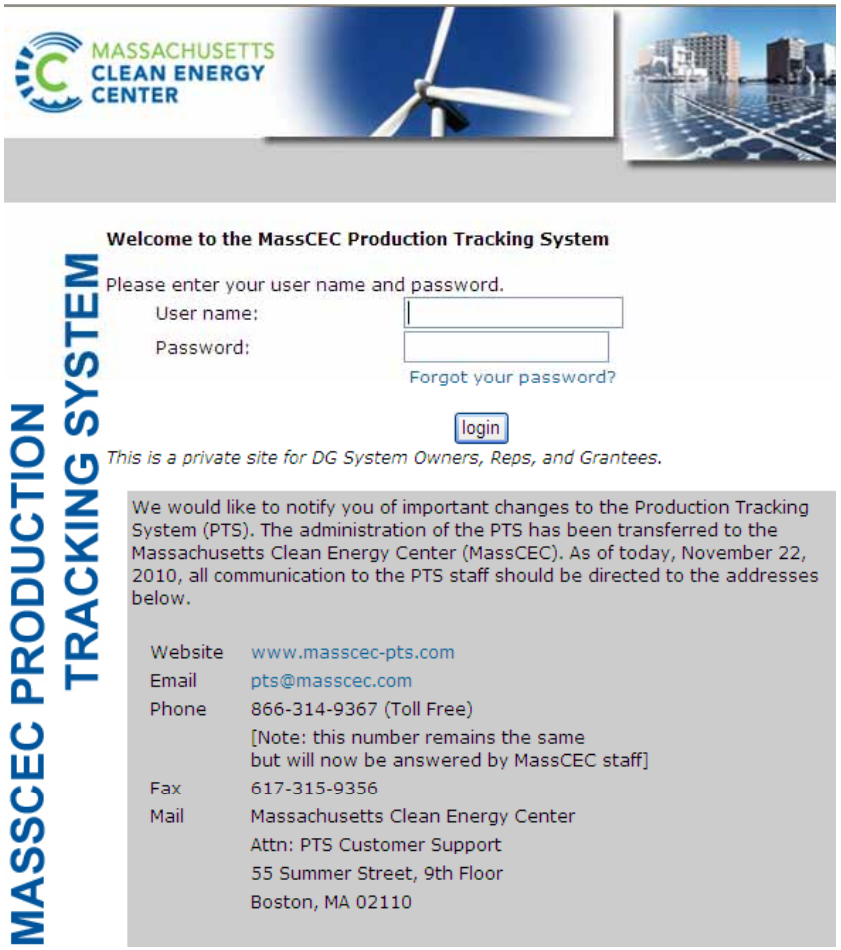
- Market-based incentive, part of the broader RPS Program
- 1 SREC (Solar Renewable Energy Certificate) represents the attributes associated with 1 MWh of qualified generation
- Units must be qualified by DOER before they can begin generating SRECs
- All generation is metered and reported to MassCEC's Production Tracking System (PTS)
- MassCEC reports generation to NEPOOL GIS, where SRECs are minted on a quarterly basis

Qualification Process

- Eligibility criteria
  - Have a capacity of 6 MW (DC) or less per parcel of land
  - Be located in the Commonwealth of Massachusetts, which includes municipal light district territories
  - Use some of its generation on-site and be interconnected to the utility grid
  - Have a Commercial Operation Date of January 1, 2008, or later
  - Cannot have received certain levels and types of funding
- Online application
- PV Detail Form
- Need *Authorization to Interconnect* from local utility before SRECs can be generated
- Review process is quick and straightforward (30 days or less)

Reporting Process

- Registered system owners report production monthly to PTS account
- MassCEC performs QA on data collected
- Follows up with any systems with issues
- Uploads production totals to corresponding generator accounts at NEPOOL GIS (quarterly)
- MassCEC will conduct audits on SREC eligible systems to ensure accuracy of data



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SREC Program Design Features

Program design features help ensure market stability and balance

- Adjustable Minimum Standard

  maintains SREC demand/supply in reasonable balance

- Forward ACP Rate Schedule

  provides investor certainty

- Solar Credit Clearinghouse Auction Account

  essential price support mechanism to assure SREC floor price

- Opt-In Term

  provides right to use Auction, adjusted to throttle installation growth rate

- Program Cap of 400 MW

  Enables sufficient market growth opportunity (exceeds Governor's goal of 250 MW by 2017)

- These features work together to ensure the market will remain in balance as more PV is built

Minimum Standard Adjustment

Compliance Year	Compliance Obligation (MWh)	Minimum Standard Percentage	Equivalent Full-Year Solar Capacity (MW)
2010	34,164	0.0679%	30
2011	78,577	0.1627%	69
2012	81,559	0.1630%	72
2013	135,495	0.2744%	119

For 2012 and beyond, the Minimum Standard (Compliance Obligation) is adjusted each August according to a formula set in the program regulation.

2013 Min. Stand = 2012 Min. Stand

+ [Projected 2012 SRECs – Actual 2011 SRECs] x 1.3

– 2011 ACP Volume + 2011 Banked Volume + 2011 Auction Volume

2013 Calculation Based on Current Formula

135,495 MWh = 81,559 MWh + [109,465 – 26,598] x 1.3 – 53,802 + 11 + 0

10-year Forward ACP Rate Schedule

- DOER released an RPS Guideline for a 10-year ACP Rate Schedule in December
- Done to reduce market risk and uncertainty
- Maintains current ACP Rate through 2013 before reducing 5% annually
- DOER announced intention to insert schedule into the MA RPS Class I Regulation at soonest possible opportunity

Compliance Year	ACP Rate per MWh
2012	$550
2013	$550
2014	$523
2015	$496
2016	$472
2017	$448
2018	$426
2019	$404
2020	$384
2021	$365
2022	$347
2023 and after	added no later than January 31, 2013 (and annually thereafter) following stakeholder review

Fall 2012 Rulemaking Process

- DOER announced intention to begin formal rulemaking process on August 30, 2012
- Primary reason for rulemaking is to make two changes to RPS Class I Regulation:
  - Insert 10-year forward ACP Rate schedule into regulation
  - Remove the subtraction of ACP Volume from Minimum Standard formula
- DOER plans to retroactively apply change to 2013 Minimum Standard, thereby increasing the demand in 2013
- Rulemaking expected to begin in early fall

Example Calculation – CY 2013	Current Formula	Proposed Formula
Compliance Obligation	**135,495 MWh**	**189,297 MWh**
	= 81,559 MWh + [109,465 - 26,598] x 1.3 - 53,802 + 11 + 0	= 81,559 MWh + [109,465 - 26,598] x 1.3 + 11 + 0
Minimum Standard	**0.2744%**	**0.3833%**
	= 135,495 MWh / 49,386,169 MWh x 100	= 189,297 MWh / 49,386,169 MWh x 100

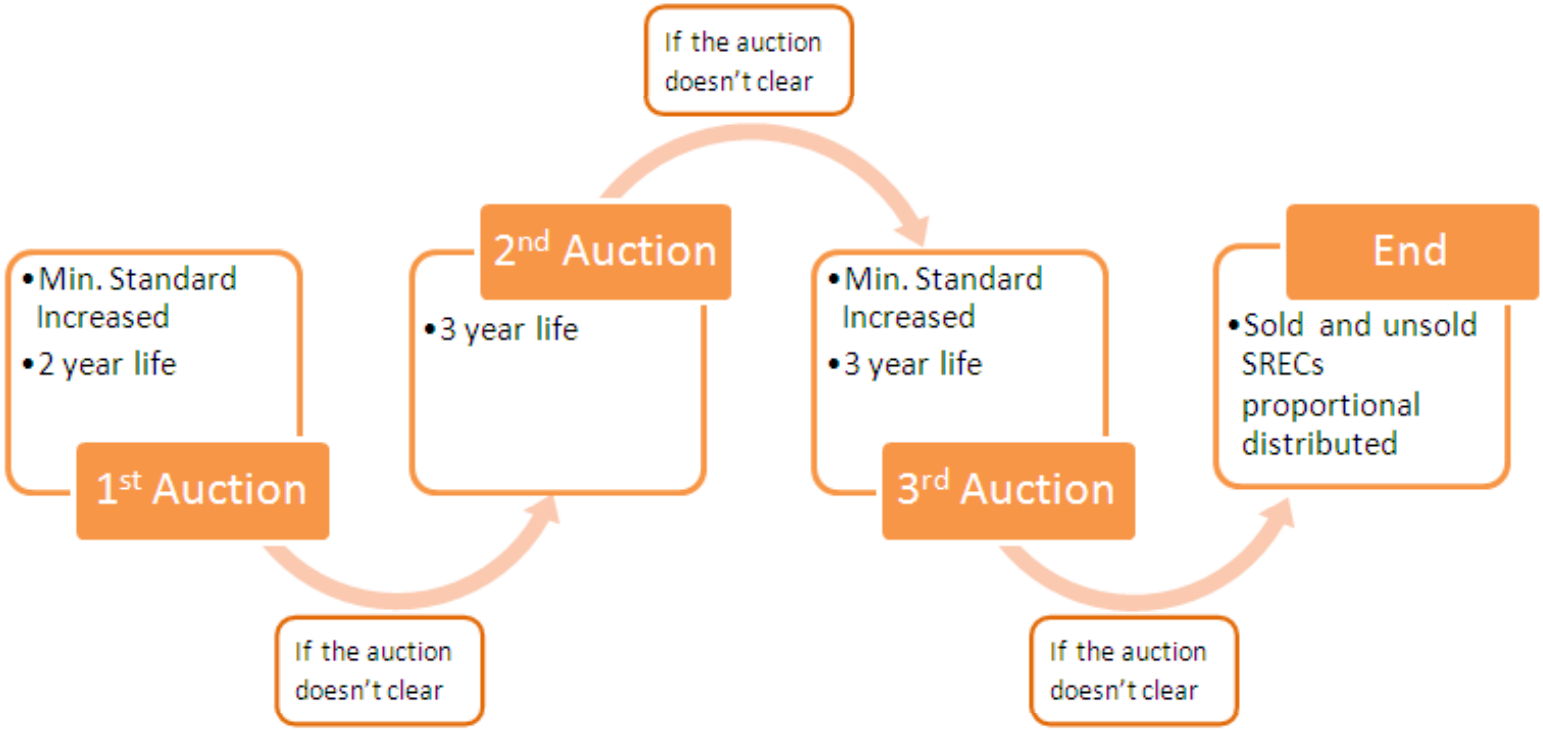
Program Design: Opt-in Term

- The Opt-In Term is the number of quarters a qualified project has the right to deposit SRECs into the Auction Account (to be assured floor price). The Opt-In Term is currently 10 years (40 quarters), but can be adjusted each July for subsequent qualified projects.
- Opt-In Term Adjustments
  - **Long Market**: Opt-In Term reduced by 4 quarters for each 10% of Compliance Obligation deposited into the Auction Account
  - **Short Market**: Opt-In Term increased by 4 quarters for each 10% of Compliance Obligation met through ACP Payments
  - Opt-In Term may not increase or decrease more than two years as a result of an annual adjustment, nor can it exceed 10 years.

Price Support – Auction Mechanism

- Solar Credit Clearinghouse Auction Account
  - Open every year from May 16th – June 15th
  - Any unsold SRECs may be deposited into the Account
- Auction will be held no later than July 31st, but after the Minimum Standard adjustment is announced
- Deposited SRECs are re-minted as "extended life" SRECs (good for compliance in either of the following two Compliance Years)
- SRECs are offered to bidders for a fixed price of $300/MWh before being assessed a $15/MWh auction fee by DOER. Bidders bid on volume willing to buy at the fixed price
- SREC owners will be paid $285/MWh for each SREC sold through the Auction

Price Support – Auction Mechanism



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Important Dates

Date	Event
January 15	SRECs from Quarter 3 of the previous calendar year are minted at the NEPOOL GIS
January 31	Any change in the ACP rate announced by this date
April 15	SRECs from Quarter 4 of previous calendar year are minted at NEPOOL GIS
May 16 - June 15	Solar Credit Clearinghouse auction account available for deposit of SRECs
July 1	Compliance Filings due from Retail Electric Suppliers (Load Serving Entities)
July 15	SRECs from Quarter 1 of current calendar year are minted at NEPOOL GIS
July 20	Opt-in term announced, effective immediately for subsequently qualified units
July 31	Auction held no later than this date, if the auction does not clear, DOER shall conduct a new auction within three business days
Cleared auction date + 10	Each successful bidder is required to submit payment for the awarded volume of SRECs within 10 business days
August 30	The final Minimum Standard shall be announced by DOER not later than this day
October 15	SRECs from Quarter 2 of the current calendar year are minted at NEPOOL GIS

Current Market Issues

- Interconnection
  - Siting challenges, delays, costs, etc.
- Property Tax Uncertainty
  - Lack of standards from one project to the next and one municipality to the next
- Difficult to secure project financing
  - Debt service providers question lending against floor due to perceived auction risk and liquidity issues
- Long-term SREC contract market very limited
  - Most contracts for short periods (3-5 years) with competitive suppliers or speculators
- SREC market oversupply driving prices downward
  - Market expects short-term oversupply to last for at least 2 years
- Prices below the auction price causing concern among project developers and financiers

Other Incentives/Initiatives

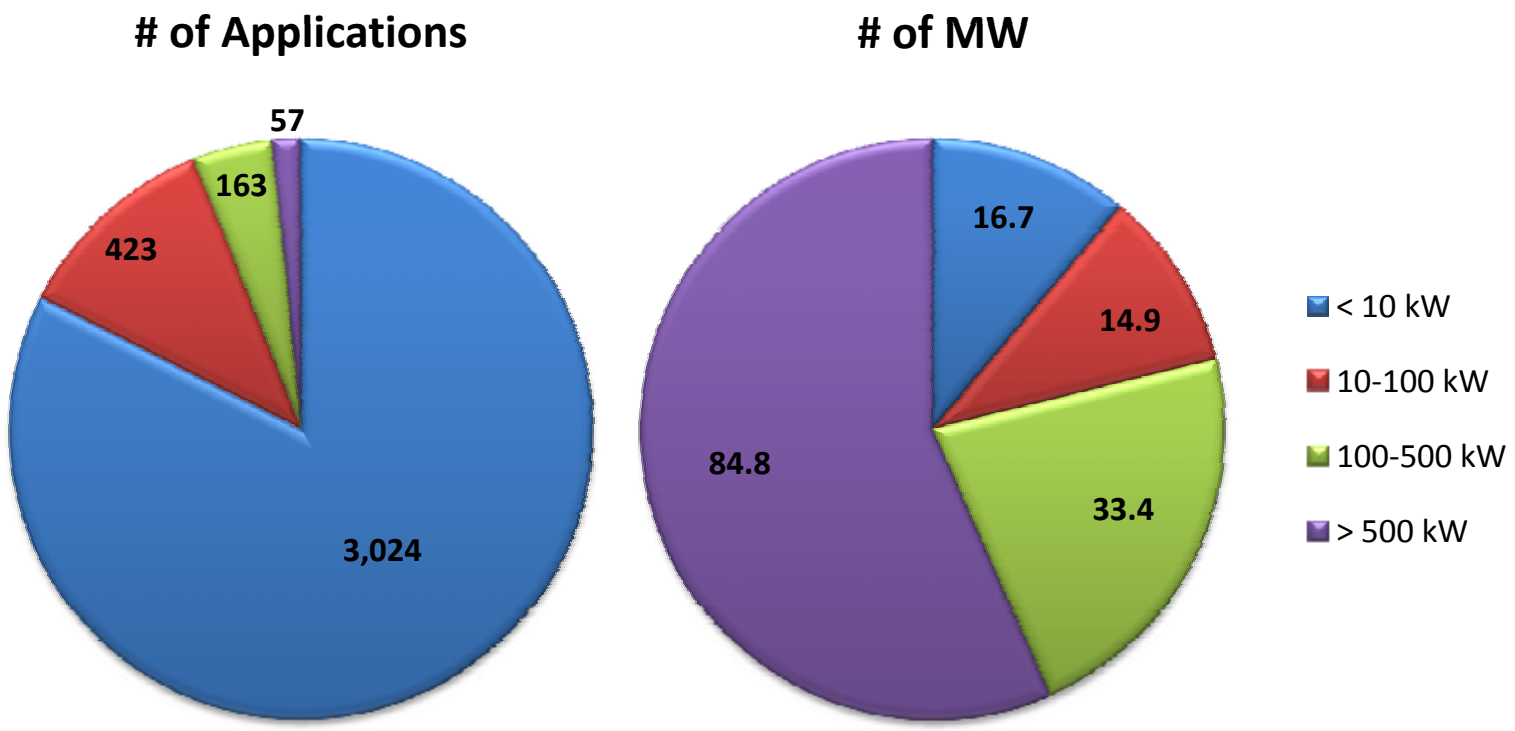
- Tax Incentives
  - Federal 30% ITC, state ITC, state property & sales tax exemptions
- Net-Metering
  - Projects in IOU service territories that meet eligibility criteria may receive credit at close to the retail rate for excess generation
- Sunshot Grant
  - MA received more than $500,000 from DOE to focus on reducing soft costs associated with solar (e.g. permitting, zoning, financing, etc.)
- Solarize Mass
  - Program designed to lower installed costs for small-scale installations through targeted marketing and bulk purchasing
- Solar Hot Water Rebate Programs
  - MassCEC rebate programs for residential and commercial solar hot water

Current SREC Program Statistics – 10/18/12

- Over 3,600 applications received
- 3,200 qualified units
- Nearly 132 MW qualified
- Nearly 124 MW of qualified projects installed
- 2,741 SRECs created in 2010
- 26,598 SRECs created in 2011
- More than 100,000 SRECs expected to be created in 2012

	Number of Systems	Capacity (MW)
Applications Received	**3,667**	**149.8**
Applications under Review	**452**	**17.9**
Applications Qualified	**3,215**	**131.9**
Qualified but Installation Incomplete	**14**	**8.0**
Qualified and Installed	**3,201**	**123.9**

Current SREC Program Statistics – 10/18/12
Activity by System Size



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Key Highlights

- MA ranks 3rd in commercial installations and 5th in residential installations in 2012
- 2nd lowest weighted average commercial installation costs
- Ranked 2nd in inverter manufacturing
- 340 of 351 MA cities & towns have at least one state supported solar installation
- More capacity has already been installed in 2012 than was installed in all years prior to 2012
- Solar generation as a percentage of the RPS increased by more than 1300% from 2010 to 2011
- Expected to increase by more than 300% in 2012

Sources: SEIA/GTM Research US Solar Market Insight Q2 Report & MA 2011 Annual RPS/APS Compliance Report (not yet published)

Questions

DOER RPS Website: www.mass.gov/energy/rps

RPS Contact: DOER.RPS@state.ma.us

DOER Solar Website: www.mass.gov/energy/solar

SREC Contact: DOER.SREC@state.ma.us