ON-FARM SOLAR PV TRAINING

WEBINAR SERIES

Webinar #1: Maryland's Solar Market

SEP 30, 2020 1:00 PM – 2:00 P.M. (EST)

This module provides an introduction to the various forms of available energy and how solar power fits into the overall mix. Explore solar technology, research, and policy developments which support new and continued opportunities for on-farm solar in Maryland. Topics address the historical development of photovoltaics, the current trends, and future forecasts of the solar market in Maryland. Learn how solar initiatives such as Maryland's energy policy and renewable energy goals are impacting the state.

WEBINAR SCHEDULE

Module #1: Maryland's Solar Market
SEP 30, 2020 1:00 PM – 2:00 P.M. (EST)

Module #2: Solar PV Basics
OCT 7, 2020 1:00 PM – 2:00 P.M. (EST)

Module #3: Solar Planning & Design
OCT 14, 2020 1:00 PM – 2:00 P.M. (EST)

Module #4: Solar Regulations & Zoning
OCT 21, 2020 1:00 PM – 2:00 P.M. (EST)

Module #5: Installation & Maintenance

UNIVERSITY OF MARYLAND EXTENSION

MARYLAND ENERGY EXTENSION

program contact
Drew Schiavone
dschiavo@umd.edu
(301) 432-2767 ext. 342

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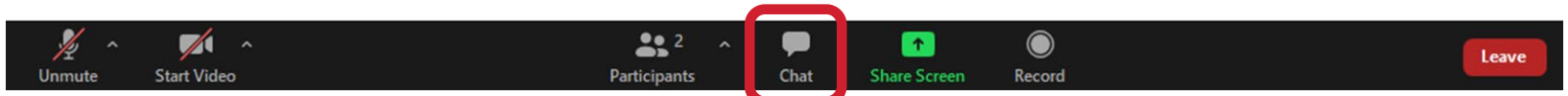
NORTHEAST SARE Sustainable Agriculture Research & Education

ON-FARM SOLAR PV TRAINING

WEBINAR SERIES

ZOOM INSTRUCTIONS



Questions

RECORDING

POLL

Session Topics

Energy Sources

- primary energy sources & conversion
- total energy reserves
- renewable and nonrenewable
- thermal & electric solar
- photovoltaic progress

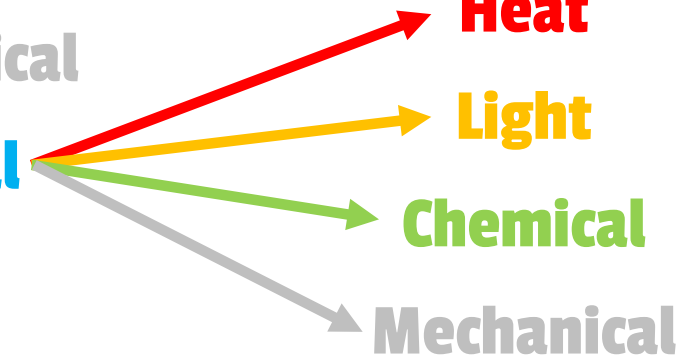
Solar Market

Farm Applications

Energy Sources

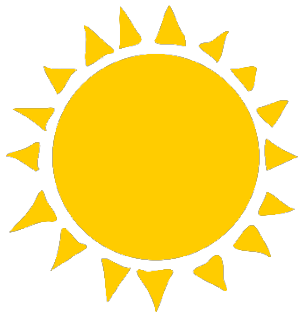
Forms of Energy

- Heat
- Light
- Chemical
- Mechanical
- Electrical



Chemical

Heat & Light



Light

Chemical

Energy Sources

PHOTOSYNTHESIS

Biogenic
Resources

CHEMICAL

Biofuels

HEAT + PRESSURE + TIME

Fossil Fuels
coal
oil
natural gas

Heat & Light
Resources

INDIRECT USE

Weather
wind
waves
precipitation
flowing water

DIRECT USE

Photovoltaics
or
Solar Thermal

Energy Sources

EARTH

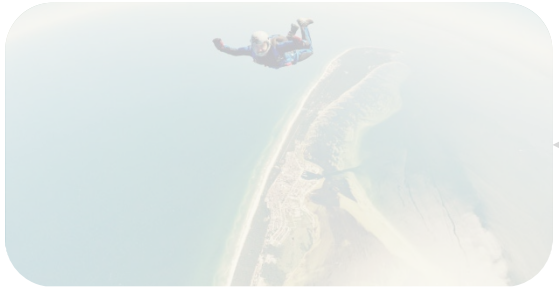
URANIUM

TIDAL

MOON ORBIT

HEAT

GEOTHERMAL

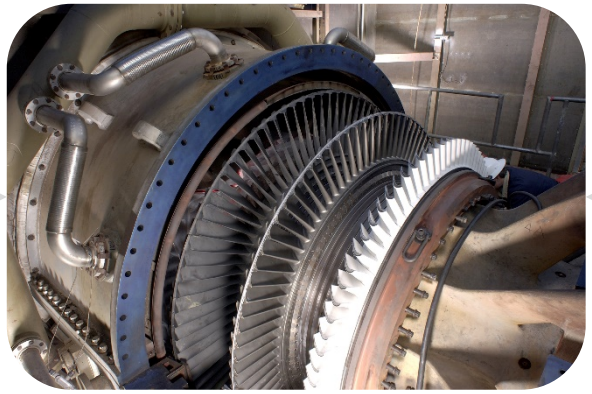


GRAVITY

SUN ORBIT

Energy Sources

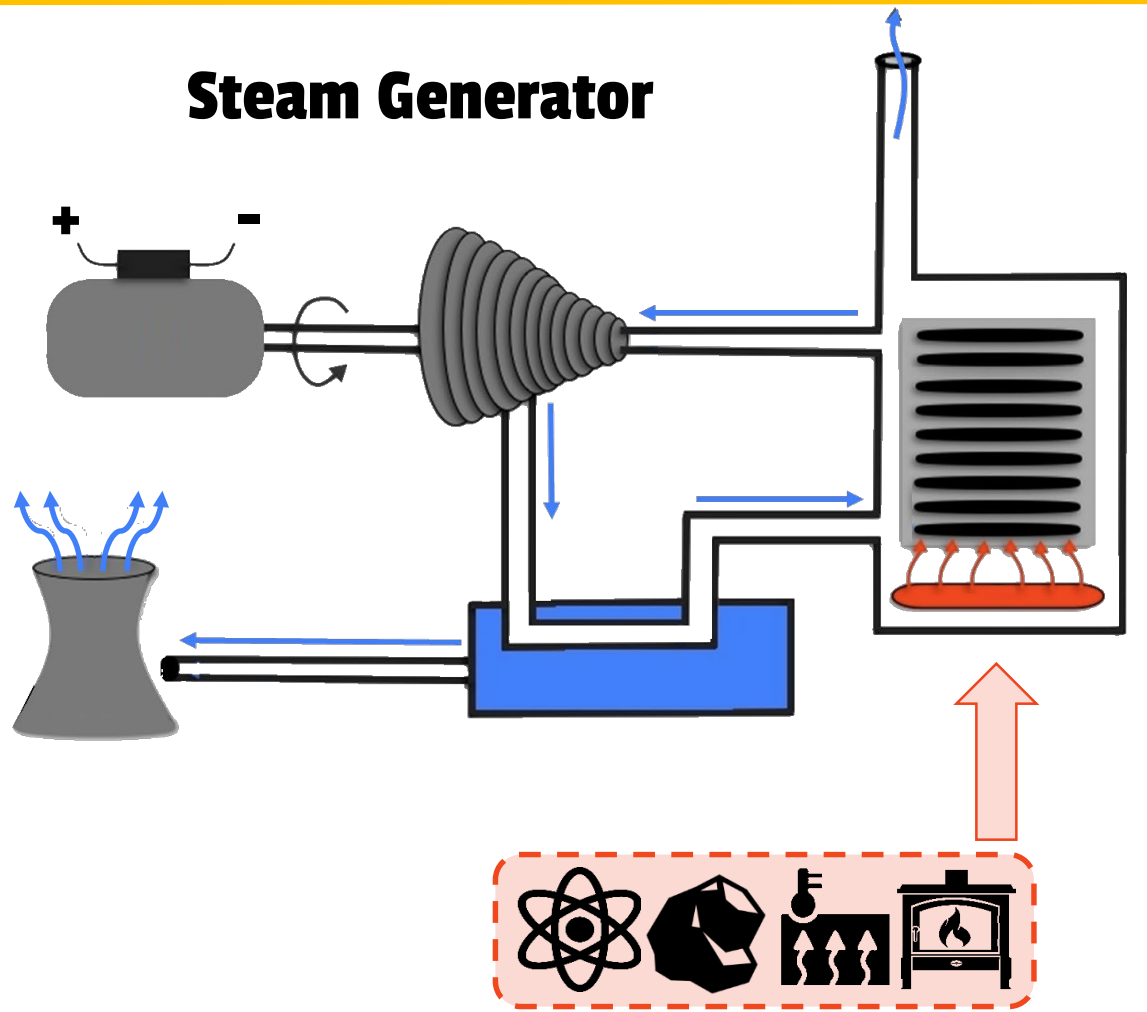
TURBINE



WIND

HYDRO

Steam Generator

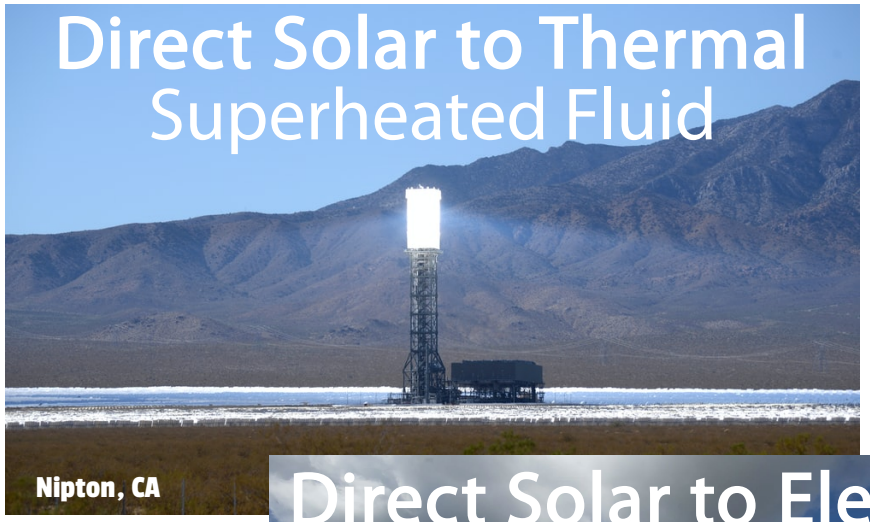


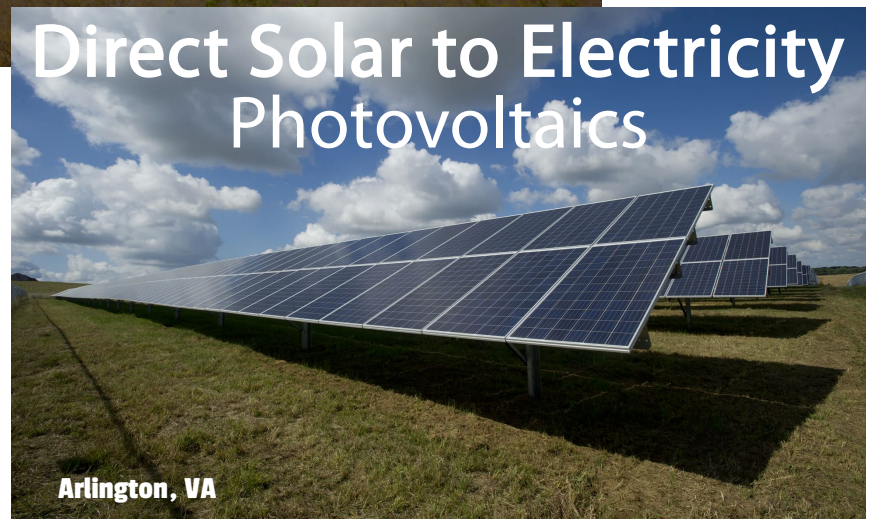
Energy Sources

Dispatchable

Non-Dispatchable

ENERGY SOURCES





Solar Energy Potential

World Energy Use	TWy/y
2015	18.5
2050	28

Finite	TWy
Coal	830
Petroleum	335
Natural Gas	220
Uranium	185+

Renewables	TWy/y
Solar	**23,000**
Wind	75 – 130
OTEC	3 – 11
Biomass	2 – 6
Hydro	3 – 4
Geothermal	0.2 – 3.0+
Waves	0.2 – 2.0
Tidal	0.3

Perez, M., & Perez, R. (2015). Update 2015--A Fundamental Look at Supply Side Energy Reserves for the Planet. *Natural Gas*, *2*(9), 215.

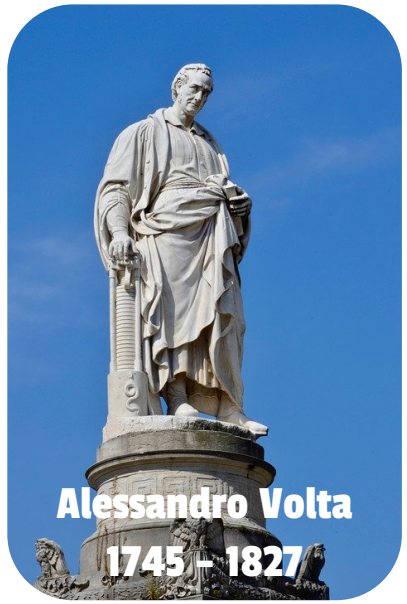
SOLAR ENERGY

Photovoltaic

PHOTO → **LIGHT**

TO

VOLTAIC → **ELECTRICITY**



PV Effect Observed
1839 Alexander Becquerel
1887 Heinrich Hertz
1905 Albert Einstein

Silicon Cell Invented
1954 Bell Labs (NJ)

Solar PV in Space
1958 Vanguard 1 satellite

Remote Operations
1970 Railroads/Road Signs
1973 "Solar One" (UD)

Low-Cost Solar
1972 Wristwatch
1978 Calculators

Session Topics

Energy Sources

Solar Market

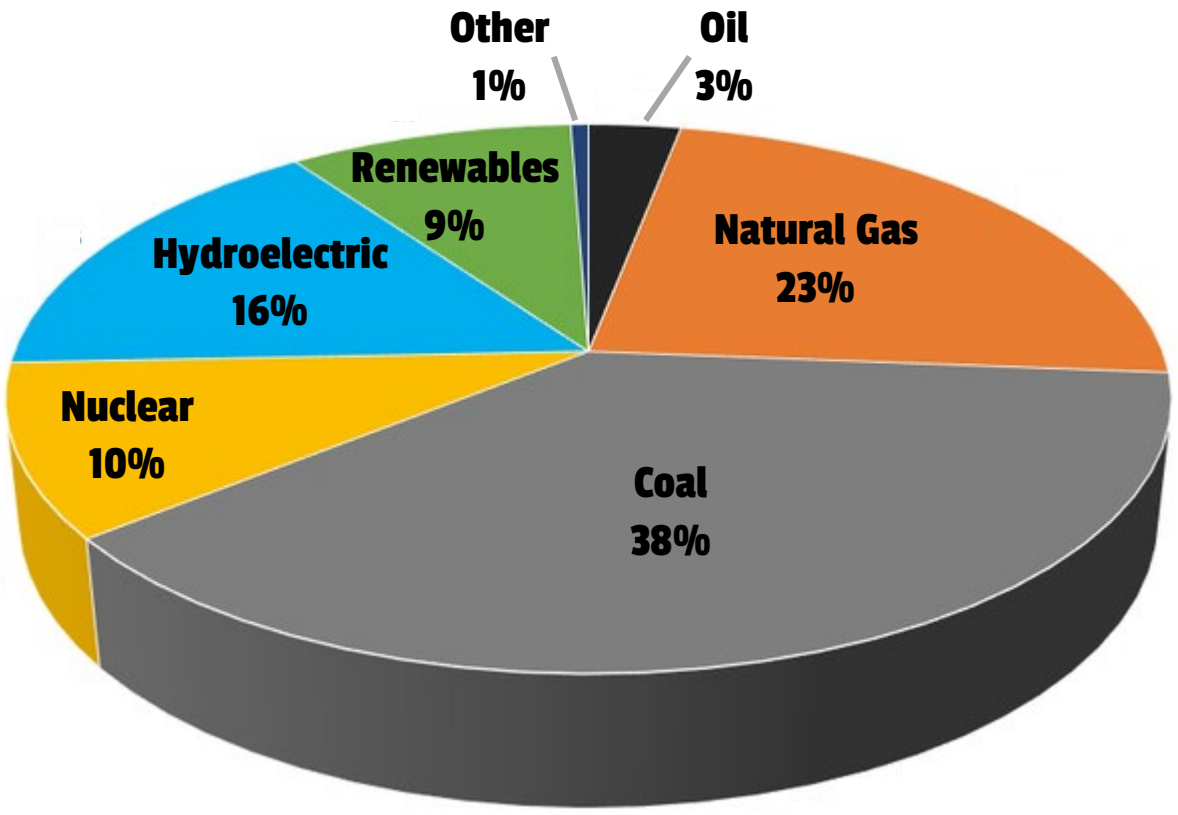
- market share & growth potential
- current trends & future forecasts
- economic & policy drivers
- applications and PV use sector

Farm Applications

Energy Trends

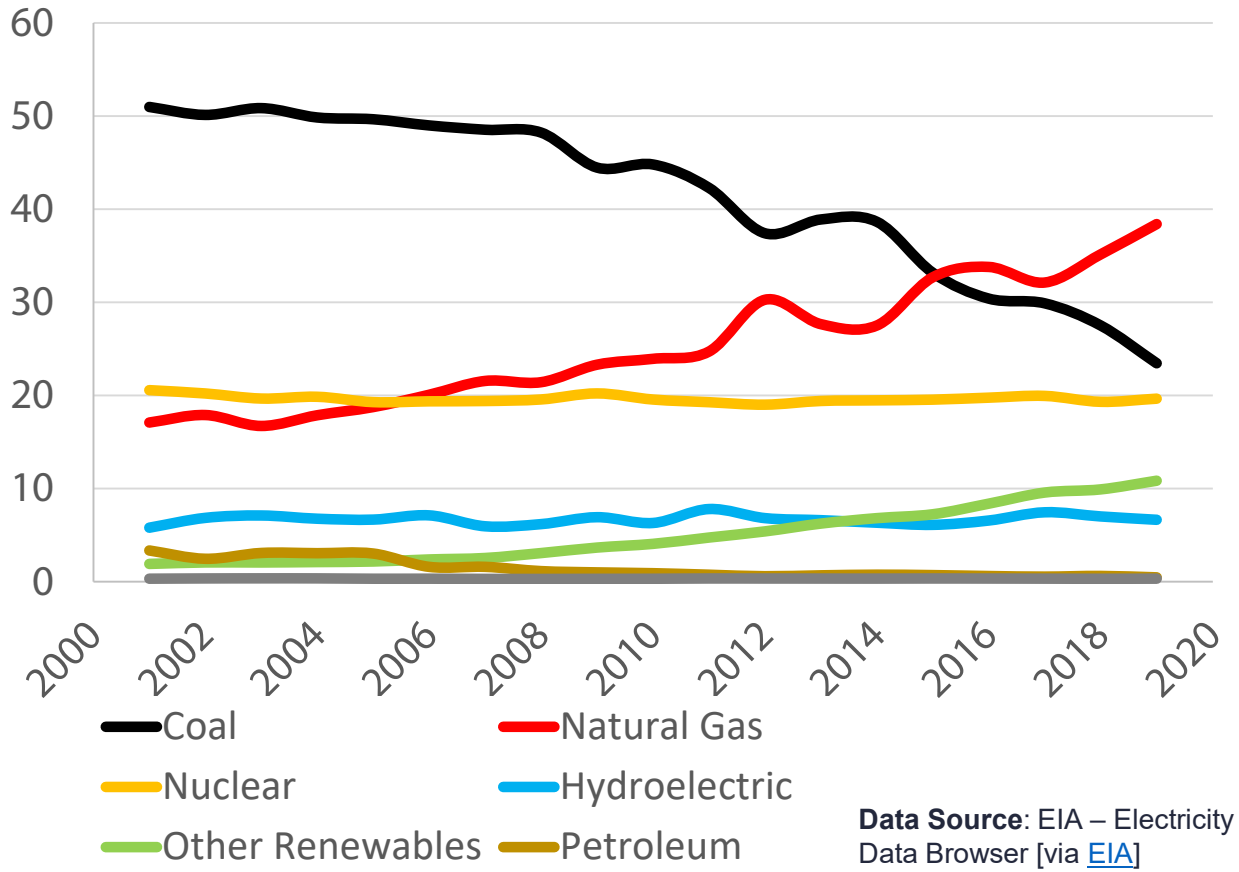
Electricity Generation

Global Share



Electricity Net Generation

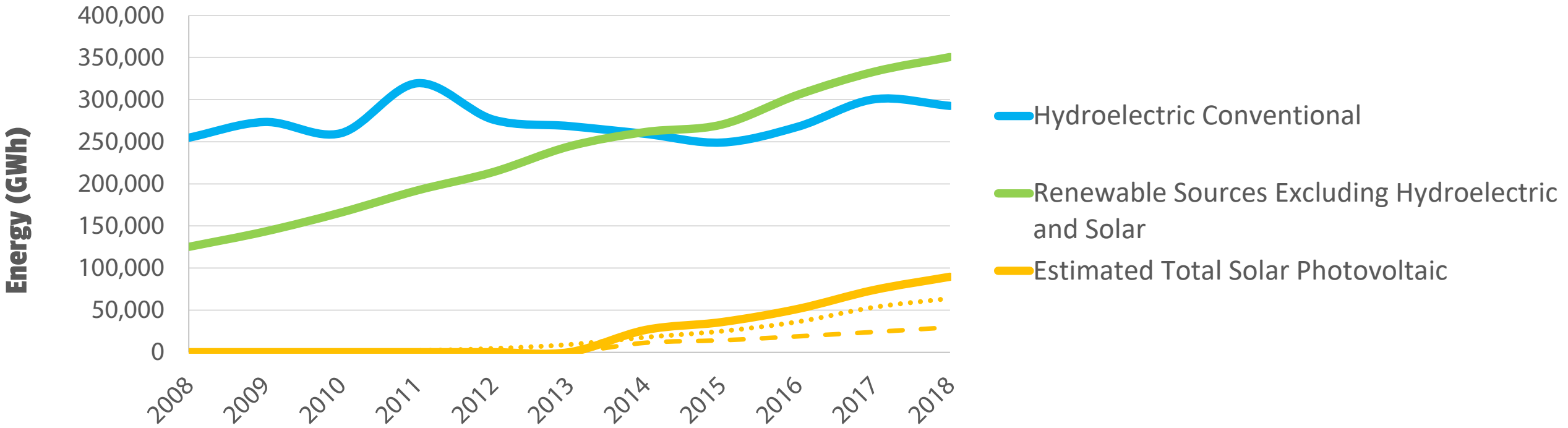
US by Fuel Source



Data Source: EIA – Electricity Data Browser [via EIA]

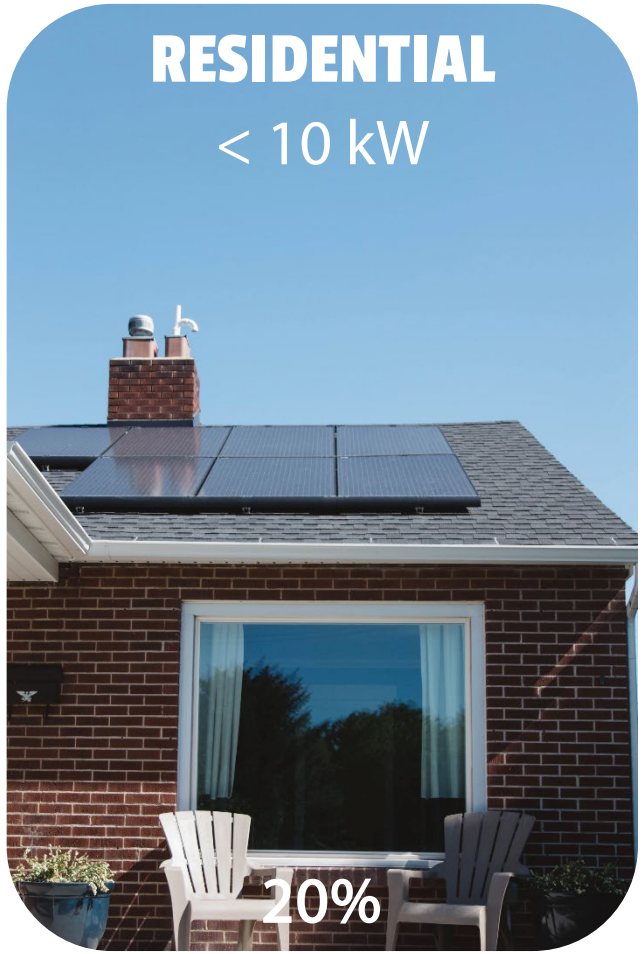
Energy Trends

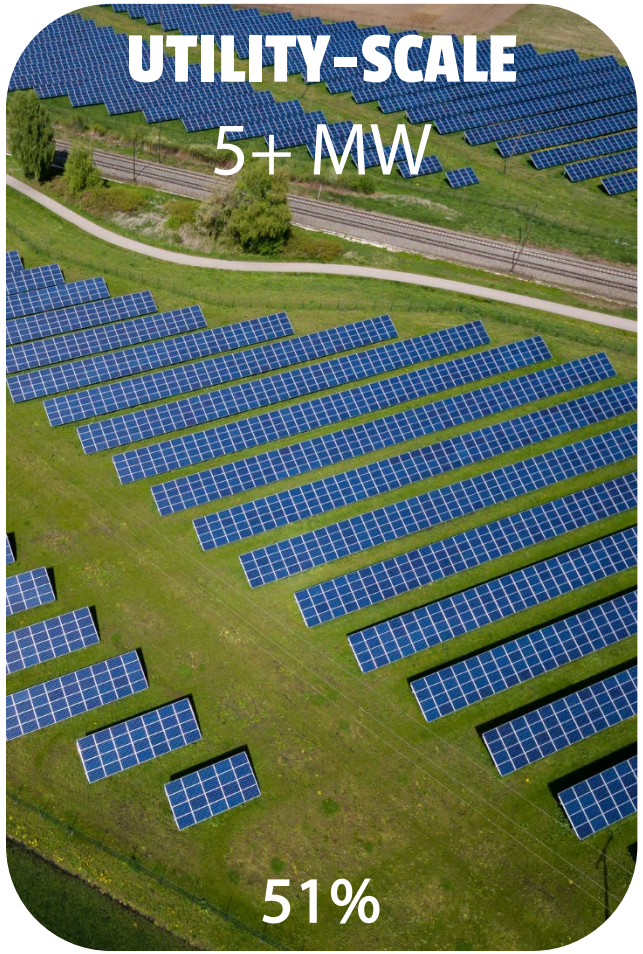
US Renewable Electricity Net Generation



Data Source: U.S. EIA, Electric Power Annual [via EIA]
Data Source: NREL, Renewable Electricity Futures Study [via NREL]

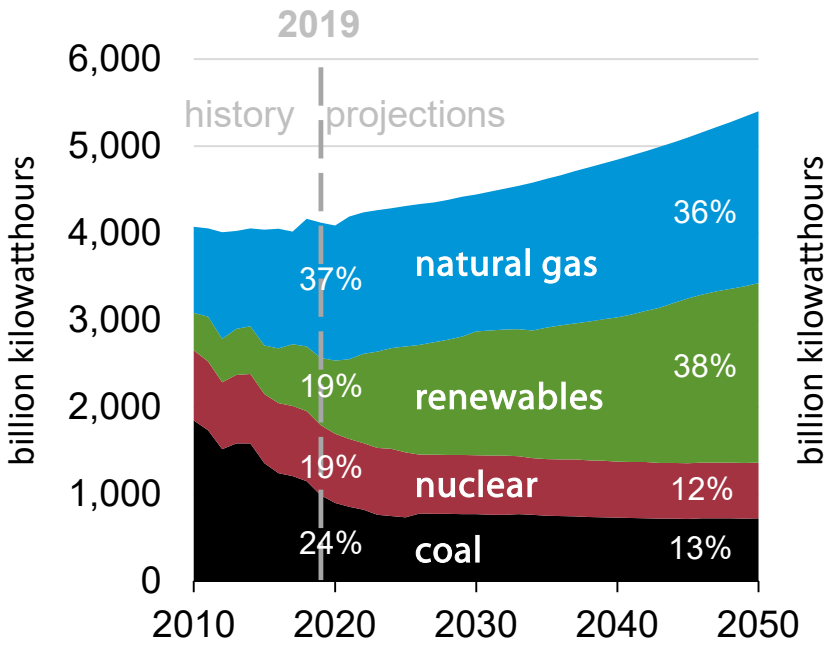
Energy Trends



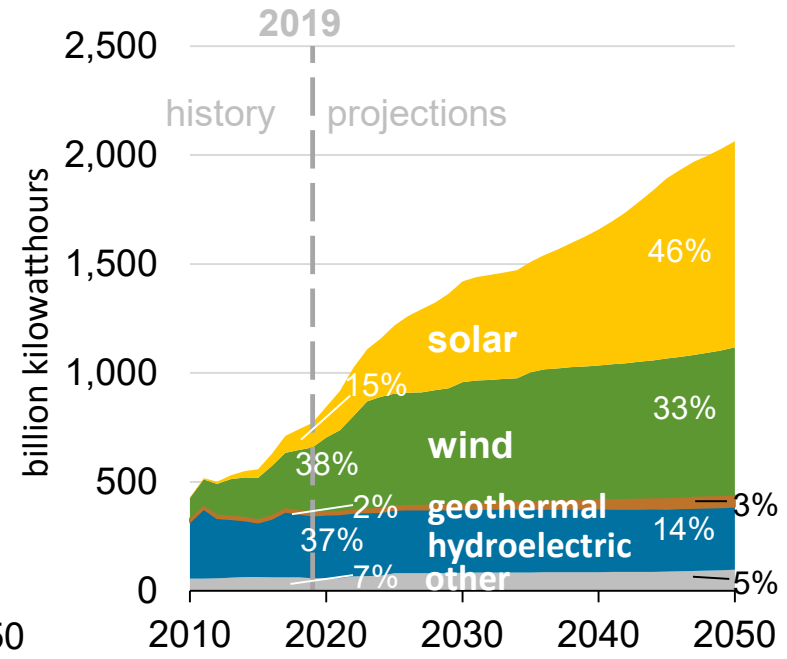


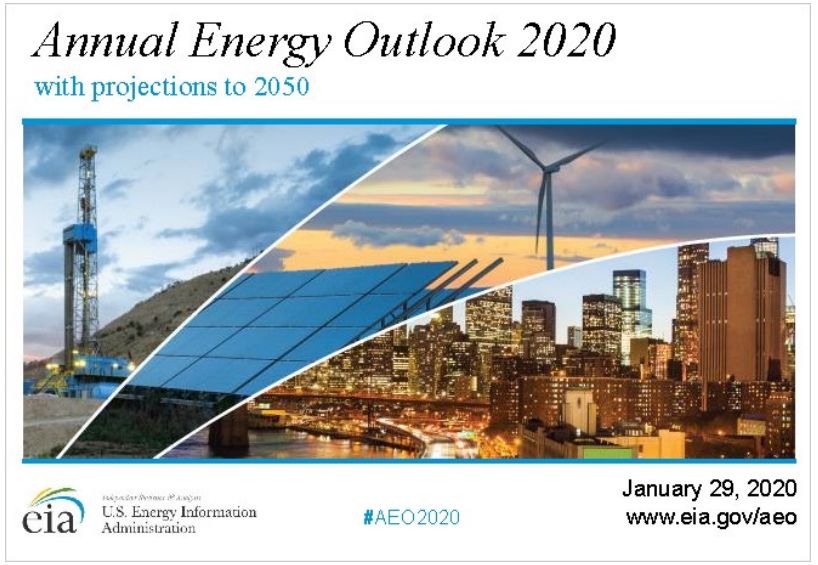
Energy Trends

Electricity Generation
from selected fuels



Renewable Electricity Gen
from selected fuels





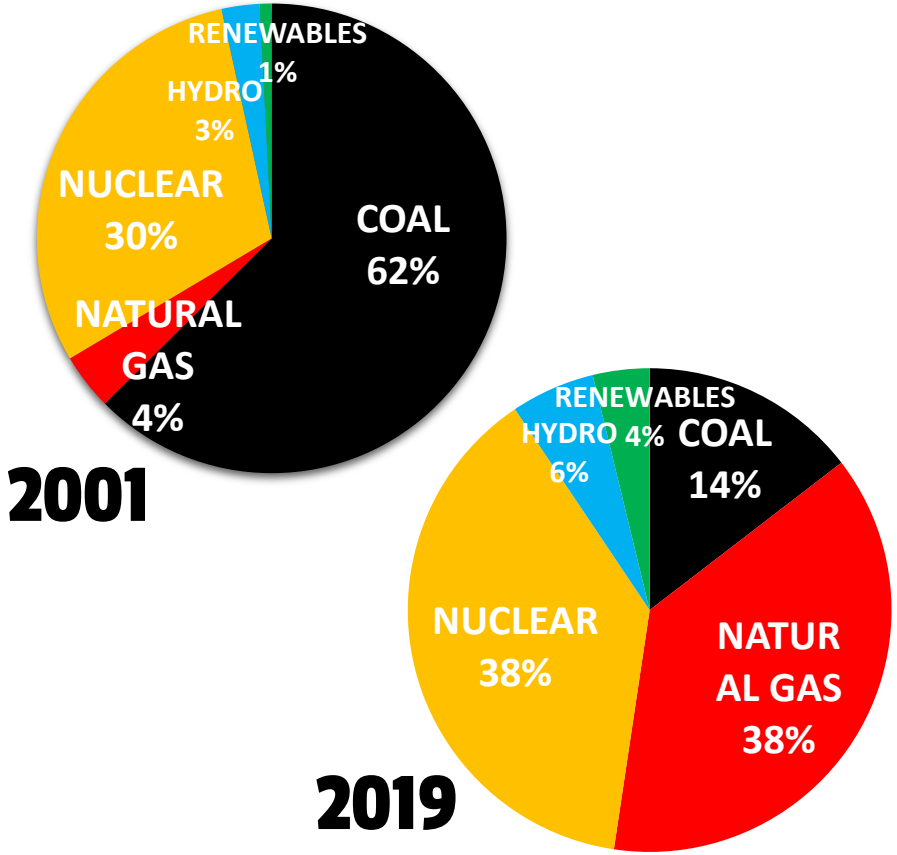
US ENERGY PRODUCTION

- Modest growth in electricity demand
- Retirements of older, less efficient fossil fuel units
- Near term availability of renewable energy tax credits
- Continued decline in capital cost of renewables, especially solar PV

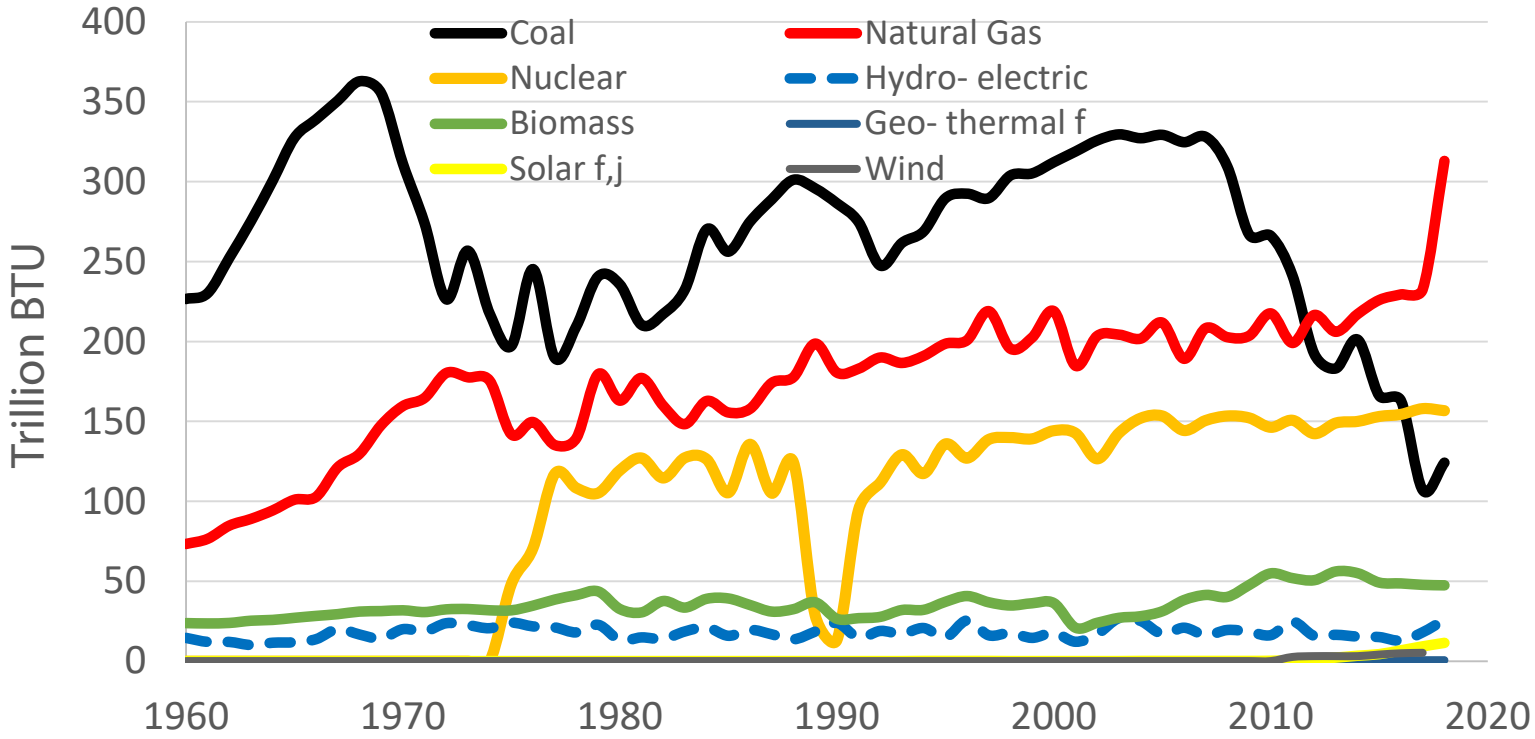
U.S. EIA, Annual Energy Outlook 2020 [via EIA]

Energy Trends

Maryland's Net Electricity Generation



Maryland's Energy Consumption



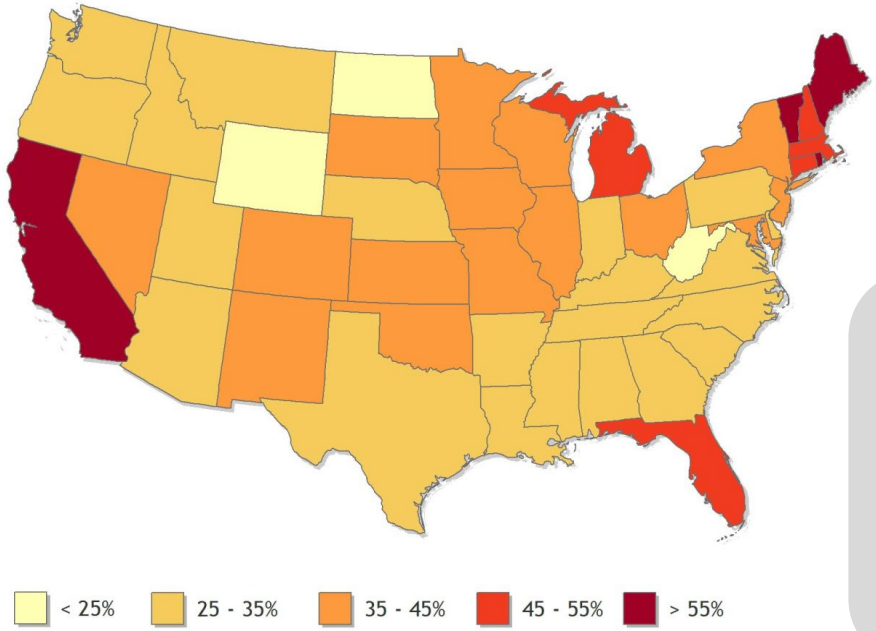
Data Source: EIA. Electricity Data Browser: Table CT2. Primary Energy Consumption Estimates, 1960-2018, Maryland (Trillion Btu) [via EIA]

Energy Trends

Potential Rooftop PV Generation

from all buildings

% of each state's total electricity sales (2013)



NREL. (2016). Rooftop Solar Photovoltaic Technical Potential in the United States: A Detailed Assessment [via NREL]

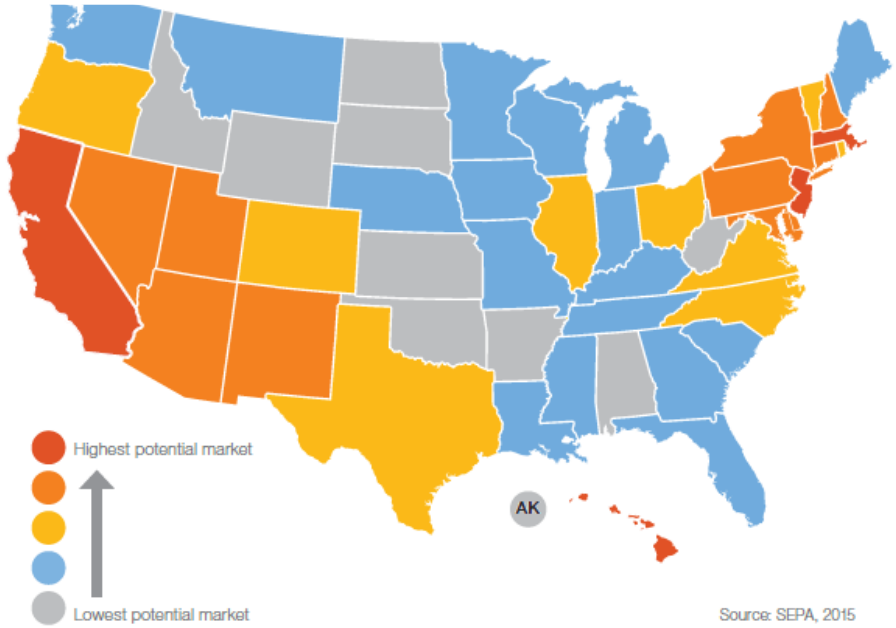
Solar capacity is be driven by:

1. solar irradiance
2. incentives & policies
3. retail electricity rates (*high avoided cost rate*)

Residential Potential Solar Market

residential

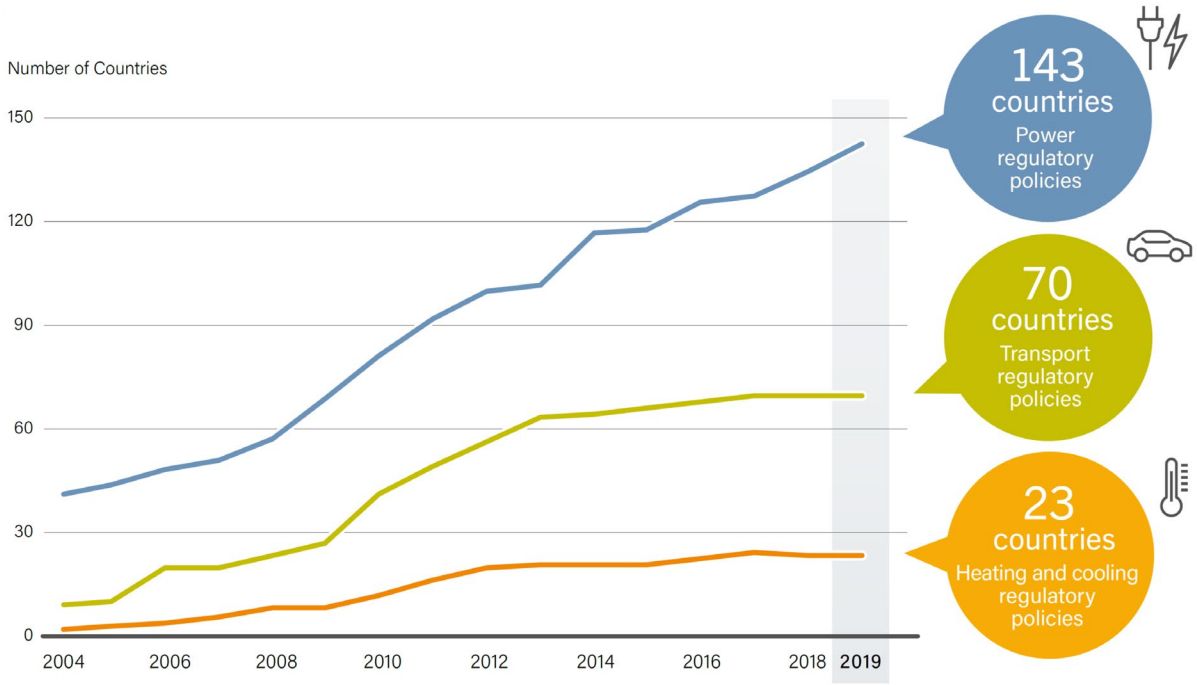
based on solar capacity, retail rates, & incentives/policies



SEPA. (2015). Solar Fundamentals Volume 2: Markets [via SEPA]

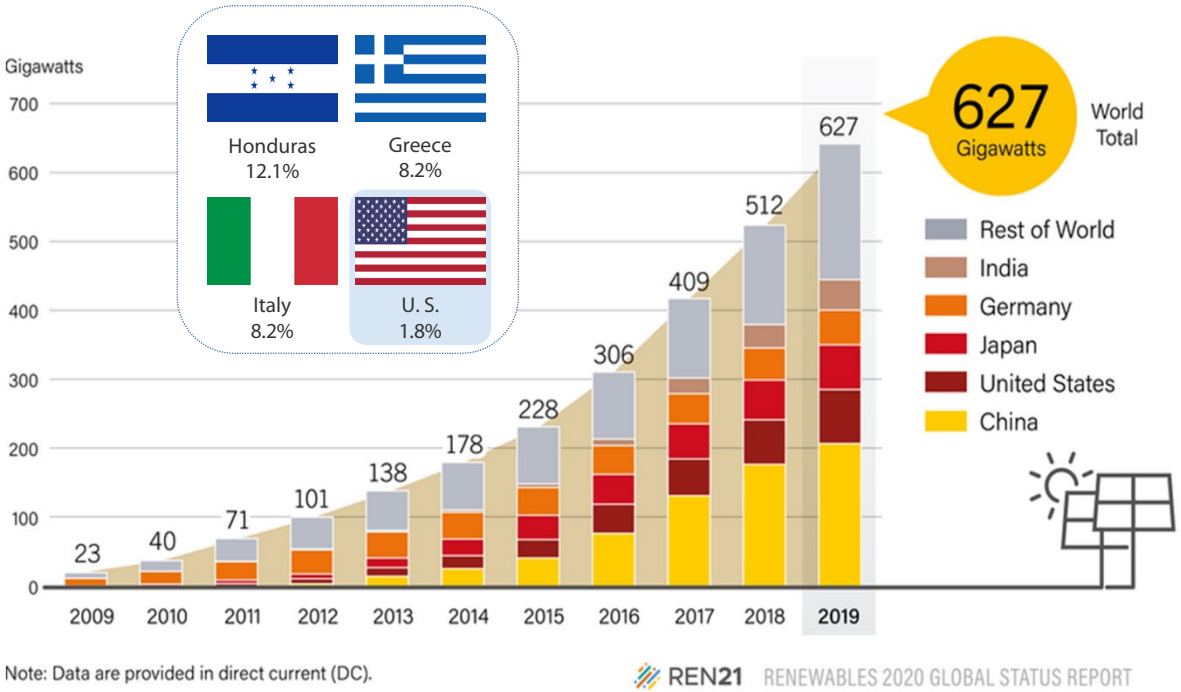
Energy Policy

Number of Countries
with Renewable Energy Policies



Renewables 2020 Global Status Report [via REN21]

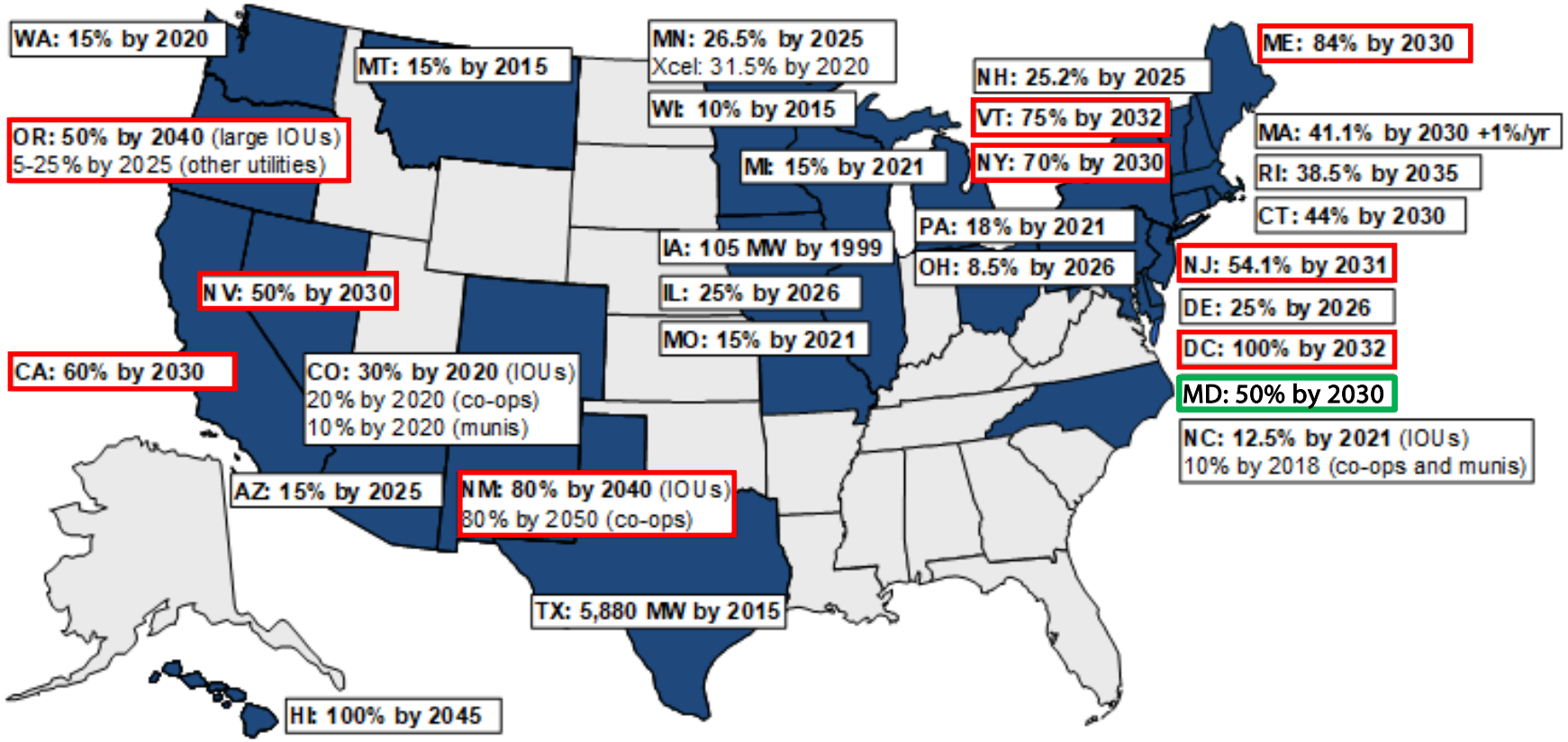
Solar PV Global Capacity
by country & region



REVE. (2019). In 2019 the solar PV market increased an estimated 12% to around 115 GW. *Evwind*. [evwind]

Energy Policy

Renewable Portfolio Standard (RPS)

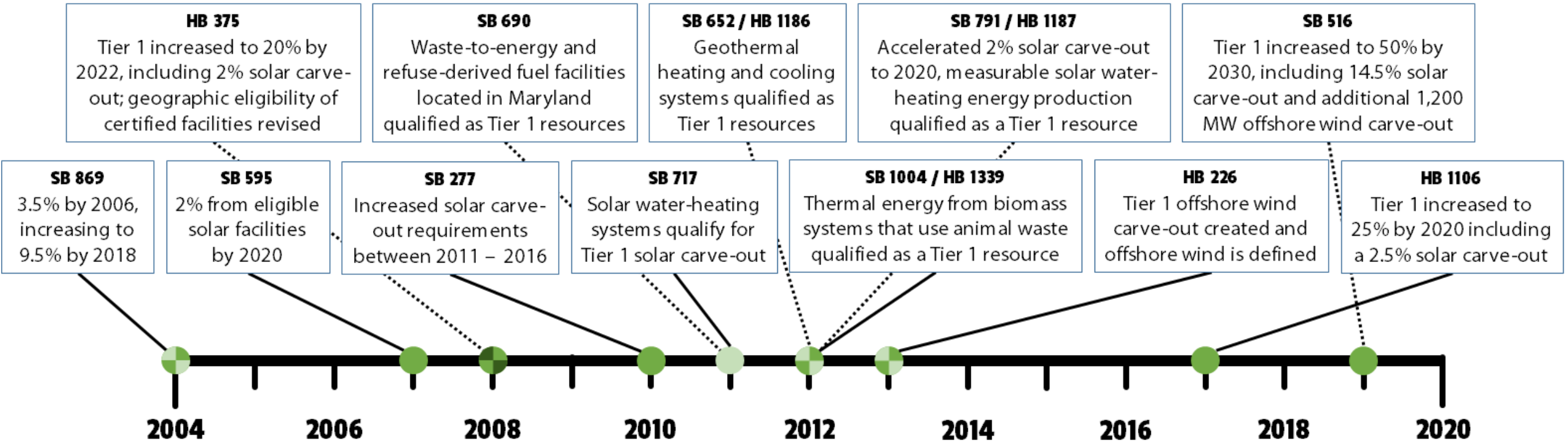


What is an RPS?

- Regulatory, state-level mandates to increase energy production from renewable sources.
- "Solar Carve-Outs" mandate a portion of RPS come from solar (*may give rise to SREC markets*)

Barbose, G.L. (July 2019). U.S. Renewables Portfolios Standards: 2019 Annual Status Update [via Berkeley Lab]

Energy Policy

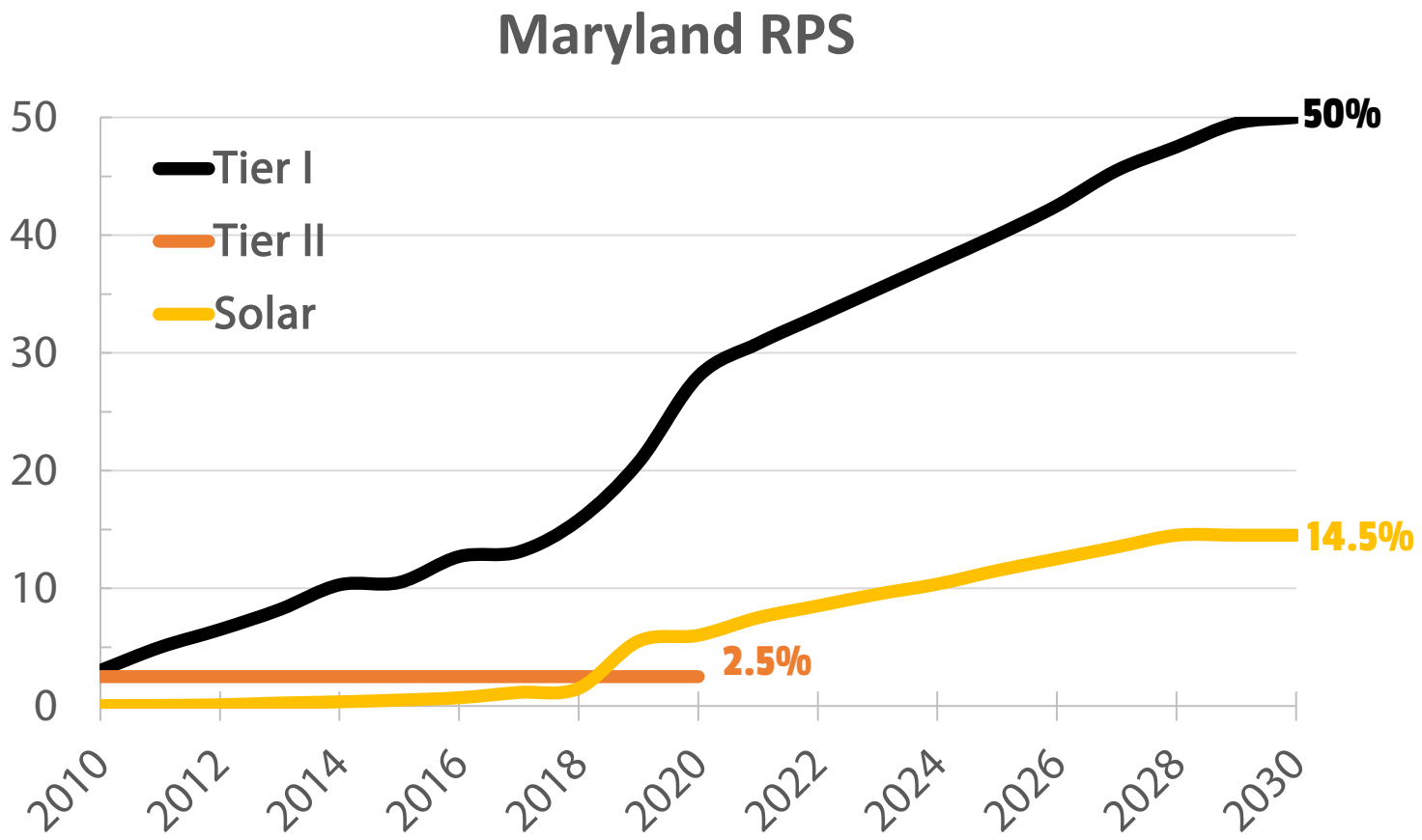


RPS Component Addressed

- Percentage Requirement
- Region Eligibility
- Resource Eligibility
- Multiple Components

Adapted from: Maryland Department of Natural Resources. (2019). Final Report Concerning MD RPS, Figure ES-1 [via MD DNR]

Energy Policy

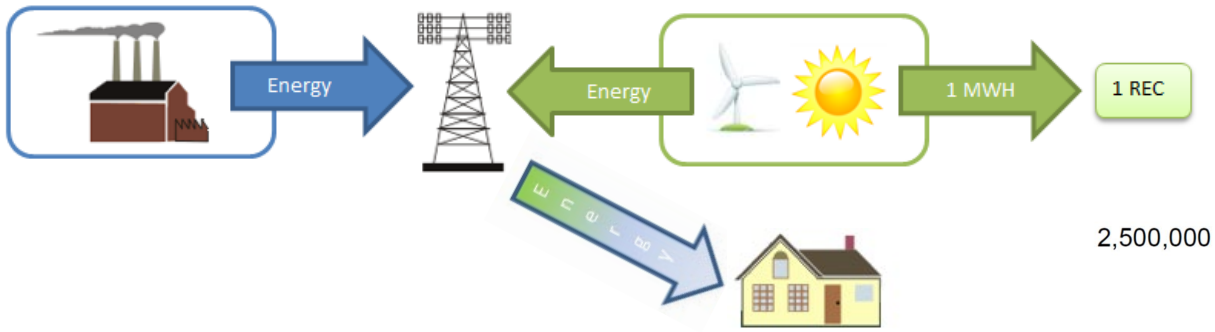


TIER I	
Solar	Geothermal
Wind	Ocean
Qualifying Biomass (*cultivated plant, waste*)	Small Hydroelectric Plant (*less than 30 MW*)
Methane (*landfill or WWTM*)	Fuel Cell (*methane or biomass*)
Poultry Litter Incineration (*in Maryland*)	Waste-to-Energy (*in Maryland*)
Thermal Systems ‡ (*Geothermal & Biomass*)	

TIER II
Hydroelectric Power (*other than pumped storage generation*)

More Information: Maryland Public Service Commission [via PSC.STATE.MD.US]

Incentives

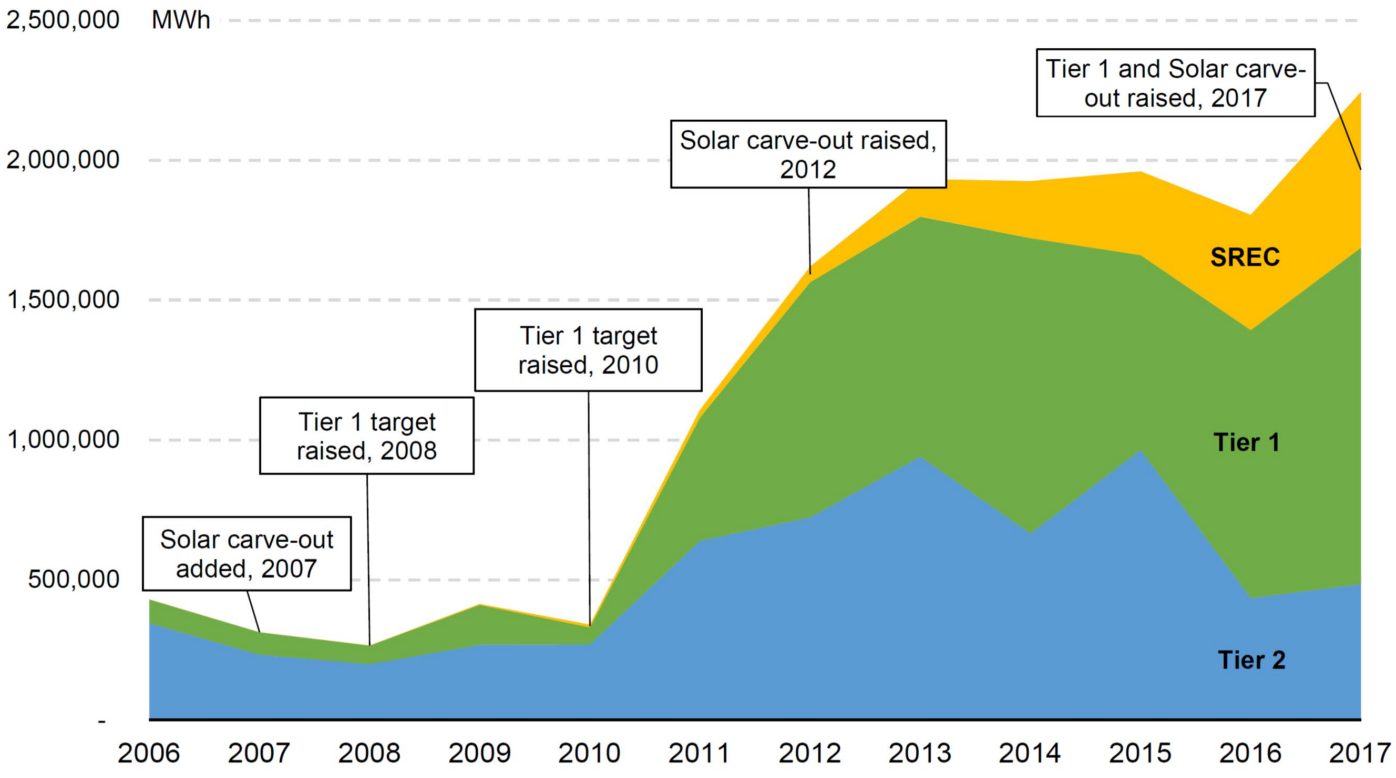


What is an SREC?

- serves as "proof" that 1 MWh of solar energy was generated
- can be purchased separate from electrical service
- Utilities purchase "credits" from solar producers to demonstrate RPS compliance

Solar Renewable Energy Credit (SREC)

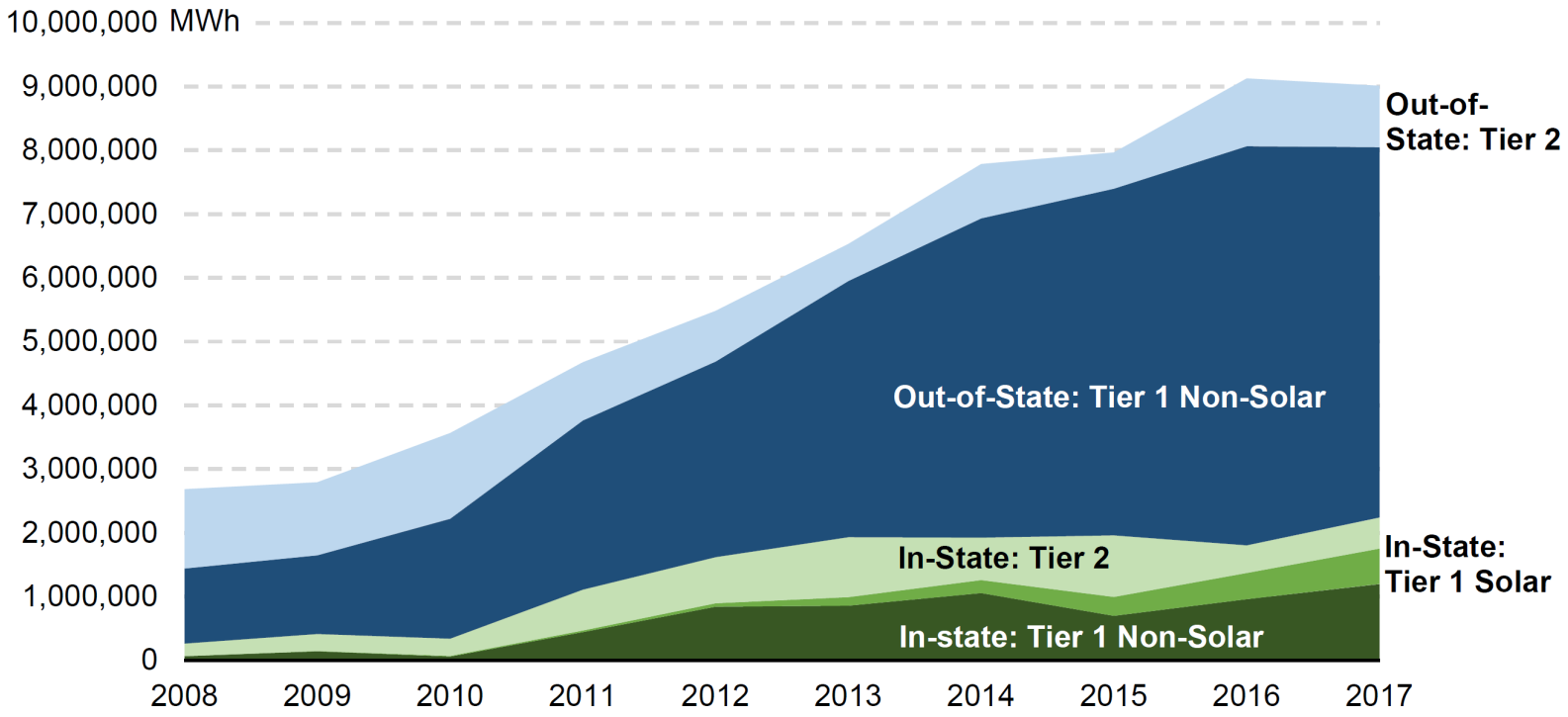
RECs Retired in Maryland for RPS Compliance



Final Report Concerning the Maryland Renewable Portfolio Standard. (December 2019). PPES-MRPS-2019, DNR Publication No. 12-091619-167 [via MD DNR]

Incentives

Maryland REC Retirement



Final Report Concerning the Maryland Renewable Portfolio Standard. (December 2019). PPES-MRPS-2019, DNR Publication No. 12-091619-167 [via MD DNR]

SREC Pricing / MWh

September 29, 2020

DC	$	430.00
MA	$	282.00
NJ	$	230.00
MD	$	79.00
PA	$	20.00
OH	$	9.00

https://srectrade.com

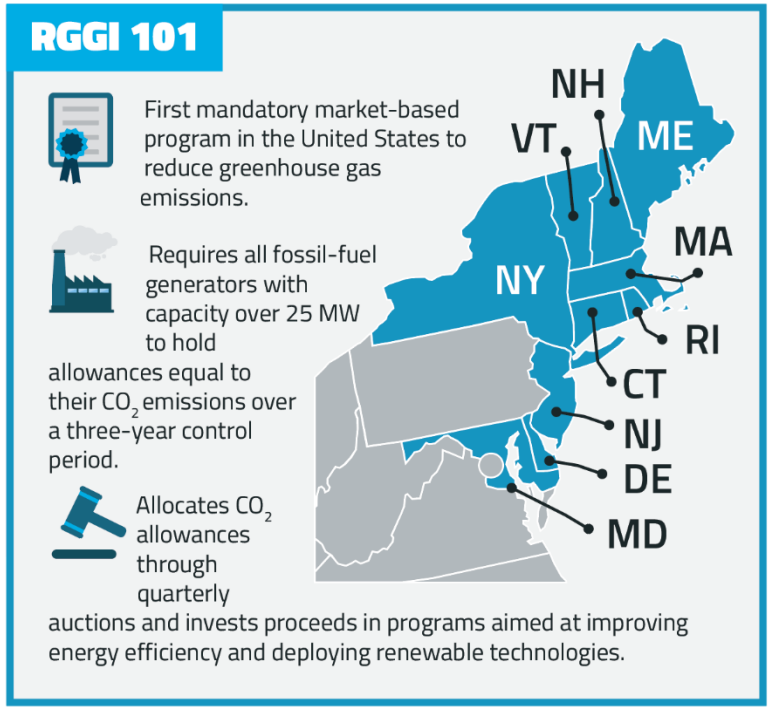
More Information: Public Service Commission of Maryland. (December 2019). Renewable Energy Portfolio Standard Report [via MD PSC]

Energy Policy

Greenhouse Gas Emissions Reduction Act (GGRA)

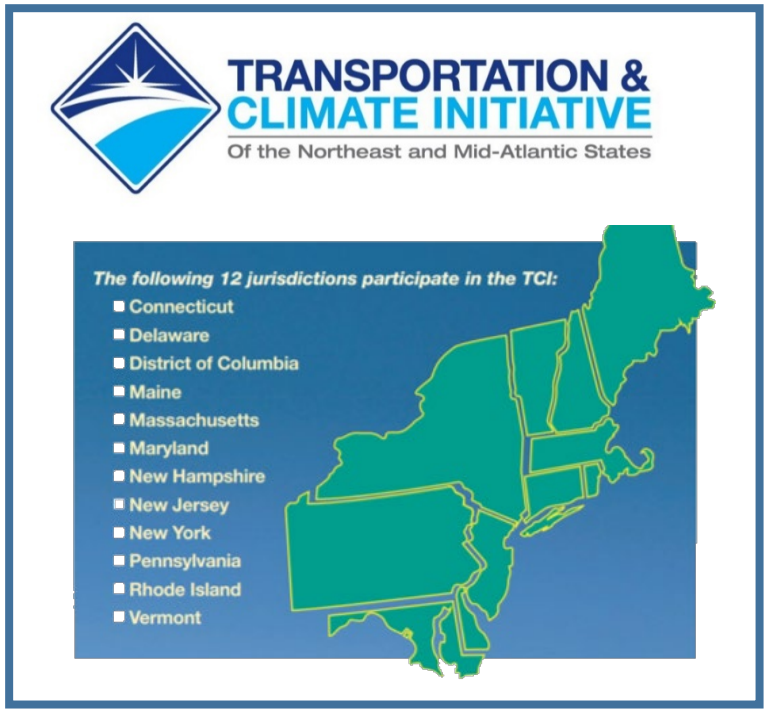
More Information: Greenhouse Gas Emissions Reduction Act (GGRA) [via [MD Dept of Environment]]

Regional Greenhouse Gas Initiative (RGGI)



More Information: Regional Greenhouse Gas Initiative (RGGI) in Maryland [via [MD Dept of Environment]]

Transportation & Climate Initiative (TCI)

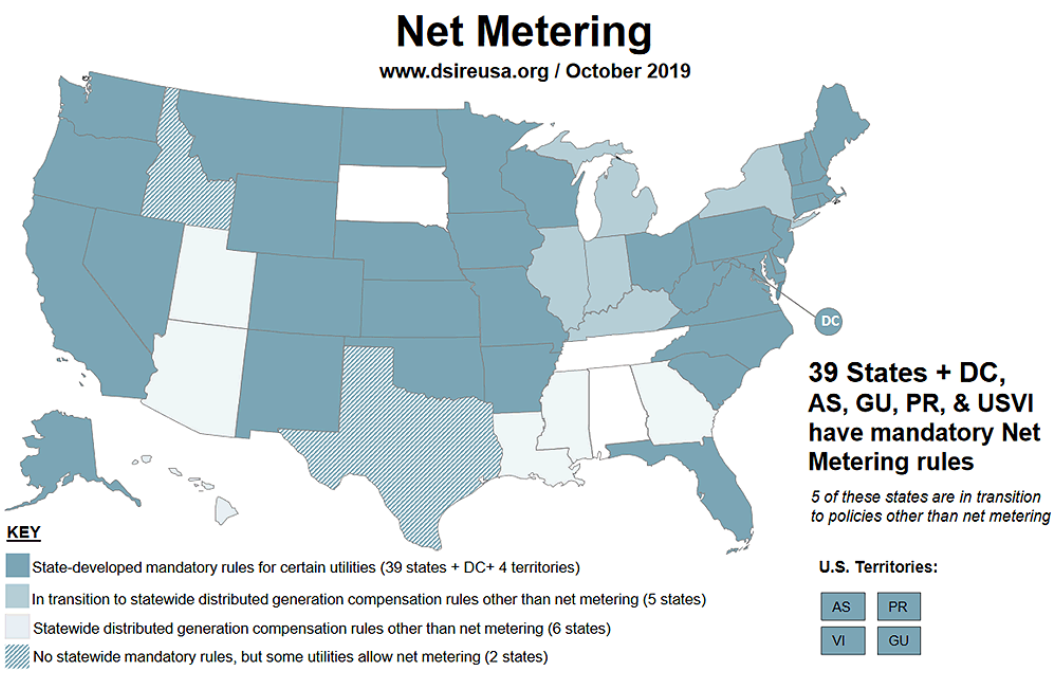


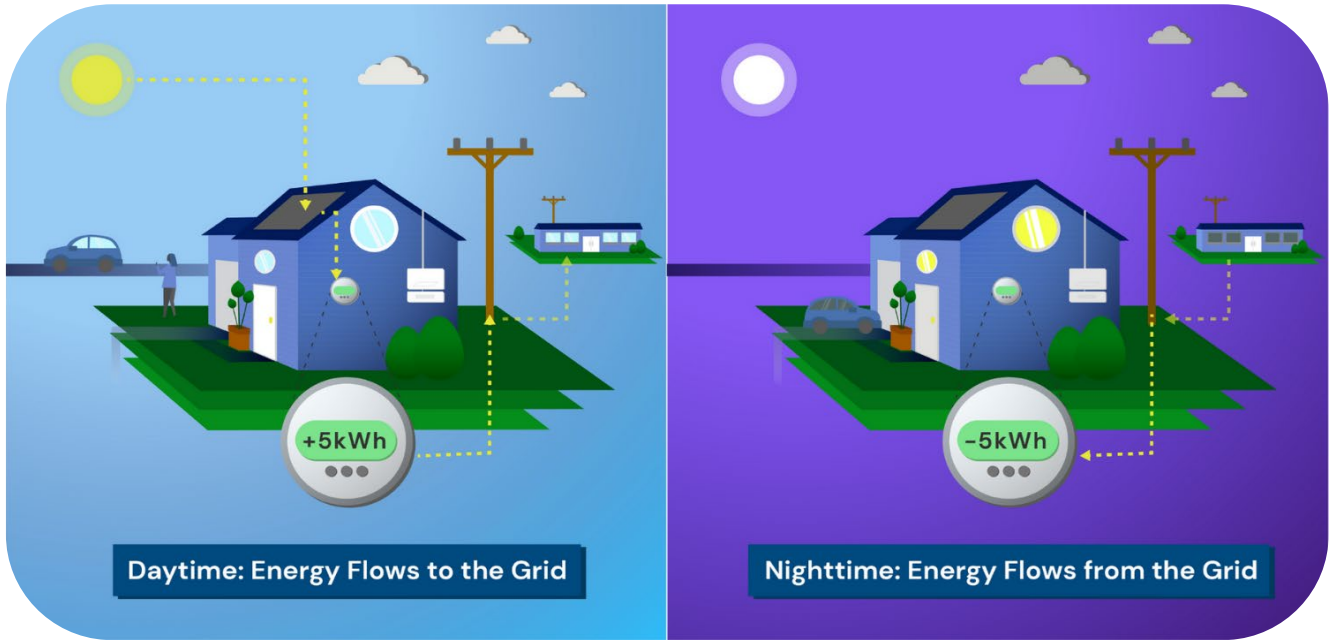
More Information: Transportation & Climate Initiative [via [TransportationAndClimate.org]]

Incentives

What is Net Metering?

- Billing mechanism to virtually "bank" your unused generation, in exchange for kWh and/or financial credits.





Monthly Electric Bill = **Amount Electricity Used** − **Amount Electricity Produced**

Incentives

Investment Tax Credit (ITC)

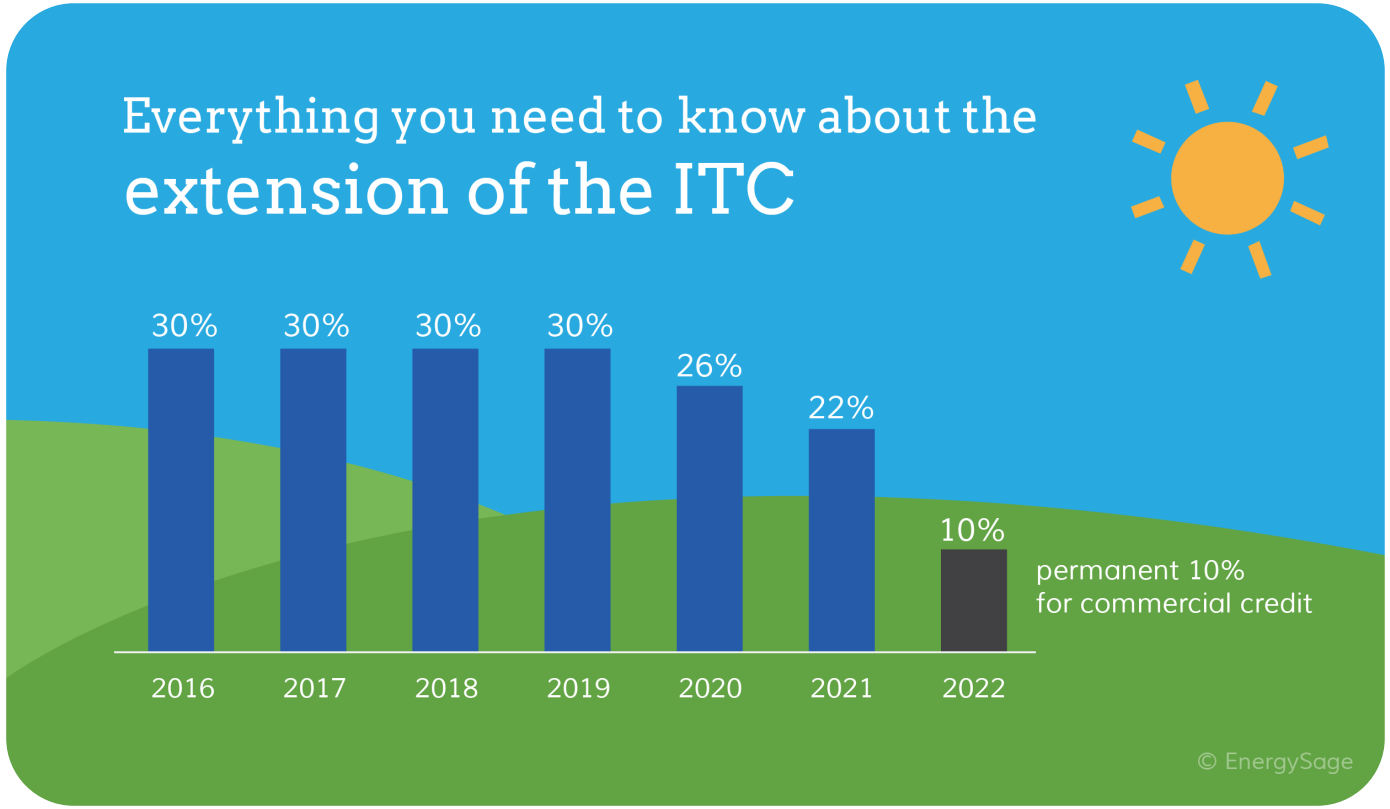
- Congress enacted the Energy Policy Act of 2005 that included the non-refundable tax credit valued at 30% of the installed cost of a solar generator

Maryland Energy Storage Income Tax Credit

- energy storage systems on residential or commercial property in MD during Tax Year 2020
- $750,000 in certificates awarded each tax year (*first come, first serve basis; currently 75.4% awarded*)
- Current law authorization for 2020, 2021, 2022

Maryland Energy Administration

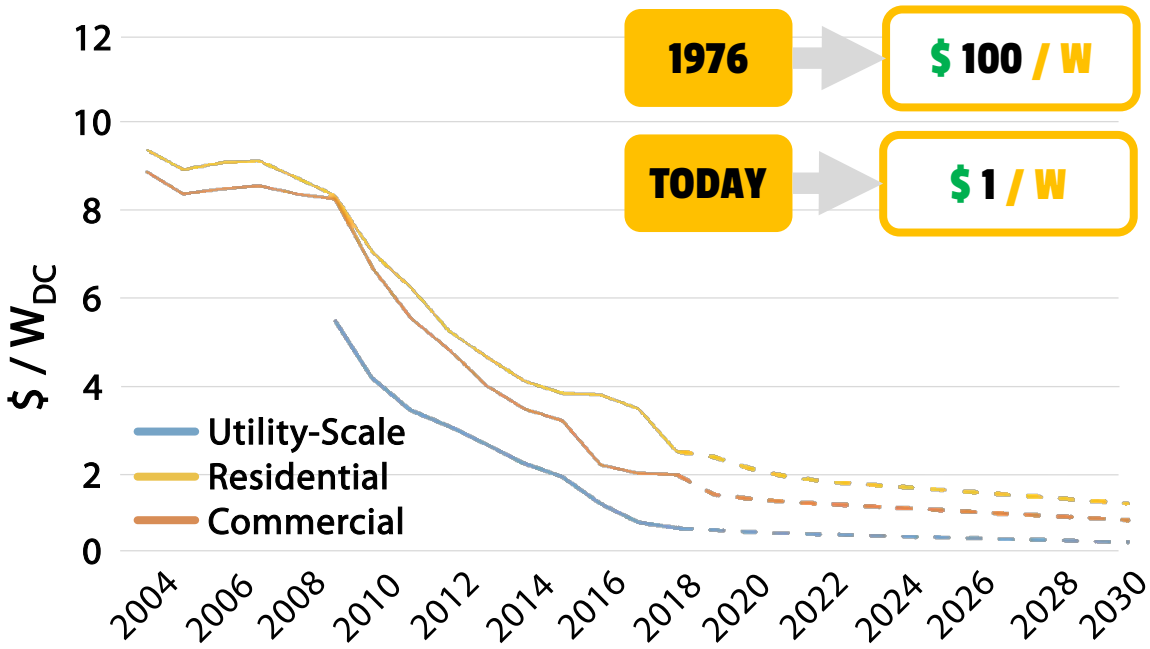
More Information: Maryland Energy Storage Income Tax Credit - Tax Year 2020. [via **Maryland Energy Administration (MEA)**]



More Information: Solar tax credit – everything you need to know about the federal ITC for 2020. (January 2020). [via **ENERGYSAGE**]

Economics

U.S. Solar Installed Costs



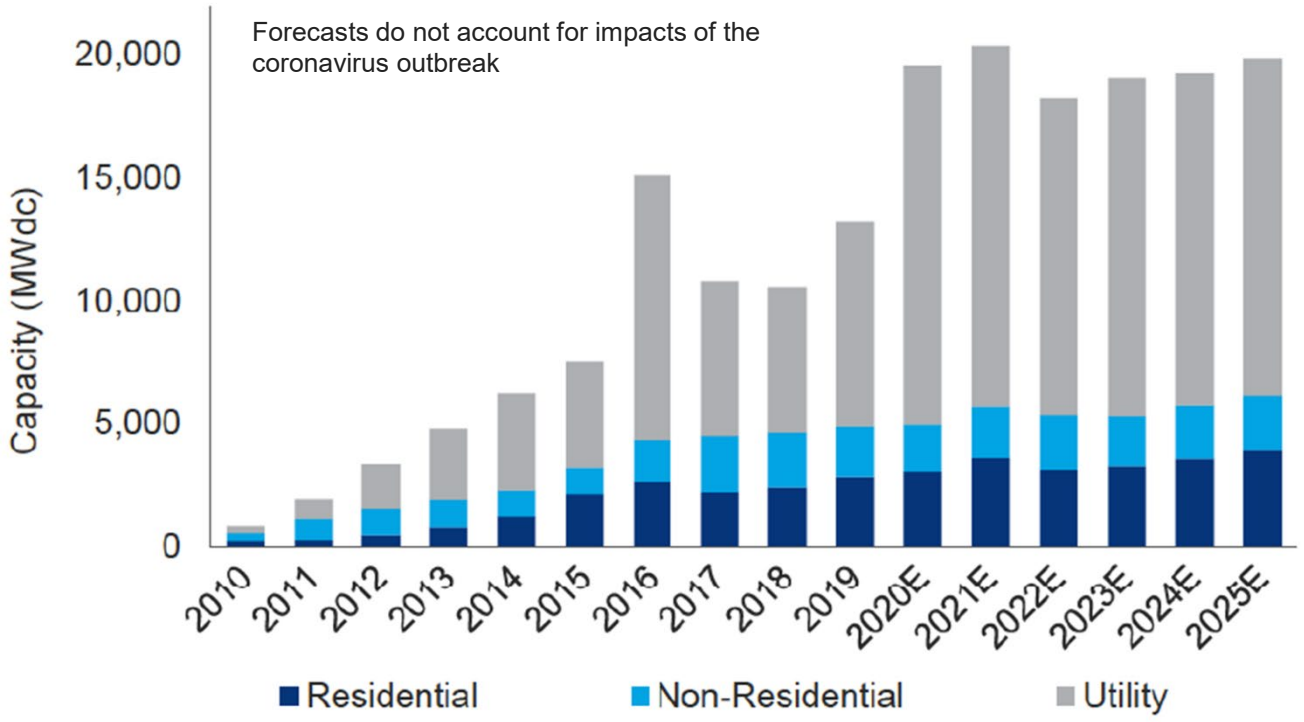
Levelized Costs

Data Source: MIT Future of Solar Energy Study

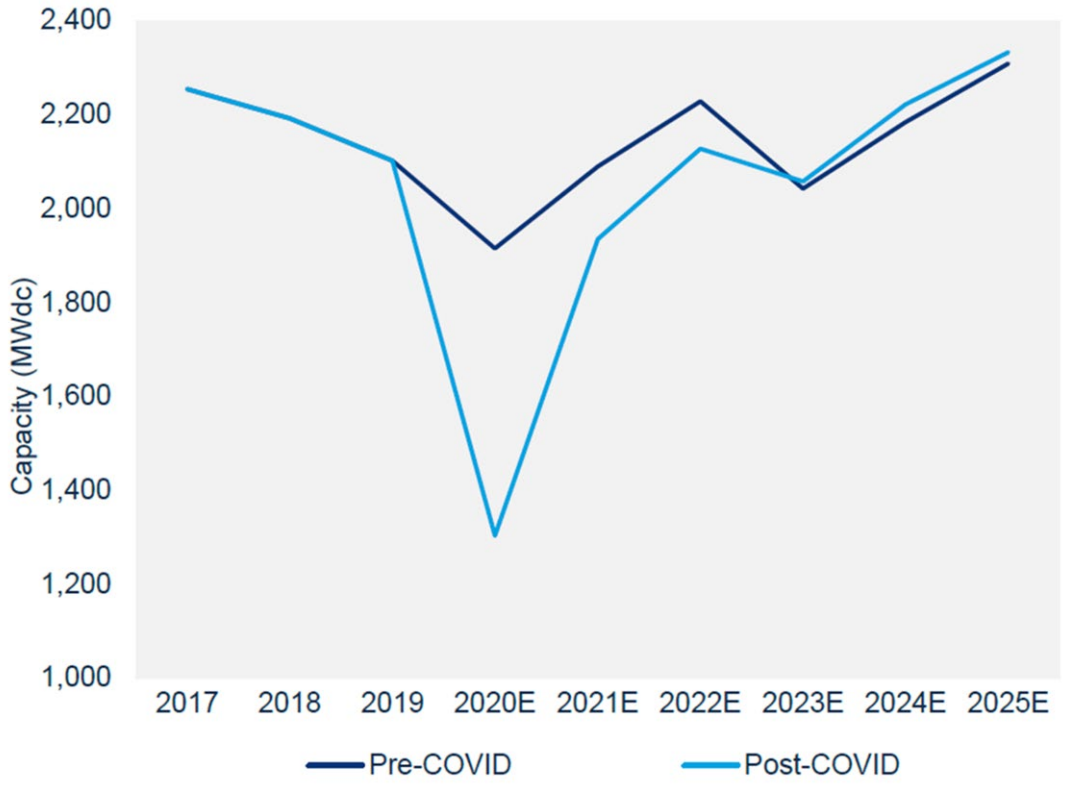
Lazard. (2018). Levelized Cost of Energy and Levelized Cost of Storage 2018 [lazard.com]

Solar Growth

Annual U.S. Solar PV Installations



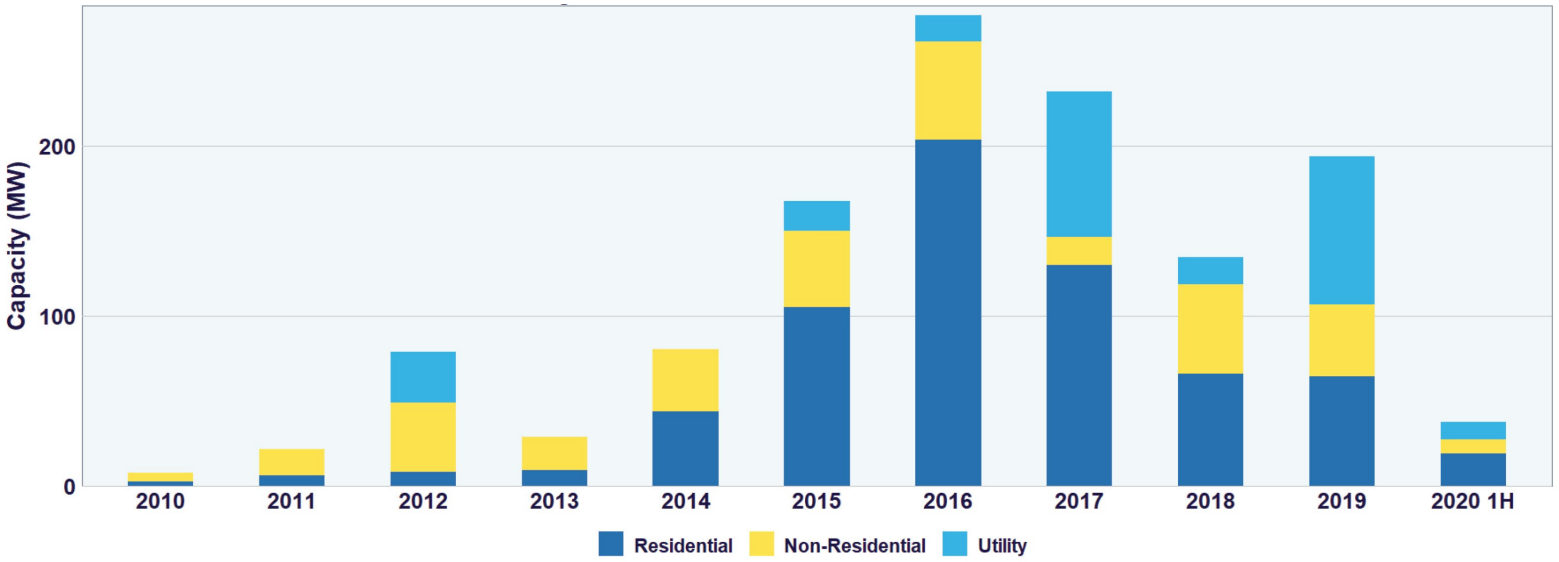
COVID Impacts



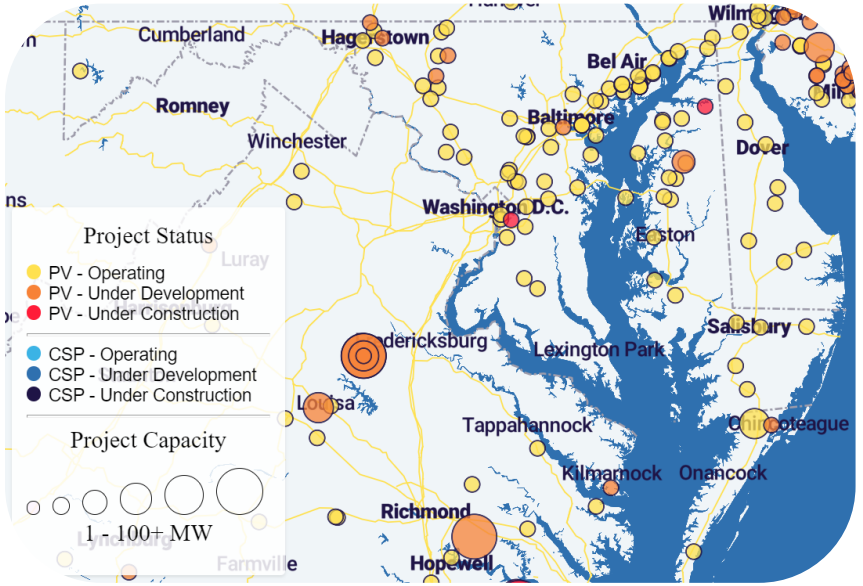
SEIA. (2019). Solar Market Insight Report 2019 Year In Review. [SEIA]

Solar Growth

Maryland Annual Solar Installations



SEIA Project Location Map

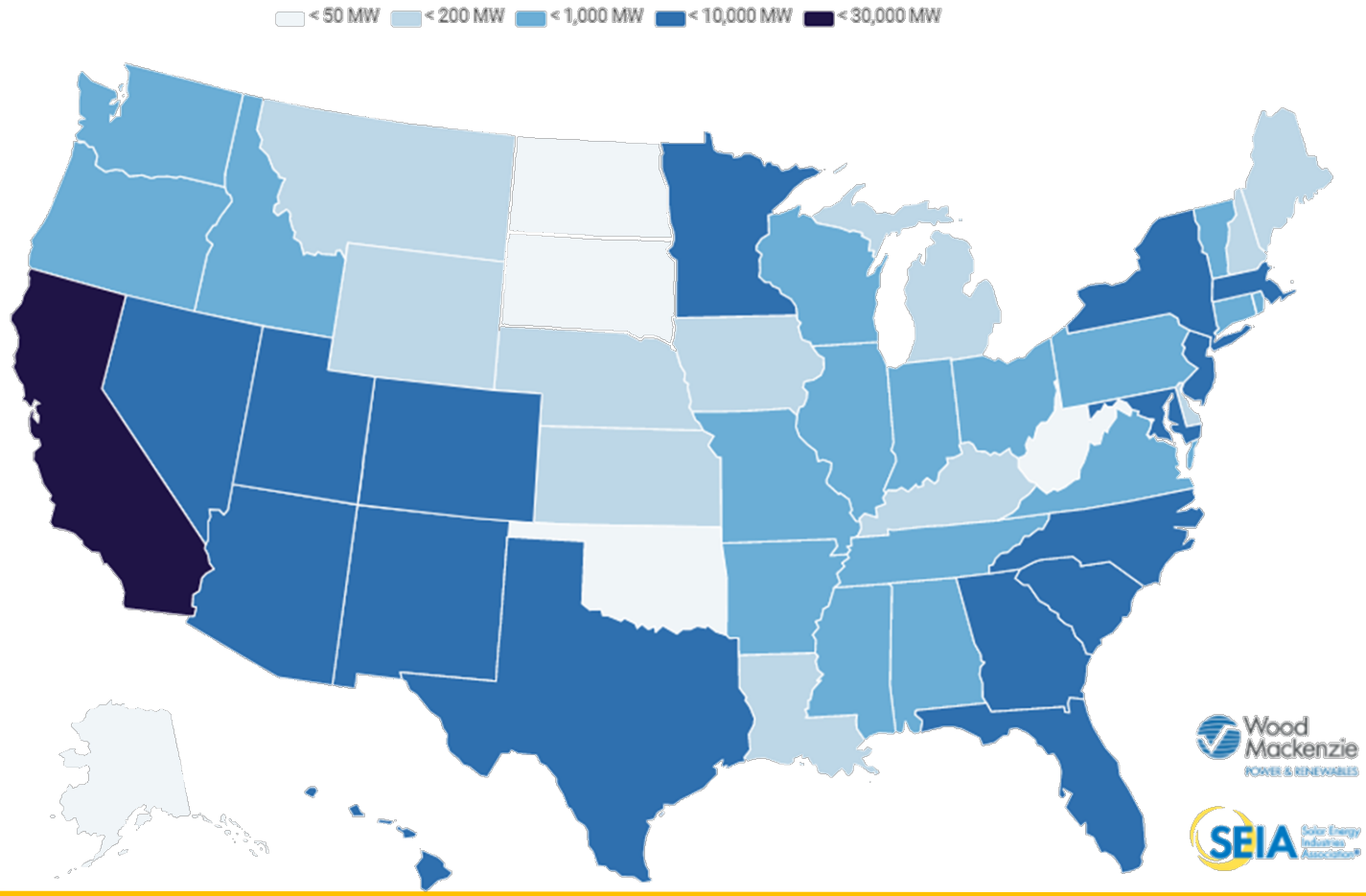


SEIA. (2020).
Maryland Solar [via SEIA]

SEIA. (2020). Project
Location Map [via SEIA]

Solar Growth

Cumulative U.S. Solar Installation by State



State	MW Installed	# Installations	Solar Jobs
California	28,471.51	1,173,243	74,255
North Carolina	6,451.05	17,788	6,617
Arizona	4,765.73	164,236	7,777
Florida	5,577.67	66,466	12,202
Texas	5,577.44	76,584	10,261
Nevada	3,612.85	58,026	7,000
New Jersey	3,386.41	125,587	6,225
Massachusetts	2,849.47	106,772	10,400
Georgia	2,664.39	2,039	4,798
New York	2,401.95	133,204	10,740
Utah	1,799.20	41,001	7,107
Colorado	1,513.95	71,257	7,174
Minnesota	1,462.89	7,482	4,335
South Carolina	1,477.10	21,233	3,307
Hawaii	1,361.94	88,641	2,484
Maryland	**1,263.37**	**70,378**	**4,854**
Virginia	1,099.65	12,586	4,489
New Mexico	1,068.33	24,380	2,021
Oregon	880.94	20,928	3,750
Connecticut	786.02	47,535	2,234
Idaho	559.97	7,074	512
Pennsylvania	550.45	32,260	4,231

SEIA. (2020). Solar Industry Research Data [via SEIA]

Solar Growth

Total Solar Installed	National Ranking	Solar Jobs	Growth Projection
1,263.37 MW	**16th**	**4,854**	**1,172.78 MW**
193.74 MW in 2019	Ranks 15th in 2019	Ranks 14th in 2019	Ranks 25th

Enough solar installed to power:
146,244 homes

Percentage of state's electricity from solar:[2]
4.15%

Price decline over the last five years:
38%

There are 233 solar companies operating in Maryland

17
Manufacturers

123
Installers/ Developers

93
Others

SEIA. (2020). Maryland Solar [via SEIA]

SESSION TOPICS

Energy Sources

Solar Market

Farm Applications

- Implementation Options
- Off-Grid vs Grid-Tied
- Farmer Motivations
- Solar Pros and Cons
- Utility-Scale Considerations

On-Farm Solar

PV Implementation

Structural Addition

- Retrofitting onto existing building
- Provides electricity
- Reduces utility-load

Building Integrated PV (BIPV)

- Integrated into new construction
- Multi-functional energy improvements
- Aesthetics

Ground-Mounted

- Permits tracking
- Requires fencing, buffers, construction
- Supports large utility-scale installations

Micro Solar

- Battery charging
- Portable & lightweight
- Mono/Multi Crystalline Silicon

Mobile Solar

- Battery-integrated
- Portable & deployable
- No diesel fuel to replenish

Pole-Mounted

- Uses batteries & energizers
- Remote or large fencing systems
- Electric fencing, lighting, water pump

On-Farm Solar

Differences

Access to Electricity

- Off-Grid: Sunshine + Battery (*no excess*)
- Grid-Tied: Sunshine + Grid

Excess Production

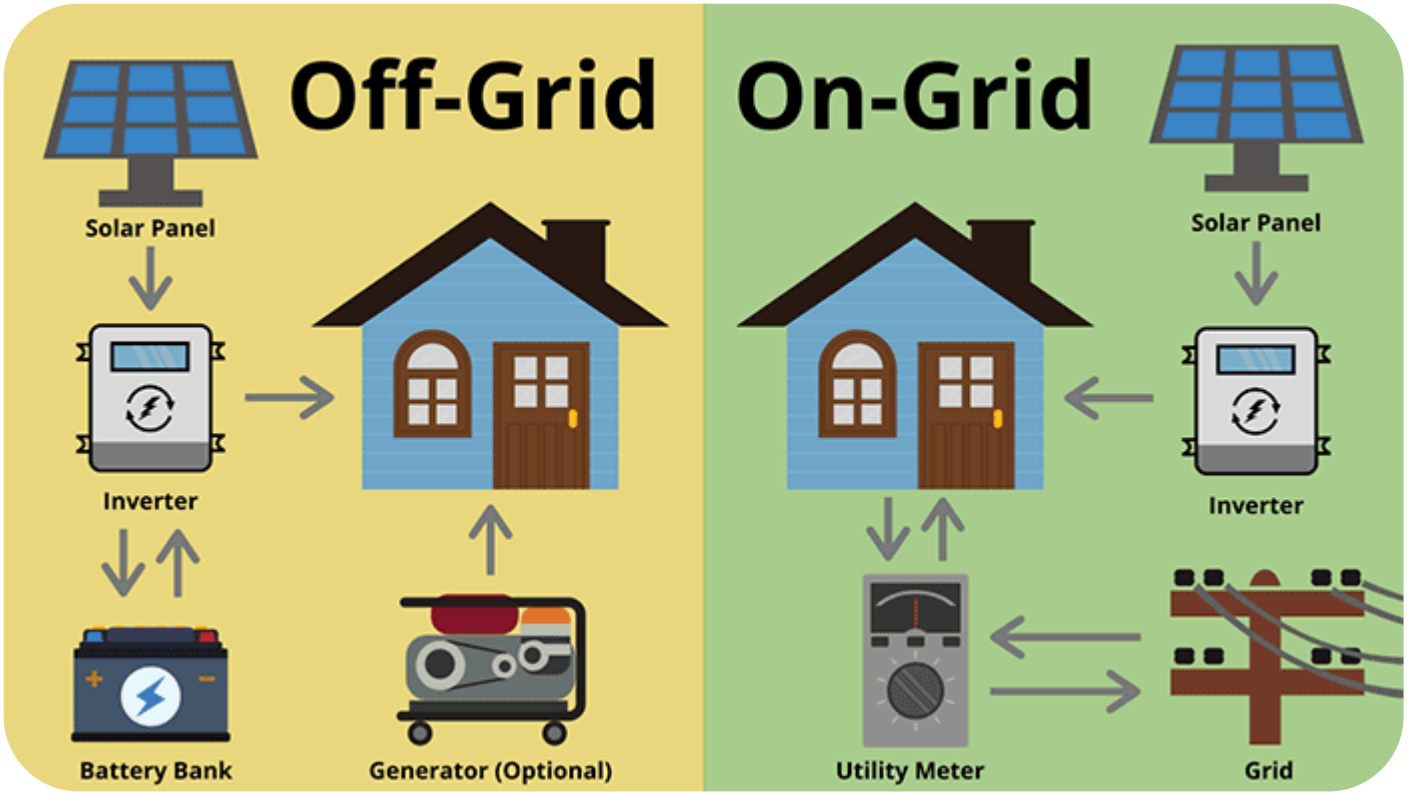
- Off-Grid: Energy Usage + Battery
- Grid-Tied: Energy Usage + Grid

Power Outages

- Off-Grid: Independent from Utility Disruptions
- Grid-Tied: No Power with Utility Disruptions

Electricity Bills

- Off-Grid: No Bills (*system investment*)
- Grid-Tied: Service Fees, Delivery & Demand Charges



On-Farm Solar

Motivations

Investment

- Lower Electric Bills
- Ensure Good ROI

Marketing

- Environmentally-Friendly
- Agritourism

Backup Power

- Independent from Grid Disruptions
- Productivity & Resiliency

Environmental Goals

- Improve Carbon Footprint
- No Emissions

On-Farm Solar

pros

Reduces an Expense

- Reduce your electric bill & control the fixed cost

Protection from Rising Electric Rates

- Reduces volatility of future energy costs & free fuel

Quickly Recover Installation Cost

- Tax credit, 100% accelerated depreciation, grants

Grow your Bottom Line

- No material or labor costs impacting savings

Sustainability

- Environmentally clean and economically sustainable

Set & Forget

- Minimal maintenance & upkeep, 25-30 year warranty

cons

Grid Dependence

- Disruptions in electric grid will stop grid-tied solar

Requires Open Space

- Roof space or cleared terrain

High Upfront Costs

- High investment with upfront capital or financing

Requires Adequate Sunshine

- Impacts from shade impact, tilt, orientation

Low Curb Appeal

- Can be unattractive

On-Farm Solar

utility-scale concerns

Takes up too much farmland

- less than residential or retail development?
- 80,000 acres to generate 10% of MD's electricity

PV projects damage farmland

- decommissioning & end-of-life restoration
- or permanent loss to commercial/residential

Hurts agricultural industry

- leasing land can keep farms in business
- landowners may earn thousands each year

Lifespan of system is too short

- lifespan & warranties for 25-30 years
- efficient operation at 30-40 years

Environmental & Wildlife Impacts

- review, planning, & permitting requirements
- siting rules & ordinances

Panels are not environmentally-friendly

- minimal emissions, noise, & glare
- can be recycled or landfilled

Images & Videos

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ON-FARM SOLAR PV TRAINING

WEBINAR SERIES

WEBINAR SCHEDULE

Module #2: Solar PV Basics
OCT 7, 2020 1:00 PM – 2:00 P.M. (EST)

Module #3: Solar Planning & Design
OCT 14, 2020 1:00 PM – 2:00 P.M. (EST)

Module #4: Solar Regulations & Zoning
OCT 21, 2020 1:00 PM – 2:00 P.M. (EST)

Module #5: Installation & Maintenance
OCT 28, 2020 1:00 PM – 2:00 P.M. (EST)

Module #6: Financial Options
NOV 4, 2020 1:00 PM – 2:00 P.M. (EST)

Module #7: Community Solar & Co-ops
NOV 11, 2020 1:00 PM – 2:00 P.M. (EST)

Module #8: Utility-Scale Leasing
NOV 18, 2020 1:00 PM – 2:00 P.M. (EST)

Module #9: Solar & Battery Storage
DEC 2, 2020 1:00 PM – 2:00 P.M. (EST)

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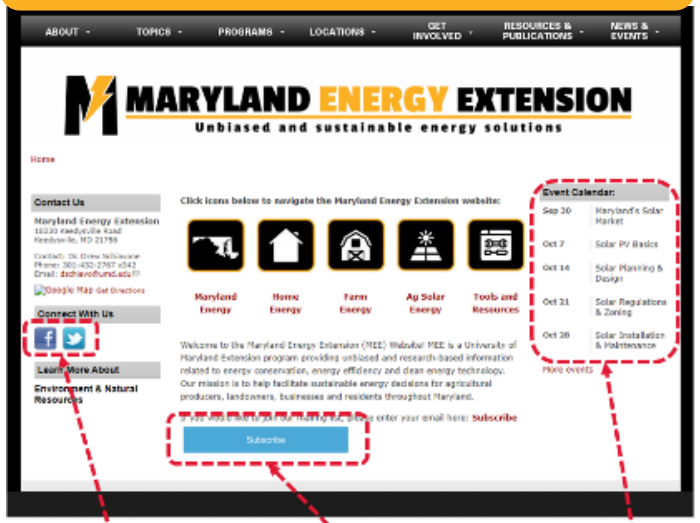

Drew Schiavone
dschiavo@umd.edu
(301) 432-2767 ext. 342

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