LEAGUE OF WOMEN VOTERS®
PLYMOUTH AREA

Sustainable Plymouth

Citizens' Climate Lobby

RUN YOUR HOME ON SUNSHINE

Phil Angell

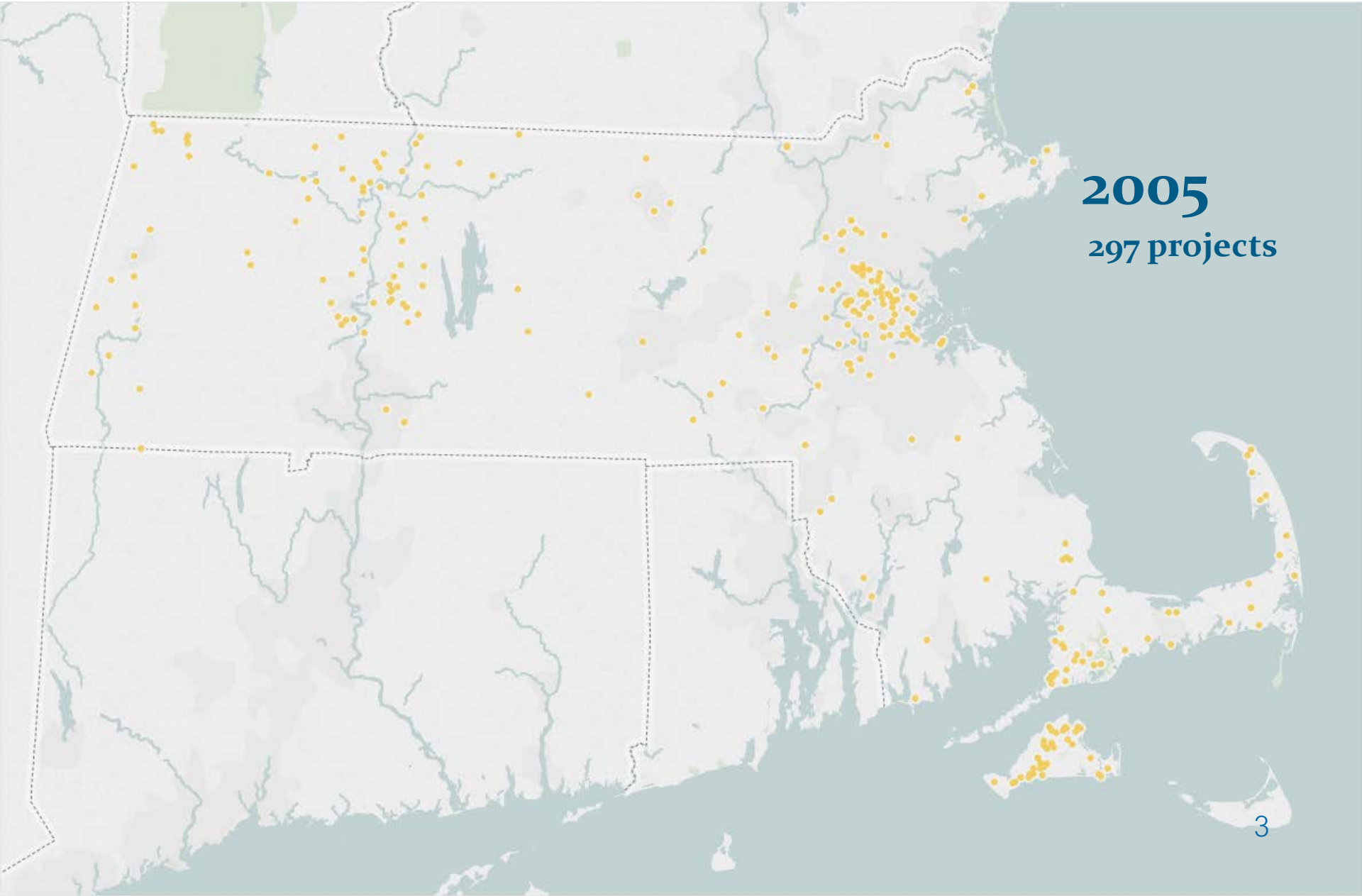
Solar Designer, Consultant, Licensed Builder, Solar powered

July 25, 2023 7:00 – 8:30pm
Plymouth Public Library

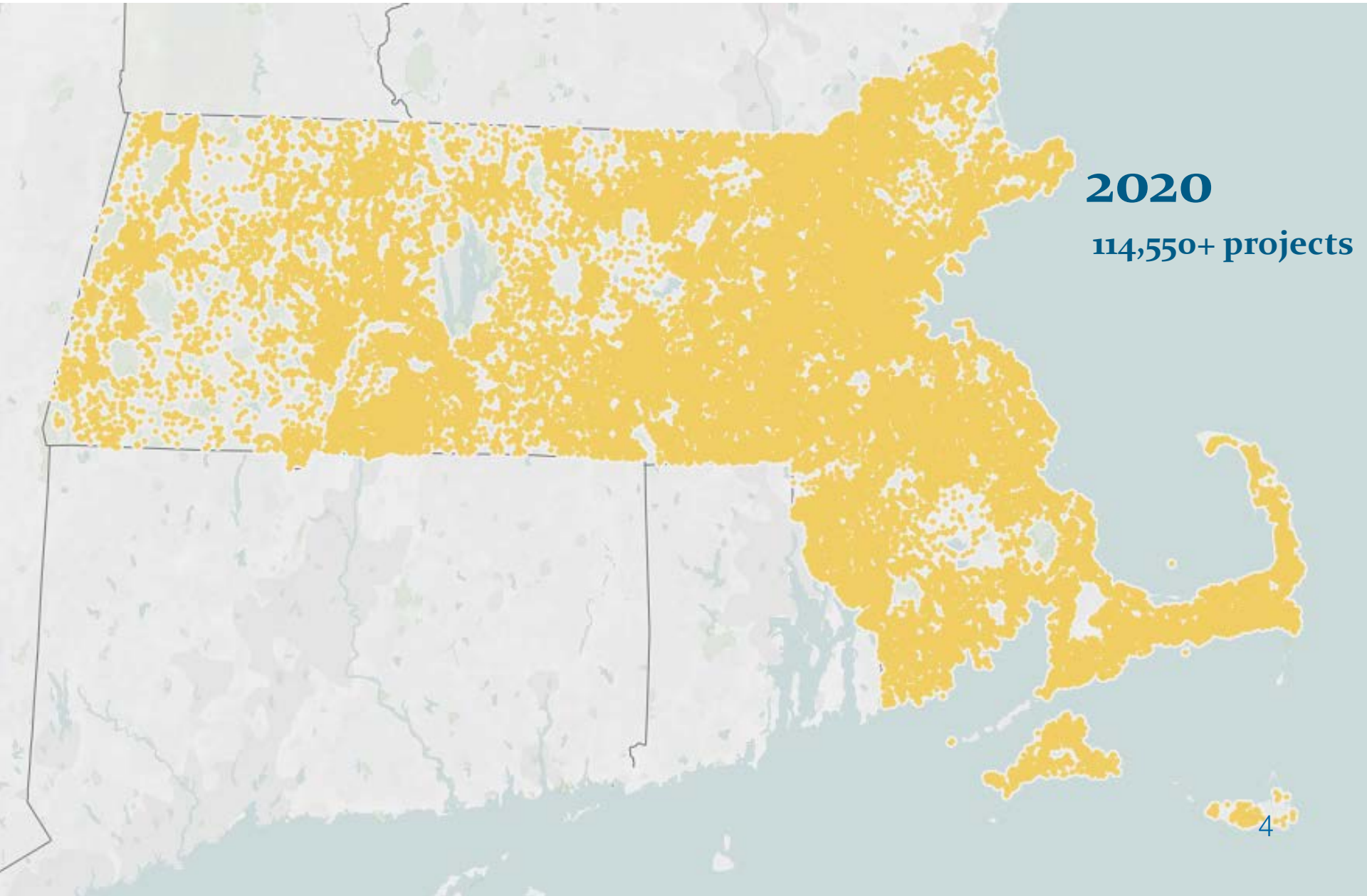
AGENDA

- Solar in Massachusetts
- How Solar Systems Work
- Planning for EV, Heat Pump
- Ownership Models
- Battery Storage
- Finding a Contractor
- Incentives & Programs

Solar PV Project Trends in Massachusetts



Solar PV Project Trends in Massachusetts



How Do Solar Panels Work?

Solar photovoltaic (PV)
Converts solar energy to electricity
System measured in kW
Electricity production in kWh
Most homeowners install between 2 kW – 12 kW

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System Components

System components:

Inverter & Racking

Racking system

Inverter

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How Does It Connect to Electric Panel?

Simple connection, most home electric systems don't need upgrades before solar

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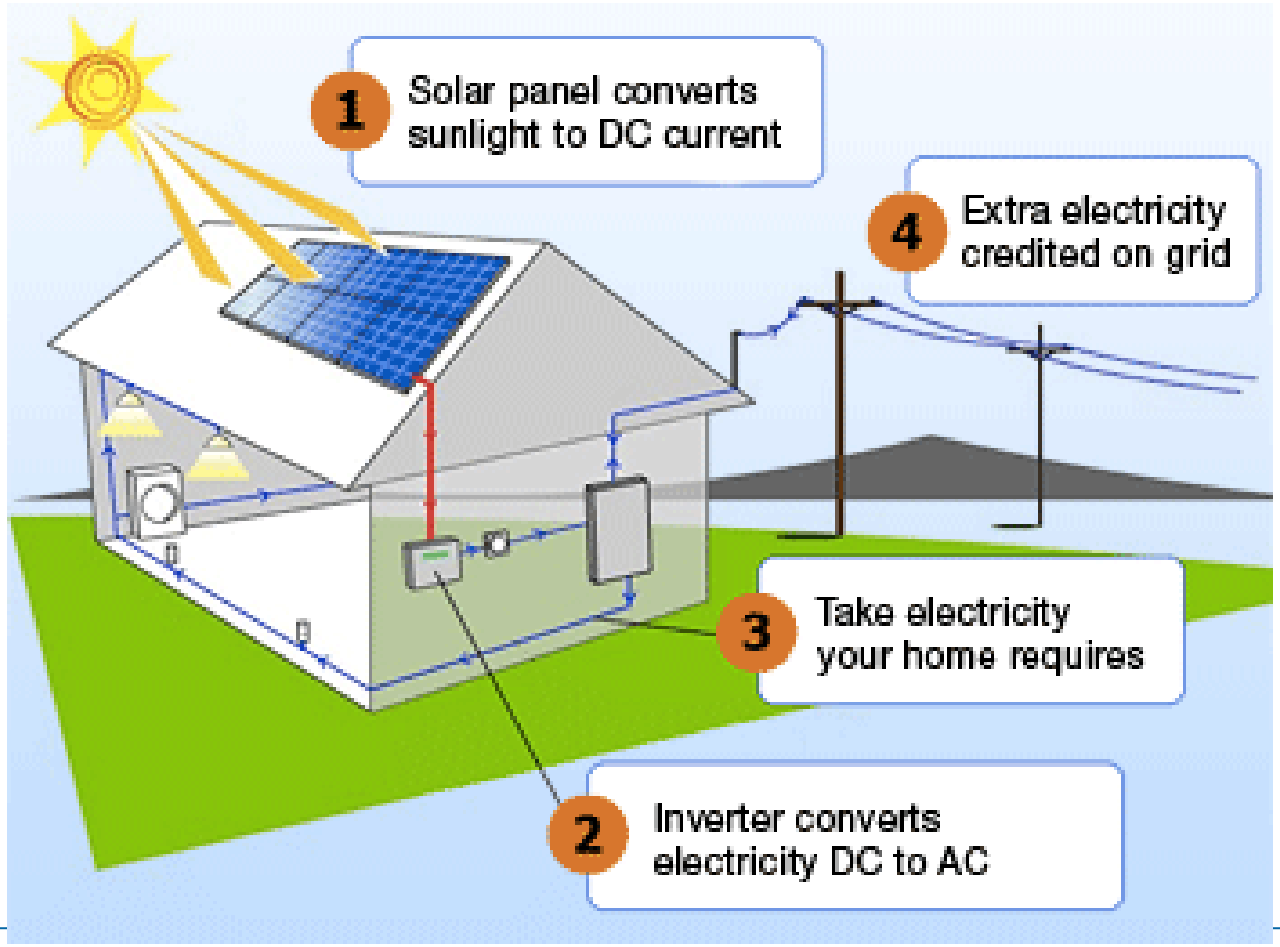
How Solar System Works

How a solar PV system works (grid tied)



What Happens if The Power Goes Out?

When grid is down, solar shuts off (safety mechanism)

Need batteries if you want you want power during outages

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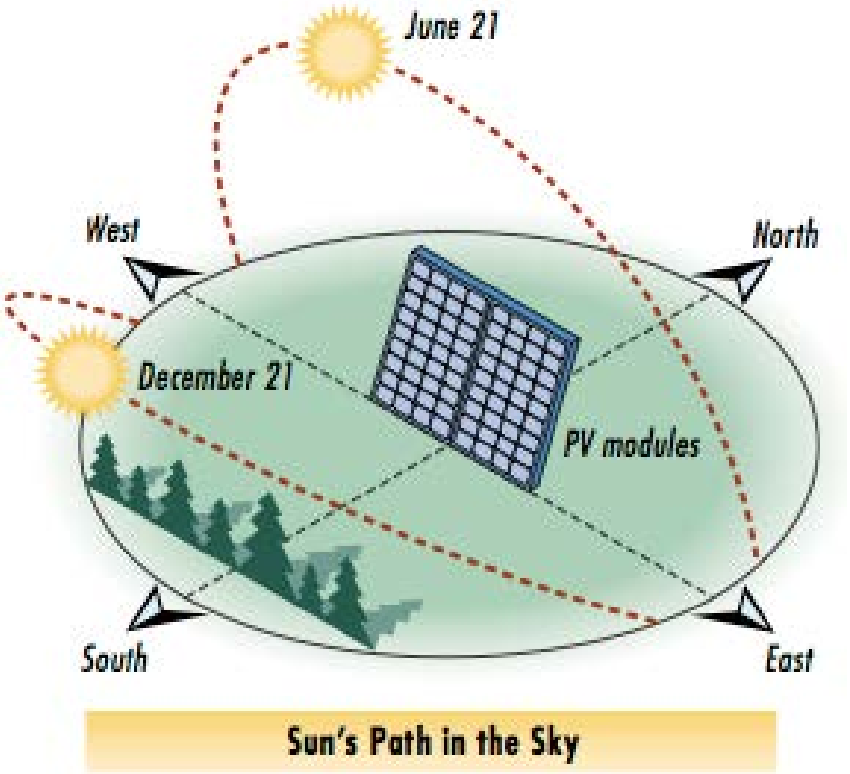
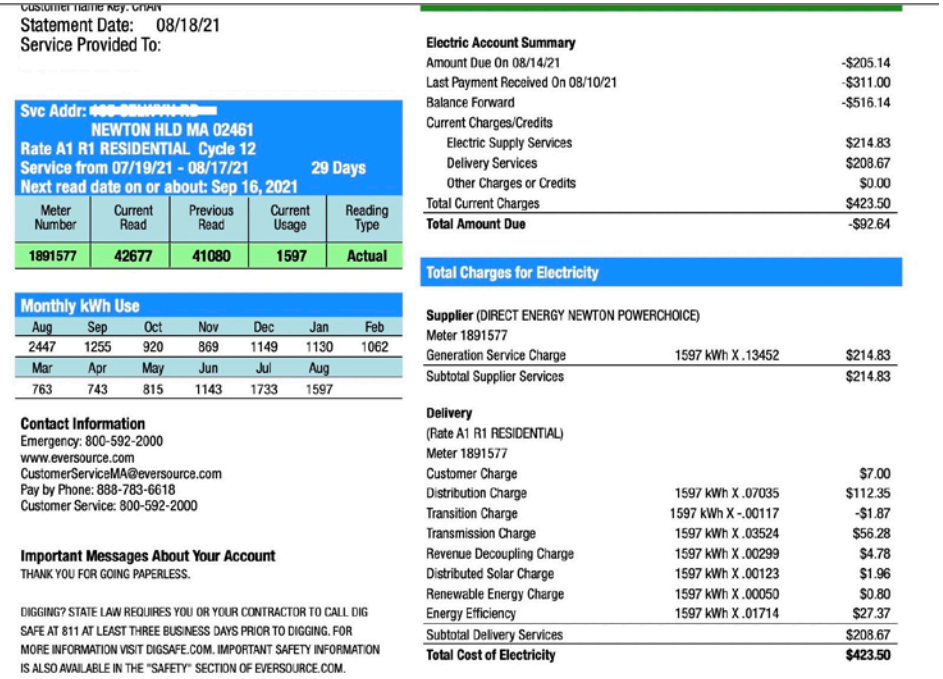
What Makes a Good Site?

- ***Appropriate*** exposure
- PV panels angled 30˚ – 45˚
- At least 4-6 hours of direct sunlight (limited shading)
- Open roof area
- Open space for a ground or pole mounted system



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

Understanding Your Home's Electricity Use



Statement Date: 08/18/21
Service Provided To:

Svc Addr: [redacted]
NEWTON HLD MA 02461
Rate A1 R1 RESIDENTIAL Cycle 12
Service from 07/19/21 - 08/17/21 29 Days
Next read date on or about: Sep 16, 2021

Meter Number	Current Read	Previous Read	Current Usage	Reading Type
1891577	42677	41080	1597	Actual

Monthly kWh Use

Aug	Sep	Oct	Nov	Dec	Jan	Feb
2447	1255	920	869	1149	1130	1062
Mar	Apr	May	Jun	Jul	Aug	
763	743	815	1143	1733	1597	

Contact Information
Emergency: 800-592-2000
www.eversource.com
CustomerServiceMA@eversource.com
Pay by Phone: 888-783-6618
Customer Service: 800-592-2000

Important Messages About Your Account
THANK YOU FOR GOING PAPERLESS.

DIGGING? STATE LAW REQUIRES YOU OR YOUR CONTRACTOR TO CALL DIG SAFE AT 811 AT LEAST THREE BUSINESS DAYS PRIOR TO DIGGING. FOR MORE INFORMATION VISIT DIGSAFE.COM. IMPORTANT SAFETY INFORMATION IS ALSO AVAILABLE IN THE "SAFETY" SECTION OF EVERSOURCE.COM.

Electric Account Summary

Amount Due On 08/14/21	-$205.14
Last Payment Received On 08/10/21	-$311.00
Balance Forward	-$516.14
Current Charges/Credits	
Electric Supply Services	$214.83
Delivery Services	$208.67
Other Charges or Credits	$0.00
Total Current Charges	$423.50
Total Amount Due	-$92.64

Total Charges for Electricity

Supplier (DIRECT ENERGY NEWTON POWERCHOICE)
Meter 1891577

Generation Service Charge	1597 kWh X .13452	$214.83
Subtotal Supplier Services		$214.83

Delivery
(Rate A1 R1 RESIDENTIAL)
Meter 1891577

Customer Charge		$7.00
Distribution Charge	1597 kWh X .07035	$112.35
Transition Charge	1597 kWh X -.00117	-$1.87
Transmission Charge	1597 kWh X .03524	$56.28
Revenue Decoupling Charge	1597 kWh X .00299	$4.78
Distributed Solar Charge	1597 kWh X .00123	$1.96
Renewable Energy Charge	1597 kWh X .00050	$0.80
Energy Efficiency	1597 kWh X .01714	$27.37
Subtotal Delivery Services		$208.67
Total Cost of Electricity		**$423.50**

Average MA Home uses 7,500 kWh / year
(EIA, 2014 state data)

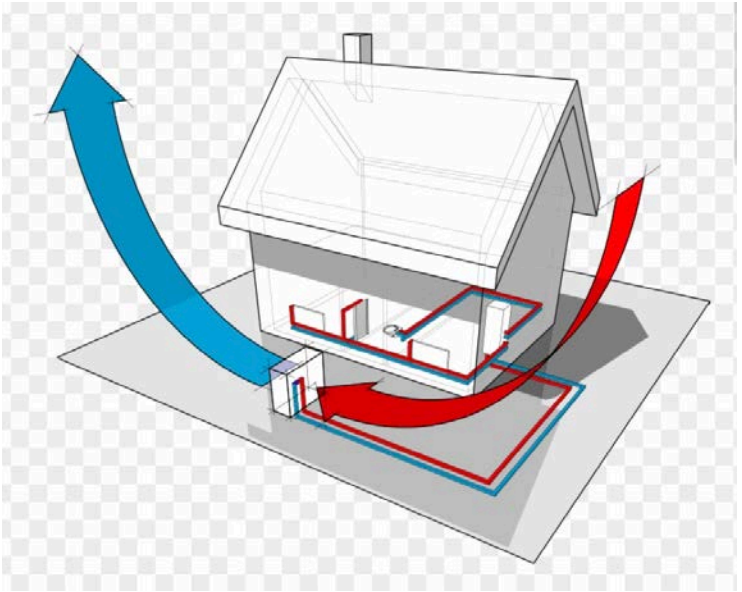
Average solar PV system in MA is about 7,000 watts or 7 kW (13,179 in sample)

Your electric bill has summary of prior year's consumption

Understanding your electricity use will assist installer in sizing solar PV system to best meet your needs

Back of the Envelope Calculation: 1 kW = approximately 1,100 kWh/year

Planning for future loads



Ownership Models

- Outright purchase
- Financed purchase
- Power Purchase Agreement
- Lease
- Community Solar

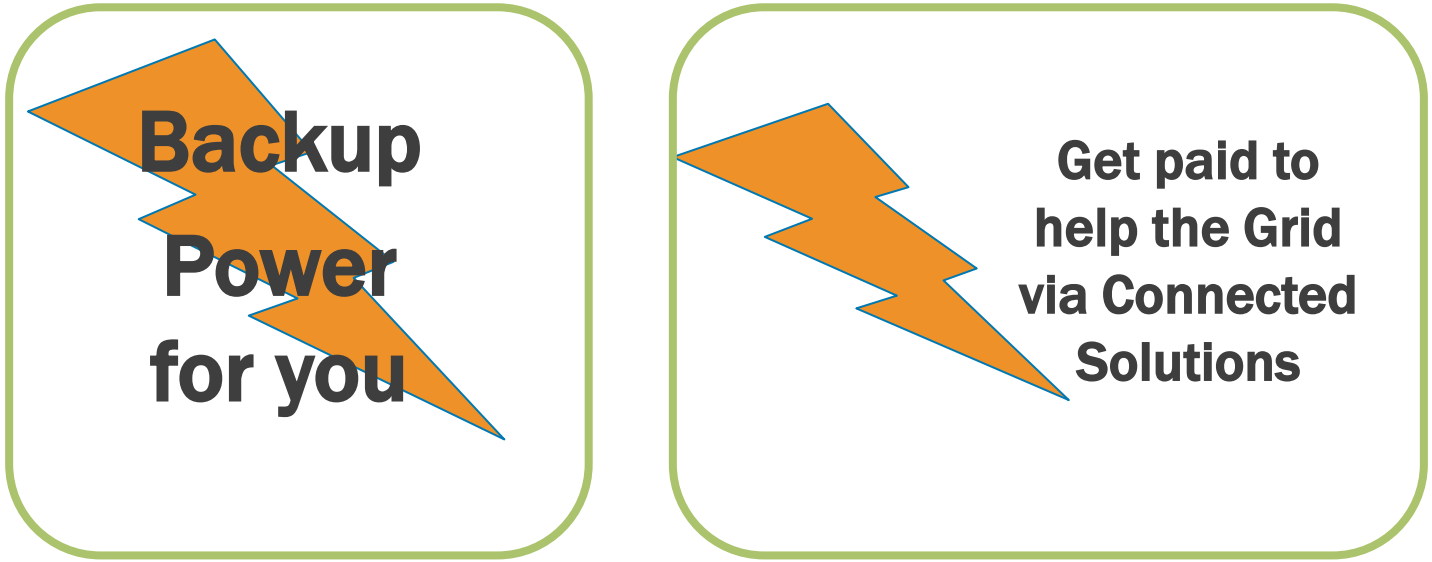



Ownership Model Details

	Direct Ownership	Third Party Ownership
Who buys and owns the system?	Homeowner	Third-party company
Are there any up-front costs for the homeowner?	Yes. May pay with cash or take out a home equity or solar loan	Low or no up-front cost
Cost Estimate for Ave Home (7 kW system)	$25,000 - $7,500 - $1,000 net $16,500 / 25 years = $660/year ($55 per month)	Reduction in future and possible current electric bill.
Who takes advantage of federal and state incentives available for solar?	Generally Homeowner	Generally third-party company
Who is responsible for maintenance and insurance?	Homeowner	Third-party company
Impact of Solar PV on Property Value	Fannie Mae guidance: real property. National lab studies, PV Value Tool	Fannie Mae guidance: personal property. LBNL study found no evidence of negative impact on value
Point of Sale: What to clarify with a realtor?	Ownership and remaining time of ongoing state incentives (SRECs / SMART incentive)*	UCC-1 subordination at refiling*

BATTERY BACKUP FOR GRID-CONNECTED HOMES

Two Functions of Battery Storage



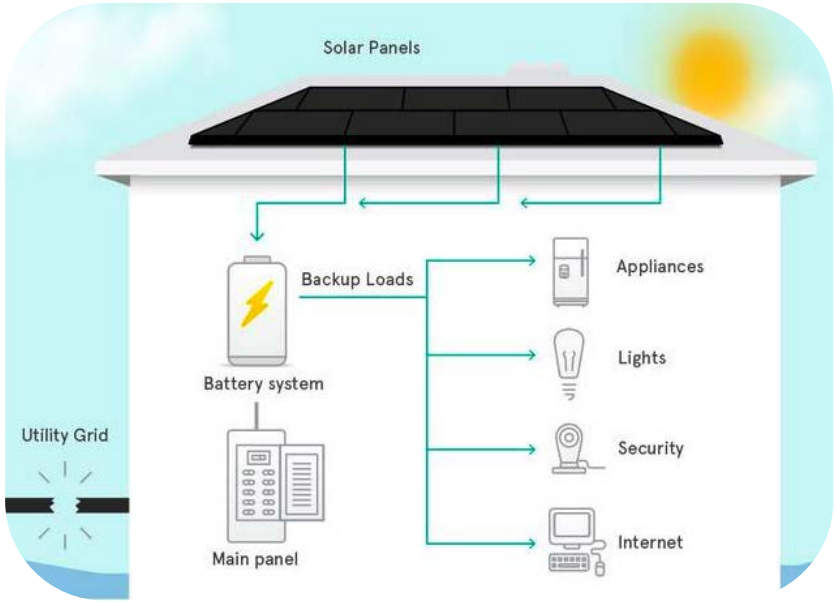
Batteries Similar to Generator, but with some important differences.

Source: Sonnen

Source: alarmcentralsecurity.com

What Can Batteries Power?

Critical home loads



Source: SolarCity

Storage during a utility outage

- Seamless backup power
- Typically only power critical loads
  - Matched to battery size/amount
  - "Critical loads sub-panel"

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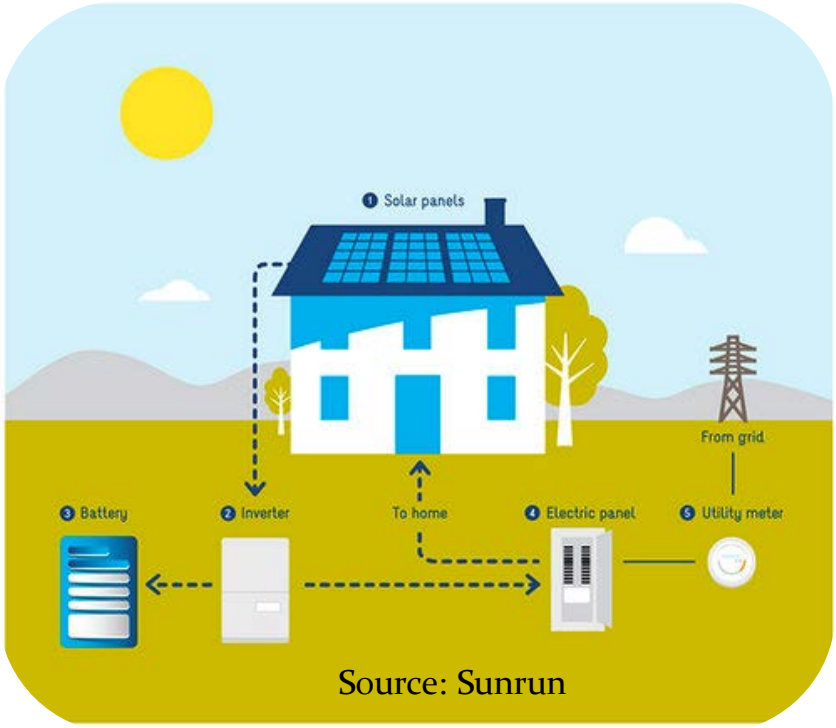
How Does Storage Work with Solar?

Installation:
- Same time as solar or retrofitted
- May require additional hardware
- May require fire-rated enclosure

Solar + Storage:
- Solar charges batteries for later use
- Grid energy can also charge batteries
- Small amounts of energy keep batteries "topped off"
- Batteries only kick in (automatically!) when power is out



Source: Sunrun

Installing Solar with Solar vs Later

With Solar

- Immediate backup power benefits
- May reduce some shared labor and admin costs by paying a contractor once instead of twice
- Eligible for 30% solar Federal Tax Credit

Later

- Solar now and wait for battery prices to fall further
- Most likely AC-coupled
- May require an additional inverter
- Supply issues

Hypothetical Small Example

The Johnsons lose power from the utility several times a year. Each time the power is out for at least a day.

6 kWh Battery Bank

- Fully re-charged by solar (5.6 kW) daily
- NOTE: No solar = 1 day only

What will run when the power is out:

- Refrigerator; small microwave
- Boiler or furnace
- Some lights; some outlets
- Cable modem

What they chose not to power:

- Stove; dryer; electric water heater

Basic Cost Estimates

Hardware cost (examples) +

Equipment	Cost	Size
Powerwall 2 (Li-ion)	$6,200	13.5 kWh
Powerwall 1 (Li-ion)	$3,000	6.4 kWh
LG Chem (Li-ion)	$6,000	6.6 kWh
Sonnen Eco 4 (Li-ion)	$10,000	4 kWh
Sealed Lead Acid	$5,200	12 kWh

Installation costs +

$3,000 - $5,000 for standalone installation and additional equipment

Maintenance costs

Varies between installers and battery chemistries

Pricing for our small 6 kWh battery example:

~$6,000 + $4,000 + $1,000

= ~$11,000

Operations and Maintenance

Warranties

- Two common warranty types:
  - Specific time period (**years**) OR duration of use (**cycles**)

- Typical Li-ion warranty: 10 years
- Examples:
  - Sonnen: 70% of max. capacity for 10,000 cycles (or 10 years)
  - Tesla: Free of defects for 10 years with unlimited cycles
- Typical lead acid warranty: 2 to 5 years
- Installer's labor should be warranted (wiring)

Note: Solar panels are warranted for 25 years

Source: https://blog.pickmysolar.com/home-battery-backup-comparison-tesla-sonnenbatterie

Finding a Contractor

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AVAILABLE INCENTIVES AND PROGRAMS

Solar Incentives in Massachusetts

High electricity prices + reduced solar PV costs + numerous incentives = economical solar projects

Incentives
Federal and State Tax Incentives
Net Metering / Utility Bill Savings
Production Incentives (SMART program)

www.house-power.com/blog/wp-content/uploads/2009/12/iStock_000009001180XSmall.jpg

Federal & State Tax Incentives

- 30% uncapped Federal tax credit for systems installed 2022-2032
  - Applies to electric panel upgrade too, if upgraded in conjunction with rooftop solar
- 30% uncapped Federal tax credit for battery storage
- 15% State tax credit (capped at $1,000)
- SMART program
- Equipment sales tax exemption
- Property tax exemption (100% for 20 years, if applicable)

Net Metering

- Meter spins forward when you use electricity from the electric company
- Meter spins backward when you generate excess and “export” electricity to the grid
- You may use net metering credits to decrease your electricity bill to zero dollars
- Smaller systems receive nearly full retail value of exported value (under 10 kW)

Solar Massachusetts Renewable Target (SMART) Program

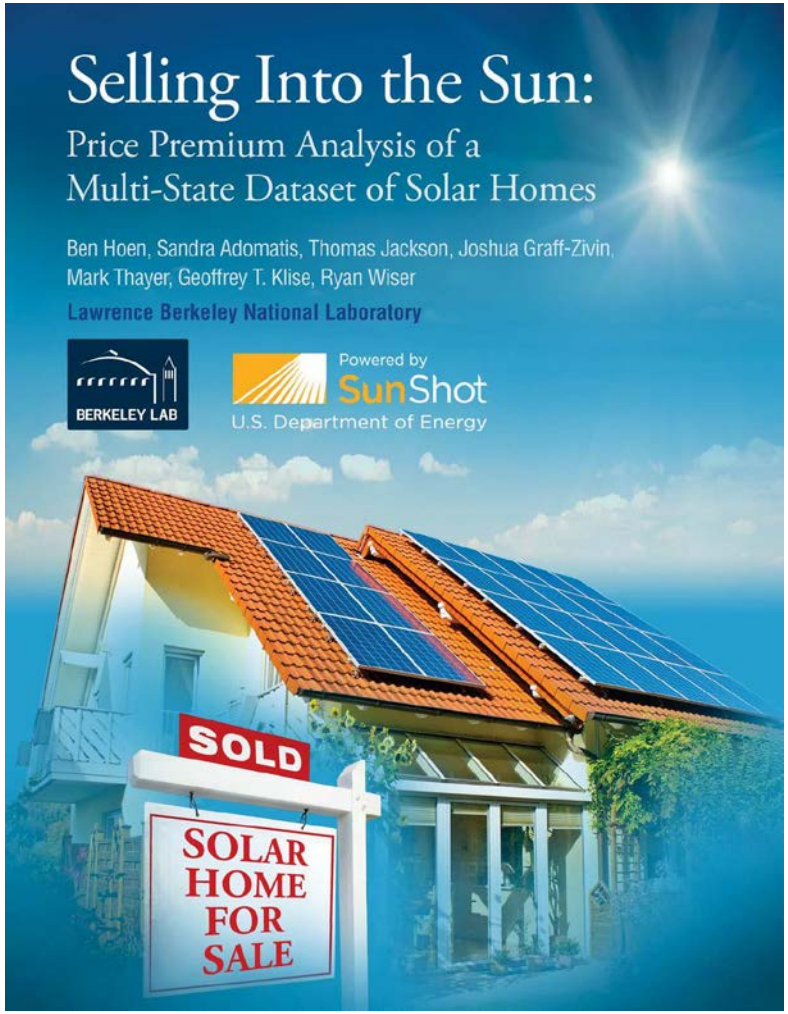
- For every unit of electricity, SMART sets a compensation rate that is the value of electricity (per kWh generated) + additional incentive
- Available with Eversource, National Grid, and Unitil (municipal utilities may participate under a separate program) 25 kW only)
- Supports installation of 3,200 MW (AC) of new solar generating capacity in MA, incentives decrease as amount of solar increases
- Compensation rate set according to project size, location, customer type as well as other project attributes
- Provides an added incentive for solar PV systems with energy storage

Impact on Property Value and Insurance

Massachusetts Renewable Energy Tax Exemption

- "Solar energy systems… used as a primary or auxiliary power system for the purpose of heating or otherwise supplying the energy needs of taxable property are exempt from local property tax for a 20-year period"
- Home Insurance
  - Usually little to no increase

Potential Impact on Home Value



Lawrence Berkeley National Lab "Selling into the Sun" Report, January, 2015

- National analysis of market value of solar PV homes
- Compared over 22,000 properties with and without PV
- Found high solar PV premiums for owned systems
- Recommends using comparable sales of other PV homes, present value of energy savings and replacement costs to predict value elsewhere.

Other Research

- *"Appraising into The Sun" six appraisers found similar premiums as above*
- *"Leasing into The Sun" no premium found for systems owned by a third-party*

Questions?