

Solar Thermal Challenge

Metropolitan Area Planning Council (MAPC)

May 9th, 2018

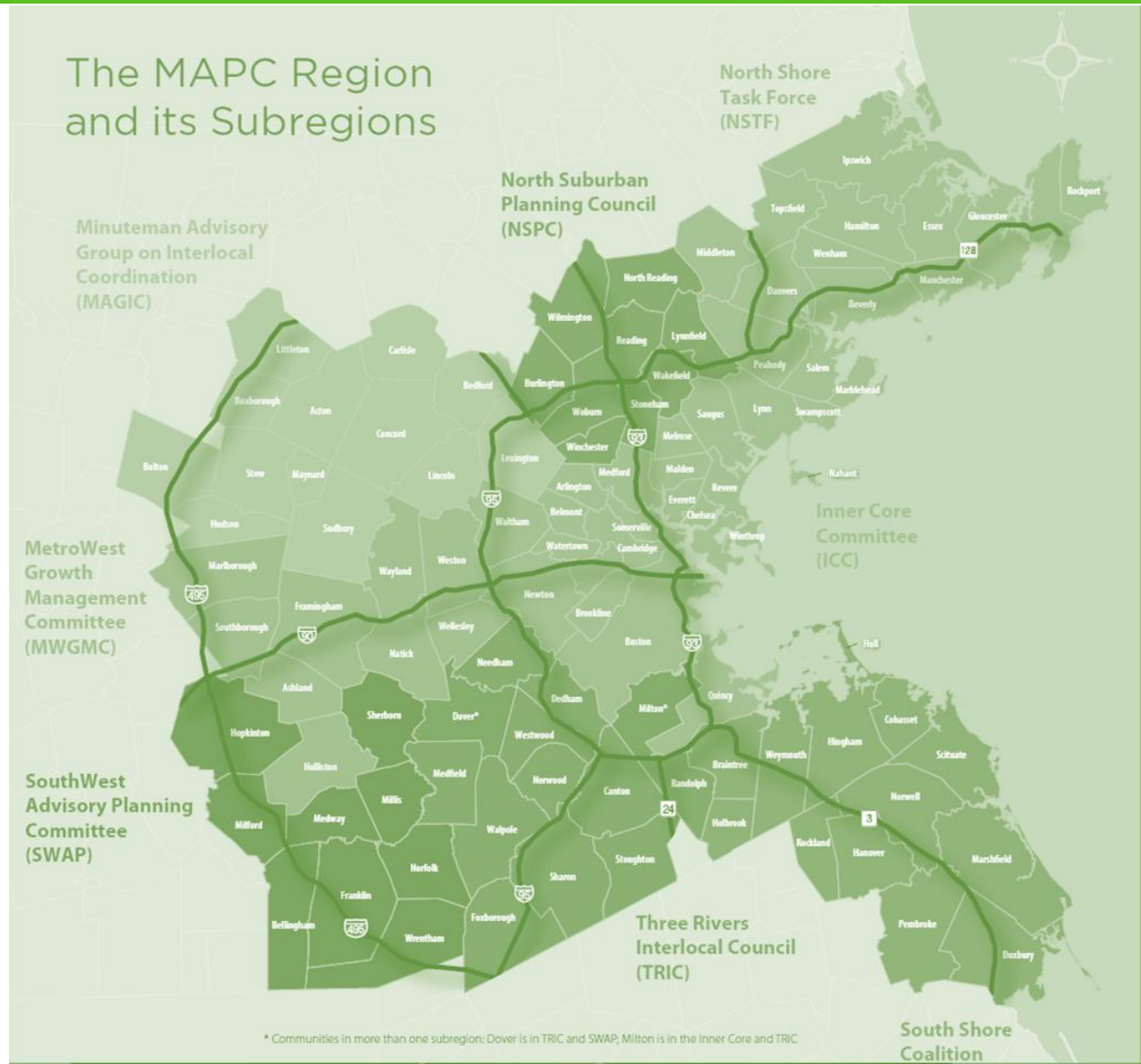
Municipal Solar Thermal Templates and Lessons Learned

MAPC
METROPOLITAN AREA PLANNING COUNCIL

MAPC: About Us

- Regional Planning Agency
- 101 cities and towns
- 80+ employees
- Wide range of planning expertise

MAPC
METROPOLITAN AREA PLANNING COUNCIL
Smart Growth & Regional Collaboration



MAPC: Clean Energy

1. Regional Energy Projects

- **ESCO Procurement**
- **Regional Solar Initiative**
- **LED Streetlight Purchasing Program**
- **Community Aggregation**
- **Hybrid Conversion Technology**
- **Energy Resiliency**

2. Local Energy Action Program

- **Connecting municipalities with incentives + plug-and-play programs**
- **Community energy and climate baselining, planning, and strategizing**
- **Outreach programming and education**
- **Net Zero Planning**

3. Energy Technical Assistance

- **Grant Writing**
- **Green Communities Designation**
- **Methane Leaks**
- **Solar Permitting and Zoning**
- **State and Local Policy**
- **Net Zero Guidance and Education**

Agenda

1. Municipal Procurement Pilot
2. Lessons Learned
3. Resources
4. Questions and Answers

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Municipal Solar Thermal Procurement Pilot

Research

- Market Research on Vendors
- Research on Solar Thermal Systems

Outreach

- Invitation for Municipality Participation
- Signed Letters of Intent

Feasibility Studies

- Request for Quotes for Chelsea and Winthrop
- RES Solar (the selected vendor) completes studies

Contracting

- Invitation for Bids for Chelsea and Winthrop
- Selection committee chooses installation vendor

Support

- Ongoing technical assistance and support for contracting and installation

Municipal Solar Thermal Procurement Pilot

- Solar thermal is a public building construction project
- Has two phases: Design & Construction
- Highly likely that designer will bid on construction

MGL c.7 §§44-57: Design for Public Building Construction

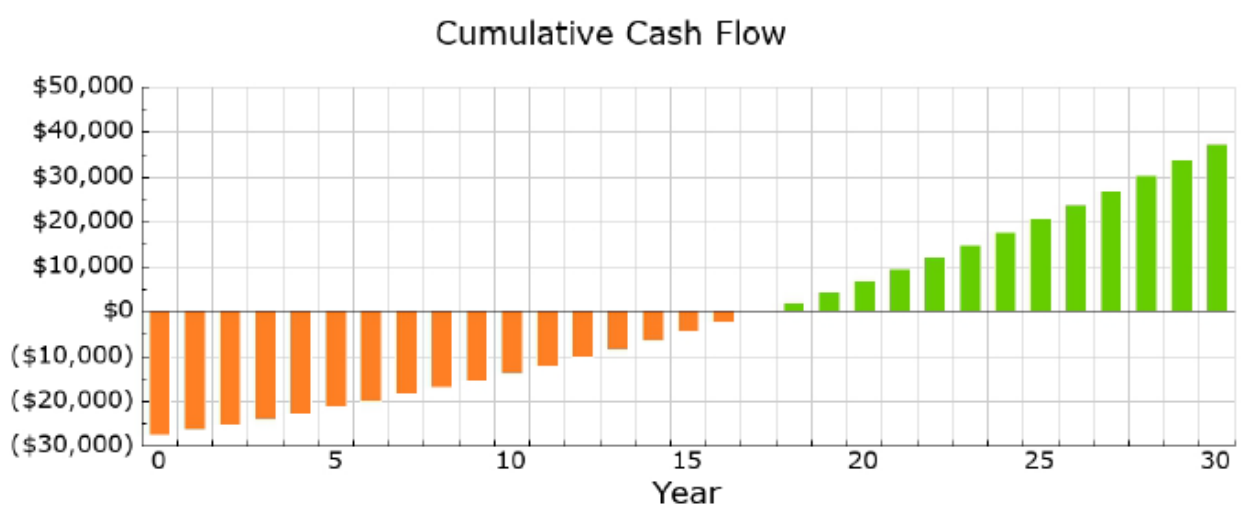
- Category for <$10K design fee
- Recommends soliciting quotes with qualifications and prices

MGL c.149: Public Building Construction

- Category for $50-150K construction cost
- Advertise in Central Register, CommBuys, newspaper, local office
- Bidders submit sealed bids with 5% bid deposit
- Lowest "responsive and responsible" bidder wins
- Payment bond required at time of contracting

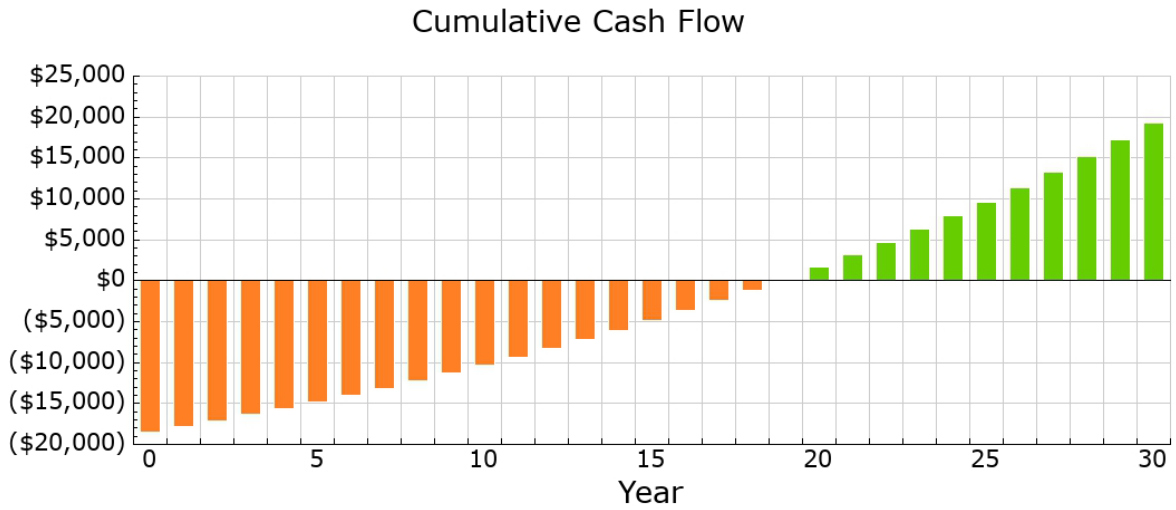
Source: http://www.mass.gov/ig/publications/manuals/dcmanual.pdf

Winthrop, MA: Ice Skating Rink



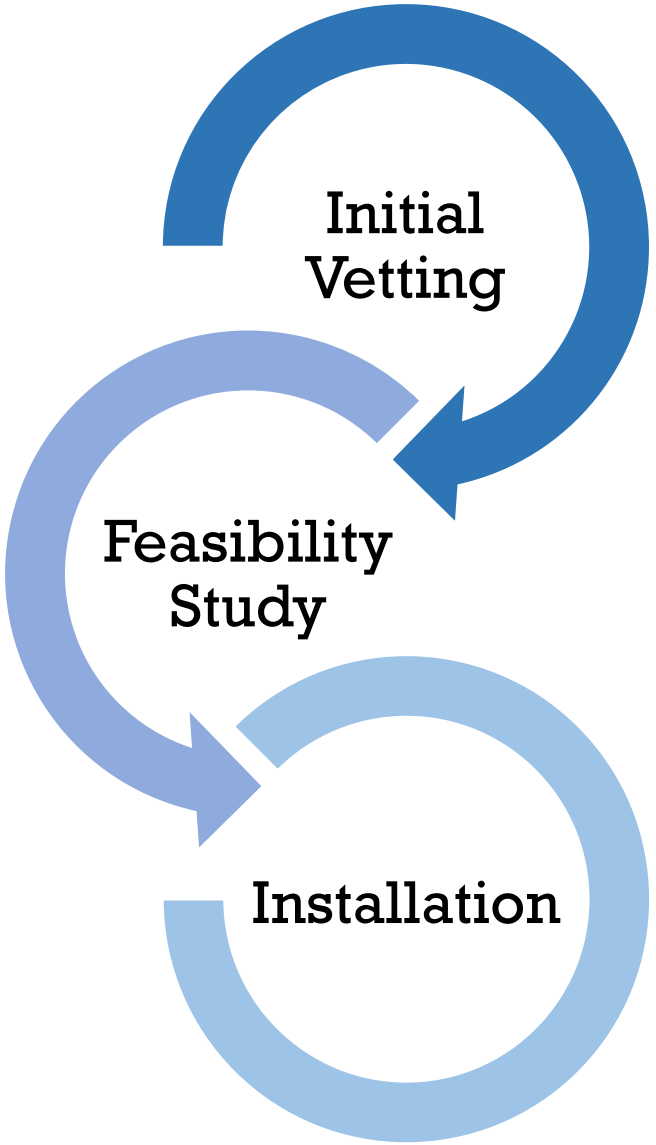
- Over 30 years, annual utility savings are anticipated to average $2,635, for **a total utility savings of $79,058**.
- Solar Water Heating System: **43,150 kWh/Year** (1,472 Therm Natural Gas)
- Cashflow payback: **17.1 years**
- Internal Rate of Return (IRR): 5.4%
- CO2 Saved over System Life: **435 tons**. (Equivalent to driving 870,000 auto miles)

Chelsea, MA: Police Station



- Over 30 years, annual utility savings are anticipated to average $1,450, for **a total utility savings of $43,487**.
- Solar Water Heating System: **21,625 kWh/Year** (738 Therm Natural Gas)
- Cashflow payback: **18.8 years**
- Internal Rate of Return (IRR): 44%
- CO2 Saved over System Life: **228 tons**. (Equivalent to driving 456,000 auto miles)

Solar Thermal Design Process



- Select the buildings that you want to focus on in the feasibility study. (Higher water use, south facing roof, high heating cost.
- Identify space for equipment
- Meet with facilities managers and code officials

- Identify buildings that could make use of the technology and for feasible buildings, develop a design and roof plan.
- One week of water metering
- MassCEC $5,000 Rebate
- Review Meeting
- Identify risks and barriers

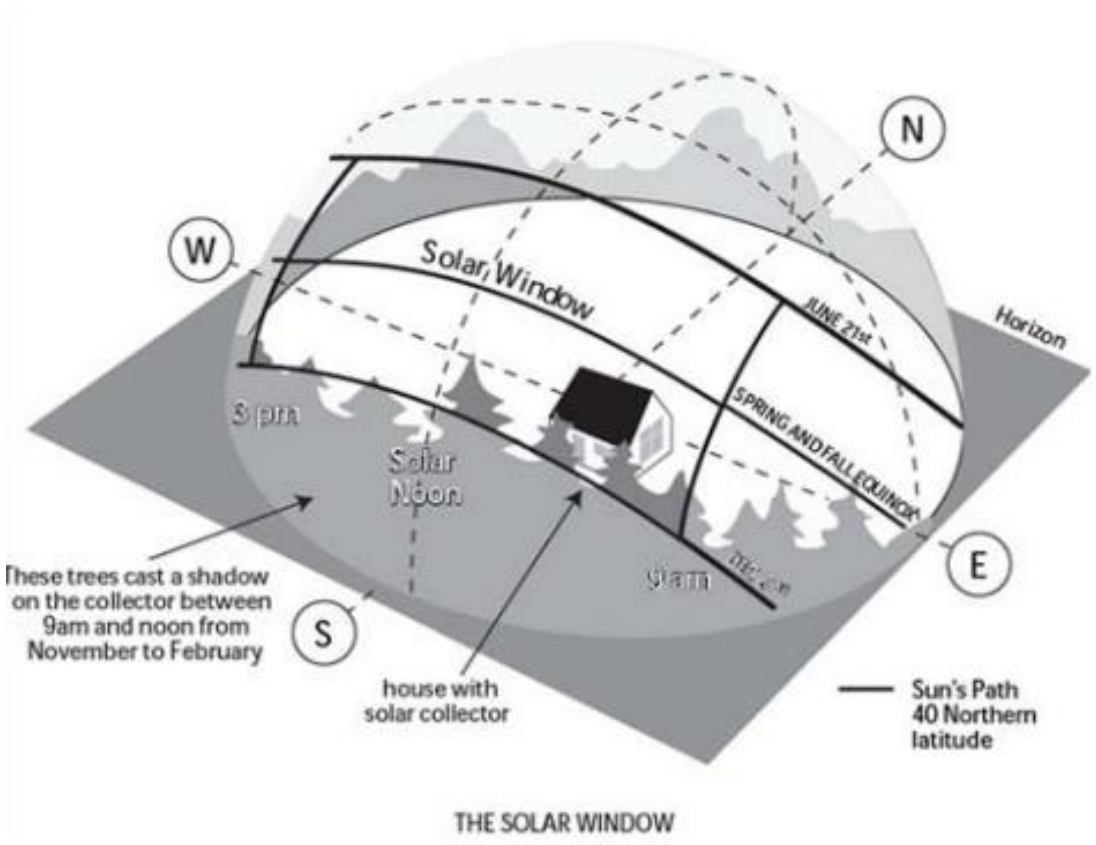
- Little to no change in design.
- Select final projects to move forward.

Initial Vetting

Select the buildings that you want to focus on in the feasibility study. (Higher water use, south facing roof, high heating cost.

- Look at utility bills for 12 months of data
- Make sure buildings have year-round use
- Identify space for equipment
- Meet with facilities managers and code officials

Siting Solar Thermal vs. Solar Photovoltaic



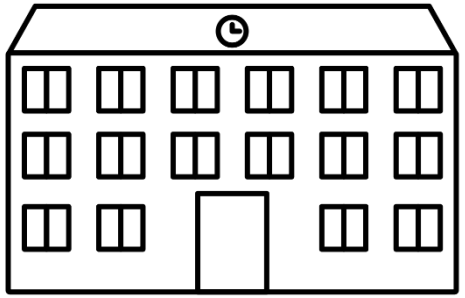
Source: NABCEP Solar Hot Water Installer Resource Guide p.13 from Solar Energy International http://www.nabcep.org/wp-content/uploads/2013/08/NABCEP-SH-Guide-8-5-13.pdf

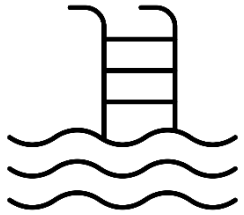
- Less roof area used than PV. Need less roof support
- Easier to re-roof around SHW. The re-roofing process for PV is usually to un-install and re-install the system

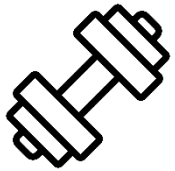
Choosing Buildings:

Looking for:

- Building with high hot water use
- Consistent hot water needs throughout the day
- Ideally uses some hot water year-round

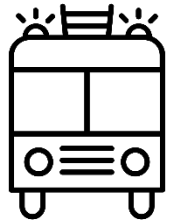


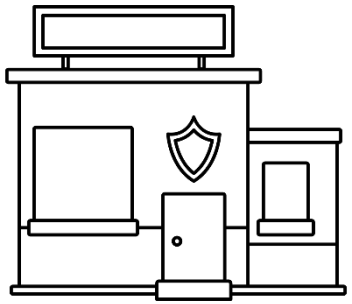




Good Candidates:

- A building with a gym or showers
- Rec center with a pool
- Ice skating rink (showers and Zamboni)
- School buildings with pools or gyms
- Police and Fire Stations





Rule of Thumb for Storage:

1 ft^2 of collector area :

1 gallon hot water storage

Room for Storage Tanks and Plumbing:

Feasibility Study

Identify buildings that could make use of the technology and for feasible buildings, develop a design and roof plan.

- One week of water metering
- MassCEC $5,000 Rebate
- Schedule a review meeting
- Identify risks and barriers in narrative and meeting

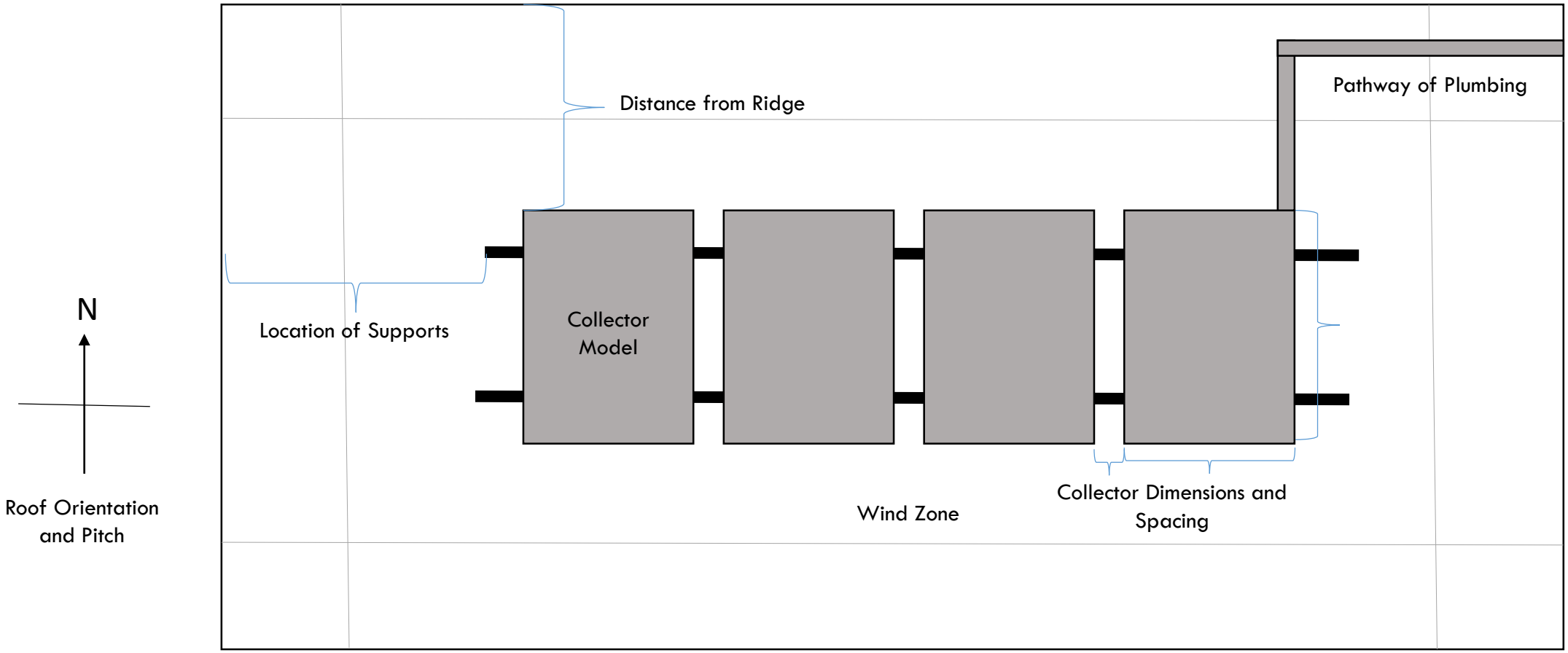
Feasibility Studies: What to Expect:

- A **Preliminary Walk-Through** if assessing multiple sites
- A **Few Hours** on site to:
  - measure roof supports
  - install water metering
  - Assess current equipment and measure space
  - Assess roof quality and measure solar insulation on site.
- Flowmeter testing for **One Week** on site for data collection
- An analysis and energy model with **RETScreen, T-Sol**, or **PolySun** tools
- An **Economic Model** including applicable incentives
- Vendor to **Apply** for feasibility study rebate

Identify Risks and Barriers:

- Ask vendor to include main risks and barriers for each potential project in the feasibility study so that you can address these in the installation procurement
- Set up a review meeting with the vendor to get their feedback and thoughts on the projects in person.
- Include facilities managers in these conversations so that you can better anticipate design changes
- Keep in mind that you will need to have a final structural report as part of the installation work.

Roof Plan: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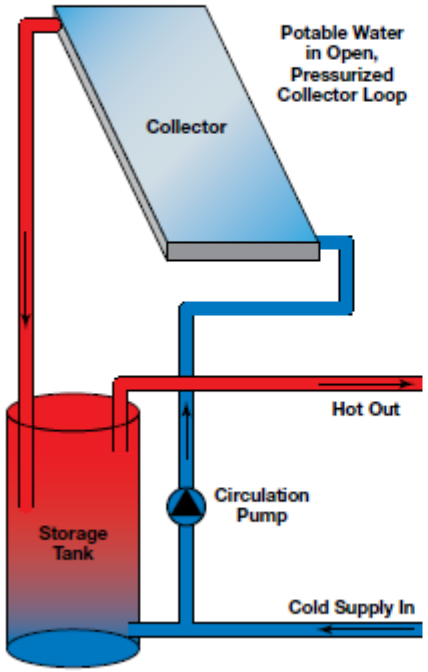
Roof Orientation and Pitch
Distance from Ridge
Pathway of Plumbing
Location of Supports
Collector Model
Wind Zone
Collector Dimensions and Spacing

Roof Plan:

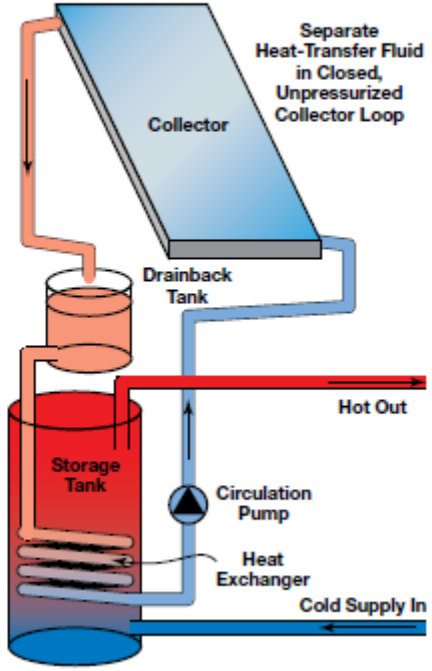
Source: NABCEP Solar Hot Water Installer Resource Guide p.56 from Solar Energy International http://www.nabcep.org/wp-content/uploads/2013/08/NABCEP-SH-Guide-8-5-13.pdf

System Diagram:

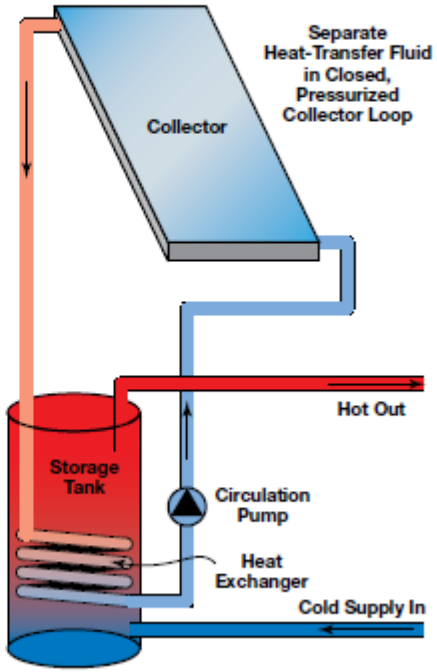
Direct Forced-Circulation:
Open-Loop



Indirect Forced-Circulation:
Closed-Loop, Drainback



Indirect-Forced-Circulation:
Closed-Loop, Antifreeze



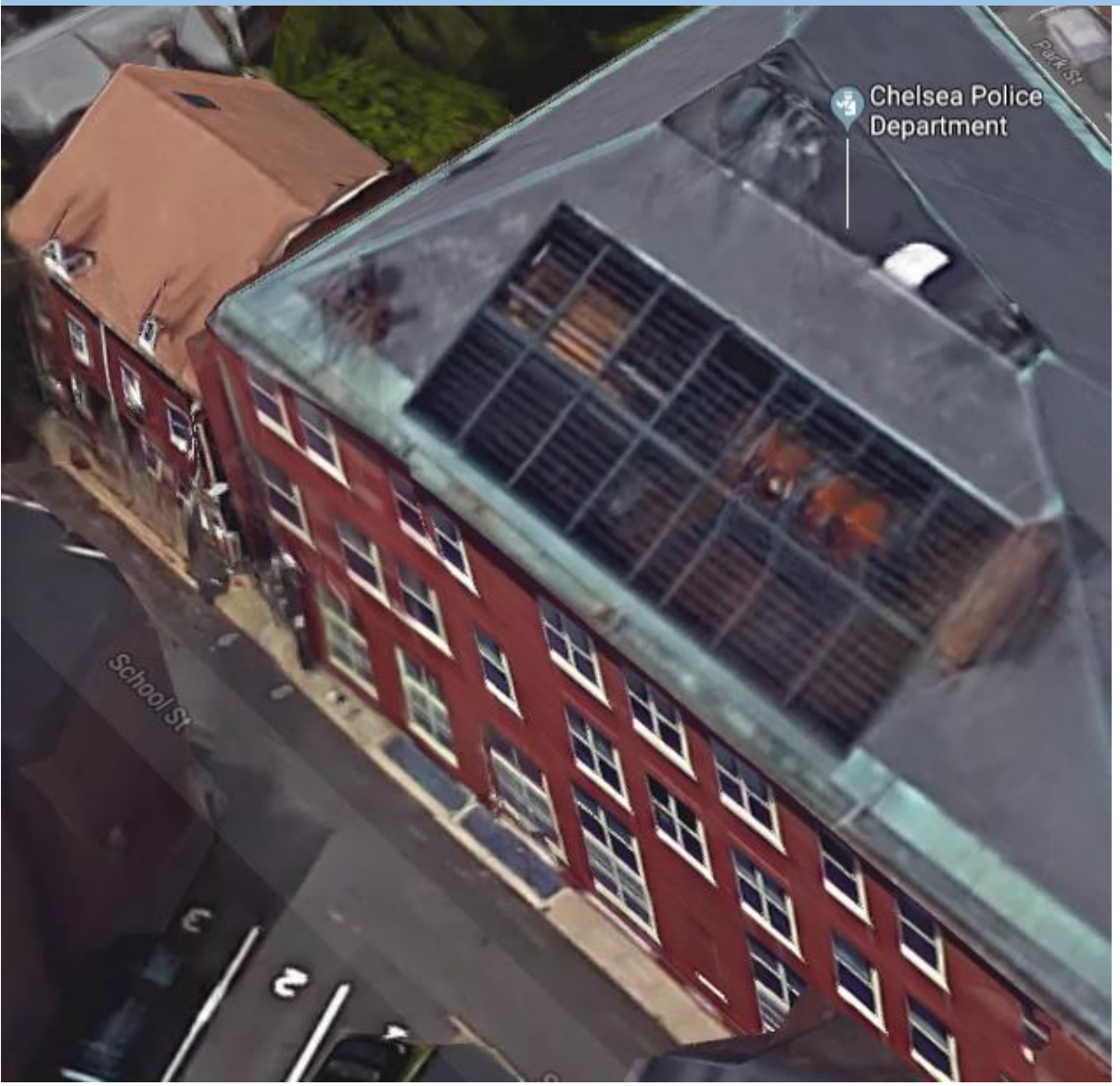
Source: NABCEP Solar Hot Water Installer Resource Guide p.57 from Solar Energy International http://www.nabcep.org/wp-content/uploads/2013/08/NABCEP-SH-Guide-8-5-13.pdf

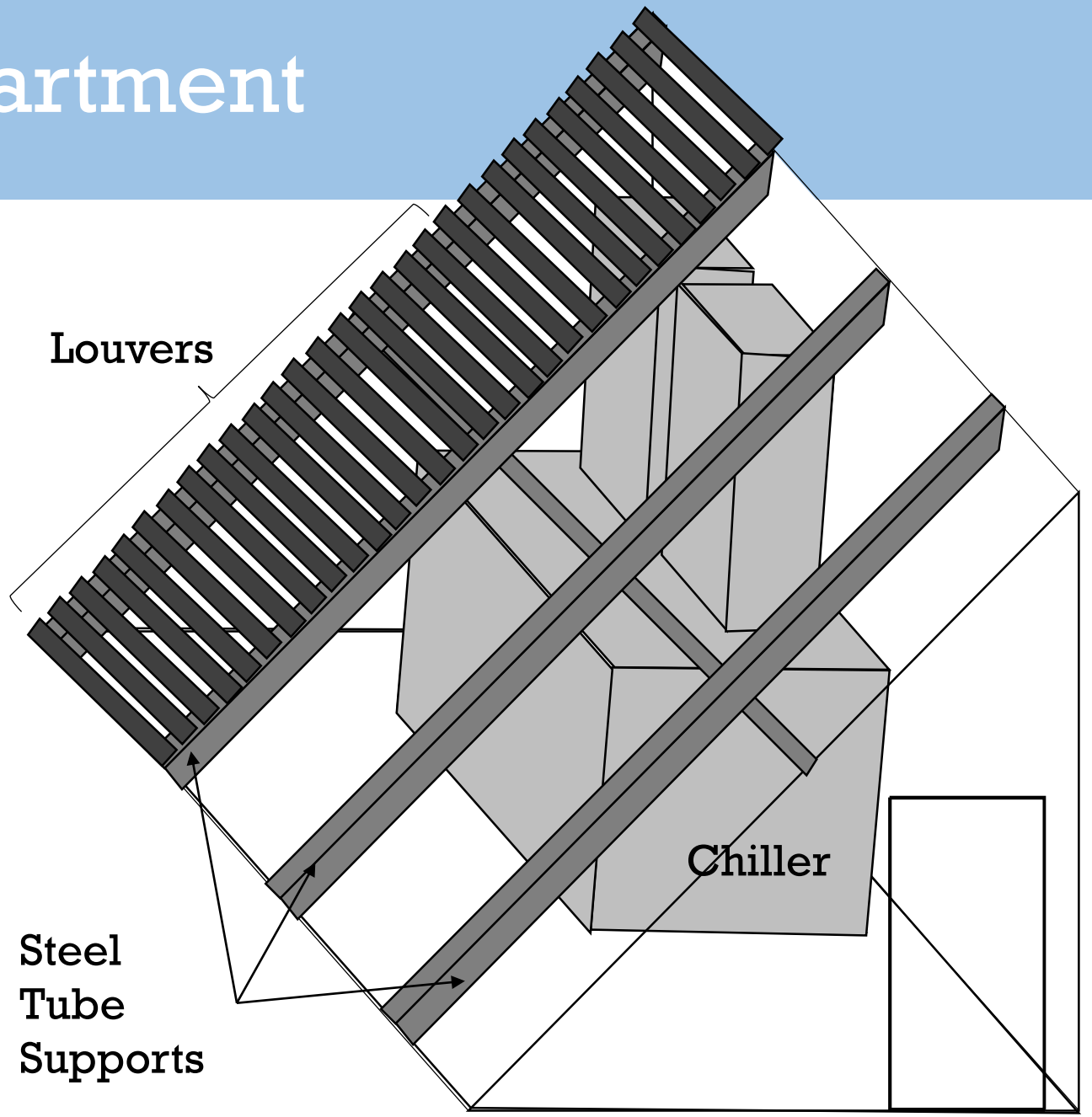
Installation

Ensure that the plans for the system meet the specifications of the feasibility study, and that the procurement is clearly organized.

- Type of collector and system
- Total annual field yield
- SRCC rating
- Storage size and equipment location

Chelsea Police Department





Chelsea Police Department

Price Form

Table 1. Gross Cost					
Item #	**Item**	**Unit**	**Quantity**	**Unit Cost**	**Total Price**
1.0	Chelsea – Material and Labor for proposed solar hot water system	System	1	$	$
2.0	Winthrop – Material and Labor for proposed solar hot water system	System	1	$	$
3.0	Maintenance	Years	10*	$	$
Total Cost					**$**
**5 years of maintenance for Chelsea and 5 years of maintenance for Winthrop*					

Table 2. Credits				
Item #	**Item**	**Chelsea**	**Winthrop**	**Total**
4.0	Value of AECs as calculated per this bid	$	$	$
5.0	Value of MassCEC Incentive as calculated per this bid	$	$	$
Total Credits				**$**
**Bidders must use the spreadsheet provided at http://mapc.ma/SHW02 to calculate value of credits. Bidders must submit a printed copy of the tab "1. Inputs & Incentives" of the spreadsheet for each of the Cities with their submission.*				

Award will be made based on the Grand Total Price. The Grand Total Price is defined as the Total of Table 1 minus the Total of Table 2 of the Bid Price form.	
Grand Total Price	$

Solar Thermal Incentive Calculator

Solar Thermal Incentive Calculator

Directions: **Fill out all yellow fields,** including: 'Installation Cost', 'Number of Collectors', 'Surface Orientation Factor', and The OG-100 SRCC ratings. The MassCEC Installation Rebate and AEC's incentive will populate. To see the methodology for an incentive, click on the tab for that incentive to see the individual calculations.

Project Name	Winthrop Ice Rink
Project Address	45 Pauline Street Winthrop, MA

Number of Collectors	10	
Surface Orientation Factor *	0.98	(.98 for Winthrop Ice Rink, .92 for Chelsea Police Station)
Annual, Average Solar Shading	1	

Fill the three fields below from the corresponding fields in the chosen collectors' OG-100 SRCC Rating. Ratings for collectors can be found here:

https://secure.solar-rating.org/Certification/Ratings/RatingsSummaryPage.aspx?type=1

COLLECTOR THERMAL PERFORMANCE RATING	
Kilowatt-Hours (Thermal) Per Panel Per Day	Thousands of Btu Per Panel Per Day

MassCEC Rebate

For **Feasibility Study:** Up to $5,000 rebate

For **Installation:** Up to 50% of the system cost or $100,000 whichever is smaller.

$$\boldsymbol{Average\ SRCC\ Rating\ \times Number\ of\ Collectors\ \times \$100}$$

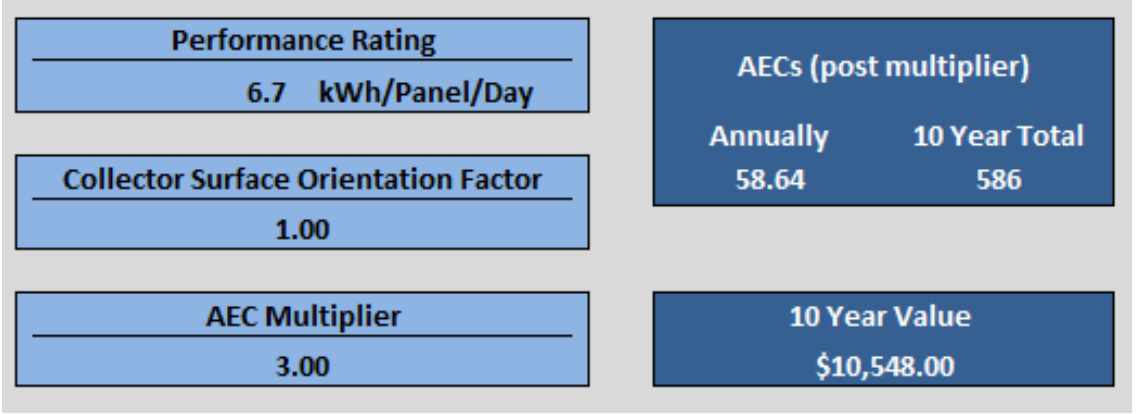
Thousands of Btu Per Panel Per Day			
Climate -> / Category (Ti-Ta)	High Radiation (2000 Btu/ft².day)	Medium Radiation (1500 Btu/ft².day)	Low Radiation (1000 Btu/ft².day)
A (-9 °F)	27.8	21.0	14.2
B (9 °F)	25.1	18.3	11.6
C (36 °F)	20.9	14.2	7.6
D (90 °F)	12.0	6.1	1.0
E (144 °F)	4.1	0.2	0.0

Alternative Energy Credits

- Small and intermediate systems do not need to be metered
- Price per AEC is expected to be between $15 and $25
- For small systems, can receive the 10 year total value

Classification	Small	Intermediate		Large
AEC calculation basis	**Calculated net renewable thermal output**	**Calculated net renewable thermal based on indirect metering**	**Calculated net renewable thermal output based on direct metering of fuel input**	**Metered net renewable thermal output**
Solar thermal: evacuated tube and flat plate solar hot water	Collector surface area less than or equal to 660 sq ft	Collector surface area between 660 and 4000 sq ft	-	Collector surface area greater than or equal to 4000 sq ft

For an 8 collector system with $18 per AEC:



https://www.mass.gov/files/documents/2017/12/14/Guideline%20on%20Metering%20and%20Calculating%20Useful%20Thermal%20Output%20of%20Eligible%20Renewable%20Thermal%20Generation%20Units-%20Part%201%20FINAL.pdf

Questions and Answers

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