New York's **Solar Thermal Roadmap**

Direction for
New York State's
Renewable Energy
Independent Future

New York
Solar Thermal
Consortium

The Solar Thermal Consortium Committee

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The Solar Thermal Consortium (STC) is a group of industrial, academic, and governmental representatives who are working to make New York State a leader in the Solar Thermal industry by identifying the roadblocks and creating a path forward via the "Solar Thermal Roadmap".

The STC is led by the collaborative efforts of Clarkson University's Center for Advanced Materials Process (CAMP), a NYSTAR Center for Advanced Technology (CAT); the New York Solar Energy Industry Association (NYSEIA); The Solar Energy Consortium (TSEC) and Droege & Comp. International Management Consultants. The STC also brings together a broad representation of industry professionals from closely related industries (such as plumbing, heating, cooling, and roofing companies), labor unions, government representatives, regulatory entities, and public advocates.

The Solar Thermal Roadmap is modeled on global best practices that have worked to create markets for this proven technology, while encouraging new ideas that will help build New York as a Solar Thermal leader. Through a deliberative and organized process the STC aims to establish a ready market through public awareness and acceptance of the advantages of Solar Thermal, thereby spurring private sector investment in the development, manufacture and sales of Solar Thermal products in NYS. The goals and visions of the STC are to:

1. Make New York the national leader in the research and development, deployment and manufacture of Solar Thermal technologies
2. Create an industrial/academic/governmental partnership to cultivate next generation Solar Thermal technologies
3. Train the workforce to manufacture, install, maintain and repair Solar Thermal systems
4. Increase residential and commercial adoption of Solar Thermal technologies for heating and cooling needs

Widespread adoption will bring Solar Thermal's many environmental, employment, and economic benefits to the state.

Special thanks to Sarah Osgood, Assistant Secretary for Renewable Energy in the Office of the Governor; Assembly Energy Committee Chairman Kevin Cahill; and Lee Willbanks, Office of State Senator Darrel J. Aubertine.

Executive Summary

The Solar Thermal Roadmap is focused on solar heat and hot water applications for residential and commercial buildings in New York State. Its goal is to develop the New York State Solar Thermal industry so that the total installed statewide capacity grows from its current estimated level of 6MW_{th} to 2,000 MW_{th} by the year 2020.

Achieving these goals will result in over $2.6B dollars in revenue and 24,000 new jobs. This level of implementation will save an estimated 6 million gallons of oil, 9.5 million ft^3 of natural gas and displace 320 million kW/h of electrical production annually by 2020 – which translates into an annual savings of over 350,000 tons of CO_2 emissions and consumer savings of over $175 Million per year. By meeting this goal, **NYS will position itself to become the national leader in the Solar Thermal industry.**

Solar thermal currently has hurdles to overcome in New York State. The technology and its benefits are not widely known by consumers. Sufficient industry knowledge and certified installers to support successful installations are currently lacking, and there are gaps in the value chain from materials to end-user.

The Solar Thermal Consortium (STC) brought together more than 130 stakeholders from industry, labor, academia, non-profit and government agencies for this effort. The stakeholder representatives worked to answer questions and provide specific recommendations. The input was used to identify the hurdles and create a plan that will lead to the development of a vibrant Solar Thermal industry in NYS.

The recommendations developed are to:

1. Create a statewide Educational Campaign and Electronic Resource to inform consumers about Solar Thermal and it benefits
2. Initiate a Solar Thermal financial incentive program to encourage installations by shortening the payback time of a Solar Thermal systems
3. Promote New York State as a location for Solar Thermal manufacturers
4. Invest in Research and Development to create a scientific base which systematically develops next generation Solar Thermal technologies
5. Clarify permitting procedures and union jurisdiction to simplify Solar Thermal installations

Funding for Solar Thermal efforts could come from the Regional Greenhouse Gas Initiative (RGGI), Renewable Portfolio Standard (RPS), NYS Public Service Commission or similar programs.

Single family "Combi" Solar Thermal system in Pomona, NY. In 2006 the system reduced the heating costs by approximately 40%.

Images and Data courtesy of Quixotic Systems, Inc.

Background

Experience has demonstrated the vulnerability of the US economy to energy supply, demand forces and costs. Volatility in oil prices will continue as worldwide demand increases and supply decreases. The effects of global climate change, also tied to fossil fuel consumption, are becoming more apparent and will become more severe in the future. The result is that energy has become a central factor in global, national, and local policy issues. The development of renewable and sustainable forms of energy is a critical concern. In this context lies the opportunity to develop industries and technologies to address future energy needs.

Incident sunlight provides over 1,000 times the total worldwide energy used by people[1] each day, every day. This makes sunlight the single largest source of energy available. Yet in the US less than 1% of our energy needs come from solar sources.[2]

Solar Thermal is one of the most promising renewable energy technologies due to its high energy production and low relative costs. It is considered, worldwide, to be one of the most cost-competitive clean energy technologies available on the market today. NYS is a heating climate, with more than 50% of our overall energy demand in buildings originating from indoor space and water heating. Therefore, the potential for exponential growth is real.

In addition to providing New Yorkers with an economical form of energy, Solar Thermal directly offsets fossil fuel consumption, reducing CO_2. NY State has an opportunity to expand this sector of the economy and position itself for a strong export base. Currently, NYS lags the world in terms of Solar Thermal usage, but there is a strong foundation upon which to grow, if the appropriate policies are put in place.

Energy Basics and the Solar Resource

Each year people use a total of 475 Quads (Quadrillion BTUs)[1]. This is equivalent to 3.8 trillion gallons of gasoline or 140 trillion kWh of electricity or 17 billion tons of coal. In contrast the sun provides about 680,000 Quads which is the equivalent of 5,500 trillion gallons of gasoline or 201,000 trillion kWh of electricity or 24,000 billion tons of coal each year.

The scale of the solar resource is even more immense when one considers that the total reserves of fossil fuels are estimated to be about 40,000 Quads. Which means the sun provides over 17 times the total energy stored in all fossil fuels in a single year.

Schematic of a typical residential Solar Thermal System. System can be used to provide hot water for domestic use (DHW), for space heating, or for both (a "combi" system)

Solar Thermal Overview

Solar Thermal is most commonly seen today in the form of flat panels or tube collectors that are used to heat a fluid. The heated fluid is then used to provide:

- **Hot water for consumption:** Domestic Hot Water (DHW) Systems provide hot water than can be used for both domestic and commercial buildings for consumption and/ or for space and pool heating. In NYS these systems can provide 50-70%[3] of the domestic hot water used in a typical residence.

Solar Air heating application at Fort Drum. Project included 27 buildings, 110,000 ft^2 of solar panels with 4 MW_{th} capacity. This application is projected to save the equivalent of 300,000 gallon of heating fuel annually displacing over 2,000 tons of CO_2.

Data and images courtesy of Solar Wall.

- **Combi systems:** These larger systems can be sized to provide both hot water and space heating to further offset energy needs.

- **Hot air for building heating:** Solar thermal systems have been developed to heat air instead of liquid. The heated air is used to provide space heating. The air can either be clean air that is drawn in (and heated) through unglazed panels mounted to the exterior and connected to the building HVAC system or building air that is re-circulated (and heated) through glazed roof mounted panels. Either system can eliminate or significantly reduce the conventional heat load.

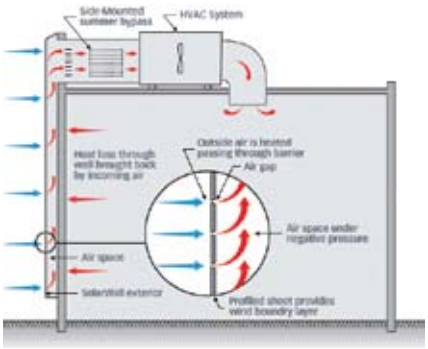
- **Cooling applications:** This technology uses the heated liquid in combination with a specialized air conditioning cycle to provide cool air. This technology has been utilized on a commercial scale; however these systems are currently expensive and complex. Significant research and development remains to advance these systems for residential use.

- **Solar Electric Generation from Low Temperature Solar Heat:** Large scale Concentrating Solar Thermal (CST) for electricity generation is being installed in the southeast U.S., where sunlight creates steam which is used to turn turbines. While CST technologies don't work in the Northeast due to the area's diffuse sunlight, international firms are aiming to use diffuse sunlight and lower temperatures to create 1 MW systems that can produce competitive-priced electricity. Significant research and development remains to advance these systems for both commercial and residential use.

Adoption of Solar Thermal Technology World Wide

International

Solar Thermal technologies have already been shown to positively impact a wide range of economic and environmental areas. Around the world, the technology is becoming widely accepted, with the Europeans far ahead of the US in deployment. In 2008 the European Union (EU) and Switzerland saw the Solar Thermal market grow by over 60% to an annual installed level of 3,300 MW_{th}/year. Germany, who leads the European market with approximately 48% of the market share, alone installed approximately 1,200 MW_{th} in 2008.[4]



Schematic of an unglazed Solar Air heating system. Air can be preheated by 30°F to 76°F before entering the air handler, reducing the load on the conventional heater.

Schematic courtesy of Solar Wall.

Solar Thermal Capacity

Solar thermal capacity is usually cited in terms of thermal power potential (MWth) and installed collector area (m2 or ft2). A typical flat plate collector has an area of about 30 ft2 (2.75 m2) and a potential of about 1.9 kWth (at 700 W/m2).[4] The 1,200 MWth installed in Germany would be about 630,000 average flat plate panels if all of the installed capacity were typical flat plate collectors

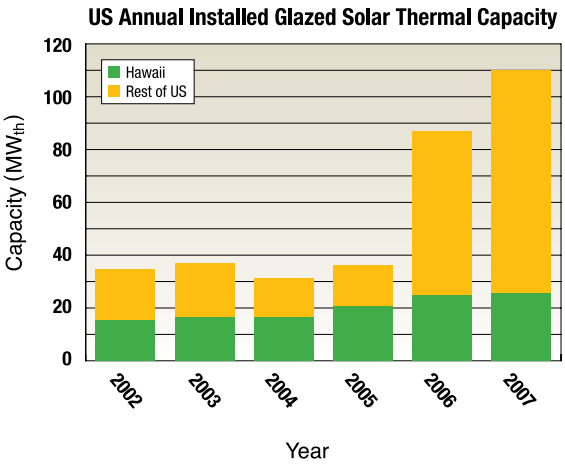
Solar Thermal has also seen application and growth in cold climates such as those encountered in NY State. In 2008 Canada installed 40 MW_{th} for both space and hot water heating.[5] Poland has one of the coldest climates in Europe. From 2001-2008 the emerging Solar Thermal market in Poland grew at an annual rate of 43%. In 2006 the installed capacity was 29 MW_{th} for the country.[6]

These experiences show that the technology works to reduce consumer energy demand and costs. In Europe Solar Thermal systems displaced the equivalent of approximately 1.2 billion barrels of oil and 4,000 tons of CO_2 emissions in 2006.[7]

Economic benefits in the form of revenue and jobs are clear as well with sales in Europe surpassing $4.1 billion in 2008. The industry currently employs more than 40,000 people.[4] In Germany alone the industry employed approximately 28,000 employees and had annual revenues of $2.3 billion during that time.[8]

These levels of adoption and market growth are a result of many factors including: energy cost, governmental regulations, aggressive marketing educational programs and incentive programs. For example, Canada provides aggressive Solar Thermal incentives aimed at solar air and solar water heating technologies, in both the commercial/industrial/institutional (ICI) sector and for residential consumers.

While energy costs and incentive programs are drivers in the adoption of Solar Thermal systems, other factors such as sustained governmental policy and targeted educational/marking campaigns also spur the market. The EU has developed a long range energy goal that includes Solar Thermal technology as a key piece in its energy portfolio. The EU goal is to provide 50% of the heating needs through Solar Thermal by 2050.[9] While these targets are quite ambitious, the EU has developed a comprehensive strategy that includes investment in technology advancement (R&D), policy support via renewable energy requirements, and public education to meet these goals. The renewable energy requirements do not mandate renewable technologies, but the cost effective nature of Solar Thermal has lead to their wide adoption within these programs.

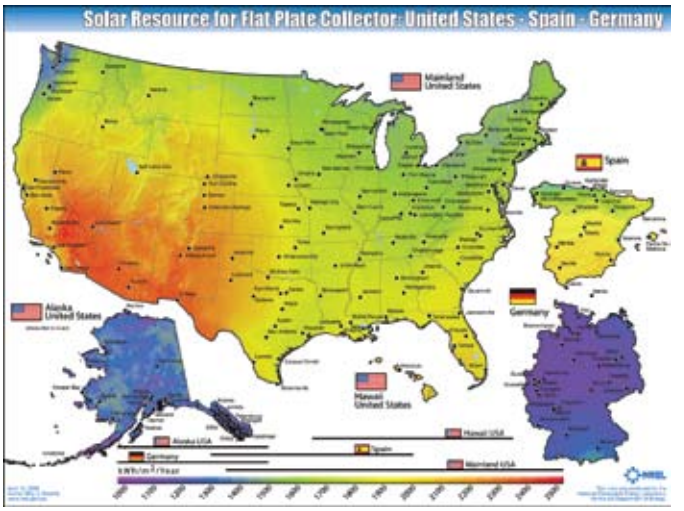


Hawaii leads the US in Solar Thermal capacity accounting for nearly 25% of the US Solar Thermal market.[10] This large per capita disparity is driven by a combination if high energy costs and strong public policy similar to the EU. The 2006 jump in installations was due to an increase in the federal investment tax credit and a spike in energy prices.

US

In the US, the renewable energy makes up approximately 7% of the total energy usage with the vast majority coming from Biomass and Hydro power. The total US installed Solar Thermal capacity is 7,600 MW_{th} which represents approximately 0.06% of the entire US energy usage.[2] While this is close to the German installed capacity of 8,000 MW_{th} the majority of this capacity is taken up by pool heating rather than by domestic hot water generation or space heating. Since heating and cooling makes up 30% of the total energy use in the US, there is an opportunity for Solar Thermal to significantly impact the energy usage. There are three primary reasons for the disparity between the US and European markets:

1. The historic relatively low energy prices in the US
2. A more developed environmental awareness in Europe
3. The lack of a focused governmental effort to encourage adoption of renewable energy systems



Germany's solar resource in comparable to Alaska, while New York State has about 25% more solar energy available.

Map courtesy of NREL.

Solar Thermal in New York State

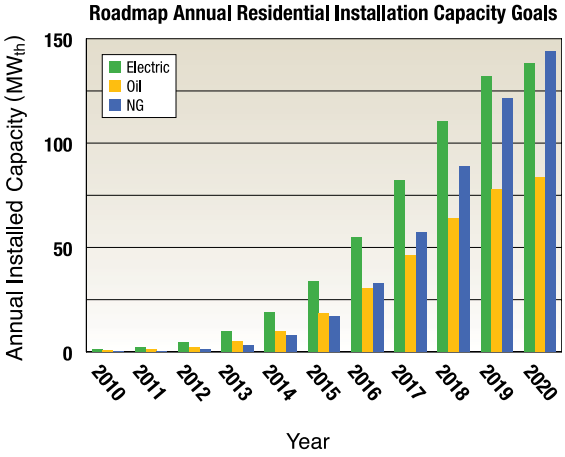
The rationale for developing a strong Solar Thermal industry in New York State comes from three areas:

1. End user energy cost savings
2. Environmental impact
3. Economic development through job creation and systems industry sales

The markets currently show that the installed Solar Thermal capacity is 8,000 MW_{th} in Germany[4] versus an estimated 6 MW_{th} in NYS. On a per capita basis the contrast is just as stark with 100 W_{th}/person installed in Germany and 0.3W_{th}/person installed per person in New York State, or a difference of nearly 1000 times. Given the positive impact that Solar Thermal has had in terms of energy consumption and job creation in Europe, New York State is truly a market waiting to be tapped.

Solar Thermal Roadmap Adoption Model

The model looks at two distinct consumers: a typical family of four requiring 80 gallons of hot water per day, and a commercial entity with a requirement of three times the hot water demand of the typical family. Systems were sized to provide 50% of the yearly hot water.[3] Installed systems costs were initially set at $8,000 and $18,000 respectively also based industry input. System costs were held fixed for three years and then prices are assumed to drop at an annual rate of 5% due to market competition and system technology advances. Energy costs are based on 2009 New York State average rates and are increased at an 8% annual rate based on recent escalation rates.[10] Adoption rates were modeled based on the 2000 MWth total installed capacity by 2020 goal with 70% percent residential and 30% commercial installations.



Roadmap annual installation level goals. Electric hot water users first, where payback is shortest, followed by oil and gas.

The Solar Thermal Model

The roadmap target goal for the Solar Thermal adoption in New York State is a total installed capacity of 2000 MW_{th} (combined residential and commercial systems) by 2020. A model for DHW systems was developed to determine the potential impact of the adoption of Solar Thermal technologies and to investigate incentive and growth levels needed to reach this goal.

Energy Cost Savings

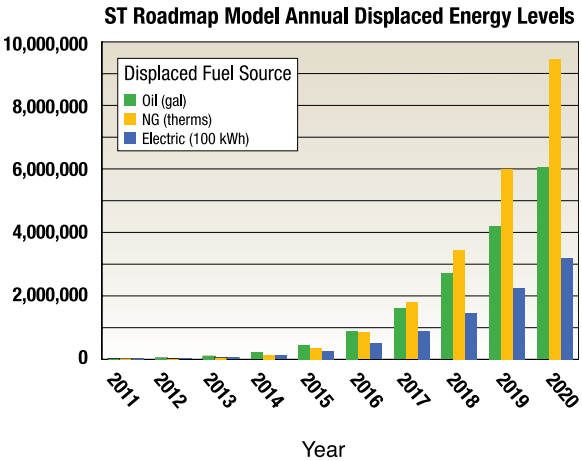
The price of energy in New York State is among the highest in the country. In 2009, electricity averaged 17.8 ¢/ kWh[11], fuel oil averaged $2.72/ gallon[12], and natural gas averaged $1.55/ 100 ft^3.[13] The four person model family will spend between $390-1100 (depending on the fuel source) to provide domestic hot water in 2010. Over the past 10 years energy prices in New York State have increased at a substantial rate averaging 9% and 11% annually for fuel oil and natural gas respectively.[10] A conservative 8% annual escalation in fuel prices is assumed in the model which drives the cost for heating hot water for the model family to $620-1,700 (depending on the fuel source) by 2020.

In 2010 the Solar Thermal model family of four will see an annual cost savings of $195-550. The total consumer cost savings in 2010, based on the current level of 500 installed systems, is estimated to be $219,000. By 2020, with an annual increase in energy prices of 8%, the savings are projected to increase to $310-850 per household. With the 2000 MW_{th} capacity reached in 2020 the total annual consumer cost savings is projected to be over $175 million.

Environmental Impact

Greenhouse gas emissions and decreasing fossil fuel supplies will play key factors in how future energy policy is shaped. Renewable sources of energy such as wind and solar (PV and thermal) offer ways to move from a carbon based energy system to more sustainable energy use. Solar Thermal technologies present a means by which this change can be made now.

The model family requires approximately 200 gallons of fuel oil, 250 therms of natural gas (1 therm ≈ 100 ft^3 of gas) or 6250 kWh of electricity to provide hot water for a given year based on an estimated 80 gallons of hot water consumption per day. The associated CO_2 emissions are 2.7 tons for fuel oil,[14] 1.5 tons for gas[14] and 4.2 tons for electricity[15] per year per household. In 2010 the total carbon savings for the 500 installed residential systems is estimated to be 873 tons of CO_2. By 2020 this level will be over 350,000 tons of CO_2 annually with a total of 935,000 tons displaced.

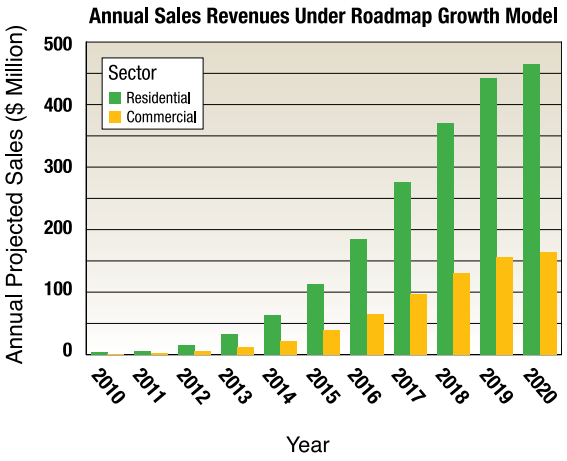


Annual displaced energy levels based on Solar Thermal Roadmap adoption model.

Fuel savings, from residential DHW applications alone, also show potential for a dramatic reduction. In 2010 the model family with a Solar Thermal system could save approximately 100 gallons of fuel oil, 125 therms of natural gas or 3,100 kWh of electricity. Based on the projected number of NYS installed systems per displaced fuel source, 2010 total savings are 15,000 gallons of fuel oil, 6,300 therms of natural gas, and 935 MWh of electricity. In 2020 annual savings grow to 6 million gallons of fuel oil, 9.5 million therms of natural gas, and 320 GWh of electricity. Total cumulative savings from residential adoption in the model are projected to be 16 million gallons of oil, 22 million therms of natural gas and 878 GWh of electricity.

Economic Impact

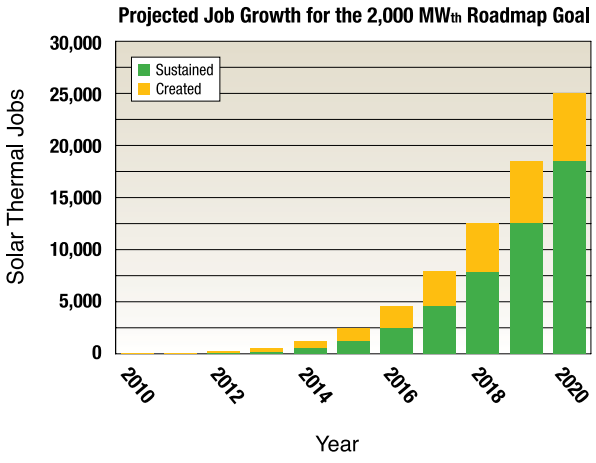
Economic impact is assessed in terms of projected sales revenues and job creation for the 2,000 MW_{th} roadmap goal. Systems were modeled with initial installed costs of $8,000 for residential systems and $18,000 commercial systems based on industry input. The costs were held fixed for 3 years and then reduced at an annual rate of 5% each year after that. The cost reduction is assumed to come from market forces (increased competition, supply) and future technological improvements. Combined residential and commercial sales start at $5 million in 2010 and rise to $629 million in 2020. Total revenues from 2010-2020 are projected to be $2.6 billion.



Under the developed model combined sales grow from $5M to $629M with sales totaling $2.6B over the next 10 years.

Job creation is modeled based on current job levels in Europe. In Europe one job is created and sustained for every 1000 ft^2 of newly installed panel area.[16] These jobs include manufacturing, installation and maintenance. At the current NYS installation level of 5 MW_{th} approximately 36 new jobs will be created and sustained. Under the developed growth model this rises to approximately 12,000 new jobs in 2020. In total approximately 24,000 jobs will be created and sustained by 2020 under the adoption plan proposed.

The model analysis shows the tremendous potential of the Solar Thermal industry, based *only* on the development of a NYS Solar Thermal *domestic hot water* market. The potential impact in terms of savings in end-user costs, energy and environmental savings, revenue and job creation are multiplied when other technologies such as solar space heating, "combi" systems and solar assisted cooling are considered. The potential impact is further multiplied when the relatively untapped US market is considered. By investing in the development of a Solar Thermal industry now, New York State positions itself to be an *industrial and technological leader* in the industry, providing the base for expansion of the economic and job potential.



Estimated job growth potential for NYS Solar Thermal industry based on European Solar Thermal job levels. An estimated 25,000 jobs could be created by achieving the 2,000 MWth Roadmap goal.

Solar Thermal Value Chain

Stake Holders

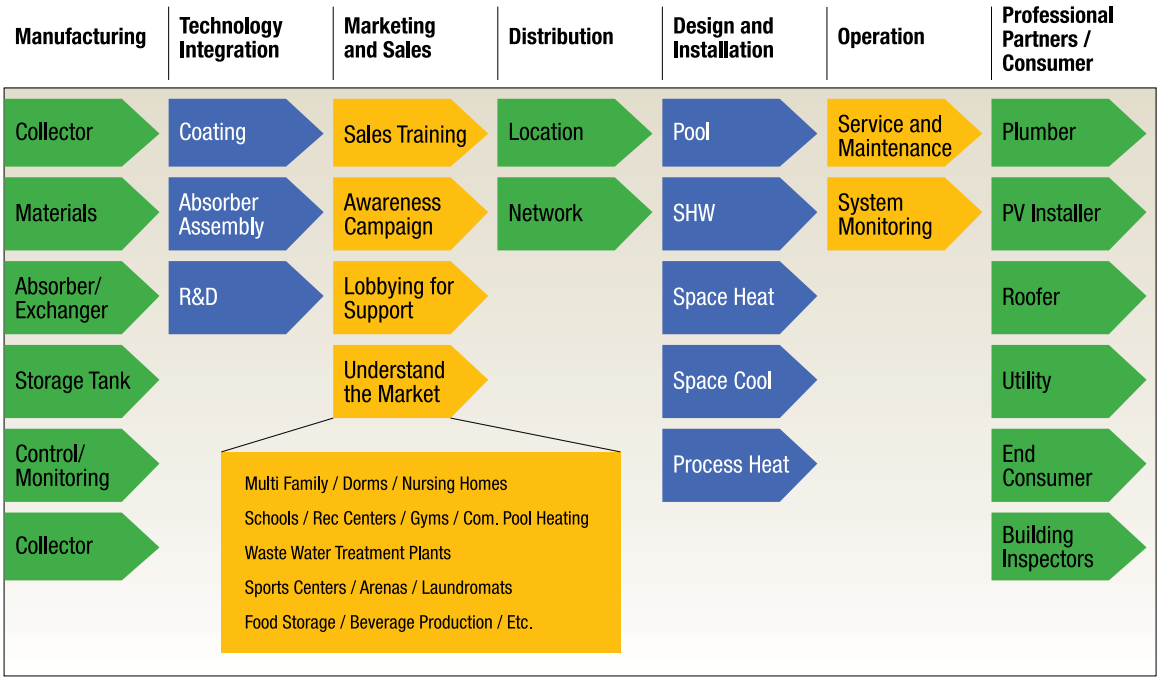
Clearly the impact of a vibrant Solar Thermal market is significant to NYS. In assessing what is required to achieve the 2,000 MW_{th} goal, the Solar Thermal Consortium performed value chain analysis to allow the identification of the stake holders and barriers to the industry and create a solution based roadmap that addresses these barriers.

Solar Thermal dairy installation.

Image courtesy of EarthKind Solar.

The value chain starts with the manufacturing of the basic components of a Solar Thermal system. These component systems must then be assembled into systems. Systems must be marketed and installed. Consumer needs drive system design which must be integrated into an existing building or new building project by contractors and architects. Systems will need to be serviced through their life. Research and development allows for new technologies to be developed and current technologies to be improved, lowering costs while increasing efficiency and lifespan. Technology advances and improvements require close coupling with industry to determine research direction based on industry needs.

Economic development organizations and public agencies play roles outside of the value chain that support the development of the industry. Economic development organizations can be tapped to aid in the development and expansion of the industrial base. They are knowledgeable in the existing industrial capability that could become suppliers of components or materials in the manufacturing process. Further economic development organizations know and understand the local and state incentives that will allow for new manufacturing capability to be located within NYS. Public Agencies' support and commitment on a local, state and national level will be required for the development of the vibrant Solar Thermal market envisioned in this roadmap.



The Solar Thermal Value Chain.

Developed by H. Sebastian Göres, Droege & Comp.

Identification of Potential Barriers

Within the value chain there are potential barriers to the development of the Solar Thermal industry in NYS. The barriers include:

- **Awareness and Perception of Solar Thermal:** The development of a growing Solar Thermal market ultimately depends on adoption by consumers which requires an awareness of Solar Thermal systems and their benefits. Solar Thermal also faces an image issue based on experiences from the 1970's and 80's. At that time the systems were perceived to be unreliable with short life times. Poor system integration and installations were primarily to blame for these experiences. The technology has advanced since then and the European experience has shown current technology to be robust and effective.

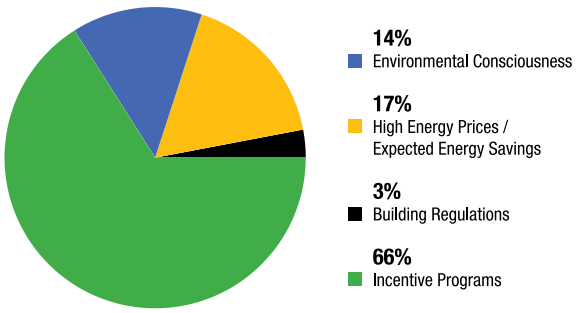
- **Support of Public Officials and Agencies:** Public sector support is required in order for Solar Thermal adoption levels envisioned by this roadmap to be achieved. The public educational campaign will require the support of both the industrial stake holders and public officials to be successful. Governmental support is also required initially to make the systems cost effective and to attract manufacturing capability to the state. This requires an educational and lobbying effort on the part of the industrial partners targeted at state, federal and national officials.

- **Availability of a Trained Workforce:** The development of a trained workforce is critical to achieve the goals of this roadmap. It is vital that the quality of installations be high so the systems function properly. An installation workforce needs to be developed and trained to ensure that this occurs. Courses are available which can provide this training but few are located in NYS.

- **System Cost**: System costs are one barrier to the widespread adoption of Solar Thermal technologies.[17] While there is a segment of the current Solar Thermal market that identifies environmental issues as the primary driver for the adoption of Solar Thermal, the goals of this roadmap cannot be achieved by this segment of the population alone. Current system and permitting costs need to be addressed to grow the industry.

- **Technology Advancement and Development:** The ability to fully realize the potential of Solar Thermal technologies is limited by long term technology development. Advanced technologies such as solar assisted cooling, integrated PV/Solar Thermal systems, and low temperature Solar Thermal electric generation are potential areas of opportunity for Solar Thermal systems. Thermal storage is also an area that if solved would allow for advancement of the industry.

US Solar Thermal Market Drivers



Market research shows that economic reasons, such as high energy prices and incentive programs, are the important drivers in the US Solar Thermal market.[17]

Steinway & Sons Piano manufacturing facility in Queens, NY. Thirty-eight tracking collectors heat a water-glycol mixture to 340°F and use an absorption chiller to provide dehumidification and cooling for the facility.

Image courtesy of Mark D'Antonio of ERS, Inc.

The Solar Thermal Roadmap

The analysis above shows that Solar Thermal technology has the potential to significantly reduce energy demands while stimulating job growth and economic development within NYS. The Solar Thermal market in NYS, and in the US, is largely undeveloped at this point. Clearly an organized effort to promote the industry would position New York State as the Solar Thermal leader. The recommendations below seek to address these barriers in a logical, cost effective manner to promote the roadmap goals of 2000 MW_{th} total installed capacity and the creation of 24,000 jobs by 2020.

Recommendations are grouped into five main categories:

1. Organization
2. Awareness and Marketing
3. Institutional Issues
4. Workforce Development
5. Research and Development

Some programs in each area are identified below.

Solar Thermal Development Organization

The success of the proposed roadmap requires a concerted effort from all stakeholders to ensure success. The Solar Thermal Consortium (STC) was formed to organize and oversee the initial effort. For the next phase, the STC could be organized under an existing organization, such as The Solar Energy Consortium (TSEC) and could at some point develop into its own organization. The STC should continue to be composed of representatives from all segments of the stake holders and should be responsible for organizing, developing and implementing the recommendations.

Awareness and Marketing

Create a Solar Thermal Resource for NYS
A Solar Thermal website should be created to provide a central resource for Solar Thermal solutions in NYS. The web site should be monitored by a university and funded by NYSEIA and NYSERDA (estimated budget $100k/year for website development and administration). The website would be a resource that includes:

Solar Thermal installation in Clarksville NY.

Image courtesy of E2G Solar.

1. **Listing of Collector Manufacturers:** Performance ratings, locations, # of years in business, collector sizes, etc.
2. **Step-by-Step Process Map for Solar Thermal:** Steps for developing and installing Solar Thermal system in NYS.
3. **Incentives Database and Instructions:** Updated database that includes all Solar Thermal incentives and the specific instructions for each incentive plan.
4. **Case Studies:** Collection of case studies online which includes sample Solar Thermal systems. Manufacturer neutral. Includes financial, performance, and visual references.
5. **Solar Thermal Applications:** Description of mainstream applications of Solar Thermal technology, including: Hot Water based Space Heating, DHW, and Solar Assisted Air Heating.

Create a Public Marketing Campaign to Promote Solar Thermal Successes
Experience in Europe shows that educational campaigns impact consumer awareness and lead to the adoption of Solar Thermal technology. It is recommended that a targeted educational campaign be developed and executed to promote the adoption of Solar Thermal technology. The purpose of this campaign would be to educate consumers on solar technology and its value, dispel myths, and alert consumers to financial incentives offered.

The campaign should be developed during the first year by a coalition of private and public sector representatives and managed by the STC. The budget ($400k - $1M during the first year) should be provided half by industry and half by the public sector. During the second and third years of the campaign the budget could include additional funds based on market growth. Educational information could be disseminated through the SolarThermal web resource site and NYSEIA.

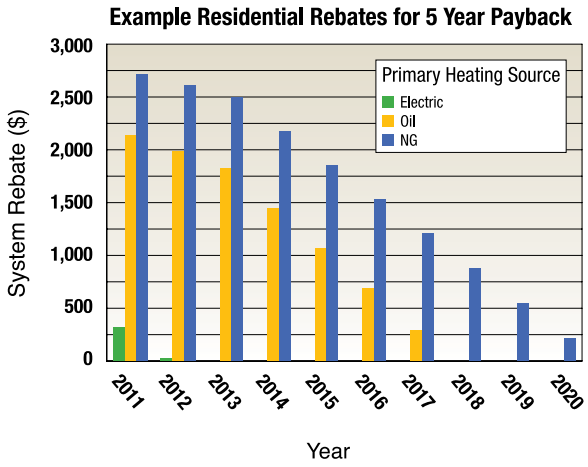
Understand Consumer Issues Surrounding Solar Thermal
In order to track consumer awareness and satisfaction it is recommended that a consumer survey be conducted each year (budget $100k/year). The survey will focus on installers, consumers, and the general public. Data from the surveys will be used to determine the market condition (number of installs, system costs, etc.), consumer satisfaction, and effectiveness of the marketing campaign.

Develop a Marketing Plan to Attract Manufacturers for NYS Economic Development
One of the goals of this roadmap is to provide economic growth within NYS. Growth in Solar Thermal sales can also lead to job increases beyond installation jobs through increased manufacturing capability within the state.

Interactions with European manufacturers during the course of developing this roadmap have indicated their desire to locate manufacturing capabilities within the US.

In order to take advantage of these growth opportunities it is recommended that within three months a committee lead by economic development organizations be formed to develop a statewide marketing plan for the expansion and attraction of manufacturing capabilities in NYS. The marketing plan should address:

1. NYS and US market potential
2. State incentives to attract companies
3. Existing workforce capability and industrial base
4. R&D capabilities



Example incentive levels required to provide a 5 year payback for the roadmap model residential Solar Thermal system. Incentives were based on primary heat source and are designed to sunset. Incentives totaled $160M compared to the $2.6B in revenue.

Drive Adoption of Solar Thermal Systems by Reducing System Costs Incentive Programs
Current tax incentive programs (30% federal, 25% state) for Solar Thermal systems provide a payback period for the average system of about 11-15 years for the model residential systems. Payback for commercial systems can be significantly shorter due to accelerated depreciation. It is recommended that an incentive program be combined with the current tax rebate program to reduce the payback term for Solar Thermal systems. It is further recommended that all incentives be tied to installer certification to encourage installation standards.

A fixed rebate model would pay a fixed amount based on systems size and capability as well on the primary heating source. Such an incentive program could include residential as well as commercial, industrial, institutional, and agricultural consumers, though they may be structured differently. The incentive program should be designed to sunset as system costs decline and energy prices escalate. This model is attractive as it decreases the upfront out of pocket expenses which may be a barrier to adoption of the technology.

Solar Thermal installation in Upstate NY.

Image courtesy of EarthKind Solar.

Solar Thermal installation at SUNY Binghamton.

Image courtesy of EarthKind Solar.

Performance based incentives would provide incentive structure based on actual energy production and would be paid each year the system is in operation. Performance monitoring of systems should be required, and the system should have to be registered in order to qualify for incentives. There is a risk, however, that the actual performance may not achieve expected performance to receive the desired rebate. Rebates should be structured so that they are returned to the manufacturer - who would then assume the risk. Incentive programs could also be tied to utility companies. For example the LIPA Solar Rebate Program is designed to offset electric usages through adoption of renewable energy sources. This is particularly attractive to customers who use electricity to provide heat and hot water. The success of the LIPA program is clear. LIPA reports that since 2000 it has paid out approximately $59M in incentives resulting in over 2,400 installations (mostly PV) on Long Island and the creation of over 50 companies to do installations. PV system costs have drop to 35% through this program and a combination of state and federal incentive programs. Such programs could be expanded or developed to include NG and oil customers.

Institutional Issues

Simplify Permitting for Solar Thermal
Solar Thermal systems cross over many predefined trades and permitting requirements. In regions of the state where permitting is required, permit costs and requirements can significantly increase systems costs. It is recommended that a permit system for Solar Thermal systems be developed such that a single permit can be applied for and granted for installation. Such a permit process would simplify installation procedures and reduce costs, while still ensuring compliance with zoning and building requirements.

Clarify Union Jurisdictional Issues
For non-residential and public installations, there are issues of jurisdiction and prevailing wage rates that need to be resolved. It is recommended that the STC work with the unions and the NYS Department of Labor to clarify jurisdiction and wage issues, and work toward their resolution.

Building Codes
Recognizing that the operation of buildings uses almost 40% of our energy demand[18], any comprehensive CO_2 plan must plan for the eventual "de-carbonizing" of buildings. It is recommended that certain levels of renewable energy be mandated directly into the building code. Generating 10-20% of the building's energy from clean sources is possible given current technologies, and it is proposed that a code be adopted so that all new buildings over 10,000ft^2 in size must generate 10-20% of their energy from onsite renewable energy generation.

Workforce Development

Expand and Promote Value of Installer Certification
To encourage minimum installation quality standards state financial incentives could eventually be offered for systems that are installed by professionals who have passed at the minimum an entry level solar hot water certification exam. The North American Board of Certified Energy Practitioners (NABCEP) does currently offer a Solar Thermal certification test, though the requirements to sit for this exam would exclude the majority of the current installers and restrict the initial growth of the industry. Currently there is no "entry level" exam, though NABCEP is currently developing one. In order to prevent a bottleneck in installation certification it is proposed that New York develop a staged program.

Stage 1: Until the development of NABSEP Entry Level Installer Certification:

- Installation by a full NABCEP Solar Thermal certified installer, or
- Installation by an installer who takes and passes an installation course offered by the Institute for Sustainable Power (ISP), an ISP-Certified Master Trainer or Affiliate, NABCEP, or an United Association of Plumbers and Pipefitters (UA) approved

Solar Thermal course, plus a 10 hour OSHA approved safety course, and
- Have a credentialed professional inspect and sign off on the installation.

Stage 2: One year after development of NABCEP Entry Level Installer Certification:

- Installation by a NABCEP Solar Thermal certified installer, or
- Installation by an entry level certified installer and
- Have a credentialed professional inspect and sign off on the installation.

Stage 3: Three years after the development of the Entry Level Installer Certification:

- Full NABCEP Solar Thermal certification

At all stages it is recommended that the installer carry liability insurance with a one million dollar minimum. Professional engineers, inspectors or licensed plumbers who undertake certification inspections would need to be credentialed by the New York Department of State, based upon experience and education.

Broaden Participation by Offering Solar Thermal Entry Level Certification Courses
To properly train and qualify New York installers and inspectors, preparation of a multi-faceted education is a sensible goal. Although there are many educational offerings a more robust and comprehensive educational program and some governmental support for it are recommended. Such courses could be offered at local community and technical colleges within New York State and could be taken as part of an educational curriculum or as part of required trade continuing educational licensure requirements. Courses could be created to impart these skills using structured on-line resources, webinars, classroom settings, videos, and hands-on work, either in a laboratory setting or on-the-job participation.

Research and Development

Despite the significant advances in Solar Thermal, additional R&D is needed to continue to reduce system costs, improve quality and performance, and develop new technologies.

While NYS has a substantial R&D base, there are few research groups within the state that focus on Solar Thermal directly. To facilitate the development of a R&D base within the state the following recommendations are made.

Creation of a Solar Thermal Center of Excellence
The Solar Thermal COE would be a collection of researchers with varied technical skills and interests aligned with Solar Thermal needs. Participants would be spread over a number of institutions and would allow for the leveraging of existing expertise. In this way NYS would nurture a developing Solar Thermal specific research base. The cluster should be developed and funded based on existing models (e.g. NYSTAR CAT Centers) in the state for Academic/Industrial partnerships.

Funding for the Solar Thermal COE would initially come from the state. The funds would be used for administrative purposes and to support initial research efforts. Research would be awarded through a competitive proposal process, with matching funds required from industrial sources. Over time the funding for the Solar Thermal COE would be predominantly from industrial sources. The development of the Solar Thermal COE in NYS would help to attract new industrial capability to the state as it would allow for strong academic/industrial collaboration supporting the local development of new technologies.

Creation of a Solar Thermal System Certification Testing Center
NYSERDA currently has an effort underway to develop small wind (less than 100 kW) and PV certification testing centers. A similar center could be developed for Solar Thermal. Currently there is a bottleneck in the system certification process as the number of systems being submitted for certification is greater than the certification capacity. Initial funding could be used to generate a business plan, gather partners, develop equipment, and create a revenue stream. It is expected that within three years of funding the certification center would be fully self-sufficient with revenues from testing paying for the continued existence of the center. Such a center would support development of in-state manufacturing capability by providing convenient testing and certification services.

Solar Thermal Roadmap Timeline

Near Term (1-3 years)

Awareness and Marketing

Industry Role

- Develop needs for marketing campaign
- Increase industry marketing budget
- Perform consumer satisfaction survey

Government Role

- Develop incentive program to shorten payback time of ST systems
- Support development of ST web resource
- Assist in development of marketing campaign

Institutional Issues

Industry Role

- Begin dialogue and define jurisdictional roadblocks
- Work with public officials to clarify permitting issues
- Develop and implement a marketing plan for the attraction of new industry to NYS

Government Role

- Work to clarify jurisdictional issues
- Develop a single ST permit to cover ST installations
- Work with state economic development organizations to develop incentive program to attract new industrial capability to state

Workforce Development

Industry Role

- Work with certification agencies to develop entry level certification exam
- Work with public officials to develop and implement clear installer certification standards

Government Role

- Develop and implement clear installer certification standards
- Identify qualified engineers, plumbers, etc. for initial system certification process

Research and Development

Industry Role

- Identify key research areas
- Link with research assets
- Begin collaborative R&D efforts

Government Role

- Support development of NYS expertise through creation of a ST Center of Excellence in State (ST COE)
- Create NYS ST testing/certification center


Mid-term (4-10 years)
Long Term (10-20 years)
Assess marketing effort and develop updated marketing campaign
Continue consumer satisfaction efforts
Determine market goals and future opportunities for sustain market growth
Sunset initial incentive programs
Determine needs for new technologies
Work with industry to define future market direction and needs
Develop codes for commercial adoption of alternative energy systems in new construction
Determine feasibility for performance based rebates (net meter equivalents)
Expand code development to include retro fits of existing commercial buildings
Develop codes to require alternative energy systems in residential buildings
Develop comprehensive educational programs that include hands-on experiences
Require certification of installers
Develop training programs to account for new technologies
Support development of comprehensive educational programs
Require certification standards
Support reduction of costs and increased efficiency of existing systems
Increase support for R&D efforts through ST COE, focus on shorter term technology advances for market
Transfer new technologies to market
Develop direction and support for future research needs
Begin to focus public research support on long term basic research for future applications
Continue support of long term research through ST COE

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Evacuated tube Solar Thermal installation.

Image courtesy of SunMaxx Solar Inc.

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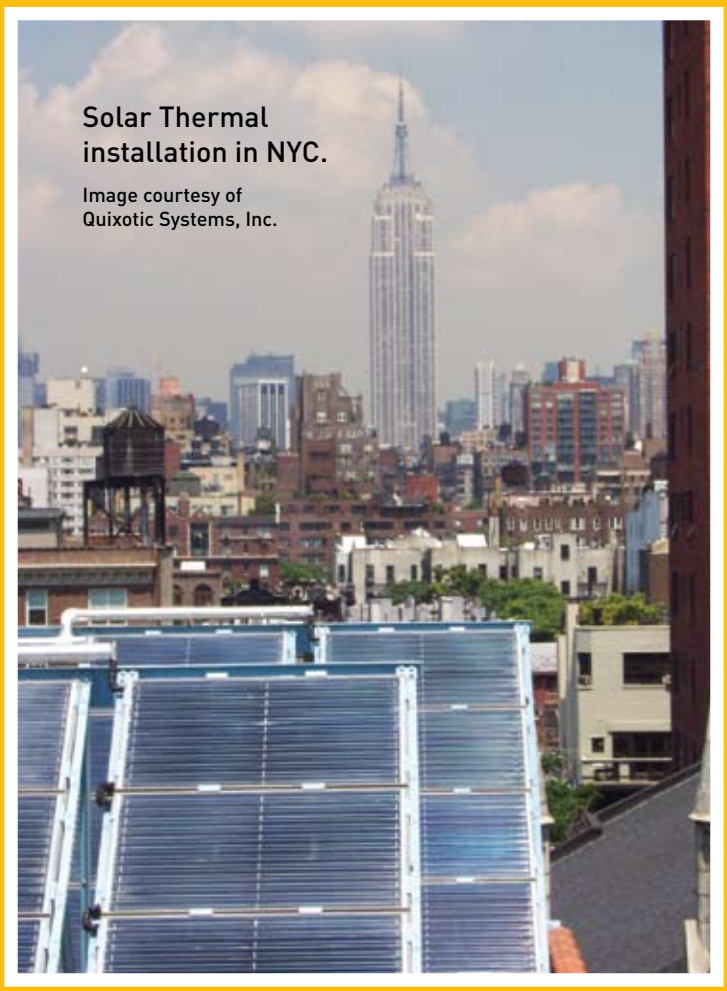

Solar Thermal
installation in NYC.

Image courtesy of
Quixotic Systems, Inc.

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