

Solar Water Heating Supply Chain Market Analysis

Study for the City of Milwaukee

Lisa Frantzis

Shalom Goffri



SOLAR THERMAL '10

September 30, 2010



Table of Contents

1

Introduction

2

SWH Markets

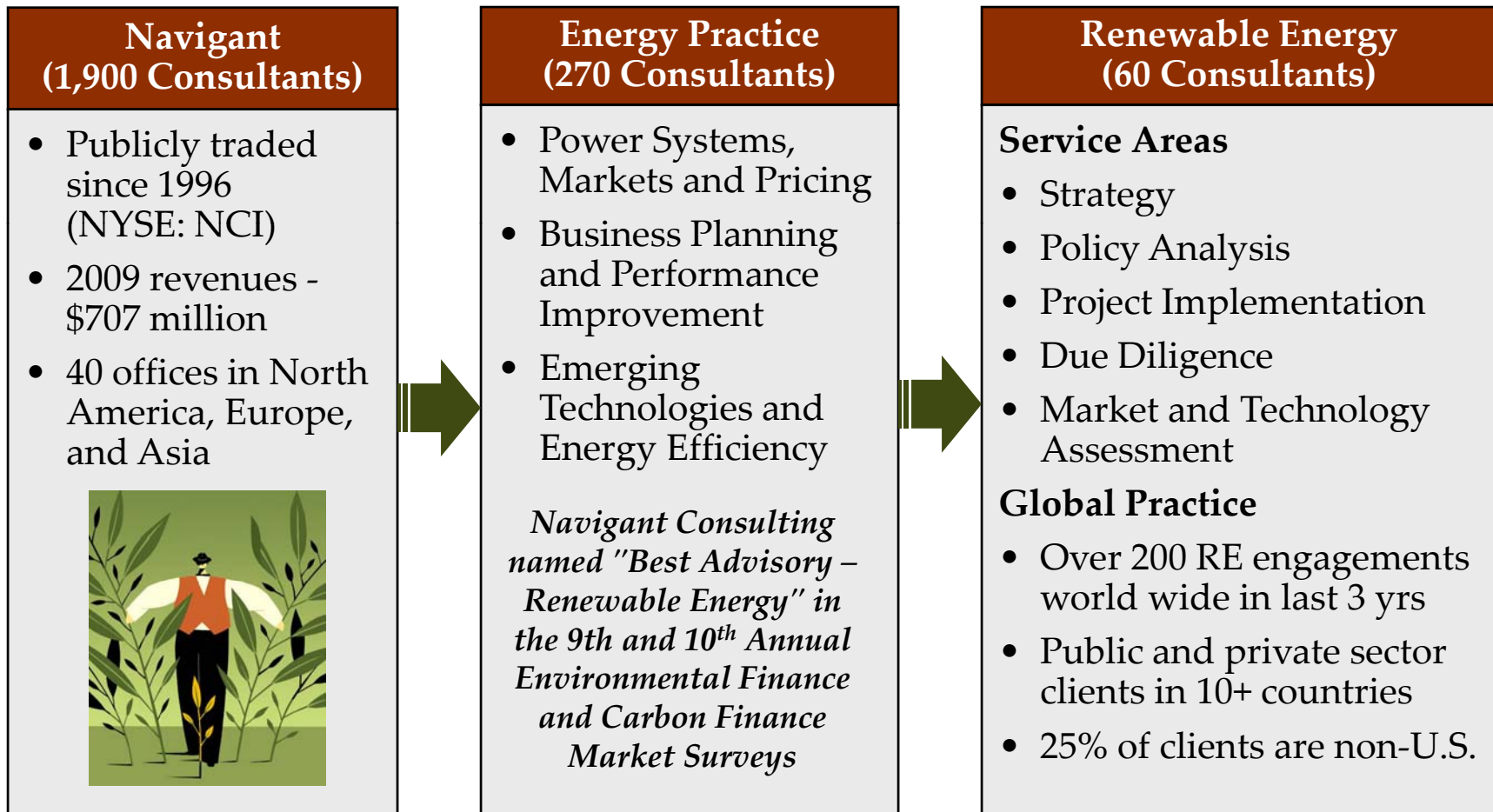
3

System Components and Supply Chain

4

Milwaukee Opportunity Analysis

Navigant is a specialized consulting firm and global leader in renewable energy technology and strategy.



Acknowledgements

NCI would like to thank the U.S. Department of Energy, We Energies, the City of Milwaukee, and the National Renewable Energy Laboratory for supporting this project. In addition, our team would like to thank the industry experts that we interviewed and all the survey respondents. Your input was valuable and had a significant contribution to the study.

Copy of Presentation is Available at Following Links

www.MilwaukeeShines.com

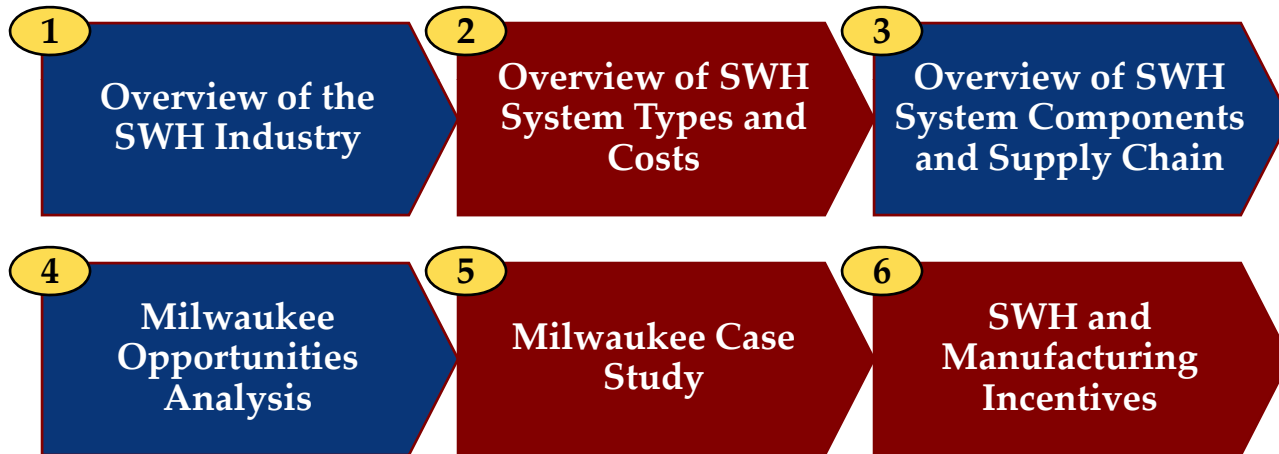
www.we-energies.com/RE

<http://solaramericacities.energy.gov>

[http://www.navigantconsulting.com/downloads/Navigant Solar Thermal Conf 9-2010v2.pdf](http://www.navigantconsulting.com/downloads/Navigant_Solar_Thermal_Conf_9-2010v2.pdf)

NCI reviewed the SWH market and analyzed the opportunity for Milwaukee area manufacturers.

NCI Scope of Work – SWH Market

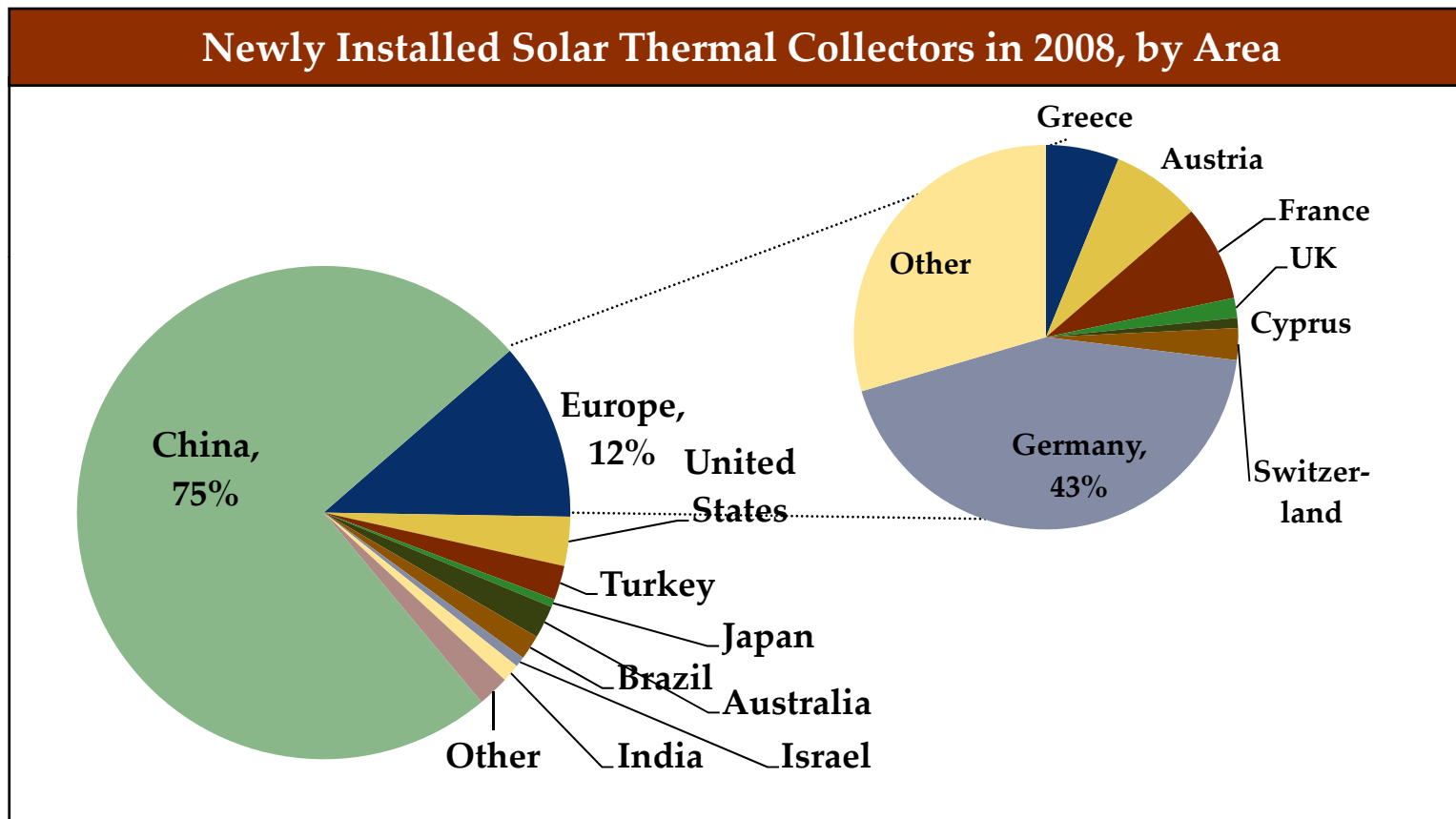


Today's presentation will focus on items 1, 3, and 4

Table of Contents

1	Introduction
2	SWH Markets
3	System Components and Supply Chain
4	Milwaukee Opportunity Analysis

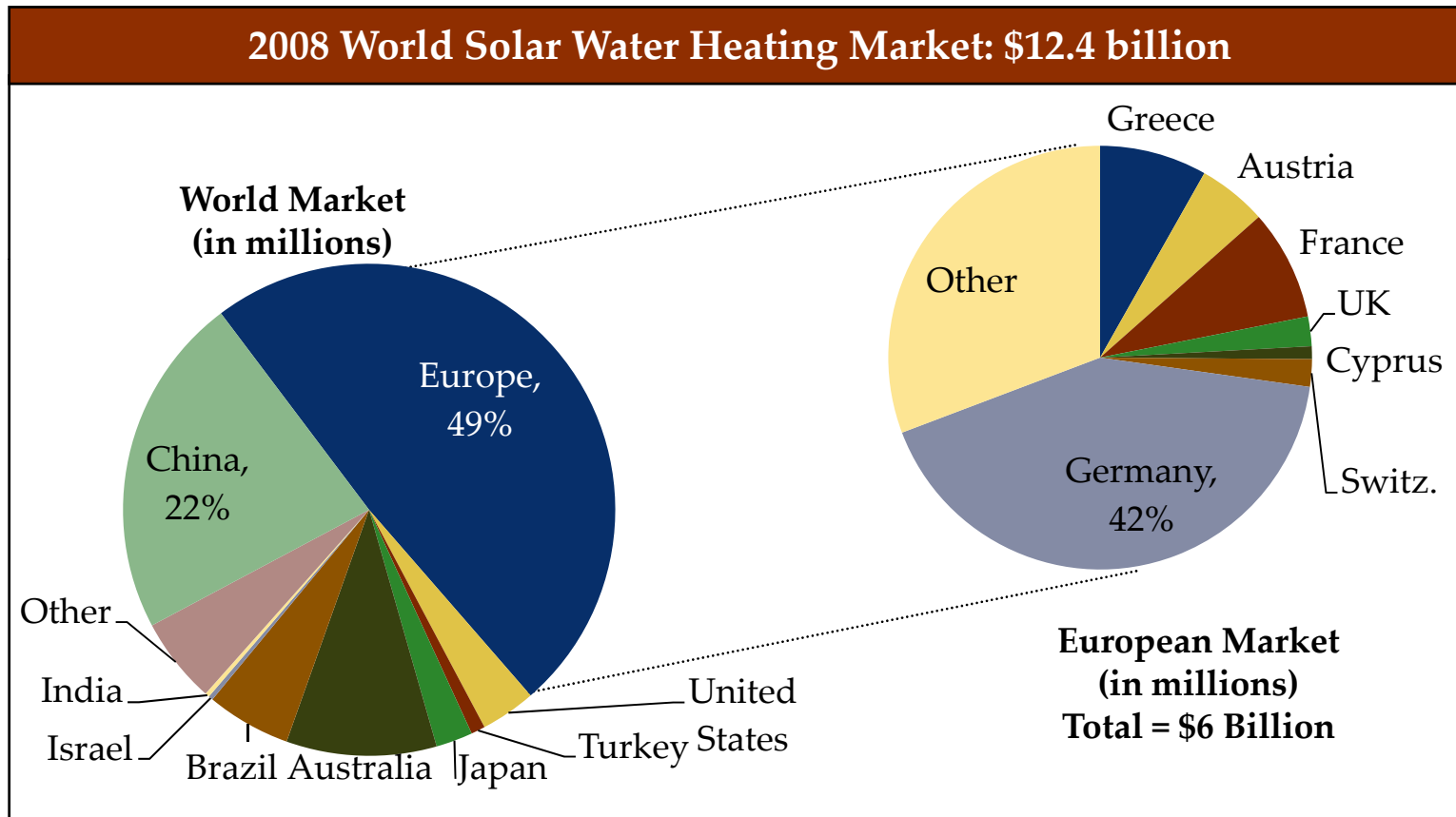
China overwhelmingly led 2008 installations with 75% of global installations....



Source: International Energy Agency Solar Heating and Cooling Programme, *Solar Heat Worldwide – Market and Contributions to the Energy Supply 2008*, Edition 2010. May, 2010.

Note: At the time of the writing of this report, complete global 2009 data was not yet available

...But Europe is the largest SWH market (in terms of revenue) with nearly half of global SWH market value.



Sources:

1. NCI Analysis
2. International Energy Agency Solar Heating and Cooling Programme, *Solar Heat Worldwide – Market and Contributions to the Energy Supply 2008, Edition 2010*. May, 2010.
3. Sensors Report, 2008. <http://www.mdpi.org/sensors/papers/s8021252.pdf>

China and Europe lead global demand for SWH systems, but for different reasons.

	Reasons for Leadership in Global SWH Demand
Europe	<ul style="list-style-type: none">• Continued long term support of SWH incentives. This helps industry plan long term• Performance based incentives. This encourages proper system design and sizing.• Education campaigns. Awareness for SWH systems is lacking in most markets, but campaigns raising awareness and pointing out the benefits of SWH systems create more customer demand.• Policy. Some municipalities are requiring SWH systems to be installed per local building codes.
China	<ul style="list-style-type: none">• Low cost systems and limited availability of electricity and natural gas have driven industry growth.<ul style="list-style-type: none">– The Chinese government does not offer incentives for manufacturers or end users.• There is often no need for freeze protection, thus helping to reduce system costs.

A variety of drivers influence global SWH markets....

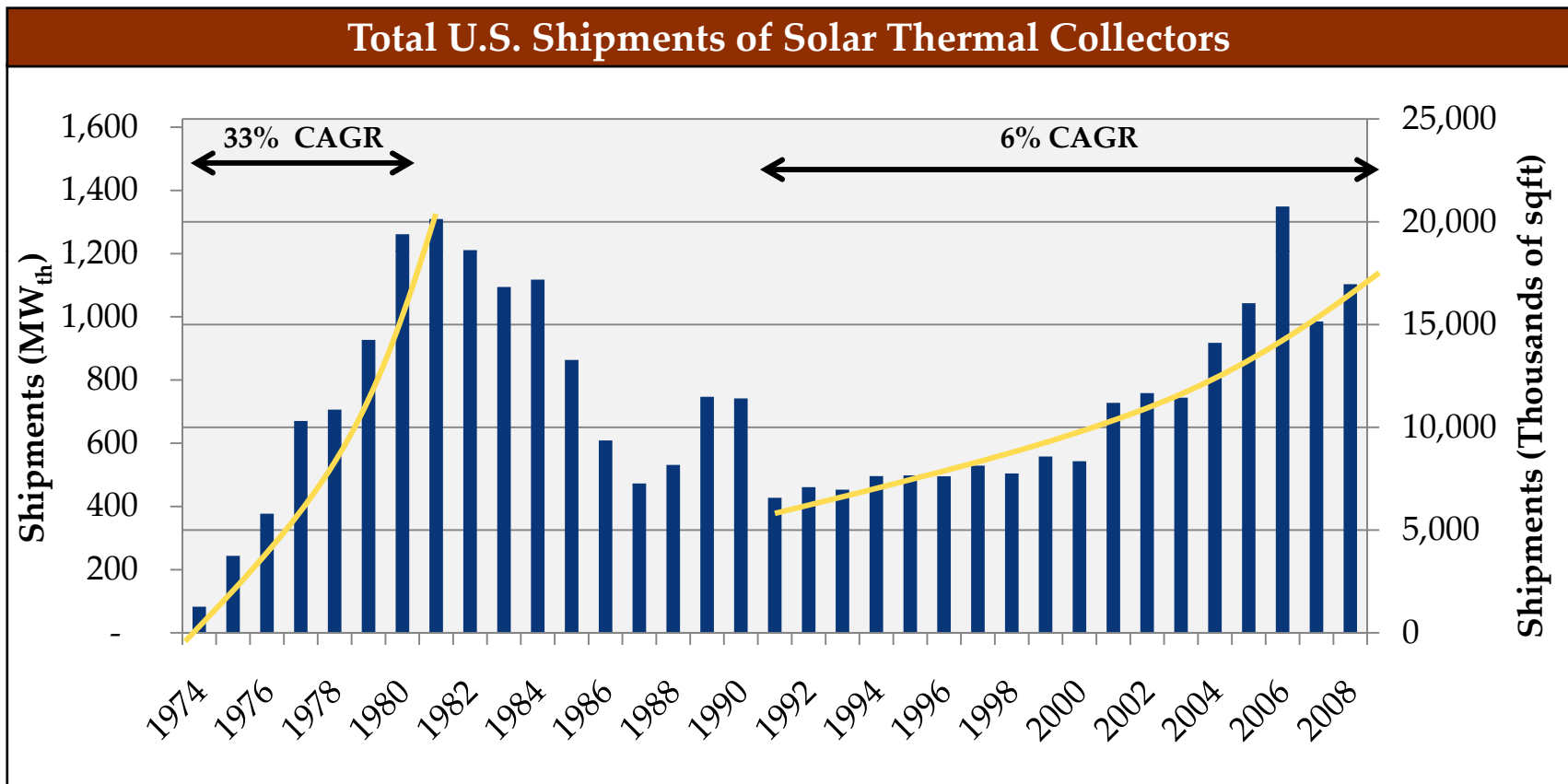
Key Drivers	Incentives	<ul style="list-style-type: none"> To counter high paybacks* in some areas, governments have established capacity-based (i.e. \$/kWth) or performance-based (i.e. \$/kWth or \$/MMBtu) incentives to encourage adoption.
	Regulation	<ul style="list-style-type: none"> Several jurisdictions (e.g. Hawaii, Israel, and Spain) have created SWH regulations, often taking the form of building code requirements that SWH be included in a certain percentage of new construction.
	Marketing	<ul style="list-style-type: none"> To counter lack of consumer awareness, governments or national trade groups have conducted large marketing campaigns.
	Lack of Infrastructure	<ul style="list-style-type: none"> Rural areas in some countries have no access to electricity or natural gas for water heating, so SWH systems are the only option for domestic hot water (beyond boiling over a fireplace).

* Given large variations in price and insulation levels around the world, some markets have relatively short payback periods without incentives.

.... But they are countered by several barriers.

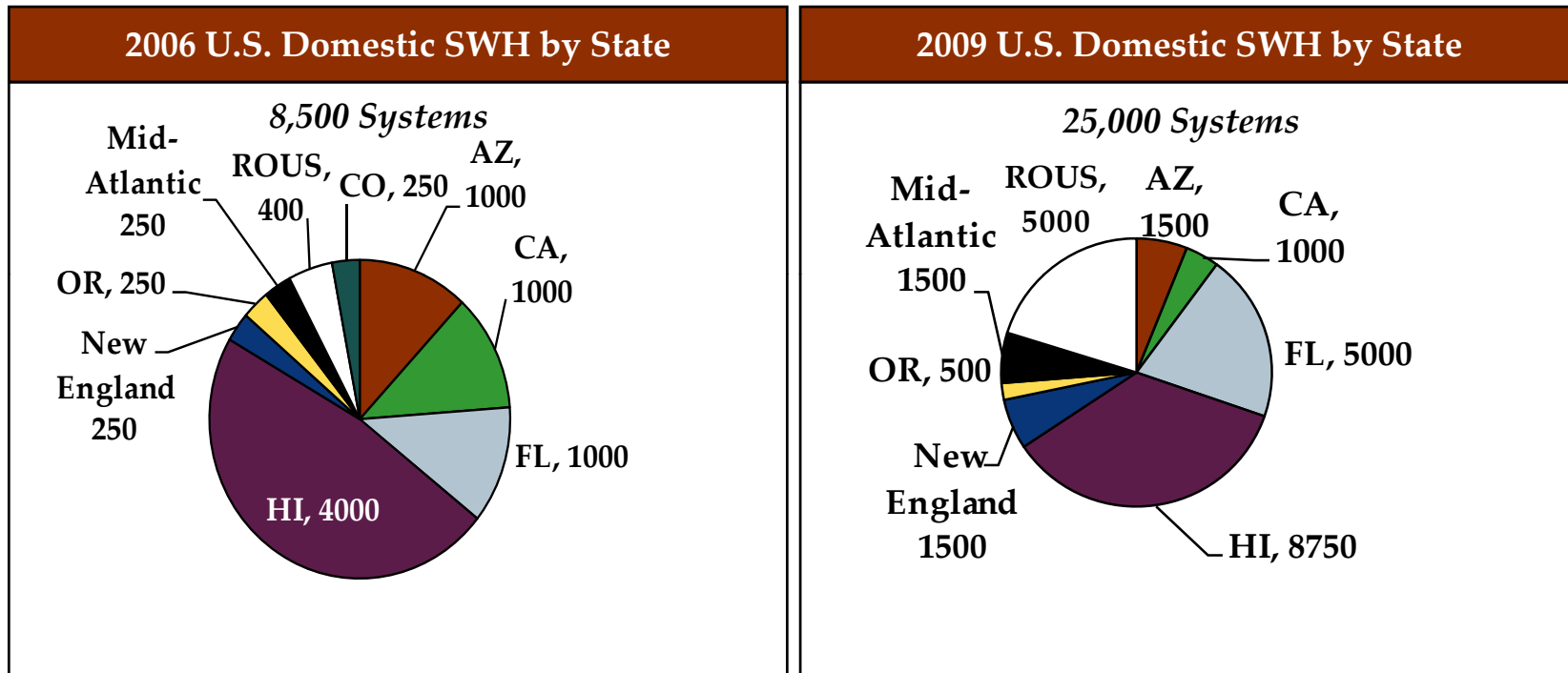
Key Barriers	Consumer Awareness	<ul style="list-style-type: none"> • Most consumers are not aware that SWH is an option for their home or business – they mostly associate “solar energy” with photovoltaics.
	Labor Supply	<ul style="list-style-type: none"> • SWH installation requires skills of plumbers and roofers, but many contractors are not trained in both.
	Economic	<ul style="list-style-type: none"> • Water heaters are typically replaced when one breaks. Since the building owner is not expecting this expense, they opt for a regular water heater with a lower up-front costs (~\$1,000 vs. ~\$6,000). • Many potential customers focus solely on pay back and these are greater than 7 years in most of the US.
	Regulations	<ul style="list-style-type: none"> • Many incentive programs require system level SRCC OG-300 certification in the U.S.: <ul style="list-style-type: none"> - The certification is for a fixed set of components, so an installer would have to get certification for every variation in component choice. - The certification process currently takes 12 to 18 months.

After 33% average annual growth prior to 1981, the U.S. market declined. Since 1991, there has been a 6% compounded annual growth rate (CAGR).



*Data reported in 1000's of sq.ft. MW_{th} is calculated based upon an internationally agreed upon conversion factor of 0.7 kW_{th}/m².
 Source: International Energy Agency's Solar Cooling and Heating Program, Solar Heating Worldwide 2008 Edition, Industry Interviews, Navigant Consulting, Inc. based on data from Energy Information Administration, Solar Thermal Collector Manufacturing Activities 2008 & Renewable Energy Annual. Annual installations domestic production and imports of low, medium and high temperature collectors.

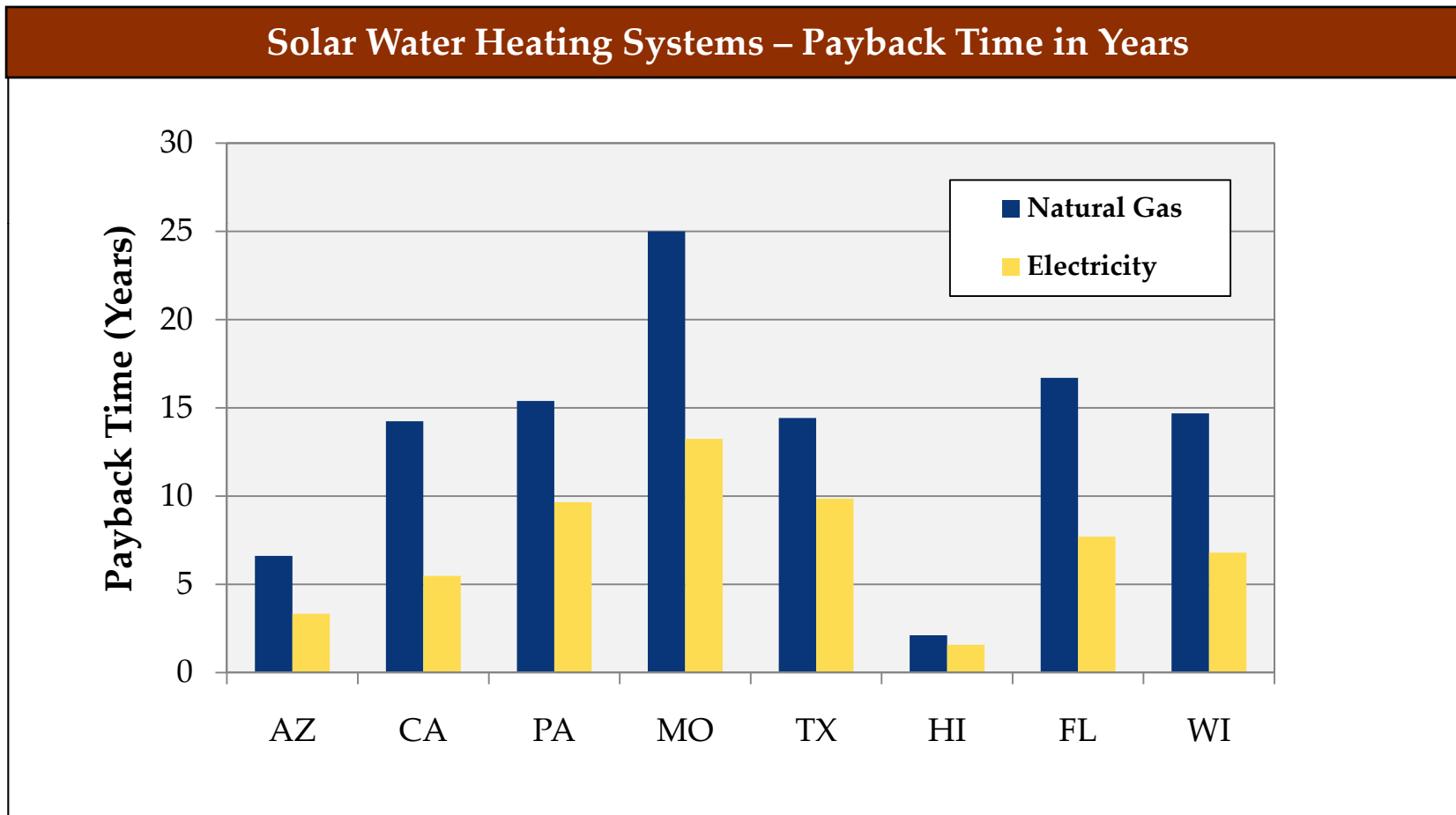
A small number of states dominate the SWH market.



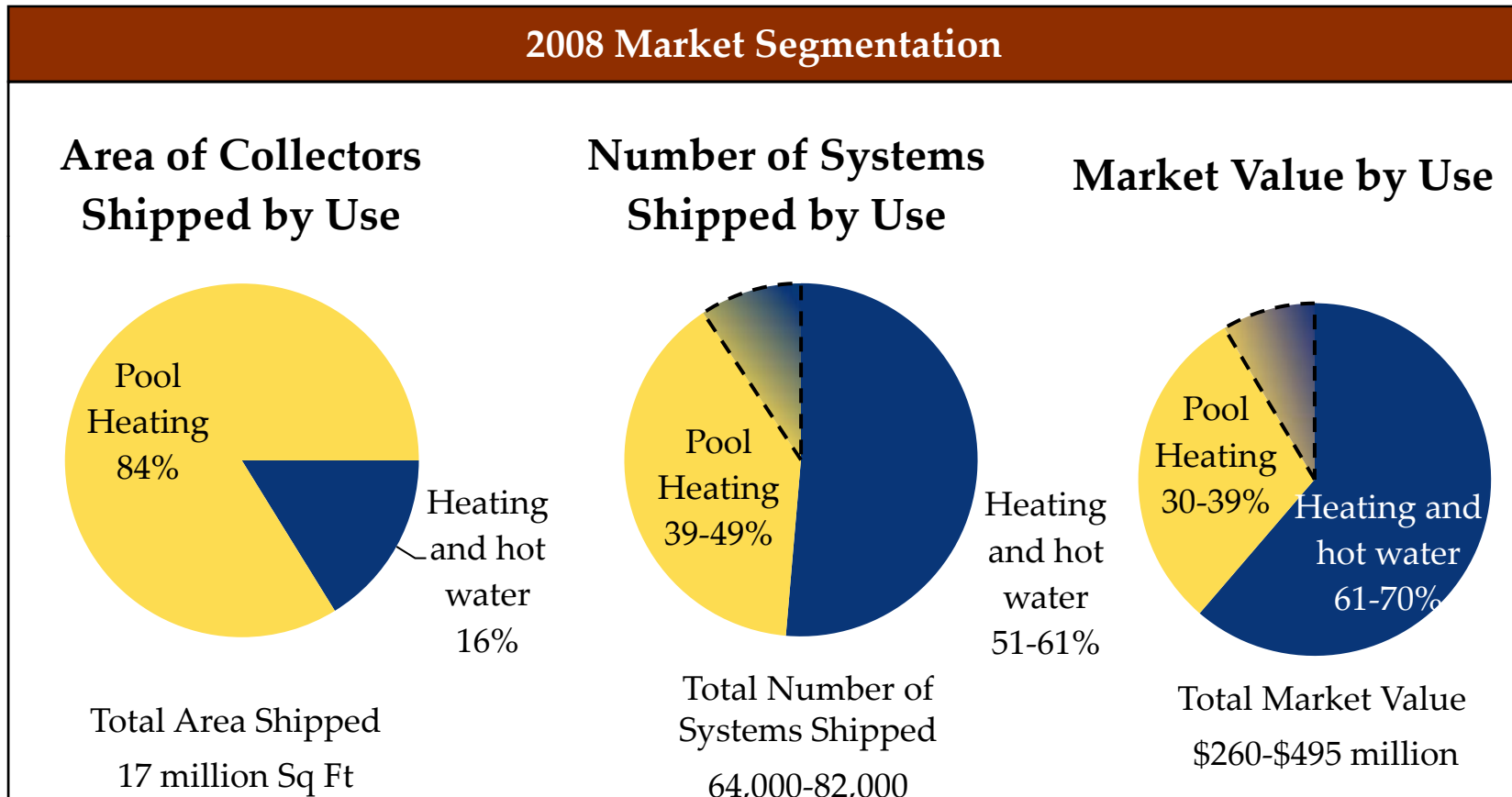
Source: Navigant Consulting, Inc. based on interview with Les Nelson, SRCC, State Incentive Programs (CA, HI, FL)

- On the order of 35% of all new U.S. solar domestic water heating systems are installed in Hawaii.
- Six states continue to account for almost 70% of all domestic SWH systems.
- On the order of ~8,500 SWH systems were sold in the U.S. in 2006, and ~25,000 in

Buildings with electric water heating in states that have high solar insolation and high electric rates will have the best payback with SWH.



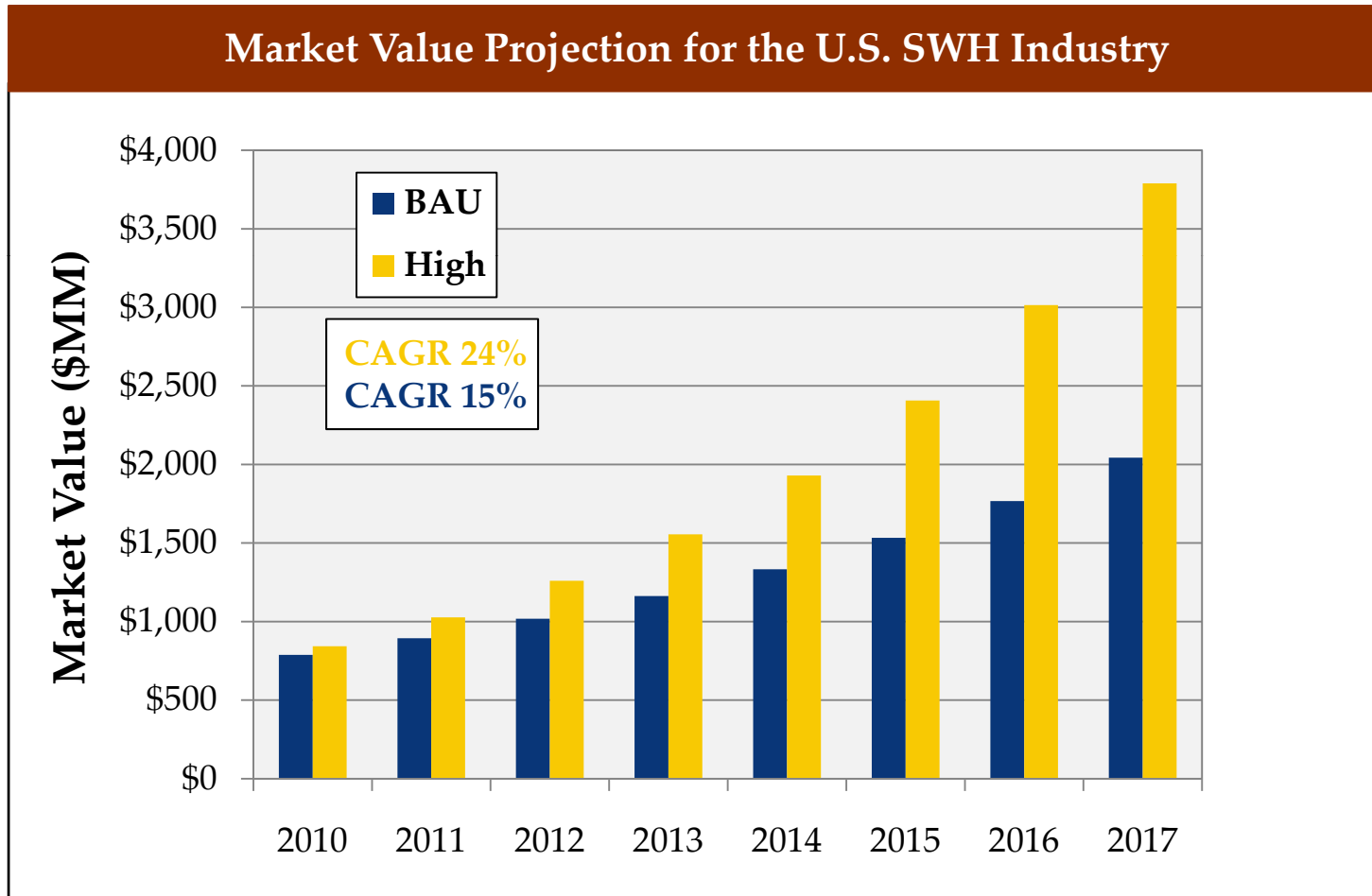
The hot water and heating market represents nearly 70% of the market value, but only 16% of the area of collectors shipped.



Source: Navigant Consulting, Inc. analysis based on data from: Industry Interviews, Energy Information Administration's Solar Thermal and Photovoltaic Collector Manufacturing Activities 2008 and Renewable Energy Annual, and internal analysis.

Note: Pool Heating System size was assumed to be 350-400sqft; Non-pool heating systems were assumed to be 50-64 sqft.

Even with optimistic U.S. market growth, the total value of the market remains modest between 2010-2017.



Source: NCI Analysis.

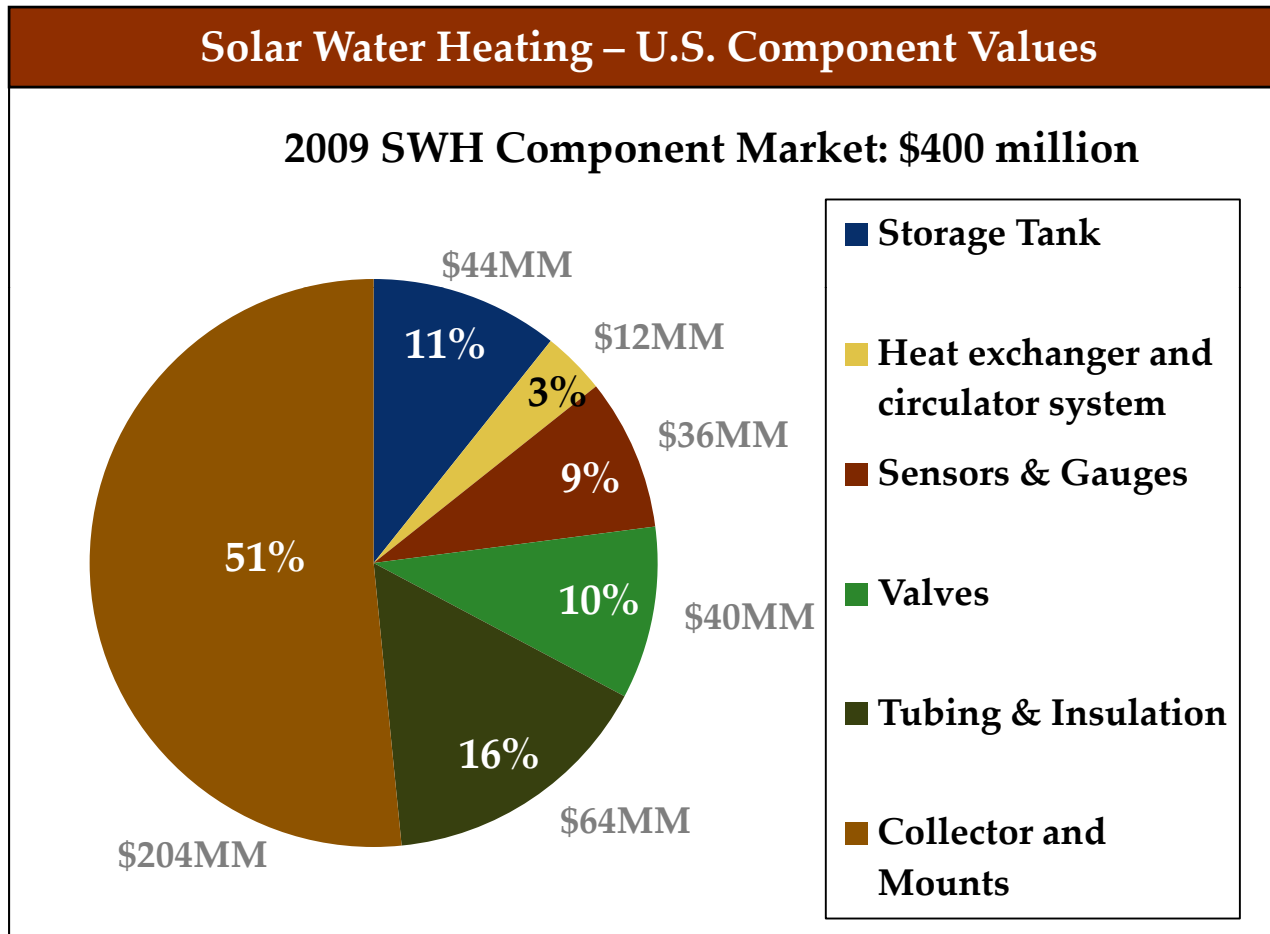
System Size: domestic SWH system 40sqft; Pool system 400 sqft;

Market Growth Assumptions

BAU: Pool CAGR 5%; other SWH CAGR 21%

High: Pool CAGR 8%; other SWH CAGR 32%

The U.S. SWH market size was \$800 million in 2009. ~50% of the total value is material cost, which is dominated by collectors.



Source: RS Means, Navigant Consulting, Inc. based on data from Energy Information Administration, Solar Thermal and Photovoltaic Collector Manufacturing Activities 2008 and Renewable Energy Annual and Industry Interviews.

Below are some likely market trends impacting SWH.

Expected SWH U.S. Market Trends	
Increased Commercial Systems	<ul style="list-style-type: none"> • Larger commercial projects are expected to increase over the coming years. • American Recovery and Reinvestment Act (ARRA) funds are likely to impact the industry only in the short term until funds are depleted. • The market will depend on available financing for projects.
Reduced Natural Gas (NG) Prices	<ul style="list-style-type: none"> • NG prices drive electricity prices. Current forecasts are not as high as several years ago as a result of shale gas. Lower NG prices may not increase electricity prices as much as once expected. <ul style="list-style-type: none"> – A carbon tax/cap and trade could lead to an increase in electricity prices.
Reduced SWH System Prices	<ul style="list-style-type: none"> • As the industry matures and manufacturing volume grows, prices are likely to decline. • Streamlining installation costs and time is expected as installers gain more experience. <ul style="list-style-type: none"> – Innovative components and preassembly will also reduce cost.
Stricter Incentive Reporting Requirements	<ul style="list-style-type: none"> • More states may adopt strict incentive reporting requirements, similar to HI and CA, which may hinder market adoption by installers. <ul style="list-style-type: none"> – But, this will result in higher quality and better design installations.

The U.S. SHW market is growing rapidly, but remains highly fragmented.

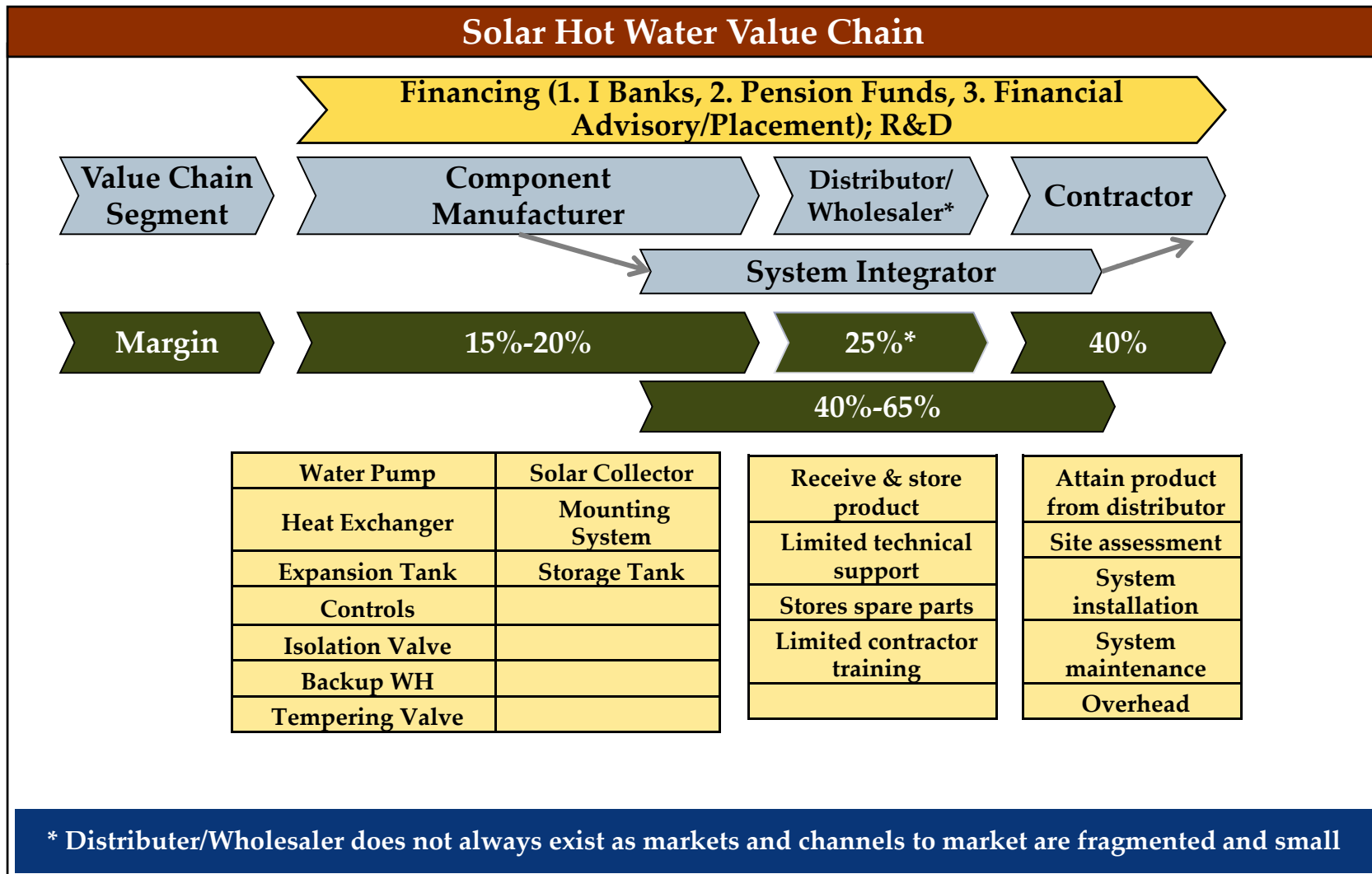
NCI's Assessment of the SHW Market

- The global SHW market is concentrated in China and Europe, with China having the largest volume of systems and Europe with highest value.
- The emerging SHW market in the U.S. SHW is growing rapidly. However, even with high growth the market is expected to remain relatively small. Currently valued around \$800 million, the market is not expected to exceed \$2-4 billion by 2017.
- The U.S is dominated by a few key states and is highly dependant on incentives, making it vulnerable to policy changes. HI, for example, was the largest market in 2009, but recent policy changes will likely negatively impact its market growth.
- Learning from the success in Europe. Growing the U.S. market will require: continued long term support of SHW incentives and other policy support, public education campaigns, and performance based incentives.

Table of Contents

1	Introduction
2	SWH Markets
3	System Components and Supply Chain
4	Milwaukee Opportunity Analysis

Contractors have the highest margins across the value chain.



The SWH industry is very fragmented. Systems are not standardized and purchasing decisions are made based on existing relationships.

SWH Supply Chain – Decision Drivers	
Suppliers	Installers usually work with a limited number of suppliers, typically ones they have strong relationships with
Decision Makers	The SWH market is still very fragmented, purchasing decisions are usually made based on existing relationships with manufacturer’s representative.
Key Drivers and Competitive Advantages	<p>Overall system cost reduction is very important moving forward.</p> <ul style="list-style-type: none"> • Pump stations and preassembled systems will reduce installation costs. • Larger system will benefit from economics of scale and capitalize on cost reduction. However, additional engineering/permitting costs are usually needed. • Many SWH system components are shared with the general water heating and plumbing industry. Increasing volumes in the SWH industry are not likely to have a large impact on prices of these components.

SWH components are usually manufactured/assembled locally with the exception of premium products that may be imported.

SWH Component Exports		
US	Exports	<ul style="list-style-type: none"> Some US manufacturers sell into international markets such as South America, the Caribbean, and the Pacific Rim
	Exporting to Europe	<ul style="list-style-type: none"> Selling into the high value European market is more difficult, mainly due to regulatory issues and shipping costs. The accepted certification in Europe is the Solar Keymark certification. To date no US manufacturer has gained this certification. The certification process and shipping costs do not allow for US products to be price competitive with local manufacturers.
EU	Exporting	<ul style="list-style-type: none"> European companies have established themselves as exporters outside their domestic market. Successful products are high quality with advanced product design such as tanks, controllers, and pumps. European products have established SRCC OG300 certification for their products to be sold in the US. Companies also assemble and manufacture locally in the US
China	Exporting	<ul style="list-style-type: none"> Chinese products are mostly used in the local Chinese market. Due to Chinese reputation for low quality products exports to EU and US markets include many sub-components that are later repackaged and rebranded by local companies.

Table of Contents

1	Introduction
2	SWH Markets
3	System Components and Supply Chain
4	Milwaukee Opportunity Analysis

CH2M Hill assessed City of Milwaukee's ability to develop a solar manufacturing sector and recommended entering the SWH market.

Previous Recommendations and Next Steps from CH2M Hill Study

- Commit to the solar products industry with solid public action
- Organize a working group of stakeholders
- Coordinate public and private interests
- Analyze situation and prioritize opportunities and actions
- Improve the Milwaukee product
- Invest to bridge gaps (specifically in local solar manufacturing initiatives, sites/buildings, and incentives)
- Commit resources to outreach and marketing
 - Develop an informational kit
 - Market to solar product companies (local/foreign, PV/SHW)
- Develop showcase projects to educate and create public enthusiasm
- Create highly visible solar product projects
 - Small PV assembly or SHW collector manufacturing operation
 - Local commercial, industrial, or small utility scale installation

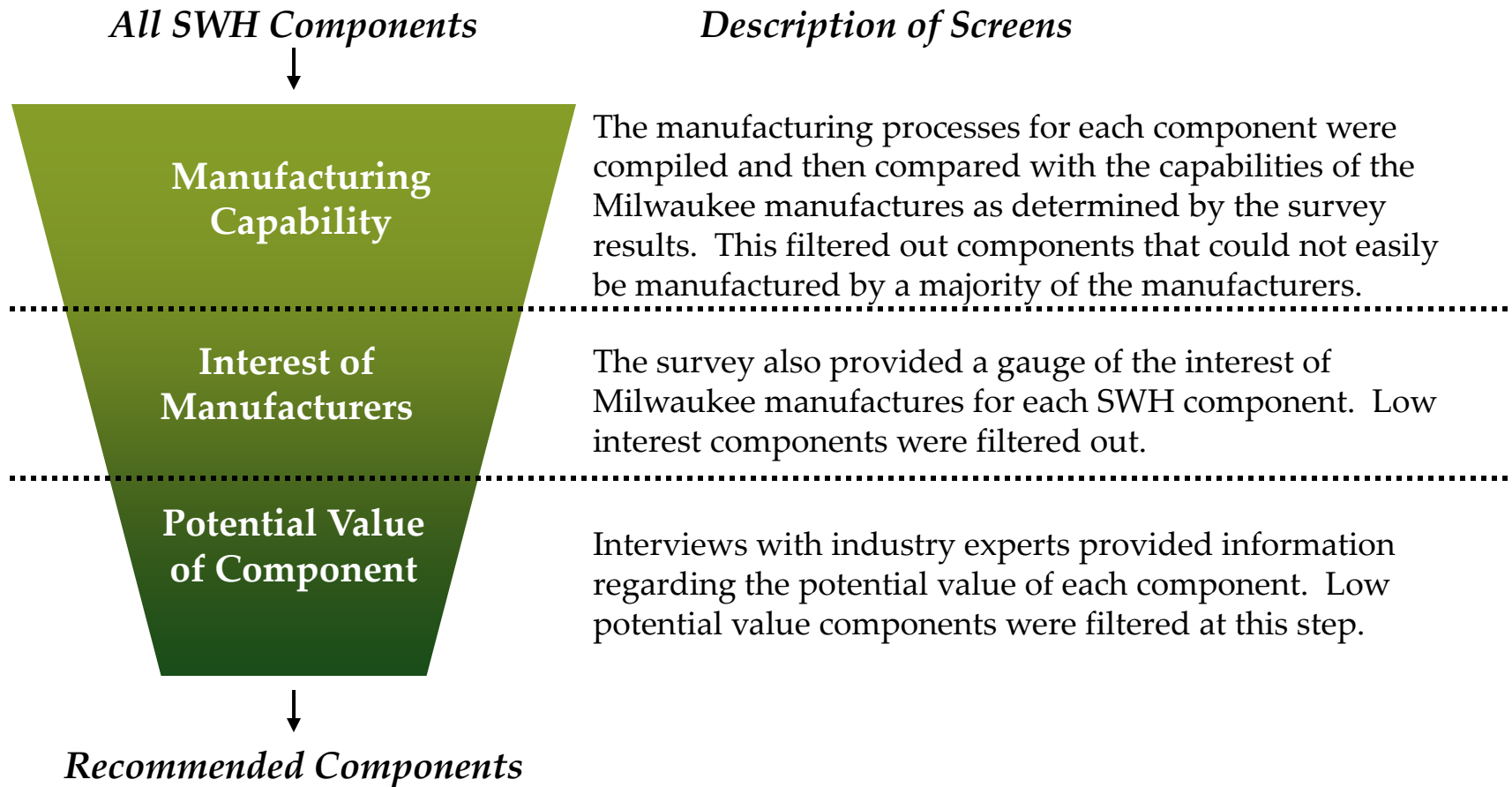
Milwaukee provides significant resources to its manufacturers.

Milwaukee's Strengths	
Existing manufacturing and engineering base	Manufacturing employs 21.5% of areas workforce, the third highest percent of manufacturing employees in the country.
Skilled manufacturing workforce	A leader in the production of medical electronics, mining machinery, power trains, forgings, and internal combustion engines.
University engineering programs	Milwaukee School of Engineering and University of Wisconsin are just two of the engineering schools in the Milwaukee area.
Abundant high-quality water supply	Access to abundant usable water as they are located on the coast of lake Michigan
Competitive electrical rates	Wisconsin's electrical rates for industrial and commercial sectors are below the national average.

Milwaukee provides significant resources to its manufacturers.

Milwaukee's Strengths	
Good transportation/distribution channels and facilities	Lake Michigan provides water transport in addition to the railways and highway infrastructure that supports Milwaukee's distribution.
Public/private enthusiasm and support for creating solar product	Many stakeholders within the state support solar development.
Milwaukee-area companies already involved in solar product supply chain	Examples include: Caleffi, A.O. Smith, JCI, Hot Water Products, Helios, and Bubbling Springs
We Energies committed to developing solar generation	We Energies has funded studies with the hope of increasing awareness and popularity in renewable energy.
Federal, state and city incentives	Milwaukee offers PACE Solar Loan Program; Wisconsin offers sales and property tax exemption on SWH systems, Federal incentives include tax credits and loan programs.

NCI applied a multi-step screening process to identify the components most suited for Milwaukee manufacturers.



Milwaukee manufacturers have strong capabilities in machining, stamping, welding, and molding.

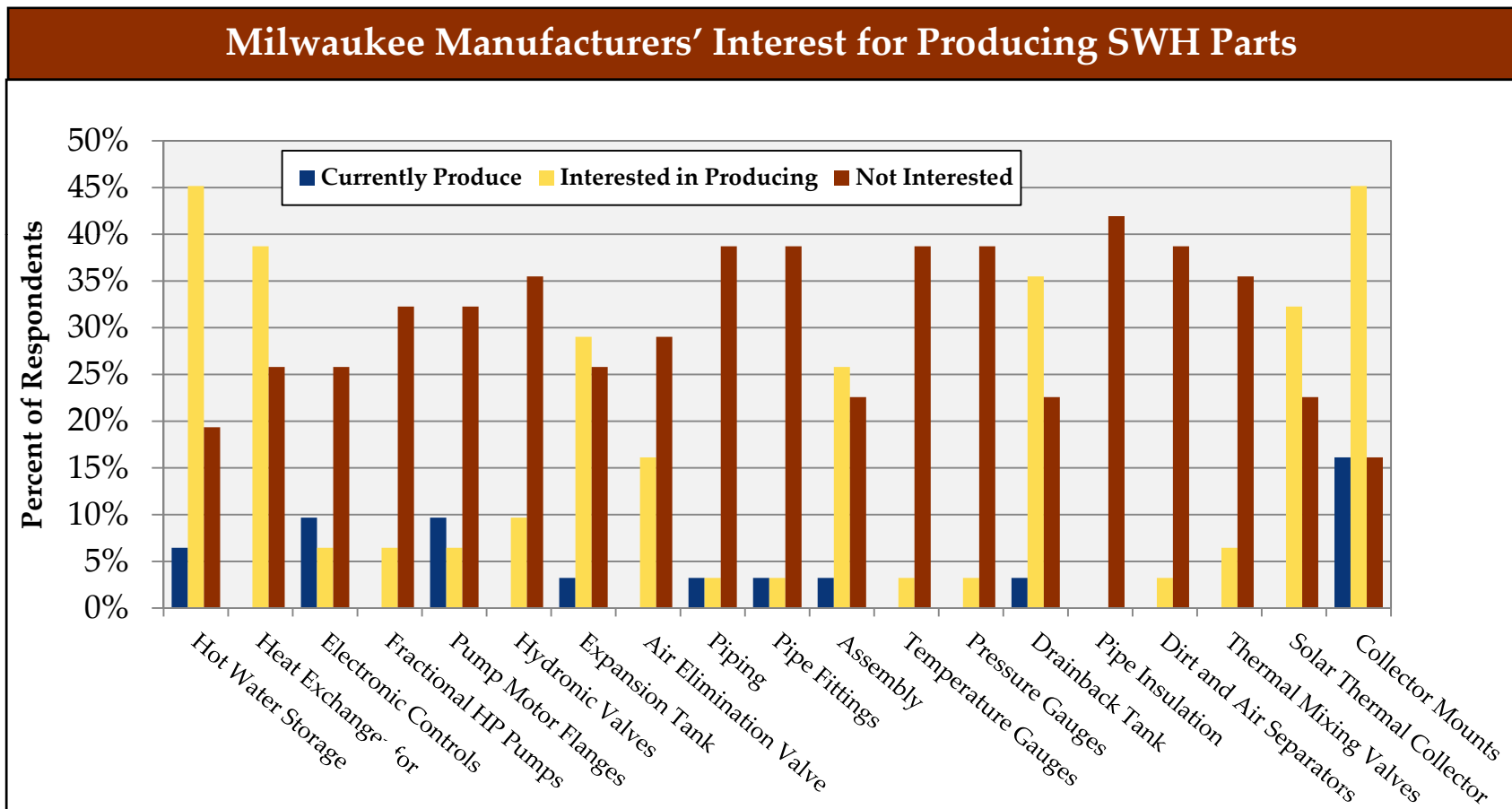
SWH Component	Machining	Stamping	Rolling	Turret Punch	Welding (TIG & MIG)	Laser Cutting	Casting	Pipe Bending	Sandblasting	Painting	Coating	Molding	Enamel Coating	Current Milwaukee Capabilities	
														High	Medium
SWH Water Storage Tank		X	X	X	X	X	X	X	X	X	X	X	X		
Heat Exchanger for potable water		X	X					X							
Electronic Controls												X			
Fractional Horsepower Pumps	X						X								
Pump Motor Flanges	X	X					X								
Hydronic Valves	X						X								
Expansion Tank		X													
Air Elimination Valve	X						X								
Piping			X												
Pipe Fittings		X													
Assembly – Pump Stations															
Temperature Gauges	X	X					X								
Pressure Gauges	X	X					X								
Drain back Tank		X	X	X	X	X	X	X	X	X	X	X	X		
Pipe Insulation															
Dirt and Air Separators	X	X					X								
Thermal Mixing Valves	X	X					X								
Solar Thermal Collector					X			X		X	X	X			
Solar Thermal Collector - Frame	X	X			X						X				
Collector Mounting system	X	X			X						X				

Current Milwaukee Capabilities	
High	
Medium	
Low	

X:
Manufacturing needed for component

Manufacturer's Interest

Milwaukee manufacturers are most interested in producing hot water storage tanks and collector mounts for the SWH industry.



Source: Survey conducted by Navigant Consulting in 2010.

Based on the Milwaukee area’s manufacturing capabilities & interest and the value-add ranking of the components, 7 components are worth considering for investment.

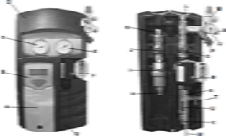

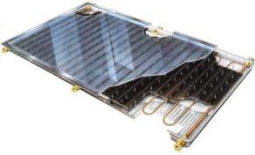

SWH Component	Capability	Interest	Value-Add
SWH Water Storage Tank	Medium	High	Medium
Heat Exchanger for Potable Water	High	High	Medium
Electronic Controls	Low	Low	High
Fractional Horsepower Pumps	Low	Low	Low
Pump Motor Flanges	Medium	Low	Low
Hydronic Valves	Low	Low	Low
Expansion Tank	High	Medium	Medium
Air Elimination Valve	Medium	Medium	Low
Piping	Medium	Low	Low
Pipe Fittings	Medium	Low	Low
Assembly – Pump Station	Medium	Medium	High
Temperature Gauges	Low	Low	Low
Pressure Gauges	Medium	Low	Low
Drain back Tank	Medium	High	Medium
Pipe Insulation	Low	Low	Low
Dirt and Air Separators	Medium	Low	Low
Thermal Mixing Valves	Medium	Low	Low
Solar Thermal Collector	Medium	High	Medium
Solar Thermal Collector Frame	High	High	High
Collector Mounting/Racking System	High	High	High



SWH Components
Assembly – Pump Station
Collector Mounting/Racking System
Solar Thermal Collector Frame
Drain Back Tank
SWH Water Storage Tank
Expansion Tank
Heat Exchanger for Potable Water




Collectors were not recommended due to their intricate design and high price which allows them to be shipped from overseas with a reduced cost impact

Below are components most suited to the Milwaukee manufacturers*.

Component	Picture	Comments
Assembly – Pump Station		<p>Pump stations are high value add components, as they reduce the installation costs of SWH systems which constitute nearly half of the total cost. The pump station is made up of manufactured parts and requires assembly, pipe brazing and a molded plastic case.</p>
Collector Mounting/ Racking System		<p>Collector racks are currently either made by the installer or the collector manufacturer. A metal fabricating shop could easily produce collector racks using metal stamping and machining.</p>
Solar Thermal Collector Frame		<p>The collector frame is typically aluminum and serves to encase the absorbing pipes, glass and insulation. The frame could be made using sheet metal stamping.</p>
Drain-back Tank		<p>Drain-back tanks are used to drain the water out of the solar collectors when there is not enough sun to prevent freezing in cold weather. The tanks are specific to the SWH market. The major manufacturing requirements are stamping, rolling, machining, and painting.</p>

*Based on value, capability and interest.

Below are components most suited to the Milwaukee manufacturers*.

Component	Picture	Comments
<p>SWH Water Storage Tanks</p>		<p>Although hot water storage tanks are currently made for the general water heating industry, the SWH industry requires tanks with two heat exchangers, one for the back up heater and one for the solar collectors. The major requirements for manufacturing are stamping, rolling, painting and assembly.</p>
<p>Expansion Tank</p>		<p>Expansion tanks are another product that is currently made for the general water heating market, however with the growing use of glycol, expansion tanks for the SWH industry must be manufactured with tougher inner bladders to resist deterioration due to the glycol. The tanks can be manufactured by stamping and assembly.</p>
<p>Heat Exchanger for Potable Water</p>		<p>Heat exchangers are an important part of the SWH market and are required to be made out of stainless steel with the growing use of glycol. The plate exchangers can be manufactured using machining, stamping, rolling and welding.</p>

*Based on value, capability and interest.

Navigant believes the SWH market could be an attractive opportunity for Milwaukee manufacturers.

Assessment of the SWH Opportunity for Milwaukee Manufacturers

- Milwaukee manufacturers have the capabilities to manufacture high quality components for the SWH industry.
- The emerging U.S. SWH component market is valued ~\$400 million and is highly fragmented, presenting opportunities for new players, but also risks.
- Navigant recommends Milwaukee manufacturers concentrate on producing high value components that customers are willing to pay a premium for; such as components that are currently imported from Europe.
- In the past, Milwaukee manufacturers have focused on one customer. However, to be successful in the SWH market, Navigant recommends targeting multiple customers.
 - The SWH industry is more fragmented with smaller customers that could quickly exit and leave a manufacturers with stranded assets.

Content of Report

This presentation was prepared by Navigant Consulting, Inc.¹ for SOLAR THERMAL '10. The work presented in this report represents our best efforts and judgments based on the information available at the time this report was prepared. Navigant Consulting, Inc. is not responsible for the reader's use of, or reliance upon, the report, nor any decisions based on the report.

NAVIGANT CONSULTING, INC. MAKES NO REPRESENTATIONS OR WARRANTIES,
EXPRESSED OR IMPLIED.

Readers of the report are advised that they assume all liabilities incurred by them, or third parties, as a result of their reliance on the report, or the data, information, findings and opinions contained in the report.

September 30, 2010

1. "Navigant" is a service mark of Navigant International, Inc. Navigant Consulting, Inc. (NCI) is not affiliated, associated, or in any way connected with Navigant International, Inc. and NCI's use of "Navigant" is made under license from Navigant International, Inc.



Key Contacts

Lisa Frantzis

Managing Director

Burlington, MA

(781) 270-8314

lfrantzis@navigantconsulting.com

Shalom Goffri

Managing Consultant

Burlington, MA

(781) 270-8374

shalom.goffri@navigantconsulting.com

Jay Paidipati

Associate Director

San Francisco, MA

(415) 399-2191

jpaidipati@navigantconsulting.com

Haley Sawyer

Senior Consultant

Burlington, MA

(781) 270-8369

hsawyer@navigantconsulting.com

Tucker Moffat

Consultant

Burlington, MA

(781) 270-8367

Tucker.moffat@navigantconsulting.com

Other Report Contributors:

Constantine Von Wentzel

William Goetzler