



SOLAR WATER HEATING TECHSCOPE MARKET READINESS ASSESSMENT

REPORTS FOR:

ARUBA
BAHAMAS
BARBADOS
DOMINICAN REPUBLIC
GRENADA
JAMAICA
ST. LUCIA
TRINIDAD & TOBAGO

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Water Heating Initiative



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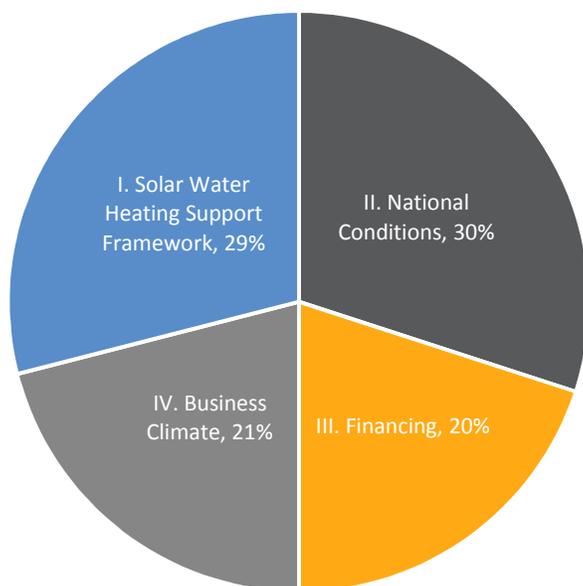
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INTRODUCTION

The *Solar Water Heating TechScope Market Readiness Assessment* was developed in 2014 under the Global Solar Water Heating (GSWH) Market Transformation and Strengthening Initiative (GSWH Project), a joint undertaking by the United Nations Environment Programme (UNEP) and the United Nations Development Programme (UNDP) and is funded by the Global Environment Facility (GEF), with co-financing by the International Copper Association (ICA). The TechScope was developed to support the growth of the global solar water heating (SWH) market by providing a replicable, high-level, and publicly available methodology to evaluate the SWH market in various countries. The TechScope was developed in consultation with a network of international SWH and renewable energy experts and uses four parameters to evaluate SWH markets in different countries:

- ⦿ **SWH Support Framework**, which includes government policies, regulations, and outreach efforts
- ⦿ **National Conditions**, which include climatic and market factors
- ⦿ **Financing**, which considers access to capital and macroeconomic conditions
- ⦿ **Business Climate**, which takes into account the ease of doing business and SWH business infrastructure.

Figure 1. Weighting of the four TechScope parameters



These parameters are composed of 18 indicators, scored on a scale of 0 to 5. These scores are then weighted to reflect their relative importance to a strong enabling environment for SWH in a given country (see Figure 1) and totaled to provide an overall national score—also on a scale of 0 to 5 (.

- ◎ **Score of 0-2.** SWH enabling environment is “emerging” and could likely benefit from additional support to accelerate SWH market growth.
- ◎ **Score of 2-3.** SWH enabling environment is “good” with a SWH market positioned for increased growth.
- ◎ **Score of 3-4.** SWH enabling environment is considered to be “strong” and likely ready to attract investment.
- ◎ **Score of 4-5.** SWH enabling environment is “very strong” – policy, market, financial, and business conditions are aligned to support SWH, and market growth is likely to be rapid.



For a full description of the methodology, parameters, and indicators, the full *Solar Water Heating TechScope Market Readiness Assessment* can be accessed online here: <http://solarthermalworld.org/content/solar-water-heating-techscope-market-readiness-report-2014>

This report contains TechScope Assessments conducted in eight Caribbean countries: Aruba, Bahamas, Barbados, Dominican Republic, Grenada, Jamaica, St. Lucia, and Trinidad & Tobago. It is recommended that the TechScope methodology be read in parallel with this report.

A module that estimates potential greenhouse gas (GHG) emissions is currently being developed as an add-on to the Market Readiness Analysis tool. Based on provided country context and deployment scenarios, this module estimates GHG emissions avoided through deployment of SWH. A discussion of how policymakers can utilize Nationally Appropriate Mitigation Actions (NAMAs) to drive international investment and improve national policy frameworks in the domestic SWH market is included in Appendix III. Two examples of potential GHG emissions reductions from theoretical deployment scenarios in two of the Caribbean countries are also included in the Appendix.

It should be noted that the “score” used in this methodology is not intended as a judgment on the comparative quality of a given country’s enabling environment for solar heating. Different countries have markedly different conditions that need to be considered in detail on a case-by-case basis. Instead, the scoring is intended to serve as a tool for focusing market and policy discussions on specific issues and providing a starting point for comparisons – rather than serving as a definitive and stand-alone comparison on its own.

The updated TechScope Market Readiness Analysis Tool, as well as instructions for use, will be freely available in October 2015.

THE CARIBBEAN CONTEXT

Small island developing states (SIDS) face significant energy challenges. Many Caribbean countries rely almost entirely on imported liquid fuels for energy production. This heavy reliance on imports can inhibit

economic development and leave SIDS vulnerable to spikes in global energy prices. National budgets are often burdened with expensive and fluctuating subsidies: for some Caribbean countries, the cost of electricity subsidies can exceed 2% of GDP (IMF, 2015a). Widespread adoption of renewable energy resources in the Caribbean can reduce fossil fuel import dependence, and if these markets are developed sustainably, create local business and employment opportunities. Since electricity is used as the primary fuel source for domestic water heating in many Caribbean countries, increased deployment of SWH can also improve grid reliability by reducing electricity demand.

Solar water heating (SWH) systems can be highly cost-effective across the Caribbean, taking advantage of the region's abundant solar resource (5-6 kWh/m²/day) (Figure 2 **Error! Reference source not found.**). Significant opportunities exist for Caribbean SIDS to support deployment of SWH, particularly in the residential and tourism sectors. Barbados is in fact one of the global leaders in SWH market deployment. With financial incentives for SWH first implemented in 1974, Barbados ranks among the top four countries in the world for installed capacity per capita, along with Austria, Cyprus, and Israel (Mauthner & Weiss, 2015).

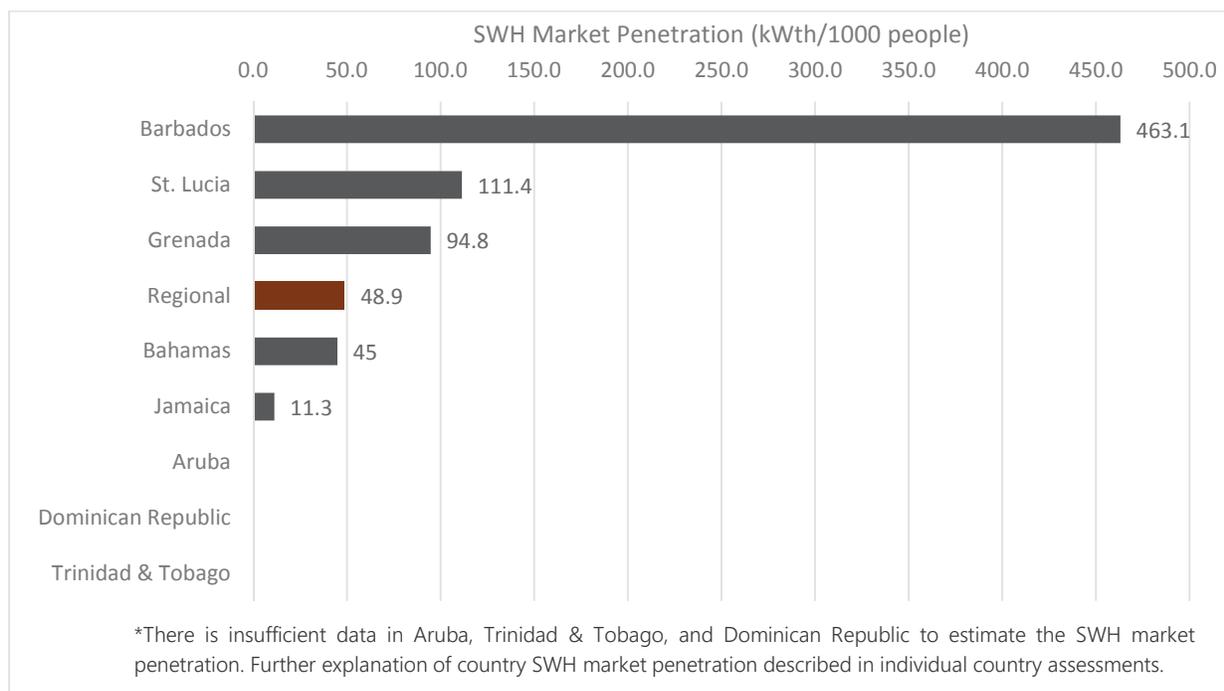
Figure 2. Country level average daily solar resource (kWh/m²/day) (Clean Energy Solutions Center, 2014)



BARRIERS TO SWH DEPLOYMENT IN THE REGION

Despite similarities in national and economic conditions between most Caribbean countries, no other SWH markets in the region have approached the level of deployment and maturity of Barbados. Average per capita deployment across the Caribbean region as a whole was estimated by the Caribbean Renewable Energy Development Programme at 48.9 kWh/1000 people (Schwerin, 2010). However, this regional average is skewed by Barbados, St. Lucia, and Grenada, as shown in Figure 3. Many other countries have much lower (or unknown) per capita penetrations.

Figure 3. SWH market penetration in the Caribbean countries (2014 estimates)



It is clear that persistent barriers to SWH adoption remain across many Caribbean countries. These barriers, which will be more evident on a country-by-country basis in the assessments in this report, include:

- **Financial barriers.** Despite short payback periods for SWH in most Caribbean countries, high upfront and financing costs remain prohibitive.
- **Weak enabling policy environments.** While many Caribbean countries have adopted renewable energy targets and action plans over the past decade, few countries have implemented specific policies to support SWH development (i.e. in national targets, building mandates, financial incentives, government supported loan programs).
- **Lack of public awareness.** While domestic SWH is ubiquitous in Barbados (80-90% of homes) and generally included in all new home construction on the island, public awareness and acceptance of SWH is significantly lower in other Caribbean countries (IEA ESTAP and IRENA, 2015).
- **Small and fragmented SWH industries.** Since most Caribbean countries have low levels of deployment, there are relatively few installers and only a limited number of renewable energy industry groups. There is also little domestic SWH manufacturing across the region outside of Barbados and St. Lucia, although some islands have companies that manufacture replacement components. SWH systems in the region are sourced either from Barbados and St. Lucia, or from international manufactures (e.g. USA, UK, Greece, Israel, Australia, and China, among others).

LIMITED SWH MARKET DATA

As reflected in the TechScope methodology, an accurate assessment of SWH markets requires reliable SWH market data. At the same time, less developed markets (which may be best positioned to benefit from TechScope assessments) typically have significant gaps in available market data.

As small islands states with small SWH markets and small energy ministries, many Caribbean jurisdictions have not collected SWH market data themselves. As noted above, the first regional survey of SWH markets in the Caribbean was conducted through CREDP and reported in 2012 (Schwerin, 2010). While this provided a valuable snapshot of some markets in the region, a follow-up survey has not yet been conducted, making the rate of market growth in the region and across individual countries very difficult to ascertain.

As will be discussed further in the individual TechScope assessments, significant (and similar) data gaps exist in many Caribbean countries. Numerous interviews with government officials, solar industry representatives, and other stakeholders were conducted during this project to identify data and characterize market size. It was found that Barbados, Grenada, and Jamaica have reliable year-on-year data that can be used for determining SWH market penetration and market growth. The Bahamas and St. Lucia have more limited data, whereas Aruba, Dominican Republic, and Trinidad & Tobago lack any reliable national market penetration data.

In addition to a lack of SWH market data, some of the international indices and publications used for TechScope indicators do not include smaller countries (or groups the Caribbean with Latin America).

Given the lack of data, proxy scores were created for several indicators in order to develop Assessment scores. In situations where there was insufficient data available and it was not possible to develop proxy scores, countries were given a score of 0 (e.g. the scores for SWH market growth in Aruba, the Dominican Republic and Trinidad and Tobago). As a result, many of these scores should be considered preliminary and do not provide a full picture of the SWH markets. It is anticipated that these scores would improve as additional data is made available in the future. Scores considered preliminary are marked with an asterisk (*).

It should be noted that a lack of data is not considered to be a negative factor in the TechScope Assessment process. The intent of the TechScope is to create a framework for policy makers and other stakeholders to analyze SWH market development in a structured way. Lower scores indicate areas where domestic and international stakeholders can focus future efforts to strengthen SWH markets through activities such as additional data gathering, program development, and/or policy intervention.

BARBADOS

Overall Score	3.07*/ 5.0
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Summary: Barbados’ overall TechScope score is 3.07*, reflecting its status as the SWH market leader in the region, and one of the most developed SWH markets in the world. Barbados trails only Cyprus, Israel, Austria, and Greece in cumulative installed capacity per capita. The 5-year average market growth rate between 2009 and 2014 was 8% - from 92.2 MW_{th} in 2009 to an estimated 133.8 MW_{th} in 2014. Over 80% of homes in Barbados are equipped with SWH according to 2015 reports so SWH market growth has slowed in recent years. The following SWH TechScope Market Readiness Assessment for Barbados provides insight on areas of strength and opportunity for this market.

General Information (2014)	
Population	286,066
GDP	\$4,348,000,000 USD
Total installed solar thermal (flat plate and evacuated tube collectors)	133.8* MW _{th}

Parameter	Score
Solar Water Heating Support Framework	1.20 / 1.45
National Conditions	0.77 / 1.50
Financing	0.55 / 1.00
Business Climate	0.55 / 1.05

PARAMETER I: SOLAR WATER HEATING SUPPORT FRAMEWORK

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
SWH Support Framework	1.20	SWH Targets	5%	5.0	0.25
		Financial Incentives for System Installation	8%	5.0	0.40
		SWH Loan Programs	7%	5.0	0.35
		Building Mandates	5%	0.0	0.0
		Outreach Campaigns	4%	5.0	0.20
		Subtotal	29%	20.0	1.20

1.1.1 SOLAR WATER HEATING TARGETS

SCORE 5.0 / 5.0

Barbados currently has a target to raise the number of household SWH's by 50 % before 2025 (UNEP, 2014). In 2013, Barbados also set a target to obtain 29% of domestic energy needs from renewable sources by 2019 (NREL, 2015c).

Barbados therefore receives a score of 5.0 for this indicator.

1.1.2 FINANCIAL INCENTIVES FOR SYSTEM INSTALLATION

SCORE 5.0 / 5.0

Barbados provides financial incentives to installers and end users alike for solar hot water systems installations. Many longstanding incentives still remain active today, while new incentives have been initiated.

The "Green Business Tax Incentives" program provides a suite of incentives to support the RE&EE market. Most notable are the provisions subsumed in the Barbados Income Tax Act BITA and directly applicable to SWH installations (Ernst & Young, 2014). Some highlights of BITA are outlined below:

Section 12: Companies which have invested money in machinery or plant can claim an initial allowance of 20% of this capital expenditure. These businesses can also claim an annual allowance of 150% of capital expenditure incurred in the income year for the purchase of machinery and plant.

Section 13: Provides an annual allowance of 20% of the capital expenditure incurred for the purpose of an energy audit and the retrofitting of a building, or the installing of a system to produce electricity from sources other than fossil fuels. This deduction is taken over a period of 5 years

Section 37: Offers a deduction of a maximum of BB\$10,000 to individuals who wholly own and occupy a residential property and who incur expenditure for outfitting the property with energy or water-saving devices. Of the BB\$10,000 maximum, up to BB\$5,000 can be claimed against the cost incurred in buying or installing “environmentally preferred products”. A further deduction of up to BB\$2,000 can be claimed against the cost incurred for a home energy audit.

Amendments to the BITA in 2013 introduced additional incentives available to green businesses that include an income tax holiday of 10 years for manufacturers and installers of RE and EE products and systems including solar electric systems (Ernst & Young, 2014).

Barbados receives a score of 5.0 as a result of its robust SWH incentives.

1.1.3 SWH LOAN PROGRAMS

SCORE 5.0 / 5.0

In 2012, the government of Barbados and the Inter-American Development Bank launched the “Sustainable Energy Investment Program (SmartFund)” – a low interest financing and grant program for renewable energy investments. The \$10 USD million SmartFund aimed to jump start the renewable energy and energy efficiency market in Barbados, targeting Small and Medium Enterprises (SMEs) as well as the residential sector. SWH systems are eligible for this financing program. Today, the Smart Fund is still providing IDB’s low interest rates mainly to SME borrowers, passed along through the Government at a 25 year tenor, including a five-year grace period, and an interest rate of roughly 1% (IDB, 2012).

In addition, in 2013, amendments to the BITA (as described in Section 1.1.2) included a claim for a tax deduction of 150% of the amount of interest on a loan for the purposes of: Constructing a new facility or upgrading an existing property to enable the generation, supply and sale of electricity from a renewable energy source; Constructing a new facility for installing or supplying renewable energy systems or energy efficient products (Ernst & Young, 2014).

As a result of the availability of loan programs and incentives for interest deductions on loans, Barbados receives a score of 5.0.

1.1.4 BUILDING MANDATES

SCORE 0.0 / 5.0

There are no existing government mandated standards for SWH in the construction of new buildings or the retrofitting of existing buildings. However, with 80-90% of homes reported to have installed SWH (IRENA and IEA ESTAP, 2015), home owners now largely expect to have SWH available in new and existing

homes (T. Haynes, personal communication, August 20, 2015). As a result, solar water heaters are often included in the design and construction of new homes regardless of a building mandate.

While Barbados receives a score of 0.0 for this indicator, it does appear that the market has moved beyond requiring government building mandates and instead consumer demand and other supportive government policies are enabling market growth.

1.1.5 OUTREACH CAMPAIGNS

SCORE 5.0 / 5.0

In the past, the Barbados Government had extensive outreach campaigns on solar water heating. These campaigns were extremely successful helping the country reach its current high SWH penetration levels and have therefore been largely phased out.

Although there are no longer any direct solar water heating outreach campaigns, the Government has continued to promote energy efficiency and renewable energy through the “Greening Barbados” initiative. Specifically, this promotion is happening through the Barbados Energy Awareness Programme which is an offshoot of the Barbados Energy Conservation Project, and the Renewable Energy Rider pilot program (Williams, 2013).

While Barbados does not currently have an ongoing outreach campaign, it is evident that the past campaigns had a significant impact on the development of the country’s solar water heating market. Therefore, Barbados receives a score of 5.0.

PARAMETER II: NATIONAL CONDITIONS

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
National Conditions	0.77	Insolation	5%	3.3	0.17
		SWH Market Penetration	4%	5.0	0.24
		Residential Energy Consumption Growth	5%	0.0	0.0
		SWH Market Growth	4%	3.0	0.12
		Competitiveness: Payback Period	7%	4.0	0.28
		Competitiveness: Heating Fuel Subsidy	5%	0.0	0.0
		Subtotal	30%	15.3	0.77

1.2.1 INSOLATION

SCORE 3.3 / 5.0

Average daily insolation levels average 5.2 kWh/m² per day in Barbados (Clean Energy Solutions Center, 2014). This results in a score of 3.3 for Barbados.

1.2.2 SWH MARKET PENETRATION

SCORE 5.0 / 5.0

The Barbados Statistical Service 2010 Housing and Population Census reported that there were approximately 78,936 private households of the approximately 94,173 dwelling units on the island. Of these dwelling units, 30,000 are estimated to have solar water heaters (Barbados Statistical Service, 2013).

In 2015 IRENA reported an increase in the country's level of SWH market penetration with an estimated 80-90% of households equipped with SWH (IRENA and IEA ESTAP, 2015).

Using existing published data, a 2014 estimate of SWH penetration can be deduced at approximately 463.08 kW_{th} /1,000 inhabitants* (see Appendix II for penetration methodology). This penetration is estimated based on available data and is subject to change when additional surveying is completed.

As a result of Barbados' global leadership in SWH, the country receives a score of 5.0.

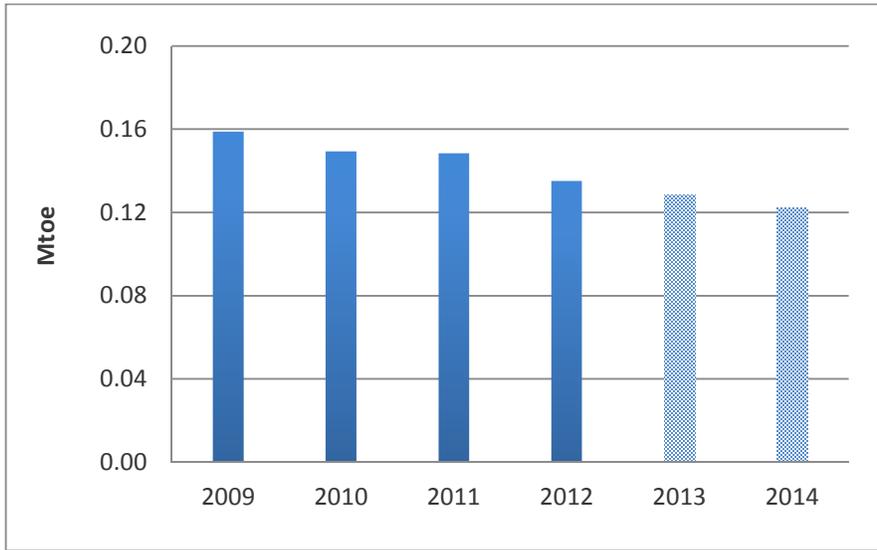
1.2.3 RESIDENTIAL ENERGY CONSUMPTION GROWTH

SCORE 0.0 / 5.0

According to the U.S. Energy Information Administration, residential energy consumption in Barbados has generally remained steady but slowly declining during 2009-2014. This is largely as a result of the run up in global oil prices (IMF, 2015c). Residential consumption has not fully returned to pre-2011 levels (Figure 4), and as a result Barbados has a 5-year average residential energy consumption growth rate of -5%.

This negative growth rate results in a score of 0 for Barbados.

Figure 4: Residential Energy Consumption in Barbados (EIA, 2015)¹



1.2.4 SWH MARKET GROWTH

SCORE 3.0 / 5.0

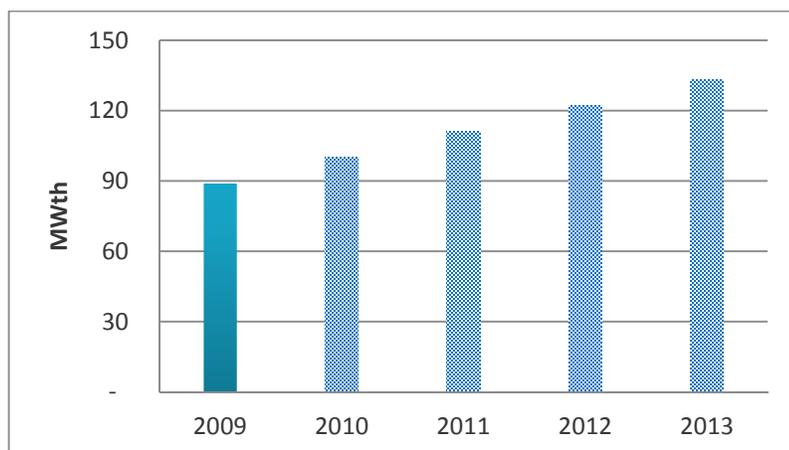
Using public market penetration data for 2006 of 55.7 MW_{th}, and 2009 of 92.2 MW_{th} reported by the International Energy Agency (IEA) Solar Heat Worldwide (2008-2015), an average 5 year annual market growth rate of 10% between 2009- 2014 can be estimated for the SWH market in Barbados (Figure 5).²

Barbados therefore receives a score of 3.0 for this indicator.

¹ 2013 -2014 consumption projection based on 3 year rolling historical average

² For all the assumptions used to calculate market growth for Barbados, please refer to Appendix II.

Figure 5: SWH Installed Capacity in Barbados



1.2.5 COMPETITIVENESS: PAYBACK PERIOD

SCORE 4.0 / 5.0

SWH system costs. Locally Manufactured SWH systems account for all of the residential SWH market in Barbados. According to the country's two leading manufacturing companies - Solar Dynamics Ltd, and Solaris Global Energy Ltd - the average collector size for a 4 person household is 2.4 gallons/square foot and the typical tank size is 65 gallons (Solar Dynamics Ltd., 2015). The average system cost ranges between \$1,800 and \$2,300 USD (including installation).

Retail energy prices. In Barbados, nearly 65% of domestic hot water systems are powered by electricity generated from heavy fuel oil (NREL, 2015c). Telephone interviews with installers suggest that home owners are typically replacing legacy electrical systems with SWH. It is assumed that SWH competes against the subsidized price of electricity, which was approximately \$0.28 USD/kWh in 2014 (NREL, 2015c).

Based on RETScreen analysis, the simple payback period for a SWH system in Barbados is 2 years, 5 months. This results in a score of 4.0 for this indicator.

1.2.6 COMPETITIVENESS: HEATING FUEL SUBSIDY

SCORE 0.0 / 5.0

In Barbados, residential electricity is subsidized at a price of \$0.28 USD/kWh. In 2011, electricity subsidies were estimated to average 1.2% of GDP (IMF, 2015).

The existence of a subsidy for electricity in Barbados does negatively affect the economic case for SWH. Barbados receives a score of 0.0 for this indicator.

PARAMETER III: FINANCING

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
Financing	0.55	Country Credit Rating	5%	0.5	0.03
		Access to Finance	15%	3.5	0.53
		Subtotal	20%	4.0	0.55

1.3.1 COUNTRY CREDIT RATING

SCORE 0.5 / 5.0

Barbados has a rating of B3 by leading credit agency Moody's, and a rating of B by S&P (Trading Economics, 2015). Barbados has maintained steady annual GDP growth for over 30 years, however GDP growth remained weak in 2014 and high external risks, a fiscal drag, and stagnant tourism resulted in a negative credit outlook by both agencies (IMF, 2015c).

The combination of these ratings gives Barbados an average score of 0.5 for this indicator

1.3.2 ACCESS TO FINANCE

SCORE 3.5 / 5.0

The access to finance score was based on an assessment of two measures with an equal weight: the country's real interest rate which serves as a proxy for the cost of borrowing, and the amount of domestic credit provided by the banking sector (as a percentage of GDP) which serves to gauge the availability of domestic loans.

The World Bank reports an average real interest rate for Barbados of 4.7% in the three year period between 2011-2013 (World Bank, 2015b). This results in a score of 2.0.

Domestic credit provided by banking sector (% of GDP) in Barbados was last measured at 136.3% in 2009, according to the World Bank (World Bank, 2015a). Because of the absence of more recent statistical data, and the stable year on year change of this metric for other countries in this region, the latest available data point is applied as a proxy. This results in a score of 5.0 for this indicator.

The combination of both scores results in an average of 3.5 for Barbados.

PARAMETER IV: BUSINESS CLIMATE

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
Business Climate	0.55	Doing Business	5%	3.0	0.15
		Manufacturing Capacity	3%	5.0	0.15
		Product Standards and Certification	5%	1.0	0.05
		Installer Certification	4%	0.0	0.0
		Industry Association	4%	5.0	0.2
		Subtotal	21%	14.0	0.55

1.4.1 DOING BUSINESS INDEX

SCORE 3.0 / 5.0

Currently, Barbados ranks at 106 out of 189 for the ease of doing business in the country (World Bank Group, 2015). The higher ranked indicators in Barbados relate to the ease of starting a business and trading across borders, whereas Barbados is ranked lower globally in terms of permitting, registering property, and protecting the interests of minority investors. The overall ease of doing business ranking results in a score of 3.0 for Barbados.

Table 1: Barbados - Doing Business Ranking:

Category	Doing Business Ranking
Starting a Business	94
Dealing with Construction Permits	147
Getting Electricity	118
Registering Property	144
Getting Credit	116
Protecting Minority Investors	177
Paying Taxes	92
Trading Across Borders	38

1.4.2 DOMESTIC MANUFACTURING

SCORE 5.0 / 5.0

In 2015, Barbados had a manufacturing value added (MVA) as percentage of GDP of 4% (UNIDO, 2015). However, it is important to mention that while Barbados has a relatively low MVA compared to the global MVA average (17%); it has one of the highest MVA's regionally.³

More importantly, in terms of solar water heating manufacturing, Barbados manufactures 100% of its SWH systems in-country. The two leading manufacturers are Solar Dynamics Ltd. and Solaris Global Energy Ltd. Moreover, Barbados is a major supplier of SWH components and systems for many countries in the region. Therefore, the MVA does not necessarily reflect the status of SWH manufacturing on the ground.

Given Barbados's well established manufacturing capability, it receives a 5 for this score.

1.4.3 PRODUCT CERTIFICATION

SCORE

1.0 / 5.0

Barbados has not established national SWH standards, certifications or testing procedures, nor has it adopted international standards, certifications or testing procedures. However, section 12E.10 of the Barbados Income Tax Act in 2013 recognizes the high costs associated with international product certification and allows a deduction of 150% of the certification cost incurred in a given income year (Ernst & Young, 2014).

Furthermore, according to industry experts, there are some processes that have been put in place by domestic manufacturers as detailed below.

Standards. Barbados does have a National Standards Institute, although they have not implemented any specific SWH standards, nor linked them to the international ISO standards for solar thermal systems (STS). Nevertheless, one of the leading SWH manufacturers and installers, Solar Dynamics, provides a temperature guarantee to its customers meaning that if any system is not performing at this guaranteed temperature, the customer can seek replacement or maintenance (Solar Dynamics Ltd., 2015).

Testing and Certification. Barbados does not have national testing facilities for solar Water Heating systems. However, Solar Dynamics has its systems tested and certified by Florida Solar Energy Center (FSEC), one of the leading certification and testing laboratories for solar products and equipment in the US.⁴ FSEC is an ISO 17025 accredited test facility through the American Association for Laboratory Accreditation (A2LA) and certifies products for quality, system design, and energy performance based on the standards they have developed over decades of experience (Florida Solar Energy Center, 2014).

³ Compared to the other eight countries being assessed, Barbados had the second highest MVA after the Dominican Republic (17%).

⁴ Other internationally recognized certification authorities Solar Rating & Certification Corporation, and Solar Keymark.

Due to the lack of national SWH standards, certifications and testing procedures, Barbados receives a score of 1. However, it is promising that Laws in Barbados have been set up to offset international certification costs, and that a leading manufacturer's equipment is being tested and certified by an internationally recognized body, thus creating a standard for their system's operation in the form of a temperature guarantee.

1.4.4 INSTALLER CERTIFICATION

SCORE 0.0 / 5.0

Although there have been a cycle of training courses conducted by organizations such as the Caribbean Renewable Energy Development Programme to build technical capacity on the island, there are currently no SWH installer certification processes in place in Barbados.⁵

Therefore, Barbados receives a score of 0.

1.4.5 INDUSTRY ASSOCIATION

SCORE 5.0 / 5.0

In 2012, the Barbados Renewable Energy Association was formed to facilitate the growth of renewable energy locally. According to industry experts, while the Association is mainly comprised of Solar PV market representatives, there is some SWH representation that does actively focus on solar water heating issues. Barbados is one of the few countries in the Caribbean with a renewable energy association of any kind.

Because Barbados has a renewable energy association with a focus on solar water heating, the country receives a score of 5.0.

⁵ Between 2006 and 2008, the UNDP and CREDP designed and implemented a series of one-off courses and workshops specifically for SWH Competency Standards for Installation and Maintenance, but these courses are no longer active and were not converted into a permanent certification process for installers.

ARUBA

Overall Score	1.23* / 5.0
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Summary: Aruba has an emerging SWH market, which could benefit from additional support to accelerate market growth. Aruba’s SWH market is currently constrained by a lack of government support policies, e.g. no incentives or consumer education and outreach programs. There is also a lack of reliable data on the SWH market, making it challenging to track the status and growth of the market. Aruba’s overall TechScope score is 1.23*, which will be discussed in detail in the sections below.

General Information (2014)	
Population	103,431
GDP	\$2,715,000,000 USD
Total installed solar thermal (flat plate and evacuated tube collectors)	[Insufficient data]

Parameter	Score
Solar Water Heating Support Framework	0.0 / 1.45
National Conditions	0.70 / 1.50
Financing	0.45 / 1.00
Business Climate	0.08 / 1.05

PARAMETER I: SOLAR WATER HEATING SUPPORT FRAMEWORK

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
SWH Support Framework	0.0	SWH Targets	5%	0.0	0.0
		Financial Incentives for System Installation	8%	0.0	0.0
		SWH Loan Programs	7%	0.0	0.0
		Building Mandates	5%	0.0	0.0
		Outreach Campaigns	4%	0.0	0.0
		Subtotal	29%	0.0	0.0

2.1.1 SOLAR WATER HEATING TARGETS

SCORE 0.0 / 5.0

The Renewable Energy & Sustainability Division of Aruba’s Department of Economic Affairs, Commerce & Industry makes no explicit mention of a SWH target for Aruba (Government of Aruba, Department of Economic Affairs, Social Affairs and Culture, n.d.). In 2012, the government announced a partnership with the Carbon War Room to transition the island to 100% renewable energy by 2020 (The Carbon War Room, 2013); however, the island is primarily focused on large-scale wind and solar PV projects to meet these goals. SWH is briefly mentioned as one of many potential strategies for addressing household energy efficiency needs to achieve the 100% renewable energy goal; however, there are no clear goals, targets or supporting policies that have been established to specifically support the development of a SWH market.

Aruba therefore receives a TechScope score of 0 for this indicator.

2.1.2 FINANCIAL INCENTIVES FOR SYSTEM INSTALLATION

SCORE 0.0 / 5.0

There are currently no specific financial incentives for the deployment of SWH in Aruba. Import duties on wind turbines, solar panels, and electric cars and parts were recently reduced to encourage adoption of clean energy technologies; however, the import of solar water heaters remains subject to a 12% duty (Pitney Bowes, 2015).

Aruba therefore receives a score of 0.0 for this indicator.

2.1.3 SWH LOAN PROGRAMS

SCORE 0.0 / 5.0

Aruba currently does not have loan programs in place for SWH. As a result, it receives a score of 0.0 for this indicator.

2.1.4 BUILDING MANDATES

SCORE 0.0 / 5.0

As part of Aruba's plan to become the world's first sustainable economy by 2020, strategies to renovate homes and commercial buildings are mentioned, but currently there is no specific building mandate for SWH (The Carbon War Room, 2013).

Aruba therefore receives a score of 0 for this indicator.

2.1.5 OUTREACH CAMPAIGNS

SCORE 0.0 / 5.0

The Aruban government and utility have established some marketing and outreach initiatives to promote green economic activities.⁶ However, there are no specific public outreach campaigns for SWH in Aruba. As a result, Aruba receives a score of 0.0 for this indicator.

PARAMETER II: NATIONAL CONDITIONS

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
National Conditions	0.70	Insolation	5%	3.3	0.17
		SWH Market Penetration	4%	0.0	0.0
		Residential Energy Consumption Growth	5%	0.0	0.0
		SWH Market Growth	4%	0.0	0.0
		Competitiveness: Payback Period	7%	4.0	0.28

⁶ This includes, for example, (1) Aruba's "Green Gateway Economic Vision and Policy 2011 – 2013," which outlines efforts to increase the empowerment of consumers to "go green"; think green, demand green and buy green, and (2) Aruba's "Green'S'Cool" (i.e. Green is Cool) vision 2020 education campaign.

		Competitiveness: Heating Fuel Subsidy	5%	5.0	0.25
		Subtotal	30%	12.3	0.7

2.2.1 INSOLATION

SCORE 3.3 / 5.0

Aruba enjoys high levels of solar irradiation, on the order of 5.0-5.5 kWh/m²/day (Clean Energy Solutions Center, 2014). Aruba's location off the coast of Venezuela means it is both out of the hurricane belt and exposed to 2,500 hours of sun per year – more than enough to make solar energy a viable venture (Utilities Aruba, 2014).

This results in a score of 3.3 for this indicator.

2.2.2 SWH MARKET PENETRATION

SCORE 0.0* / 5.0

Official statistics for SWH market penetration in Aruba do not yet exist. Therefore, Aruba scores 0 for this indicator, though this score should be considered preliminary until a market installation assessment has occurred.

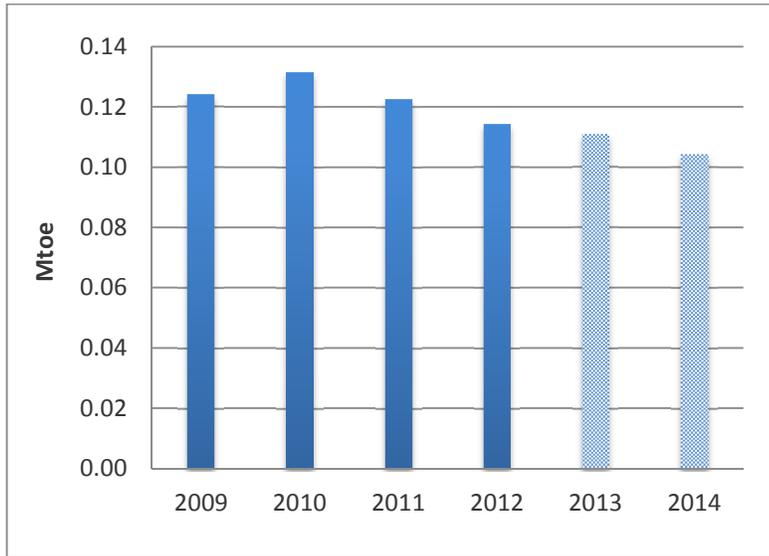
2.2.3 RESIDENTIAL ENERGY CONSUMPTION GROWTH

SCORE 0.0 / 5.0

Residential energy consumption in Aruba declined during the four-year period of 2009-2014 (EIA, 2015). Aruba has a four year residential energy consumption growth rate of -3.3% (see Figure 6).

This results in a score of 0 for this indicator.

Figure 6: Aruba Residential Energy Consumption (EIA, 2015)



2.2.4 SWH MARKET GROWTH

SCORE 0.0* / 5.0

Official statistics for SWH market penetration in Aruba do not yet exist. Desk research and interviews did not provide reliable data to estimate SWH market growth. It is recommended that further research into solar water heating market penetration and growth be conducted to provide a more accurate reflection of the current state of the market.

Therefore, Aruba receives a 0 for this score.

2.2.5 COMPETITIVENESS: PAYBACK PERIOD

SCORE 4.0 / 5.0

SWH systems costs. A range of SWH system types are currently available to residential customers, including evacuated tubes and flat plate designs. Installation costs may range from approximately \$1,174 USD to \$2,039 USD depending mainly on system size and the location of the installation (Retraco Ltd, 2015). Typical tank size ranges from 23.8 gallons to 52.8 gallons (see Table 2)

Table 2: Aruba - SWH System Sizes and Prices

SWH Tank Size	SWH Average System Price
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	(excl. installation) ⁷
23.8 gallon	2,100 (\$1,174 USD)
38.3 gallon	2,900 (\$1,621 USD)
52.8 gallon	3,650 (\$2,039 USD)

Retail Energy Prices. According to industry experts, and similar to other countries in this assessment, the vast majority of water heaters in Aruba are electric. On average, residential electricity costs \$0.25 USD/kWh (NREL, 2015a).

Based on RETScreen analysis using the above assumptions, the payback period is approximately 2 years, 9 months and results in a score of 4.0 for this indicator.

2.2.6 COMPETITIVENESS: HEATING FUEL SUBSIDY

SCORE 5.0 / 5.0

As mentioned in Section 2.2.5, electricity is the main fuel source for water heating. Currently, there are no electricity subsidies in Aruba (Utilities Aruba, 2014). Aruba's power provider, N.V. Elmar charges residential customers an inverted block rate⁸ of approximately \$0.25 USD/kWh in 2013 (NREL, 2015a).

The absence of a subsidy in the electricity sector results in a score of 5.0 for this indicator.

PARAMETER III: FINANCING

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
Financing	0.45	Country Credit Rating	5%	0.0	0.0
		Access to Finance	15%	3.0	0.45
		Subtotal	20%	3.0	0.45

2.3.1 COUNTRY CREDIT RATING

SCORE 2.0 / 5.0

⁷ Exchange rate: 1.0 Aruban Florin: 0.56 USD

⁸ Inverted block rate: the more electricity a customer consumes the higher average rate the customer pays.

S&P gives Aruba a credit rating of BBB+. Fitch gives Aruba a rating of BBB (Trading Economics, 2015). These ratings are equivalent to a lower-medium grade Moody's rating between Baa1 and Baa3 (Quad Capital Advisors LLC, 2015).⁹

According to the IMF, Aruba remains vulnerable to external shocks primarily in the tourism sector, which has resulted in some investment delays. However, the country continues to reduce its external debt position and is poised to make a steady recovery from the economic downturn over the last 5 years (IMF, 2015b).

The combination of these factors results in a score of 2.0 for this indicator.

2.3.2 ACCESS TO FINANCE

SCORE 3.0 / 5.0

IMF data in 2015 estimates a real interest rate of 5.2% in 2013 (IMF, 2015b). The most recent data on domestic credit provided by the banking sector (as a percentage of GDP) is from 2010 and 2011 and was recorded as 56%. Since more recent data is not available, the data from 2010 and 2011 were used to calculate this portion of the score.

The combination of both scores results in an average of 3.0.

PARAMETER IV: BUSINESS CLIMATE

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
Business Climate	0.08	Doing Business	5%	0.0	0.0
		Manufacturing Capacity	3%	1.0	0.03
		Product Standards and Certification	5%	1.0	0.05
		Installer Certification	4%	0.0	0.0
		Industry Association	4%	0.0	0.0
		Subtotal	21%	2.0	0.08

2.4.1 DOING BUSINESS INDEX

SCORE 0.0 / 5.0

There is currently no World Bank data or ranking for Aruba on the global Doing Business Index. The Aruba Investment Agency promotes Aruba's as having a favorable investment climate due to its status as a

⁹ Moody's has not provided a rating for Aruba.

constituent country within the Kingdom of the Netherlands (ARINA, 2015). While the efforts made by the Aruba Investment Agency may improve the ease of doing business in Aruba, there is insufficient data available to draw a reasonable conclusion for this indicator.

The country therefore receives a TechScope score of 0 for this indicator.

2.4.2 DOMESTIC MANUFACTURING

SCORE 1.0 / 5.0

Aruba has a manufacturing value added (MVA) (as percentage of GDP) of 4% (UNIDO, 2015). Aruba imports most of its SWH systems from regional and international manufacturers with local installers completing basic assembly, retrofitting, and installation. The absence of SWH manufacturing locally and low MVA, the country receives a score of 1.0 for this indicator.

2.4.3 PRODUCT CERTIFICATION

SCORE 0.0 / 5.0

There is currently no SWH product certification system in Aruba. While NV Elmar and the Department of Trade and Industry do register and approve renewable energy technologies used in households (Department of Economic Affairs, Social Affairs and Culture, n.d.), industry experts report that this does not extend to a clear product or standard that govern manufacturing or performance specifications for SWH collectors.

A score of 0.0 is given for this indicator.

2.4.4 INSTALLER CERTIFICATION

SCORE 0.0 / 5.0

There is also currently no national certification or standard for SWH installers. This results in a score of 0.0 for this indicator.

2.4.5 INDUSTRY ASSOCIATION

SCORE 0.0 / 5.0

Aruba does not currently have an industry association dedicated to renewable energy or SWH specifically. This results in a score of 0.0 for this indicator.

BAHAMAS

Overall Score	1.89* / 5.0
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Summary: The SWH market in the Bahamas is emerging and could benefit from additional government support and targeted incentives. Although the market growth cannot be estimated, estimated penetration in 2012 was 45 kW_{th} capacity/1000 people. The overall TechScope score for The Bahamas is 1.89*, which will be discussed in greater detail in the sections below.

General Information (2014)	
Population	382,571
GDP	\$8,510,500,000 USD
Total installed solar thermal (flat plate and evacuated tube collectors)	17.2 MW _{th}

Parameter	Score
Solar Water Heating Support Framework	0.35 / 1.45
National Conditions	0.66* / 1.50
Financing	0.70 / 1.00
Business Climate	0.18 / 1.05

PARAMETER I: SOLAR WATER HEATING SUPPORT FRAMEWORK

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
SWH Support Framework	.75	SWH Targets	5%	0.0	0.0
		Financial Incentives for System Installation	8%	5.0	0.4
		SWH Loan Programs	7%	5.0	.35
		Building Mandates	5%	0.0	0.0
		Outreach Campaigns	4%	0.0	0.0
		Subtotal	29%	10.0	.75

3.1.1 SOLAR WATER HEATING TARGETS

SCORE 0.0 / 5.0

Currently, the Bahamas does not have national solar water heating targets. The country does include broad renewable energy goals in its National Energy Policy 2013 – 2033 (Ministry of Environment and Housing & Ministry of Works & Urban Development, 2012). The policy outlines a national focus on the development of indigenous renewable energy resources and includes a goal of increasing the percentage of renewables in the energy mix to 30% by 2030 with 10% of that produced by households and businesses. The Bahamas aims to have solar water heating systems installed on 20% to 30% of all households, but this goal has not been adopted as a formal national target (NREL, 2015b).

The lack of a specific target for SWH results in a score of 0 for this indicator.

3.1.2 FINANCIAL INCENTIVES FOR SYSTEM INSTALLATION

SCORE 0.0 / 5.0

Ministry officials confirm that currently there are no financial incentives to promote the installation of solar water heaters. However, in 2008, the Government of the Bahamas reduced the import duties on solar technologies from 42% to 10% making the imports of raw materials and parts for solar technologies more affordable (NREL, 2015b).

The Bahamas receives a score of 0 for this indicator.

3.1.3 SWH LOAN PROGRAMS

SCORE 0.0 / 5.0

While installers have partnered with local commercial banks to offer financing schemes to residential customers, there is currently no government-supported loan program (e.g. interest rate buy-downs, low-interest loans, loan loss reserves, etc.) for the deployment of SWH in the Bahamas. This results in a score of 0.0 for this indicator.

3.1.4 BUILDING MANDATES

SCORE 0.0 / 5.0

There are currently no building mandates in the Bahamas for SWH. This results in a score of 0.

3.1.5 OUTREACH CAMPAIGNS

SCORE 0.0 / 5.0

In the past, the Bahamas has led outreach campaigns focused on solar water heating. In 2011, the Bahamas Government’s energy efficiency initiative called “30/30 by 2030” was established to promote the National Energy Policy’s objectives of reducing rising energy costs by integrating alternative power sources (Gibbs, 2011). The second initiative included encouraging the replacement of traditional electric water heaters with solar water heaters with the goal of reducing the costs of high-electricity consumption and wasteful-usage of municipal water resources.

From 2008-2013, the Organization of American States (OAS) implemented the Caribbean Sustainable Energy Program (CSEP), through the Caribbean Energy Awareness and Education Programme (CEEAP) and with the financial support from the European Union. The Bahamas was one of the beneficiary countries of CSEP. This program has been successful in promoting education literacy within the science curricula for renewable energy and energy efficiency technologies but has been discontinued pending increased funding (Singh, 2015).

Although the Bahamas has had SWH outreach campaigns in the past, there are currently no active outreach programs. Therefore, the Bahamas receives a score of 0.

PARAMETER II: NATIONAL CONDITIONS

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
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National Conditions	0.66	Insolation	5%	3.9	0.19
		SWH Market Penetration	4%	0.8	0.03
		Residential Energy Consumption Growth	5%	1.6	0.08
		SWH Market Growth	4%	0.0	0.0
		Competitiveness: Payback Period	7%	5.0	0.35
		Competitiveness: Heating Fuel Subsidy	5%	0.0	0.0
		Subtotal	30%	11.3	0.66

3.2.1 INSOLATION

SCORE 3.9 / 5.0

The Bahamas has a good solar resource for applications such as solar hot water systems, with insolation averaging between 5.5 and 6.0 kWh/m²/day (Clean Energy Solutions Center, 2014).

This results in a score of 3.9.

3.2.2 SWH MARKET PENETRATION

SCORE 0.8 / 5.0

In 2012, SWH market penetration in The Bahamas was estimated to be 45 kW_{th} per 1,000 inhabitants, just short of the estimated regional average of 48.9 average of kW_{th} per 1,000 inhabitants (Schwerin, 2010). The Bahamas receives a score of 0.8 for this indicator as a result.

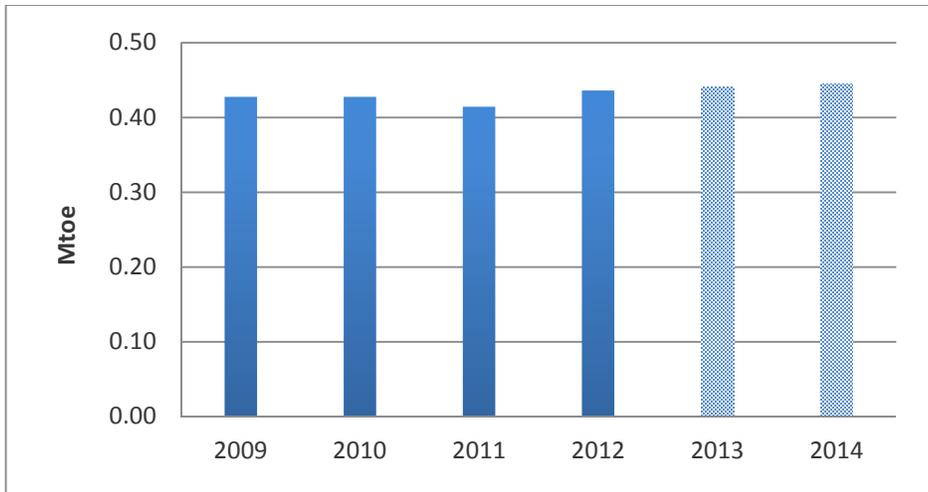
3.2.3 RESIDENTIAL ENERGY CONSUMPTION GROWTH

SCORE 1.6 / 5.0

According to U.S. Energy Information Administration, average residential energy consumption in The Bahamas has remained stable over the 5-year period of 2009 – 2014 (see Figure 7). The Bahamas has a 5-year average residential energy consumption growth rate of less than 1% driven down by increased international oil prices and the global economic recession that impacted the economy sharply 2011. This overall flat growth rate returns a score of 1.6 for this indicator.

Figure 7: Bahamas Residential Energy Consumption (EIA, 2015)¹⁰

¹⁰ 2013 -2014 consumption projection based on 3 year rolling historical average (EIA)



3.2.4 SWH MARKET GROWTH

SCORE 0.0 / 5.0

Official statistics for SWH market growth in The Bahamas do not yet exist. The single penetration 2012 data point of 45 kW_{th} per 1,000 inhabitants is not sufficient to establish market growth trends. Desk research and interviews did not provide reliable data to estimate SWH market growth. Therefore, The Bahamas receives a 0 for this score. It is recommended that further research into solar water heating market penetration and growth be conducted to provide a more accurate reflection of the current state of the market.

3.2.5 COMPETITIVENESS: PAYBACK PERIOD

SCORE 4.0 / 5.0

SWH System Costs. The Bahamas imports SWH systems from both regional and international manufacturers including in the US and China. There are many brands of solar water heaters available to consumers in the Bahamas. To date, US-made systems with an insulated tank tend to be most popular. Additionally, less costly systems from China are quite prevalent, but their quality varies by supplier. The Danish company Grundfos provides the most commonly used circulation pump. On average, residential system costs range from \$1,800 to \$2,300 USD.

Retail energy prices. In the Bahamas, traditional domestic hot water systems are largely powered by electricity generated from diesel and heavy fuel oil (NREL, 2015b). According to interviews, homeowners replacing existing water heaters with SWH are typically vacation homeowners and in need of replacing legacy electrical systems. It is assumed that SWH competes with the partially subsidized price of electricity, which averages \$0.32 USD/kWh, which is on par with the Caribbean regional average of \$0.33 USD/kWh (NREL, 2015b).

Based on RETScreen analysis, the simple payback for a SWH system in The Bahamas is 1 year 7 months- assuming there are no household grants or other financial incentives. This results in a score of 4.0.

3.2.6 COMPETITIVENESS: HEATING FUEL SUBSIDY

SCORE 0.0 / 5.0

In The Bahamas, residential electricity is subsidized at a price of \$0.32 USD/kWh. In 2011, electricity subsidies were estimated to average 0.5% of GDP between 2011 and 2013 (IMF, 2015a).

The existence of a subsidy for electricity in The Bahamas negatively affects the economic case for SWH. Bahamas receives a score of 0.0 for this indicator.

PARAMETER III: FINANCING

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
Financing	0.70	Country Credit Rating	5%	2.0	0.10
		Access to Finance	15%	4.0	0.60
		Subtotal	20%	6.0	0.70

3.3.1 COUNTRY CREDIT RATING

SCORE 2.0 / 5.0

The Bahamas have a rating of Baa2 by leading credit agency Moody's, and a rating of BBB- by S&P (Trading Economics, 2015).

The IMF reported in 2015 that economic recovery from the global financial crisis is at a slower pace because of the Bahamas heavy dependence on extra-regional tourism (IMF, 2014b). This helps to explain the country's current economic outlook categorized as stable to negative.

The combination of these ratings gives the Bahamas an average score of 2.0 for this indicator.

3.3.2 ACCESS TO FINANCE

SCORE 4.0 / 5.0

According to the World Bank, in 2014, the Bahamas' real interest rate was 4.8%, in line with its 5-year average of 4.3%. This results in a score of 4.

During the same period, the amount of domestic credit provided by the banking sector averaged 103%, resulting in a score of 4. The combination of both scores results in an average score of 4.0 for this indicator.

PARAMETER IV: BUSINESS CLIMATE

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
Business Climate	0.18	Doing Business	5%	3.0	0.15
		Manufacturing Capacity	3%	1.0	0.03
		Product Standards and Certification	5%	0.0	0.0
		Installer Certification	4%	0.0	0.0
		Industry Association	4%	0.0	0.0
		Subtotal	21%	4.0	0.18

3.4.1 DOING BUSINESS INDEX

SCORE 3.0/ 5.0

The Bahamas rank 97 out of 189 countries according to the World Bank’s Doing Business 2015. Table 3 shows a breakdown of each individual indicator makes up the complete Doing Business Ranking. The Bahamas score a high ranking in areas such as paying taxes and trading across borders, but lower ranking in property registration and accessing credit locally. The overall ease of doing business ranking results in a score of 3.0 for the Bahamas.

Table 3: Bahamas - Doing Business Ranking

Category	Doing Business Ranking
Starting a Business	15
Dealing with Construction Permits	17
Getting Electricity	12
Registering Property	32
Getting Credit	22
Protecting Minority Investors	18
Paying Taxes	1
Trading Across Borders	9

3.4.2 DOMESTIC MANUFACTURING

SCORE 1.0 / 5.0

The country has an MVA score of 4% (UNIDO, 2015). As mentioned in section 3.2.5, The Bahamas imports its SWH systems from regional and international manufacturers with local installers usually completing basic assembly, retrofitting and installation. The lack of manufacturing locally is indicative of the country's economy that is heavily skewed towards the hospitality and service industry with no significant penetration of manufacturing and heavy industry. As a result the Bahamas receives a score of 1.0 for this indicator.

3.4.3 PRODUCT CERTIFICATION

SCORE 0.0 / 5.0

There is currently no certification system in place for SWH systems in The Bahamas and this results in a score of 0 for this indicator.

3.4.4 INSTALLER CERTIFICATION

SCORE 0.0 / 5.0

There is no national certification process for local installers. This results in a score of 0 for this indicator.

3.4.5 INDUSTRY ASSOCIATION

SCORE 0.0 / 5.0

The Bahamas Renewable Energy Association was established in 2013. According to reports however, as of 2015, the Association has not been incorporated by the Government of Bahamas and does not actively support SWH specifically (Hartnell, 2014). For this reason, the Bahamas receives a score of 0 for this indicator.

DOMINICAN REPUBLIC

Overall Score 2.52* / 5.0



Summary: The Dominican Republic's SWH market is currently emerging and has yet to utilize SWH at a significant scale. The market does currently have a strong renewable energy legal and policy framework, but one that is focused on larger scale commercial technology applications. Additionally, there is an absence of residential SWH market data, making it difficult to track the status and growth of the market. The Dominican Republic's overall TechScope score is 2.52*, which will be discussed in detail in the sections below.

General Information (2014)

Population	10,528,954
GDP	\$63,968,961,563 USD
Total installed solar thermal (flat plate and evacuated tube collectors)	[insufficient data]

Parameter	Score
Solar Water Heating Support Framework	0.95 / 1.45
National Conditions	0.72* / 1.50
Financing	0.35 / 1.00
Business Climate	0.50 / 1.05

PARAMETER I: SOLAR WATER HEATING SUPPORT FRAMEWORK

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
SWH Support Framework	0.95	SWH Targets	5%	0.0	0.0
		Financial Incentives for System Installation	8%	5.0	0.4
		SWH Loan Programs	7%	5.0	0.35
		Building Mandates	5%	0.0	0.0
		Outreach Campaigns	4%	5.0	0.0
		Subtotal	29%	15.0	0.95

4.1.1 SOLAR WATER HEATING TARGETS

SCORE 0.0 / 5.0

Currently, no targets for SWH exist in the Dominican Republic. However, the country does have numerous domestic laws recognizing the necessity to transition the energy sector to cleaner fuels. Most significantly, a 2007 law was passed (CNE, n.d.), setting a target of achieving 25% renewable energy in the country’s final electricity consumption by 2025 (Ochs et al., 2011).

Nevertheless, the lack of a specific target for SWH results in a score of 0 for this indicator.

4.1.2 FINANCIAL INCENTIVES FOR SYSTEM INSTALLATION

SCORE 5.0 / 5.0

Article 4 of The Dominican Republic’s Law 57-07 explicitly mentions “opening the door” to sustained financing for the renewable sector through financial incentives.¹¹ These incentives include tax exemptions and customs tariffs exemptions for equipment, parts, machinery and accessories for the production of energy from renewable resources. In addition, Article 12 provides a tax deduction of 33.3% to households and businesses that purchase renewable energy systems to meet their energy needs.

SWH is eligible for these incentives and the Dominican Republic results in a score of 5.0 for this indicator.

¹¹ Chapter II, Paragraph VII

4.1.3 SWH LOAN PROGRAMS

SCORE 5.0 / 5.0

Currently, Banco Hipotecario Dominicano (BHD) León is the only commercial bank that provides a credit line for renewable energy, energy efficiency and clean energy production (Fu-Bertaux & World Watch Institute, 2011). Supported by the International Finance Corporation (IFC), the credit line offers low-interest (~5.5%) medium-term loans to developers of small to medium-sized projects and can be used to finance up to 80% of the project's installed costs (Fu-Bertaux & World Watch Institute, 2011). Furthermore, the terms ensure that the interest rate for external financing for renewable energy projects is limited to 5% for investors.

Because SWH projects would qualify for financing under these loan schemes, the Dominican Republic receives a score of 5.0 for this indicator

4.1.4 BUILDING MANDATES

SCORE 0.0 / 5.0

There are currently no building mandates for SWH in The Dominican Republic. This renders a score of 0 for this indicator.

4.1.5 OUTREACH CAMPAIGNS

SCORE 5.0 / 5.0

In March 2015, the Organization of American States (OAS) launched the Dominican leg of its Caribbean Sustainable Energy Program (CSEP) with the financial support from the European Union. This program has been successful in promoting the education literacy within the science curricula (Singh, 2015). The CSEP does not focus specifically on promoting solar water heating adoption, however, and the Dominican Republic scores a 0.0 for this indicator.

PARAMETER II: NATIONAL CONDITIONS

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
National Conditions	0.72	Insolation	5%	3.9	0.19
		SWH Market Penetration	4%	0.0	0.0
		Residential Energy Consumption Growth	5%	5.0	0.25

		SWH Market Growth	4%	0.0	0.0
		Competitiveness: Payback Period	7%	4.0	0.28
		Competitiveness: Heating Fuel Subsidy	5%	0.0	0.0
		Subtotal	30%	12.9	0.72

4.2.1 INSOLATION

SCORE 3.9 / 5.0

Average daily insolation levels in the Dominican Republic average 5.5-6.0 kWh/m²/day (Clean Energy Solutions Center, 2014).

Based on the scoring methodology, The Dominican Republic receives a score of 3.9.

4.2.2 SWH MARKET PENETRATION

SCORE 0.0* / 5.0

Official statistics for residential SWH market penetration do not yet exist.

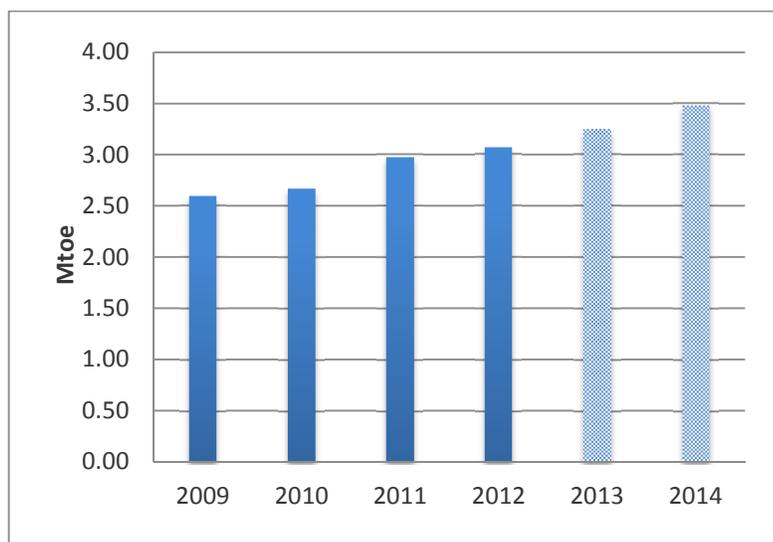
The Dominican Republic receives a score of 0 for this indicator. This score should be considered preliminary because of the lack of official SWH market penetration data for

4.2.3 RESIDENTIAL ENERGY CONSUMPTION GROWTH

SCORE 4.0 / 5.0

According to the U.S. Energy Information Administration, residential energy consumption in the Dominican Republic has generally remained flat during the five year period of 2009-2014 (Figure 8). Consumption fell slightly in 2009 and 2010 as a result of the increase in global oil prices and the subsequent increase in the cost of power, but has since rebounded (IMF, 2014a). The Dominican Republic has a 5-year average residential energy consumption growth rate of 6%. This returns a score of 4.0 for this indicator.

Figure 8: The Dominican Republic's Residential Energy Consumption (EIA, 2015)¹²



4.2.4 SWH MARKET GROWTH

SCORE 0.0*/ 5.0

As mentioned in section 4.2.2, official statistics for residential SWH market growth do not yet exist for the Dominican Republic and the market could not be adequately characterized through desk research and telephone interviews. As a result, this indicator receives a score of 0.

4.2.5 COMPETITIVENESS: PAYBACK PERIOD

SCORE 4.0* / 5.0

SWH System Costs. Using average system information from a leading regional SWH system, the average collector size for a 4-person household is 2.4 gallons per square foot and the typical tank size is 65 gallons (Solar Dynamics Ltd., 2015). The average system cost ranges between \$1,800 USD and \$2,300 USD (including installation).¹³

Retail energy prices. In the Dominican Republic, the majority of water heaters are electric and therefore SWH competes directly with electricity that has an average retail rate of \$0.22 USD/kWh (Institute of the Americas, 2015).

¹² 2013 -2014 consumption projection based on 3 year rolling historical average (EIA)

¹³ Please note that system and installation costs and specifications from a regional SWH manufacturer have been used as a proxy for the Dominican Republic.

Based on RETScreen analysis, the simple payback for a SWH system with the above specifications in the Dominican Republic is 3 years, 3 months. This results in a score of 4.0.

4.2.6 COMPETITIVENESS: HEATING FUEL SUBSIDY

SCORE 0.0 / 5.0

According to the IMF, total electricity subsidies are estimated at about 2% of GDP in The Dominican Republic. In March 2003, the Fund for the Stabilization of the Electricity Rate (FETE) was created to reimburse residential users with consumption below 300 kWh/month for electricity rate increases (IDB, 2013).¹⁴

The Dominican Republic receives a score of 0 for this indicator because of its energy subsidies and its effect on the economic competitiveness of SWH.

PARAMETER III: FINANCING

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
Financing	0.35	Country Credit Rating	5%	1.0	0.05
		Access to Finance	15%	2.0	0.30
		Subtotal	20%	3.0	0.35

4.3.1 COUNTRY CREDIT RATING

SCORE 1.0 / 5.0

The Dominican Republic received a rating of B1 from Moody's and BB- from S&P (Trading Economics, 2015). The combination of these ratings and a stable to positive economic outlook results in a score of 1.0 for this indicator.

4.3.2 ACCESS TO FINANCE

SCORE 2.0 / 5.0

¹⁴ This subsidy would be paid to distributors for the difference between the applied rate (real rate charged to users) and the indexed rate (the theoretical rate that included the cost structure of the electricity system)

According to the World Bank, between 2010 and 2014, The Dominican Republic's real interest rate averaged 11.1%. This results in a score of 2. During the same period, the amount of domestic credit provided by the banking sector averaged 48%, which results in a score of 2. The combination of both scores results in an average of 2.0 for this indicator.

PARAMETER IV: BUSINESS CLIMATE

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
Business Climate	0.3	Doing Business	5%	3.0	0.15
		Manufacturing Capacity	3%	5.0	0.15
		Product Standards and Certification	5%	0.0	0.0
		Installer Certification	4%	0.0	0.0
		Industry Association	4%	5.0	0.20
		Subtotal	21%	13.0	0.5

4.4.1 DOING BUSINESS INDEX

SCORE 3.0 / 5.0

Currently, the World Bank ranks the Dominican Republic 84 out of 189 for the ease of doing business in the country. This high ranking reflects the ease of trading across borders and paying taxes. Lower rankings in electricity access and starting a business, results in an overall ease of doing business score of 3.0.

Table 4: Dominican Republic - Doing Business Ranking

Category	Doing Business Ranking
Starting a Business	19
Dealing with Construction Permits	18
Getting Electricity	27
Registering Property	10
Getting Credit	14
Protecting Minority Investors	12
Paying Taxes	7
Trading Across Borders	2

4.4.2 DOMESTIC MANUFACTURING

SCORE 5.0 / 5.0

In 2013, The Dominican Republic had an MVA of 22.6% (UNIDO, 2015), which exceeds the global average of approximately 17% and results in a score of 5.0 for this indicator.

4.4.3 PRODUCT CERTIFICATION

SCORE 0.0 / 5.0

There is currently no certification system in place for SWH in The Dominican Republic. This results in a score of 0 for this indicator.

4.4.4 INSTALLER CERTIFICATION

SCORE 0.0 / 5.0

Similar to product certification discussed in section 1.4.3, there is also an absence of national certification for local installers. This results in a score of 0 for this indicator.

4.4.5 INDUSTRY ASSOCIATION

SCORE 5.0 / 5.0

The Dominican Republic Association of Renewable Energy Businesses is actively involved in the country mainly with utility sector reform. There is no indication that SWH is a priority however. The existence of this active Association results in a score of 5 for this indicator.

GRENADA

Overall Score

2.69* / 5.0



Summary: The SWH market in Grenada is strong with an overall TechScope score of 2.69*. Annual SWH growth averaged 8% between 2010 and 2014 with a total increase in installed capacity from approximately 6.86* MW_{th} in 2009 to 10.08* MW_{th} in 2014. The following sections provide greater insight into Grenada's SWH TechScope Market Readiness Assessment.

General Information (2014)

Population	106,303
GDP	\$882,222,222 USD
Total installed solar thermal (flat plate and evacuated tube collectors)	10.08* MW _{th}

Parameter	Score
Solar Water Heating Support Framework	1.0 / 1.45
National Conditions	0.96* / 1.50
Financing	0.55 / 1.00
Business Climate	0.18 / 1.05

PARAMETER I: SOLAR WATER HEATING SUPPORT FRAMEWORK

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
SWH Support Framework	0.75	SWH Targets	5%	0.0	0.0
		Financial Incentives for System Installation	8%	5.0	0.4
		SWH Loan Programs	7%	5.0	0.35
		Building Mandates	5%	0.0	0.0
		Outreach Campaigns	4%	0.0	0.0
		Subtotal	29%	10.0	0.75

5.1.1 SOLAR WATER HEATING TARGETS

SCORE 0.0 / 5.0

The government established broad renewable energy goals as part of the “Greenada Vision 2030.” The plan seeks to make Grenada one of the first countries to go 100% green in its energy sector by 2030 (The Government of the Republic of Grenada, 2011). However, there is no mention of a national solar water heating target.

The lack of a specific target for SWH results in a score of 0 for this indicator.

5.1.2 FINANCIAL INCENTIVES FOR SYSTEM INSTALLATION

SCORE 0.0 / 5.0

Grenada does not have financial incentives in place to support development of SWH. However, the National Energy Policy 2030 proposes development of incentives and other enabling policies to encourage use of SWH in new and existing homes (The Government of the Republic of Grenada, 2011). While these policies are in the process of being implemented, they have not yet been rolled out. Therefore, Grenada currently receives a score of a 0.

5.1.3 SWH LOAN PROGRAMS

SCORE 5.0 / 5.0

Grenada has several residential loan programs for SWH, which have been developed in part due to national

energy legislation. The Energy Efficiency Act, as outlined in Annex VI of the 2011 Grenada National Energy Policy, requires commercial banks to provide financial special loan programs to help businesses and homeowners invest in energy efficiency technologies (The Government of the Republic of Grenada, 2011). In particular, the Act stipulates that all new home mortgages provide EC\$5,000 interest-free to encourage homeowners to finance SWH.

In addition, the Grenada Public Service Cooperative Credit Union (PSCCU) – in partnership with the OAS and the United Nations Industrial Development Organization (UNIDO) – provides low interest financing for SWH for a period up to five years. This fund has been available since 2010 (IRENA, 2012).

Due to the presence of the Government’s support of SWH loan programs, Grenada receives a score of 5.

5.1.4 BUILDING MANDATES

SCORE 5.0 / 5.0

Grenada’s National Energy Policy includes a mandate to deploy solar water heaters in all government buildings, hotels, and other commercial buildings (The Government of the Republic of Grenada, 2011). Specifically, Annex VI of the Energy Efficiency Act lays out special commercial building planning regulations, which stipulate that no new hotel will be granted planning permission without a specified energy contribution from SWH (The Government of the Republic of Grenada, 2011). Similar mandates do not extend to the residential sector. In recognition of the mandate for hotels, Grenada receives a score of 5.

5.1.5 OUTREACH CAMPAIGNS

SCORE 0.0 / 5.0

Based on research and interviews, it is unclear if Grenada has run public outreach campaigns on SWH. The country has undertaken capacity building and training programs on renewable energy technologies for electricians and engineers as outlined in section 5.4.4. However, because there is no known outreach program for SWH, Grenada receives a score of 0.0.

PARAMETER II: NATIONAL CONDITIONS

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
National Conditions	0.96	Insolation	5%	3.3	0.17
		SWH Market Penetration	4%	1.8	0.07
		Residential Energy Consumption Growth	5%	5.0	0.25

		SWH Market Growth	4%	3.0	0.12
		Competitiveness: Payback Period	7%	5.0	0.35
		Competitiveness: Heating Fuel Subsidy	5%	0.0	0.0
		Subtotal	30%	18.1	0.96

5.2.1 INSOLATION

SCORE 3.3 / 5.0

Grenada enjoys high levels of solar irradiation, on the order of 5.3 kWh/m²/day (Clean Energy Solutions Center, 2014) with the strongest solar radiation in the southern part of the island and along the coast. This results in a score of 3.3.

5.2.2 SWH MARKET PENETRATION

SCORE 1.8 / 5.0

In 2012, the overall SWH market penetration for Grenada was approximately 80 kW_{th} capacity per 1000 people (Schwerin, 2010). Although this is low when compared to the regional market leader (Barbados with 319 kW_{th} capacity per 1000 people), it is well above the regional average (48.9 kW_{th} capacity per 1000). Using this estimate and market assumptions outlined in Appendix II, 2014 penetration for Grenada is estimated at 94.8 kW_{th} capacity per 1000 people.

Grenada therefore receives 1.8 for this indicator

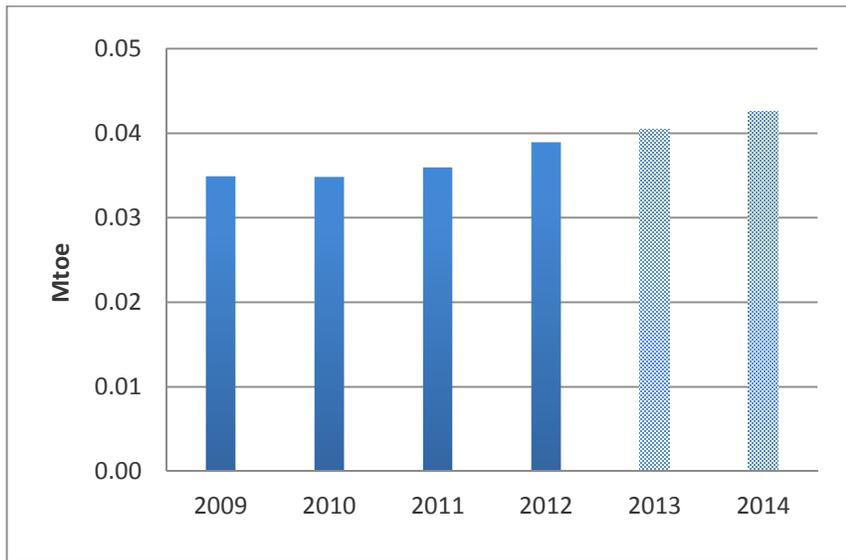
5.2.3 RESIDENTIAL ENERGY CONSUMPTION GROWTH

SCORE 5.0 / 5.0

Residential energy consumption in Grenada makes up approximately 35% of total energy consumption (NREL, 2015c).

Between 2009 and 2014, average consumption grew by 4%, as shown in Figure 9 (EIA, 2015). This results in a score of 5.0 for this indicator.

Figure 9: Grenada Residential Energy Consumption (EIA, 2015)¹⁵



5.2.4 SWH MARKET GROWTH

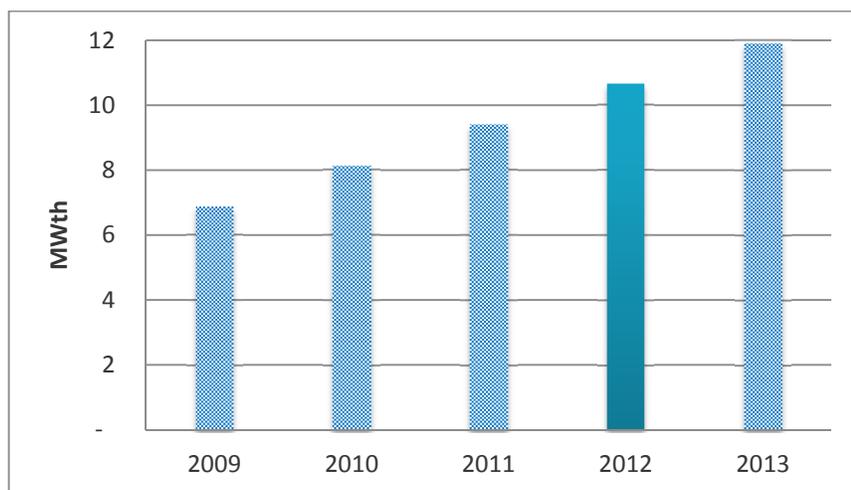
SCORE 5.0 / 5.0

Solar hot water systems are commonly used in middle- to upper-income households in Grenada. According to a 2012 study of Grenada’s energy market, the overall number of solar thermal collectors imported into Grenada increased by 400% between 2000 and 2008 (IRENA, 2012). In 2008, approximately 4,000 solar water heaters were installed in Grenada, and the country has maintained an upward growth trend since then (importing on average 900 units annually) (Sustainable Energy for All, 2014a). It is estimated that Grenada’s 5 year average SWH growth rate (between 2009 and 2014) is 8% (Figure 10). Further description of the methodology applied can be found in Appendix II.

As a result of this market growth, Grenada receives a TechScope score of 5.0 for this indicator.

¹⁵ 2013 -2014 consumption projection based on 3 year rolling historical average (EIA)

Figure 10: SWH Installed Capacity in Grenada



5.2.5 COMPETITIVENESS: PAYBACK PERIOD

SCORE 4.0 / 5.0

SWH system costs. The average collector size is 156 square feet (2.4 gallons/square foot) and the typical tank size is 65 gallons. SWH system costs range from \$1,100 to \$1,850 USD. Grenada does not manufacture SWH. It imports the majority of pre-fabricated flat plate systems from nearby Barbados.

Retail energy prices. In Grenada, domestic hot water systems are powered by electricity generated from diesel (NREL, 2015d). Interviews suggest that those who replace existing water heaters with SWH were replacing legacy electrical systems. Residential electricity rates are one of the highest of the studied countries, averaging \$0.42 USD/kWh in 2014 (NREL, 2015d).

Based on RETScreen analysis, the simple payback for a SWH system in Grenada is approximately 3 years, assuming there are no grants or other financial incentives. This results in a score of 4.0.

5.2.6 COMPETITIVENESS: HEATING FUEL SUBSIDY

SCORE 0.0 / 5.0

IMF estimates electricity subsidies accounted for 2.3% of GDP in 2013, up from 1.2% of GDP in 2011 and 2008 (IMF, 2015a).

The presence of this subsidy results in a score of 0 for this indicator.

PARAMETER III: FINANCING

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
Financing	0.56	Country Credit Rating	5%	0.5	0.03
		Access to Finance	15%	3.5	0.53
		Subtotal	20%	4.0	0.56

5.3.1 COUNTRY CREDIT RATING

SCORE 0.5 / 5.0

Grenada has been given a credit rating of B- from S&P (Trading Economics, 2015), which is equivalent to a non-investment grade B3 Moody's rating (Quad Capital Advisors LLC, 2015). However, the IMF reported in 2015 that the country's fiscal performance is positive, with the government on track in 2015 to deliver its first primary surplus in over 10 years (IMF, 2015). This rating results in a score of 0.5 for this indicator.

5.3.2 ACCESS TO FINANCE

SCORE 3.5 / 5.0

According to the World Bank, Grenada's average real interest rate was 7.6% from 2009-2013.

In 2014, the real interest rate decreased to 5%, well below the five year average. This results in a score of 3. During the same period, the amount of domestic credit provided by the banking sector was 81%, resulting in a score of 4. The combination of both scores results in an average of 3.5.

PARAMETER IV: BUSINESS CLIMATE

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
Business Climate	0.18	Doing Business	5%	2.0	0.10
		Manufacturing Capacity	3%	1.0	0.03
		Product Standards and Certification	5%	1.0	0.05
		Installer Certification	4%	0.0	0.0
		Industry Association	4%	0.0	0.0

5.4.1 DOING BUSINESS INDEX

SCORE 2.0 / 5.0

Grenada ranks 126 out of 189 countries according to the World Bank's Doing Business 2015. Table 5 shows a breakdown of each individual indicator making up the complete Doing Business Ranking. Grenada scores a high ranking for dealing with construction permits and trading across borders but has a weaker domestic credit environment. The overall ease of doing business ranking results in a score of 2.0 for Grenada.

Table 5: Grenada - Doing Business Ranking

Category	Doing Business Ranking
Starting a Business	9
Dealing with Construction Permits	7
Getting Electricity	17
Registering Property	17
Getting Credit	22
Protecting Minority Investors	18
Paying Taxes	12
Trading Across Borders	7

5.4.2 DOMESTIC MANUFACTURING

SCORE 1.0 / 5.0

In 2013, Grenada had a MVA of 3% (UNIDO, 2015), which is significantly below the global average of approximately 17%. There is currently no manufacturing of SWH in Grenada. SWH products are instead imported primarily from regional manufacturers in nearby Barbados. Grenada therefore receives a score of 1.0 for this indicator.

5.4.3 PRODUCT CERTIFICATION

SCORE 1.0 / 5.0

Standards and certification. The Grenada Bureau of Standards (GDBS) plays a key role in establishing standards and certification for products and goods. In particular, it is responsible for ensuring that high quality renewable energy equipment enters the Grenada market (IRENA, 2012). However, it is not clear if specific standards and certifications have been developed for solar water heating.

Testing. Although a thorough testing program has not been developed, the local University - St George's University - in conjunction with Grenada Solar Power Company launched a research Programme to assess the different solar module types for Caribbean application.

Because Grenada has a national standards body they receive a score of 1 for this indicator.

5.4.4 INSTALLER CERTIFICATION

SCORE 0.0 / 5.0

There is currently no national certification for installers of SWH in Grenada. However, in recent years, Grenada has established a capacity building and education framework for renewable energy. In 2012 Grenada implemented a capacity building program with introductory training for electricians and engineers in renewable energy technologies (IRENA, 2012).

Due to the lack of an installer certification program the country receives a score of 0.

5.4.5 INDUSTRY ASSOCIATION

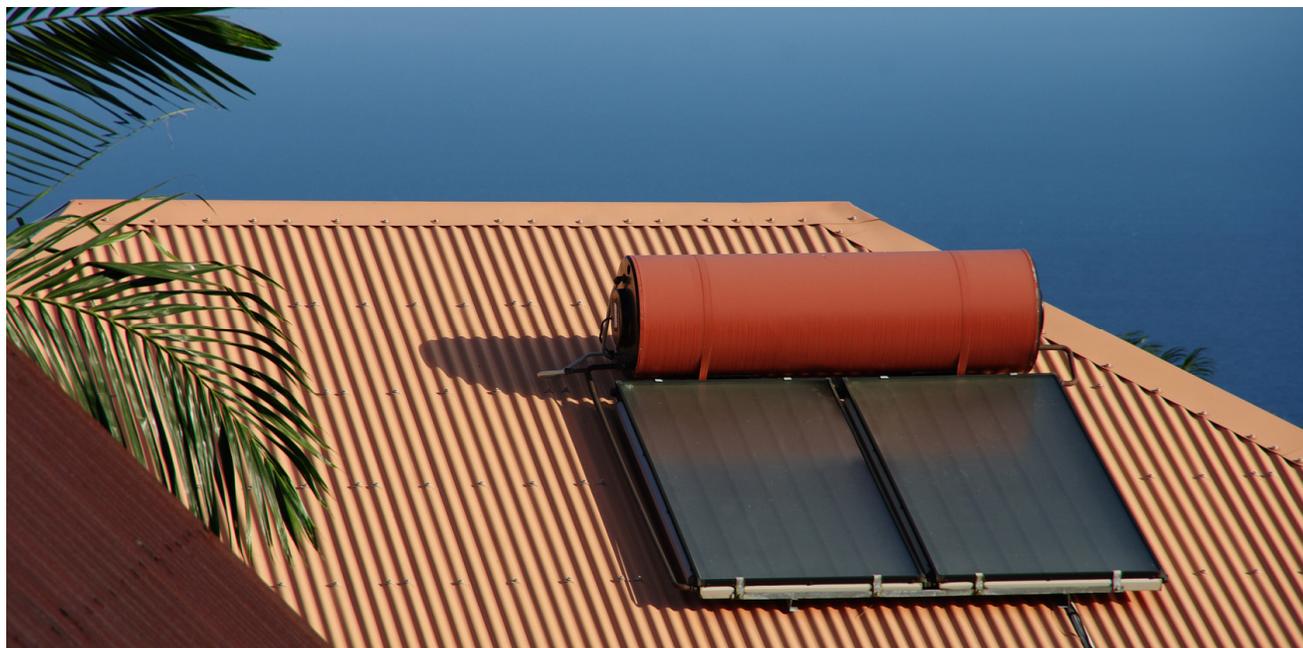
SCORE 0.0 / 5.0

Grenada does not have a renewable energy industry association. However, Grenada does have an Association of Architects that plays a role in the installation of integrated renewable energy sources in buildings. Grenada receives a score of 0 for this indicator since it does not have a formal association focusing on solar water heating.

JAMAICA

Overall Score

2.31* / 5.0



Summary: Jamaica's SWH market is emerging and could benefit from additional support to accelerate SWH market growth. Estimates from 2014 indicated a total installed capacity of 30.8* MW_{th} up from 24.36* MW_{th} in 2009. The market remains constrained, however, by a lack of government support policies and outreach efforts. Additionally, there is an absence of residential SWH market data making it difficult to track the status and growth of the market. Jamaica's overall TechScope score is 2.31*, which will be discussed in detail in the sections below.

General Information (2014)

Population	2,721,252
GDP	\$14,362,262,585 USD
Total installed solar thermal (flat plate and evacuated tube collectors)	30.8 MW _{th}

Parameter	Score
Solar Water Heating Support Framework	0.35 / 1.45
National Conditions	1.06* / 1.50
Financing	0.39 / 1.00
Business Climate	0.51 / 1.05

PARAMETER I: SOLAR WATER HEATING SUPPORT FRAMEWORK

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
SWH Support Framework	0.35	SWH Targets	5%	0.0	0.0
		Financial Incentives for System Installation	8%	0.0	0.0
		SWH Loan Programs	7%	5.0	0.35
		Building Mandates	5%	0.0	0.0
		Outreach Campaigns	4%	0.0	0.0
		Subtotal	29%	5.0	0.35

6.1.1 SOLAR WATER HEATING TARGETS

SCORE 0.0 / 5.0

The Energy Division of Jamaica’s Ministry of Science, Technology, Energy and Mining (MSTEM) makes no explicit mention of a SWH target for Jamaica in its National Energy Policy 2009 – 2030 or its Vision 2030 National Development Plan (Sustainable Energy for All, 2014b). In 2012, the government set broad targets of 20% renewable energy by 2030.

Because no specific SWH targets have been stipulated, Jamaica receives a score of 0 for this indicator as a result

6.1.2 FINANCIAL INCENTIVES FOR SYSTEM INSTALLATION

SCORE 0.0 / 5.0

There are currently no specific financial incentives for the deployment of SWH in Jamaica.

Renewable energy products and systems including SWH devices are exempt from General Consumption tax according to the General Consumption Tax Act of 2004. In addition, in 2013 the Common External Tariff (CET) was suspended on 16 energy saving items, of which SWH systems are included (Jamaica Information Services, 2013). This exemption is part of an amendment to the Customs Act, with an exemption period of 5 years from January 1, 2013 to December 31, 2017.

On its own, tax and tariff removals have not been proven effective incentives in the further development of SWH markets. According to the TechScope methodology, this results in a score of 0 for this indicator.

6.1.3 SWH LOAN PROGRAMS

SCORE 5.0 / 5.0

The Government of Jamaica currently makes residential loans available through its National Housing Trust (NHT) for SWH of up to USD\$1,000 at modified interest rates (Ministry of Energy and Mining, 2009).

Additional loan facilities exist alongside the NHT program. The Development Bank of Jamaica (DBJ) manages several credit lines aimed at increasing the capacity of private banks to make loans for energy efficiency and renewable energy projects. Although these facilities largely target small and medium size enterprises, they have been disbursed to individuals through commercial banks like First Global Bank, National Commercial Bank and Scotia Bank, mortgage banks such as Victoria Mutual Building Society, and the Jamaica National Building Society (Ministry of Energy and Mining, 2009).

Due to Jamaica's active SWH loan programs, Jamaica receives a score of 5.0 for this indicator.

6.1.4 BUILDING MANDATES

SCORE 0.0 / 5.0

Currently there are no national mandates for including SWH in existing or new residential construction in Jamaica.

A draft National Building Code developed by the Bureau of Standards Jamaica and the Ministry of Science Technology Energy & Mining includes guidance for "greening" buildings. Additionally The Jamaica Green Building Council (JGBC) is working to integrate current standards such as the 2012 International Green Construction Code (IGCC) of the International Code Council (ICC) into local building construction (Sustainable Energy for All, 2014b). The new code is expected to make buildings more efficient and reduce waste.

Although there is potential for promotion of SWH through developing government schemes, due to the absence of guidelines and mandates for SWH in buildings and construction currently, Jamaica receives a score of 0 for this indicator.

6.1.5 OUTREACH CAMPAIGNS

SCORE 0.0 / 5.0

There are currently no specific outreach campaigns for SWH in Jamaica. There have been efforts to increase awareness of the merits of renewable energy more generally however. In 2012, the Inter-American Development Bank (IDB) and Development Bank of Jamaica jointly launched "GreenBiz", a roughly \$800,000 USD initiative to demonstrate the benefits of energy efficiency measures in business and to train certified energy auditors to heighten energy efficiency awareness through public showcases of energy

projects, radio and television interviews, advertising, educational workshops and seminars, and an energy fair (Sustainable Energy for All, 2014b).

Since Jamaica does not have an active outreach campaign dedicated to SWH, the country receives a score of 0 for this indicator.

PARAMETER II: NATIONAL CONDITIONS

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
National Conditions	1.06	Insolation	5%	3.9	0.19
		SWH Market Penetration	4%	0.2	0.01
		Residential Energy Consumption Growth	5%	5.0	0.25
		SWH Market Growth	4%	2.0	0.08
		Competitiveness: Payback Period	7%	4.0	0.28
		Competitiveness: Heating Fuel Subsidy	5%	5.0	0.25
		Subtotal	30%	20.1	1.06

6.2.1 INSOLATION

SCORE 3.9 / 5.0

The average global horizontal irradiance for Jamaica is 5.5-6.0 kWh/m²/day (Clean Energy Solutions Center, 2014), creating favorable conditions for SWH. The TechScope score for this indicator is therefore 3.9.

6.2.2 SWH MARKET PENETRATION

SCORE 0.2* / 5.0

Official statistics for SWH market penetration in Jamaica do not yet exist. Through desk research and interviews with government officials and installers, various estimates for solar water heating penetration were provided (Schwerin, 2010). Using a combination of historical data and baseline assumptions, a SWH market penetration of 11.33 MW_{th} was calculated for 2014. Appendix II outlines this methodology in detail.

This results in a score of 0.2 for this indicator.

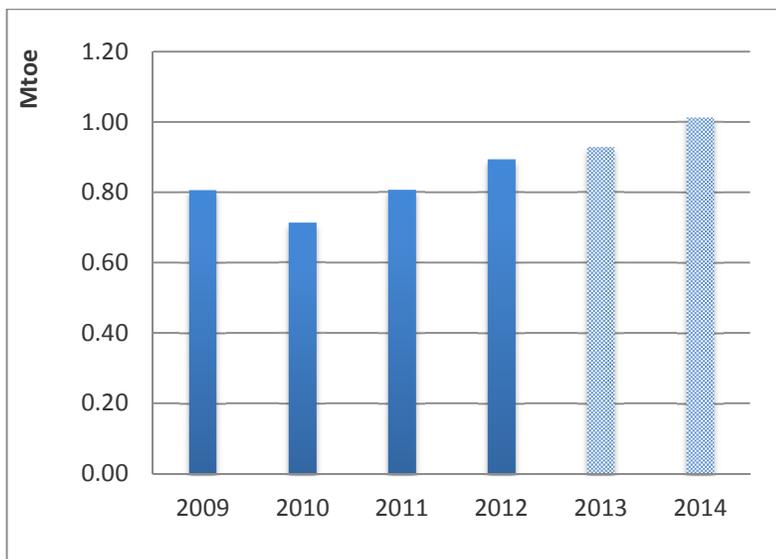
6.2.3 RESIDENTIAL ENERGY CONSUMPTION GROWTH

SCORE 5.0 / 5.0

Residential energy consumption in Jamaica makes up approximately 25% of total energy consumption and 33% of total electricity consumption (Makhijani & Ochs, 2013; Sustainable Energy for All, 2014b). Similar to other energy importing countries in the Region, residential energy consumption has been affected by high international oil prices (Figure 11). The average growth in residential consumption between 2009 and 2014 has remained positive, however, at 4%.

The residential energy consumption trend results in a score of 5 for this indicator.

Figure 11: Residential Energy Consumption in Jamaica (EIA, 2015)¹⁶



6.2.4 SWH MARKET GROWTH

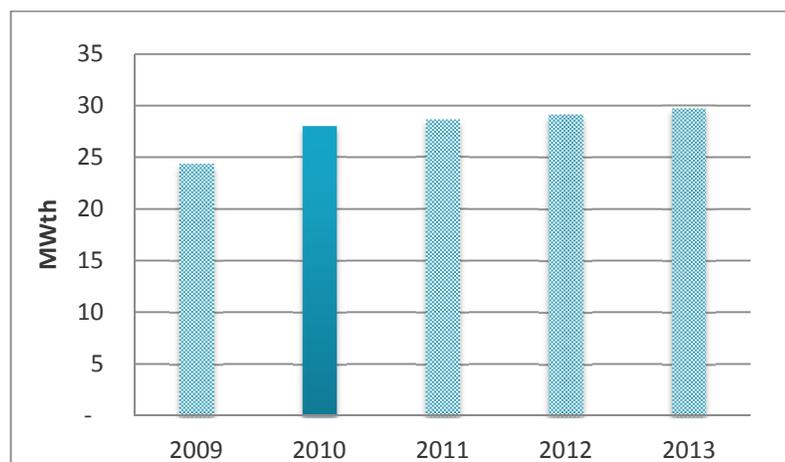
SCORE 2.0* / 5.0

In 1998, The Jamaica Public Service Company, in partnership with the World Bank, established a solar water heating initiative that installed over 1,000 solar water heating systems, of which 300 were residential (Jamaica Public Service Company Limited, 2013). This initiative was one of many that helped to establish Jamaica's SWH market.

¹⁶ 2013 -2014 consumption projection based on 3 year rolling historical average (EIA)

These installations, combined with assumptions laid out in Appendix II, result in an estimated 2014 penetration of 11.33 kW_{th} capacity/1000 and a growth rate of 5% between 2009 and 2014 (Figure 12). This results in a score of 2.0 for this indicator.

Figure 12: Estimated SWH Market Growth in Jamaica



6.2.5 COMPETITIVENESS: PAYBACK PERIOD

SCORE 4.0* / 5.0

SWH system costs. According to industry professionals, the Jamaican market is split between evacuated tube collectors imported from China and flat plate collectors from manufacturers in Barbados, Greece, and Israel, among others. Total SWH installation cost estimates average between \$1,050 and \$1,500 USD and typically include a warranty of 5-10 years on the storage tank; 2-5 years for the SWH panel; and a 1 year warranty for operation and management.

Retail energy prices. In Jamaica, the vast majority of residential users heat water with electricity. The average electricity price paid by Jamaican residential customers in 2014 averaged \$0.32 USD/kWh.

Based on RETScreen analysis using the above system assumptions, the simple payback is 4 years, 9 months and this results in a score of 4.0 for Jamaica.

6.2.6 COMPETITIVENESS: HEATING FUEL SUBSIDY

SCORE 5.0 / 5.0

According to the IMF's 2015 report on subsidies in the Caribbean, Jamaica does not have any implicit or explicit subsidies on electricity in the residential sector. Fluctuating global oil prices have generally been passed through to residential customers, most apparent when electricity prices in the country more than

doubled between 2005 and 2011 (IMF, 2015a). Jamaica therefore receives a TechScope score of 5.0 as the absence of price subsidies for electricity improves the economic viability of SWH.

PARAMETER III: FINANCING

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
Financing	0.39	Country Credit Rating	5%	0.3	0.01
		Access to Finance	15%	2.5	0.38
		Subtotal	20%	2.8	0.39

6.3.1 COUNTRY CREDIT RATING

SCORE 0.3 / 5.0

Jamaica has been given a rating of Caa2 from Moody's and B from S&P (Trading Economics, 2015). A gradual economic recovery is underway with strong employment growth in 2015 and public debt on a downward trajectory (IMF, 2015d). Although this outlook is stable to positive, the country's high level of indebtedness and external risk results in a score of 0.3 for this indicator.

6.3.2 ACCESS TO FINANCE

SCORE 2.5 / 5.0

According to the World Bank, in 2013, Jamaica's real interest rate was 8.7%, below its four-year average of 10%. This results in a score of 2. During the same period, the amount of domestic credit provided by the banking sector is 51%, resulting in a score of 3. The combination of both scores results in Jamaica's average score of 2.5.

PARAMETER IV: BUSINESS CLIMATE

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
Business Climate	0.51	Doing Business	5%	4.0	0.20
		Manufacturing Capacity	3%	2.0	0.06
		Product Standards and Certification	5%	1.0	0.05
		Installer Certification	4%	0.0	0.0

	Industry Association	4%	5.0	0.20
	Subtotal	21%	12.0	0.51

6.4.1 DOING BUSINESS INDEX

SCORE 4.0 / 5.0

Jamaica ranks 58 out of 189 countries according to the World Bank’s Doing Business 2015. Table 6 shows a breakdown of each individual indicator justifying this ranking. Jamaica scores a high ranking in areas involving starting a business; including permitting and access to credit, while reliability of electricity, paying taxes, and trading across borders are ranked lower. Jamaica’s overall ease of doing business results in a score of 4.0.

Table 6: Jamaica Doing Business Ranking

Category	Doing Business Ranking
Starting a Business	1
Dealing with Construction Permits	2
Getting Electricity	24
Registering Property	16
Getting Credit	4
Protecting Minority Investors	8
Paying Taxes	23
Trading Across Borders	25

6.4.2 DOMESTIC MANUFACTURING

SCORE 2.0 / 5.0

Jamaica’s manufacturing value added (MVA) as percentage of GDP is 7% (UNIDO, 2015).

It is important to note that while Jamaica has a relatively low MVA compared to the global average of 17%, it is high relative to other countries in the region. More importantly, in terms of solar water heating manufacturing, the domestic SWH market in Jamaica consists of both installation and service companies; some that import SWH equipment and parts from regional and international manufacturers, and others that have in-country engineering and manufacturing operations. It is important to note that MVA does not necessarily reflect the status of SWH manufacturing on the ground. Jamaica’s overall score for this indicator to 2.

6.4.3 PRODUCT CERTIFICATION

SCORE 1.0 / 5.0

The Bureau of Standards Jamaica was established by The Standards Act of 1969 to promote and encourage standardization in relation to commodities, processes and practices (Bureau Standards Jamaica, 2015). Industry experts have confirmed that the Bureau previously had facilities and laboratory for the testing of solar equipment and products but currently does not offer this service (D. Barrett, personal communication, August 26, 2015). At this time, Jamaica receives a score of 1.0 for this indicator.

6.4.4 INSTALLER CERTIFICATION

SCORE 0.0 / 5.0

Jamaica receives a score of 0.0 for this indicator as there currently is no specific certification for installers of SWH in the country. Interviews with installers however have indicated that it is typical for international manufacturers to provide training and certification for the application of those SWH products available in the Jamaica market.

6.4.5 INDUSTRY ASSOCIATION

SCORE 5.0 / 5.0

Although the Jamaica Solar Energy Association has been established and operating since 1999 (Jamaica Solar Energy Association, n.d.), there is currently no dedicated industry association specifically for SWH. The JSEA was designed to encourage the use of renewable energy, specifically solar. The Association is composed of manufacturers, retailers, marketers, installers and providers of solar energy and those in academia. Jamaica therefore receives a score of 5.0 for this indicator.

ST. LUCIA

Overall Score 2.07* / 5.0



Summary: The solar water heating market in St. Lucia is good. Trailing only Barbados in the Region in terms of market penetration. In 2012, SWH penetration was estimated at 111.4 kW_{th} capacity/1000 people. St. Lucia's overall TechScope score is 2.07*, which will be discussed in detail in the sections below in order to provide greater insight into the SWH TechScope Market Readiness Assessment for St. Lucia.

General Information (2014)

Population	183,598
GDP	\$1,365,426,555 USD
Total installed solar thermal (flat plate and evacuated tube collectors)	20.5 MW _{th}

Parameter	Score
Solar Water Heating Support Framework	0.20 / 1.45
National Conditions	0.99* / 1.50
Financing	0.58*/ 1.00
Business Climate	0.30 / 1.05

PARAMETER I: SOLAR WATER HEATING SUPPORT FRAMEWORK

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
SWH Support Framework	0.20	SWH Targets	5%	0.0	0.0
		Financial Incentives for System Installation	8%	0.0	0.0
		SWH Loan Programs	7%	0.0	0.0
		Building Mandates	5%	0.0	0.0
		Outreach Campaigns	4%	5.0	0.20
		Subtotal	29%	5.0	0.20

7.1.1 SOLAR WATER HEATING TARGETS

SCORE 0.0 / 5.0

Although explicit mention is given to a national renewable energy generation target of 35% by 2020, St. Lucia does not currently have quantitative targets for SWH. For this reason, St. Lucia receives a score of 0 for this indicator (NREL, 2015e).

7.1.2 FINANCIAL INCENTIVES FOR SYSTEM INSTALLATION

SCORE 0.0 / 5.0

In the past, St. Lucia has had incentives for SWH that were available to installers and residential users.

- ⦿ **Tax Deduction for first time SWH buyers.** The Government encouraged private investment in SWH by allowing first time purchasers to claim up to Eastern Caribbean (EC) \$6,500 (\$2,407 USD) on their income tax returns.
- ⦿ **Import tax exemption for renewable energy technologies.** Renewable energy technologies, including SWH systems and SWH system parts, are exempt from import duties (Global Environment Facility (GEF), 1999).

Interviews with Ministry officials however, confirmed that the income tax deduction program is no longer available.

St. Lucia receives a score of 0, as its import tax exemption is not sufficient to obtain a higher score for this indicator.

7.1.3 SWH LOAN PROGRAMS

SCORE 0.0 / 5.0*

There are currently no government-supported loan programs in St. Lucia. However, local banks are offering SWH leasing to customers and short-term credit options to finance the purchase of SWH systems (Ephraim & Tulsie, 2010).

The scoring for this indicator is dependent on whether the government is supporting loan programs. Although some private banks and credit unions are providing loans for SWH, there are no government-sponsored programs to support SWH lending. Therefore, St. Lucia receives a score of 0.0.

7.1.4 BUILDING MANDATES

SCORE 0.0 / 5.0

Section E.2 of St. Lucia's National Energy Policy (NEP) directs the building sector to increase energy efficiency. Explicit mention is given for the use of SWH in new buildings of large hot water consumers, such as tourist resorts (Ministry of Physical Development and the Environment, 2010). Further, the development of an Energy Efficiency Building Code (EEBC) was proposed as a mandatory step for new constructions and retrofits in commercial buildings. In subsequent years, the EEBC will become mandatory for both public and private sector buildings.

St. Lucia receives a score of 0 for this indicator due to the fact that specific SWH mandates have not yet been rolled out.

7.1.5 OUTREACH CAMPAIGNS

SCORE 5.0 / 5.0

In 2014 the Organization of American States launched the 2014-2015 Caribbean Sustainable Energy Program (CSEP) in St. Lucia that has been successful in promoting education literacy within the science curricula for renewable energy and energy efficiency technologies (Singh, 2015). This program is still active.

The Government of St. Lucia has in the past sponsored an annual Energy Awareness Week in partnership with the CARICOM community to educate consumers mainly about energy efficiency applications in everyday living, including solar water heating (Global Sustainable Energy Islands Initiative & The St. Lucia Co-operative League Limited, 2005).

Interviews with Government officials did not confirm that this sponsorship program was still active. However, with the support of Regional agencies like the OAS with local outreach, St. Lucia receives a score of 5 for this indicator.

PARAMETER II: NATIONAL CONDITIONS

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
National Conditions	0.99	Insolation	5%	3.3	0.17
		SWH Market Penetration	4%	2.1	0.08
		Residential Energy Consumption Growth	5%	2.1	0.10
		SWH Market Growth	4%	1.0	0.04
		Competitiveness: Payback Period	7%	5.0	0.35
		Competitiveness: Heating Fuel Subsidy	5%	5.0	0.25
		Subtotal	30%	18.5	0.99

7.2.1 INSOLATION

SCORE 3.3 / 5.0

The amount of daily sunshine received over St. Lucia is at its maximum from February to May and minimum around September (GEF, 1999). The average solar irradiance ranges between 5.0 and 5.5 kWh/m²/day (Clean Energy Solutions Center, 2014). St. Lucia therefore receives a score of 3.3 for this indicator.

7.2.2 SWH MARKET PENETRATION

SCORE 2.1* / 5.0

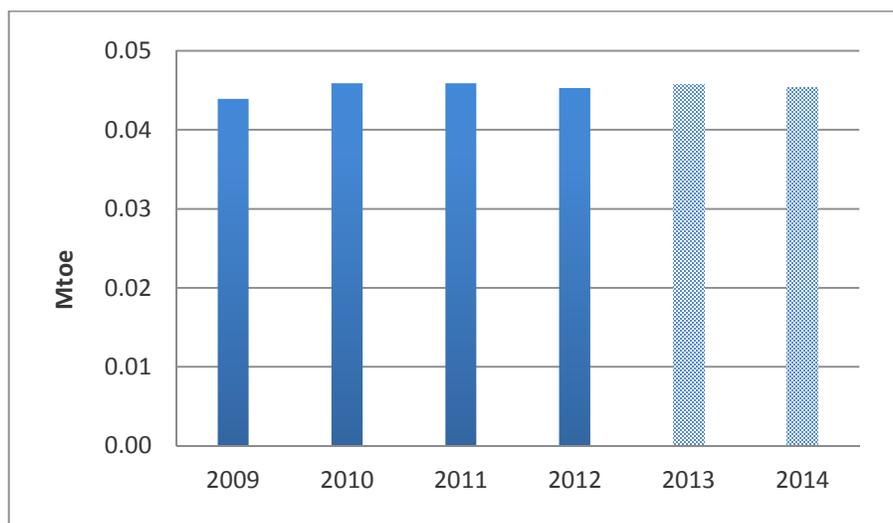
As mentioned in the introduction, St. Lucia has managed to have significant market penetration of SWH of 111.4 kW_{th} capacity/1000 people; considerably higher than the Caribbean average of 48.9 kW_{th} capacity/1000 people, and only trailing Barbados in the Region (Schwerin, 2010). St. Lucia receives a score of 2.1 for this indicator.

7.2.3 RESIDENTIAL ENERGY CONSUMPTION GROWTH

SCORE 2.1 / 5.0

Despite a slowdown in 2012 brought on by the increased cost of imported oil, average residential energy consumption growth in St. Lucia stayed positive at 1% during the five-year period of 2009-2014, as shown in Figure 13 (EIA, 2015). This results in a score of 2.1 for St. Lucia.

Figure 13: St. Lucia's Residential Energy Consumption (EIA, 2015)¹⁷



7.2.4 SWH MARKET GROWTH

SCORE 0.0* / 5.0

Official annual statistics for installed SWH capacity in St. Lucia do not yet exist. Interviews and desk research did not uncover sufficient data to calculate a reliable estimate for SWH market growth. Therefore, St. Lucia receives a 0 for this score. However, given St. Lucia's relatively high level of SWH penetration as outlined in section 7.2.2, it is likely that there has been growth in the market in recent years. As data becomes available, this score may change.

7.2.5 COMPETITIVENESS: PAYBACK PERIOD

SCORE 4.0 / 5.0

SWH system costs. Both evacuated tube collectors and flat plate collectors are available to the St. Lucian residential market. Flat plate SWH systems are manufactured locally by regional manufacturer, Solar Dynamics EC Ltd. The upfront cost of SWH for a four-person household ranges between \$1,237 and \$1,385 USD, with the system specifications for various household sizes listed in Table 7 (Global Sustainable Energy Islands Initiative & The St. Lucia Co-operative League Limited, 2005).

Table 7: SWH System Specifications and Costs in St. Lucia

Customer Base	Unit Size	Cost (\$EC/\$USD)*
---------------	-----------	--------------------

¹⁷ 2013 -2014 consumption projection based on 3 year rolling historical average (EIA)

2 person household	35-50 gallon tank, 15-20 or 21-25 square foot collector	EC\$2,670-\$3,200/\$988-\$1185 USD
4 person household	65 or 66 gallon tank, 25-35 or square foot collector**	EC\$3,340-\$3,740/\$1,237-\$1,385 USD
6 person household	74 or 80 gallon tank, 35- 40 square foot collector	EC\$3,870-\$4,400/\$1,433- \$1,629 USD

*XCD: USD 0.37: 1

**Customer can increase the collector area for an additional EC\$280-\$370 depending on the size selected.

Retail energy prices. Households in St. Lucia pay approximately \$0.34 USD/kWh for electricity (NREL, 2015e). Although the average cost of an electric water heater is EC\$95 is substantially lower than SWH costs SWH is a viable and competitive option for domestic consumers.

Based on RETScreen analysis, the payback period for a SWH system with the above specifications and costs is 1 year, 4 months, and results in a score of 4.0 for this indicator.

7.2.6 COMPETITIVENESS: HEATING FUEL SUBSIDY

SCORE 5.0 / 5.0

St. Lucia does not have subsidies in the residential electricity sector (IMF, 2015a). St Lucia receives a score of 5.0 as a result.

PARAMETER III: FINANCING

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
Financing	0.58	Country Credit Rating	5%	1.0	0.05
		Access to Finance	15%	3.5	0.53
		Subtotal	20%	4.5	0.58

7.3.1 COUNTRY CREDIT RATING

SCORE 1.0*/5.0

St. Lucia has not been rated by Moody's or S&P. The Caribbean Information & Credit Services Limited (CariCRIS), a regional credit rating agency in the Caribbean, has given St. Lucia a "CarBBB" rating. However an equivalency to Moody's and S&P cannot be determined (Caribbean Information Credit Services Limited,

2015). In order to determine a comparable rating for St. Lucia, further comparison of the CariCRIS rating to international ratings agency Moody's was made with four other Caribbean countries that had scores by Moody's and CariCRIS.¹⁸

Based on this comparison, it was determined that St. Lucia's credit rating could fall between the Moody's Ba1 to B3* rating tier, which has an S&P equivalent of BB+ to B-* (Quad Capital Advisors LLC, 2015).¹⁹ This is in line with the range of ratings received by most Caribbean countries, including most of the countries in this report.²⁰

According to the IMF, St. Lucia has avoided a recession and a recent increase in tourism and fiscal stimulus has some supported more robust economic activity. The combination of its equivalent rating and a stable economic outlook results in a score of 1 for this indicator.

This score is subject to change based on more accurate international credit rating for St. Lucia.

7.3.2 ACCESS TO FINANCE

SCORE 3.5 / 5.0

According to the World Bank, between 2010 and 2014, St. Lucia's real interest rate averaged 5.7%. This results in a score of 3. During the same period, the amount of domestic credit provided by the banking sector was 116%, which results in a score of 4. The combination of both scores results in an average of 3.5.

PARAMETER IV: BUSINESS CLIMATE

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
Business Climate	0.30	Doing Business	5%	2.0	0.10
		Manufacturing Capacity	3%	5.0	0.15
		Product Standards and Certification	5%	1.0	0.05
		Installer Certification	4%	0.0	0.0
		Industry Association	4%	0.0	0.0
		Subtotal	21%	8.0	0.30

¹⁸ Trinidad & Tobago, Barbados, Dominica, St. Vincent

¹⁹ Does not consider macroeconomic factors and other country specific economic factors that play into an international credit rating. Ideally, scores for Eastern Caribbean (EC) countries could be a more accurate comparison, however most of these countries, like St. Lucia do not have an international credit rating. Moody's has scored First Citizens Bank in St. Lucia—a prominent local and regional bank—as Baa2 (Credit Rating, Trading Economics, 2015). The Moody's credit score for First Citizens Bank can also be used as a proxy for St. Lucia.

²⁰ With the exception of Trinidad & Tobago and The Bahamas

7.4.1 DOING BUSINESS INDEX

SCORE 2.0 / 5.0

Currently, the World Bank ranks St. Lucia at 100 out of 189 for the Ease of Doing Business in the country (Trading Economics, 2015). The score for individual indicators within the complete Doing Business Ranking can be seen in Table 8.

High scores are received for the ease of paying taxes, and dealing with construction permits. Lower rankings are received for the ease of getting credit, and registering property. These scores result in an overall Ease of Doing Business TechScope score of 2.0 for St. Lucia.

Table 8: St. Lucia - Doing Business Ranking

Category	Doing Business Ranking
Starting a Business	8
Dealing with Construction Permits	6
Getting Electricity	7
Registering Property	19
Getting Credit	25
Protecting Minority Investors	18
Paying Taxes	5
Trading Across Borders	14

7.4.2 DOMESTIC MANUFACTURING

SCORE 5.0 / 5.0

In 2013, St. Lucia had a Manufacturing Value Added (MVA) as a percentage of GDP of 5%. (UNIDO, 2015). Solar Dynamics started SWH manufacturing in St. Lucia (Solar Dynamics EC Ltd) and therefore despite its low MVA score, St. Lucia is awarded a 5 for this indicator.

7.4.3 PRODUCT CERTIFICATION

SCORE 1.0 / 5.0

There is currently no certification system in place for SWH in St. Lucia. Leading regional SWH manufacturer, Solar Dynamics Limited however, does have manufacturing operations in St. Lucia (Solar Dynamics EC Ltd) and provides system performance guarantees, including temperature guarantees. These systems have also

been certified by the Florida Solar Energy Center, an International Certification and Standards entity (Husbands, 2012; Solar Dynamics Ltd., 2015).

7.4.4 INSTALLER CERTIFICATION

SCORE 0.0 / 5.0

There are no national certifications for local installers of SWH in St. Lucia. This results in a score of 0 for this indicator.

7.4.5 INDUSTRY ASSOCIATION

SCORE 0.0 / 5.0

There is currently no Industry Association dedicated to SWH or other solar technologies in St. Lucia. The St. Lucia Manufacturers Association, incorporated in 2001, is responsible for promoting and developing the country's manufacturing sectors. Its membership however currently does not include enterprises from the renewable energy or solar thermal sectors (St. Lucia Manufacturers Association, 2015). For this reason, St. Lucia receives a score of 0 for this indicator.

TRINIDAD & TOBAGO

Overall Score 1.87/ 5.0



Summary: Trinidad and Tobago’s solar water heating market is emerging and is in the early stages of market formation. Constrained by competition with domestic natural gas and the existence of subsidies in the electricity sector, the SWH market has not yet grown at a significant scale. Trinidad and Tobago’s overall TechScope score is 1.87. This will be discussed in detail in the sections below in order to provide greater insight into the market’s existing position and readiness for SWH.

General Information (2014)

Population	1,341,151
GDP	\$24,433,812,700 USD
Total installed solar thermal (flat plate and evacuated collectors)	solar tube [insufficient data]

Parameter	Score
Solar Water Heating Support Framework	0.60 / 1.45
National Conditions	0.38*/ 1.50
Financing	0.58 / 1.00
Business Climate	0.31 / 1.05

PARAMETER I: SOLAR WATER HEATING SUPPORT FRAMEWORK

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
SWH Support Framework	0.60	SWH Targets	5%	0.0	0.0
		Financial Incentives for System Installation	8%	5.0	0.4
		SWH Loan Programs	7%	0.0	0.0
		Building Mandates	5%	0.0	0.0
		Outreach Campaigns	4%	5.0	0.2
		Subtotal	29%	10.0	0.60

8.1.1 SOLAR WATER HEATING TARGETS

SCORE 0.0 / 5.0

Trinidad & Tobago does not have a national solar water heating targets, although SWH is highlighted as a potential strategy in the 2011 Draft Renewable Energy Policy Framework (Renewable Energy Committee, 2011).

The lack of a specific target for SWH results in a score of 0 for this indicator.

8.1.2 FINANCIAL INCENTIVES FOR SYSTEM INSTALLATION

SCORE 5.0 / 5.0

Although there is no government mandated target for SWH, households have been offered a 25% government tax credit on the cost of a SWH installation since 2011, up to TTD\$10,000 (or approximately \$1,666 USD) (Dookeran, 2010). There is also a 150% wear and tear allowance for SWH equipment, and SWH systems are exempted from the value added tax (VAT).

The existence of these financial incentives results in a score of 5.0 for this indicator.

8.1.3 SWH LOAN PROGRAMS

SCORE 0.0 / 5.0

Beyond tax incentives, there are currently no national loan programs for SWH in Trinidad & Tobago

Commercial banks like First Citizen Bank (FCB), have in the past offered a low interest loan scheme for solar energy systems including SHW for a limited time in 2013. This promotion was done in partnership with a local solar energy distributor, but has since been discontinued.

The absence of loan programs results in a score of 0 for this indicator.

8.1.4 BUILDING MANDATES

SCORE 0.0/ 5.0

Currently, there are no government mandated requirements for the use of SWH the building and construction sector.

With the support of international partners, there have been efforts to integrate more energy efficient building practices and materials into the construction of homes. In 2014, a 5-year agreement between the Trinidad & Tobago Government and the Global Environment Facility (GEF) was signed, with an objective to improve energy efficiency in the country's social housing sector. The program included a \$2.04 USD million grant – with up to \$10 USD million co-financing to build 200 new housing units with energy efficiency standards and technologies and to retrofit 100 existing homes with the same (GEF, 2014).

Although there have been efforts to improve energy efficiency broadly, Trinidad & Tobago receives a score of 0 since there are no building mandates for SWH.

8.1.5 OUTREACH CAMPAIGNS

SCORE 5.0 / 5.0

In 2012, The Ministry of Energy and Energy Affairs started a series of national public awareness campaigns: "My Energy, My Responsibility", "Think 7" and "Where does my Energy Come From?" to sensitize the public about the energy sector, promote energy efficiency and introduce the concept of renewable energy including solar water heating (Ministry of Energy & Energy Affairs, 2015). With a focus on public awareness, including a communication and an interactive website, energy efficiency and conservation is promoted with simple messages.

More specifically, the Ministry of Energy and Energy Affairs and the Ministry of Legal Affairs, Consumer Affairs Division have also conducted joint informational campaigns, issuing public advisory notices in all the national newspapers specifically on the acquisition of SWH and the benefits thereof.

In 2015, the Government along with the University of Trinidad and Tobago announced the completion of the country's first "solar house" as an integral part of its education and outreach efforts. The house is Trinidad and Tobago's first fully solar powered, energy efficient home, and produces all of its electricity from solar PV panels and heats its water using SWH. Located on the University campus, this house will be

open to the public to demonstrate and educate on the benefits and feasibility of solar and renewable energy incorporation in everyday life (Moore, 2015).

Trinidad and Tobago receives a score of 5.0 for this indicator.

PARAMETER II: NATIONAL CONDITIONS

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
National Conditions	.38	Insolation	5%	3.3	.17
		SWH Market Penetration	4%	0.0	0.0
		Residential Energy Consumption Growth	5%	4.3	.21
		SWH Market Growth	4%	0.0	0.0
		Competitiveness: Payback Period	7%	0.0	0.0
		Competitiveness: Heating Fuel Subsidy	5%	0.0	0.0
		Subtotal	30%	7.6	.38

8.2.1 INSOLATION

SCORE 3.3 / 5.0

Average daily insolation in Trinidad & Tobago ranges between is 5.0 kWh/m²/day and 5.5kWh/m²/day (Clean Energy Solutions Center, 2014). Trinidad and Tobago receives a score of 3.3 for this indicator.

8.2.2 SWH MARKET PENETRATION

SCORE 0.0 / 5.0

There is currently no baseline country data for SWH market penetration in Trinidad & Tobago. In 2011, the Ministry of Energy and Energy Affairs estimated that there were approximately 100 residential SWH systems and 15 commercial systems installed in the country (Meister Consultants Group, 2011).

Also in 2008, under the United Nations' Development Programmes GEF Small Grants Programme (SGP), a SWH Pilot Project was undertaken with a focus on promoting the introduction of SWH systems in the tourism (i.e. host home) sector. This was a collaborative effort of the Tobago Bed and Breakfast Association (TBBA) and the Trinidad Host Home Association (THHA) (The Renewable Energy Committee, 2011).

Telephone interviews with local installers and other SWH experts yielded insufficient data to adequately characterize the market.

For this reason, Trinidad & Tobago receives a score of 0.

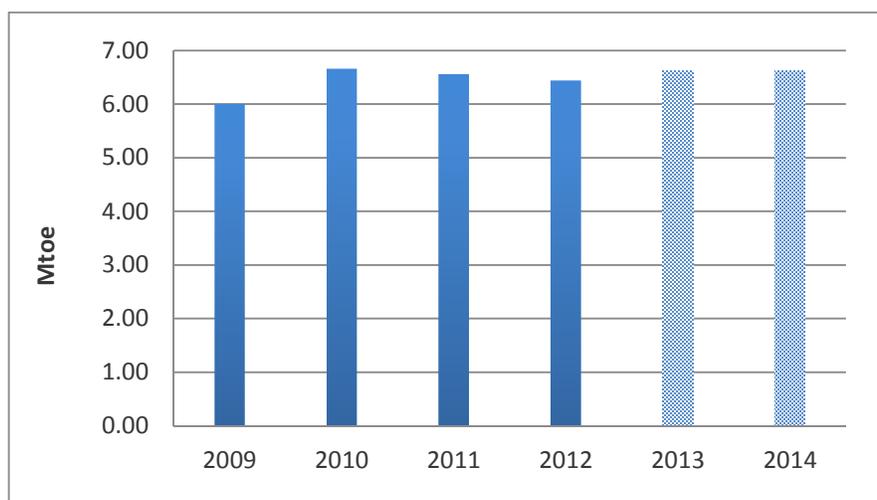
8.2.3 RESIDENTIAL ENERGY CONSUMPTION GROWTH

SCORE 5.0 / 5.0

In Trinidad and Tobago, the residential sector consumes approximately 29% of total electricity used in the country (NREL, 2015f). Of this consumption, electrical water heaters account for 58% of typical household electricity consumption (UNFCCC, 2013). The average domestic electricity demand in Trinidad & Tobago is 16.6 kWh per day, and is about two times higher than in Barbados; a country with a very similar living standard. Over the 5 year period between 2009 and 2014, the growth rate in residential energy consumption fell from a high of 11% in 2009- 2010 to -2% in 2011-2012 to average out at 2% over that period (Figure 14).

Due to a positive average 5-year residential energy consumption growth rate, Trinidad & Tobago receives a score of 5.0.

Figure 14: Trinidad & Tobago Residential Energy Consumption (EIA, 2015)²¹



8.2.4 SWH MARKET GROWTH

SCORE 0.0*/5.0

As mentioned in section 8.2.2, there is currently no data on the penetration of SWH in Trinidad and Tobago. Desk research and interviews did not provide reliable data to estimate SWH market growth. It is

²¹ 2013 -2014 consumption projection based on 3 year rolling historical average (EIA)

recommended that further research into solar water heating market penetration and growth be conducted to provide a more accurate reflection of the current state of the market.

As a result, Trinidad and Tobago receives a score of 0.

8.2.5 COMPETITIVENESS: PAYBACK PERIOD

SCORE 0.0/ 5.0

SWH system costs. Regionally manufactured flat panel collectors account for the majority of solar water heaters in Trinidad and Tobago and according to industry experts, residential SWH installation costs range between TTD\$12,000 and TTD\$15,000.

Retail energy prices. As mentioned in section 8.2.3, electricity is the main source of water heating in Trinidad and Tobago. The cost of natural gas fired electricity in Trinidad and Tobago is currently \$0.044 USD/KWh (NREL, 2015f).

As a result, a RETScreen simple payback period based on these system and cost assumptions and including the Government tax credit (TTD\$2500) is 12 years.²² This longer payback period results in a score of 0 for this indicator.

8.2.6 COMPETITIVENESS: HEATING FUEL SUBSIDY

SCORE 0.0 / 5.0

As mentioned in Section 8.2.4, Trinidad and Tobago has significant electricity subsidies which make SWH uncompetitive with conventional electrical heating systems (IMF, 2015a).

The country receives a score of 0 for this indicator as a result.

PARAMETER III: FINANCING

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
Financing	.58	Country Credit Rating	5%	2.5	.13
		Access to Finance	15%	3.0	.45
		Subtotal	20%	5.5	.58

²² RET Screen analysis, August 2015. System assumptions: cash (equity) payment of TTD\$13,500 with tax credit TTD\$2500 on a 20 year system

8.3.1 COUNTRY CREDIT RATING

SCORE 2.5 / 5.0

Trinidad & Tobago received a rating of Baa2 from Moody's and A from S&P (Trading Economics, 2015). According to the IMF, the economy is embarking on sustainable growth with robust non-energy sector investments and tapering inflation. The recent changes in the energy markets represent a major economic challenge for Trinidad & Tobago, however and this uncertainty has informed the stable to negative economic outlook for the country (IMF, 2014c). A combination of these ratings results in a score of 2.5 for this indicator.

8.3.2 ACCESS TO FINANCE

SCORE 3.0 / 5.0

According to the World Bank, between 2010- 2013, Trinidad & Tobago's real interest rate averaged 1.9%. This results in a score of 4. During the same period, the amount of domestic credit provided by the banking sector is 33%, which results in a score of 2. The combination of both scores results in an average of 3 for this indicator.

PARAMETER IV: BUSINESS CLIMATE

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
Business Climate	.26	Doing Business	5%	3.0	.15
		Manufacturing Capacity	3%	2.0	.06
		Product Standards and Certification	5%	2.0	0.1
		Installer Certification	4%	0.0	0.0
		Industry Association	4%	0.0	0.0
		Subtotal	21%	5.0	.31

8.4.1 DOING BUSINESS INDEX

SCORE 3.0 / 5.0

Currently, the World Bank ranks Trinidad & Tobago 79 out of 189 for the Ease of Doing Business ranking. Table 9 summarizes the scores for the individual indicators. Trinidad scored a higher ranking for the ease of starting a business, and trading across borders, the reliability of the power supply, and access to credit.

The country received lower rankings for property registration, and construction permitting. Trinidad & Tobago's overall ease of doing business receives a TechScope score of 3.0.

Table 9: Trinidad & Tobago Doing Business Ranking

Category	Doing Business Ranking
Starting a Business	7
Dealing with Construction Permits	21
Getting Electricity	6
Registering Property	27
Getting Credit	9
Protecting Minority Investors	5
Paying Taxes	14
Trading Across Borders	14

8.4.2 DOMESTIC MANUFACTURING

SCORE 2.0/5.0

In 2013, Trinidad & Tobago had a Manufacturing Value Added (MVA) as a percentage of GDP of 7% (UNIDO, 2015). Although this is well below the global average of approximately 17%, the country's MVA is one of the Caribbean's highest, and results in a score of 2.0 for this indicator.

8.4.3 PRODUCT CERTIFICATION

SCORE 2.0 / 5.0

The Trinidad and Tobago Bureau of Standards (TTBS) regulates the development, promotion and enforcement of quality standards in Trinidad and Tobago. The following public specifications exist for raw materials for SWH collectors (Ministry of Energy and Energy Industries, 2015):

- ⦿ **TTS 106: 2012, Solar Water Heater Systems.** Design and installation requirements: This standard has been published in 2012. (The requirements specified in the FSEC (Florida Solar Energy Centre) were used to develop this standard and modified for T&T conditions).
- ⦿ **TTS/EN 12975-1:2012, Thermal Solar Systems and Components.** Solar Collectors – Part 1: General requirements: (This standard was adopted from the European Committee for Standardization (CEN) standard EN 12975-1:2006+A1:2010 and modified for T&T conditions).

Standards for SWHs are voluntary, no national certification systems exist, and no testing is done locally. There are existing proposals for establish testing facilities but no thermal testing facilities currently exist.

Therefore, Trinidad and Tobago receives a score of 2.0 for this indicator.

8.4.4 INSTALLER CERTIFICATION

SCORE 0.0 / 5.0

There is no national certification process²³ for installers in Trinidad & Tobago resulting in a score of 0 for this indicator.

8.4.5 INDUSTRY ASSOCIATION

SCORE 0.0 / 5.0

There is no industry association for renewable energy or specifically for SWH and Trinidad and Tobago receives a score of 0.0 for this indicator.

²³ The University of the West Indies (UWI), St. Augustine, offers courses on energy auditing and solar photovoltaic installation, but no such courses exist specifically for SWH.

CONCLUSION

This report used The *Solar Water Heating TechScope Market Readiness Assessment* to develop TechScope Assessments for eight Caribbean countries: *Aruba, Bahamas, Barbados, Dominican Republic, Grenada, Jamaica, St. Lucia, and Trinidad & Tobago*. The eight countries assessed in this study provide a representative snapshot of residential SWH markets in the Caribbean region, with their respective milestones and opportunities.

As mentioned before, the “score” used in this methodology is not intended as a judgment on the comparative quality of a given country’s enabling environment for solar water heating. Different countries have markedly different conditions that need to be considered in detail on a case-by case basis. Instead, the scoring is intended to serve as a tool for focusing market and policy discussions on specific issues and providing a starting point for comparisons – rather than serving as a definitive and stand-alone comparison on its own.

In the section below, the main findings of the eight TechScope assessments are outlined to provide some insights into the status of the SWH market in the Caribbean region.

RESEARCH FINDINGS

Figure 15 shows the results and ranking of the 8 countries analyzed in the Caribbean TechScope Assessment. As explained in the introduction, these rankings are based on the aggregated scores of four market parameters. Each country’s individual scores are summarized in Appendix I.

As a world leader in SWH market penetration, Barbados emerges as the only country in this assessment to receive a *strong* TechScope score above 3.0, in line with expectations for the more mature SWH market. Grenada, The Dominican Republic, Jamaica and St. Lucia all score between 2.0 and 3.0, which represents markets with *good* enabling environments, positioned for additional growth if market conditions are maintained or improved. The Bahamas, Trinidad & Tobago and Aruba are all categorized as having *emerging* SWH markets, with TechScope scores that fall below 2.0. The research findings for each of the four TechScope parameters are summarized below.

Figure 15: Ranking of SWH TechScope Scores

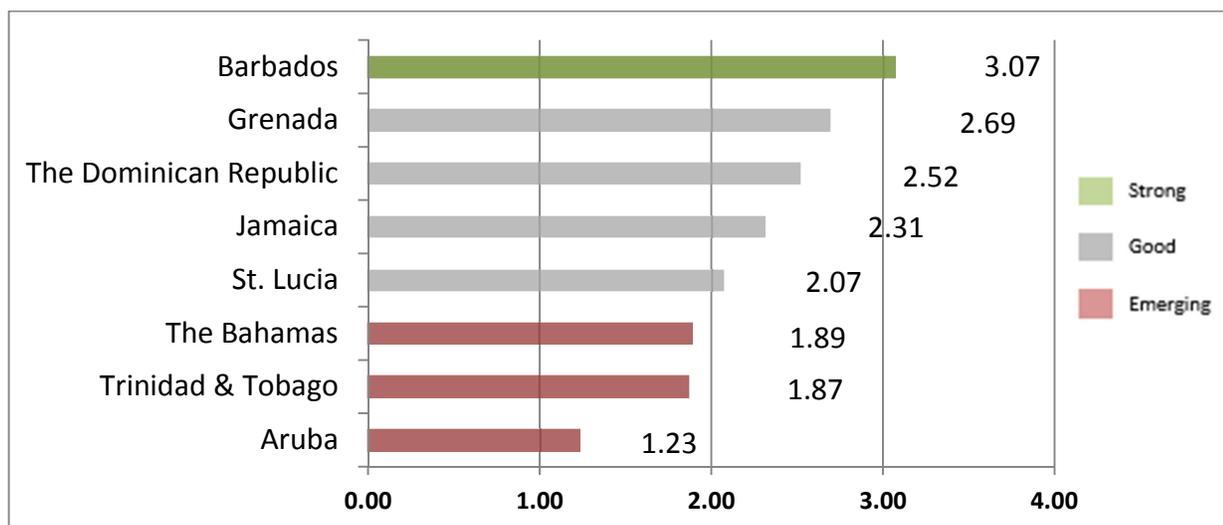


Table 10: Aggregated TechScope Scores by Parameter and Country

Parameter	Highest Possible Score	Barbados	Aruba	The Bahamas	Dominican Republic	Grenada	Jamaica	St. Lucia	Trinidad & Tobago
I. Solar Water Heating Support Framework	1.45	1.20	0.00	0.35	0.95	1.00	0.35	0.20	0.60
II. National Conditions	1.50	0.77	0.70	0.66	0.72	0.96	1.06	0.99	0.38
III. Financing	1.00	0.55	0.45	0.70	0.35	0.55	0.39	0.58	0.58
IV. Business Climate	1.05	0.55	0.08	0.18	0.50	0.18	0.51	0.30	0.31
OVERALL SCORE	5.00	3.07	1.23	1.89	2.52	2.69	2.31	2.07	1.87

Parameter I - SWH Support Framework. The TechScope scores received for this parameter (see Table 10) varied widely across the eight countries assessed. It is noteworthy that of all four Parameters, Parameter I country rankings (i.e. from highest score to lowest score) tracked closest to the overall TechScope country ranking. Some additional observations can be made:

- At the top of the ranking, Barbados' score is driven up by the existence of explicit SWH national targets; the sole country in the study to achieve this milestone. Barbados leads in four of the five sub-categories of Parameter I, as its longstanding and defined SWH targets have enabled and informed the

subsequent development of SWH fiscal policies and promotional programs to ensure these targets are attained.

- Financial incentives and loan programs carry the heaviest weight for this Parameter, and Barbados is joined by the Dominican Republic and Jamaica at the top. Aside from Barbados, these other two countries have good SWH markets, as reflected in their overall TechScope scores. This does suggest that while they do exist, financial incentives and loan programs are not having considerable impact on SWH uptake.
- Beyond national level financial incentive and loan programs, lower scoring countries, with the exception of Aruba, have had some form of SWH loan facility supported by an international development agency or provided by a local bank. In the former case, these internationally supported programs were completed, while many of the local bank loans were described by those interviewed having unfavorable interest rates and shorter tenors than needed for SWH investment.
- With the exception of Grenada, Barbados and the other countries assessed fall short in their provision of explicit national building mandates for SWH. This absence of building mandates is indicative of the emerging nature of most of these markets. Barbados stands out again as an exceptional case in this respect, as the lack of building mandates historically has not inhibited SWH market growth. This is largely due to the country's strength in promoting SWH through other mechanisms. Today SWH are ubiquitous in the residential market, thus making the establishment of building mandates needless at this point.

Parameter II – National Conditions. The TechScope scores in this category were relatively low and driven down by the absence of sufficient baseline installation data, and the existence of residential electricity subsidies (see Table 10). Some other observations include:

- Market penetration data does not exist for three of the eight countries (Aruba, the Dominican Republic, Trinidad and Tobago), and with the exception of Barbados, St. Lucia, and Grenada, the remaining countries reported penetration estimates that tracked closely or were below the regional average (see Introduction, Figure 2). Of the five countries with available market penetration data, 5-year market growth, between the 2009 and 2014, was estimated for three (Barbados 10%, Grenada 8%, Jamaica 5%) due to information availability. A detailed methodology of how SWH market growth is derived is described in Appendix II. This does support the overall TechScope results that suggest that most of the eight countries have emerging to good SWH markets.
- Similar to the Caribbean solar photovoltaic market (MCG, 2014); all-in SWH system costs remain largely non-transparent in the Caribbean. There is a fairly wide range of estimated SWH installed system costs reported between \$1,500 (Jamaica) on the lower end and \$2,250 USD (Trinidad & Tobago) on the upper end, for a four-person household. Cash equity was described as the dominant form of customer payment for systems with debt either too expensive or unavailable. This aligns with the earlier results where incentive financing and loans schemes were absent in most countries.

- Industry experts agreed that residential customers showed little preference between system collector types (i.e. evacuated tube and flat plate collectors) largely because of a lack of awareness about the merits of different SWH technologies. System price however, strongly influenced purchasing choices made by consumers according to interviews. Most countries import complete systems or parts and raw materials from a wide range of regional and international manufacturers (see Table 11).²⁴ The market has expanded significantly since 2002 when Regional manufacturers from Barbados represented 80% of the Region’s market share (Perlack & Hinds, 2003). According to industry experts, today, some of this market share has been eroded, due in parts to: a wider variety of systems on the global market; no common SWH product standards regionally; a larger amount local installers and service companies, and the removal of common external tariffs on SWH systems and parts in some countries studied.²⁵ In response, Barbados manufacturers have set up manufacturing in regional export markets such as St. Lucia and enhanced their product capabilities and differentiation (see section 1.4.3.).

Table 11: SWH Imported System Manufacturers and Countries of Origin

Manufacturer Name	Country of Origin
Calpak	Greece
Eco2Solar	Europe
EISol	Israel
Grunfos	Germany, Denmark
Mark2	Europe
JinYi	China
Solar Dynamics, Sunpower	Barbados
Solaris Global Energy	USA, Barbados ²⁶
Solahart	Australia
Sonnenkraft	UK

²⁴ This list is not exhaustive and only represents the responses of a limited amount of local manufacturers interviewed.

²⁵ Exact market share of Regional manufacturers out of Barbados could not be determined or estimated during this study.

²⁶ Acquired Barbados Manufacturer AquaSol. AquaSol was founded in Barbados in 1981 and was one of the first three SWH manufacturers on the island and in the Caribbean.

- ⦿ Electricity is the primary energy source for water heating in the residential sector and rates to residential users in 2014, ranged between US\$0.04 in Trinidad & Tobago and US\$0.43 in Grenada with an average of US\$0.28. While Trinidad & Tobago is an exceptional case due to its significant natural gas resources, it is important to note, that a simple RETScreen payback calculation resulted in this country being a major outlier with a payback period of 12 years. With the exception of Trinidad & Tobago, all other 7 countries have RETScreen payback periods within a 4-year period, with Grenada SWH payback of 1 year the shortest and driven by the unsubsidized price of electricity.

Parameter III – Financing. While some countries have stronger domestic credit availability (the Bahamas, Barbados), most countries scores are lower as a result of macroeconomic challenges over the past three years, and high levels of indebtedness trending in the Region. When observing this Parameter, in conjunction with financing incentives, loan programs, and outreach campaigns in Parameter I, and residential energy consumption in Parameter II, a pattern can be identified.²⁷

- ⦿ The countries with no existing financial incentives or national loan schemes were also those that exhibited:
 - Stable to negative economic outlooks from the International Monetary Fund IMF in 2015.²⁸ Attributed to persistent macroeconomic challenges across the Caribbean region, triggered by economic recessions in some key tourism markets;
 - Negative or flat residential energy consumption growth patterns in the last three years;
 - Below investment grade credit ratings.

It can therefore be deduced from this pattern that countries in the Region, especially those with lower scores, may have a diminished ability to independently resource programs that stimulate their SWH market. These programs include: sustained and consistent public sector incentives and loan programs and financing for outreach campaigns.

Lower residential consumption in recent years points to a softened demand-side market and precipitates low levels of consumer interest in SWH; a barrier reported by local installers surveyed.

Parameter IV - Business Climate. TechScope scores were low across the board for these indicators, which presents a potential opportunity for regional cooperation.

- ⦿ Although several countries in the region have standards bodies, only Trinidad & Tobago has products standards for SWH, and none of the countries assessed had product certification or installer certification procedures in place. Barbados' and St. Lucia's scores are lifted in this category due to the fact that they have domestic SWH manufacturing and supply a large percentage of their regional market. Of the 8 countries assessed none have a dedicated SWH industry association. Jamaica has an active solar energy

²⁷ Trinidad & Tobago is an exception to this observation

²⁸ Barbados is also in the midst of an economic slowdown but has not abandoned its financial and loan programs. During its 1990-1994 economic recession however, programs were pulled back and discontinued to later be reinstated. The market was emerging then and therefore this pattern could be anticipated with the emerging countries profiled in this assessment all else equal.

industry association, and the Dominican Republic has a renewable energy association, and therefore its score is boosted for this Parameter.

CONSIDERATIONS

Based on the findings of the eight TechScope assessments, preliminary considerations to improve SWH uptake in the Caribbean Region are outlined below.

- ◎ **Boost data collection efforts, through SWH market and installer surveys, to better establish SWH installation baselines.** Obtaining sufficient baseline market data for SWH, through desk research and expert industry interviews, is challenging. This underscores the need for enhanced installed data collection. Conducting comprehensive SWH market and installer surveys can shed light on common, and exceptional characteristics across markets. Ultimately, estimates of the total potential for SWH deployment can be improved, and with it, a stronger understanding of how local SWH markets are growing vis-à-vis one another.
- ◎ **Export regional best practices in public outreach campaigns.** While high upfront costs were cited by local installers as the principal deterrent for SWH investment by residential consumers, an awareness of the benefits of SWH systems proved to be one of the primary root causes of low residential SWH uptake. To stimulate demand-side interest, effective cases of past and present promotional outreach, particularly on the benefits and simplicity of SWH, can be re-packaged and shared within the region. The “My Energy, My Responsibility” multi-year communication campaign launched in 2012 by the Trinidad & Tobago Ministry of Energy and Energy Affairs is an award-winning example of how public awareness about home-based renewable energy applications like SWH can be disseminated through simple messaging and interactive, multi-media platforms (Trinidad and Tobago Guardian, 2013). The GSWH Project also developed guidelines on SWH awareness raising (*“Guide for Awareness Raising Campaigns”*) that could help national governments and regional institutions to develop an outreach guide for promoting SWH.
- ◎ **Coordinate and support a regional SWH clearing house for sharing industry best practices.** Observing that there are few national or regional associations, no venues for the industry to exchange best practice, build business relationships, aggregate buying power for materials and business services, and advocate for stronger regional enabling environments exists. An opportunity for the formation of a regional SWH clearinghouse therefore can be considered valuable. Formal and informal professional networks can be formed and the creation of this virtual forum can deepen connections and strengthen regional cooperation.
- ◎ **Explore the implementation of phased building mandates, starting with SWH systems on public buildings and new housing developments.** While not directly targeting the existing commercial and residential sector in its first phase, public sector deployment of SWH, in tandem with promotional

campaigns as described above, coupled with financial incentives, can enhance the effectiveness of uptake in other high-potential sectors (i.e. residential, tourism, commercial). While such policies may not be needed in mature markets such as Barbados, the absence of binding and enforceable measures for SWH within the national support frameworks of emerging markets can inhibit potential growth.

- ◎ **With the support of International partners, strengthen SWH financing schemes and other fiscal incentives to promote SWH investment.** Although most countries did have some supply-side fiscal provisions in place (e.g. import tariff relief for SWH systems and parts), high upfront SWH system costs, compared to traditional electrical water heaters, remains one of the main barriers for residential SWH uptake. Given the high level of indebtedness of Caribbean economies, and the fact that some economies remain in a recessionary period, the feasibility of extensive and sustained government-led fiscal incentives could be supported by international partners. Nationally Appropriate Mitigation Actions (NAMAs) are one potential pathway for governments to receive international financial support for incentive programs (see Appendix III for further discussion on use of NAMAs for SWH market development)
- ◎ **Explore creation of a regional SWH testing and certification scheme for the Caribbean.** Given the general lack of standards, testing, and certification in the eight countries assessed, it may be valuable for industry stakeholders and governments to create a voluntary regional certification scheme to help improve system quality control across the region. Examples of regional certification initiatives include the Solar Heaters Arab Mark and Certification Initiative (SHAMCI) and the recent Latin American certification partnerships. SHAMCI is a quality certification scheme for the solar thermal products and services in the Arab region. SHAMCI is the first certification scheme for solar thermal products in the Arab region and developing countries. SHAMCI is based on Solar Keymark, the regional European certification scheme, but is tailored to fit developing countries' conditions. It leverages the international experience through the support provided by the United Nations Environment Programme (UNEP) under the GSWH Project (Gattiglio, 2015). Similarly, in August 2015, 14 Latin American countries announced a partnership with the Pan American Standards Commission (COPANT) on developing regional standards for SWH harmonized with ISO standards (Kriele, 2015).

APPENDIX I

SUMMARY OF COUNTRY TECHSCOPE SCORES

BARBADOS

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
I. SWH Support Framework	29%	SWH Targets	5%	5.0	0.25
		Financial Incentives for System Installation	8%	5.0	0.40
		SWH Loan Programs	7%	5.0	0.35
		Building Mandates	5%	0.0	0.00
		Outreach Campaigns	4%	5.0	0.20
		Subtotal	29%	20.00	1.20
II. National Conditions	30%	Insolation	5%	3.3	0.17
		SWH Market Penetration	4%	5.0	0.20
		Residential Energy Consumption Growth	5%	0.0	0.00
		SWH Market Growth	4%	3.0	0.12
		Competitiveness: Payback Period	7%	4.0	0.28
		Competitiveness: Heating Fuel Subsidy	5%	0.0	0.00
		Subtotal	30%	15.33	0.77
III. Financing	20%	Country Credit Rating	5%	0.5	0.03
		Access to Finance	15%	3.5	0.53
		Subtotal	20%	4.00	0.55
IV. Business Climate	21%	Doing Business	5%	3.0	0.15
		Manufacturing Capacity	3%	5.0	0.15
		Product Standards and Certification	5%	1.0	0.05
		Installer Certification	4%	0.0	0.00
		Industry Association	4%	3.0	0.15
		Subtotal	21%	14.00	0.55
TOTAL	100%		100%	53.33	3.07

ARUBA

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
I. SWH Support Framework	29%	SWH Targets	5%	0.0	0.00
		Financial Incentives for System Installation	8%	0.0	0.00
		SWH Loan Programs	7%	0.0	0.00
		Building Mandates	5%	0.0	0.00
		Outreach Campaigns	4%	0.0	0.00
		Subtotal	29%	0.0	0.0
II. National Conditions	30%	Insolation	5%	3.3	0.17
		SWH Market Penetration	4%	0.0	0.00
		Residential Energy Consumption Growth	5%	0.0	0.00
		SWH Market Growth	4%	0.0	0.00
		Competitiveness: Payback Period	7%	4.0	0.28
		Competitiveness: Heating Fuel Subsidy	5%	5.0	0.25
		Subtotal	30%	12.33	0.70
III. Financing	20%	Country Credit Rating	5%	0.0	0.00
		Access to Finance	15%	3.0	0.45
		Subtotal	20%	3.00	0.45
IV. Business Climate	21%	Doing Business	5%	0.0	0.00
		Manufacturing Capacity	3%	1.0	0.03
		Product Standards and Certification	5%	1.0	0.05
		Installer Certification	4%	0.0	0.00
		Industry Association	4%	0.0	0.00
		Subtotal	21%	2.00	0.08
TOTAL	100%		100%	17.33	1.23

BAHAMAS

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
I. SWH Support Framework	29%	SWH Targets	5%	0.0	0.00
		Financial Incentives for System Installation	8%	0.0	0.00
		SWH Loan Programs	7%	5.0	0.35
		Building Mandates	5%	0.0	0.00
		Outreach Campaigns	4%	0.0	0.00
		Subtotal	29%	5.00	0.35
II. National Conditions	30%	Insolation	5%	3.9	0.19
		SWH Market Penetration	4%	0.8	0.03
		Residential Energy Consumption Growth	5%	1.6	0.08
		SWH Market Growth	4%	0.0	0.00
		Competitiveness: Payback Period	7%	5.0	0.35
		Competitiveness: Heating Fuel Subsidy	5%	0.0	0.00
		Subtotal	30%	11.32	0.66
III. Financing	20%	Country Credit Rating	5%	2.0	0.10
		Access to Finance	15%	4.0	0.60
		Subtotal	20%	6.00	0.70
IV. Business Climate	21%	Doing Business	5%	3.0	0.15
		Manufacturing Capacity	3%	1.0	0.03
		Product Standards and Certification	5%	0.0	0.00
		Installer Certification	4%	0.0	0.00
		Industry Association	4%	0.0	0.00
		Subtotal	21%	4.00	0.18
TOTAL	100%		100%	26.32	1.89

DOMINICAN REPUBLIC

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
I. SWH Support Framework	29%	SWH Targets	5%	0.0	0.00
		Financial Incentives for System Installation	8%	5.0	0.40
		SWH Loan Programs	7%	5.0	0.35
		Building Mandates	5%	0.0	0.00
		Outreach Campaigns	4%	5.0	0.20
		Subtotal	29%	15.00	0.95
II. National Conditions	30%	Insolation	5%	3.9	0.19
		SWH Market Penetration	4%	0.0	0.00
		Residential Energy Consumption Growth	5%	5.0	0.25
		SWH Market Growth	4%	0.0	0.00
		Competitiveness: Payback Period	7%	4.0	0.28
		Competitiveness: Heating Fuel Subsidy	5%	0.0	0.00
		Subtotal	30%	12.89	0.72
III. Financing	20%	Country Credit Rating	5%	1.0	0.05
		Access to Finance	15%	2.0	0.30
		Subtotal	20%	3.00	0.35
IV. Business Climate	21%	Doing Business	5%	3.0	0.15
		Manufacturing Capacity	3%	5.0	0.15
		Product Standards and Certification	5%	0.0	0.00
		Installer Certification	4%	0.0	0.00
		Industry Association	4%	5.0	0.20
		Subtotal	21%	8.00	0.50
TOTAL	100%		100%	38.89	2.52

GRENADA

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
I. SWH Support Framework	29%	SWH Targets	5%	0.0	0.00
		Financial Incentives for System Installation	8%	5.0	0.40
		SWH Loan Programs	7%	5.0	0.35
		Building Mandates	5%	5.0	0.25
		Outreach Campaigns	4%	0.0	0.00
		Subtotal	29%	15.00	1.00
II. National Conditions	30%	Insolation	5%	3.3	0.17
		SWH Market Penetration	4%	1.8	0.07
		Residential Energy Consumption Growth	5%	5.0	0.25
		SWH Market Growth	4%	3.0	0.12
		Competitiveness: Payback Period	7%	5.0	0.35
		Competitiveness: Heating Fuel Subsidy	5%	0.0	0.00
		Subtotal	30%	18.10	0.96
III. Financing	20%	Country Credit Rating	5%	0.5	0.03
		Access to Finance	15%	3.5	0.53
		Subtotal	20%	4.00	0.55
IV. Business Climate	21%	Doing Business	5%	2.0	0.10
		Manufacturing Capacity	3%	1.0	0.03
		Product Standards and Certification	5%	1.0	0.05
		Installer Certification	4%	0.0	0.00
		Industry Association	4%	0.0	0.00
		Subtotal	21%	4.00	0.18
TOTAL	100%		100%	41.10	2.69

JAMAICA

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
I. SWH Support Framework	29%	SWH Targets	5%	0.0	0.00
		Financial Incentives for System Installation	8%	0.0	0.00
		SWH Loan Programs	7%	5.0	0.35
		Building Mandates	5%	0.0	0.00
		Outreach Campaigns	4%	0.0	0.00
		Subtotal	29%	5.00	0.35
II. National Conditions	30%	Insolation	5%	3.9	0.19
		SWH Market Penetration	4%	0.2	0.01
		Residential Energy Consumption Growth	5%	5.0	0.25
		SWH Market Growth	4%	2.0	0.08
		Competitiveness: Payback Period	7%	4.0	0.28
		Competitiveness: Heating Fuel Subsidy	5%	5.0	0.25
		Subtotal	30%	20.10	1.06
III. Financing	20%	Country Credit Rating	5%	0.3	0.01
		Access to Finance	15%	2.5	0.38
		Subtotal	20%	2.75	0.39
IV. Business Climate	21%	Doing Business	5%	4.0	0.20
		Manufacturing Capacity	3%	2.0	0.06
		Product Standards and Certification	5%	1.0	0.05
		Installer Certification	4%	0.0	0.00
		Industry Association	4%	5.0	0.20
		Subtotal	21%	12.00	0.51
TOTAL	100%		100%	39.85	2.31

ST. LUCIA

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
I. SWH Support Framework	29%	SWH Targets	5%	0.0	0.00
		Financial Incentives for System Installation	8%	0.0	0.00
		SWH Loan Programs	7%	0.0	0.00
		Building Mandates	5%	0.0	0.00
		Outreach Campaigns	4%	5.0	0.20
		Subtotal	29%	5.00	0.20
II. National Conditions	30%	Insolation	5%	3.3	0.17
		SWH Market Penetration	4%	2.1	0.08
		Residential Energy Consumption Growth	5%	2.1	0.10
		SWH Market Growth	4%	1.0	0.04
		Competitiveness: Payback Period	7%	5.0	0.35
		Competitiveness: Heating Fuel Subsidy	5%	5.0	0.25
		Subtotal	30%	18.49	0.99
III. Financing	20%	Country Credit Rating	5%	1.0	0.05
		Access to Finance	15%	3.5	0.53
		Subtotal	20%	4.50	0.58
IV. Business Climate	21%	Doing Business	5%	2.0	0.10
		Manufacturing Capacity	3%	5.0	0.15
		Product Standards and Certification	5%	1.0	0.05
		Installer Certification	4%	0.0	0.00
		Industry Association	4%	0.0	0.00
		Subtotal	21%	8.00	0.30
TOTAL	100%		100%	35.99	2.07

TRINIDAD AND TOBAGO

Parameter	Score	Indicator	Indicator Weight (as a % of Total Score)	Indicator Score (Raw)	Indicator Score (Weighted)
I. SWH Support Framework	29%	SWH Targets	5%	0.0	0.00
		Financial Incentives for System Installation	8%	5.0	0.40
		SWH Loan Programs	7%	0.0	0.00
		Building Mandates	5%	0.0	0.00
		Outreach Campaigns	4%	5.0	0.20
		Subtotal	29%	10.00	0.60
II. National Conditions	30%	Insolation	5%	3.3	0.17
		SWH Market Penetration	4%	0.0	0.00
		Residential Energy Consumption Growth	5%	4.3	0.21
		SWH Market Growth	4%	0.0	0.00
		Competitiveness: Payback Period	7%	0.0	0.00
		Competitiveness: Heating Fuel Subsidy	5%	0.0	0.00
		Subtotal	30%	7.60	0.38
III. Financing	20%	Country Credit Rating	5%	2.5	0.13
		Access to Finance	15%	3.0	0.45
		Subtotal	20%	5.50	0.58
IV. Business Climate	21%	Doing Business	5%	3.0	0.15
		Manufacturing Capacity	3%	2.0	0.06
		Product Standards and Certification	5%	2.0	0.10
		Installer Certification	4%	0.0	0.00
		Industry Association	4%	0.0	0.00
		Subtotal	21%	7.00	0.31
TOTAL	100%		100%	30.10	1.86

APPENDIX II

ESTIMATING SWH MARKET PENETRATION AND MARKET GROWTH

BARBADOS, GRENADA, JAMAICA

BASELINE DATA

Official statistics for SWH market penetration in Barbados, Grenada and Jamaica were in the case of Barbados, dated (2009 IEA estimates) or in the case of Grenada and Jamaica, indicative (Schwerin, 2010). Through desk research and interviews with government officials and installers, various estimates for solar water heating penetration were identified. In order to derive a representative penetration value for Barbados, Grenada and Jamaica, a combination of existing market reports formed the baseline estimates used, and can be summarized in Table 12 below.

Table 12: Reported Market Penetration Data for Barbados, Grenada, Jamaica

Report and Year	Reported kWth capacity/1000 people	Country
IEA IHC Worldwide 2015	319*	Barbados 2009 data revision
IEA IHC Worldwide 2014	320	Barbados 2009 data revision
IEA IHC Worldwide 2013	322	Barbados 2009 data revision
IEA IHC Worldwide 2012	322	Barbados 2009 data revision
IEA IHC Worldwide 2011	322	Barbados 2009 data revision
IEA IHC Worldwide 2010	202.7*	Barbados 2006 data revision
IEA IHC Worldwide 2008	207.57	Barbados 2006 data revision
Schwerin 2010/CREDP 2013	80**	Grenada 2012 estimate
Schwerin 2010/CREDP 2013	6.1**	Jamaica 2012 estimate

*The most recent report data revision for 2006 and 2009 market penetration are the 2 historical data points used by MCG

** Estimate not used in MCG analysis due to inconsistencies with more recent international and national level estimates on households with SWH. Estimate seems to understate current penetration levels in Jamaica.

- **Barbados.** In 2015, IRENA reported that an estimated 80-90% of households in Barbados had SWH. The Barbados Statistical Review reported in 2013 that there were 94,173 households in Barbados.

- ◎ **Grenada.** SE4ALL reported in 2014 that by 2008 there were 4000 SWH installed in Grenada. The report also states that in 2009, there was an annual import of 900 SWH units into the country and that by 2014 there had been 7200 SWH units in Grenada.
- ◎ **Jamaica.** The Sustainable Energy Roadmap for Jamaica (World Watch Institute, 2014) estimated approximately 7,000 households with SWH in 2006, which grew to 20,000 by 2010. Additionally, industry experts estimated that in 2014, approximately 2-3% of households have SWH (up from 0.9% estimated by the Petroleum Corporation of Jamaica in 2012). In 2014, there were approximately 881,078 households in Jamaica (World Watch Institute, 2014).

MCG METHODOLOGY

MCG estimated the installed capacity of a typical SWH system using the International Energy Agency (IEA) conversion factor for 2 prominent types of solar thermal collectors in the Caribbean: the glazed flat plate collectors, and the evacuated tubular collectors. We estimated a typical collector system of approximately $2m^2$, the installed capacity can be derived using the average of the following IEA conversion factors:

Glazed flat plate collector: 0.671kWth/m²

Evacuated tubular collectors: 0.717 kWth/m²

An approximate average of 0.7 kWth/m² was then used to calculate cumulative installed capacity and market penetration for Grenada and Jamaica’s SWH market (see Table 13). MCG then used a straight-line calculation to estimate growth for years with no data and determine an annual average growth rate during the period 2007 – 2014.

The Barbados penetration growth rate from 2010 - 2014 (i.e. the year after the last reported penetration number) was adjusted downward to 33.3% of the 2007 – 2009 cumulative average growth rate (i.e. 6%) largely to take into account the country’s 2010 economic slowdown, thus providing a more conservative 2014 penetration number. Furthermore, analyzing the Barbados SWH market’s average historical growth during the 1990 – 1994 economic recession (Perlack & Hinds, 2003), an average annual growth rate of 6% was confirmed for the period 1990 - 1996 (i.e. including 2 years after the recession). This represented a fall of 33.3% from the pre-recession 2 year growth rate between 1988 and 1990 (i.e. the same percentage decline used in this analysis).

This adjustment to average annual was not made for Grenada and Jamaica. These markets can still be characterized largely as emerging and in a growth phase and there was no data to support a historical growth pattern.

Table 13: MCG Estimated Cumulative Installed Capacity for Barbados, Grenada and Jamaica

Barbados	2006	2007	2008	2009	2010	2011	2012	2013	2014
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Cumulative Installed Capacity (<i>MWth</i>)	56.0	68.1	80.1	92.2	106.1	112.4	119.2	126.3	133.8
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Grenada	2006	2007	2008	2009	2010	2011	2012	2013	2014
Cumulative Installed Capacity (<i>MWth</i>)			5.6	6.8	7.3	7.9	8.4	9.0	10.08

Jamaica	2006	2007	2008	2009	2010	2011	2012	2013	2014
Cumulative Installed Capacity (<i>MWth</i>)	9.8	14.4	18.9	23.5	28.0	28.7	29.4	30.1	30.8

APPENDIX III

OPPORTUNITIES FOR GREENHOUSE GAS REDUCTIONS FROM SWH IN THE CARIBBEAN

As described throughout this report, strong potential for solar water heating (SWH) market growth exists in many countries. SWH provides an alternative to conventional heating sources that is both cost-effective and sustainable. Globally, there are over 406 gigawatts (GW_{th}) of installed solar heating capacity producing 340 terawatt-hours (TWhs) of energy per year (Mauthner & Weiss, 2015). The potential for SWH remains largely untapped in most countries and represents a significant opportunity for energy savings and for greenhouse gas emissions (GHG) reductions.

In addition to GHG reductions, SWH can also diversify national energy supply, reduce the need for investment in larger-scale energy generation, and improve energy access to those without existing water heating systems. It can stabilize the grid by alleviating strain, build resilience by providing continued access to hot water during power outages, and reduce the need to rely on fossil fuel imports. SWH can also reduce localized air pollution and create local economic development opportunities.

For developing countries, Nationally Appropriate Mitigation Actions (NAMAs) provide a pathway for realizing co-benefits of growing a SWH market. NAMAs can help a country overcome market development barriers while also making voluntary commitments to reduce GHG emissions. NAMAs emerged from the international climate negotiations under the framework of the UNFCCC and are a “set of policies and actions that countries undertake as part of a commitment to reduce greenhouse gas emissions” (Haselip et al., 2014). They allow a country to drive investment through its sustainable development priorities.

A NAMA can be financed by its host country, but the international community can also provide support for the NAMA in terms of financing, technology deployment, and capacity building. NAMAs that focus on SWH policies or programs for a country create the necessary market conditions for growing SWH, such as setting performance and quality control standards, requiring or incentivizing installation, or providing financing to make SWH feasible (Haselip et al., 2014). UNEP’s Guidebook for the Development of Nationally Appropriate Mitigation Action for Solar Water Heaters [provides detailed guidance about NAMAs for SWH](#).

For countries interested in developing a NAMA connected to SWH, UNEP’s SWH GHG Calculator can provide estimated emissions reductions from a SWH initiative. The calculator has been integrated into the TechScope Market Readiness Assessment Tool. The calculator allows policymakers to quantify GHG emissions reductions that can be associated with increased SWH deployment, helping to establish SWH targets that correlate to levels of GHG emissions reductions. This information can inform the development of a NAMA, showing estimated potential GHG emissions reductions from SWH policies and programs. The

GHG Calculator is designed as a companion to the [SWH Techscope Market Readiness Assessment](#) methodology detailed in this report, which helps policymakers and international organizations assess the policy, finance and investment, business, and quality control infrastructure of a country's SWH market.

Figure 16 Figure 17 below are the results of two demonstration scenarios for using the SWH GHG Calculator to estimate GHG reductions from SWH units that replace the use of conventional fossil fuels. The calculator was used for two Caribbean countries: the Dominican Republic and Trinidad and Tobago. Each scenario assumes the development of SWH generation of 1,000 kW_{th}, displacing energy use from heating water with electricity. The results provide an example of how policymakers could use the calculator to help develop GHG reduction estimates for a SWH NAMA proposal (Haselip et al., 2014):

Figure 16: TechScope GHG Summary Report for the Dominican Republic

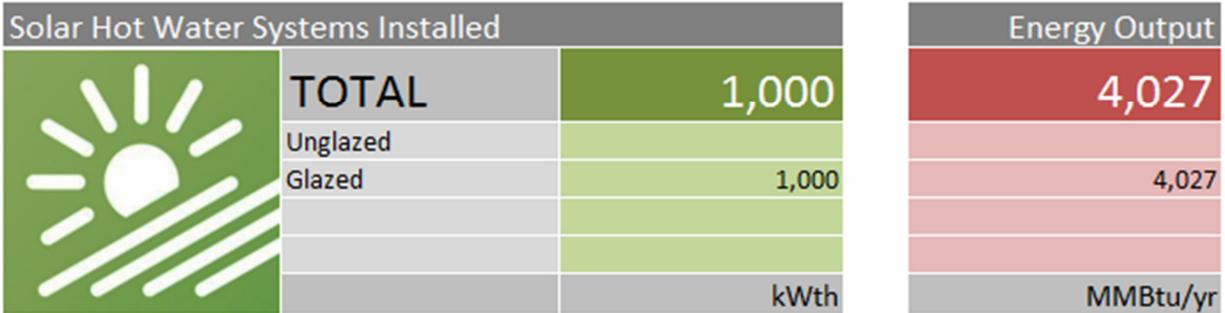
Techscope Report

Greenhouse Gas Calculator for Residential Solar Water Heating

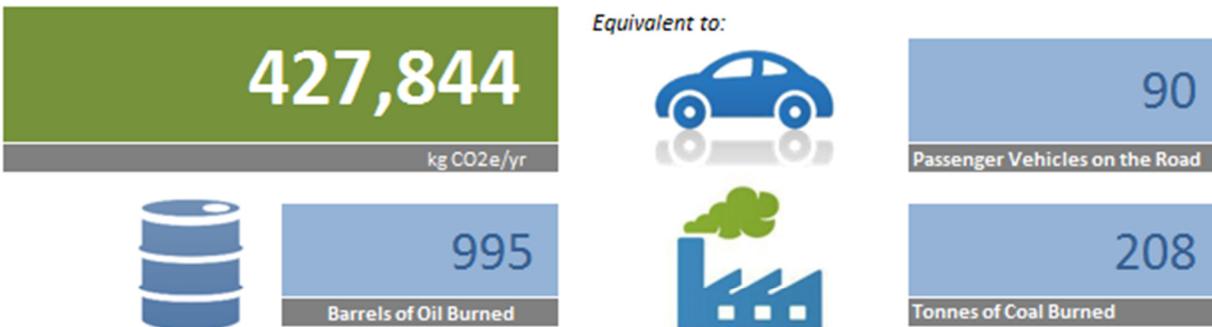
Country:

Dominican Republic

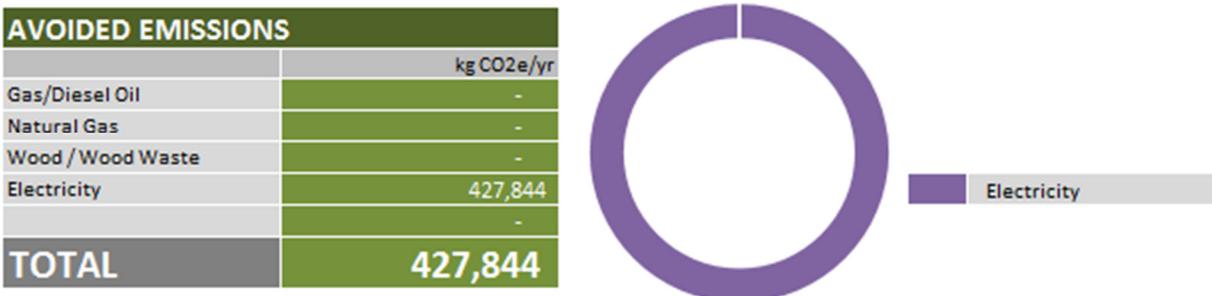
OUTPUT OF SOLAR WATER HEATING SYSTEMS INSTALLED



TOTAL GREENHOUSE GAS REDUCTIONS



GHG REDUCTIONS BY AVOIDED FOSSIL FUEL TYPE



For the Dominican Republic, SWH development with 1,000 kW_{th} of yearly generation would reduce approximately 427,844 kg of carbon dioxide emissions per year. Factors affecting this number include insolation, which is a measure of the kWh of energy that strike each square meter of land area per day.

The Dominican Republic has an average solar insolation value of 2,113 kWh/m²/year, on the higher end of solar insolation rates for the Caribbean (Figure 2, pg. 12), which increases the efficiency of SWH in the country (Clean Energy Solutions Center, 2014).

The GHG reductions that can come from displacing traditional heating systems with SWH systems depend on the primary heating fuel for that country that is being displaced. This scenario assumes that the SWH development offsets electricity generation in the Dominican Republic, the majority of which come from mixed fossil fuel sources.²⁹ Countries use different primary heating fuels and those that rely heavily on fossil fuels (such as diesel oil or gas, or fossil fuel-dominated electricity sectors) will see greater reductions in GHG emissions.³⁰

For Trinidad and Tobago, SWH development with 1,000 kW_{th} of capacity would reduce approximately 326,600 kg of carbon dioxide emissions per year. Similar to the Dominican Republic, this scenario assumes that SWH development offsets electricity generation emissions in Trinidad and Tobago. The GHG reduction would be lower since Trinidad and Tobago has a lower insolation value of 1,849 kWh/m²/year, on the lower end for the Caribbean region (Clean Energy Solutions Center, 2015). Trinidad and Tobago's electricity sector also has a lower effective CO₂e emissions factor, 0.558 lbs/CO₂e/kWh whereas the Dominican Republic electricity sector is 0.639 lbs/Co2e/kWh, leaving more potential for reductions in the Dominican Republic's electricity sector.

²⁹ The fossil fuel mix for electricity generation in the Dominican Republic is estimated to be: 60.6% oil products, 20.2% natural gas, and 14% coal (Sucre, 2013).

³⁰ Several assumptions were used to conduct this scenario analysis. For both the Dominican Republic and Trinidad and Tobago, the average collector yield for Barbados was used since neither country had this data available. The Dominican Republic and Trinidad and Tobago are likely to install systems similar to Barbados and have similar climactic conditions. The analysis also assumed that each country used 100 percent glazed SWH systems, which is what is typically used in the Caribbean. The tool's default assumptions were used for the efficiency of the SWH system. Country-specific insolation values and fuel distribution and emissions data were available and used for both countries.

Figure 17. TechScope GHG Summary Report for Trinidad & Tobago

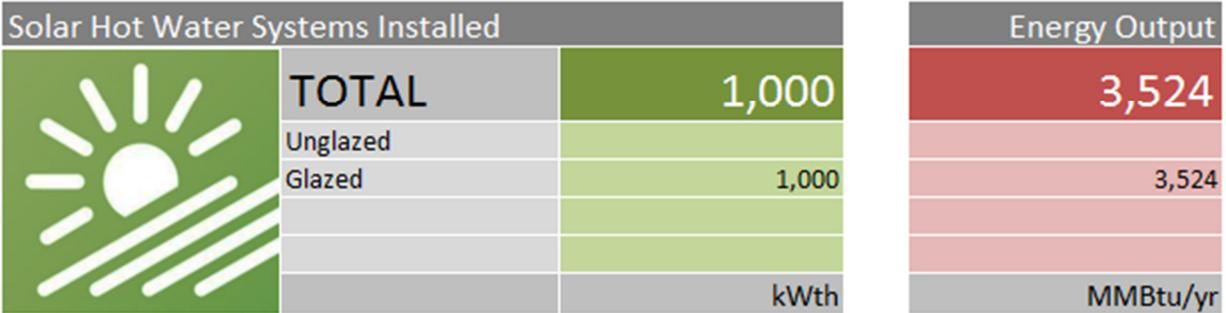
Techscope Report

Greenhouse Gas Calculator for Residential Solar Water Heating

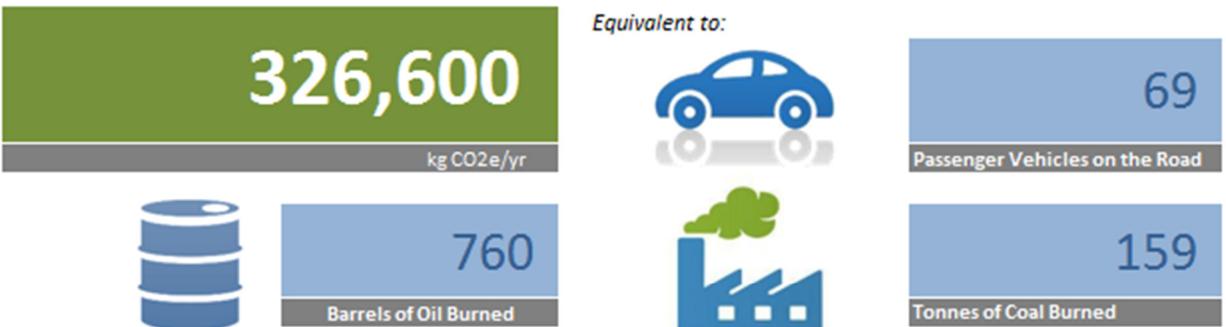
Country:

Trinidad and Tobago

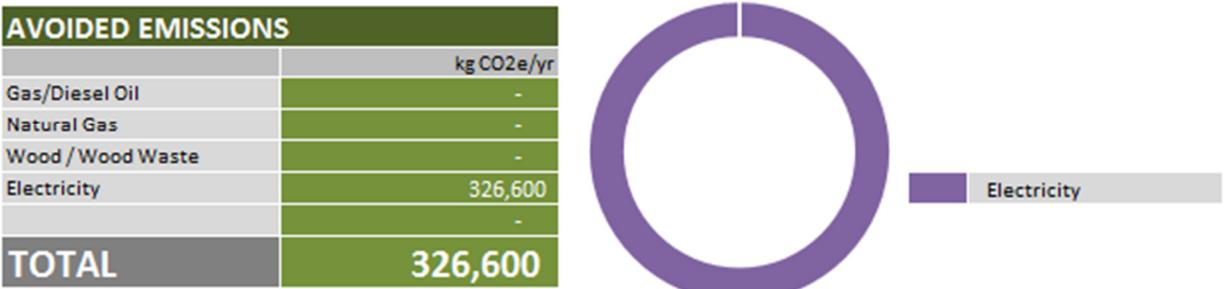
OUTPUT OF SOLAR WATER HEATING SYSTEMS INSTALLED



TOTAL GREENHOUSE GAS REDUCTIONS



GHG REDUCTIONS BY AVOIDED FOSSIL FUEL TYPE



Further details on using the GHG Calculator can be found within the tool in the “user manual” tab. The tool can be used as a companion to the TechScope methodology and is meant to help policymakers to plan a SWH market development initiative. Where a country is considering developing a NAMA for SWH, the GHG Calculator can aid in the planning process by helping to estimate GHG emissions reductions from a SWH policy or program. It can also aid in target setting, where policymakers wish to determine the quantity of SWH systems needed to meet GHG emissions reduction targets.

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The Solar Water Heating TechScope Market Readiness Assessment was developed as part of the Global Solar Water Heating (GSWH) Market Transformation and Strengthening Initiative.

This report uses the TechScope methodology to analyze the SWH enabling environments of eight Caribbean countries: Aruba, Bahamas, Barbados, Dominican Republic, Grenada, Jamaica, Saint Lucia, and Trinidad and Tobago. This report does not detail the TechScope methodology and is intended to be read alongside the original SWH TechScope Market Readiness Assessment report (UNEP, January 2014).