Work Package 6: Business models and local benefits[1]

WP Leader Energieinstitut der Wirtschaft: Summary

Market for solar cooling and hot water production in Cuba

Sustainable cooling technologies, using renewable energy sources and climate friendly cooling liquids gain more and more attention. Solar thermal driven refrigeration and air-conditioning is particularly attractive to countries like Cuba and other Caribbean Countries with a high rate of solar radiation. Compared with fossil fuels, solar radiation is sustainable and renewable and the availability is usually given during required periods of high cooling loads. Solar collector systems used as source for solar cooling can be used in periods with lower ambient temperatures for heating and hot water production. Globally, solar heating and cooling has a vast potential for meeting built environment needs. The International Energy Agency (IEA) estimates that solar heating (hot water and space heating) will deliver 9.3 EJ of solar heat and 1.5 EJ of solar space cooling annually by 2050 (IEA, 2012)[2]. Many countries in Europe and Asia have taken the lead over the past two decades in the implementation of solar heating and cooling solutions.

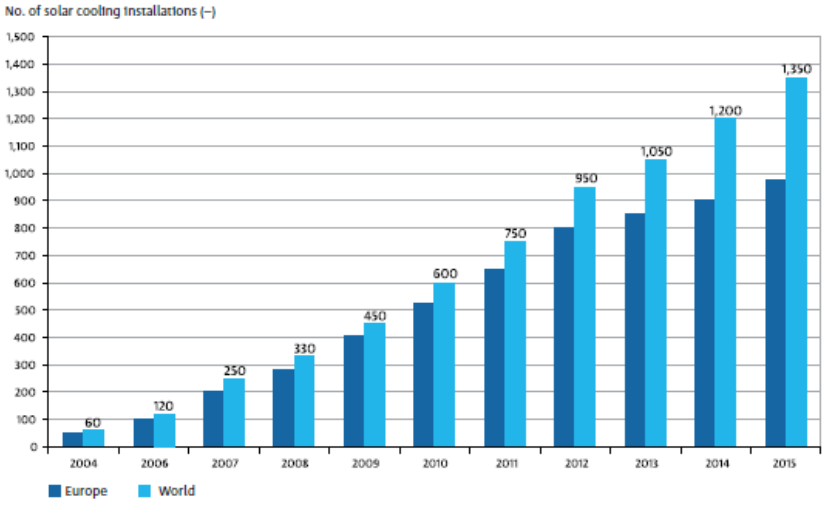


Figure 7. Market development of solar air conditioning and cooling systems (Weiss et al, 2017)

[1] **This document was prepared as part of the project Cuba Solar.**
Cuba Solar was co-financed by Österreichische Forschungsförderungsgesellschaft (FFG) in the framework of the "Beyond Europe" programme.

[2] IEA, 2012, Technology roadmap: solar heating and cooling.https://www.iea.org/publications/ freepublications/publication/technology-roadmap-solar- heating-and-cooling.html

Suitable applications for combined solar cooling (air condition) and hot water production:

- Public and private buildings (office buildings, universities, education centers)
- Health care (hospitals, clinics)
- Tourism (hotels, recreation centers)

Depending on the time period and temperature quality/limits of conditioned air hot water storage tanks have to be integrated in the system.

Air conditioning equipment in Cuba

For the production, trading and services of air conditioning equipment in Cuba, the factory FRIOCLIMA was founded in 2006 and it is subordinated to the Electronic Industries Business Group.

FRIOCLIMA dedicates their production, commercialization and technical services of air conditioning and ventilation equipment in Cuba to the requests and needs of customers. It has an experience working in this sector since 1992 and its products are mainly used in industries such as tourist, food, agriculture and medical-pharmaceutical. All of its productions replace imports and it is the only one of its kind in Cuba.

The locally produced and traded equipment is based on conventional electrical compression AC-technology.

The current capacity of the local production of FRIOCLIMA does not satisfy Cuban demand for central climate equipment. This capacity is shown below[3]:

MAIN PRODUCTIONS	**Annual Capacity**	**Annual Demand**
Chillers	20	30
Air conditioner	120	150
Basic Fancoils	1000	3000
Other productions	500	500

The following table shows savings by import substitution for Cuba if FRIOCLIMA produced all of the equipment demanded in Cuba[2].

MAIN PRODUCTIONS	**Production cost (USD)**	**Import Price (CIF) (USD)**	**Saving per import substitution per unit (USD)**
Chillers ~ 50 TR	85,000.00	120,000.00	35,000.00
Air conditioners	6,200.00	8,000.00	1,800.00
Basic Fancoils	500.00	700.00	200.00

[3] Information from IRC in the preparatory project submission form

FRIGOCLIMA is also working with foreign companies listed in Cuba, such as:

- Mitsubishi Electric
- Daikin
- Panasonic
- Kaysun
- Eurofred/General (Spain)

Currently, 80% of the technological equipment has more than 20 years of operation. FRIGOCLIMA needs to update its technologies and undertake an investment process in order to guarantee high productivity and competitiveness to international standards[4].

In these days most of the equipment for new chiller cooling systems (hotels, hospitals, office buildings) is imported.

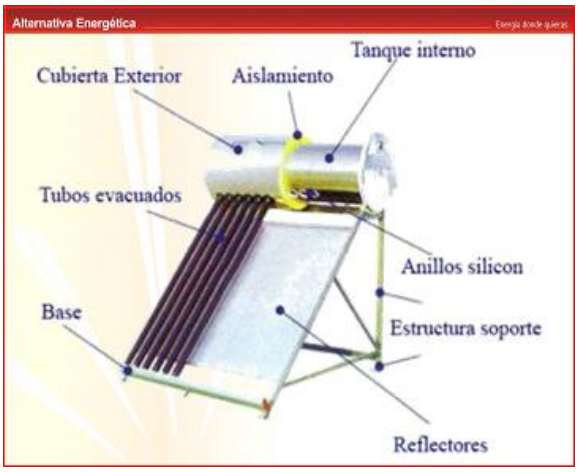
Solar Heaters in Cuba[3]

The production of solar heaters in Cuba began in the 1980s of the last century. The strategic business unit responsible for manufacturing solar heaters in Cuba is RENSOL.

In 2009, RENSOL opened the only factory of solar heaters in Cuba. The factory produces three models of solar heaters: Two of them are thermosyphonic models for individual domestic systems and the one is an industrial model for centralized systems. All models of solar heaters are based on Chinese vacuum tube technology.

The factory produces 3 models of solar heaters. Two of them are standardized thermosyphonic products with integrated boiler for individual domestic systems and the one is an industrial model for centralized systems. These models are shown below.

Domestic model

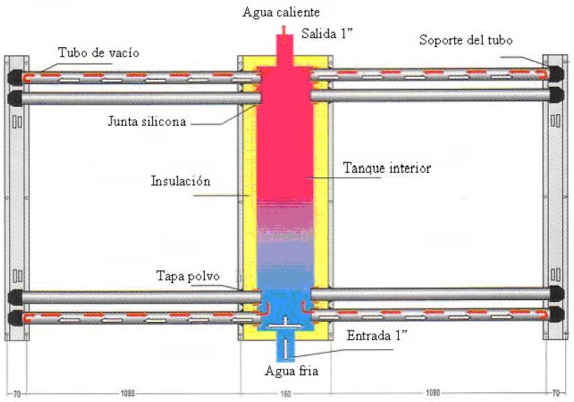


[4] Information from IRC in the preparatory project submission form

Technical data

Item	LPC 47-1510-30 ACF	LPC 47-1525-30 ACF
Tank Capacity (liters)	90	200
Production (l/day at 50°C)	130	300
Inside Tank	• Ø-350 mm, • Material-Stainless Steel SUS 304-2B, • Thickness-0,5 mm	
Outer Tank	• Ø 450 mm, • Material Pre-lacquered steel, • Thickness-0,4 mm	
Thermal isolation	Polyurethane foam with 50 mm of thickness	
Vacuum tube Dimensions	Ø 47 x 1500 mm	
Numbers of tubes	10	25
Tube-Tank Union	Silicone ring with ø 47 mm	
Diameter of connection	15 mm (1/2" NPT)	
Work pressure	Atmospheric (1,5 mca maximum)	
Raw area / opening area (m²)	1,82 / 1,1	3,9 / 2,4
Empty weight / Full weight	35 / 167	50 / 260
Electric backrest	(In tank) 1,5 kW (Optional)	
Welding	Automatic of Argon-Continuous Contact	

Industrial model



Technical data

Item	*LPC 47-1530*
Production (l/day at 50°C)	*390*
Collector	• *Ø-350 mm,* • *Material-Stainless Steel SUS 304-2B,* • *Thinckness-0,6 mm*
Coating of the collector	• *Ø-450 mm,* • *Material-Pre-lacquered steel,* • *Thinckness-0,5 mm*
Thermal isolation	*Polyurethane foam with 50 mm of thickness*
Vacuum tube Dimensions	*Ø 47 x 1500 mm*
Number of tubes	*30*
Tube-Collector Union	*Silicone ring with ø 47 mm*
Diameter of connection	*25 mm (1" NPT)*
Work pressure	*Atmospheric (1,5 mca maximum)*
Raw area / opening area (m²)	*6,2 / 3,75*
Empty weight / Full weight	*32 / 150*
Welding	*Automatic of Argon-Continuous Contact*

Installed production capacity is around 9,000 units per year, equivalent to 18,000 m² average and the maximum production has been a few more than 5,000 units in 2012 and 2016.

From the first year of production in 2010 to the end of 2016 the factory has produced 20,310 solar heaters distributed per year as follows:

Year	**Until 2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**Total**
Solar heaters	8 659	1 031	416	5 002	4 450	2 533	1 860	5 018	20 310

In order to increase production of hot water by solar energy, Cuba has a governmental policy. It has established as a goal for the residential sector the installation of around 100 000 m^2 with an investment cost around 300 million USD. In the non-residential sector, which includes hospital and schools, the policy proposes to install 100,000 m^2 of industrial heating with an investment cost around 8 million USD.

Today in Cuba solar thermal collectors (vacuum tubes) are used for hot water supply, mostly in hotels. We have a factory in Cuba and are increasing the capacity of production.

Market potential in Cuba

Cuba has many political and business relations with other countries in the Caribbean and South America. Therefor the Cuban project partner IRC is interested in co-operating with SOLID in the whole region.

In Cuba, mainly the tourism sector and the pubic building sector (office buildings, hospitals, etc.) are of interest for the solar cooling and hot water production as proposed for the IPK hospital.

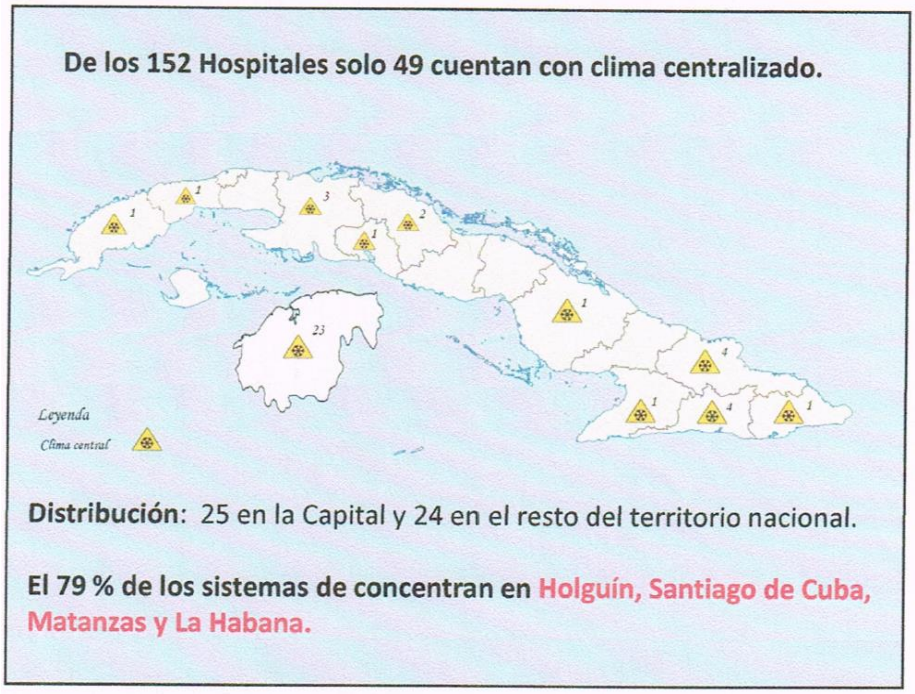
Tourism sector

Cuba is planning to add 100,000 hotel rooms, 47 entertainment facilities, and 24 golf courses by 2030[5]. The Cuban Ministry of Tourism (MINTUR) has named the capital city of Havana a priority destination for tourism investment. Havana currently has 15 hotels operated with foreign companies along with 95 management agreements accounting for 65 percent of Cuba's total number of guestrooms. According to MINTUR, investments in 2018 reached $1.035 billion, driving for a 3.5-percent increase in Cuban tourism this year compared to the same period last year.

Havana's current hotel development pipeline includes the following hotels: Packard, which is scheduled to open in 2018, Prado y Malecón, which is opening in 2019, Corona, Metropolitano and Gran Hotel. Other projects include hotels on Malecón and D streets, 3rd and 70th streets across from the Panorama Hotel, G and 29th streets and on 25th and Ki streets near the Tryp Habana Libre Hotel.
Beside city hotels, large tourism developments are in the planning stage, like the Punta Colorado Golf & Marina Project[6].
The utilisation of renewable energy like solar energy is obligatory for all these new projects. Combined systems for solar cooling and hot water production are one possibility to integrate solar energy in the energy systems.

Health care (hospitals, clinics)

Currently an investment project for refurbishment of the air conditioning system for 152 hospitals and clinics until 2023 is under discussion. Out of these 152 hospitals, 49 hospitals have central cooling and it would be possible to operate with combined systems for solar cooling and hot water production.



Source: Modernizacion de los sistemas de clima en hospitales Cubanos, Empresa RC (Refrigeracion y calderas)

[5] https://cubaholidays.co.uk/news/119332/cuba-plans-to-add-103000-hotel-rooms-and-24-golf-courses-by-2030
[6] http://puntacoloradagolfmarina.com/project/?lang=en

Barriers

Currently the main technical barriers for solar thermal cooling systems in Cuba are:

- lack of available domestic collector systems and required collector components
- lack of available domestic absorption cooling systems and required components
- lack of operation and maintenance know how

For a market penetration in a country such as Cuba, solar cooling systems need to fulfil criteria such as robustness, affordability, and availability.