

# SWC50-The Century of Solar Celebration Newsletter – September 2021

This month we provide

- A brief overview of solar research and applications in the decade 2010-2019 (2010's);
- A focus on Spain; and
- A special announcement about SWC 2021

The overview of solar in the 2010's provides some key highlights taken from the booklet: ISES SWC50 The Century of Solar Stories and Vision Booklet

For more highlights, please refer to the booklet or the <u>ISES</u> <u>Solar Energy Museum – Past, Present and Future</u>

# **ISES 2010's**

Significant events in the history of ISES in the 2010's include:

- In January 2010, in line with the new relationship with IRENA, ISES attends the inaugural World Future Energy Summit (WFES) in Abu Dhabi. ISES was represented by ISES President Dave Renné. Since then, ISES has regularly participated in the annual WFES as well as the IRENA General Assemblies, held immediately prior to the WFES.
- In December 2010, Christine Hornstein stepped down as ISES Executive Director. Jennifer McIntosh is appointed as Head of Secretariat.



Jennifer McIntosh

• In 2012, ISES initiates a free monthly webinar series, providing high-quality renewable energy technical presentations on a monthly basis. The first webinar, on Solar Thermal Electricity, and led by Prof. Manuel Romero, was held on 4 September 2012.

## What is SWC50 – The Century of Solar?

In 1970 solar research pioneers met at the first International Solar Energy Society (ISES) Conference in Melbourne Australia. ISES commemorated in 2020 this first Solar World Conference with a special 50th Anniversary Virtual Conference, called the Solar World Congress at 50 (SWC50).

During these past 50 years solar energy has grown from being emerging technologies to a vibrant industry. The Century of Solar highlights the transformation in the global energy sector that has taken place since the first Solar World Congress in 1970 and looks forward to the next 50 years when solar energy will be a major cornerstone of the global energy system. While the focus of the Century of Solar is on the evolution of solar energy, the importance of other renewable energy sources working together to reach the 100% renewable energy world goal will be a central theme.

**SWC50 - The Century of Solar** is about the people: researchers, industry players, policy makers, and leaders of NGOs and Non-profit organizations who have all contributed to make solar energy the fastest growing contributor to new electricity capacity.

- In 2013 ISES:
  - Formerly becomes a member of the REN21 Steering Committee and participated in the first steering committee meeting in Abu Dhabi on 17 January, and the second at the UNFCCC COP-19, Warsaw on 17 November.
  - Formed partnering relationships with key international organizations such as IRENA (where ISES provided inputs to the IRENA Renewable Energy Learning Platform and the Global Solar and Wind Atlas); the IEA's Renewable Energy Working Party, the UN's Sustainable Energy for All Program, the UN Foundation's Practitioner Network, the UNFCCC, ACORE and LAC-CORE.
- In 2015 ISES:
  - Launches its <u>Conference Proceedings Database</u> of proceedings from Solar World Congresses, EuroSun conferences and section events. The website provides a searchable open access platform for the conference proceedings.
  - Becomes a Founding Member of the GO100% Renewable Energy Campaign led by the World Future Council.
  - Becomes a Founding Member as well as Member of the Board of the Directors of the Global Solar Council, launched in conjunction with UNFCCC COP-21, Paris, December 10.
  - Becomes a sponsor of the International Energy Agency's Solar Heating and Cooling Technology Cooperation Programme, and becomes a Member of the Executive Committee.
- In 2017, the first <u>Elsevier-ISES Renewable Transformation Challenge (RTC)</u> is launched. The objective of the Renewable Transformation Challenge is to recognize and honour outstanding work encouraging progress towards a world powered by renewable energy and with accessible energy for all. The first winner of the RTC, Dr. Sebastian Groh of ME SolShare was announced during the awards banquet at SWC 2017, Abu Dhabi
- In 2017, ISES introduces a new award, ISES Fellows, to recognise people who have given many years of distinguished service to ISES and have advanced the use of solar and renewable energy through research, education, communication and deployment.
- In 2018, ISES launches a new infographics publication and published the first instalment titled "Dispelling the Myths - Renewables in the Grid". The infographics address myths about renewable energy grid integration, storage, load management and energy transmission.
- In December 2019, Dave Renné completes his final term as ISES President. His ten years is the longest term of any President in the 65 years history of ISES. His legacy is that ISES has a high profile and excellent working relationships with the many other organisations that have formed over the last 10 to 20 years such as REN21, IRENA, Global Solar Council etc.

<b>ISES President in the 2010's</b>			
Years	President	Country	
2010-2019	Dave Renné	USA	

Year	Location	Overview
2011	Kassel Germany	Theme: Rapid Transition to a Renewable Energy World 720 participants
2013	Cancun Mexico	Theme: Renewables Working Together for All 750 participants
2015	Daegu South Korea	Theme: Achieving the Renewable Energy Transformation 450 participants
2017	Abdu Dhabi UAE	Theme: Innovation for the 100% Renewable Energy Transformation 500 participants
2019	Santiago Chile	Theme: Innovation in Transforming Energy Systems and Markets to 100% Renewable Energy 422 participants

# Solar World Conferences 2010's

# Photovoltaics' 2010's

# The decade where the very large solar farms and the term GW became common!

The global PV industry grew at an average compound annual rate greater than 35%. The Chinese Renewable Energy Law of 2005 and the investments by the Chinese Government in Renewables during this decade had the result that in 2018, 73% of the world's PV manufacturing is by Chinese companies and 42.5.% of modules installed in 2018 is in China. The Passivated Emitter and Rear Cell (PERC) and ½-cell modules are introduced to increase the performance and modules are fast approaching 500W in size. Solar farms kept increasing in size with the largest being 2.04GW installed in India in 2019. No summary points are provided for this decade, the following facts and figures is the story of PV for this decade.

In accordance with the IEA Trend reports during the 2010's

- Annual installations grew from 16.9GW in 2010 to 111.6 GW in 2019.
- Cumulative installed capacity grew from 39GW in 2010 to approximately 623GW in 2019.
- In 2010, off grid systems represented 1% of the annual installations and by 2019 this had decreased to less than 0.2%.
- In 2010, Grid connected centralised systems represented approx. 22% of the annual installations and by 2019 and it was 59%.
- In 2010, Grid connected centralised systems represented 24% of the cumulative installed capacity and by 2019 this had grown to 59%.

## Solar Thermal 2010's

Key points from the IEA SHC data:

- IEA SHC collected data from 63 countries and estimated that all other countries represented 5% total annual installed capacity.
- The total annual installed capacity was 62.5 million m2 in 2010, peaked at 77.5 million m2 in 2104 and had decreased to 44.1 million m2 in 2018. (Collectors for air heating represented 1%)
- Chinas dominance of the market represented 78.3% of the total annual installed capacity in 2010 and represented 75.6% in 2018.
- In 2010, ETC's represented 79.6% of the recorded annual installed capacity and this decreased to 69% in 2018. However, this is partly due to a reduced Chinese market in 2018 compared to 2010.
- Calculations were undertaken of the total cumulative installed capacity allowing for systems being removed after a specified number of years. This showed that cumulative capacity grew from 333 million m2 in 2010 to 665 million m2 in 2018.

Note The 2021 IEA-SHS Annual Solar Heat Worldwide report provided figures up 2018.

Other significant events in the history of Solar Thermal in the 2010's include:

- In 2011, the largest solar cooling installation worldwide was commissioned at the United World College in Singapore. The 2.73 MW<sub>th</sub> / 3,900 m<sup>2</sup> solar thermal collector field powers a 1,500 kW cooling unit, which is based on a single-effect lithium bromide absorption chiller.
- The first IEA SHC International Conference on Solar Heating and Cooling for Buildings and Industry was held in San Francisco in 2012. This conference joined the ISES Solar World Congress in 2017 in Abu Dhabi and 2019 in Santiago.
- Establishment of the Global Solar Certification Network (GSCN), during its first meeting in Spain, in April 2014. The GSCN was developed under the framework of the IEA SHC Task 57 "Solar Standards and Certification".
- In 2016, there was the opening of the Silkeborg (Denmark) solar district heating plant comprising 150 000 m2 of large module collectors (110 MWth). The Silkeborg plant was the largest among more than 100 district heating plants with solar collector arrays of 2 – 110 MWth (1 500 – 150 000 m2 collector area) installed in Denmark from around 2007 until end 2017.
- In 2019, the southern Tibetan town of Saga became home to the fourth solar district heating plant in the region after similar systems had already been installed in Langkazi, Shenzha and Zhongba. The Saga plant has a heat generation capacity of 13.4 MWth (19,136 m2) and includes large flat plate collectors as well as two storage units that can hold 4,500 m3 each.

# **CSP 2010's**

The 2010's saw a growth in the number of CSP systems being installed globally and Thermal Energy Storage (TES) was included in a number of the systems. The following is a sample of the plants that came online in this decade:

- In 2010,the 75 MW Martin Next Generation Integrated Solar (CSP) Combined Cycle (ISCC) was completed and came online. Over the next few years ISCC plants were installed including:
  - $\circ$   $\,$  Ain Beni Mathar, Morocco (2010) 20 MW  $\,$
  - Kuraymat, Egypt (2011) 20MW
  - Hassi R'mel, Algeria (2011) 20 MW
  - Agua Prieto, Mexico (2013)-15MW
- In Spain 2011, Gemasolar, a 17 MW molten-salt tower plant with 15 hours of TES became the first commercial molten-salt tower plant to come online.
- In 2013:
  - The Godawari Solar Project became the first CSP project to operate in India. As of 2020, three CSP plants are operating in India with a total capacity of 200 MW.
  - The last 50 MW trough CSP plant out of a total of fifty CSP plants began operation, bringing the total capacity of CSP plants in Spain to 2.3 GW.
  - Solana, a 250 MW trough plant with six hours of TES came online in Arizona. The following years two more 250MW trough plants were installed in California.
- In 2014, Crescent Dunes, Nevada, a 110 MW molten salt power tower with 10 hours of TES, came online.
- In 2015:
  - The 100 MW Kaxu parabolic trough plant came online in South Africa. As of 2020, there are six CSP plants with a combined capacity of 500 MW operating in South Africa.
  - Noor I, a 160 MW parabolic trough plant with 3 hours of TES, became the second commercial CSP plant in Morocco. As of 2020, there are three CSP plants operating in Morocco with a combined capacity of 500 MW.
  - China approved 20 demonstration CSP projects ranging in size from 50 to 100 MW. Proposed projects include power tower and trough and linear Fresnel technologies.
- In 2018, Ashalim A, a 110 MW parabolic trough with 4.5 hours of TES and Ashalim B, a 121 MW superheated steam power tower began operation in Israel.
- In 2019:
  - $\circ$  The 50 MW Shagaya CSP plant with 10 hours of TES began operation in Kuwait.
  - The Waad Al-Shamal ISCC 50 MW plant began operation in Saudi Arabia.

# Solar Architecture/Buildings 2010's

Significant developments included:

- In 2010:
  - With the growth of "Zero Energy Buildings", the US National Renewable Energy Laboratory develops a classification system defined in a report : Net-Zero Energy Buildings: A Classification System Based on Renewable Energy Supply Options.
  - In May 2010, the EU Energy Performance of Buildings Directive states:
    - Each Member State shall establish a long-term renovation strategy to support the renovation of the national stock of residential and non-residential buildings, both public and private, into a highly energy efficient and decarbonised building stock by 2050, facilitating the cost-effective transformation of existing buildings into nearly zero-energy buildings.
  - IEA-SHC Task 40 / EBC Annex 52 launches a website with an interactive map of the world showing locations of Net Zero Energy Buildings. Clicking on the building location on the map provides information on that building. (<u>https://batchgeo.com/map/net-zero-energybuildings</u>)
- IEA -SHC Task 41 Solar Energy and Architecture launches a website in 2014 with a collection of case studies including a wide range of new built or retrofitted building types such as single and multi-family housing, offices, schools and universities, stadiums, culture buildings, etc. The case studies include active solar (photovoltaic and solar thermal) and passive solar. More than 230 case studies were proposed and evaluated by a broad range of trained architects from universities, research institutes, dissemination organisations and professional practices. 50

projects from 11 countries were selected to be included in the Collection of Case Studies. (<u>http://task41casestudies.iea-shc.org</u>)

- In 2015, IEA -SHC Task 47 releases the report: Lessons Learned from 20 Non-Residential Building Renovations. The report summarizes the findings from 20 exemplary renovation projects. The buildings are divided into three categories; educational buildings, office buildings and historic & protected buildings. In the summary chapter, the key findings from all the buildings are described. More detailed information for each building category is presented under the respective chapters.
- In 2017, IEA-SHC Task 51 Solar Energy in Urban Planning releases a collection of 34 case studies from Austria, Canada, China, Denmark, France, Germany Italy, Norway, Sweden and Switzerland. The case studies are indicative of the state of the art of leading developments in the planning of solar energy in new and existing urban areas and also include examples of solar landscape planning. The report is available from following website <u>https://task51.ieashc.org/Data/Sites/1/publications/Task51-Report-C1-1805031.pdf</u> while there is a clickable map on the case studies from the following site <u>https://task51.iea-shc.org/case-studies</u>

## PV in Developing Countries 2000's

This decade sees the off-grid market focused on two solutions for the unelectrified people in developing countries. The solutions are Plug and Play Solar Home Systems and Mini-Grids. However, there is still a market for component based solar home systems which have a higher peak watt rating than those being provided by Plug and Play Systems. Lighting Global introduces a Product Quality Assurance Program for the testing and approval of Plug and Play Solar Home Systems. The Global Off-Grid Lighting Association (GOGLA) is formed and many of its members are from those companies providing the products approved through Lighting Global. In the second half of the decade, bi-annual off grid solar trend reports are developed, and the results are summarised below. The mini-grid market expands as a solution for electrifying villages globally and in particular those in Sub-Saharan Africa. Many bi-lateral and multilateral donors now focus in on this area and the number of companies and products has grown. A key driver for all of this interest in off grid solutions was Sustainable Development Goal 7 (SDG7), which called for universal access to sustainable energy by 2030. A significant development as the decade progressed is that with the growth of the Plug and Play market, product prices were greatly reduced and in parallel with this is the development of more efficient appliances and LED lighting. This resulted in a 50W PV system being able to power similar appliances to what would need a 300-500W system 20 years prior. Due to the rapid expansion of the plug and play market and the installation of micro-grids in the developing countries, the data provided for this decade focuses on those installations as distinct from the donor projects as shown in previous decades.

• In 2010 1.14 billion people in the world did not have access to electricity, representing 16.5% of the total population. This had decreased to 939 million by 2016, representing 12.6% of the population.

Other significant events in the 2010's include:

- In 2011 Former UN Secretary-General Ban Ki-moon launched the **Sustainable Energy for All initiative (SEforALL)**. Today an independent organization, SEforALL's is an international organization working with leaders in government, the private sector and civil society to drive further, faster action toward achievement of Sustainable Development Goal 7 (SDG7), which calls for universal access to sustainable energy by 2030.
- In 2012:
  - The **Global Off Grid Lighting Association (GOGLA**) is established. **GOGLA** is the global association for the off-grid solar energy industry. **GOGLA** now represents over 180 members as a neutral, independent, not-for-profit industry association.
  - The IFC launches Lighting Asia with a report on the off grid solar lighting market for seven Asian countries. The overall program becomes known as Lighting Global with Lighting Africa and Lighting Asia being regional programs. Lighting Global's quality assurance program tests off-grid lighting products while also providing business support to companies who sell products that meet the quality standards.

- In 2015,
  - The Sustainable Development Goals (SDGs), were adopted by all United Nations Member States as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030. Sustainable Development Goal 7 (SDG7) calls for universal access to sustainable energy by 2030.
  - In order to monitor the progress towards SDG7, the **World Bank/ESMAP** and the **International Energy Agency** led a consortium of 23 international agencies to establish the SE4All Global Tracking Framework (GTF) which describes how to measure baseline and progress towards the SE4All goals by gathering energy data regularly. This led to measuring energy access in the tiers as identified in the following table. Tiers 1, 2, and 3 can include many of the SHS's on the market

			TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
	1. Peak	Power		Min 3W	Min 50W	Min 200W	Min 800W	Min 2kW
ATTRIBUTES	Capacity	capacity ratings <sup>28</sup> in W or daily Wh)		Min 12 Wh	Min 200Wh	Min 1.0kWh	Min 3.4kWh	Min 8.2kWh
		OR Services	-	Lighting of 1,000 Imhr/day	Electrical lighting, air circulation, television, and phone charging are possible			
	2. Availability (Duration)	Hours per day		Min 4 hrs	Min 4 hrs	Min 8 hrs	Min 16 hrs	Min 23 hrs
		Hours per evening		Min 1 hr	Min 2 hrs	Min 3 hrs	Min 4 hrs	Min 4hrs
	3. Reliability						Max 14 disruptions per week	Max 3 disruptions per week of total duration <2hrs
	4. Quality						Voltage prob affect the use appliances	lems do not e of desired
	5. Affordability		Cost of a standard consumption package of 365 kWh/year < 5% of household income					otion 5% of
	6. Legality						Bill is paid to pre-paid ca authorised re	o the utility, rd seller, or presentative
	7. Health & Safety						Absence of p accidents and of high risk in	ast d perception the future



By end of 2019

- Nearly 180 million people have benefited from using Lighting Global quality verified solar products, and more than 52.4 million people are currently meeting their basic (Tier 1) electricity needs. More than 42.1 million quality verified products have been sold since 2009.
- An estimated 420 million people worldwide are benefitting from off-grid solar products but only 55% of these people (231 million) currently benefit from Tier 1 or better access to electricity.

# Focus on Spain

The first contact of Spanish scientists with ISES took place during the ISES Solar World Congress held in 1975 at U.C.L.A., Los Angeles, California, when two researchers from the National Institute of Aerospatiale Technique (INTA), Pedro Pérez del Notario and Julio Fernández Sintes, attended that conference. There, they met another Spanish delegate, Rafael Úrculo, who was there representing the Spanish association ATECYR (Technical Association of Air Conditioning and Refrigeration). ATECYR organized a group devoted to solar energy and, in view of the great number of members interested in the topic, ATECYR established contacts with ISES in 1979 in order to set up a Spanish Section of ISES. On March 18 1981, the Spanish Government approved the association under the name of ISES España, which was ratified by ISES. The headquarters of the association was established in Madrid at the Instituto Eduardo Torroja of the CSIC (Spanish Council for Scientific Research). Interest in the topic was increasing, and in the first half of the 1980s the number of members of ISES España reached nearly 150.

ISES España continued to develop its activities in the 1980s, but many of its members were leaving the association, and in 1990 there were economic problems because of lack of payment of the fees of its members to ISES and bad administrative management. So, the association was suspended by ISES in 1991.

However, in 1993 The "new" Spanish Section of ISES was integrated with the Spanish Association of Solar Energy (Asociación Española de Energía Solar)

# Sample of Pioneers from Spain Pre-1980

Each month this newsletter will have a sample of people involved with renewable energy prior to 1980. These come from the focus country for that edition of the newsletter.

It is impossible to cover the many people who have contributed to the development of renewable energy prior to 1980 in this monthly newsletter. What is included in each newsletter is just a snapshot of those involved. Those included in the newsletter are either taken from or will be included in the next edition of the SWC50 celebratory booklet: The Century of Solar-Stories and Visions.

## Antonio Luque Lopez

Antonio Luque is a Spanish scientist and entrepreneur in photovoltaic solar energy. He graduated in Telecommunications Engineering at Technical University of Madrid (UPM) in 1964. He obtained his PhD in 1966, presenting the first laser developed in Spain. He soon became Professor of physical electronics at the School of Telecommunication Engineering at UPM. His early research in photovoltaic devices in the mid 70s lead to the foundation of the Solar Energy Institute (IES) at UPM in 1979, one of the oldest research institutions worldwide fully devoted to photovoltaics. Prof. Lugue's scientific work has been focused on reducing the cost of solar energy through the invention of photovoltaic novel concepts. In 1976, he invented the bifacial solar cell concept, able to convert the light received in both sides of the cell. In 1997, he invented the intermediate band solar cell, one of the very few solar cell concepts with potential to overcome the Shockley-Queisser limit and topic of research in many international centers. Among other prizes, he has been awarded the Spanish National Research Prize (1987), the Alexandre-Edmond Becquerel Prize awarded by the European Commission (1992) and the IEEE William Cherry prize for research in solar energy (2006). He is also Doctor Honoris Causa by several universities and member of the Russian Academy of Science. Founder and Chairman of the board of directors of Isofotón, a company that manufactured and industrialized bifacial solar cells since the early 80s and one of the largest silicon PV module manufacturers in the early 2000.

## Luis Crespo

Luis Crespo began work in solar in 1977. He began working in CASA/EADS and founded – aged 25 – the Solar Department, starting to develop components and applications for concentrated solar systems. He designed the first European heliostat, which still receives visitors at the PSA (Plataforma Solar de Almería). He was the system responsible in the international consortium that built the CRS IEA plant in Almería, which was connected to the grid in 1981. Then he moved to the laboratory of the Spanish utilities (ASINEL) as Head of the New Energy Technology department. He was Manager of the first 1 MW wind turbine in Spain and Technical Director of the Spanish-German GAST project, aiming to design a 20 MW high temperature air cooled CSP plant and its core components. In 1985, he was appointed director of the Spanish Renewable Energy Institute (IER) launching a large number of R&D projects in PV, CSP, Wind and Biomass within European and Spanish programs. He negotiated the PSA IEA projects transfer to the IER, converting the PSA in the largest CSP lab at world level. The interest in commercial deployment of renewables declined around 1990 and he then switched to innovation management and financial fields always having renewables in focus. The dawn of CSP technology happened in 2007 and he was called to come back to his roots directing the Spanish (Protermosolar) and European (ESTELA) CSP industry associations. He is still President of Protermosolar. He contributed to build 50 CSP plants (2,3 GW) – the largest fleet at world level – which are performing as expected after 10 years of operation. More recently he succeeded to include 5 new GW of CSP plants in the Spanish Climate and Energy plan

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- submitted to the EU Commission - as an essential piece for the Energy Transition. This was a great achievement after a long professional career.

For the current edition of the booklet others from Spain listed in the pioneer's section include:

Name	Year Started	Research or Industry
Valeriano Ruiz	During 1970's	Research
Eduard Lorenzo	1979	Research
Michael Geyer	1981	Industry
Manuel Romero	1982	Research
Fernando Artigas	1983	Research
Gonzalo Piernavieja	1991	Research

# Growth in Solar in Spain

**Photovoltaics** 



Source- IEA PVPS Trends Report 2020

# **Solar Thermal (Water Collectors)**



Source- IEA-SHC Annual Solar Heat Worldwide (2007-2020)



# **Renewable Energy Pioneers**

Without the efforts of individual researchers, system designers, system installers, business leaders, policy makers and those within the donor community, the renewable energy industry would not have grown from watts to Gigawatts in the last 50 years. ISES' way of acknowledging the many people was by issuing a call for the submission of Renewable Energy Pioneers to be listed in the celebratory booklet.

ISES will be releasing an updated version of the booklet in December 2021 and therefore **ISES is re**issuing the call for submissions of the names of individuals covering the following two categories:

**Research Pioneers:** Individuals who started their research in 1995 or earlier.

**Industry Pioneers:** Individuals who actively started working in or with the renewable energy industry in 1995 or earlier.

Names and information can be submitted <u>here</u>. Individuals can submit on behalf of themselves or on behalf of someone else, in particular for those who might have passed away. (**Note:** If you have previously submitted and are included in the current edition of the booklet, you will be included in the updated edition and do not need to resubmit.)

## Partners of SWC50

ISES acknowledges the support provided by the Platinum Partners: GSES from Australia and NREL from USA; Gold Partner: Smart Energy from Turkey.







## **ISES Solar World Congress 2021**

From October 25-29, the <u>ISES Solar World Congress 2021</u> will take place as an online event and we are looking forward to this first ever virtual Solar World Congress!



# Highlight your solar expertise by becoming a SWC 2021 Sponsor!

The ISES Solar World Congresses have been the leading solar congresses for over 50 years - join SWC 2021 and benefit from a truly well connected, divers and enthusiastic solar community from all around the globe!

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