



شركة وادي الرياض
Riyadh Valley Co

Solar Energy

The Sustainable shift to a Shining Future



September 2021

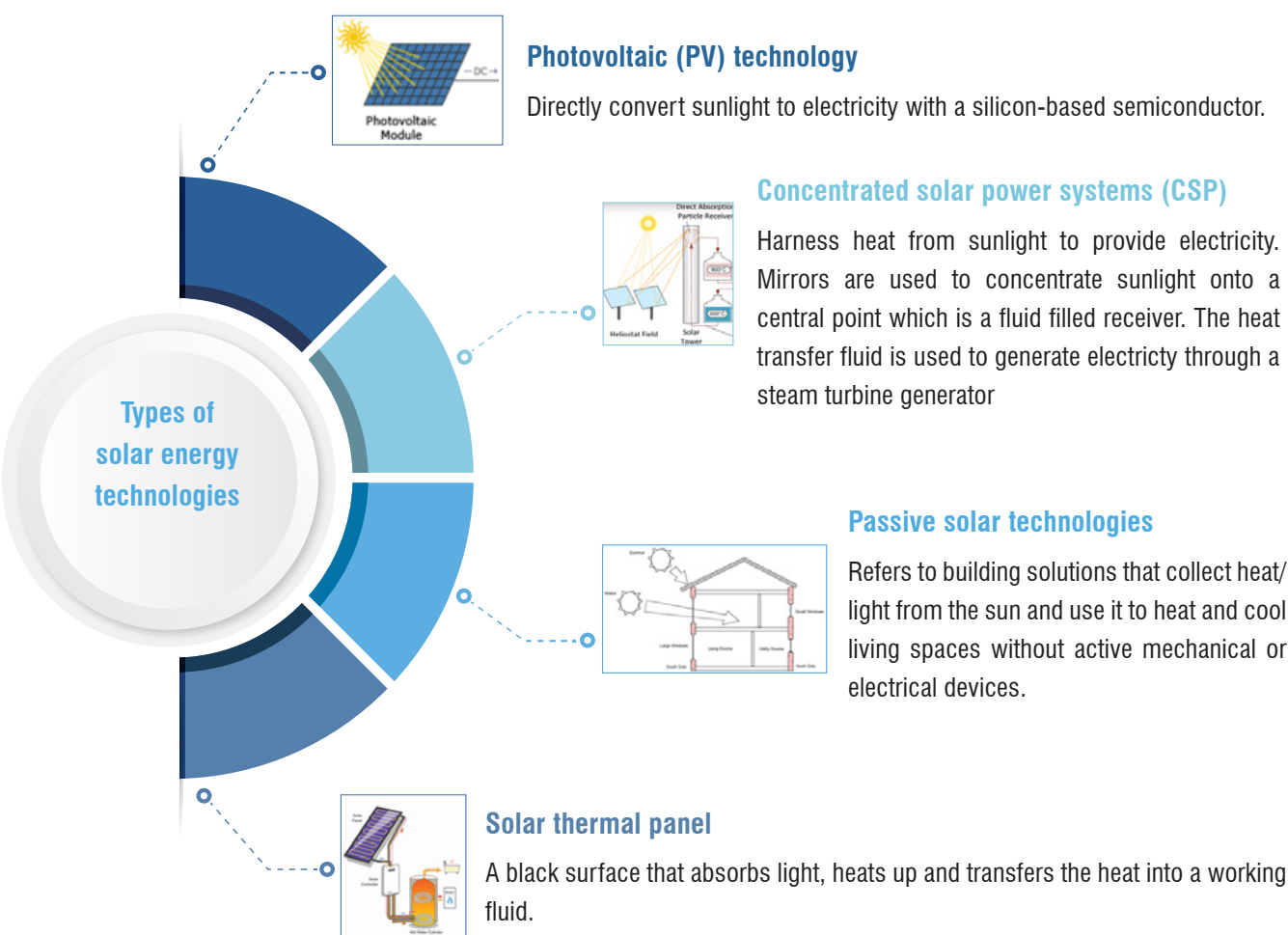
Solar Energy Overview

Why Solar Energy?

Increasing global energy demand and negative environmental impact of fossil fuel and their imminent depletion has increased the importance of renewables. Of the renewables, solar offers much potential as the solar energy received by the earth in one hour is greater than the energy used by everyone in the world in one year. It could be harnessed directly from the sun even in cloudy weather.

Solar energy could be harnessed through different techniques

Types of solar energy technologies



Source: Viridian Solar, NREL, World Bank, Simpleray

Concentrated Solar Power (CSP) outranks Solar Photovoltaics (PV) in terms of reliability and durability

Advantages of CSP over PV technology

	Solar Photovoltaics	Concentrated Solar Power
Lifetime	25 years	40 years
Output	Generates DC which is to be converted to AC to enable distribution	Generates AC current directly
Storage	Not capable of producing thermal energy; Storage using external batteries such as Li-ion batteries is suitable to store relatively less energy and for shorter time periods	Capable of storing thermal energy using Thermal Energy Storage technologies (TES), which are suitable for storing energy in bulk for longer duration
Reliability	Variable output that peaks around midday and falls towards zero during night time/cloudy days	Facility to store solar power allows power generation during night time/ cloudy days and better management of fluctuations

Source: World Bank, MDPI, SolarFeeds; Note: DC- Direct Current, AC - Alternating Current

Of the different CSP technologies, solar tower combines the advantages of efficiency and maturity

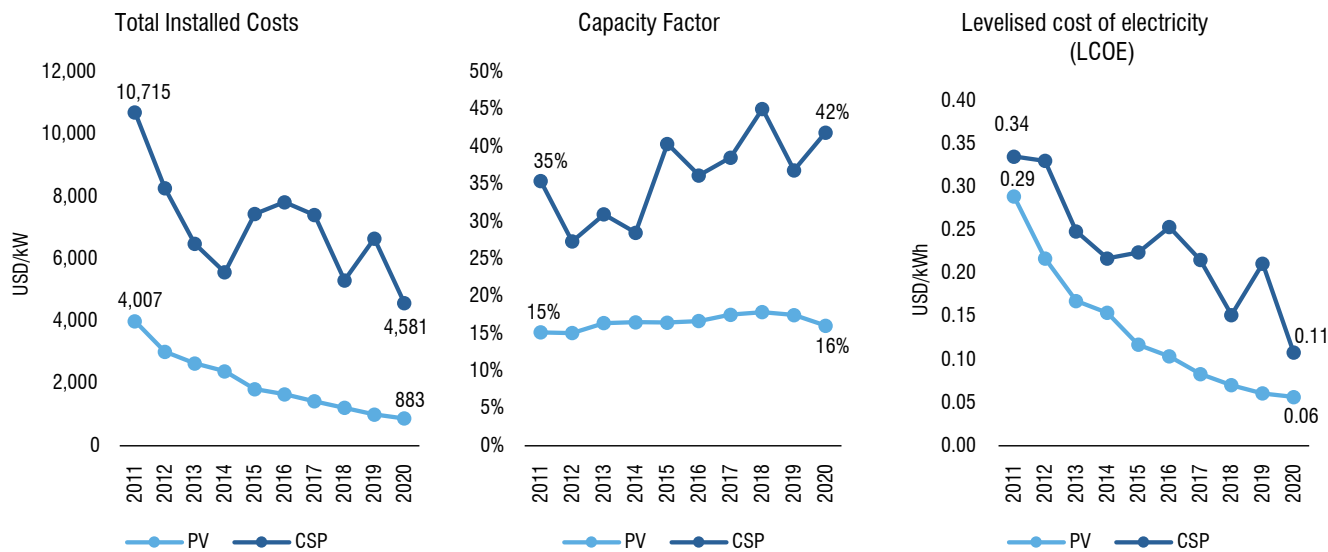
Characteristics and Maturity of different CSP technologies

	Parabolic Trough	Linear Fresnel	Solar Tower	Beam-Down	Down Dish-Stirling Engine
Characteristics	<ul style="list-style-type: none">High radiative and convective energy losses	<ul style="list-style-type: none">Lower efficiencyLow cost due to fewer moving parts and no tracking	<ul style="list-style-type: none">High efficiencyHigh cost due to expensive heliostat fieldHigh temperature HTF possible	<ul style="list-style-type: none">Lower efficiency than best solar tower due to added mirrorsLower storage cost	<ul style="list-style-type: none">High engine efficiencyHigh cost due to expensive engines (one for each dish)
Maturity	Most mature	Few installations	Commercial deployments	Early development	Proposed Installation

Source: MIT

Falling costs favor adoption of solar energy; Though CSP appears costlier than PV, CSP scores in terms of higher capacity factor and its capability to store energy

Global weighted-average of total installed costs, capacity factors and levelised cost of electricity (LCOE) for Solar PV and CSP (2011-2020)



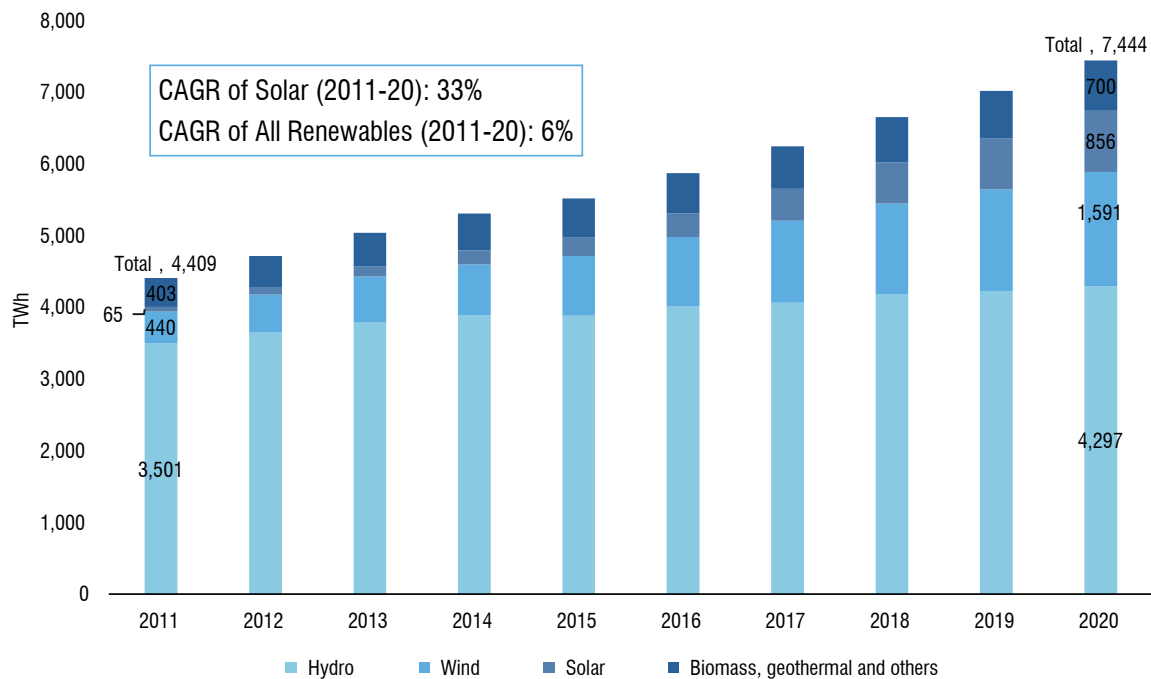
Source: IRENA; Note: Capacity factor, an indicator of reliability, measures how often a plant is running at maximum power. LCOE refers to the full life-cycle costs of a power generating technology per unit of electricity

Renewable Energy Trends – Global



Globally, energy generation from renewables has seen healthy growth in the last decade; Solar has outpaced other sources in its rate of growth.

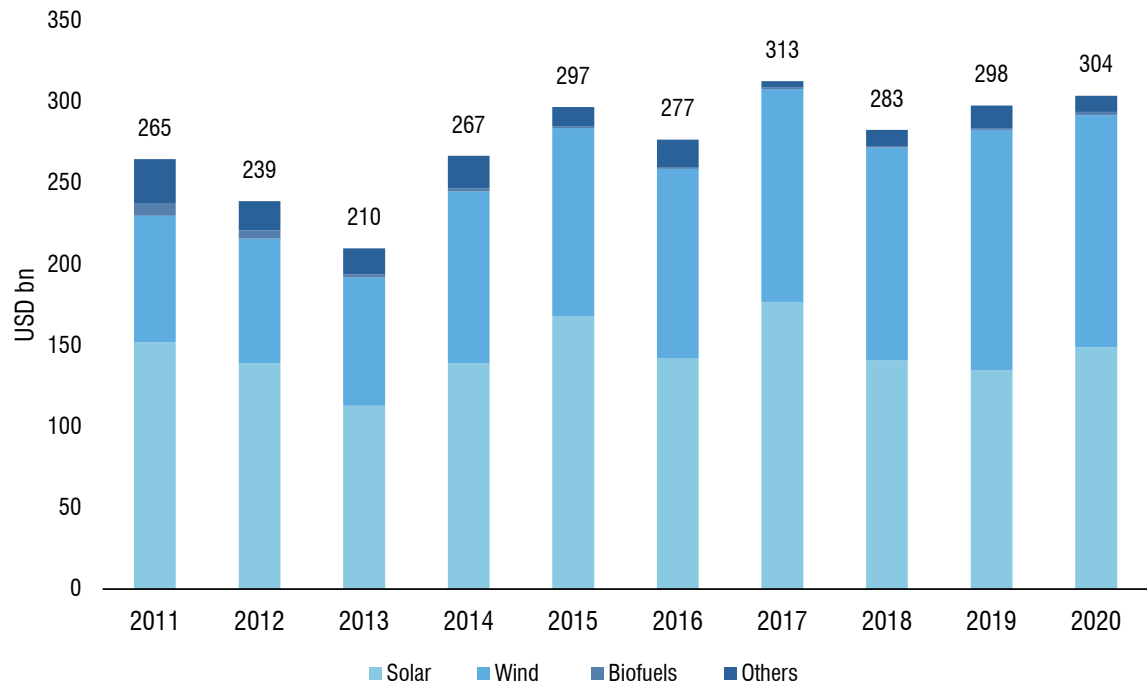
Global Renewable Energy Generation by Source (2011-2020)



Source: Our World in Data

Globally, investments in renewable energy have remained healthy in recent years

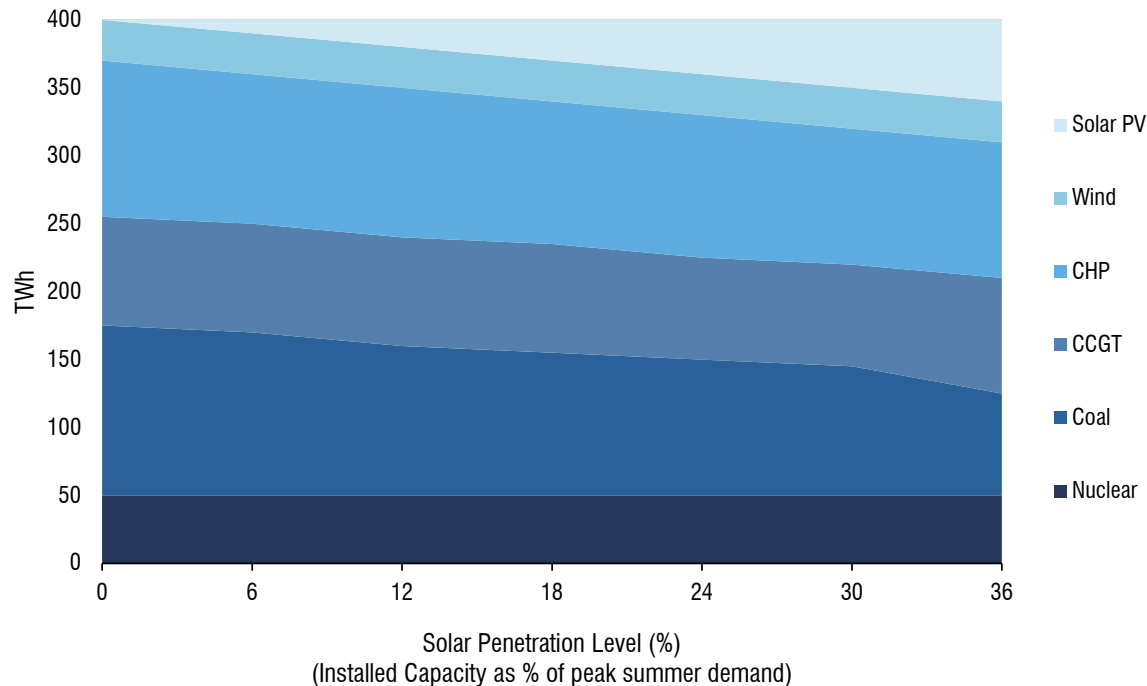
Global New Investments in Renewable Energy



Source: Bloomberg NEF

Higher penetration of solar energy results in steeper fall in usage of coal

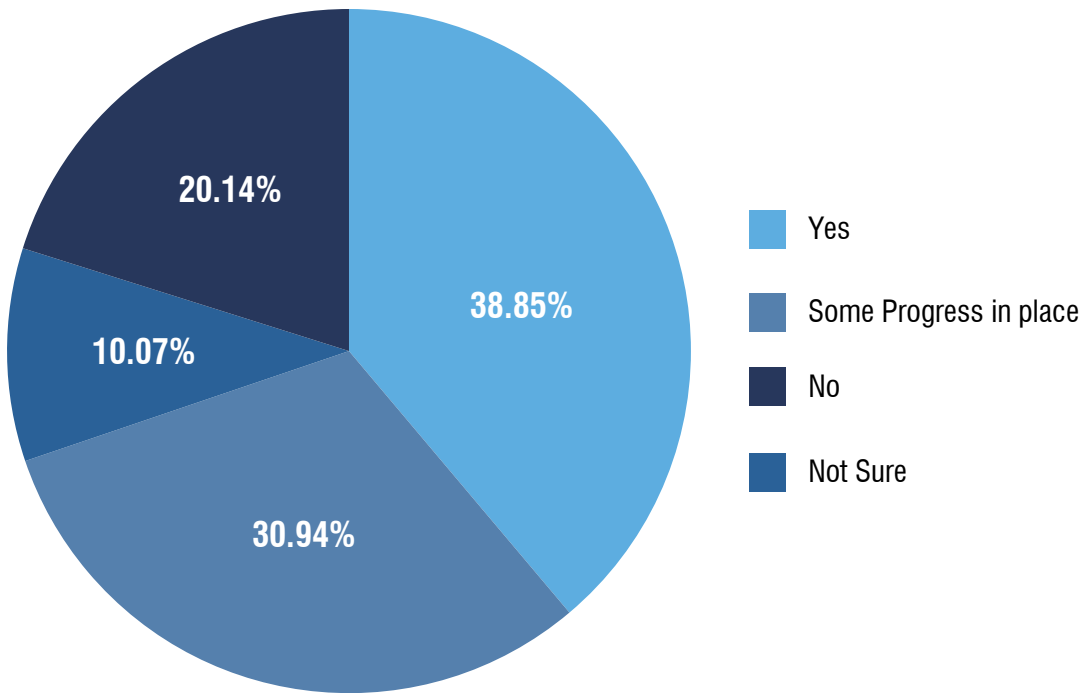
Effect of change in Installed Solar PV Capacity on Annual Electricity Production



Source: MIT; Note: CCGT- Combined cycle gas turbine, CHP - Combined heat and power, Solar PV – Solar Photovoltaics; Solar penetration level refers to installed capacity of solar power generation (solar PV in this case). It is represented as a percentage of peak demand. At higher levels of installed capacity of solar PV, the drop in electricity generation from coal is steeper than other sources.

Governments worldwide are favouring solar energy adoption

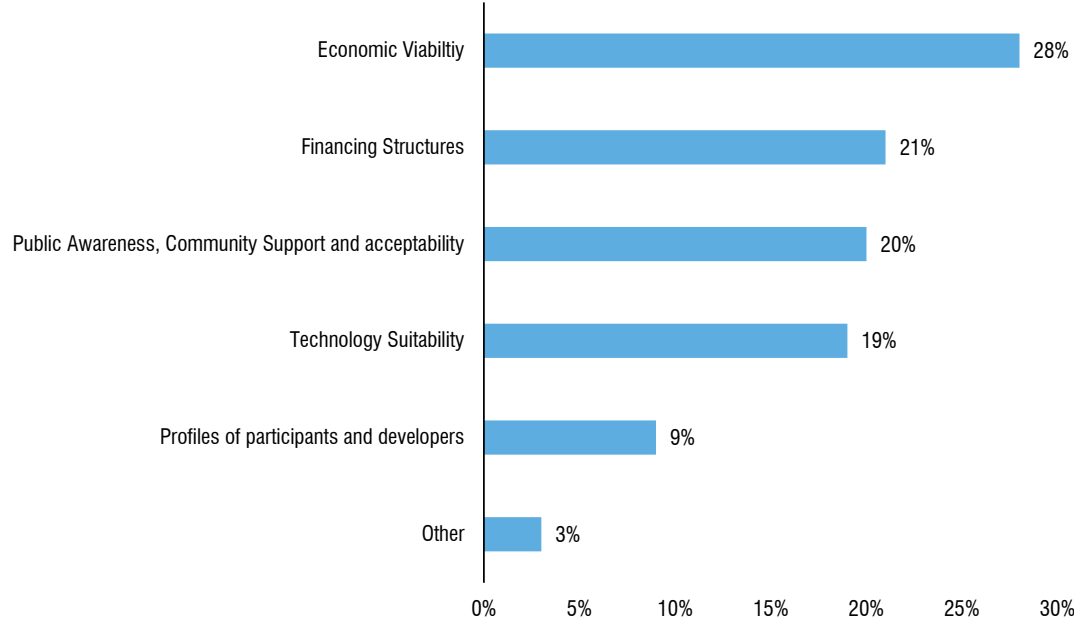
Distribution of response of industry experts from around the world on presence of solar energy strategy in their country



Source: Deloitte Survey; The survey participants were executives across the world whose primary industry was oil and gas production, solar generation, banking, asset management or professional services.

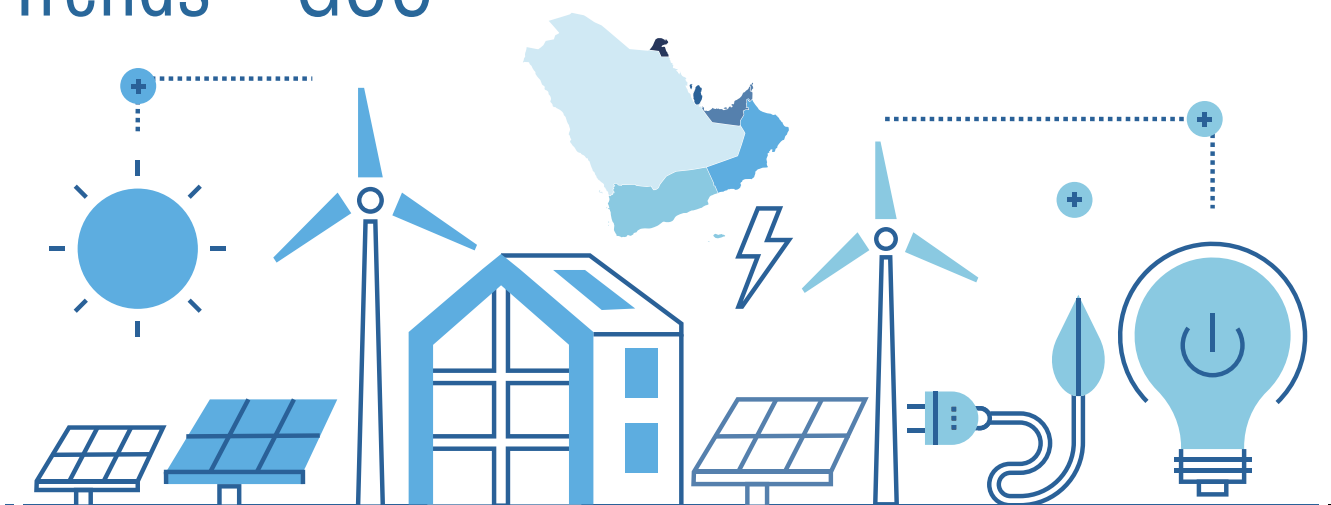
Economic viability and financing structures are important to solar projects' growth

Distribution of survey responses on factors influencing growth of solar projects



Source: Deloitte Survey

Renewable Energy Trends – GCC



UAE and Saudi Arabia are leading renewable energy capacity expansion in GCC

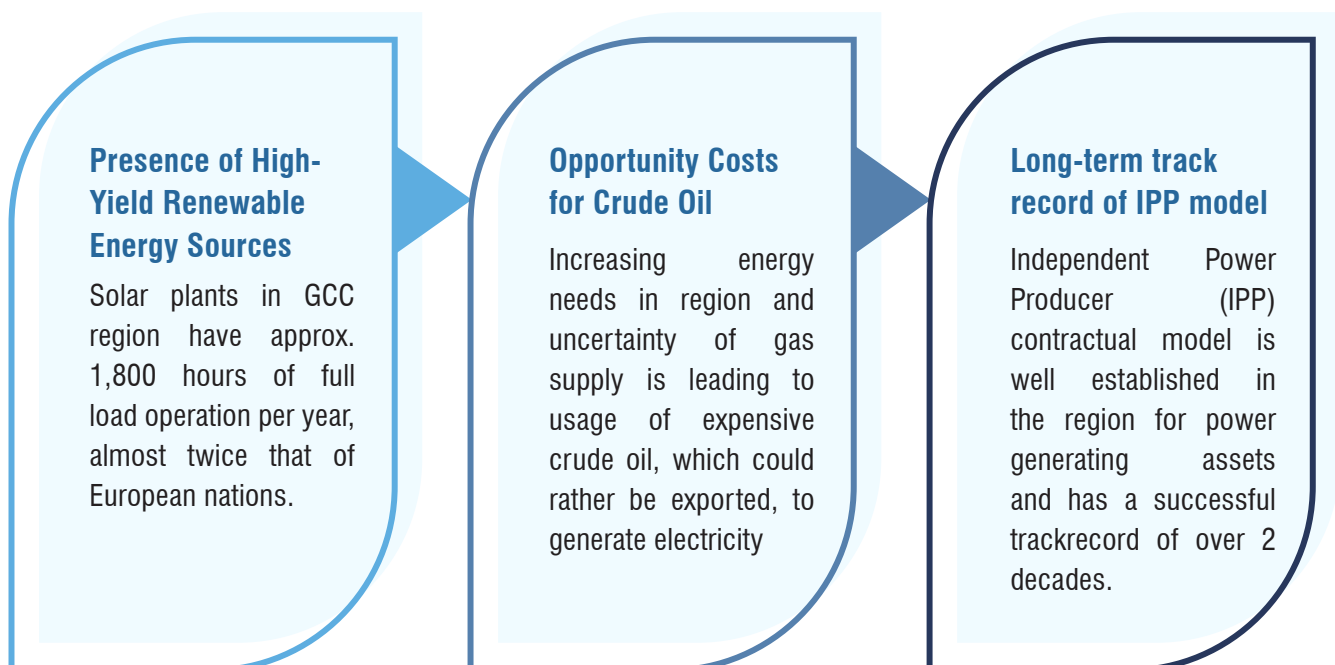
Renewable Energy (RE) Capacity and Targets in GCC countries (MW)

Country	2020					2019				Share of RE in electricity generation		
	Solar PV	Solar CSP	Wind	Bio Energy	Total RE	Total RE	2020	Targeted Share	Target Year	2020	Targeted Share	Target Year
Saudi Arabia	359	50	3	0	412	412	87	37	24	0.30%	50%	2030
UAE	2,439	100	0	1	2,540	1,919	599	356	142	4.02%	44%	2050
Oman	109	0	50	0	159	59	8	8	2	0.53%	30%	2030
Qatar	5	0	0	38	43	43	43	43	43	0.24%	20%	2030
Kuwait	43	50	12	0	106	106	55	44	33	0.23%	15%	2030
Bahrain	10	0	1	0	10	10	7	7	7	0.03%	10%	2035

Source: IRENA, ArabNews, BP, Our World in Data; Note: Solar PV – Photovoltaics, CSP – Concentrated Solar Power. Bahrain's RE share as of electricity generation as of 2019. Total RE values may not match the sum of individual values due to rounding off

GCC Countries hold great potential for Renewable Energy

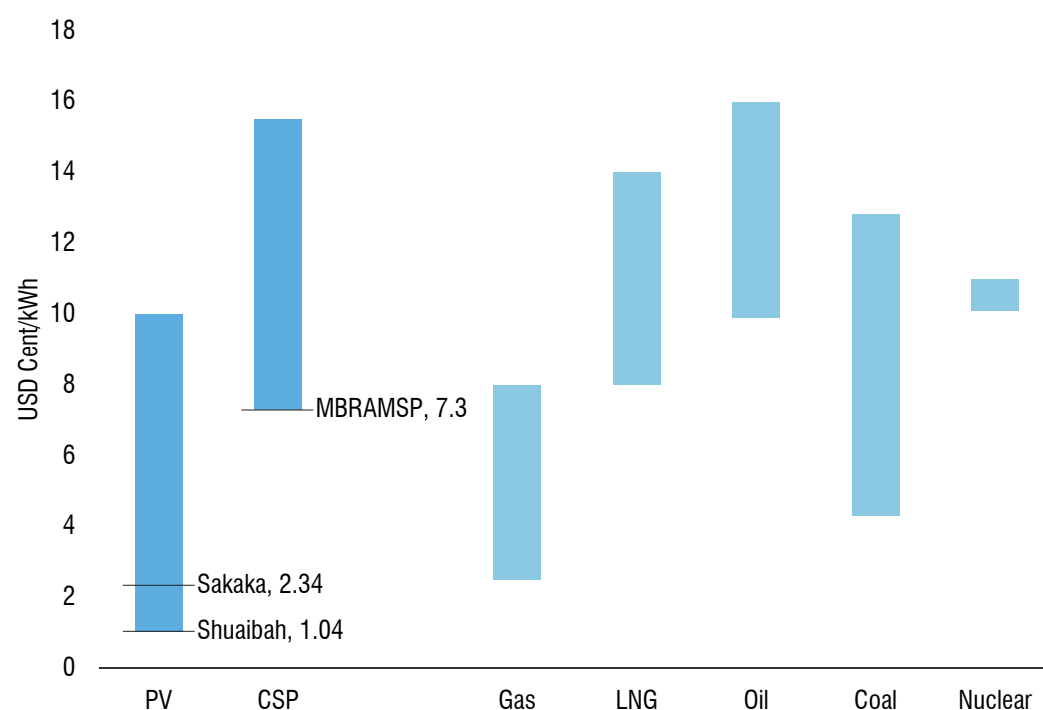
Factors driving shift towards renewable energy in GCC



Source: Strategy&

Prices for utility scale solar projects in GCC are among the lowest in the world and the cost keeps coming down.

Price of utility-scale electricity generation technologies in the GCC



Sources: IRENA, Derived from Mills, 2018; Channell et al., 2015; Manaar, 2014; Scribblar, 2015.

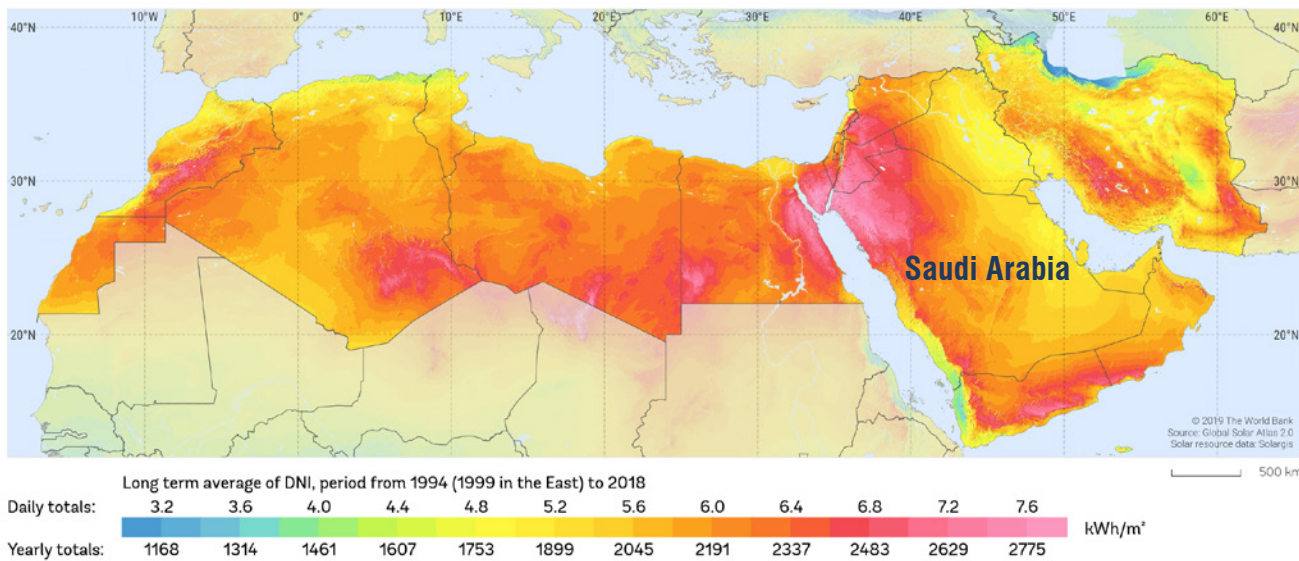
Note: Solar PV - Low price = 600 MW Shuaibh solar PV; CSP - Low price = 700 MW MBRAMSP IVb in Dubai and High price = Morocco's Noor II; Coal - Low price = Hassyan Clean Coal Power Plant; other values are estimates

Solar Energy in Saudi Arabia



Higher level of direct normal irradiation in Saudi Arabia makes it suitable for solar power generation in general and usage of CSP technology in particular

Potential for solar energy generation in Saudi Arabia



Source: Global Solar Atlas

Saudi Arabia is accelerating solar power generation with Shuaibah Project, setting record for lowest PV tariff in the world

Key Solar Projects in Saudi Arabia

Authority	Phase	Project/ Site Name	Technology	Size (MW)	Price (cents/kWh)	Status
 الشركة السعودية للكهرباء Saudi Electricity Company		Waad Al-Shamal	CSP	50	N.A	Completed in 2018
	Phase 1	Sakaka	Solar PV	300	2.34	Completed in 2019
		Sudair	Solar PV	1,500	1.24	Under Construction
		Jeddah	Solar PV	300	1.62	
		Shuaibah	Solar PV	600	1.04	Contract Awarded
	Phase 2	Rabigh	Solar PV	400	1.70	
		Qurrayat	Solar PV	200	1.78	
		Madinah	Solar PV	70	1.94	
		Rafha	Solar PV	20	3.49	
	Phase 3	Ar Rass	Solar PV	700	N.A	Bids received
 رؤية 2030 البرنامج الوطني للطاقة المتجددة National Renewable Energy Program		Saad	Solar PV	300	N.A	
		Wadi Ad Dawasir	Solar PV	120	N.A	
		Layla	Solar PV	80	N.A	

Source: IRENA, National Renewable Energy Program (NREP), SPA, Energy Utilities; Note: SEC - Saudi Electricity Company; REPDO - Renewable & Project Development Office; As of 02 Aug 2021

Increasing demand and policy support augurs well for solar energy sector in Saudi Arabia

Solar Energy Sector in Saudi Arabia

Governance

-  Ministry of Energy
-  Ministry of Industry and Mineral Resources
-  Renewable Energy Project Development Office (REPDO)
-  King Abdullah City for Atomic and Renewable Energy
-  Saudi Energy Efficiency Centre

Key Investors

-  Taqlia Energy
-  Public Investment Fund (PIF)

Research

-  King Abdullah City for Science and Technology
-  King Abdullah University of Science and Technology
-  King Saud University
-  King Fahd University of Petroleum and Minerals

Growth Drivers

- Rising domestic oil consumption
- Young citizens' entry into job market
- Reduced solar panel production costs
- Increasing demand for energy sources to deliver strategic infrastructure projects
- Government and policy support
- Strong industrial base such as oil and gas and petrochemicals
- Access to government specialized funds

Challenges

- Uncertainty of large projects
- Solar prices competitiveness
- High capital expenditure
- Large installation area

Opportunities

- Easy availability of finance
- Significant investment in value chain
- Presence of key players
- Feed-in-tariff

Localizing renewable energy value chain through accommodative regulation and collaboration with private sector

Saudi Arabia's Key initiatives in Solar and Renewable Energy

Government Initiatives and Regulatory Development

- Renewable Energy Project Development Office established to oversee the country's renewables program
- The Electricity and Cogeneration Regulatory Authority set out framework for the connection of Small Scale Solar PV Systems to the Distribution System
- Neom City to be completely run on renewable energy

Regulatory Incentives

- 100% FDI in renewables
- Custom duty exemption on import of primary raw materials, manufacturing equipment and spare parts
- Land incentives with subsidised leases for projects

Public-Private Partnership

- MoU between Saudi Arabia's Crown Prince and SoftBank to establish world's largest Solar PV project by 2023
- National Industrial Clusters Development Program and SABIC partner to develop a US\$ 2 bn solar and carbon black integrated complex
- King Abdullah City for Atomic and Renewable Energy partners with Saudi Technical Institute for training and development in renewable energy
- Saudi Standards, Quality and Metrology Organization (SASO) MoU with Saudi Aramco and SEC to collaborate on energy efficiency and rationalization program

Source: Deloitte, ICLG

Key players in Saudi Arabia are actively contributing to the sector's growth

Private sector players and their initiatives

Company Name	Notable Initiatives
 ACWA Power	<ul style="list-style-type: none"> Set global benchmark with a renewable energy portfolio exceeding 1 GW comprising 10 projects across four countries
 AEC-KACO	<ul style="list-style-type: none"> Introduced the country's first PV inverter line in September 2015 with production capacity of 2,000 units or 1 GW per year
 Al-Afandi Group	<ul style="list-style-type: none"> Plans to build a solar panel factory covering 55,000 sq.m. that is set become the largest facility in the Middle East, with an initial production capacity of 120 MW per year
 Desert Technologies	<ul style="list-style-type: none"> Acquired a 75 MW crystalline silicon assembly line and a 20MW amorphous silicon manufacturing line in 2014 and installed them at its headquarters in Jeddah
 King Abdulaziz City for Science and Technology (KACST)	<ul style="list-style-type: none"> Built the first PV module assembly line in the country in 2010. Its Current annual capacity has reached 100 MW. Localised 40% of PV module raw materials in Saudi Arabia
 Saudi Electricity Company	<ul style="list-style-type: none"> Invited expressions of interest for two 50 MW solar IPP projects to be located in Al-Jouf and Rafha north of the kingdom. It is collaborating with KACST and Taqnia Energy to build the 50 MW Layla PV plant in the city of Aflaj.
 Taqnia Energy	<ul style="list-style-type: none"> Founded in 2014 to develop and invest in bankable, technology focused energy business opportunities. Building a PV manufacturing facility in Taif using polycrystalline technology and plans to reach an annual production capacity of 500 MW.

Source: RVC



Overview of Solencorp

Solencorp is involved in harnessing solar energy through concentrated solar power technology (CSP) using solar power tower. Solencorp uses particle heat receiver (PHR), wherein solid particles are used as a heat transfer medium, instead of the molten salts or pressurized steam that are conventionally used in CSP. The Company operates as an advisor and brokerage of this technology.

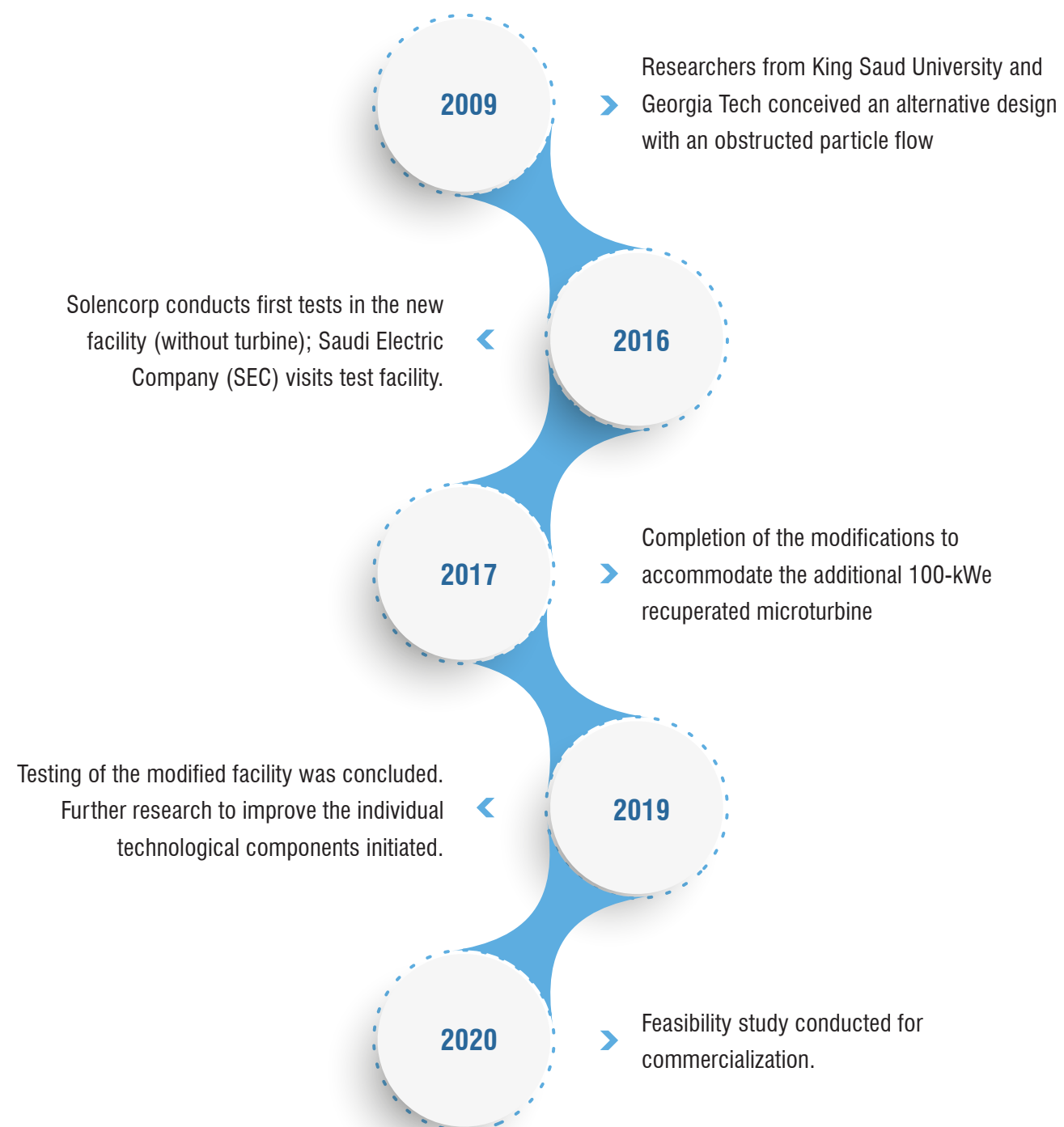
Project Location: King Saud University

Founded in - 2009

Key Highlights

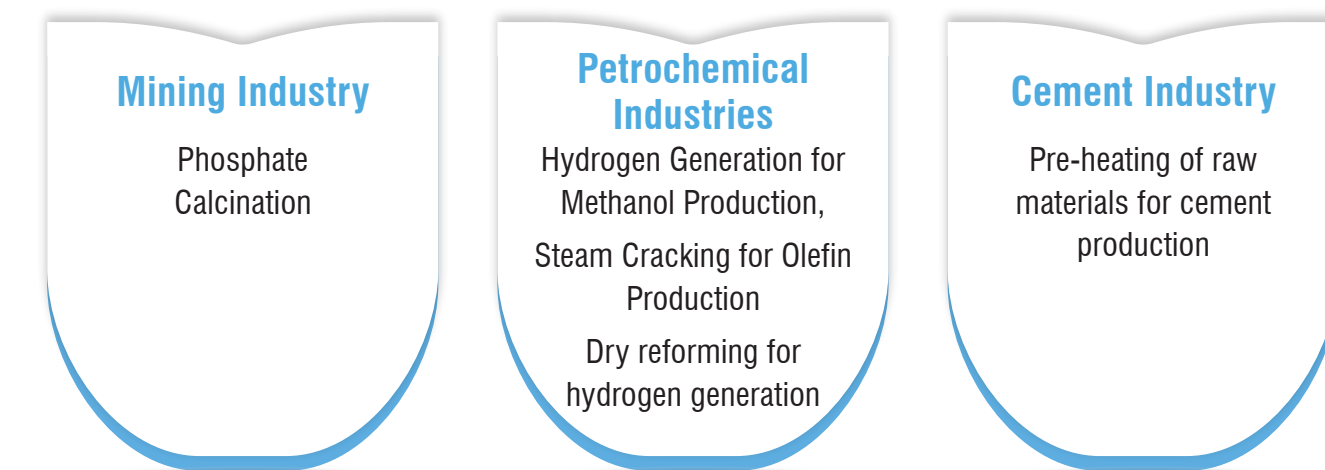
- Solencorp, initiated as project in King Saud University, aims to become the first commercial company for PHR technology in solar applications
- The company has conducted an intensive R&D for more than 10 years and expects proof of concept to be completed by 2024, followed by potential commercialization.
- Saudi Arabia's target to install around 3GW of solar CSP by 2030 and localization of the value chain presents a potential opportunity for Solencorp to grow.

Solencorp's PHR timeline and Key Milestones



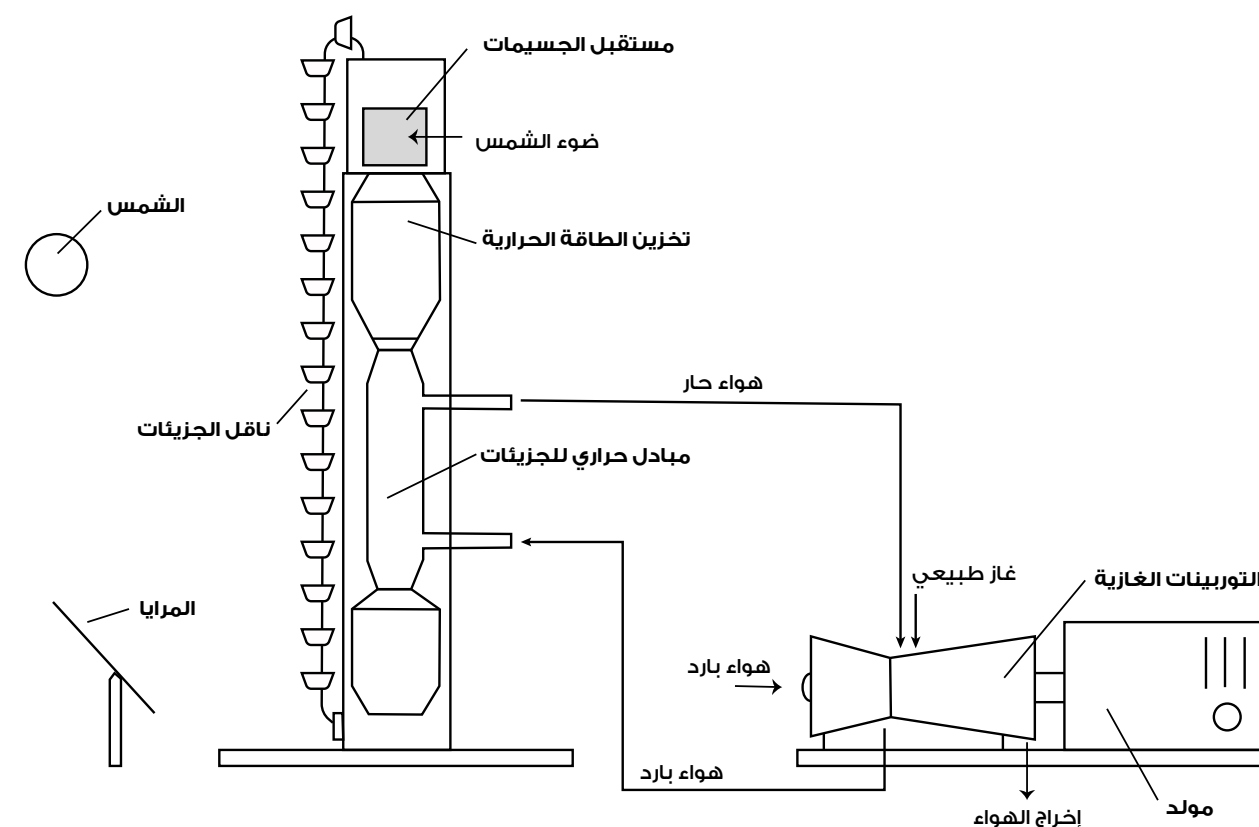
Source: Solencorp

Use cases for Solencorp's Output



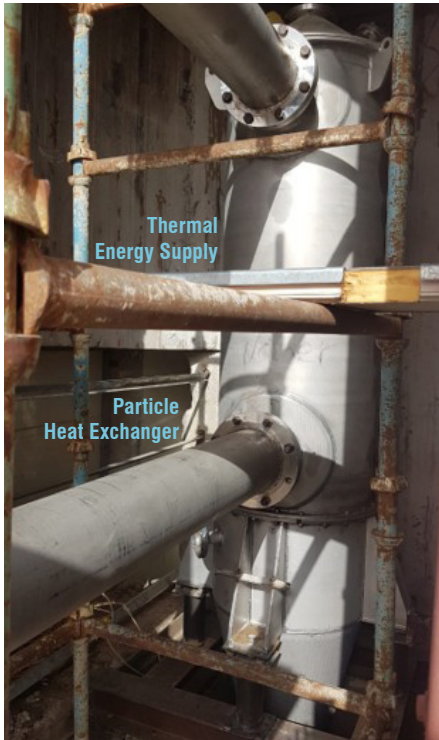
Source: Solencorp

Solencorp's CSP Particle Heat Receiver (PHR) System Design



Source: Solencorp

Solencorp's Current Technology and Testing Facility



Source: Solencorp

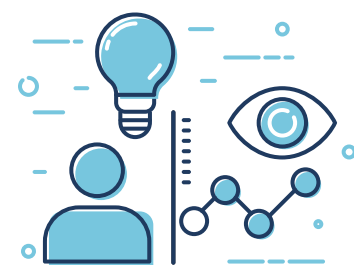




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Riyadh Valley Company

Riyadh Valley Company established in 2010 by Royal Decree No.116 dated 13/4/1431 AH to be the investment arm of King Saud University in the fields of Knowledge Economy and the university strategic projects.



Vision

To be the regional leader in knowledge-based investment and technology.



Mission

Riyadh Valley Company is a strategic investor, focused on leveraging the local capabilities, investing locally and globally in growth - stage businesses to create financial and strategic returns that will support the future of economic development in the Kingdom.

Investment Sectors:



Knowledge Investments



Healthcare investment



Renewable energy & sustainable resources



Information & Communication technology



Real Estate Investments



Innovation and R&D Projects



Educational Projects



Healthcare Projects



Commercial Projects

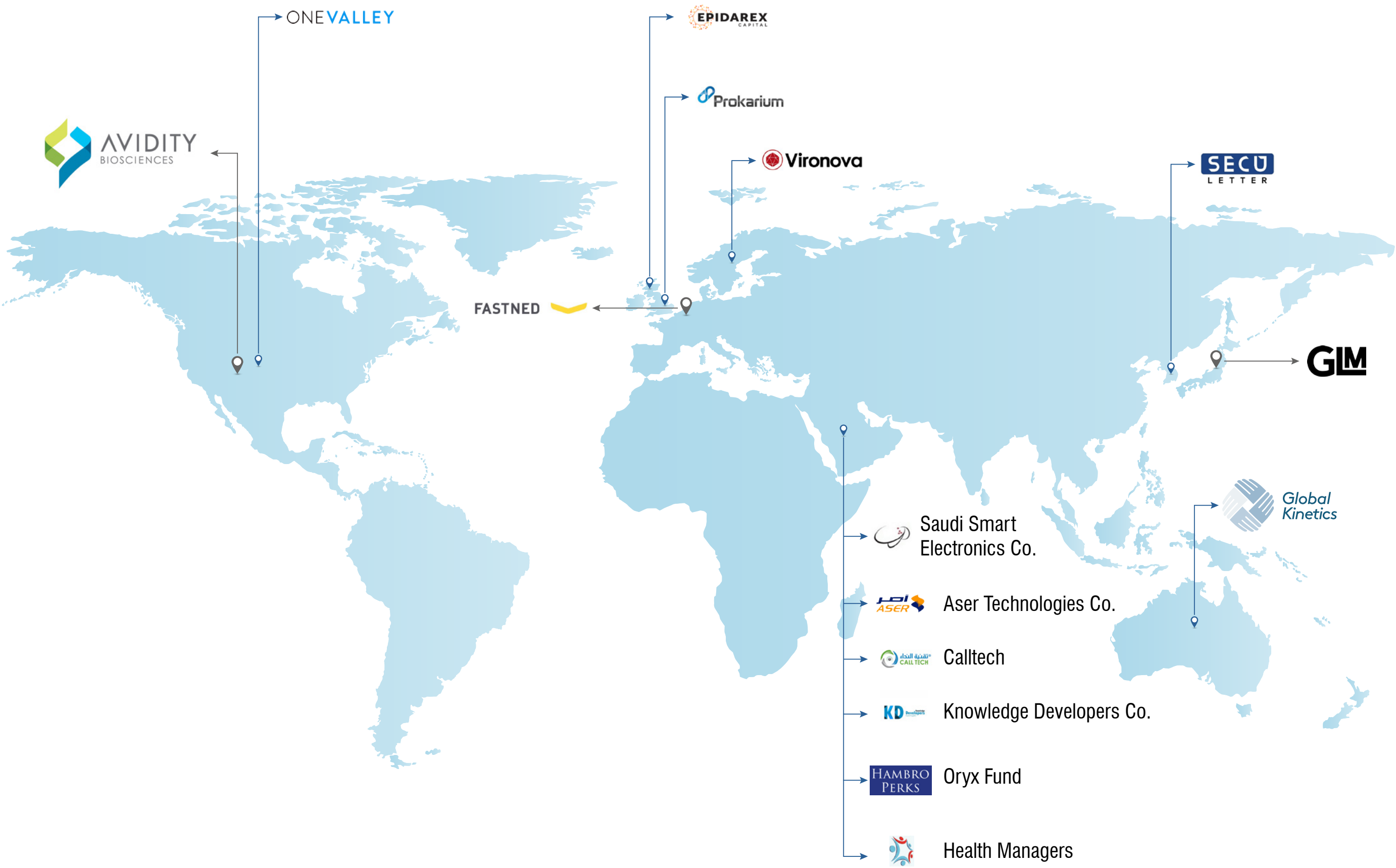


Residential Projects



Mixed-use Projects

Knowledge Investment Portfolio



Real Estates Investment portfolio



Sudair Pharma Company Project

Research center and company offices for Sudair Pharma Company



ELM Information Security Company Project

Innovation Center project for Elm information security company



Four Directions Company Project

Commercial and office project contains office buildings and multi-use halls



Retail Real Estate Company Project

Social-Entertaining and sports project



Derma Clinic Company Project (Residential)

Residential project for Derma Medical Clinics



City Lights Real Estate Company Project

Entertainment-Commercial project contains screens on the building and architectural blocks, in addition to areas for live shows



NMR Real Estate Company Project

Mixed-use project includes a hotel, restaurants and cafes



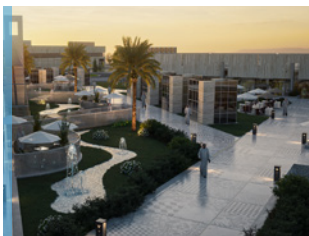
Al-soroo Al-Mubarakah Company Project

Mixed-use project contains office complex, Mall, Restaurants, cafes, and walkway for visitors



Obeikan Company Project

Commercial project contains various stores near the Common First Year building



Four Directions Company Project

Residential & commercial project



Derma Clinic Company Project

Medical-Commercial project contains several medical clinics, medical products stores, and pharmacies



Dur Alkuttab Company Project

Educational project for Primary Schools



Arrowad For Higher Education Company Project

Educational complex, Arrowad colleges University campus in Riyadh



Omnia Real Estate Development Company Project

Commercial project contains various shops



Unified Real Estate Development Project

Cultural-Entertainment project that includes Luxury restaurants, Cafes, Cinemas and green spaces



University Boulevard

Commercial-Entertainment project gives visitors a different experience, and it includes Restaurants and cafes



Sahat Al-Ardh Company Project

A commercial project contains various shops



Majd Real Estate Project

Office-space project



Riyadh Valley Company

Kingdom of Saudi Arabia, Riyadh – King Saud University, Innovation Tower

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Riyadh Valley Company (RVC)