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Saudi Arabia Renewable Energy Industry Outlook

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1. EXECUTIVE SUMMARY

1.1. INITIATIVES TO PROMOTE RENEWABLE ENERGY

One of the key goals of Vision 2030 is to develop Saudi Arabia's solar energy sector. Saudi Arabia started the National Renewable Energy Program (NREP) in February 2017, which is overseen by the newly established Renewable Energy Project Development Office (REPDO). Power consumption in Saudi Arabia is increasing at an annual rate of 8 percent, causing Saudi Electricity—the Gulf's largest utility provider—to invest billions of dollars in capacity expansion projects. The country's solar power business is booming, owing to rising electricity consumption.

- According to REPDO, 12 projects are in progress in Saudi Arabia since January 2019—the largest of them is a project with 600 MW capacity.¹
- REPDO's first bidding round, which was announced in 2017, included the 300 MW Sakaka solar Independent Power Producer (IPP) and 400 MW Dumat AI Jandal wind farm.²

1.2. FUTURE OUTLOOK

In 2018, Saudi Arabia's Public Investment Fund (PIF) and Softbank announced a 12-year strategic plan to build between 150 GW-200 GW of solar energy by 2030.³ The investment in renewable and sustainable energy in Saudi Arabia and other Gulf Cooperation Council (GCC) countries can provide reserves worth US\$87 billion and eliminate CO₂ emissions by 1 gigaton (GT). King Abdullah City for Atomic and Renewable Energy (K.A.CARE) is overseeing the adoption of atomic, renewable, and sustainable energy in a bid to ensure that 50 percent of the total consumed electricity comes from non-fossil fuels by 2032. The rise of the renewable and sustainable energy industry in Saudi Arabia has had an impact on job possibilities, services, and training. By 2030, the number of jobs supported by the global renewable and sustainable energy industry is predicted to greatly increase, with an estimated 80,000 jobs in Saudi Arabia alone.⁴

 $[\]label{eq:linear} {}^{1} \ https://www2.deloitte.com/content/dam/Deloitte/xe/Documents/financial-services/Deloitte-solar-energy-report.pdf.$

² https://oxfordbusinessgroup.com/analysis/solar-powered-diversifying-energy-mix-through-solar-and-wind-projects.

³ https://www.pif.gov.sa/en/MediaCenter/Pages/NewsDetails.aspx?NewsID=38.

⁴ https://repository.psau.edu.sa/jspui/retrieve/c9b7b907-a0a0-4a10-9cec-

²⁵⁰⁸¹⁴⁷⁹debd/Renewable%20and%20sustainable%20energy%20production%20in%20Saudi%20Arabia%20according%20to%20Sau di%20Vision%202030%3B%20Current%20status%20and%20future%20prospects.pdf.



2. INTRODUCTION TO RENEWABLE ENERGY SECTOR

2.1. OVERVIEW AND KEY INDUSTRY TRENDS

Saudi Arabia's total electricity generation capacity has grown since 2000 owing to an increase in electricity generated from renewable sources. The country's renewable sector is growing mostly because of its policies, such as the differentiated feed-in tariff (FiT) scheme, which has had a significant impact on the sector's development.

Saudi Arabia has increased its usage of renewable energy in recent years, with a focus on wind and solar power. It has one of the largest renewable energy production capacities in the GCC, accounting for 19 percent and 18 percent, respectively, of total GCC wind and solar production. With a bold goal to deploy more renewable energy, it has successfully bid on large-scale wind and solar energy projects.



FIGURE 1. KEY INDUSTRY TRENDS

Source: Gulf Research Center Analysis, 2021.



Recently, the renewable energy industry in Saudi Arabia has been witness to some major trends including large amounts of investment in projects, increased participation of private sector players, and a growing recognition of the importance of green energy.

2.2. SAUDI ARABIA RENEWABLE ENERGY: MARKET SIZE AND FORECAST (2019–2028)

FIGURE 2. SAUDI ARABIA RENEWABLE ENERGY: MARKET SIZE AND FORECAST, 2019–2028 (US\$ MILLION)



Source: Gulf Research Center Analysis, 2021.

The Saudi renewable energy market is projected to reach US\$2,053.8 million by 2028 from US\$196.8 million in 2019. Growing population, rising demand for electricity, and increasing investments in solar and wind projects are among the major factors used in the estimation of the market size.



2.3. COVID-19 IMPACT ON THE SAUDI RENEWABLE ENERGY SECTOR

Energy consumption across the world has been directly impacted by the COVID-19 pandemic. According to recent data from the International Energy Agency (IEA), global energy consumption fell by 3.8 percent in the first quarter of 2020. This was visible across a variety of energy sources. According to the data, the consumption of coal dropped by 8 percent from 2019, while that of oil dropped by roughly 5 percent. On the contrary, renewable energy sources were adopted more than other sources.

During the pandemic, REPDO announced the launch of the third cycle of the Kingdom's National Renewable Energy Program in April 2020 and received offers from firms qualified to build four solar PV projects with a total capacity of 1,200 MW. Thus, the pandemic has had a minor impact on Saudi Arabia's renewable energy sector.⁵

⁵ https://kfcris.com/pdf/5440c4e76de30c54bb5d2ae4ab214bd460226cb6c94e0.pdf.



3. RENEWABLE ENERGY SECTOR

3.1. COMPONENTS OF RENEWABLE ENERGY INDUSTRY

FIGURE 3. COMPONENTS OF RENEWABLE ENERGY INDUSTRY



Source: Gulf Research Center Analysis, 2021.



3.2. ECONOMIC CONTRIBUTION

Saudi Arabia has planned to become carbon neutral by 2030, with renewable energy accounting for 50 percent of its total electricity generation.⁶ In 2016, the government stated that it aims to attract investments of US\$30–50 billion in renewable energy by 2023, including investments from the private sector.⁷





Note: Annual Fuel Savings are shown in Billion Barrels of Oil Equivalent (BBOE) Source: IRENA 2016.⁸

 $[\]label{eq:constraint} ^{6} https://www.rechargenews.com/energy-transition/we-will-be-pioneering-saudi-arabia-reveals-50-renewables-goal-by-2030-but-is-that-realistic-/2-1-954094.$

⁷ https://www2.deloitte.com/content/dam/Deloitte/xe/Documents/financial-services/Deloitte-solar-energy-report.pdf.

⁸ https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA_Market_GCC_2016.pdf.



If the renewable energy plans for the power sector in the GCC region are achieved, then 2.5 billion barrels of oil equivalent might be saved during the 2015–2030 period. In 2030, Saudi Arabia, the region's largest consumer of fossil fuels for electricity generation, would save roughly 170 million barrels of oil equivalent (MBOE), accounting for about 44 percent of the GCC's total 2030 savings.

3.2.1. Government Initiatives and Programs

- The Saudi Technical Institute for Electricity Services in Riyadh and K.A.CARE signed a memorandum of understanding (MoU) and collaboration in January 2019. The agreement calls for training and development in the field of renewable energy, taking advantage of both sides' current resources and knowledge.⁹
- The Saudi Crown Prince Mohammed bin Salman and SoftBank founder Masayoshi Son have signed an MoU to build the world's largest solar photovoltaic (PV) energy plant by 2030.¹⁰
- Between 2018 and 2023, Saudi Arabia plans to invest US\$50 billion in renewable energy, with a target of 27.3 GW of installed capacity, increasing to 58.7 GW by 2030, of which 40 GW will come from solar PV and 2.7 GW from concentrated solar power (CSP).¹¹
- The Saudi Industrial Development Fund (SIDF) announced the Mutjadeda program in September 2019, with a budget of SAR105 billion (US\$28 billion) to encourage local enterprises interested in manufacturing and investing in the renewable energy sector. The SIDF will provide loans of up to SAR1.2 billion (US\$319.9 million) to support component manufacturers or participation in independent power producer schemes as part of the initiative.¹²
- The Paris Agreement was adopted by Saudi Arabia in November 2016, and its Intended Nationally Determined Contribution became its nationally determined contributions. By 2030, the goal was to prevent up to 130 million tonnes of carbon dioxide (CO2) equivalent emissions.
- On January 31, 2005, the Kingdom of Saudi Arabia accepted the Kyoto Protocol. The main goal was to reduce greenhouse gas emissions in the atmosphere.

 $[\]label{eq:starses} {\sc starses} {\sc star$

 $^{^{10}\} https://www2.deloitte.com/content/dam/Deloitte/xe/Documents/financial-services/Deloitte-solar-energy-report.pdf.$

¹¹ https://oxfordbusinessgroup.com/analysis/solar-powered-diversifying-energy-mix-through-solar-and-wind-projects.

¹² https://oxfordbusinessgroup.com/analysis/solar-powered-diversifying-energy-mix-through-solar-and-wind-projects.



MAJOR INVESTMENTS 3.3.

TABLE 1. MAJOR INVESTMENT IN RENEWABLE PROJECTS

Project Name	Location	Cost (US\$ Billion)	Expected Date of Completion	
NEOM	Northwest of Saudi Arabia	500	2025	
The Renewable Energy Project	Multiple Locations	200	2030	
King Salman Energy Park	Between Dammam and Al Ahsa	1.6	2021	

Note: Journal of Cleaner Production 2020.13

¹³ https://repository.psau.edu.sa/jspui/retrieve/c9b7b907-a0a0-4a10-9cec-25081479debd/Renewable%20and%20sustainable%20energy%20production%20in%20Saudi%20Arabia%20according%20to%20Sau di%20Vision%202030%3B%20Current%20status%20and%20future%20prospects.pdf.



4. RENEWABLE ENERGY INDUSTRY DYNAMICS

4.1. SNAPSHOT OF RENEWABLE ENERGY INDUSTRY DYNAMICS

FIGURE 5. SNAPSHOT OF RENEWABLE ENERGY INDUSTRY DYNAMICS



Source: Gulf Research Center Analysis.

4.2. KEY INDUSTRY DRIVERS

• Increasing Government Initiatives to Promote Green Energy

Saudi Arabia understands the value of a diverse energy mix in ensuring its long-term economic development. As a result, the Ministry of Energy has committed to extend its energy leadership through the deployment of renewable energy to satisfy the rising electricity demand. The National Renewable Energy Program (NREP) is a strategic initiative launched by the country under Vision 2030 and the King Salman Renewable Energy Endeavor. The initiative attempts to maximize Saudi Arabia's renewable energy potential. In light of the goals set forth in Vision 2030, which include establishing the renewable energy industry and supporting its advancement while working to meet the Kingdom's commitments to reduce carbon emissions, the program lays out an organized and specific road map to diversify local energy sources, stimulate economic development, and provide sustainable economic stability to Saudi Arabia.



FIGURE 6. TOP TECHNICAL BIDS FOR 300 MW SAKAKA PV PROJECT



Top 8 Technical Bids for 300 MW Sakaka PV Project

Source: Solar Media Limited, 2021.14

• Net-Metering Regulations

Net-metering is a strategy that encourages private investment in renewable energy by allowing consumers to pay for what they use. The Energy and Cogeneration Authority created a regulatory framework in 2018 that allows electricity consumers to run small-scale solar power (less than 2 MW) producing equipment and export unused power to the national grid, balancing their own usage. As a result, a substantial financial incentive is created, and private sector investment in small-scale renewable energy applications is accelerated.

This went into effect in July 2018, and only pre-qualified, registered installers were allowed to complete the task. Furthermore, the Energy and Cogeneration Regulatory Authority (ECRA) has announced a threefold rise in electricity tariffs.

Most residential users will now pay 18 ha/kWh, compared to 5 or 10 ha/kWh previously. Users will see an increase in their monthly power bill because of this. The increasing tariffs will also strengthen the economic case for renewable energy projects – instead of a payback period of 10–15 years, small-scale solar PV deployments will now have a payback period of 5–7 years, which is appealing, given the

¹⁴ https://www.pv-tech.org/technical-bids-for-300mw-of-solar-in-saudi-arabia-already-breach-2-cents/.



system's 25-year lifespan. Furthermore, a time-of-use tariff might be used as a policy incentive, with greater tariffs.

4.3. KEY INDUSTRY CHALLENGES

• Concerns Regarding High Installation Cost

Investment in renewable energy has encountered several obstacles across Saudi Arabia, including financial and technological issues, as well as tiny market share. Renewable energy technologies, maintenance, and training are still excessively expensive when compared to traditional energy sources. As a result, the share of renewable energy in total energy has been very less compared to traditional sources. High temperatures and considerable volumes of dust, which are not suitable for photovoltaic (PV) and concentrated solar power (CSP) technology, are further obstacles to renewable energy investment in Saudi Arabia. High temperatures limit the efficiency of PV systems, while dust affects the output level of reflectors, especially in CSP systems. On the other hand, the installation of cooling and washing systems might alleviate these issues. Thus, renewable energy production confronts several obstacles, including technological concerns, high initial project costs, low efficiency.

4.4. KEY INDUSTRY OPPORTUNITIES

• Incorporation of New Energy-Generating Technologies

Solar energy is one of the government-managed renewable energy technologies (such as Photovoltaic [PV], Concentrated Solar Power [CSP], and wind energy). Saudi research concentrates on these technologies because they appear to be more suited to the country's climate and location. Solar photovoltaic (PV) technology is the most widely used technology for generating renewable energy because it is extremely efficient and simple to install. CSP technology is great for producing power in cities on a big scale. CSP technology might be utilized for both desalination and large-scale power generation. Wind energy is also regarded as a low-cost renewable energy source in many parts of the world.



4.5. PORTER'S FIVE FORCE ANALYSIS

FIGURE 7. PORTER'S FIVE FORCE ANALYSIS

Bargaining Power	Bargaining Power	Threat of New	Threat of	Competitive
of Suppliers	of Buyers	Entrants	Substitutes	Rivalry
It is a relatively narrow market with a restricted number of suppliers. As a result, suppliers have modest bargaining power. However, the power is not excessively high since the order value is excessively high.	Buyers have a lot of bargaining leverage since moving to a nonrenewable energy source is inexpensive, and consumers will quickly switch if they locate a cheaper source of energy.	The threat of new entrants is minimal since the cost of generating renewable energy is quite high. For example, the installation of a wind turbine or a solar panel requires heavy investment, which is making the entry of new companies extremely difficult.	As long as alternative renewable energy sources remain cost-effective, the threat of substitutes will remain strong.	The sector has not yet reached the level of competitiveness because it is still relatively young, and companies are still establishing themselves in the business. As a result, competitive rivalry is minimal.

Source: Global Institute for Research & Education, 201415

4.6. POLITICAL, ECONOMIC, SOCIAL, TECHNOLOGICAL, ENVIRONMENTAL AND LEGAL FACTORS ANALYSIS

FIGURE 8. PESTEL ANALYSIS



¹⁵ https://www.longdom.org/articles/an-analysis-of-the-oil-and-gas-industrys-competitiveness-using-porters-five-forces-framework.pdf.



5. CURRENT INDUSTRY LANDSCAPE

5.1. CURRENT RENEWABLE ENERGY INFRASTRUCTURE

NREP is a strategic initiative launched on the direction of His Majesty King Salman Bin Abdulaziz Al Saud as part of Vision 2030 to increase the Kingdom's share of renewable energy production, achieve a balance in the mix of local energy sources, and fulfill the Kingdom's carbon-reduction commitments. The Ministry of Energy is focusing on diversifying the national energy mix utilized in power production through the initiative, with a goal of increasing the use of natural gas and renewable energy sources to ~50 percent by 2030, while minimizing the use of liquid fuel.¹⁶ This is due to the Saudi government's focus on renewable energy production, which subsequently encourages the development of renewable energy infrastructure.

In recent years, several small and large-scale renewable energy projects have been launched, reinforcing the renewable energy sector's infrastructure. In 2018, Saudi Arabia had 142 megawatts (MW) of installed renewable energy capacity, with wind power accounting for 3 MW and PV contributing 139 MW. Saudi Arabia accounted for 20 percent of the GCC's total installed renewable energy capacity. In January 2019, REPDO announced that it would offer contracts for 11 projects totaling 2.2 GW of solar power in 2019, including a 600-MW solar park in Makkah. The Park will be constructed by REPDO and will be part of a bigger 2.6-GW solar complex. PIF and its partners produced the remaining 2 GW directly.¹⁷ Saudi Arabia's Vision 2030 plans to produce 58.7 GW of renewable energy by 2030, of which 40 GW will be produced from solar PV, 16 GW from wind energy, and 2.7 GW from CSP;¹⁸ however, the first target of 27.3 GW is expected to be reached by 2024.

¹⁶ https://www.vision2030.gov.sa/thekingdom/explore/energy/.

¹⁷ https://oxfordbusinessgroup.com/news/plan-turn-saudi-arabia-renewable-energy-leader.

¹⁸ https://iclg.com/practice-areas/renewable-energy-laws-and-regulations/saudi-arabia.



5.2. UPCOMING RENEWABLE ENERGY PROJECTS





Source: National Renewable Energy Program.19

List of Upcoming Renewable Projects

TABLE 2. LIST OF UPCOMING RENEWABLE PROJECTS

Project	Technology Category
Sakaka PV IPP	PV
Sudair PV IPP	PV
The Red Sea Project	PV & Wind
Redstone CSP IPP	CSP – Tower
Neom Helios (Green Hydrogen)	PV & Wind
300 MW Jeddah Solar Plant	PV
Dumat Al-Jandal Wind Farm	Wind
600 MW Shuaibah Project	PV
300 MW Rabigh Project	PV
200 MW Qurayyat Project	PV
50 MW Al Madinah	PV
20 MW Rafha	PV

Note: PV = Photovoltaic.

¹⁹ https://www.ief.org/_resources/files/events/1st-ief-irena-seminar-on-renewable-and-clean-energy-technology-outlooks/faisal-alyemni.p.



6. CURRENT INDUSTRY COMPETITIVE LANDSCAPE

6.1. ACWA POWER

6.1.1. Key Facts

ACWA POWER		
Founded	2004	
Corporate Address	Building 1, Ground Floor, Business Gate Office Complex, Airport Road, P.O. Box 22616 Riyadh-11416, Saudi Arabia	
Telephone	+966 11 2835555	
URL	www.acwapower.com	
Location	Middle East	

6.1.2. Business Description

ACWA Power is a power generating and desalinated water production plant developer, investor, coowner, and operator with operations in ten countries across Middle East and North Africa (MENA), Southern Africa, and Southeast Asia. With an investment value of more than US\$33 billion, ACWA Power's portfolio can generate more than 22 GW of power and 2.5 million m3/day of desalinated water, which will be delivered in bulk to state utilities and industrial giants under long-term off-take contracts under public-private-partnership, concession, and utility services outsourcing models. Its energy portfolio comprises coal pollution mitigation, efficient combined cycle power plants, solar [photovoltaic (PV)] and concentrated solar power (CSP), geothermal, wind, and waste-to-energy (WtE).

6.1.3. Products and Services

Product/Service Category	Description	
Renewable Projects	Wind Energy, Solar Energy, Desalination Plant	



6.1.4. Financial Overview

As ACWA Power is a privately held company, financials are not available in the public domain.

6.1.5. SWOT Analysis



Source: Press Releases, Newsletters, and Company Annual Reports.

6.1.6. Key Developments

Month & Year	Development	Category	Description
April 2021	Sudair Solar PV Project	Project Launch	With a PIF-backed consortium signing a 25-year power purchase deal with the Saudi Power Procurement Company, ACWA Power began the Sudair 1.5 GW Solar PV project.



6.2. ALFANAR GROUP

6.2.1. Key Facts

ALFANAR GROUP	
Founded	1976
Corporate Address	Between Exits 5 & 6, Near King Abdulaziz Center for National Dialogue, P.O. Box 301, Riyadh 11411, Saudi Arabia
Telephone	920 006111
URL	www.alfanar.com
Location	Middle East and Europe
Number of Employees	2,000

6.2.2. Business Description

Electrical construction goods, engineering, procurement, and construction solutions for conventional and renewable power plants, linked engineering services, and design engineering are the main activities of alfanar. The company has a strong international presence in the Middle East, Asia, Africa, and Europe. alfanar has a number of subsidiaries located all over the world, including alfanar Industrial City in Saudi Arabia, Contactum in the UK, ZIV in Spain, SFA Electric in Turkey, Kopp in Germany, EA in Italy, alfanar Electrical Systems in the UAE, and alfanar Engineering Services in India. alfanar's products show the company's commitment to excellent quality, safety, and performance. They are designed and manufactured in modern factories using cutting-edge technologies and techniques and are subjected to stringent quality control throughout the manufacturing process.

6.2.3. Products and Services

Product/Service Category	Description
Project Development	PV, CSP, Wind, Grid Connected Captive, Biomass, Geothermal, Waste to Energy, and Independent Water Producer in the water sector

Source: Press Releases, Newsletters, and Company Annual Reports.

6.2.4. Financial Overview

As alfanar Group is a privately held company, financials are not available in the public domain.



6.2.5. SWOT Analysis



Source: Press Releases, Newsletters, and Company Annual Reports.

6.2.6. Key Developments

Date	Development	Category	Description
2021	alfanar acquired Senvion.	Acquisition	alfanar acquired wind turbine manufacturer Senvion India from Senvion GmbH.



6.3. MASDAR

6.3.1. Key Facts

MASDAR	
Founded	1968
Corporate Address	Khalifa City A, Masdar City, Masdar City Incubator blg 1, 2nd flr, Presidential Flight, Abu Dhabi, Abu Dhabi, United Arab Emirates
Telephone	+971 26533333
URL	www.masdar.ae
Location	MENA, Europe
Number of Employees	200+

6.3.2. Business Description

The Abu Dhabi Future Energy Company is a world pioneer in renewable energy and urban sustainability. In the MENA region as well as in worldwide markets, the firm creates economically viable renewable energy projects. Its advanced clean technology innovation is helping to construct the world's most sustainable metropolis. The firm also provides expertise and industry platforms to help the UAE's renewable energy and clean-tech industries expand, generating new income streams in the long run.

6.3.3. Products and Services

Product/Service Category	Description
Renewable Energy	Photovoltaic Power, Concentrated Solar Power, Wind, Waste to Energy

Source: Press Releases, Newsletters, and Company Annual Reports.

6.3.4. Financial Overview

As Masdar is a privately held company, financials are not available in the public domain.



6.3.5. SWOT Analysis



Source: Press Releases, Newsletters, and Company Annual Reports.

6.3.6. Key Developments

Date	Development	Category	Description
2021	UAE's Masdar signs solar power agreement	Project Launch	The Iraqi electricity ministry signed an agreement with Masdar to build solar power projects with a total capacity of 2,000 megawatts in central and southern Iraq.



6.4. ELECTRICITE DE FRANCE

6.4.1. Key Facts

ELECTRICITE DE FRANCE	
Founded	1984
Corporate Address	22 30, 22 Avenue De Wagram, Paris, Ile-De-France, 75008, France
Telephone	+33 967670596
URL	www.edf.fr
Location	Europe, Asia, MENA
Number of Employees	62,000

6.4.2. Business Description

Electricite de France SA (EDF) is a French energy company with interests in generation, transmission, distribution, energy supply and trading, and energy services. Its strengths include strong market position, integrated business strategy, diverse asset portfolio, and improved performance in the France power generation business line, despite a drop in working capital. The firm might profit from rising power consumption in France as well as beneficial European Union investments and strategic efforts. On the other hand, operational difficulties, seasonality of operations, and hazards in the wholesale market may have an impact on its operations.

6.4.3. Products and Services

Product/Service Category	Description
Renewable Project Development	Photovoltaic Power, Concentrated Solar Power, Wind, Waste to Energy



6.4.4. Financial Overview



Source: Press Releases, Newsletters, and Company Annual Reports.

6.4.5. SWOT Analysis



Source: Press Releases, Newsletters, and Company Annual Reports.

6.4.6. Key Developments

Date	Development	Category	Description
2021	Dumat Al Jandal utility- scale wind farm	Project	Consortium led by EDF Renewables and Masdar will deliver the 400 MW Dumat Al Jandal utility-scale wind farm project in Saudi Arabia



6.5. ENGIE

6.5.1. Key Facts

ENGIE	
Founded	2008
Corporate Address	1 Place Samuel De Champlain, Courbevoie, Ile-De-France, 92400, France
Telephone	+33 144220000
URL	www.engie.com
Location	Europe, Middle East, Asia

6.5.2. Business Description

Gaz de France acquired SUEZ in 2008, resulting in the formation of Engie. The company concentrates its efforts on being Europe's leading power, gas, and infrastructure company. Its activities include natural gas and electricity procurement, production, and marketing as well as construction and maintenance of key natural gas and electricity infrastructure and creation and sale of energy and environmental services. Engie, a power producer with operations in more than 70 countries, has roughly 100 GW of installed capacity spanning natural gas, nuclear, coal, solar, onshore and offshore wind, biomass, and geothermal. Engie has a client base of 24 million.

6.5.3. Products and Services

Product/Service Category	Description
Renewable Solutions	Hydroelectricity, Solar Energy, Wind Energy, Geothermal Energy, Biomass, Biogas/Biomethane



6.5.4. Financial Overview



Source: Press Releases, Newsletters, and Company Annual Reports.

6.5.5. SWOT Analysis



Source: Press Releases, Newsletters, and Company Annual Reports.

6.5.6. Key Developments

Date	Development	Category	Description
2020	New renewable projects	Project	ENGIE won 235 MW wind and solar bids, cementing its position as France's top renewable energy provider.



7. PUBLIC-PRIVATE PARTNERSHIPS IN RENEWABLE ENERGY SECTOR

7.1. RECENT DEVELOPMENTS IN PPP ACROSS RENEWABLE ENERGY SECTOR

Public-private partnership (PPP) is an important part of the National Transformation Program (NTP) of Saudi Arabia; the program intends to raise private sector investment from 40 percent of GDP in 2016 to 65 percent by 2030.²⁰ In Saudi Arabia, the private sector plays a critical role in the development of renewable energy projects. PPPs for sustainable energy projects are on the rise in the GCC, with UAE and Saudi Arabia leading the way. The initiatives are helpful to Saudi Arabia both financially and environmentally.²¹ Crown Prince Mohammed bin Salman inaugurated the 300 MW Sakaka PV Independent Power Producer, which cost SAR1.2 billion (US\$319 million).²² ACWA Power, a Saudi Arabian company, has received a solar Public Venture contract for US\$300 million, making it the first private company to win a mega project under the Public Private Partnership (PPP) model.

As part of its pledge to power the 28,000 sq. km destination entirely with renewable energy, the Red Sea Development Company has inked its first significant PPP utilities package with ACWA Power. The PPP deal anticipates generating up to 650,000 MWh of renewable energy to power the destination and other utility systems while emitting zero carbon dioxide.²³

²⁰ https://argaamplus.s3.amazonaws.com/321ad358-202d-47af-8536-e9c732863040.pdf.

²¹ https://www.arabianbusiness.com/energy/462172-sustainability-focused-projects-on-the-rise-regionally.

²² https://www.power-technology.com/news/acwa-power-renewable-project/.

²³ https://www.constructionweekonline.com/business/268861-saudis-trsdc-signs-first-ppp-utilities-package-with-acwa-power.



7.2. LIST OF MAJOR PPPS

FIGURE 10. TENTATIVE SAUDI PPP PIPELINE, 2017



Note: IWP = Independent Water Projects and ISTP = Independent Sewage Treatment Plant. Source: MEED and Saudi Arabia's National Centre for Privatization 2017.²⁴

²⁴ https://www.meed.com/saudi-ppp-and-privatisation-progress-and-

prospects#:~:text=Public%2Dprivate%20partnership%20(PPP),participation%20of%20the%20private%20sector.



8. INITIATIVES TO PROMOTE RENEWABLE ENERGY SECTOR

8.1. CASE STUDY 1: EVALUATING THE POTENTIAL ENERGY SAVINGS OF RESIDENTIAL BUILDINGS AND UTILIZING SOLAR ENERGY IN THE MIDDLE REGION OF SAUDI ARABIA²⁵

8.1.1. Introduction

In recent years, developing countries have taken significant steps in the face of rising energy use to support global efforts to tackle climate change issues. To become more sustainable, Saudi Arabia has implemented important policy initiatives to promote energy efficiency (EE) in numerous areas, particularly in the building industry. Saudi Arabia's population is growing at a pace of 1.54 percent per year, which is closely related to the annual rate of increase in energy consumption. According to the IEA, energy consumption increased by 41.7 percent from 7.2 MWh in 2006 to 10.2 MWh in 2018. Such rapid growth of population requires an active infrastructure expansion in all areas, particularly residential buildings. Furthermore, 2.32 million new residential buildings are expected to be built in the coming years to fulfill the need of the country's growing population.

8.1.2. Conclusion

EE measures in Riyadh reduced energy consumption by 27 percent for walls, 14 percent for roofs, and 6 percent for windows, while in Qassim, energy consumption was reduced by 29 percent, 13 percent, and 6 percent for walls, roofs, and windows, respectively. Selecting a high energy efficiency rate (EER) heating, ventilation, and air conditioning (HVAC) system was the most effective energy efficiency solution, which reduced energy consumption by 33 percent and 32 percent in Riyadh and Qassim, respectively.

²⁵ https://journals.sagepub.com/doi/full/10.1177/0144598720975144.



8.2. CASE STUDY 2: RETURN ON INVESTMENT (ROI) FOR USING RENEWABLE ENERGY TO POWER-UP A TYPICAL HOUSE IN SAUDI ARABIA²⁶

8.2.1. Description

This case study covers two types of renewable energy sources to power the residence—photovoltaic solar energy and hydrogen fuel-cell energy. To avoid the usage of expensive storage batteries, the hydrogen fuel-cell energy system is proposed to be utilized to power up houses throughout the night. During the day, the solar PV energy source is used to power residences.

The total power generated by the two energy systems is combined and compared with the analyzed house's actual power usage.

Month	Power Consumption (kW/day)	Power Consumption (kW/month)	Cost from Grid (US\$)
January	23.3	722.3	13.63
February	23.8	690.2	13.20
March	72.6	2,250.6	64.02
April	126.6	3,924.6	108.66
Мау	131.6	4,079.6	134.55
June	138.4	4,152.0	136.86
July	139.7	4,330.7	142.58
August	151.0	4,681.0	153.79
September	142.4	4,272.0	140.70
October	135.9	4,212.9	138.81
November	127.1	3,813.0	105.68
December	23.5	728.5	13.71

TABLE 3. MONTHLY POWER CONSUMPTION OF THE ANALYZED HOUSE AND RELATED GRID COST

Source: Sustainable Cities and Society (SCS), 2015.

²⁶ https://www.sciencedirect.com/science/article/abs/pii/S2210670715000281.



Bracket: kW-hr	Price: \$/kW-hr
1-2,000	0.01
2,001-4,000	0.03
4,001-6,000	0.03
6,001-7,000	0.04
7,001-8,000	0.05
8,001-9,001	0.06
9,001-10,000	0.06
>10,000	0.07

TABLE 4. ELECTRICITY MONTHLY COST IN SAUDI ARABIA

Source: Sustainable Cities and Society (SCS), 2015.

8.2.2. Conclusion

A case study is provided for researching how to power a typical Saudi Arabian home utilizing hybrid solar PV and hydrogen fuel-cell energy sources. The proposed hybrid system is designed using the house's daily electricity use over the course of a year. Excess electricity generated by the projected renewable energy installations is sold to the grid at a preferred price. Based on an assumed price of US\$0.06/kWh for power sold to the grid, the proposed system's return on investment is estimated to be 3.5 years. After this time, a profit of ~US\$7,754 per year is earned.



8.3. CASE STUDY 3: RENEWABLE RESOURCE MONITORING AND MAPPING PROGRAM IN SAUDI ARABIA²⁷

8.3.1. Challenge

The Renewable Resource Monitoring and Mapping (RRMM) program was started by K.A.CARE to build a sustainable energy mix for Saudi Arabia. To evaluate the renewable resources in Saudi Arabia, understanding of size, geographic distribution, features, and variability of solar and wind resources is required. The availability of solar and wind resources is influenced by factors such as aerosols, weather patterns, and geography. K.A.CARE aims to enable power project implementation, as well as technical research, development, and innovation by accurately describing these renewable energy resources, to optimally harness the Kingdom's renewable resources.

8.3.2. Solution

The RRMM program is supported by Battelle. The firm focuses on constructing a field monitoring network for solar resources, airborne dust, and meteorological conditions as well as building the capacity of host government staff to manage the network sustainably and publicly share the data. The project includes an assessment of existing waste-to-energy databases and demonstration projects as well as the identification of information needs for appraising prospective waste-to-energy resources in the country. The project also includes the development of an online, GIS-based Atlas to communicate quality-assured monitoring data with stakeholders via a secure, bilingual online Atlas tool.

8.3.3. Outcome

The RRMM program will aid in achieving Saudi Arabia's renewable resource targets (e.g., 41 GW of solar electricity capacity by 2032) and providing data and tools to stimulate research, development, and innovation in the Kingdom's renewable energy industry. Saudi-based enterprises will be able to give vital support to renewable resource assessment through the operation and maintenance of the stations along with the required data analysis.

²⁷ https://www.battelle.org/case-studies/case-study-detail/renewable-resource-monitoring-mapping-program-in-saudi-arabia.



9. PRIMARY RESEARCH STUDY ANALYSIS

9.1. OVERVIEW

The following primary research was conducted through online mode across Saudi Arabia to gather insights pertaining to the renewable energy industry. The number of primary respondents was 150.

9.2. DEMOGRAPHICS

The young adult population aged between 29-35 years dominated the participation collectively and accounted for overall 28 percent of the primary respondents. Furthermore, females formed almost 53 percent of the group that participated while 47 percent were males.



FIGURE 11. AGE GROUP AND GENDER COMPOSITION OF RESPONDENTS

Source: Gulf Research Center Analysis, 2021 and High Beam Global.





FIGURE 12. LOCATION OF RESPONDENTS

Source: Gulf Research Center Analysis, 2021 and High Beam Global.

As seen in Figure 12, most respondents in the survey came from three popular cities: Riyadh, Jeddah, and Dammam, which accounted for 82 percent of all respondents. Other non-metro city respondents made about 18 percent of the total number of people surveyed.





Source: Gulf Research Center Analysis, 2021 and High Beam Global.

Furthermore, respondents from working groups as well as Saudi nationals dominated the poll, accounting for about 69 percent and 77 percent, respectively, of the total survey group.



9.3. RENEWABLE ENERGY AWARENESS AND ATTITUDE



FIGURE 14. AWARENESS ABOUT THE DIFFERENCE BETWEEN RENEWABLE & NON-RENEWABLE ENERGY SOURCES AND KYOTO AGREEMENT

Source: Gulf Research Center Analysis, 2021 and High Beam Global.

About 69 percent of respondents are aware of the distinction between renewable and non-renewable energy sources, whereas about half are aware of the Kyoto Agreement.





Source: Gulf Research Center Analysis, 2021 and High Beam Global.

As shown in Figure 15, 51 percent of respondents are aware of the Paris Agreement and 50 percent are aware of government energy-saving schemes.





FIGURE 16. PRIME CONTRIBUTOR TO MEETING THE ENERGY DEMAND IN SAUDI ARABIA

Source: Gulf Research Center Analysis, 2021 and High Beam Global.

Half of respondents strongly agree that, in comparison to public and private enterprises, the government makes the most important contribution to meeting the Kingdom's energy demands and ensuring its long-term development, as seen in Figure 16.





Source: Gulf Research Center Analysis, 2021 and High Beam Global.

As seen in Figure 17, more than half of the respondents strongly agree that solar will be their preferred energy source in the coming years, ahead of wind, geothermal, hydro or tidal, and biomass.





FIGURE 18. SHIFT TOWARDS SUSTAINABLE ENERGY ALTERNATIVES IN UPCOMING YEARS

Source: Gulf Research Center Analysis, 2021 and High Beam Global.

As shown in Figure 18, nearly 98 percent of respondents believe that in the next three years, they will convert to clean energy solutions to meet their energy needs.



FIGURE 19. ELEMENTS THAT INFLUENCE THE DECISION TO SWITCH TO CLEAN ENERGY

Source: Gulf Research Center Analysis, 2021 and High Beam Global.

Cost of purchase and energy savings are the key elements that influence the decision to switch to clean energy from present energy sources, as shown in Figure 19.





FIGURE 20. RESPONDENTS' PERSPECTIVES ON CLEAN ENERGY

Source: Gulf Research Center Analysis, 2021 and High Beam Global.

Respondents agree that the government adequately promotes the benefits of clean energy solutions and that incentives or government schemes will encourage the use of clean energy solutions in residential facilities, as seen in Figure 20.



FIGURE 21. FACTORS THAT HAMPER RENEWABLE ENERGY ADOPTION

Source: Gulf Research Center Analysis, 2021 and High Beam Global.

As seen in Figure 21, the high cost of installation, limited awareness of renewable energy among the general population, and a lack of initiatives or incentives that assist adoption are the key issues preventing residential users from adopting renewable energy.



9.4. CURRENT RENEWABLE ENERGY INFRASTRUCTURE AND PROGRAMS



FIGURE 22. CLEAN ENERGY SOLUTIONS IMPLEMENTATION & PLANS TO SHIFT TOWARDS CLEAN ENERGY SOLUTIONS

Source: Gulf Research Center Analysis, 2021 and High Beam Global.

About half of the respondents said that clean energy solutions had been deployed near their home, and 57 percent said that their community or commercial organization had made plans to change to clean energy solutions in the next three years.

FIGURE 23. RESPONDENTS' VIEW ON ADDITIONAL PAYMENT FOR SOLAR ENERGY SOLUTIONS & APPROACH OF LOCAL MUNICIPALITIES



Source: Gulf Research Center Analysis, 2021 and High Beam Global.

About 56 percent of respondents are willing to pay a higher price for solar energy solutions, while 53 percent believe that local governments are working to improve the status of renewable energy infrastructure.



FIGURE 24. PRESENCE OF SOLAR ENERGY EQUIPMENT VENDORS & ORGANIZATION INITIATIVES TOWARDS CLEAN ENERGY



Source: Gulf Research Center Analysis, 2021 and High Beam Global.

Approximately 46 percent of respondents reported that solar energy equipment vendors are located near their accommodation, whereas 61 percent stated that their current business has not begun to adopt clean energy initiatives.

9.5. GOVERNMENT INITIATIVES: FEEDBACK AND SATISFACTION LEVEL



FIGURE 25. SATISFACTION LEVEL REGARDING GOVERNMENT INITIATIVES

Source: Gulf Research Center Analysis, 2021 and High Beam Global.

In terms of satisfaction, most survey respondents appear to be pleased with the government's plan to meet 50 percent of its energy needs from renewable sources by 2030 as well as the country's development of the world's largest solar PV project worth US\$200 billion.



10. RENEWABLE ENERGY SECTOR COMPARISON: SAUDI ARABIA VERSUS REST OF MIDDLE EASTERN ECONOMIES

10.1. OVERVIEW

The GCC countries offer an excellent market for renewable energy deployment. Indeed, the argument for rapid renewable energy deployment in this region is stronger than in many other developing economies. The GCC countries, which are located at the core of the global sunbelt, have some of the world's highest solar exposure. Solar power facilities in the region can expect to operate at full capacity for 1,750–1,930 hr/year.²⁸

In 2019, renewable energy capacity investment in the Middle East & Africa fell 8 percent, i.e., US\$15.2 billion, down from a record high of US\$16.5 billion in 2018.



10.1.1. Renewable Energy Investment

FIGURE 26. RENEWABLE ENERGY INVESTMENT IN MIDDLE EAST & AFRICA IN 2019 AND GROWTH RATE OF CHANGE IN 2018 (US\$ BILLION)

Source: Global Trends in Renewable Energy Investment 2020.29

²⁸ https://www.strategyand.pwc.com/m1/en/reports/the-outlook-for-renewable-energy-in-the-gcc.html.

²⁹ https://www.fs-unep-centre.org/wp-content/uploads/2020/06/GTR_2020.pdf.



In 2019, the UAE invested about US\$4.5 billion in the development of the renewable energy industry, whereas Saudi Arabia invested approximately US\$0.5 billion in the same year.

10.1.2. Employment in Renewable Energy Sector

Renewable energy has a significant potential for job development on a large scale. More jobs are created by renewable energy technologies than by fossil-fuel technology. For example, solar PV facilities generate at least twice as many jobs per unit of power generation as coal or natural gas installations. Similarly, the GCC countries can expect significant employment growth because of renewable energy deployment.³⁰



FIGURE 27. DIRECT JOBS IN THE RENEWABLE ENERGY SECTOR BY GCC COUNTRY, BY 2030 (PERCENT)

Source: International Renewable Energy Agency (IRENA) 2016.

³⁰ https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA_Market_GCC_2016.pdf.



FIGURE 28. SUSTAINABLE ENERGY PLANS AND TARGETS IN GCC



GCC Sustainable Energy Plans

Source: International Renewable Energy Agency (IRENA) 2016.

Kuwait has established a target of using 15 percent renewable energy by 2030. Similarly, the UAE has set a goal of using about 24 percent clean energy in overall energy consumption. Qatar has set a target of increasing renewable energy capacity by 20 percent by 2030.



10.1.3. Utility-Scale Renewable Energy Projects in GCC

Renewable energy deployment is predicted to surge across the GCC region. Nearly 7 GW of additional renewable power generation capacity was scheduled in early 2020, led by the UAE, Oman, and Saudi Arabia. The GCC countries have invested in project developers, manufacturing businesses, and research & development projects in the renewable energy value chain. The UAE receives most investments.³¹

Country	Project	Technology	Size (MW)	
Saudi Arabia	Sakaka	Solar PV	300	
	Mohammed bin Rashid Al	CSP	700	
	Maktoum Solar Park, Phase IV	Solar PV	250	
	Mohammed bin Rashid Al Maktoum Solar Park, Phase III	Solar PV	800	
UAE	Mohammed bin Rashid Al Maktoum Solar Park, Phase II	Solar PV	200	
	Mohammed bin Rashid Al Maktoum Solar Park, Phase I	Solar PV	13	
	Noor Abu Dhabi, Sweihan	Solar PV	1,177	
	Shams 1	CSP	100	
	Miraah Solar Thermal	Solar Thermal	1,000 (GWth)	
Oman	Ibri PV Plant	Solar PV	500	
	PDO Amin PV Plant	Solar PV	100	
Qatar	Al-Kharsaag	Solar PV	900	
Kuwait	Shadaya	CSP	50	
	Shagaya	Solar PV	10	
	Al Dibdibah/ Shagaya Phase II	Solar PV	1,200-1,500	
Bahrain	Askar Landfill	Solar PV	100	
Banrain	Al Dur	Solar-Wind Hybrid	5	

TABLE 5. UTILITY-SCALE RENEWABLE ENERGY PROJECTS IN GCC AS OF JANUARY 2019

 $Note: \ \mathsf{CSP} = \mathsf{Concentrated} \ \mathsf{Solar} \ \mathsf{Power}, \ \mathsf{PV} = \mathsf{Photovoltaic}, \ \mathsf{MW} = \mathsf{Mega} \ \mathsf{Watt}, \ \mathsf{GWth} = \mathsf{Gigawatt-thermal}.$

Source: A Prominent Consulting Firm.³²

³¹ https://www2.deloitte.com/content/dam/Deloitte/xe/Documents/financial-services/Deloitte-solar-energy-report.pdf.

³² https://www2.deloitte.com/content/dam/Deloitte/xe/Documents/financial-services/Deloitte-solar-energy-report.pdf.



11. WAY FORWARD

11.1. RECOMMENDATION 1

Saudi Arabia has one of the highest solar energy densities in the Middle East and North Africa region. As a result, it will be a leader in solar energy electricity generation using both photovoltaic and concentrated solar power technologies. In its December 2020 report, the International Energy Agency said: "Solar PV [power], if deployed at large scales and under favourable climatic conditions, can be very cost competitive."

In January 2019, Saudi Arabia set a new renewable energy target of developing and installing 58.7 GW of clean power sources over the next decade. The 2030 target will involve the development of 40 GW of photovoltaic (PV) solar capacity and 2.7 GW of concentrated solar power (CSP) capacity.

11.2. RECOMMENDATION 2

With the continual increase in population accompanied by climate change, the Saudi government can reduce the burden of subsidies to create energy for all sectors by adopting renewable and sustainable energy resources.

11.3. RECOMMENDATION 3

In the Jizan region, geothermal energy could be a good source of renewable energy. Hundreds of employment opportunities will be created for Saudis. In addition, research studies in tidal energy resources are required. This will not only help creating job opportunities but will also create opportunities for better utilization of energy resources.

11.4. RECOMMENDATION 4

Private sector funding coupled with strong government support for solar, wind, tidal and other renewable sources will significantly boost the Saudi Arabian market demand. Increased investments and technological advancements will also enhance environmental protection and reduce the cost of energy production. Growth in smart grid systems and technological advancements in storage systems will boost the adoption of new clean energy sources.



12. APPENDIX

12.1. LIST OF ABBREVIATIONS/GLOSSARY

TABLE 6. LIST OF ABBREVIATIONS/GLOSSARY

Acronym	Expansion
US\$	US Dollar
Bn	Billion
CAGR	Compound Annual Growth Rate
DROT	Drivers, Restraints, Opportunities, Trends
GCC	Gulf Cooperation Council
ррр	Public-Private Partnership
PIF	Public Investment Fund
SWOT	Strengths, Weaknesses, Opportunities, and Threats
Mn	Million
GDP	Gross Domestic Product
NREP	National Renewable Energy Program
REPDO	Renewable Energy Project Development Office
GT	Gigaton
K.A.CARE	King Abdullah City for Atomic and Renewable Energy
FiT	Feed-In Tariff
MBOE	Million Barrels of Oil Equivalent
MoU	Memorandum of Understanding
PV	Photovoltaic
SIDF	Saudi Industrial Development Fund
CSP	Concentrated Solar Power
MW	Megawatts
NTP	National Transformation Program
KSA	Kingdom of Saudi Arabia
EE	Energy Efficiency
EER	Energy Efficiency Rate
HVAC	Heating, Ventilation, and Air Conditioning



Acronym	Expansion
ROI	Return On Investment
RRMM	Renewable Resource Monitoring and Mapping
IRENA	International Renewable Energy Agency
MENA	Middle East and North Africa
IEA	International Energy Agency
IPP	Independent Power Producer
CSP	Concentrated Solar Power
ECRA	Energy and Cogeneration Regulatory Authority

12.2. REFERENCES

- International Renewable Energy Agency
- Renewable Energy Project Development Office
- King Abdullah City for Atomic and Renewable Energy
- Saudi Industrial Development Fund
- Public Investment Fund



12.3. QUESTIONNAIRE

Questionnaire – Renewable Energy Sector

<u>Target Audience</u>: Anyone above the age of 18+ years and either a resident of Saudi Arabia or has lived more than 3+ years in the country

Questionnaire: Total 4 sections and 22 questions

Section A – Demographics (5 questions)				
Question	Options			
	18 to 23 years old			
	24 to 28 years old			
Q1. Age	29 to 35 years old			
	36 to 45 years old			
	Above 45 years old			
02 Conder	Male			
	Female			
	Riyadh			
	Jeddah			
	Makkah			
	Madinah			
	Sultanah			
Q3. Location	Dammam			
	Ta'if			
	Tabuk			
	Al Kharj			
	Buraydah			
	Other City - Please specify			
04 Occupation	Working			
	Non-Working			
05 Nationality	Saudi Nationality			
	Non-Saudi Nationality			



Section B – Renewable Energy Awareness and Attitude (10 questions)				
Questions	Option(s)			
	Yes			
Q1. Do you know the difference between renewable and non-renewable energy sources?	No			
	Maybe, not sure			
	Yes			
Q2. Are you aware of the Kyoto Agreement?	No			
	Maybe, not sure			
	Yes			
Q3. Are you aware of the Paris Agreement?	No			
	Maybe, not sure			
	Yes			
Q4. Are you aware of any current energy saving schemes of the government?	No			
	Maybe, not sure			

Q5. According to you, who is the prime contributor to ensuring the meeting of energy demand (both present and future) as well as sustainable development of the Kingdom

Factor	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Government					
Public					
Private Industries					
All the above					
Others					



Q6. Which of the following energy sources would you wish to contribute more to your daily energy requirements in the future?

Factor	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Solar					
Wind					
Hydro or Tidal					
Geothermal					
Biomass					
Others					

Q7. How likely are you to switch to clean energy solutions for your energy requirements in the next three years?							
Definitely	Definitely Very Probably Probably Possibly Probably Not Definitely Not						

Q8. What factors would influence your decision to shift to clean energy?						
Factor	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
Cost of purchasing						
Maintenance Cost						
Ease of switching						
Energy savings						
Associated incentives for switching						
Ease of access						



Q9. State your agreement with the following set of statements					
Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The government sufficiently promotes the benefits of clean energy solutions.					
Incentives or government schemes will encourage the adoption of clean energy solutions in my residential facility.					
The government is taking necessary steps and initiatives to facilitate the adoption of clean energy in your city.					
The government is transparent in its efforts to minimize its carbon footprint.					
Willing to rent solar panel for installation rather than buying and installing the equipment.					

Q10. What factors according to you are currently hindering the adoption of renewable energy among residential users?								
Factors	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree			
High cost of installation								
Limited awareness among the general population								
Lack of initiatives or incentives that facilitate the adoption								
Lack of equipment availability and maintenance or service centres nearby								
Inadequate information to evaluate the viability and cost savings through clean energy at my residential home								

Section C – Current Renewable Energy Infrastructure and Programs (6 questions)					
Questions	Option(s)				
Q1. Presently, are there any clean energy solutions	Yes				
implemented near your area of residence?	No				

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	Maybe, not sure					
Q2. Are there any plans in your society or commercial organization to shift towards clean energy solutions in the	Yes					
	No					
next three years?	Maybe, not sure					
Q3. Are you open to pay an additional sum of money to adopt solar energy solutions?	Yes					
	No					
	Maybe, if there are some tax incentives involved					
04. Are there any initiatives supported by the local	Yes					
municipalities to improve the current state of infrastructure for clean energy?	No					
	Maybe, not sure					
	Yes					
Q5. Are there any solar energy equipment vendors available near your accommodation?	No					
	Maybe, not sure					
Q6. Does your current organization have any clean energy initiatives or programs to minimize carbon footprint within Saudi Arabia?	Yes					
	No					
	Maybe, do not know					
	Not working yet					



Section D - Government Initiatives: Feedback and Satisfaction Level (1 questions)								
Questions			Option(s)					
Q1. State your agreement/satisfaction regarding the following set of statements.								
Factors	Option – 1	Option – 2	Option – 3	Option – 4	Option – 5			
Are you satisfied with the government's initiative to meet 50% of its energy requirement from renewable sources by 2030?	Extremely Satisfied	Very Satisfied	Neutral	Slightly Satisfied	Not at all satisfied			
Saudi Arabia is to develop world's largest solar PV project worth US\$ 200 billion	Extremely Satisfied	Very Satisfied	Neutral	Slightly Satisfied	Not at all satisfied			
The government should create awareness about the incentives for switching to clean energy sources.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree			
Large corporations should accommodate clean energy initiatives in their corporate social responsibility (CSR) policies	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree			
The government as well as corporations should prioritize clean energy initiatives in their sustainable development goals in the coming years.	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree			



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Gulf Research Centre - Cambridge University of Cambridge Sidgwick Avenue, Cambridge CB3 9DA, UK Tel:+44-1223-760758 Fax:+44-1223-335110



Gulf Research Center Foundation Avenue de France 23 1202 Geneva Switzerland Tel: +41227162730 Email: Info@grc.net



مركز الخليج للأبحاث مؤسسة الملك فيصل الخيرية

البرج الشمالي، الدور ١١، الوحدة FN11A

شارع الملك فهد الفرعي، حي العليا الرياض

م.ب 10082 الرياض 12212 المملكة العربية السعودية **+966 11 211 2567** البريد الالكتروني: info@grc.net



مركز الخليج للأبحاث (المركز الرئيسي) 19 شارع راية الاتحاد ص.ب 2134 جدة 21451 الملكة العربية السعودية 4966 12 6511999 فاكس: 26531375 1266

البريد الالكتروني: info@grc.net





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