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Powering the Transition: Forecasting and Closing the Skills Gap for Saudi Arabia's Renewable Energy Sector

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Registered offices
Bonn and Eschborn

Köthener Str. 2-3
10963 Berlin

T +49 30 338424 186
E info@giz.de
I www.giz.de

Authors:
Ouissem Ghorbel, Managing Partner, Matine Consulting
Sahbi Amara, Renewable energy expert, Growth Sense Engineering

Responsibles:
Dr. Louy Qoaider, Head of H2- diplo and Decarbonisation Office in Riyadh

Reviewers:
Dr. Mehmet Soytas, National Labor Observatory
Mr. Cian Mulligan, King Abdullah Petroleum Studies and Research Center
Dr. Louy Qoaider, Head of H2- diplo and Decarbonisation Office in Riyadh

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Content

List of Abbreviations

CAGR	Compound Annual Growth Rate
CSP	Concentrated Solar Power
FTE	Full-Time Equivalent
GDP	Gross Domestic Product
GVA	Gross Added Value
GW	Gigawatt
IPP	Independent Power Producer
MW	Megawatt
N/A	Not Applicable / Not Available
PIF	Public Investment Fund
PPA	Power Purchase Agreement
Q2	Second Quarter
Q4	Fourth Quarter
R&D	Research and Development
REPDO	Renewable Energy Project Development Office
RFQ	Request for Quotation
SAR	Saudi Arabian Riyal
SME	Small and Medium Enterprise
USD	United States Dollar

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Executive Summary

General Context

Saudi Arabia is pursuing an ambitious transition under Vision 2030, aimed at diversifying the Kingdom's economy and reducing its dependence on oil by promoting strategic sectors, including the renewable energy sector. Saudi Arabia has already made a considerable progress towards this transition, meeting 97% of its non-oil GDP objective of 2023 and boosting its non-oil exports that reached 23% of total exports. Renewable energy plays a pivotal role in this shift, with the Kingdom planning to announce 20 GW of new projects each year and to reach 110 to 130 GW of renewable energy by 2030. However, achieving this goal face a major challenge: the availability of a skilled workforce.

Labor Market Overview

Under Vision 2030, Saudi Arabia's labour market is already undergoing a significant transformation. While the Kingdom has already made achievements reducing overall unemployment levels, especially among Saudi women, that reached 12.8% in the second quarter of 2024, and developing a more skilled workforce, especially among Saudi nationals. The rise of the renewable energy sector will further reshape the Kingdom's labour market. This includes not only an increased demand for skilled professionals, but also the need to ensure a better alignment of education and vocational training systems to secure a workforce that possesses the skills needed in renewable energy.

Workforce Requirements for the Renewable Energy Sector

Based on actual and future announcements, it is projected that Saudi Arabia would rather reach a renewable energy capacity of 127.8 GW by 2032, split into 94.1 GW of solar energy and 33.7 GW of wind energy, and will therefore need between 91,000 and 127,000 workers at peak workforce demand in 2030[1].

To meet the demand for 91,000 workers in the renewable energy sector, the Kingdom would require:

- Engineering roles: Approximately 74,300 across mainly the disciplines of electrical, civil, mechanical and 'other[2]' engineering
  - 23,700 engineers
  - 25,200 technicians
  - 25,400 operators
- Business profiles: 14,000 roles in business related fields
- Other categories: 3,000 roles in various other fields

The demand for entry-level and junior professionals will be significant, as the Kingdom would require 46,000 junior professionals by 2030, whereas it would require approximately 20,000 experienced specialists.

[1] Based on authors and reference study estimates for the base-case scenario
[2] Encompasses a wide range of engineering disciplines excluding electrical, civil and mechanical

By 2030, at least 29,000 Saudi nationals are expected to fill roles within the renewable energy sector, including a minimum of 12,200 Saudi engineers and technicians. Therefore, the share of Saudi nationals in the renewable energy workforce would reach 32% of total workforce in the sector. Eventually, this share is expected to increase to 45% by 2032, as many of the less critical and less appealing to Saudi nationals, jobs will phase out.

The development of the renewable energy components manufacturing in Saudi Arabia will create an additional 11,000 job opportunities, bringing the total requirement to 102,000 workers. However, the Kingdom faces strong competition from other countries in the region aiming to benefit from the first mover advantage in establishing a renewable energy component manufacturing industry.

Workforce Challenges

Given the urgent workforce requirements, Saudi Arabia could face challenges in securing the necessary talent to meet the growing demands of the sector.

It is likely that the Kingdom will face shortfalls in securing the needed number of junior professionals in the following disciplines:

- Electrical engineering: To meet sector needs, the renewable energy sector would need to attract 73% of electrical engineering graduates, who currently sustain a 91% employment rate in other industries.
- Civil engineering: The sector would require 58% of civil engineering graduates, who currently sustain a 90% employment rate across other industries.
- Mechanical engineering: Meeting demand would involve attracting 43% of mechanical engineering graduates, who currently sustain an 86% employment rate in other industries.
- Other engineering disciplines: The sector would need to attract 77% of graduates in "other" engineering fields, where employment rates currently range from 82% to 97% across other industries.

In contrast, the Kingdom is well positioned to meet the demand of junior business-related profiles, as the number of university graduates in these disciplines exceeds by far the sector's needs.

To meet the 20,000 experienced profile needs in the renewable energy sector, Saudi Arabia could address this demand through upskilling and reskilling workers from sectors such as mining, quarrying, electricity, gas, and air conditioning, while also attracting foreign expertise to fill critical gaps.

In summary, while Saudi Arabia faces challenges in attracting a skilled workforce to support the growth of its renewable energy sector, effective strategies are essential to unlock its full potential. Competitive salaries, favourable working conditions, targeted upskilling and reskilling programs, along with attracting foreign expertise to fill critical gaps, will be key to meeting the sector's growing demands.

01. Section 1: Contextual Analysis

Vision 2030 Overview

Before the launch of Vision 2030, Saudi Arabia's economy was heavily reliant on oil revenues, which accounted to an average of 40% of the Kingdom's real GDP "Gross Domestic Product" between 2010 and 2016. This dependence made the economy highly vulnerable to fluctuations in global oil prices, particularly during the oil price collapse in 2014-2015. Additionally, Saudi Arabia faced demographic pressures with a young and growing population that required sustainable job creation outside the oil sector.

The global shift towards renewable energy and increased sustainability further emphasized the need for diversification. These challenges outlined the urgency for Saudi Arabia to reduce its reliance on oil and develop a more resilient, diversified economy, leading to the elaboration of the Vision 2030 strategy.

Launched in 2016, Vision 2030 is a transformative economic blueprint designed to reduce the Kingdom's heavy reliance on oil revenues and foster a more diversified, sustainable economy, by introducing a variety of economic and social reforms aimed at strengthening non-oil sectors and positioning the Kingdom as a global leader across multiple industries.

The Kingdom aims to pivot itself from a historically oil-centric economy to one that fosters sustainable growth across various sectors. Under Vision 2030, several key macroeconomic targets have been identified to facilitate this transformation.

Saudi Arabia has set ambitious targets under Vision 2030 to reduce its dependence on oil, empower its private sector, and develop its human capital by lowering unemployment and increasing women's participation in the workforce. While several years from 2030, the Kingdom has already made considerable progress, achieving its non-oil GDP target for 2023, reaching the unemployment rate set for 2030 ahead of schedule, and exceeding its women's workforce participation goal.

Target / Sub-target	Baseline (2016)	Current state (2023)	Goal (2030)
1. Reduce Oil dependence	**40% of the GDP (average 2010 – 2016)[3]**	**31%[3]**	**N/A**
1.1. Non-oil GDP	SAR 1,590 billion[3]	SAR 1,883 billion[3]	SAR 4,970 billion[4]
1.2. Non-Oil exports	16%[5]	23%[5]	50%[4]
1.3. Government revenue	SAR 163 billion[3]	SAR 629 billion[3]	SAR 1 trillion[5]
2. Boost private sector's growth	**40% of the GDP[6]**	**45% of the GDP[6]**	**65% of the GDP[6]**
2.1. Small & Medium Enterprises (SMEs)	20%[4]	N/A	35%[4]
3. Develop human capital & improve employment	**N/A**	**N/A**	**N/A**
3.1. Saudis Unemployment rate	12.3%[4]	7.1%[7] (Q2 2024)	7%[4]
3.2. Women participation rate in the workforce	22%[4]	35.4%[7] (Q2 2024)	30%[4]

Table 1: Saudi Arabia main macroeconomic targets, baseline versus current state versus 2030 goal.

Vision 2030, through its Vision Realization Programs (VRPs) and supporting initiatives, aims to reduce Saudi Arabia's reliance on oil by fostering growth in key strategic sectors such as Mining, Tourism & Entertainment, Manufacturing, Digital Economy, and Renewable Energy.

Key industry (non-exhaustive)	Criteria	Baseline (2016)	Current State (2023)	Goal (2030)
Mining	Total revenues in USD billion	2.92[8]	4.18[8]	70[9]
Tourism & entertainment	Contribution to GDP in %	N/A	4.45%[10]	10%[10]
Manufacturing	Total revenues in SAR billion	330[11]	529[3]	895[11]
Digital economy	Contribution to GDP in %	13% (2017)[12]	14% (2022)[13]	19.2% (2025)[12]
Renewable Energy	Operating capacity in GW	N/A	2.2 GW	110 to 130 GW

Table 2: Key promoted sectors for economic diversification, baseline versus current state versus 2030 goal.

[3] General Authority for Statistics Saudi Arabia, GDP and national accounts Q4 2023, Authors' analysis
[4] Saudi Arabia's Vision 2030
[5] General Authority for Statistics Saudi Arabia, International Trade of Saudi Arabia, 2023
[6] Vision 2030, Annual report 2023
[7] General Authority for statistics Saudi Arabia, Labor market statistics report Q2 2024
[8] General Authority for Statistics Saudi Arabia, GDP and national accounts Fourth Quarter of 2023, Other Mining and Quarrying
[9] Investor Guide, Mineral exploration and Mining in Saudi Arabia, January 2022
[10] Saudi Arabia National Tourism Strategy, Saudi Arabia Ministry of Tourism
[11] Saudi Arabia's National Strategy for Industry, Evolving Ecosystem & Future Opportunities, 2023
[12] Vision 2030, National Transformation Program
[13] General Authority of statistics Saudi Arabia, Digital Economy statistics 2022

Economic diversification and industry targets

Saudi Arabia has made significant progress in its transition towards a non-oil economy, reaching 97% of its non-oil GDP target for 2023. This growth in non-oil activities and their increasing contribution to GDP has also driven the share of non-oil exports to total exports up to 23% in 2023.

The Kingdom aims to achieve a non-oil GDP of 4,970 billion SAR by 2030, with a target of 1,934 billion SAR for 2023. In 2023, Saudi Arabia reached a non-oil GDP of 1,883 billion SAR, successfully meeting 97% of its annual target and 38% of its 2030 goal.

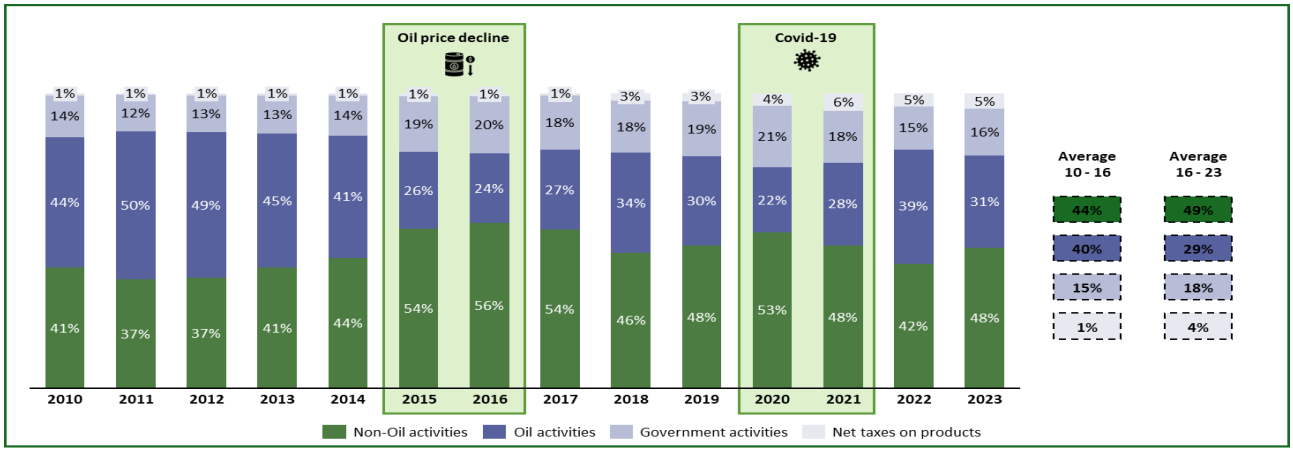


Figure 1: Breakdown of Saudi Arabia's GDP, by main economic activities, in percentage, 2010 – 2023[14]

Since 2016, non-oil GDP has experienced steady growth, with growth rates ranging between 1% and 11%, except for a decline of -4% recorded in 2020. In contrast, growth rates in oil-related activities have shown significant volatility, fluctuating between -36% and 75%, highlighting the substantial variability in oil revenues. The high volatility in the growth rates of oil revenues can be directly attributed to fluctuations in international crude oil prices. As the following graph illustrates, there is a strong correlation between crude oil prices and the growth rates of oil revenues.

[14] General Authority for Statistics Saudi Arabia, GDP and national accounts Fourth Quarter of 2023

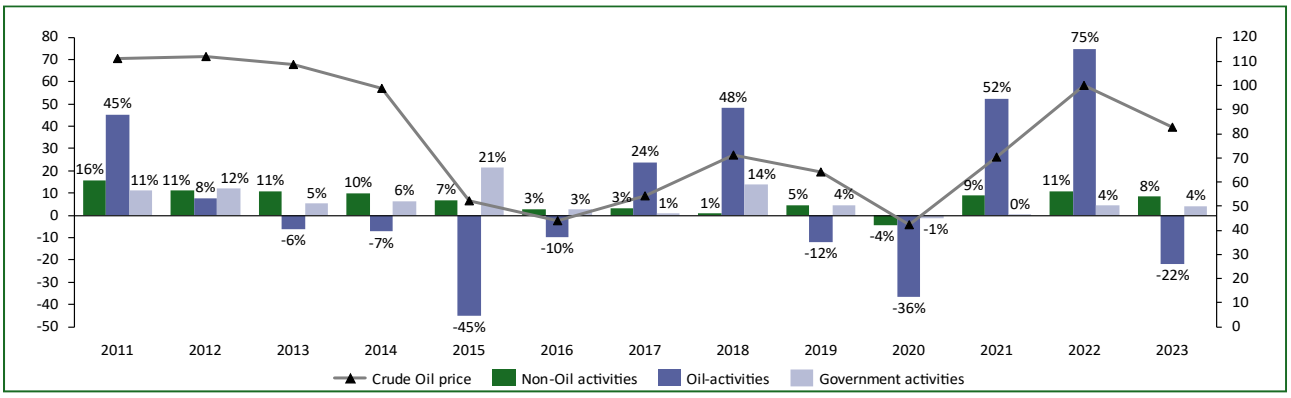


Figure 2: GDP growth rates by main economic activity versus evolution of crude oil price Brent in nominal US Dollars, 2011 – 2023[15]

Despite being one of the priority sectors for economic diversification, the mining and quarrying sector averaged a contribution of 27% of Saudi Arabia's GVA16 "Gross Added Value" between 2016 and 2023, compared to an average GVA contribution of 38% between 2010 and 2016 (before Vision 2030).

On the other hand, sectors such as manufacturing and financial services (including insurance, real estate, and business services) averaged a contribution of 14% and 12%, respectively between 2016 and 2023, compared to an average of 11% and 10% between 2010 and 2016.

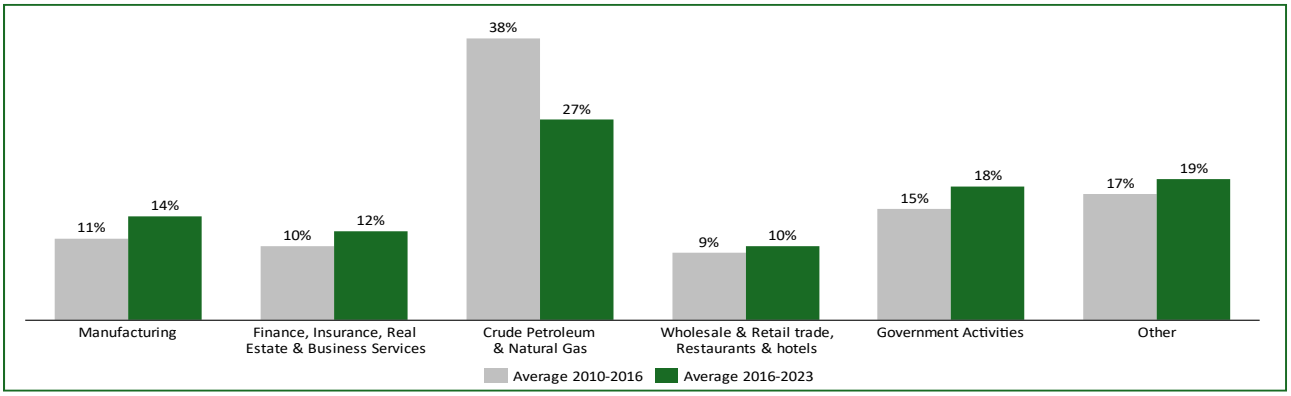


Figure 3: Percentage contribution to GDP by kind of economic activity, 2010 – 2023[17]

The share of non-oil exports of the total exports reached 23% in 2023. Non-oil exports used to average 17% of total exports between 2010 and 2016. This share increased, reaching an average of 24% between 2016 and 2023.

[15] General Authority for Statistics Saudi Arabia, GDP and national accounts Fourth Quarter of 2023 / World Bank Commodity Price Data

[16] Gross Added Value « GVA »: GVA is an economic metric that represents the value generated by a sector or industry. GVA is often used as an indicator of the economic output of a specific industry or sector.

[17] General Authority for Statistics Saudi Arabia, GDP and national accounts Fourth Quarter of 2023

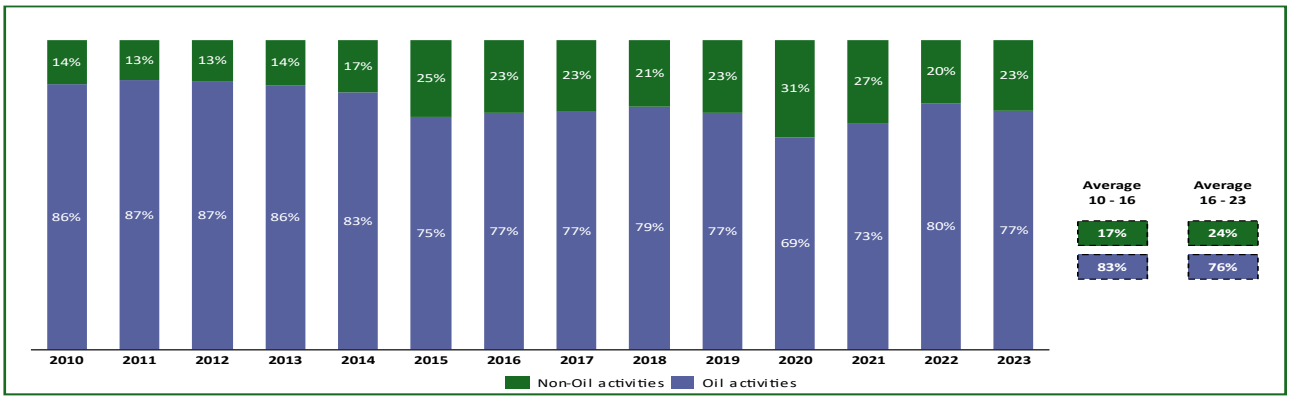


Figure 4: Evolution of Saudi Arabia's exports, Oil vs Non-Oil, 2010 – 2023[18]

This increase results from the implementation of various measures aimed at promoting exports, including incentives and services provided by the Saudi Export Development Authority. These initiatives are designed to enhance Saudi non-oil exports by covering part of the costs associated with certain export activities, such as registering products in target markets, obtaining export-related certifications, participating in international exhibitions, facilitating visits from potential buyers, providing legal support, and offering consulting services.[19]

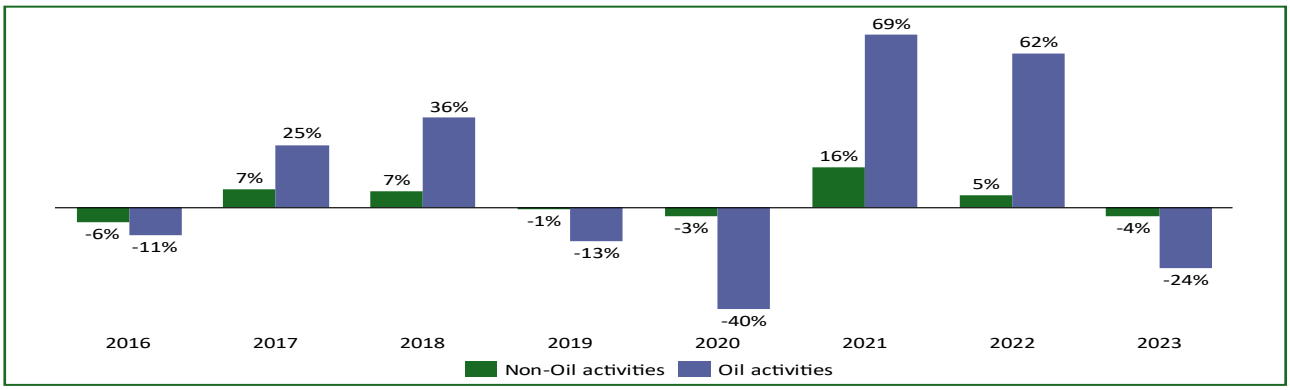


Figure 5: Evolution of exports growth rates, in percentage, Oil versus Non-Oil activities, 2016 - 2023[18]

Following a similar trend as GDP, non-oil export growth rates fluctuated between -6% and 16% from 2016 to 2023. In contrast, oil export activities experienced significant volatility during the same period, with growth rates ranging from -40% to 69%, by broader economic and market dynamic including shifts in global demand, geopolitical events, and supply-demand imbalances, that significantly influenced oil prices and export volumes.

Transition to a clean-energy economy

Saudi Arabia is actively expanding its renewable energy capacity by announcing several mega-projects, with plans to unveil 20 GW of renewable energy projects annually and an ambitious target of 110 to 130 GW by 2030.

Saudi Arabia aims to achieve an energy mix by 2030 that consists of 50% natural gas and 50% renewable energy. Of this renewable share, solar photovoltaic (PV) technology will play the dominant role, contributing the largest portion, while wind energy will account for a smaller segment. In recent

[18] General Authority for Statistics Saudi Arabia, International Trade of Saudi Arabia, 2023
[19] Saudi Exports Development Authority, Annual report 2023

years, the Kingdom has made significant strides in advancing renewable energy projects, with REPDO and PIF working together towards this objective. A total of 45 projects, collectively accounting for 34.8 GW of capacity, are currently at various development stages. These projects represent 27% of the Kingdom's 2030 target of 130 GW.

A renewable energy project goes through six phases, starting from issuing a Request for Quotation (RFQ) to reaching full operational deployment. The table below details each of these stages.

Stage	Description
RFQ released	A request for bids from suppliers or contractors is issued for project equipment and services.
Signed Power Purchase Agreement	A contract, the Power Purchase Agreement, has been signed to sell the generated electricity.
Financial close reached	All financing agreements are secured, and funding is in place.
Under construction	Physical construction of the project is underway. This involves activities like site preparation, installation of equipment (solar panels, wind turbines, etc.) and building the necessary infrastructure.
Permitting stage	The project is obtaining regulatory approvals and licenses.
Operating	The project is fully built, connected to the grid and supplying green electricity.

Table 3: Description of the different renewable energy projects' stages.

The total identified projects have a combined capacity of 34.8 GW, with solar energy projects making up 29 GW (83.3%) and wind projects accounting for 5.8 GW (16.7%).

The current installed capacity is 2.2 GW, with 1.8 GW (82%) derived from solar energy and 400 MW (18%) generated from wind energy.

The remaining 32.6 GW pipeline is distributed across various stages, as illustrated in the figure below.

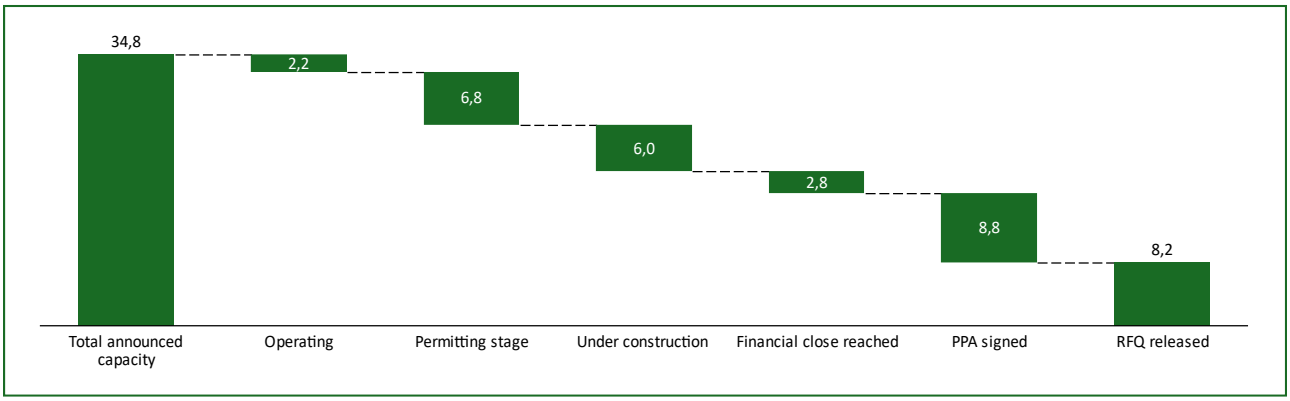


Figure 6: Breakdown of announced renewable energy projects by project status.

Upon the announcement of the Minister of Energy Prince Abdulaziz bin Salman Al-Saud, Saudi Arabia is planning to announce 20 GW of renewable energy capacities annually to reach the 130 GW newest goal by 2030. The Kingdom is accelerating the implementation of renewable energy projects. Between tenders and signed Purchase Power Agreements (PPAs), the total announced capacity reached 2.2 GW in 2022, approximately 10.4 GW in 2023, and an ongoing 16.2 GW in 2024.

As Saudi Arabia advances toward achieving its 2030 target capacity, it is estimated that the funding for clean energy will get to USD 235 billion, of which USD 190 billion are dedicated to renewable energy[20]. This funding is going to be a joint effort between, the Renewable Energy Program Development Office “REPDO” and the Public Investment Fund “PIF,” which took the commitment of developing 70% of Saudi Arabia’s renewable energy target by 2030.

The Kingdom’s strategy extends beyond only deploying renewable energy capacity, aiming also to manufacture key components locally, boosting further its economy and creating job opportunities.

As part of its efforts to localize the renewable energy industry, PIF has recently entered two strategic partnerships to localize the production of solar energy equipment. The first partnership, with 'Jinko Solar' and 'Vision Industries Company', aims to produce high-efficiency solar cells and panels, with an expected annual capacity of 10 GW. A second partnership, signed with 'TCL Zhonghuan Renewable Energy Technology' and 'Vision Industries Company,' focuses on producing wafers and ingots for solar panels, with an annual capacity of 20 GW. These projects are designed to meet the growing demand for renewable energy while contributing to the Kingdom's goal of localizing 75% of its renewable energy projects by 2030.

[20] GCC Capex Wave Series Saudi Arabia Capex Super-Cycle: Diversifying, Decarbonizing, Digitalizing, Goldman Sachs

02. Section 2: Labor Market Analysis

Saudi Arabia's labour market is transforming under Vision 2030, which aims to diversify the economy and foster sustainable growth. Alongside economic reforms, the Kingdom is focused on building a skilled, inclusive workforce to support its ambitious goals.

Historically reliant on expatriate labour, particularly in specialized and technical roles, Saudi Arabia is now prioritizing a skilled workforce, under Vision 2030, focusing on emerging industries and greater inclusion of women and youth through education, training, and employment initiatives.

Evolution of Saudi Arabia's labour market

1. Evolution of unemployment rates

Despite the growing working-age population and the challenges of COVID-19, Saudi Arabia has reduced its overall unemployment rate from 5.6% in 2016 to 3.3% in Q2 2024, driven largely by a significant drop in female unemployment from 21.3% to 10.8% over the same period.

Saudi Arabia is characterized by a growing and young population, making it essential for the Kingdom to develop a skilled workforce that aligns with the goals of Vision 2030 but also to generate sufficient employment opportunities to address the needs of this demographic.

The working-age population in Saudi Arabia grew at a CAGR of 7.5% between 2013 and 2022, significantly outpacing the total population's CAGR of 4.3% over the same period. By 2022, the working-age population accounted for 75.5% of the total population, highlighting its significant weight within the overall demographic structure.

Despite a growing working-age population and increased pressures on the economy and job creation, and temporary setbacks during the COVID-19 crisis, Saudi Arabia has successfully reduced its unemployment rate from 5.6% in 2016 to 3.3% by Q2 2024.

This overall reduction is largely attributed to the Kingdom's focused efforts to improve women female labour force participation, resulting in drastic decrease women's unemployment rate, dropping from 21.3% in 2016 to 10.8% by Q2 2024.

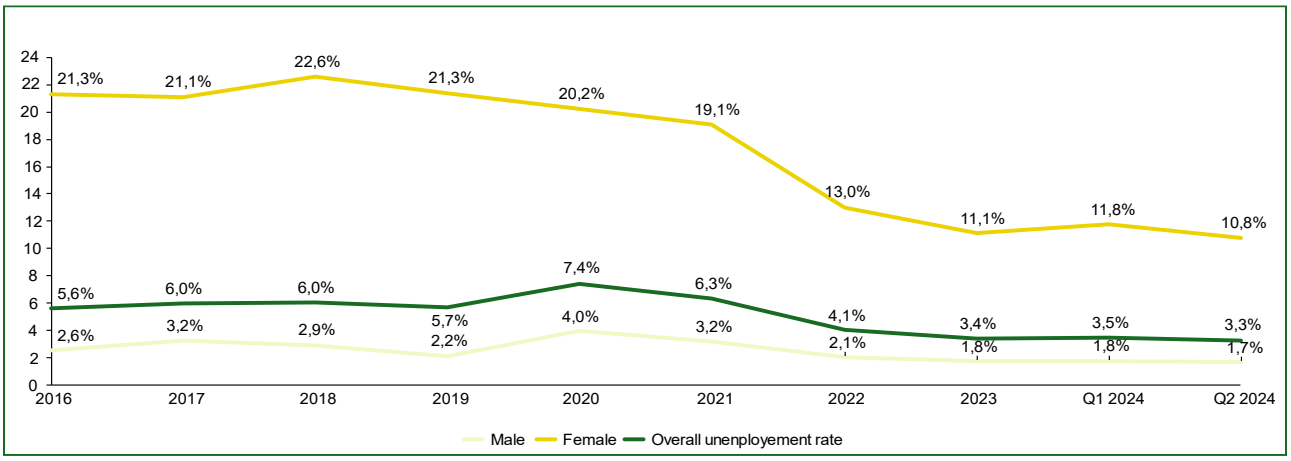


Figure 7: Evolution of unemployment rates in Saudi Arabia, Saudi and non-Saudi 2016 - Q2 2024[21]

2. Evolution of Saudi Arabia's workforce

Saudi Arabia's workforce has grown from 13.6 million in 2017 to 16.9 million in Q2 2024, driven by Vision 2030 efforts. While Saudi nationals' employment has increased, non-Saudis still represent 77% of the workforce in Q2 2024.

Since the launch and operationalization of Vision 2030, Saudi Arabia has made significant strides in job creation, with the total employed workforce increasing from 13.6 million in 2017 to 15.9 million by 2023, reflecting a 3% CAGR over the period. Despite the Covid-19 challenges, the recovery has not only offset the losses but also resulted in employment levels surpassing pre-2020 numbers. By the second quarter of 2024, the workforce counts reached 16.9 million, reflecting the success of Vision 2030 in driving job creation, rather than being merely an effect of post-pandemic recovery.
A significant portion of Saudi Arabia's workforce consists of non-Saudi employees, who represented an average of 75.6% of total employment from 2017 to Q2 2024, compared to 24.4% for Saudi nationals. While the non-Saudi workforce still dominates, the growth rate of Saudi nationals' employment has been improving, with a 3.6% CAGR between 2017 and 2023, outpacing the non-Saudis 2.4% CAGR.

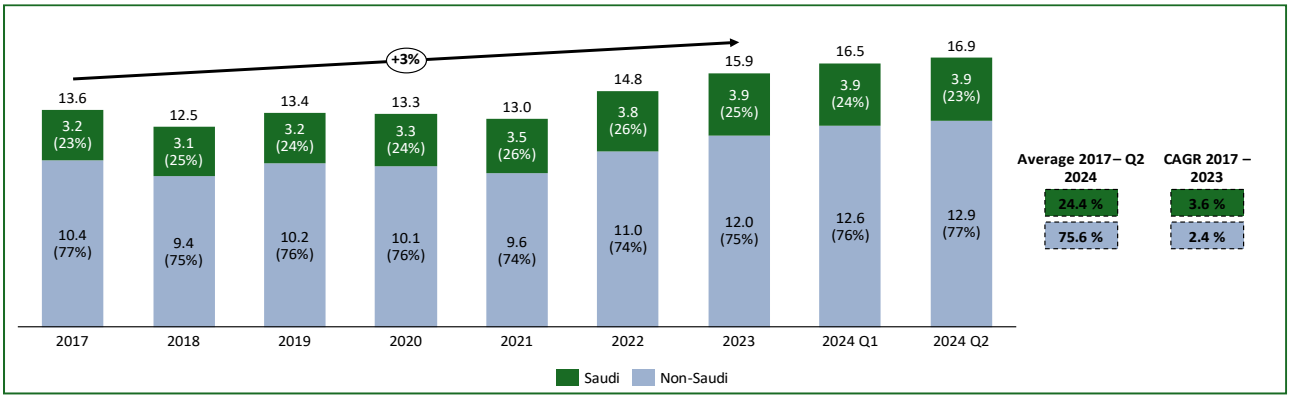


Figure 8: Distribution of Saudi Arabia's workforce counts, Saudi versus Non-Saudi, in million employees, 2017 - Q2 2024[22]

Despite significant progress in reducing female unemployment, the labour market remains predominantly male, with men representing 81% of the total workforce in Q2 2024.

[21] General Authority for statistics Saudi Arabia, Labor market statistics reports 2016 - Q2 2024
[22] General Authority for statistics Saudi Arabia, Labor market statistics reports 2018 - Q2 2024

The Kingdom's labour market is predominantly male, with men representing an average of 81.4% of the total workforce from 2017 to Q2 2024, compared to 18.6% for women. Despite accounting for less than 20% of the workforce, the number of female workers has been growing rapidly, with a CAGR of 7.5% from 2017 to 2023, outpacing the 4.7% CAGR for male workers.

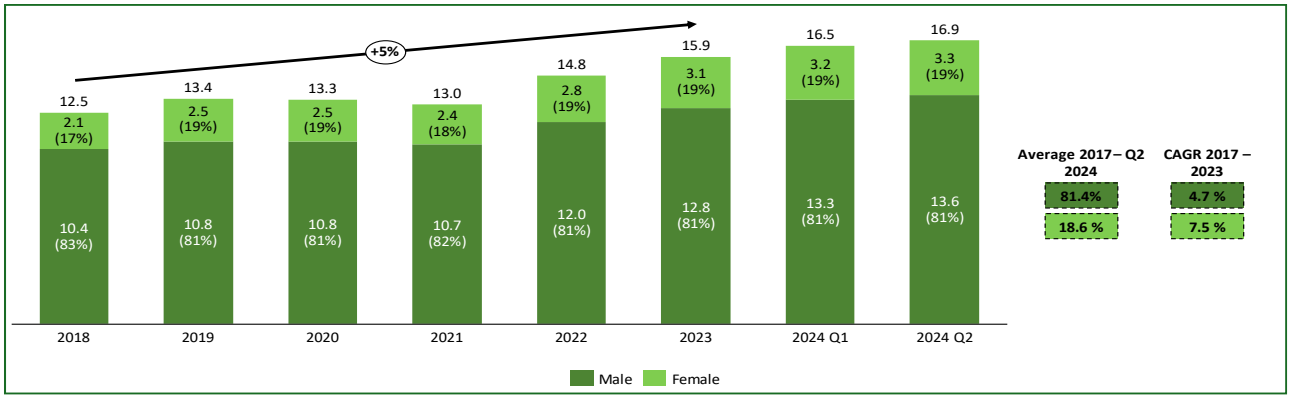


Figure 9: Distribution of workforce counts, Saudi and non-Saudi, Male versus Female, in million employees, 2018 - Q2 2024 [23]

The largest growth in Saudi Arabia's workforce has been observed under the social insurance framework, with an 8% CAGR from 2017 to 2023. Excluding domestic workers, the private sector remains the largest employer, accounting for 86% of the workforce in Q2 2024.

Saudi Arabia's workforce is categorized under three key employment regulations: civil service, social insurance, and domestic worker regulations.

Between 2017 and Q2 2024, workers under social insurance regulations constituted an average of 67.6% of the total workforce. Domestic worker regulations accounted for 23.7%, while civil service regulations represented 8.7%.

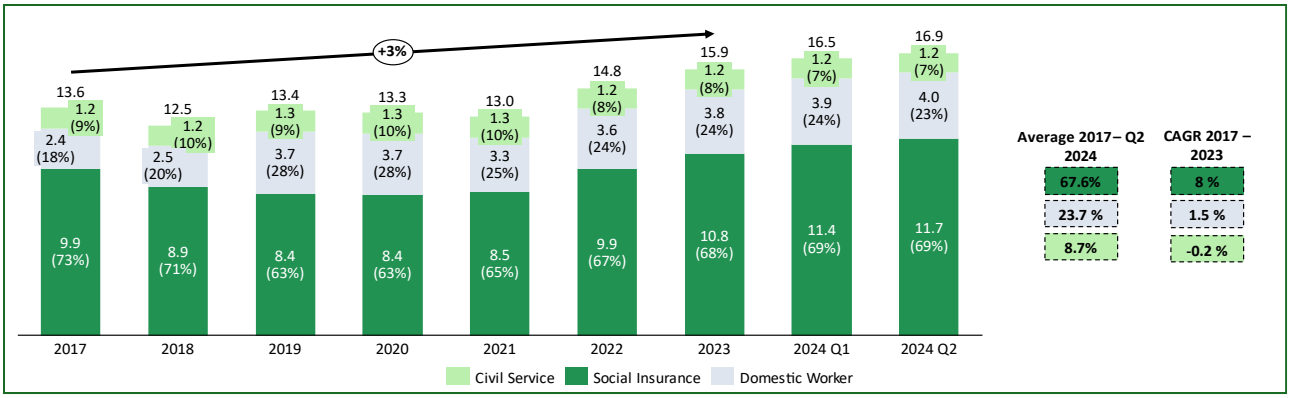


Figure 10: Distribution of workforce counts, Saudi and non-Saudi, by adopted regulation in million employees, 2017 - Q2 2024 [24][25]

[23] General Authority for statistics Saudi Arabia, Labor market statistics reports 2018 - Q2 2024
[24] General Authority for statistics Saudi Arabia, Labor market statistics reports 2017 - Q2 2024
[25] Employment figures refer to GOSI-registered salaried workers in the private sector, as well as public sector employees tracked in official records. They do not include self-employed individuals, military personnel, or informal employment categories. For the purposes of workforce planning in the renewable energy sector, this data offers a consistent and relevant basis focused on formal employment trends.

Regulatory framework	Description
Civil service	Refers to government employees working in ministries and agencies under civil service rules. They implement state policies and manage public administration, with their pay and pensions provided directly by the government.
Social insurance	A system managed by the General Organization for Social Insurance that offers financial benefits like retirement pensions, disability support, and compensation for work-related injuries, funded by contributions from both employers and employees
Domestic worker	Refers to professionals who provide social welfare services such as counselling and community support, regulated by the Ministry of Human Resources and Social Development.

Table 4 : Description of Saudi Arabia employment regulatory frameworks

Excluding domestic workers, the Kingdom's workforce is heavily concentrated in the private sector, which accounts for 81.4% of the total. The private sector workforce grew at a CAGR of 3.7% between 2017 and 2023, slightly surpassing the public sector's growth rate of 3.5%. On average, public-sector workers represent 15.5% of the total workforce during this period.

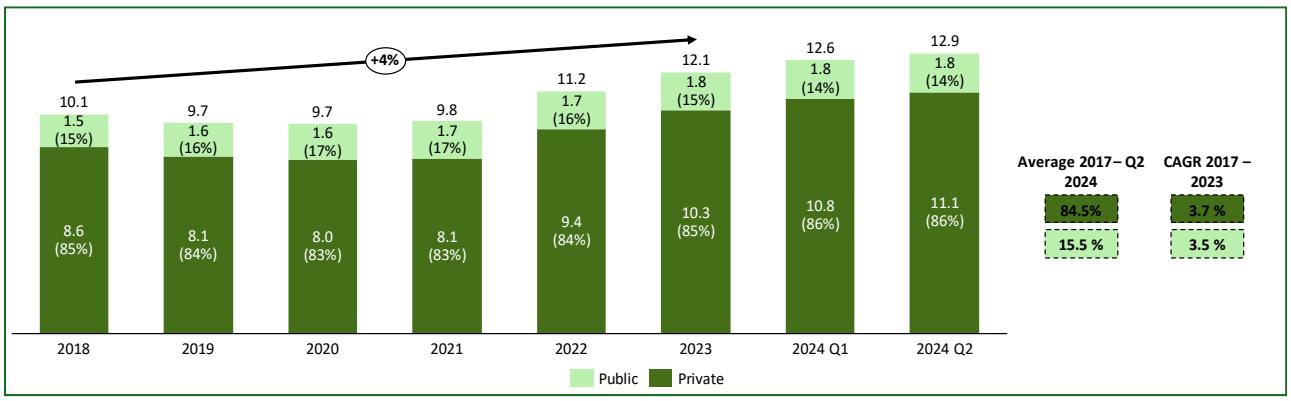


Figure 11: Distribution of workforce counts, Saudi and non-Saudi, by sector, public versus private, in million employees, 2018 - Q2 2024 [26]

10 industries account for nearly 90% of Saudi Arabia's workforce, with workforce concentration in these industries remaining stable since 2019.

As of Q2 2024, Saudi Arabia's workforce stands at 16.9 million, comprising 11.1 million workers in the private sector, 1.8 million in the public sector, and the remainder employed as domestic workers. Out of the 11.7 million workers under the social insurance framework in Q2 2024, five industries account for approximately 70% of the total workforce. Mainly: Construction, Wholesale and retail trade; repair of motor vehicles and motorcycles, Manufacturing, Administrative and support service activities

The top 10 industries make up 89% of workers covered by the social insurance framework, a share that has remained steady between 87% and 90% from 2019 to Q2 2024.

[26] General Authority for statistics Saudi Arabia, Labor market statistics reports 2018 - Q2 2024

Industry	Number of workers in Q2 2024 (Thousand worker)	Percentage of total workers in Q2 2024	Ranking						CAGR 2019 - 2023
			2019	2020	2021	2022	2023	Q2 2024	
Construction	2,895	25%	1	1	1	1	1	1	4%
Wholesale and retail trade; repair of motor vehicles and motorcycles	1,648	14%	2	2	2	2	2	2	-4%
Administrative and support service activities	1,170	10%	3	3	3	3	4	4	1%
Manufacturing	1,342	11%	4	4	4	4	3	3	10%
Accommodation and food service activities	680	6%	5	5	5	5	6	6	14%
Other activities	1,079	9%	✕	✕	✕	✕	5	5	105%
Human health and social work activities	449	4%	6	6	6	6	8	8	6%
Transportation and storage	567	5%	7	7	8	7	7	7	20%
Public administration and defense; compulsory social security	282	2%	9	8	7	9	9	9	8%
Other service activities	251	2%	8	9	9	10	✕	✕	1%

Legend : Rank | Not in the Top 10 | Positive CAGR | Negative CAGR

Figure 12: Evolution of Top 10 industries in terms of workforce counts, Saudi and non-Saudi, 2019 - Q2 2024 [27]

Elementary occupations still make up 40% of Saudi Arabia's workforce. However, the professionals and managers categories have experienced the highest growth, with CAGRs of 24% and 21%, respectively, between 2021 and 2024.

The distribution of the 11.7 million workers under the social insurance framework highlights a significant concentration in elementary occupations, which accounted for 4.58 million workers in Q2 2024, representing approximately 40% of the total workforce.

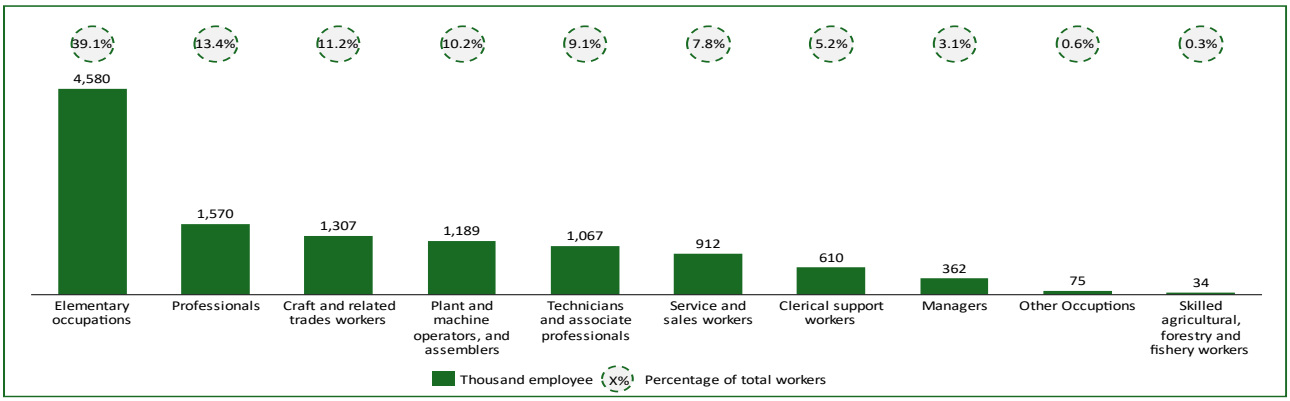


Figure 13: Distribution of total workforce counts, Saudi and non-Saudi, by occupation, in thousand employees, Q2 2024 [28]

The occupations experiencing the highest growth in the number of employees, as measured by CAGR, are professionals, with a 24% CAGR between 2021 and 2023, followed by service and sales workers, growing at a 21% CAGR during the same period. Additionally, managers and plant and machine operators, and assemblers both recorded significant growth, each with a 19% CAGR.

[27] General Authority for statistics Saudi Arabia, Labor market statistics reports 2019 - Q2 2024
[28] General Authority for statistics Saudi Arabia, Labor market statistics report Q2 2024

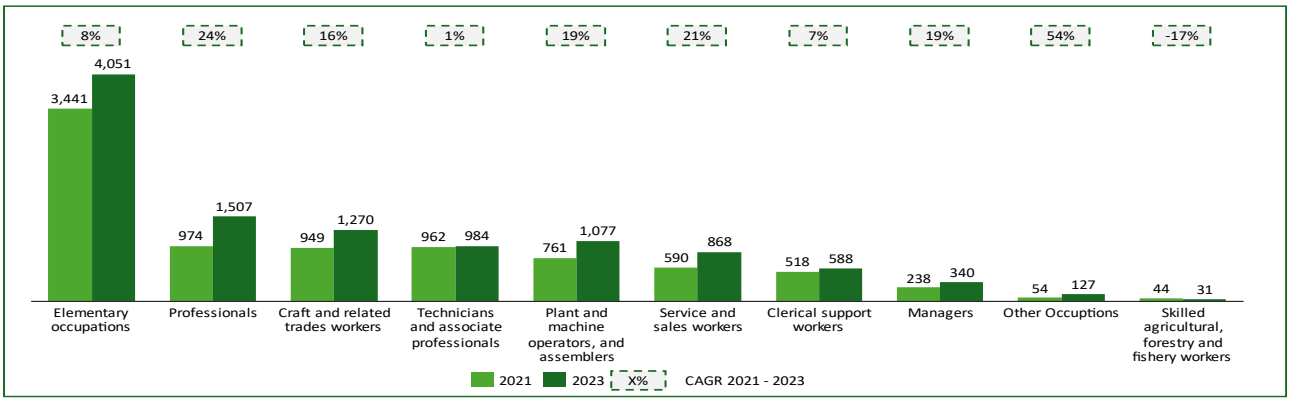


Figure 14: Evolution of total workforce counts, Saudi and non-Saudi, by occupation, in thousand employees, 2021 – 2023 [29]

Deep Dive Saudi nationals workforce

1. Evolution of unemployment rates among Saudi nationals

Saudi Arabia has reduced Saudi nationals' unemployment to 7.1% by Q2 2024, nearly achieving its Vision 2030 target six years in advance, driven by a significant progress in female employment.

Saudi Arabia has successfully reduced the unemployment rate among Saudi nationals from 12.3% in 2016 to 7.1% in Q2 2024. This significant progress aligns with the ambitious objectives set under Vision 2030, which aimed to bring Saudi nationals' unemployment down to 7% by 2030. Remarkably, the Kingdom has nearly achieved this target six years ahead of schedule. The decline in Saudi Arabia's unemployment rate reflects a combined effort to reduce unemployment among both Saudi males and females. For Saudi males, the unemployment rate dropped from 5.9% in 2016 to 4% in Q2 2024, while Saudi females experienced a remarkable decrease from 34.5% in 2016 to 12.8% in the same period. This remarkable drop in female unemployment highlights Saudi Arabia's strong commitment to empowering women in the workforce.

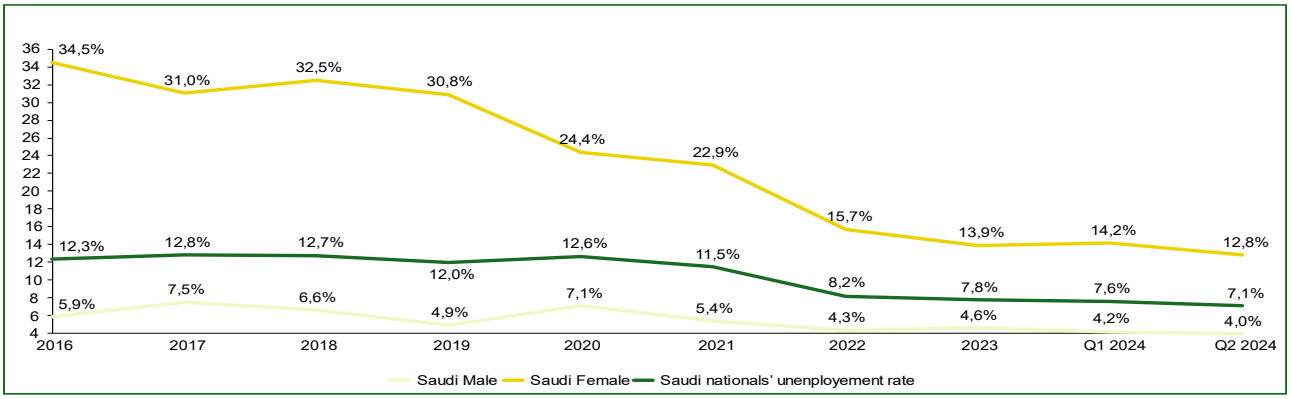


Figure 15: Evolution of Saudi nationals' unemployment rate, Male versus Female 2016 - Q2 2024 [30]

2. Evolution of the Saudi nationals workforce

[29] General Authority for statistics Saudi Arabia, Labor market statistics reports 2021 - 2023
[30] General Authority for statistics Saudi Arabia, Labor market statistics reports 2016 - Q2 2024

The decrease in female unemployment has led to a notable increase in the presence of Saudi women in the Saudi workforce, with their share rising from 34% in 2018 to 40% in Q2 2024.

The number of Saudi nationals in the workforce grew from 3.1 million in 2018 to 3.9 million in Q2 2024, reflecting a 5% CAGR between 2018 and 2023. Over this period, Saudi male nationals accounted, on average, for 62% of the total Saudi workforce, while female nationals represented about 38%. However, the growth rates between the two groups varied significantly, with female Saudi nationals growing with a 7.5% CAGR from 2018 to 2023, compared to just 2.7% for males. This sharp increase in female workforce participation led to a rise in their share of the total Saudi national workforce, growing from 34% in 2018 to 40% by 2023.

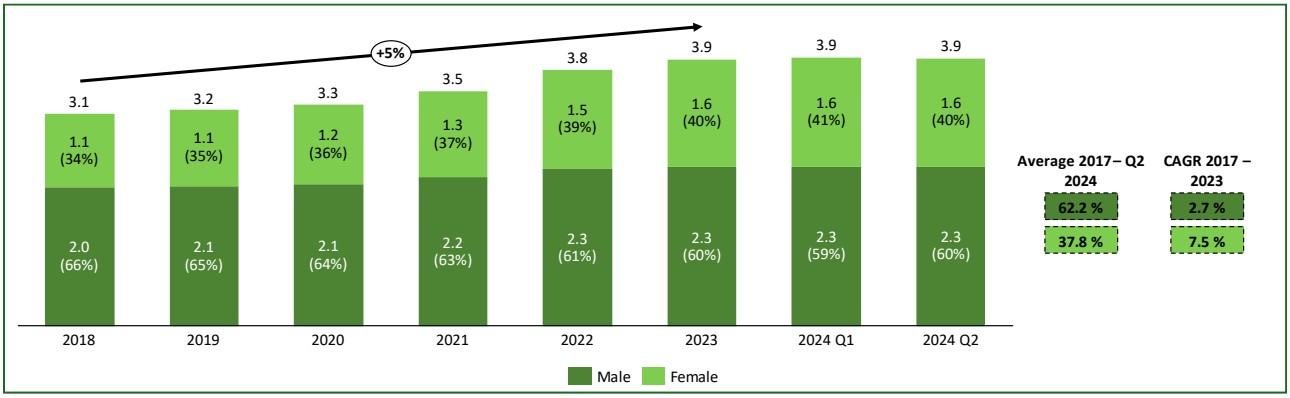


Figure 16: Distribution of Saudi nationals' workforce counts, Male versus Female, in million employees, 2018 - Q2 2024 [31]

Despite a slight shift toward the private sector, Saudi nationals continued strong presence in the public sector may be due to the average salaries, which are 43% higher than those in the private sector.

The distribution of Saudi nationals between the private and public sectors highlights a gradual shift toward private sector employment, with their share in the private sector increasing from 55% in 2018 to 59% by Q2 2024.

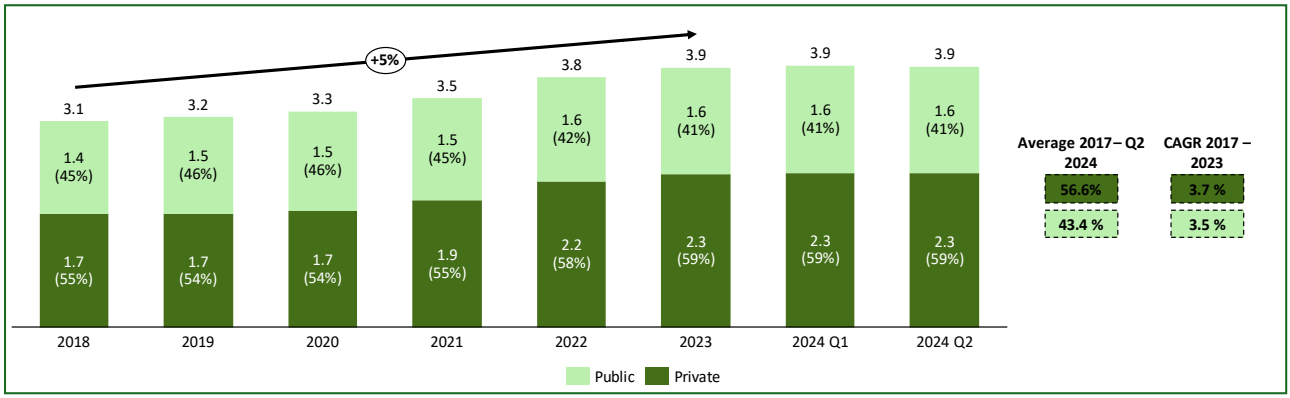


Figure 17: Distribution of Saudi nationals' workforce counts by sector, public versus private, in million employees, 2018 - Q2 2024[31]

Additionally, in Q2 2024, the public sector employed a total of 1.8 million workers, including both Saudis and non-Saudis. Of these, 1.6 million, or 91%, were Saudi nationals.

[31] General Authority for statistics Saudi Arabia, Labor market statistics reports 2018 - Q2 2024

The preference of Saudi nationals for public sector employment could be attributed, in part, to the significant salary disparity, with average wages being 45.3% higher in the public sector compared to the private sector. In 2020, public sector salaries for Saudi nationals averaged 11,688 SAR, while private sector counterparts received an average of 8,031 SAR, according to the latest available data from the General Authority for Statistics.

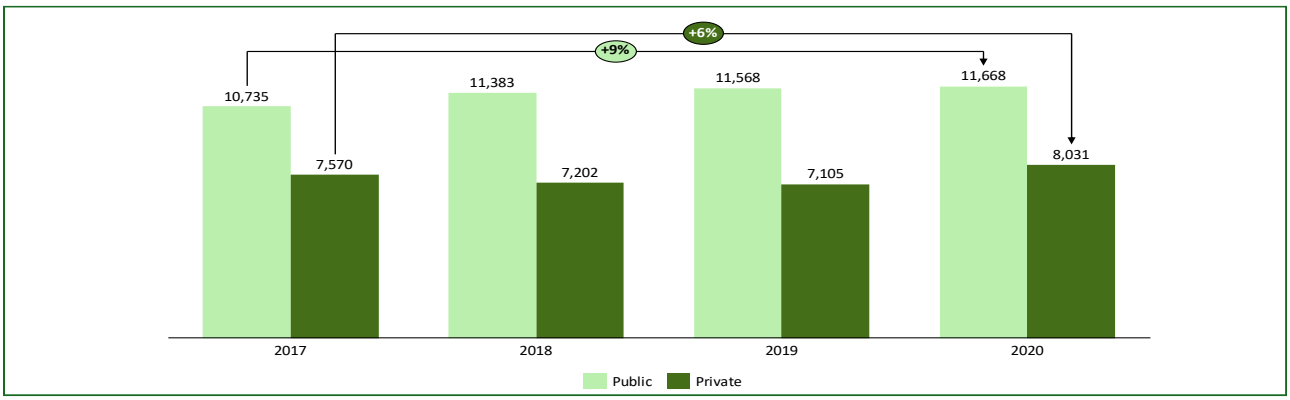


Figure 18: Evolution of Saudi nationals' average salaries by sector, public versus private, in SAR, 2017 – 2020 [32]

The top 10 industries under social insurance account for 83% of Saudi nationals, with the rankings remaining mostly stable over the past five years. In Q2 2024 construction surpassed wholesale and retail trade to become the top sector.

As of Q2 2024, approximately 2.7 million Saudi nationals are employed under the social insurance framework. Nearly 60% of these workers are concentrated in five key industries: wholesale and retail trade (including the repair of motor vehicles and motorcycles), construction, manufacturing, public administration and defense (including compulsory social security), and human health and social work activities.

Moreover, the Top 10 industries in terms of Saudi nationals workforce counts account for 83% of the total Saudi workforce under the social insurance framework.

Industry	Number of workers in Q2 2024 (Thousand worker)	Percentage of total workers in Q2 2024	Ranking						CAGR 2019 - 2023
			2019	2020	2021	2022	2023	Q2 2024	
Wholesale and retail trade; repair of motor vehicles and motorcycles	396	14.3%	1	1	1	1	1	2	-1%
Construction	400	14.4%	2	2	2	2	2	1	8%
Manufacturing	370	13%	3	3	3	3	3	3	15%
Human health and social work activities	224.3	8.1%	4	4	4	4	5	5	7%
Public administration and defense; compulsory social security	224.7	8.1%	5	5	5	6	4	4	10%
Administrative and support service activities	185	6.7%	6	6	6	5	6	6	13%
Accommodation and food service activities	141	5.1%	9	8	7	7	7	7	18%
Mining and quarrying	118	4.3%	7	7	8	10	10	10	-0.2%
Transportation and storage	137	5%	✗	10	10	8	8	8	23%
Education	99	3.6%	8	9	9	✗	✗	✗	7%

Legend : Rank | Not in the Top 10 | Positive CAGR | Negative CAGR

Figure 19: Evolution of Top 10 industries in terms of Saudi nationals' workforce counts, 2019 - Q2 2024 [33]

[32] General Authority for statistics Saudi Arabia, Labor market statistics reports 2016 - 2020
[33] General Authority for statistics Saudi Arabia, Labor market statistics reports 2019 - Q2 2024

While the rankings of these industries have remained relatively stable over the years, a notable shift occurred in Q2 2024 when Construction overtook Wholesale and Retail Trade, historically the leading employer of Saudi nationals, thus pushing this industry to the second position.

Professionals, managers, and technicians represent 58% of the Saudi nationals workforce, with professionals and managers growing at CAGRs of 22% and 16% between 2021 and 2023, indicating a skilled Saudi nationals workforce.

The distribution of the 2.7 Saudi nationals registered under the social insurance framework reflect a skilled labour force with managers, professionals as well technicians and associated professionals accounting for 58% of the Saudi nationals workforce.

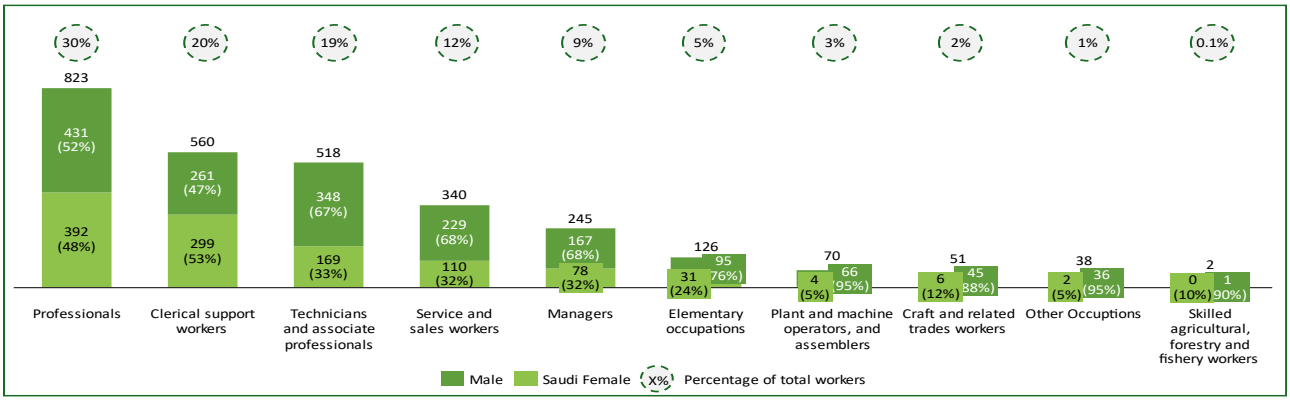


Figure 20: Distribution of Saudi nationals' workforce counts by occupation, Male versus Female, in thousand employees, Q2 2024 [34]

The occupations showing the fastest growth in employment, measured by CAGR between 2021 and 2023, are “other occupations”, which grew at an important 43% CAGR, followed by Professionals at 22% CAGR. Additionally, the category of Managers recorded notable growth with a 16% CAGR during the same period.

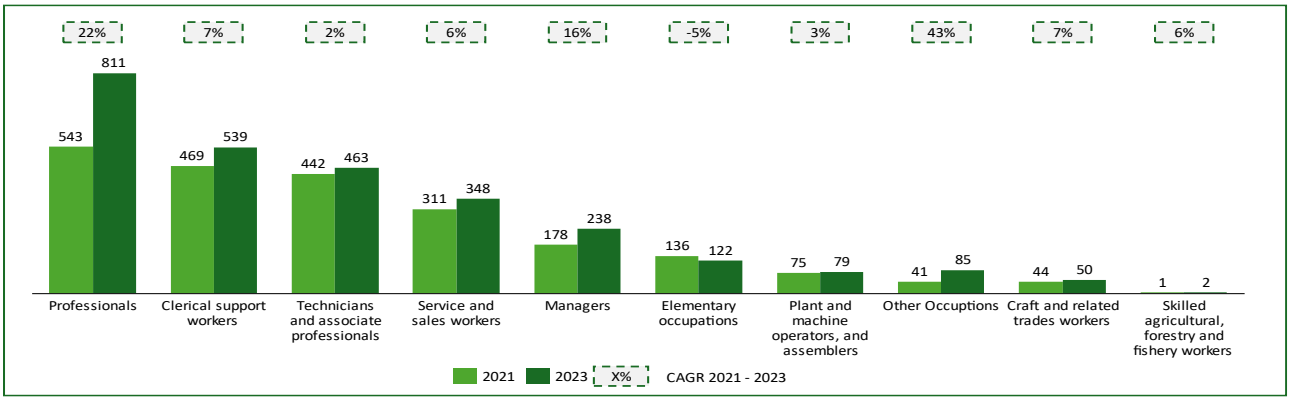


Figure 21: Evolution of Saudi nationals' workforce counts by occupation, in thousand employees, 2021 – 2023 [35]

[34] General Authority for statistics Saudi Arabia, Labor market statistics report Q2 2024
[35] General Authority for statistics Saudi Arabia, Labor market statistics reports 2021 - 2023

03. Section 3: Future Talent Needs

Renewable energy development is one of the key pillars of Saudi Arabia's Vision 2030, reflecting the Kingdom's commitment to diversifying its economy and transitioning to sustainable energy sources. Minister of Energy, Prince Abdulaziz bin Salman Al Saud, recently announced the Kingdom's ambition to achieve 110 to 130 GW of renewable energy capacity by 2030.

This target would be reached through the annual tendering of 20 GW of solar and wind energy projects, building upon already operational and announced projects. Reaching this target would enable the Kingdom to generate 50% of its energy from renewable sources by 2030.

This section explores the emerging renewable energy talent pool, projecting workforce counts demand and identifying the essential skills required to support Saudi Arabia's renewable energy ambitions.

To estimate and qualify the labour force required to achieve Saudi Arabia's renewable energy targets, the authors developed an Excel-based estimation model. This model relies on four key parameters presented in the following illustration.

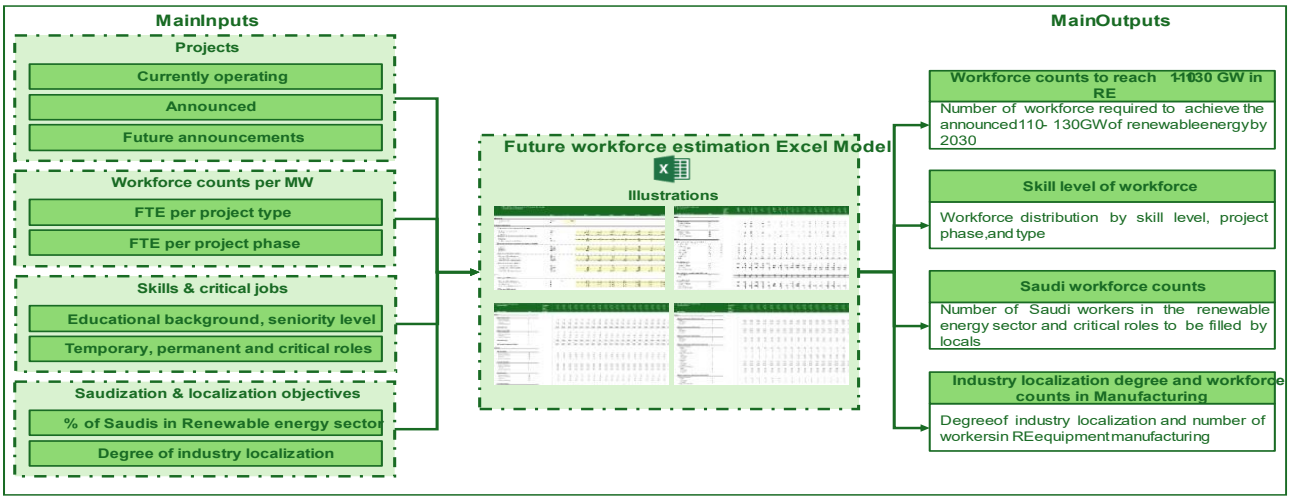


Figure 22: Authors' workforce estimation Excel model framework.

The model also relies on two scenarios, a worst-case scenario that suggests that Saudi Arabia, will only tender 15 GW annually and a base case scenario aligned with the yearly 20 GW annual tendering announced by the Saudi Energy minister. These estimates were also backed up by the study "Greening India's workforce, issue paper 2017" for FTEs per MW.

Future renewable energy capacity in Saudi Arabia

1. General approach

As of today, Saudi Arabia has an operational renewable energy capacity of 2.2 GW, including 1.8 GW of solar energy and 400 MW of wind energy. Beyond this, the Kingdom has 32.6 GW of renewable energy projects at various stages, ranging from released RFQs to permitting. For modelling purposes, we have incorporated 25 GW, excluding projects lacking a clear commissioning timeline.

The pace of project announcements has surged remarkably, with announced capacities growing from 2.2 GW in 2022 to 10.4 GW in 2023 and 16.2 GW in 2024. While the Kingdom's target of announcing 20 GW annually remains ambitious, the growth trajectory in recent years suggests that it is within reach.

To ensure accurate estimates, we developed two scenarios:

- **Conservative scenario:** Announcements stabilize at 15 GW annually, aligning with the pace of 2024.
- **Base-case scenario:** The Kingdom achieves its 20 GW annual target.

For both scenarios, we assumed that 70% of the future announced capacity will be solar energy projects and 30% will be wind energy projects. Each renewable energy project is modelled through four standardized phases:

- **Business development:** Lasts 6 months, regardless of capacity or energy type.
- **Design and Pre-construction:** Lasts 6 months, regardless of capacity or energy type.
- **Construction:** Lasts 24 months, regardless of capacity or energy type.
- **Operations and maintenance:** 20 years for wind projects and 25 years for solar projects.

2. Conservative Scenario

Under the conservative scenario, Saudi Arabia would reach a total of 102.8 GW of operating renewable energy capacity by 2032, split into 76.6 GW of solar energy and 26.2 GW of wind energy.

Under the conservative scenario, and assuming that Saudi Arabia will tender 15 GW of renewable energy capacities annually, the Kingdom is projected to achieve 72.8 GW of total installed capacity by 2030 and 102.8 GW by 2032. This includes 76.6 GW of solar energy, comprising 74.6% of total capacity, and 26.2 GW of wind energy, accounting for the remaining 25.4%.

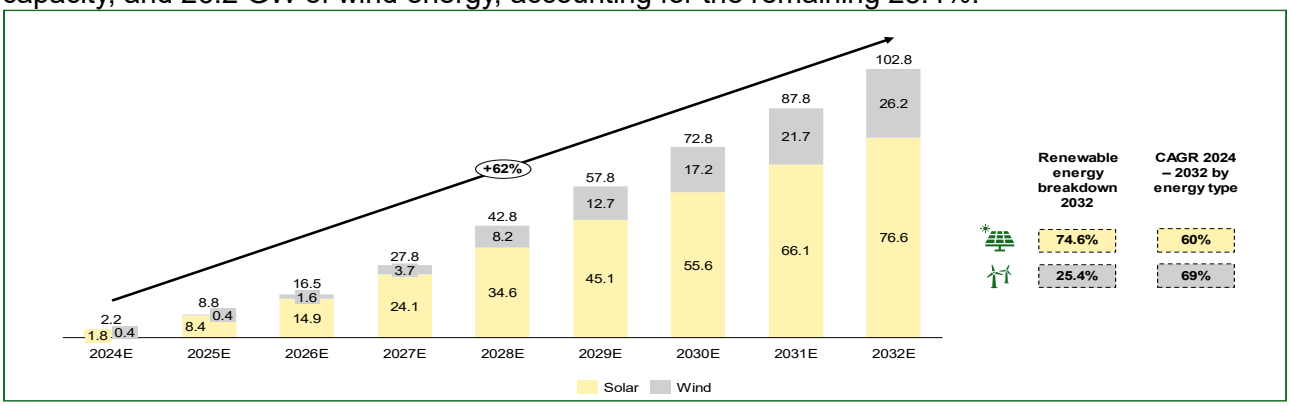


Figure 23: Evolution of Saudi Arabia total operating capacity by energy type, in GW, 2024E – 2032E, conservative scenario

3. Base-case scenario

Under the base-case scenario, Saudi Arabia would reach a total of 127.8 GW of operating renewable energy capacity by 2032, split into 94.1 GW of solar energy and 33.7 GW of wind energy.
Under the base-case scenario, if Saudi Arabia tenders 20 GW of renewable energy projects annually, the Kingdom is expected to reach 87.8 GW of total installed capacity by 2030 and 127.8 GW by 2032. This includes 94.1 GW of solar energy, representing 73.6% of total capacity, and 33.7 GW of wind energy, accounting for the remaining 26.4%.

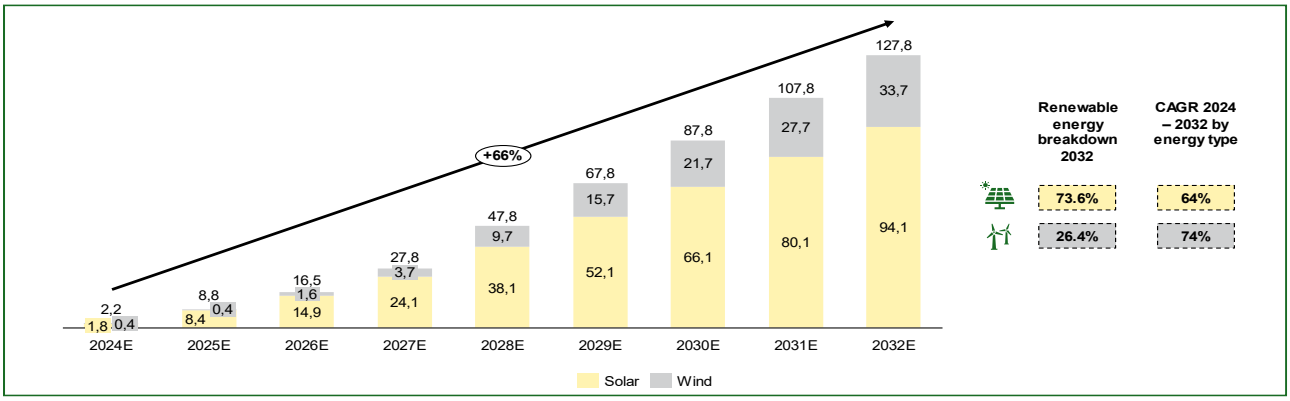


Figure 24: Evolution of Saudi Arabia total operating capacity by energy type, in GW, 2024 - 2032, base-case scenario.

The evolution of GW capacity across the four project phases reveals dynamics that will later impact the workforce counts. GWs under “Operations and Maintenance”, and therefore operating capacity is set to grow steadily as projects come to completion and reach commercial commissioning. GWs under both “Business development” and “Design / Pre-construction” remains stable between 2025 and 2030, corresponding to a consistent pace of project announcements, before coming to an end as projects transition to later phases.
The most notable fluctuations occur in the "Construction" phase, where the number of projects under construction is expected to surge between 2025 and 2030, driven by the simultaneous development of multiple projects. This will decline as projects are finalized and transitioned into operation. This will directly impact workforce requirements, with high demand for construction-related roles in the short to medium term and the need to redeploy these workers into other sectors starting in 2031.

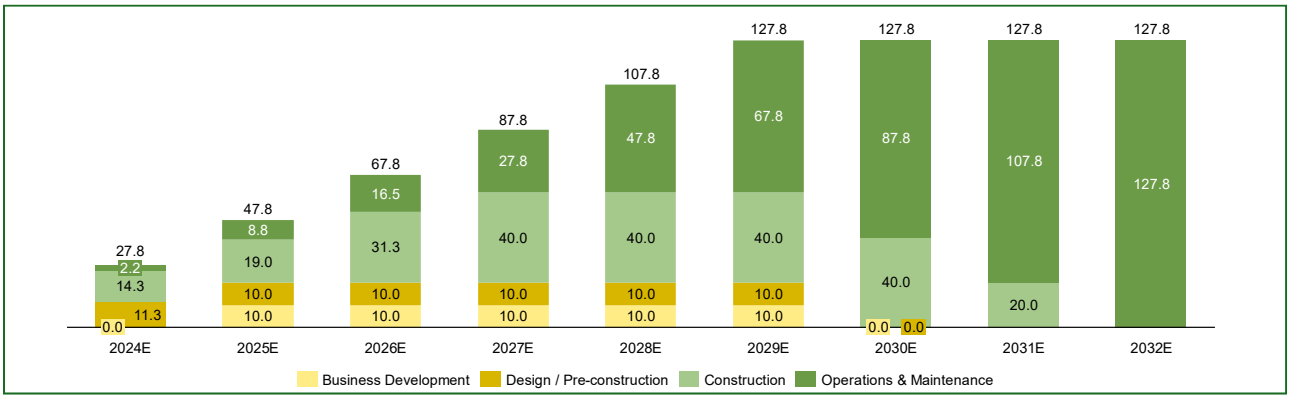


Figure 25: Evolution of number of GWs in each project phase, 2024E – 2032E, base-case scenario.

Future renewable energy talent pool

To ensure accurate estimates for future workforce requirements in the renewable energy sector, we employed two complementary methodologies based on:

- Full-Time Equivalents (FTEs) per MW per project phase and energy type based on the study "Greening India's workforce, issue paper 2017".
- FTEs per MW per project phase and energy type developed by the authors thanks to their expertise in renewable energy plants.

Under the base-case scenario, achieving the projected renewable energy capacity of 127.8 GW by 2032 will require Saudi Arabia to mobilize between 91,000 and 127,000 workers at peak workforce demand in 2030.

To reach the targeted capacity, the Kingdom would require mobilizing 91,000 (authors' estimates) to 127,000 (reference study-based estimates) workers at peak workforce demand in 2030. The difference between the two methods lies in the productivity improvements factored in the authors' calculations, particularly during the construction phase. These improvements are driven by advancements in the capacity of solar panels and wind turbines, as well as innovations in construction technologies, enabling faster and more efficient deployment of renewable energy projects.

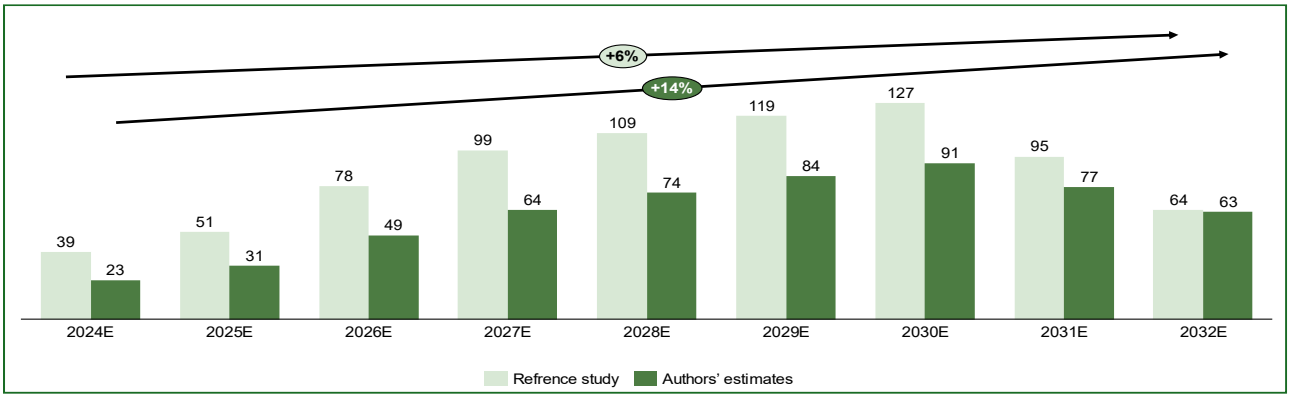


Figure 26: Saudi Arabia workforce requirements in the renewable energy sector, in thousand workers, 2024E – 2032E, reference study.

For all the forthcoming analysis, we will adopt the authors' estimates under the base-case scenario, which anticipates that Saudi Arabia will achieve 127.8 GW of renewable energy capacity by 2032. This scenario projects a peak workforce demand of ~91,000 workers in 2030, reflecting the year with the highest labour requirements.

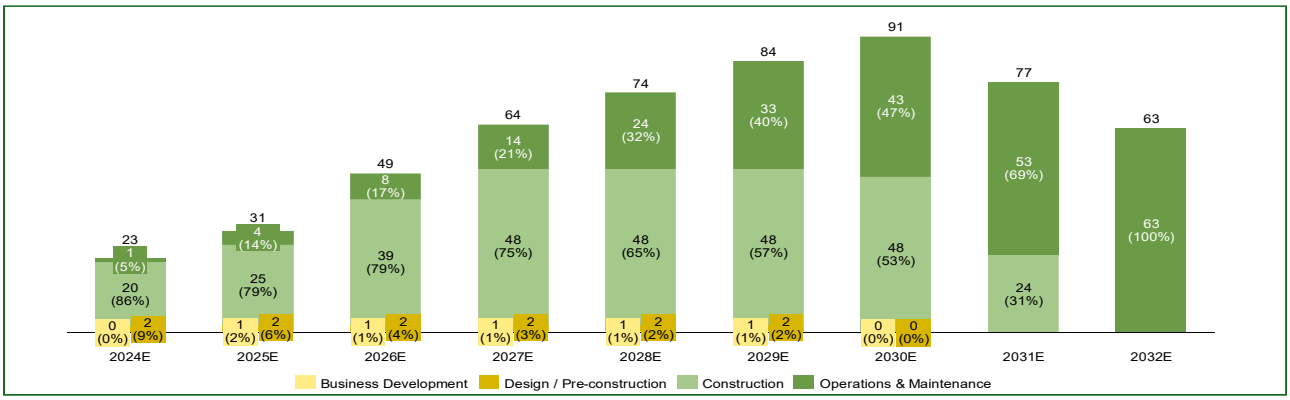


Figure 27: Evolution of Saudi Arabia's workforce counts in Renewable energy by project phase, in thousand workers, 2024E – 2032E.

The evolution of workforce dynamics in Saudi Arabia's renewable energy sector reveals critical trends tied to the progression of projects across their lifecycle, highlighting the sector's complexity and the importance of workforce management in the sector.

- Business Development and Design / Pre-construction: Workforce levels in these two early project phases are expected to remain steady at approximately 3,000 workers throughout the project announcement years (2024-2029). After this period, and as no new projects are being initiated, the need for workers in these two phases will entirely diminish by 2030.
- Construction: As the most labour-intensive phase, construction will account for a significant portion of the workforce.
- Operations and maintenance: Initially, O&M workforce requirements will be minimal, reflecting the current 2.2 GW of installed capacities. However, as new projects reach commercial operation, the demand of O&M roles will steadily increase, both in numbers as well as in share of total renewable energy workforce.

To refine workforce estimates and enable strategic workforce planning, the projected peak workforce demand of 91,000 has been categorized into six distinct disciplines. These include four engineering specialties, a business-oriented profiles discipline, and a broader category for other supporting roles.

Discipline	Description	Examples
Mechanical Engineering	• Focuses on the design, development, and maintenance of mechanical systems essential in renewable energy projects	• Mechanical Engineer • Turbine Technician • Maintenance Engineer
Civil Engineering	• Involves planning and constructing infrastructure to support renewable energy installations, such as wind farms or solar plants	• Site Engineer • Structural Engineer • Project Manager
Electrical Engineering	• Specializes in the design and management of electrical systems and equipment to ensure efficient energy generation and distribution	• Electrical Engineer • Electrical Technician
Other Engineering	• Encompasses various specialized engineering fields that contribute to renewable energy projects, such as environmental or chemical engineering	• Environmental Engineer • Chemical Engineer
Business Profiles	• Supports project management, financing, and strategic planning within the renewable energy sector	• Roles in Finance, Human Resources, Business Development, Procurement & Logistics, Communication, etc.
Other	• Encompasses senior leadership, legal, and administrative roles critical to overseeing and supporting renewable energy projects	• General Manager • Legal Counsel • Executive / Project Assistant

Figure 28: Key workforce disciplines in Renewable Energy projects, authors' framework.

By 2030, the projected distribution of the renewable energy workforce highlights the dominance of engineering roles, with approximately 74,000 workers in engineering disciplines, representing 80% of the total workforce. Among these, electrical engineering is expected to represent a significant portion, compromising 34% of the total workforce.

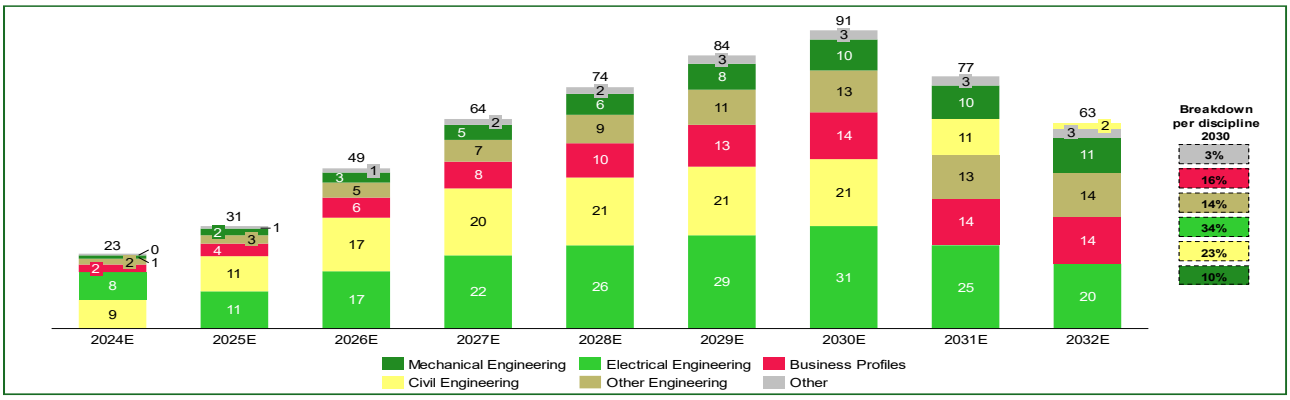


Figure 29: Evolution of workforce counts by discipline, in thousand workers, 2024E – 2032E.

Workforce demand across all disciplines is projected to increase progressively as installed capacities scale up. Only civil engineering, closely tied to the construction phase of projects, will follow a distinct trajectory. Its demand will rise significantly during the construction-heavy years between 2025 and 2030, before declining post-2030 as projects transition to operations.

By 2030, the ~74,300 engineering roles required in Saudi Arabia's renewable energy sector will be distributed as follows: 23.700 engineers (33%), 25.200 technicians (34%), and 25.400 operators (34%).

To provide a clear breakdown of engineering roles, the engineering workforce is segmented into three levels of skill: engineers, technicians and operators. The illustration below provides specific examples of roles within each category across the different engineering disciplines.

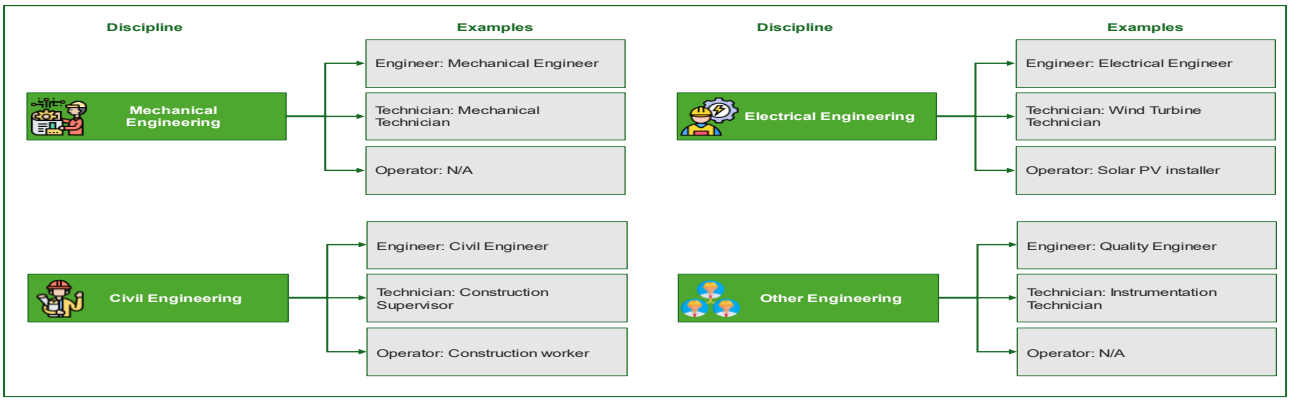


Figure 30: Illustration of examples of roles for each category across engineering disciplines.

By 2030, Saudi Arabia's renewable energy sector will require approximately 74,000 engineering-related profiles, distributed across 23,700 engineers, 25,200 technicians, and 25,400 operators. The demand for operators, which is closely tied to civil engineering roles in the construction phase, will decline starting in 2031 as project completions reduce construction activity. By 2032, operator roles are expected to phase out entirely as all planned projects become fully operational.

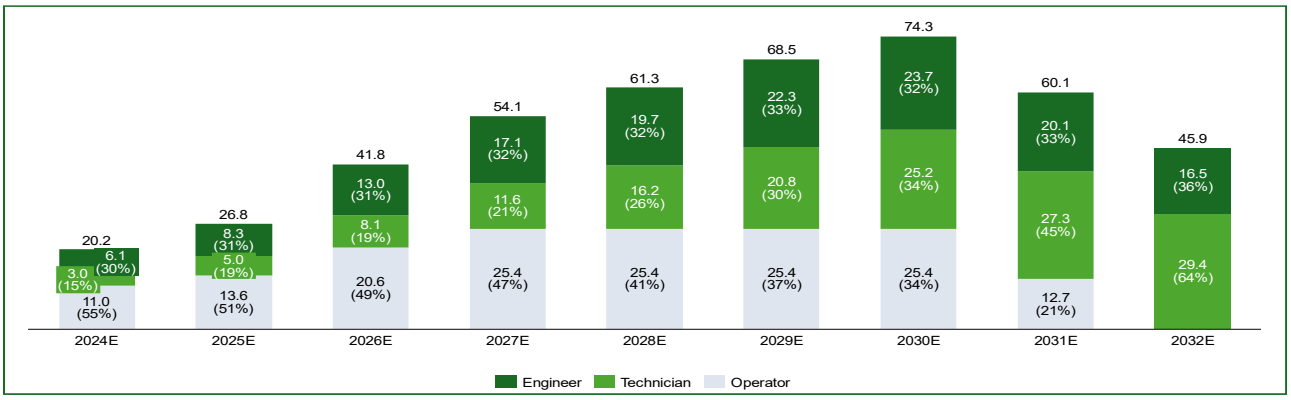


Figure 31: Evolution of engineering disciplines required workforce by engineer, technician and operator, in thousand workers, 2024E – 2032E.

Excluding operators, Saudi Arabia is projected to need around 46,200 entry-level and junior professionals and ~20,000 experienced specialists by 2030 to support the growth of its renewable energy sector.

The projected workforce for Saudi Arabia's renewable energy sector is segmented into two seniority levels:

- Junior profiles: Compromising of fresh university and vocational training graduates and professionals with 1 to 5 years of experience.
- Senior profiles: Representing professionals with over 5 years of experience.

Based on the authors' assumptions and aligned with industry practices, a 70% junior to 30% senior workforce ratio is projected across the six identified disciplines, which translates into an approximate supervision ratio of 1 senior to every 2.3 juniors, which will remain stable over the entirety of the projection period.

When applied to workforce distribution, excluding operators, it is estimated that by 2030, the peak workforce demand year, Saudi Arabia will require approximately 46,000 juniors and 20,000 seniors across the sector.

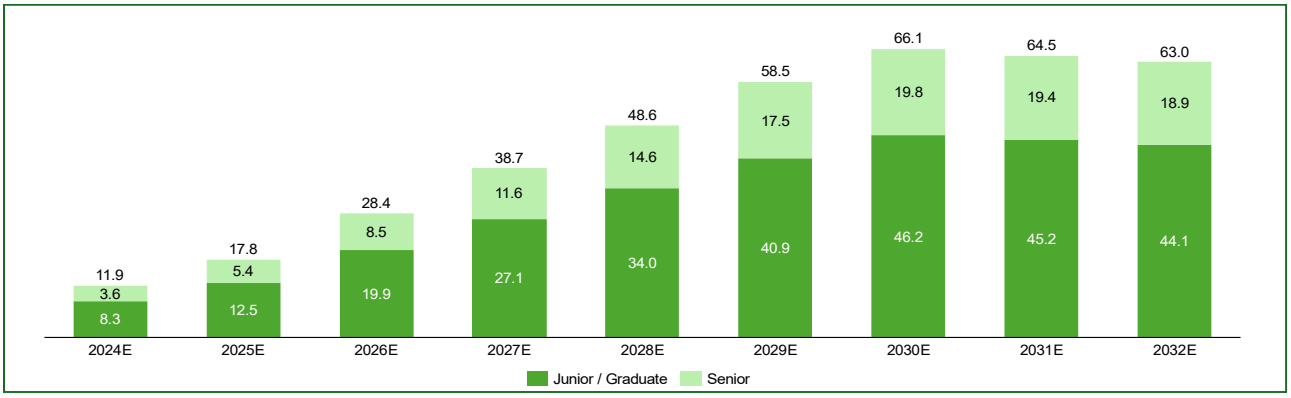


Figure 32: Evolution of Saudi Arabia's projected workforce counts by seniority level, excluding operators, in thousand workers, 2024E – 2032E.

At least 30,000 Saudi nationals are expected to fill renewable energy positions by 2030, including a minimum of 12,200 Saudi engineers and technicians, representing 42% of the total Saudi workforce in the sector.

To estimate the number of Saudi nationals expected to fill positions in the renewable energy sector, we based our projections on two key hypotheses:

- **Engineers and technicians:** Renewable energy projects must comply with Saudization goals for engineering disciplines, requiring a minimum of 25% of engineers and technicians to be Saudi nationals.[36]
- **Operators:** All operator roles are projected to filled by non-Saudis. These roles are typically temporary, lower-skilled, and less aligned with the Saudi nationals' expectations.
- **Business profiles and other disciplines:** These roles are expected to be fully Saudized, encompassing both very high-level critical positions (e.g., general managers, project managers) that need to be filled by Saudi nationals, and entry-level or graduate positions mainly under the business profiles discipline, which Saudi Arabia can cover through its existing pipeline of university and vocational training graduates.

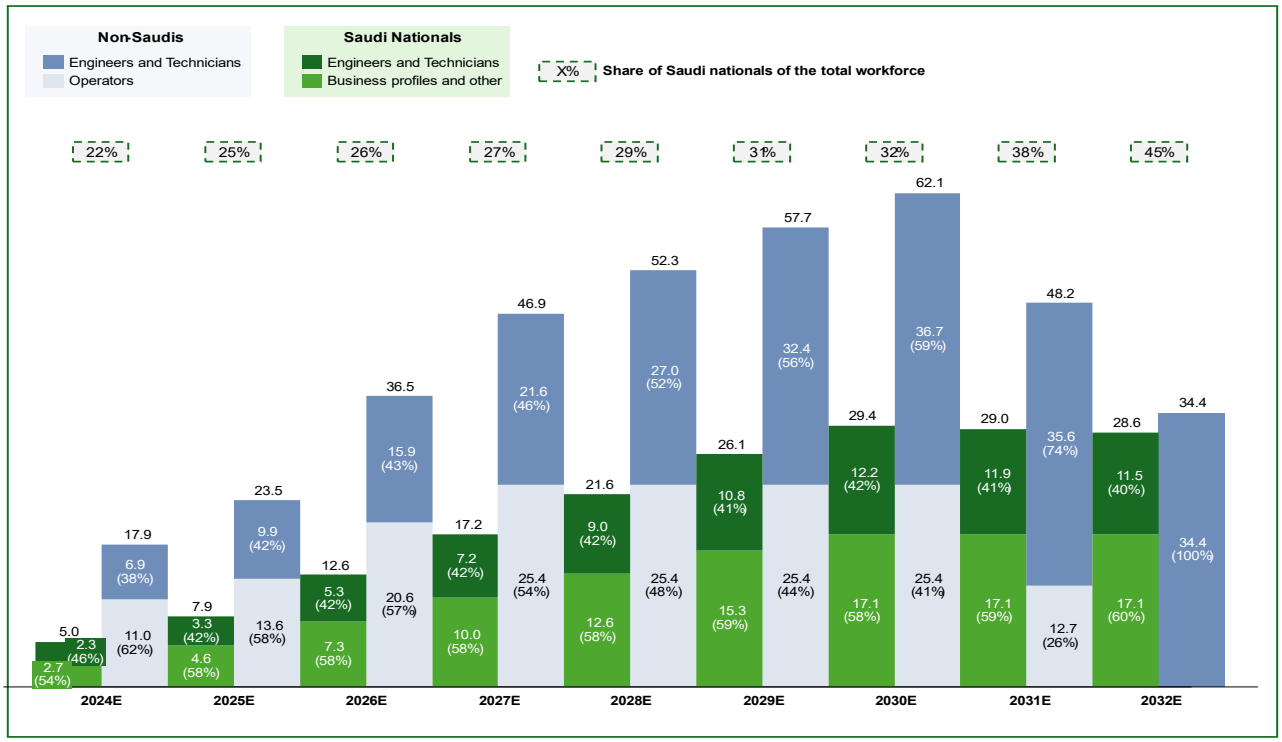


Figure 33: Distribution of projected renewable energy workforce by Engineers & Technicians, Business profiles & others and Operators, Saudis versus Non-Saudis, in thousand workers, 2024E – 2032E.

Based on these assumptions, by 2030, the sector will require approximately 17,100 workers in business-related profiles and "Others" disciplines and at least 12,200 Saudi engineers and technicians. This would result in a total Saudi workforce of at least 29,400 nationals compared to 62,100 non-Saudis, bringing the overall share of Saudis in the sector to 32%.

As renewable energy projects transition from construction to operations, the demand for operators, predominantly non-Saudi workers closely tied to the construction phase, is expected to decline significantly. This reduction in non-Saudi roles will progressively elevate the share of Saudi nationals in the sector, reaching an estimated 45% by 2032.

36 https://www.zawya.com/en/legal/regulations/saudization-of-25-of-engineering-professions-effective-from-july-21-t78uptec, consulted on the 2nd of December 2024

	2024	2025	2026	2027	2028	2029	2030	2031	2032
Mechanical Engineering	**268**	**478**	**802**	**1 155**	**1 583**	**2 011**	**2 391**	**2 556**	**2 721**
Engineer	247	325	513	669	747	825	855	670	485
Technician	38	154	289	487	837	1 187	1 537	1 887	2 237
Civil Engineering	**633**	**784**	**1 212**	**1 533**	**1 593**	**1 653**	**1 583**	**983**	**383**
Engineer	516	654	1 021	1 298	1 373	1 418	1 383	883	383
Technician	118	130	192	235	235	235	200	100	0
Electrical Engineering	**942**	**1 352**	**2 117**	**2 864**	**3 831**	**4 410**	**5 058**	**4 998**	**4 938**
Engineer	364	500	773	1 030	1 308	1 476	1 593	1 508	1 423
Technician	577	851	1 344	1 835	2 522	2 935	3 465	3 490	3 515
Other Engineering	**427**	**695**	**1 157**	**1 638**	**2 173**	**2 708**	**3 201**	**3 316**	**3 431**
Engineer	399	585	950	1 291	1 576	1 861	2 103	1 968	18 33
Technician	27	110	206	348	598	848	1 098	1 348	1 598
Business profiles	**2 212**	**3 756**	**5 996**	**8 236**	**10 476**	**12 716**	**14 316**	**14 316**	**14 316**
Other	**499**	**852**	**1 292**	**1 732**	**2 172**	**2 612**	**2 812**	**2 812**	**2 812**
Total	**4 998**	**7 917**	**12 576**	**17 159**	**21 635**	**26 111**	**29 361**	**28 981**	**28 601**

Table 5: Evolution of projected Saudi nationals renewable energy by discipline, 2024E – 2032E

Assuming no further renewable energy projects are developed in Saudi Arabia beyond 2030, an estimated 28,400 temporary positions would be affected. These include approximately 25,400 non-Saudi operators, around 2,300 non-Saudi engineers and technicians, and fewer than 800 Saudi professionals.

Under the assumption that Saudi Arabia does not initiate additional renewable energy projects beyond the 128,8 GW expected to be operational by 2032, the Kingdom's renewable energy workforce is set to decline, from a peak of ~91,400 jobs in 2030 to ~63,000 by 2032. This figure represents the permanent positions required for the operations and maintenance of renewable energy plants.

The remaining 28,400 positions that will be phased out are considered as temporary. These include approximately 25,300 non-Saudi operators, mostly with backgrounds in civil and electrical engineering, and ~3,000 engineers and technicians, of whom 2,200 are non-Saudis and fewer than 800 Saudi nationals.

This decline is driven by the natural evolution of renewable energy projects lifecycles. Temporary roles are associated to the stages of business development, design, preconstruction and construction phases of renewable energy projects and are typically structured as two-year contracts.

These roles were sustained by the strong pipeline of projects initiated between 2024 and 2030. In the absence of further project announcements beyond this period, therefore these contracts are set to expire by 2032. Consequently, many of these professionals, particularly civil engineers, technicians and site operators will need therefore to transition to other sectors such as construction, infrastructure, or industrial services, where their skills can be redeployed.

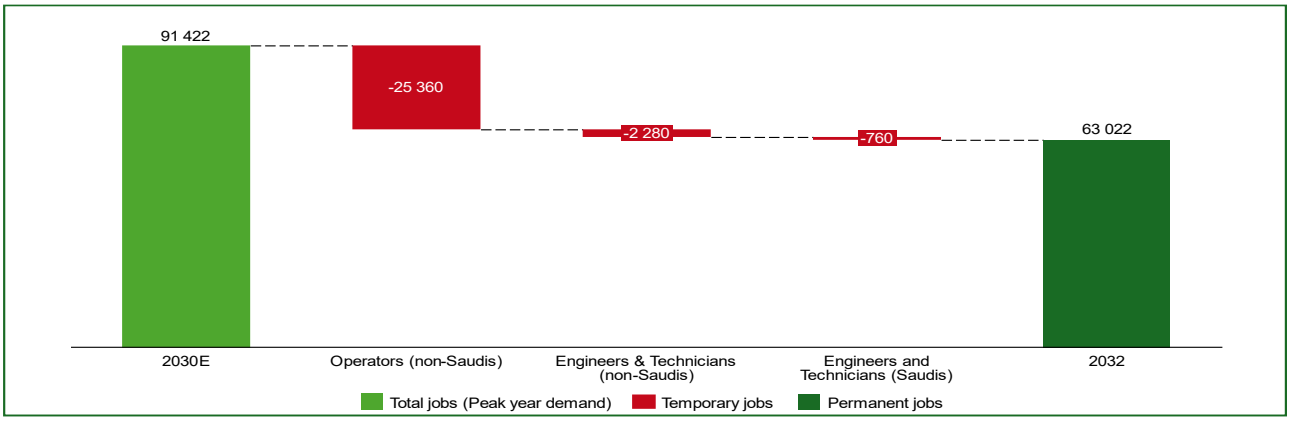


Figure 34 : Breakdown of workforce by job type, permanent versus temporary, 2030, 2032

If Saudi Arabia successfully develops its renewable energy component manufacturing industry, it will need 11,000 additional workers alongside 91,000 for the implementation of renewable energy projects, bringing total workforce requirements to approximately 102,000.

Saudi Arabia is not only advancing the Saudization of the renewable energy sector but also appears to pursue a localization strategy aiming to produce renewable energy components within the Kingdom. As mentioned in the first section, Saudi Arabia has already initiated partnerships with leading global manufacturers to produce solar cells, panels, ingots among other components.
However, setting up manufacturing facilities is a complex process and could take several years. Production is unlikely to begin before the start of 2027. Initial estimates suggest that Saudi Arabia, may start with an annual manufacturing capacity of around 6 GW for various components, including solar and wind energy technologies. This capacity is expected to gradually expand to reach approximately 15 GW by 2032.

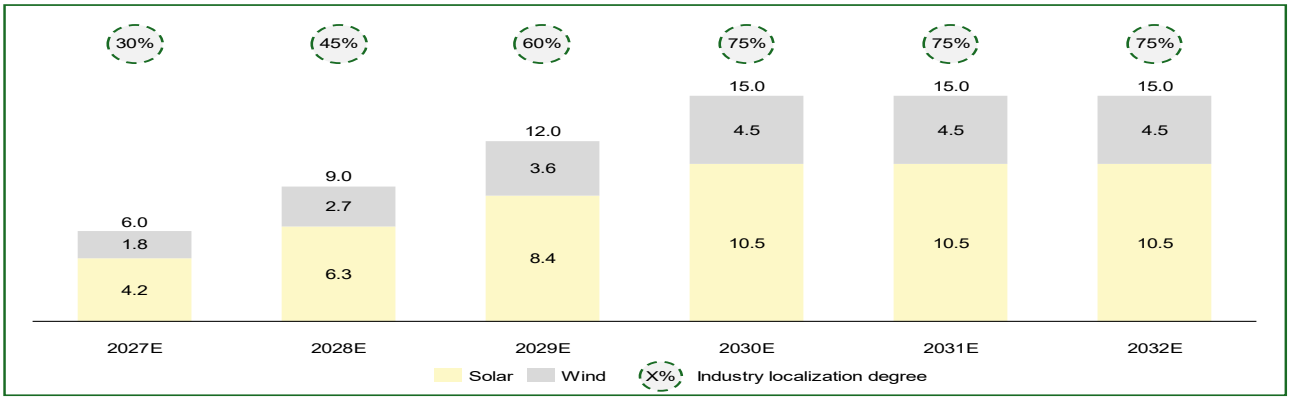


Figure 35: Evolution of Saudi Arabia's annual renewable energy components manufacturing capacity, in GW, solar versus wind components, 2024E – 2032E.

To achieve this manufacturing capacity, Saudi Arabia would require an additional 11,000 workers by 2032.

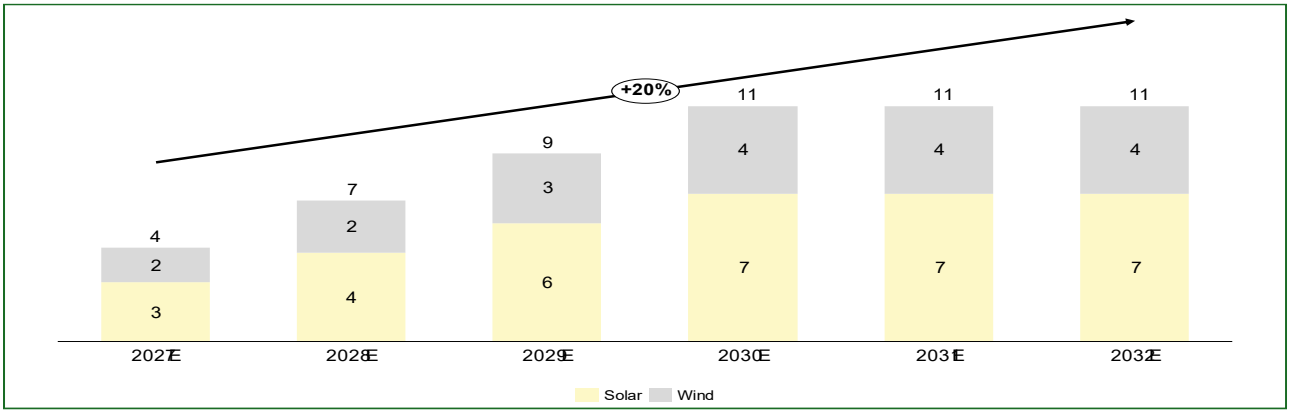


Figure 36: Evolution of Saudi Arabia's workforce counts in renewable energy manufacturing, solar versus wind, in thousand workers, 2024E – 2032E.

Establishing a renewable energy component manufacturing industry in Saudi Arabia presents significant challenges, despite the progress the Kingdom has already made, Saudi Arabia faces three primary challenges for developing this sector:

- **First Mover Takes All:** With several regional competitors already advancing in renewable energy manufacturing, Saudi Arabia faces a challenging landscape. To position itself as the most advantageous base, KSA must differentiate itself from established players like China, known for their low-cost production. This will require not only strong incentives, world-class infrastructure, and skilled labour but also highly competitive electricity and labour costs to attract leading companies that can serve the broader regional market.
- **Broaden Market Reach Beyond Domestic Demand:** To ensure success, the industry must extend its focus beyond Saudi Arabia's own demand (taking into consideration the 75% industry localization goal), building capacity to supply the entire region. This wider market reach will drive investment, help achieve economies of scale and strengthen the industry's resilience.
- **Human Resources and Research & Development capabilities:** Establishing renewable energy manufacturing in Saudi Arabia faces the significant challenge of developing advanced R&D and securing a skilled workforce. Leading renewable energy components manufacturing countries like China made substantial advances in R&D and maintain highly competitive labour costs, making it difficult for Saudi Arabia to match. Moreover, salaries in the Kingdom are higher, adding cost pressure.

The competition and first-mover advantage challenge remain the most pressing obstacles for Saudi Arabia, as they remain beyond the Kingdom's direct control. Regionally, Oman has already taken solid steps into establishing a renewable energy manufacturing industry, including plans for a 10 GW annual solar panel production capacity, set to be executed through two 5 GW phases, potentially threatening Saudi Arabia's first-mover advantage. Furthermore, Turkey benefits not only from its geographic proximity to the Middle East but also from a well-established manufacturing sector with an annual solar panel production capacity exceeding 5 GW, which it can scale rapidly. Globally, China dominates the renewable energy components market with unmatched production capacity and highly competitive pricing, solidifying its position as the world's leading supplier. In 2023, China

accounted for 96% of the global wafers capacity and 88% of the global cell capacity, highlighting its position in the photovoltaic supply chain. This dominance extends also to cost leadership as China produces modules at USD 0.15 per watt, significantly lower than its nearer competitors, such as India (USD 0.22), Europe (USD 0.30) and the United States of America (USD 0.40). Moreover, nine of the of the top ten PV inverters manufacturers are based in China, with a collective market share of 81%[37]

In addition to the estimated 100,000 jobs linked to renewable energy capacity installation and component manufacturing, additional employment opportunities are expected to emerge in related sectors. Startups focusing on innovative solutions, such as solar panel cleaning technologies, adaptation of panels to Saudi Arabia's specific conditions, and other tailored innovations, are likely to contribute. Furthermore, as the Kingdom integrates tens of gigawatts of renewable energy into its grid, the need for expertise in smart grid management will grow. This includes balancing energy from traditional sources with renewable inputs, ensuring efficiency, and maintaining grid stability, creating demand for specialized roles in grid operations and energy management.

[37] Renewable Energy and Jobs, Annual Review 2024, International Renewable Energy Agency

04. Synthesis and Gap Analysis

Saudi Arabia's renewable energy ambition will require attracting at least 100,000 workers by the sector's high demand years. While the Kingdom has sufficient financial capabilities to fund the development of projects and plants and demonstrates strong political and administrative commitment to reaching the country's renewable energy goals, securing a skilled workforce emerges as the primary challenge to the Kingdom. This is particularly pressing as estimates suggest that at least 31,000 workers may be needed by 2025. To address this, Saudi Arabia must adopt robust strategies and engage in workforce strategic planning to ensure a sustainable and qualified talent pool, leveraging on the expertise of both Saudi nationals and expatriates.

This section examines the Kingdom's workforce readiness to support the renewable energy sector needs, focusing on both the numbers required and the technical skills needed.

A framework has been established to assess workforce readiness and identify potential gaps across three core dimensions:

- **Quantitative:** Evaluates whether the Kingdom can meet workforce demands across key disciplines at both junior and senior levels.
- **Qualitative:** Assesses if the existing talent pools possess the necessary skills and qualifications to fulfil the technical and operational requirements of the renewable energy industry.
- **Work conditions:** Examines the attractiveness of the renewable energy industry compared to established industries within the Kingdom, specifically in terms of competitive salaries and potential challenges related to plants locations.

Quantitative gap analysis

1. Junior roles

Saudi Arabia will require approximately 46,000 junior / entry level profiles by 2030 across the six identified disciplines.

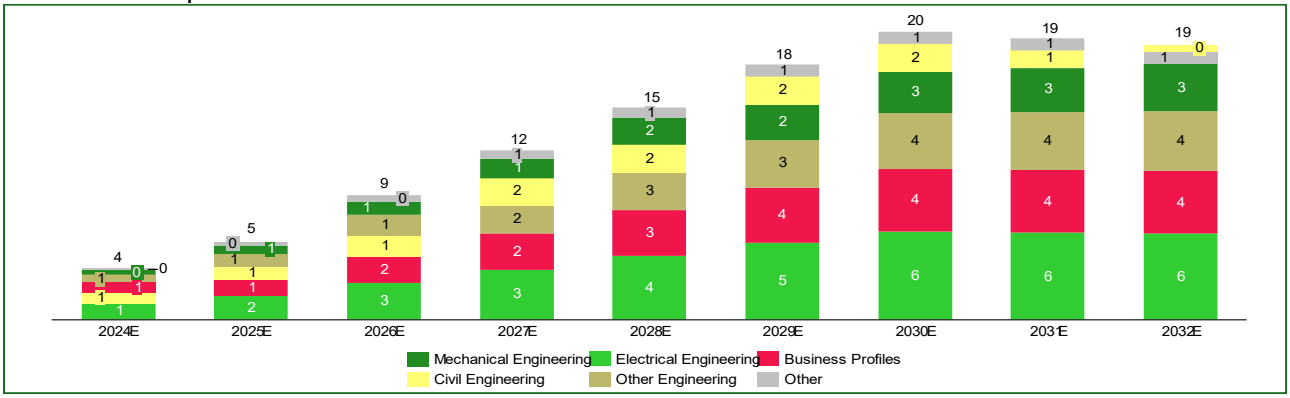


Figure 37: Evolution of junior / entry-level workforce by discipline, 2024E – 2032E.

Electrical engineering

The renewable energy sector could rely on the supply of electrical engineering graduates from the Kingdom's universities to meet its needs. However, attracting 73% of these graduates, currently maintaining a 91% employment rate across other industries, represents a significant challenge.

The electrical engineering discipline is the most critical in terms of junior-level workforce demand within Saudi Arabia's renewable energy sector. On average, the sector will require an additional 2,023 electrical engineering graduates annually, with demand peaking at 2,164 in 2028 and 2029, accounting for 73% of the total number of graduates.

Saudi Arabia's universities currently produce 2,945 electrical engineering graduates annually, which theoretically covers this demand, however with an employment rate of 91%[38] within other industries leaves only 265 graduates available to transition into renewable energy roles. This indicates a significant challenge in attracting enough electrical engineering graduates to meet the renewable energy sector's growing and urgent needs.

Under the scenario, of minimum Saudization, the peak demand would be approximately 541 juniors, which represents 18% of the total universities' graduates, reducing thus significantly the likelihood of a talent gap.

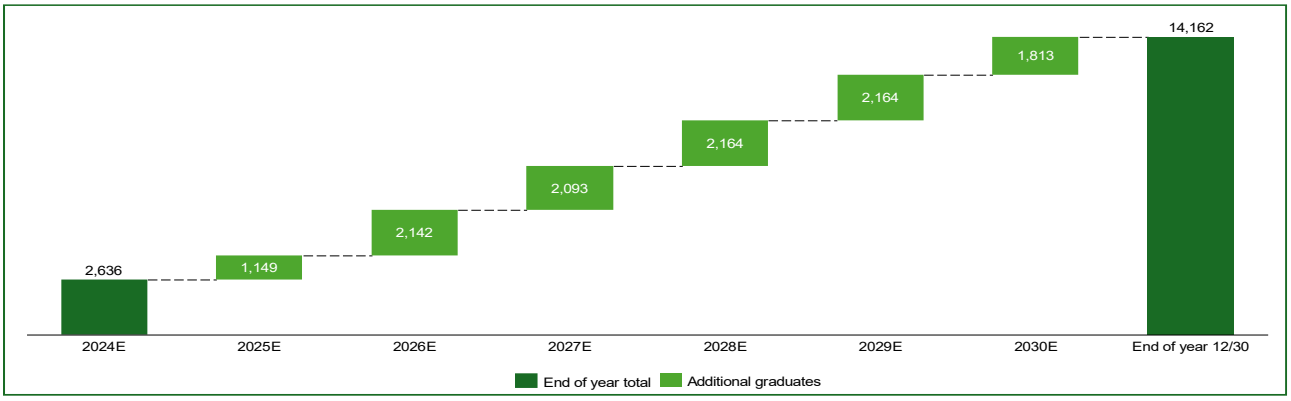


Figure 38: Evolution of workforce counts needs for Electrical Engineering graduates, 2024E – 2030E.

Civil engineering

The renewable energy sector in Saudi Arabia could face a shortfall in civil engineering talent, as meeting workforce needs would require attracting 58% of civil engineering graduates, currently sustaining a 90% employment rate across other industries.

The civil engineering discipline presents a distinct dynamic compared to other fields in the renewable energy sector. Demand for civil engineering graduates would peak in 2026, requiring nearly 1,200 graduates. This demand will decline significantly in 2028 as projects move from construction to operations, thus leaving ~200 graduates to transition into other roles by 2030.

[38] Graduate employment in the Saudi Labor Market, 2021 university graduates and their Employment until 2022, Kingdom of Saudi Arabia, 2023, National Labor Observatory

Saudi universities, produce 2,069 civil engineering graduates annually, which could theoretically meet this demand. However, with an employment rate of 90% in other sectors [38], only ~200 remain available, indicating a significant challenge to attract enough counts of civil engineering graduates.
If the sector adheres to the 25% Saudization requirement for engineering roles, peak demand will drop to ~300 graduates, which accounts for only 15% of the annual number of graduates in this field, thus reducing significantly the likelihood of a talent gap.

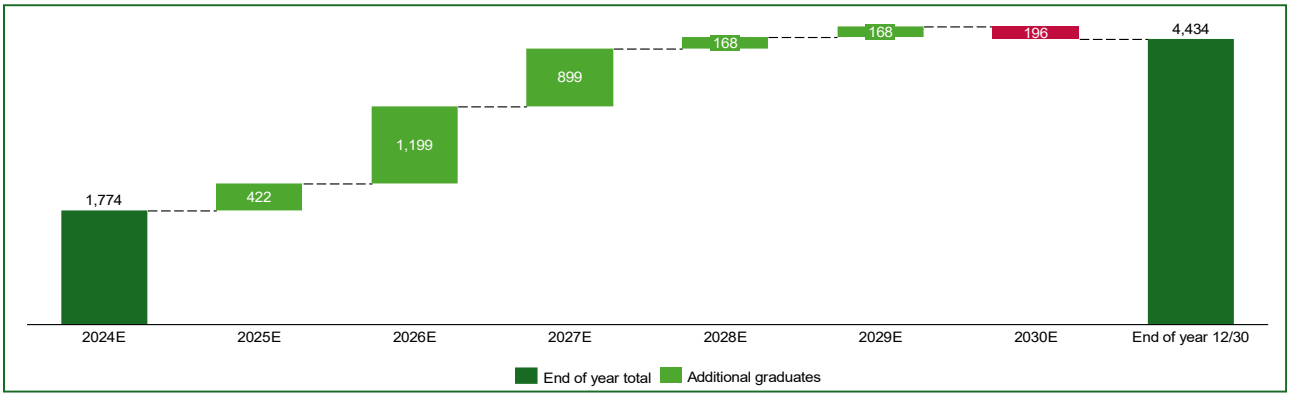


Figure 39: Evolution of workforce counts needs for Civil Engineering graduates, 2024E – 2030E.

Mechanical engineering

The renewable energy sector could rely on the supply of mechanical engineering graduates from the Kingdom's universities to meet its needs. However, attracting 43% of these graduates, who currently maintain an 86% employment rate across other industries, represents a significant challenge.

The renewable energy sector is projected to require an average of 983 additional mechanical engineering graduates annually, reaching a peak of ~1,200 in 2028 and 2029. This demand accounts for 43% of the total university graduates in this field, based on the assumption that graduation rates remain stable.
Saudi Arabia's universities currently produce 2,761 graduates annually, which theoretically covers this demand. However, with an employment rate of around 89% within other industries [38] leaves only 293 graduates available to transition into renewable energy roles. This indicates a significant challenge in attracting enough mechanical engineering graduates to meet the renewable energy sector's growing and urgent needs.
Alternatively, if the sector adheres strictly to the minimum Saudization requirement of 25% for engineering roles, the peak need would be around 300 graduates, equivalent to only 11% of the total annual university graduates in this discipline. This reduced demand could be easily met, eliminating therefore any talent gap under this scenario.

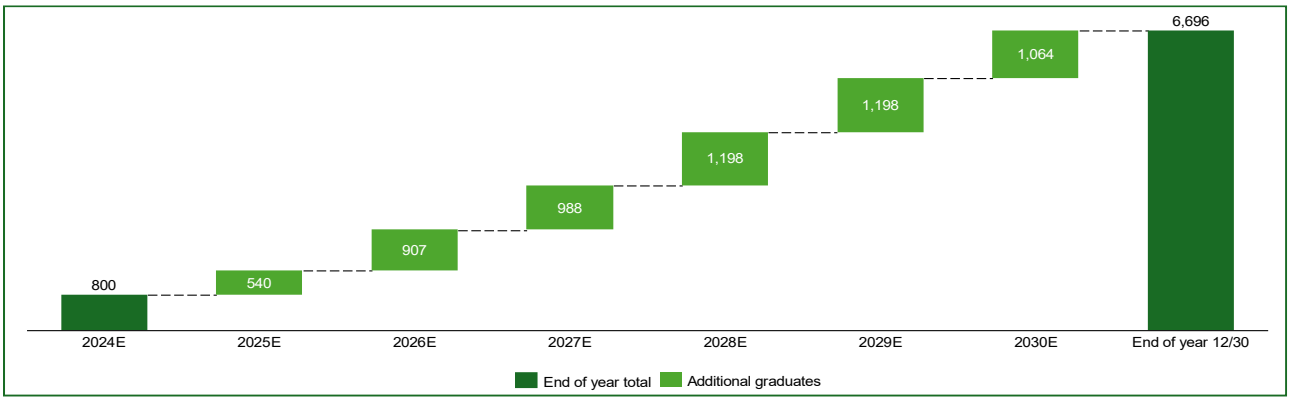


Figure 40: Evolution of workforce counts needs for Mechanical Engineering graduates, 2024E – 2030E.

Other engineering

The sector faces also the risk of a shortfall of "other" engineering junior profiles, as meeting workforce demands would require attracting 77% of these graduates.

Saudi Arabia's renewable energy sector is projected to require on average 1,295 graduate engineers and technicians annually in various fields excluding mechanical, civil and electrical engineer. This demand is projected to peak, reaching ~1,500 other engineering profiles by 2027 and 2028, representing 64.5% of total university graduates in these fields, based on the assumption that graduation rates remain stable.

Saudi Arabia universities produce yearly 2,323 of "other engineering" which theoretically meets the demand, however with employment rates that range between 82% and 97%,[38] leaves only 70 to 418 available graduates. This represents a significant challenge to attract enough "other engineering" graduates to transition into renewable energy roles.

If the sector adheres strictly to the minimum Saudization requirement of 25% for engineering roles, the peak need would be around 375 graduates, equivalent to 16% of the total annual university graduates in this discipline. Under this scenario, the demand of engineers and technicians in these disciplines would likely be met, reducing the risk of a talent gap.

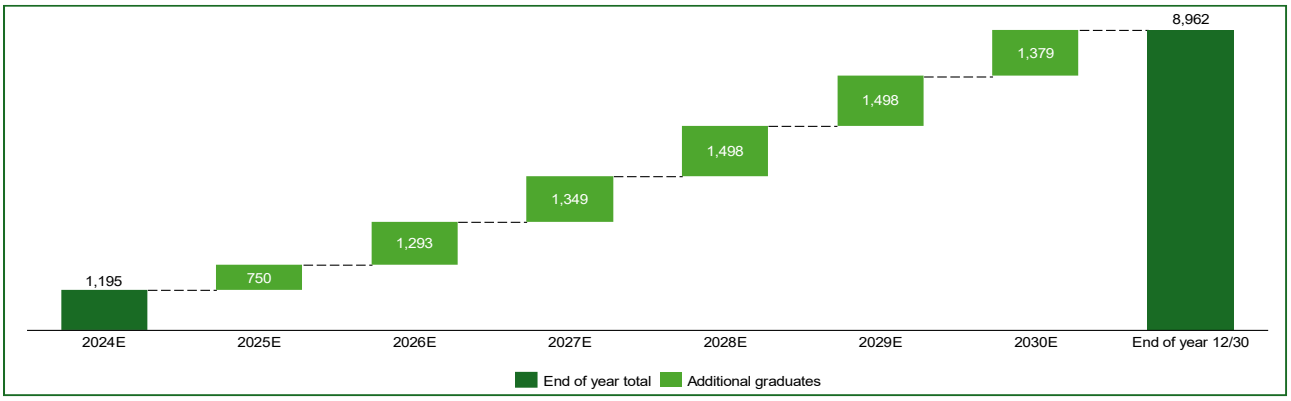


Figure 41: Evolution of workforce counts needs for Other Engineering graduates, 2024E – 2030E.

Business profiles

Saudi Arabia's universities are well-equipped to meet the renewable energy sector's demand for junior business profiles, with graduate output significantly exceeding the sector's needs.

Business profiles in the renewable energy sector are projected to require an average of 1,412 graduates annually, representing less than 3% of the total university graduates in business fields. With Saudi universities producing over 51,000 business-related graduates each year and employment rates ranging between 56% and 63%[38], the Kingdom has a significant surplus of available talent. Therefore, it is safe to say that Saudi Arabia is well-positioned to meet the renewable energy sector's demand for junior business profiles.

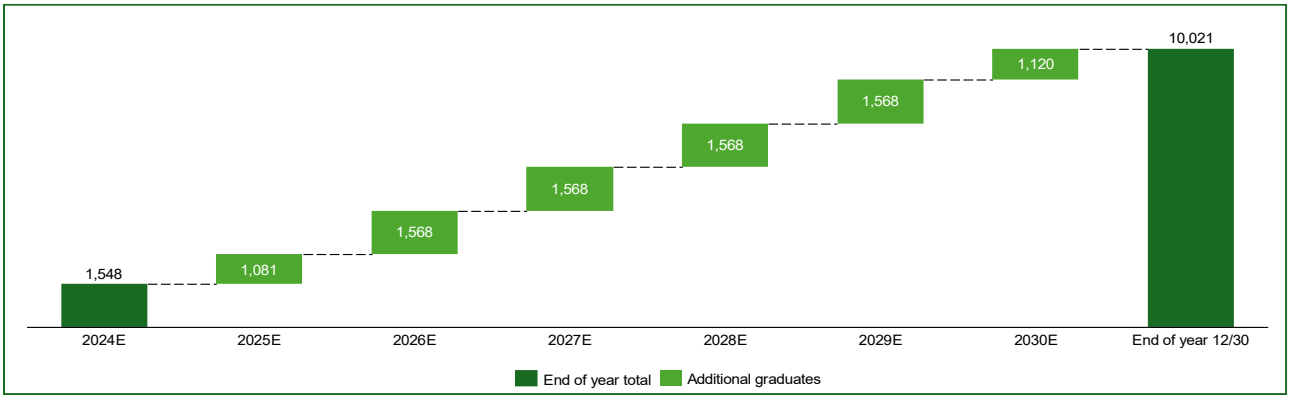


Figure 42: Evolution of workforce counts needs for Business profiles graduates, 2024E – 2030E.

2. Senior Roles

Under the base case scenario, Saudi Arabia will require approximately 20,000 senior profiles by 2030, across the six identified disciplines.

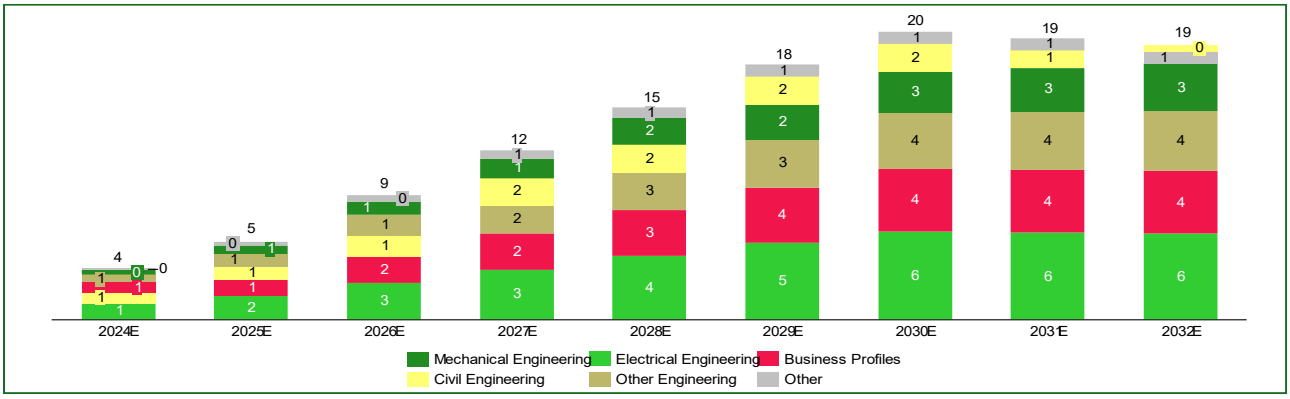


Figure 43: Evolution of junior / entry-level workforce by discipline, 2024E – 2032E.

Saudi Arabia could address the renewable energy sector's senior-level profile needs through upskilling and reskilling workers from the mining and quarrying, as well as the electricity, gas, and air conditioning sectors, while attracting foreign expertise to fill critical gap.

Saudi Arabia faces an imperative to ensure the availability of senior-level profiles required for the renewable energy sector. This could be achieved through a dual approach: reskilling and upskilling existing talent from other sectors withing the Kingdom's labour market, while also working on attracting foreign expertise to fill critical roles.

Sectors like mining and quarrying, along with electricity, gas, steam, and air conditioning, stand out as strong candidates for workforce transition. These industries already have talent with skills that closely match the needs of the renewable energy sector. Additionally, both sectors have seen slight declines in workforce numbers in recent years, making them well-suited to transition to the renewable energy sector by reskilling and up-skilling them.

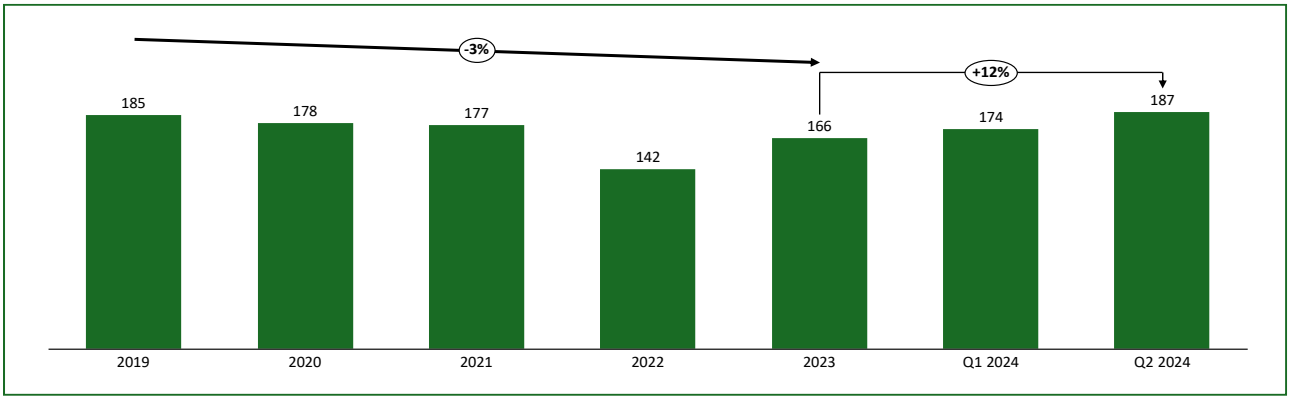


Figure 44: Evolution of the number of workers in the Mining & Quarrying sector, in thousand workers, 2019 – Q2 2024 [39]

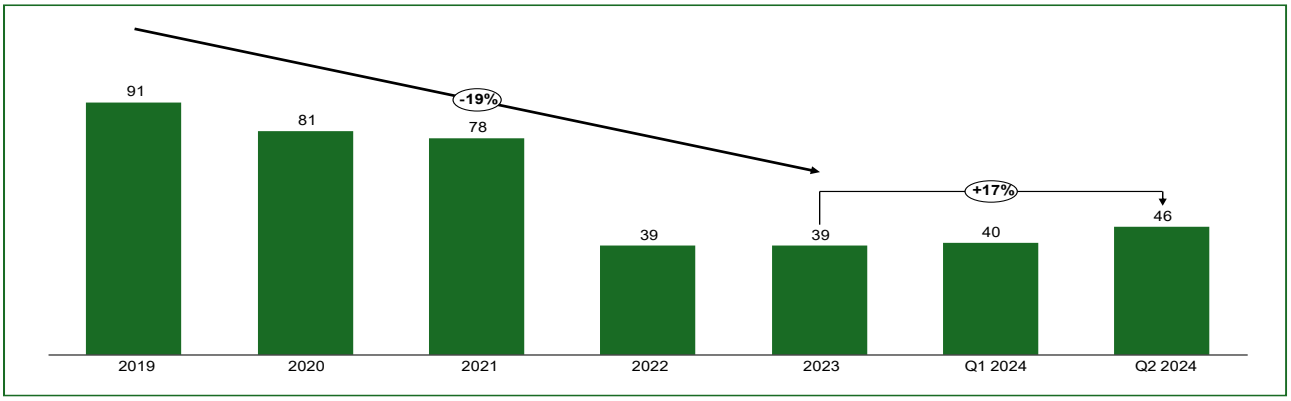


Figure 45: Evolution of the number of workers in the Electricity, gas, steam & air conditioning sector, in thousand workers, 2019 – Q2 2024 [39]

Qualitative Gap Analysis

To assess whether Saudi Arabia's talent pools possess the necessary skills to meet the demands of the renewable energy sector, three key parameters are evaluated:

- **University curricula alignment:** Assessing whether universities in Saudi Arabia, particularly within engineering fields, offer programs or courses tailored to renewable energy technologies and applications.
- **Relevance of vocational training programs:** Evaluating the availability of vocational training initiatives offering certifications or practical training that address the specific skills required for renewable energy roles.
- **Workforce development initiatives:** Reviewing initiatives led by companies, employment agencies, or related organizations that provide specialized training or certifications designed to build expertise aligned with renewable energy sector needs.

[39] General Authority for statistics Saudi Arabia, Labor market statistics reports 2019 – Q2 2024

Saudi Arabia is building a skilled renewable energy workforce through the combined efforts of universities, vocational training systems, and initiatives by energy companies, ensuring an increasingly skilled talent pool to meet the sector's evolving demands.

1. University curricula alignment

Based on the review of a selected 30 universities in Saudi Arabia offering engineering programs, a total of 148 programs across the primary engineering fields associated with the renewable energy sector were identified.

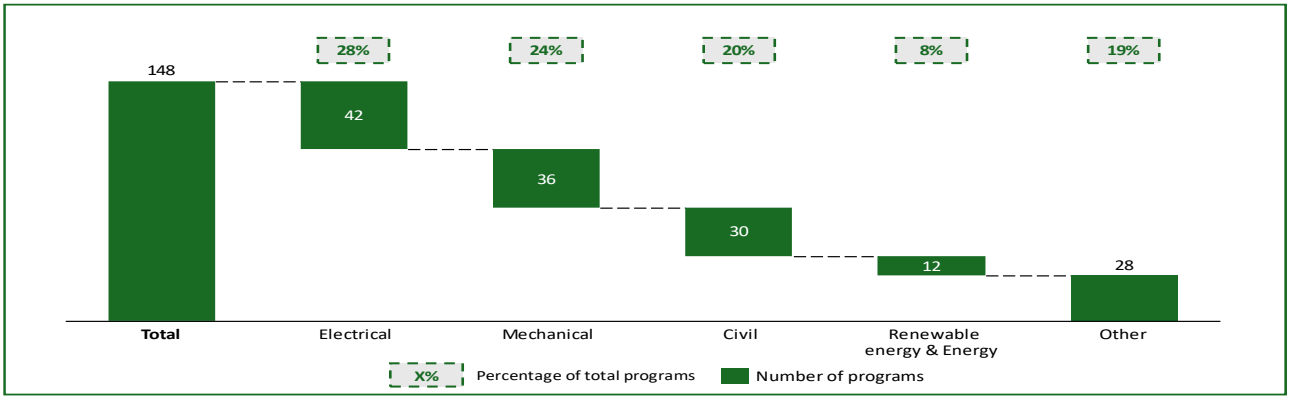


Figure 46: Breakdown of the assessed university programs by engineering discipline.

Approximately 42% of the programs evaluated include at least one elective course focusing on renewable energy technologies, which indicates a notable degree of alignment between academic training and the sector's needs. This alignment suggests that a significant portion of graduates from these disciplines possess foundational knowledge relevant to renewable energy.

Additionally, universities are actively expanding their offerings with undergraduate and master's programs specifically dedicated to renewable energy technologies. Among the 148 programs evaluated, 12 programs (8%) are fully focused on renewable energy, further reinforcing the capacity of universities to equipe graduates with skills needed to support the growth of the sector.

2. Vocational training programs relevance

As Saudi Arabia's renewable energy sector expands rapidly, the country's vocational training ecosystem is adapting to meet the growing demands. While there is still further room for development, the vocational training system is already offering a variety of training programs tailored to the renewable energy sector.

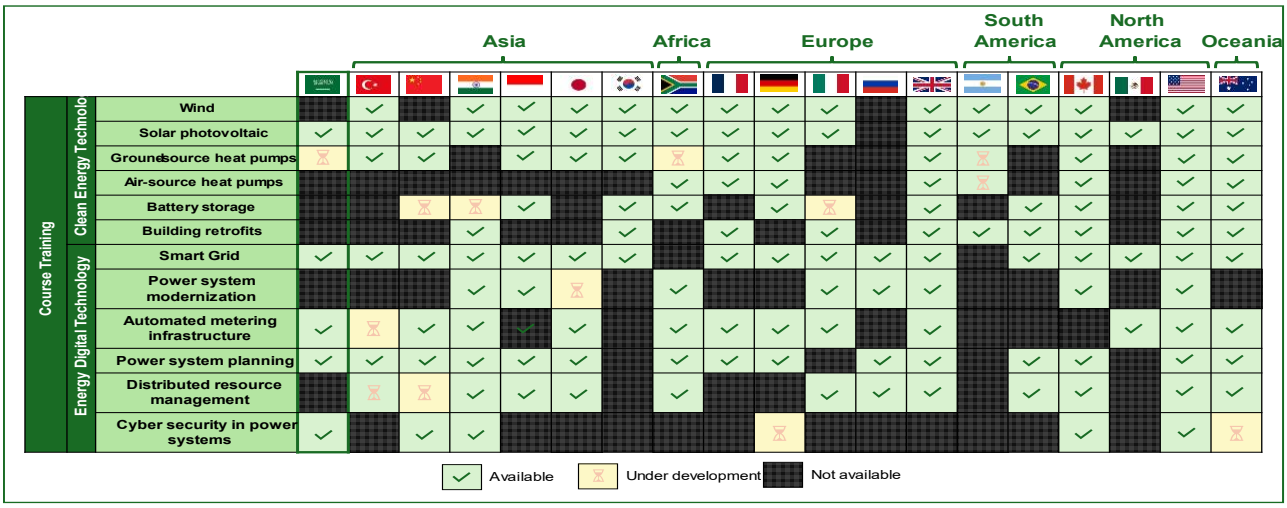


Figure 47: Benchmark of offered renewable energy trainings, Saudi Arabia versus a selection of countries [40]

Technical colleges also offer a multitude of certifications in the renewable energy field covering solar, wind and hydrogen technologies.

Technical College	Certificate
Onaizah Colleges [41]	CEM: Certified Energy Manager
	CEA: Certified Environmental Auditor
	CMVP: Certified Measurement and Verification Professional
	CIEP: Certified Industrial Energy Professional
	CHD: Certified HVAC Designer
	CMRP: Certified Maintenance & Reliability Professional
	Certified renewable energy project developer: photovoltaics
	Certified PV professional
	Certified renewable energy project developer: Biogas
	Certified renewable energy project developer: PV-diesel hybrid systems
	Certified renewable energy project developer: solar thermal
	Certified renewable energy project developer: wind power
	Green Energy Finance Specialist (GEFS)
	Green hydrogen and renewable power to X professional
Saudi Polytechnic Institute for Renewable Energy[42]	Renewable Energy Track

Table 6: Examples of certificates in renewable energy offered by technical colleges in Saudi Arabia

3. Workforce development initiatives

In addition to the initiatives led by universities and vocational training systems, several companies and organizations operating in Saudi Arabia's renewable energy sector have launched notable efforts to support skill development. Some of the key initiatives include:

[40] International Energy Agency, World Employment 2023
[41] https://www.oc.edu.sa/en/cert-ree
[42] https://www.spire.edu.sa/programs/1

- ACWA Power: ACWA Power partnered with the Higher Institute for Water and Power Technologies (HIWPT), a vocational training institute, to launch a program intitled “Renewable Energy and Occupational Safety program” aiming to empower local talents in sectors like water desalination and power generation.[43]
- Neom: NEOM Green Hydrogen Company (NGHC) partnered with the Energy and Water Economy (EWA) to launch a specialized vocational training program designed to upskill Saudi nationals with subjects related to green hydrogen plants operation, maintenance and optimization. Though this partnership, two programs are now available for Saudis.
    - A 2-year program in Renewable Energy Technology and Green Hydrogen aiming to produce technicians destinated to graduates with diploma certificates from technical colleges or bachelor’s degrees in science.
    - A 1-year program designed for bachelor’s degree holders in engineering[44]
- Maersk: Maersk training partnered with Saudi Electric Services Polytechnic (SESP) to establish a technical training program focused on renewable energy subjects. This collaboration aims to train 3,000 individuals, equipping them with the technical skills needed to support Saudi Arabia’s growing renewable energy sector.[45]

Work conditions

Saudi Arabia faces the challenge of offering competitive salaries and favourable working conditions to attract skilled talent and close any potential quantitative or qualitative gap, while maintaining the sector's competitiveness.

Saudi Arabia is positioned to meet the renewable energy sector’s workforce needs both in terms of quantity and quality. **The country can cover these requirements under the minimum Saudization thresholds, with room to gradually increase local workforce participation.** Significant efforts are underway through universities, vocational training programs, and initiatives led by companies and organizations to equip the workforce with the skills needed for the sector.
However, the real challenge lies in attracting the required talent to the sector. To succeed, the renewable energy industry must compete with other established sectors that require similar skill sets and are already well-positioned in terms of attractiveness to both Saudi nationals and expatriates.
Two key factors will determine the sector's ability to attract talent:

- **Salaries:**

The renewable energy sector in Saudi Arabia faces the challenge of attracting skilled workers, especially with competition from other established sectors. To address this, the sector must offer competitive salaries while keeping costs under control, particularly in terms of KWH pricing and component costs. The focus is on two occupational categories: scientific, technical, and human specialists (mainly engineers), who earned an average of 11.6 thousand SAR per month in 2022,

[43]https://www.acwapower.com/news/acwa-power-and-the-higher-institute-for-water-and-power-technologies-launch-the-renewable-energy-and-occupational-safety-program/
[44] https://nghc.com/news/neom-green-hydrogen-company-and-energy-water-academy-partner-to-train-saudi-arabias-future-green-energy-workforce/
[45]https://container-news.com/maersk-training-and-sesp-to-upskill-saudi-arabias-workforce-for-renewable-energy/

and scientific, technical, and human technicians (mainly technicians), with an average salary of 5.8 thousand SAR. The challenge is to offer attractive salaries while ensuring the sector remains financially sustainable and does not struggle with high personnel costs.

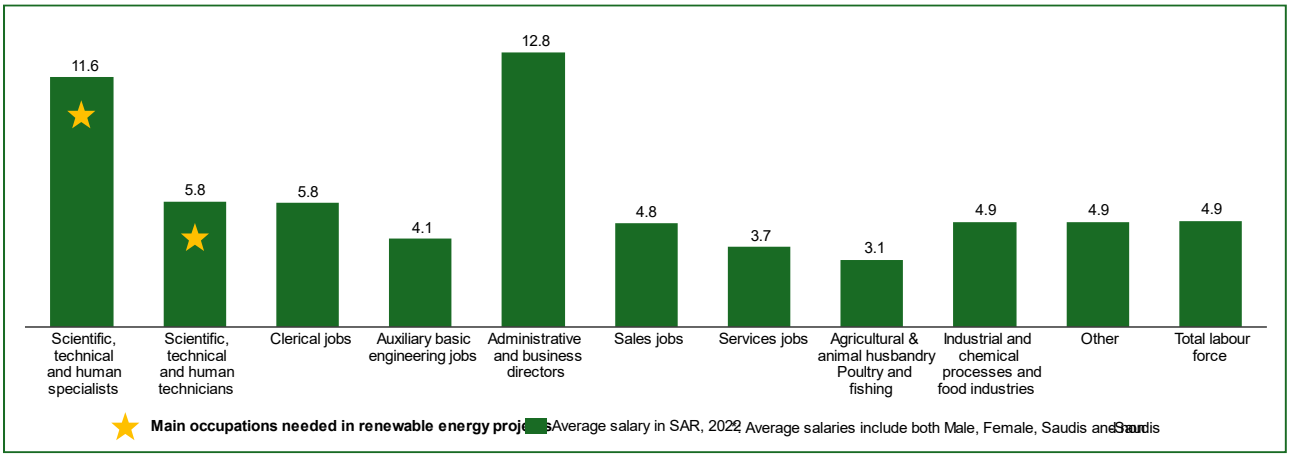


Figure 48: Average Salary by occupation category in Saudi Arabia 2022 [46]

- **Work locations:**

A key challenge for the renewable energy sector in Saudi Arabia is the remote location of many projects. While workers are not required to live on-site permanently, the need for skilled labour during construction and early operation phases often involves extended periods on location. Long commutes and the lack of basic facilities in these areas can make it harder to attract and retain qualified workers, especially those who prefer jobs closer to urban centers. For example, the Sakaka PV IPP site is located 27 km southwest of central Sakaka, and the Ar Rass PV IPP site is located 24 km southeast of the city of Ar Rass in Al Qassim province. The distance from urban centres can influence workers' job preferences, making it more difficult for the sector to attract enough talent.

Figure 49: Sakaka PV IPP and Ar Rass PV IPP sites locations [47]

In conclusion, Saudi Arabia faces notable challenges in the development of its renewable energy sector, the development of a skilled workforce to support the sector's rapid expansion remains the most critical challenge. However, the joint efforts of universities, vocational training systems and initiatives within the industry are laying a solid foundation to overcome this challenge. With

[46] General Organization for Social Insurance
[47] Sakaka Solar Energy Park and Ar Rass Solar Energy Park Environmental and Social impact Assessment reports

continuous focus on reskilling, enhancing the sector attractiveness to attract local talent by leveraging international expertise to fill critical gaps, Saudi Arabia is well-positioned to overcome this challenge and achieve its ambitious renewable energy targets.

Recommendations

The following recommendations are designed to address Saudi Arabia's renewable energy workforce challenges. This issue affects a diverse range of stakeholders, including decision-makers, educational and vocational training institutions, and industry operators. It is essential that every link in this chain fulfils its role effectively to overcome existing challenges and help the Kingdom achieve its ambitious renewable energy development goals, therefore we recommend these stakeholders to:

Ministry of Energy:

- **Develop a strategy and a roadmap for the development of the renewable energy sector:** Given that the Kingdom's renewable energy capacity targets have already been revised twice since the launch of Vision 2030, there is a need to have a unified renewable energy strategy with clear strategic pillars, a detailed implementation timeline, and measurable milestones to achieve the newly announced target of 110–130 GW of installed capacity. The implementation timeline should specify the expected projects size for each year, target launch dates as well as the roles and responsibilities of all stakeholders across the renewable energy value chain.
- **Develop a strategy for the renewable energy components manufacturing:** The national objectives for local manufacturing within the renewable energy sector remain ambiguous. It is currently unclear whether the Kingdom aims to focus on R&D, full-scale manufacturing, assembly. Similarly, it's unclear whether the Kingdom aims to focus on satisfying its local needs or to serve the needs of the MENA region. It's important to develop a dedicated strategy to the renewable energy components manufacturing that details the intended positioning, timelines, target technologies, and the incentives the Kingdom has to offer to attract investors and industrial players. Given the increasing competition across the region, it is essential for the Kingdom to act fast to secure a first-mover advantage. Furthermore, the strategic choices, will have significant implications in terms of workforce requirements, both in counts and in the skills needed.

Ministry of Human Resources and Social Development / National Labor Observatory:

- **Establish a "Renewable Energy Observatory":** To ensure that workforce development keeps pace with Saudi Arabia's renewable energy ambitions, it is important to have a centralized, observatory dedicated to the sector. This platform would collect and analyse operational data from existing and upcoming projects, including FTE/MW requirements, employment trends, skill gaps, salary benchmarks, and working conditions. By consolidating inputs from developers, vocational institutions, and other stakeholders, the observatory would enhance the precision of workforce planning, inform policy decisions, and support the design of targeted training programs.

Ministry of Education / Universities and vocational training centres

- **Improve the capacity for disciplines that could face the risk of shortage:** Anticipate the projected needs of the renewable energy sector, especially in terms of electrical, mechanical and civil engineers and by expanding the capacity in terms of the number of students and trainees. This effort should also include reskilling and upskilling initiatives to support the transition of workers from declining sectors.
- **Realign curriculums with sector needs:** Adopt a competency-based approach to curriculum development, ensuring that the programs offered by universities and vocational training institutions, develop the skills needed in the sector. This includes revisiting course content, delivery methods, and assessment tools.
- **Co-built programs with renewable energy for both fresh graduates and experienced professionals:** Foster close collaboration between educational institutions, renewable energy developers, and leading international universities to design and deliver tailored degree and certification programs. These co-built programs should focus on practical learning and on the latest industry innovations and technologies. In particular, intensive short-term programs could (3~6 months bootcamps) can be developed to address the most in-demand skills in the sector.
- **Incentivize local workforce development:** Encourage companies to invest in the training of their employees and to actively contribute to renewable energy training programs, in collaboration with universities and vocational training centres through fiscal incentives.

Developers and operators of renewable energy projects

- **Develop and reinforce onboarding & On-the-Job Training:** To close the skills gap and accelerate workforce readiness, renewable energy developers and operators should create effective onboarding and on-the-job training programs. These initiatives should be designed to provide new hires with practical, hands-on experience, aligning them with specific project requirements and operational standards.

Limitations of the study and strategic opportunities

Limits:

- **Narrow scope of current estimates:** The workforce estimates presented in this study focus solely on large-scale renewable energy projects, excluding employment opportunities in residential and industrial applications, which are likely to generate substantial additional job opportunities. These new job opportunities, however, could also exert pressure on the demand for a skilled workforce.
- **Evolving national goals:** Saudi Arabia's renewable energy targets have shifted from 9 GW to 58,7 GW to recently 110~130 GW by 2030. This pattern of future capacity revision underscores the ambitions of the Kingdom to undergo the energy transition, but it can also highlight the possibility of further changes impacting workforce estimations.
- **Unclear manufacturing strategy:** The Kingdom's position regarding renewable energy manufacturing remains undefined, with the current announced joint ventures focusing only on solar energy components. Moreover, it is still unclear whether the Kingdom wants to focus on R&D, full-scale production or just assembly, which is a crucial factor in determining the workforce counts and specific skills required for the manufacturing industry.
- **Rapid technological evolution:** Rapid innovations, including automation and efficiency improvement solutions, are likely to reduce the requirements in terms of FTEs needed per installed MW, as some tasks could become fully automated making certain roles obsolete.
- **Limited consideration of competition from other sectors:** While the study includes data on the number of graduates in key disciplines like engineering and technical fields, it does not fully account for how other sectors may also need these same workers. This competition for talent across sectors could make it harder to meet the renewable energy sector's workforce needs. A deeper analysis of how talent is shared between sectors was beyond the scope of this report.
- **No future scenario modelling of workforce shifts:** The workforce projections in this study are based on current trends and do not include future scenarios such as changes in technology or economic conditions. As a result, possible shifts in jobs or the emergence of new roles (for example due to automation are not fully captured.

Strategic Opportunities

The insights and estimates provided by this study can serve as a catalyst for strategic thinking and enhanced planning in Saudi Arabia's renewable energy sector. By addressing key workforce challenges, the Kingdom can better position itself to successfully achieve its energy transition goals.

Key Strategic Opportunities

- **Sector evolution planning and decision-making**: This study can act as a foundation to develop a detailed plan for the renewable energy sector that integrates workforce

considerations. Led by the Ministry of Energy, this effort could align capacity goals with talent availability and ensure future workforce readiness.

- **Saudization blueprint:** The analysis offers a starting point for designing Saudization strategies tailored specifically to the renewable energy sector. Such strategies would balance localization goals with the sector's unique talent demands.
- **Education and training system alignment:** Universities and vocational training centres could leverage these findings to adapt curricula and programs, ensuring they address the sector's evolving requirements. This would help maintain a constant supply of junior talent equipped with the necessary skills to work in this sector.

Refining estimates through stakeholder collaboration

Further refinement of workforce estimates can be achieved through a collaborative approach involving key stakeholders:

- **Ministry of Energy:** For precise capacity forecasts, aligning workforce planning with strategic goals, and clarifying Saudi Arabia's position in renewable energy manufacturing (e.g., R&D, production, or assembly).
- **Universities and Training Centres:** Collecting detailed data on graduate numbers and skills will enable a more accurate gap analysis, helping bridge workforce requirements effectively.
- **Operational Renewable Energy Projects:** Leveraging real-world data from operational projects like Sakaka Solar and Dumat Al-Jandal Wind Plants could further refine FTE estimates per MW based on Saudi-specific factors.
- **Manufacturing JVs:** Collaboration with companies involved in announced joint ventures can provide insights regarding workforce needs for manufacturing renewable energy components, further improving the study's estimates.

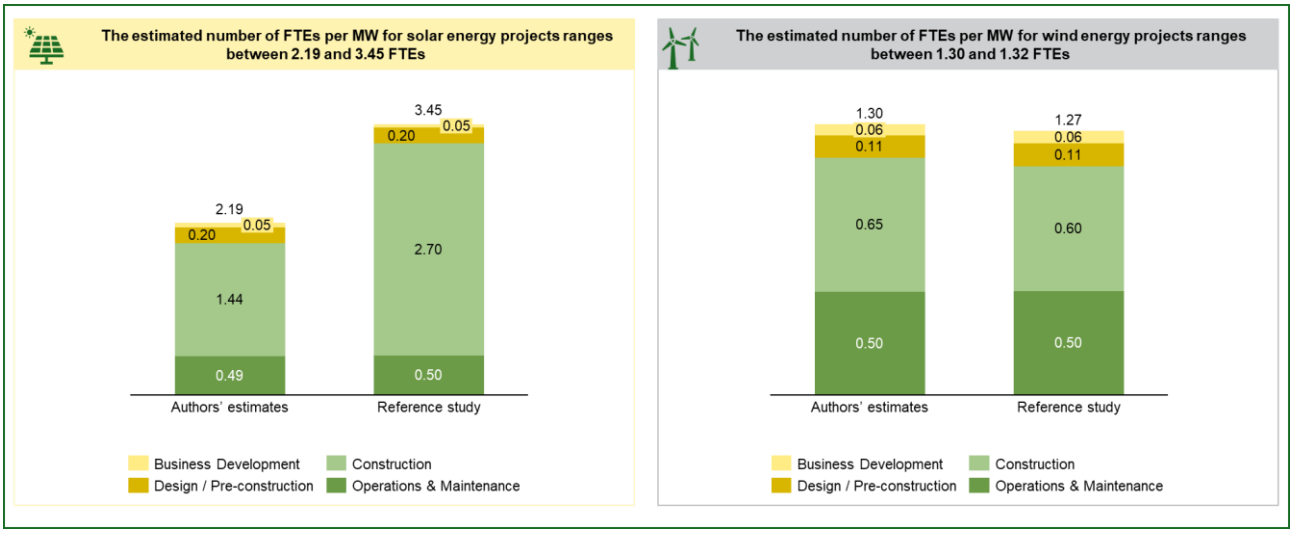
Annexes

Annex 1: Saudi Arabia's 11 Vision Realization Programs

#	Vision Realization Program (VRP)	Main objectives
1	**Financial Sector Development Program**	Transforms Saudi Arabia's financial industry by enhancing the competitiveness of its banking, insurance, stock, and debt markets. In collaboration with the Saudi Central Bank (SAMA) and the Capital Market Authority (CMA), the Program focuses on making banking services more accessible, investing in technology, and expanding the range of financial products available.
2	**Fiscal Sustainability Program**	Strengthens financial discipline through the establishment of entities like the Government Expenditure & Projects Efficiency Authority and the National Debt Management Centre.
3	**Health Sector Transformation Program**	Transforms the Kingdom's healthcare sector to improve access and ensure comprehensive, high-quality and integrated healthcare through digitization, innovation, financial sustainability, and private sector investment.
4	**Housing Program**	This program provides housing solutions that enable Saudi families to own homes.
5	**Human Capability Development Program**	Focuses on equipping Saudi citizens with the skills and capabilities needed to meet the evolving demands of the labour market. It emphasizes education, training, and lifelong learning to drive national development.
6	**National Industrial Development & Logistics Program**	Transforms the Kingdom into a leading global player in the energy, mining, logistics, and industrial sectors. These high-growth areas are diversifying Saudi Arabia's economy, creating quality jobs, and ensuring sustainable growth for future generations.
7	**National Transformation Program**	This program has played a central role in transforming Saudi Arabia since the launch of Vision 2030. Aimed at creating a diversified, innovative, and world-leading nation, the program covers a wide range of themes, including empowering the private sector, accelerating digitization, achieving government excellence, and developing economic partnerships
8	**Pilgrim Experience Program**	Upholds the Kingdom's dedication and service to the two Holy Mosques and pilgrims, providing the finest services, facilitating their spiritual journey and enriching their experience.

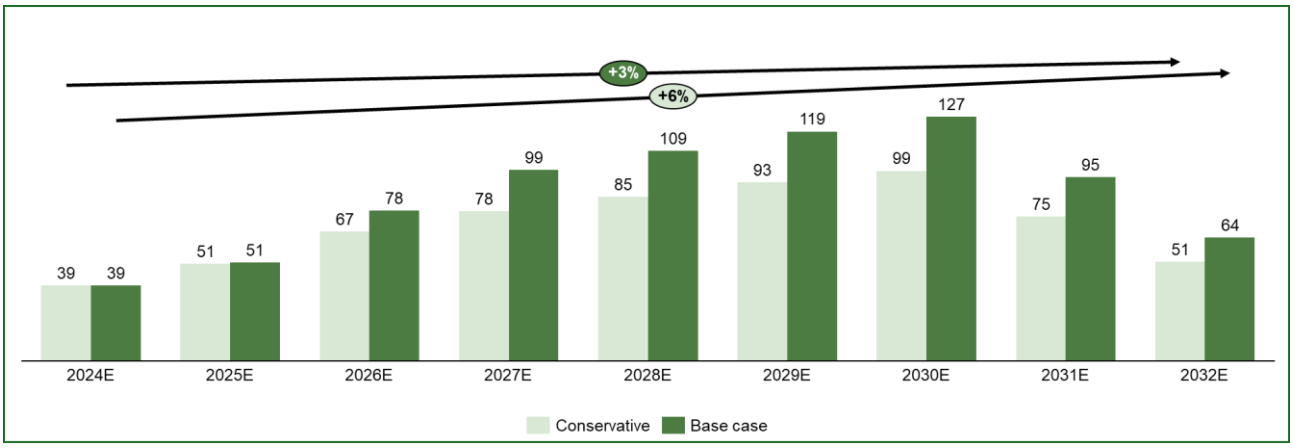
#	Vision Realization Program (VRP)	Main objectives
9	**Privatization Program**	Strengthens the private sector by providing access to government assets and boosting service delivery. It aims to enhance service quality, cost savings, economic diversity and growth, and increase competitiveness for the Kingdom
10	**Public Investment Fund Program**	Maximizes the impact of the Public Investment Fund, the engine that drives the diversification of Saudi Arabia's economy. It seeks to boost new sectors and opportunities for growth.
11	**Quality of Life Program**	Enhances lifestyles by developing an environment that promotes participation in cultural, entertainment, and sports activities. This program aims to improve overall well-being and happiness[48].

Annex 2: FTE per MW solar versus wind energy projects:

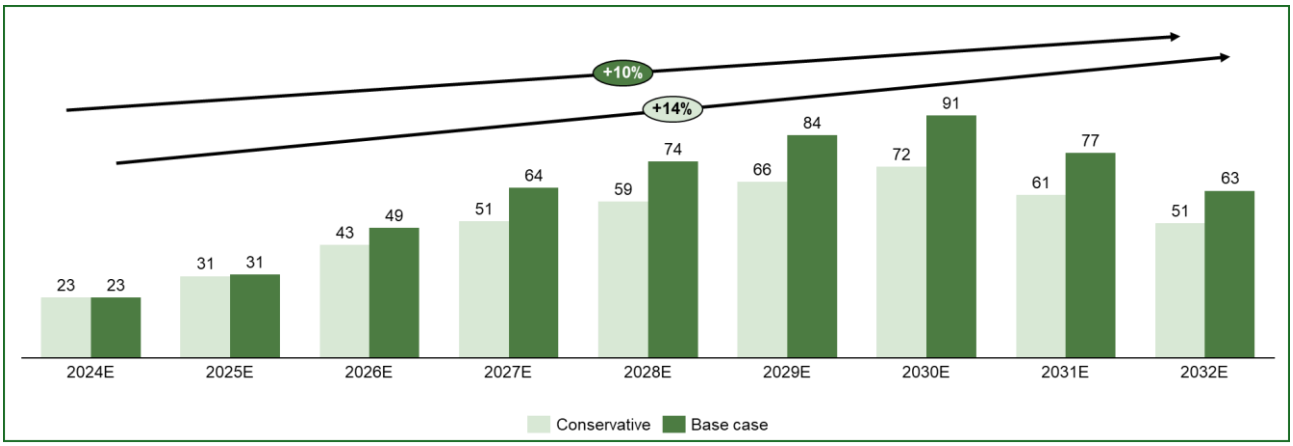


[48] Vision 2030, Annual report 2023

Annex 3: Workforce estimates based on reference study, conservative versus base-case scenario



Annex 4: Workforce estimates based on authors' estimates, conservative versus base-case scenario



Annex 5: Saudi Arabia operational and announced renewable energy projects

#[49]	Project	Type	Capacity (MW)	Status	Cost (Million dollars)	Announcement Year	Commissioning date
1	Sakaka	Solar	300	Operating	302	2017	April 2021
2	Duwmat Al-Jandal	Wind	400	Operating	480	2017	December 2021
3	Jeddah South Noor	Solar	300	Operating	237	2019	January 2023
4	Rabigh	Solar	400	Operating	205	2019	April 2023
5	ArRass	Solar	700	Operating	450	2020	August 2024
6	Jubail	Solar	47.5	Operating	N/A	N/A	2023
7	Haradh	Solar	30	Operating	N/A	N/A	2021
8	Al Kharj	Solar	15	Operating	N/A	N/A	2019
9	Qurrayat	Solar	200	Permitting stage	N/A	2019	2025
10	Al-Shuaiba 2	Solar	2031	Permitting stage	1900	2023	2025
11	Sudair	Solar	1500	Permitting stage	924	2023	2025
12	ArRass 2	Solar	2000	Permitting stage	N/A	2023	2026
13	Saad 2	Solar	1125	Permitting stage	N/A	2023	2026
14	Madina	Solar	50	Under construction	N/A	2019	2025
15	Rafha	Solar	20	Under construction	N/A	2019	2025
16	Layla	Solar	80	Under construction	105	2019	2025

[49] Solar- and Wind-Energy Utilization in the Kingdom of Saudi Arabia: A Comprehensive Review, Fakher Eldin M, Suliman, King Khalid University, / Saudi Principal Buyer Press releases / Ministry of energy official website / Renewable energy statistics 2022, Saudi Arabia's General Authority for statistics / Team Analysis

17	Wadi Aldwaser	Solar	120	Under construction	115	2020	2025
18	Saad	Solar	300	Under construction	200	2022	2025
19	Al-Faisaliah	Solar	600	Under construction	N/A	N/A	N/A
20	RedSea	Solar	340	Under construction	N/A	N/A	N/A
21	Al-Khahfa	Solar	1425	Under construction	N/A	N/A	N/A
22	Al-Maala	Solar	410	Under construction	N/A	N/A	N/A
23	Neom	Solar	2200	Under construction	N/A	N/A	N/A
24	Neom	Wind	1650	Under construction	N/A	N/A	N/A
25	Duba 1	Solar	550	Under construction	N/A	N/A	N/A
26	Dharan	Solar	10.5	Under construction	N/A	N/A	N/A
27	Medyan Umluj	Wind	400	Under construction	N/A	N/A	N/A
28	Al-Shuaiba	Solar	600	Financial close reached	305	2019	2025
29	Al-Henakiyah	Solar	1100	Signed Power Purchase Agreement	N/A	2022	2025
30	Yanbu	Wind	700	Signed Power Purchase Agreement	N/A	2022	2026
31	Waad Al-Shamal	Wind	500	Signed Power Purchase Agreement	N/A	2022	2026
32	Tabarjal	Solar	400	Signed Power Purchase Agreement	N/A	2022	2026
33	Al-Ghat	Wind	600	Signed Power Purchase Agreement	N/A	2022	2027
34	Haden	Solar	2000	Signed Power Purchase Agreement	N/A	2024	N/A
35	Al-Muwaih	Solar	2000	Signed Power Purchase Agreement	N/A	2024	N/A
36	Al-Khusaybi	Solar	1500	Signed Power Purchase Agreement	N/A	2024	N/A

37	AsSadawi	Solar	2000	RFQ released	N/A	2023	N/A
38	Almas'a	Solar	1000	RFQ released	N/A	2023	N/A
39	Al-Henakiyah 2	Solar	400	RFQ released	N/A	2023	2027
40	Rabigh 2	Solar	300	RFQ released	N/A	2023	2027
41	Dawami	Wind	1500	RFQ released	N/A	2024	N/A
42	Najran	Solar	1400	RFQ released	N/A	2024	N/A
43	Samtah	Solar	600	RFQ released	N/A	2024	N/A
44	Ad Darb	Solar	600	RFQ released	N/A	2024	N/A
45	As Sufun	Solar	400	RFQ released	N/A	2024	N/A

Annex 6: List of universities offering renewable energy degrees and courses

1- List of universities offering degrees in Renewable Energy

#	University	Degree Type	Degree	Specialization
1	Al-Baha University	Master of Science	Renewable Energy Engineering	
2	Fahad Bin Sultan University	Bachelor	Renewable Energy Engineering	
3	King Abdulaziz University	Masters	Renewable Energy Engineering	
4	King Fahd University of Petroleum and Minerals	Master of Engineering	Renewable Energy	
5	King Saud University	Graduate Program in the Joint Renewable Energy Program Council	Renewable Energy	Solar Energy Technology
				Hydrogen Energy Technology
				Wind Energy Technology
6	Qassim University	Masters	Renewable Energy	
7	University of Bisha	Bachelor	Renewable Energy Engineering	
		Master of Science	Renewable Energy Engineering	
8	Taif University		Mechanical Engineering	Renewable Energy and sustainable energy engineering

#	University	Degree Type	Degree	Specialization
9	Umm Al-Qura University	Master of Science	Electrical Engineering	Renewable Energy
10	Princess Nourah bint Abdulrahman University	Bachelor of Science	Electrical Engineering	Renewable Energy
11	Hail University	Bachelor	Electrical Engineering	Renewable Energy

2- List of universities with engineering departments offering at least one elective course in Renewable Energy

#	University	Degree Type	Degree	Specialization
1	King Saud University	Bachelor of Science	Electrical Engineering	
			Mechanical Engineering	
2	King Fahd University of Petroleum and Minerals	Concentrations (CX) programs		Energy Efficiency
				Hydrogen Mobility
				Renewable Energy and Energy storage
		Focused (MX) Master's Program		Sustainability and Environmental Management

#	University	Degree Type	Degree	Specialization
				Sustainability and Renewable Energy
3	King Abdulah University of Science and Technology	Master of Science	Materials Science and Engineering	
			Mechanical Engineering	
4	King Abdulaziz University	Bachelor	Mechanical Engineering	
5	Taif University	Bachelor	Mechanical Engineering	
			Electrical Engineering	
			Civil Engineering	
6	Umm Al-Qura University	Bachelor	Electrical Engineering	Power Systems
		Master of Science	Electrical Engineering	Electric Power Generation
		Master of Science	Electrical Engineering	Smart Grids
7	Imam Abdulrahman Bin Faisal	Bachelor	Energy Engineering	
		Master	Engineering Management	
8	King Faisal University	Bachelor	Electrical Engineering	

#	University	Degree Type	Degree	Specialization
			Mechanical Engineering	
		Master	Electrical Engineering	
			Mechanical Engineering	
9	University of Tabuk	Bachelor	Electrical Engineering	
			Mechanical Engineering	
10	Najran University	Bachelor	Electrical Engineering	
			Mechanical Engineering	
11	Imam Mohammad Ibn Saud Islamic University	Bachelor	Chemical Engineering	
12	Alfaisal University	Bachelor	Electrical Engineering	
			Mechanical Engineering	
13	Shaqra University	Bachelor	Mechanical Engineering	
14	Northen Border University	Bachelor of Science	Electrical Engineering	Electrical Power and Machines Engineering

#	University	Degree Type	Degree	Specialization
		Master of Science	Electrical Engineering	
15	Al-Baha University	Bachelor of Science	Electrical Engineering	
			Mechanical Engineering	
16	Effat University	Bachelor	Electrical Engineering	Power and Control Systems
		Master of Science	Energy Engineering	
17	Islamic University of Meddinah	Bachelor	Electrical Engineering	
			Mechanical Engineering	
18	University of Hafr Al Batin	Bachelor	Electrical Engineering	
			Mechanical Engineering	
19	University of Bisha	Bachelor	Electrical Engineering	
20	Fahad Bin Sultan University	Bachelor	Electrical Engineering	
		Bachelor	Mechanical Engineering	
		Master	Electrical Engineering	

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