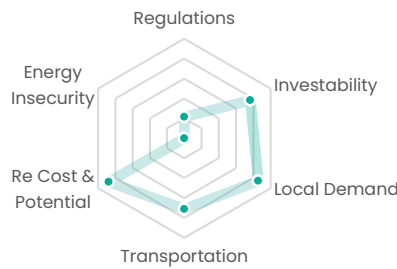
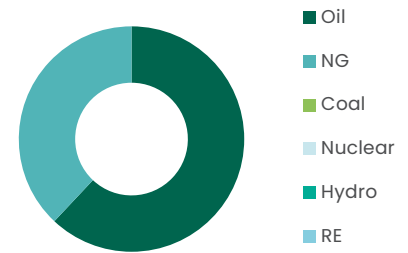


GDP – USD (bn):	<b>700</b>
GDP per capita – USD:	<b>20,110</b>
Land area ('000 km <sup>2</sup> ):	<b>2,150</b>
Population density (per km <sup>2</sup> ):	<b>16</b>
Grid emissions factor (gCO <sub>2</sub> /kWh):	<b>718</b>

### Hydrogen Drivers Matrix



### Primary Energy Mix



## 1.1 Regulatory commitment

- Ambitious hydrogen export plans but as yet little detail
- Economic diversification driver
- No carbon pricing

## 3.6 Transportation

- Low population density supports co-siting of H<sub>2</sub>, RE and offtake, and greenfield pipelines
- Extensive ammonia supply chain

## 3.8 "Investability"

- Rated A- by S&P
- 62nd in WB Ease of Doing Business
- Extensive track record of IPP and infrastructure procurement

## 4.4 RE cost and potential

- Vast solar resources at world record low prices
- Good onshore wind resources
- Corporate PPA activity growing

## 4.3 Local demand potential

- 20th largest steel manufacturing
- 7th largest oil refiner
- 7th largest ammonia producer

## 0.0 Energy insecurity

- Net energy exporter

## Oil giant pushes diversification with hydrogen export ambitions, backed by mega projects

While Saudi Arabia has not instituted any net zero commitments, clean hydrogen appears as a key pathway to economic diversification and resilience against declining oil demand, for a country whose petroleum sector makes up more than 40% of GDP and almost 90% of the national budget. Under its National Renewable Energy Program (NREP), the country plans to invest USD15.9bn into renewables. Building on decades of experience tendering large energy projects to an international audience, the Renewable Energy Project Development Office (REPDO) has procured c.5GW of wind and solar IPPs at world record low prices over the last 5 years, leveraging a de-risked and well-banked project structure. This model is a strong framework that could also be leveraged for green hydrogen.

While Saudi hosts large, energy-intensive industries, the lack of carbon pricing domestically means that there is little underlying economic incentive for local clean hydrogen use. Development of clean hydrogen projects may therefore continue to be Government-led, rather than organic private sector efforts, which in turn would leave it to the Government to dictate the pace of clean hydrogen deployment. That said, Saudi Arabia is among the world's largest oil refiners and ammonia producers. Accordingly, to the extent that Saudi industries sell to markets that will erect carbon borders, such as the EU, local clean hydrogen production will be an obvious choice.

### Ground zero for green ammonia

As green ammonia emerges as the only economic format today in which to ship green hydrogen in the absence of

pipelines, Saudi Arabia, as the world's 7th largest ammonia producer, is well positioned to establish a leadership position thereon. NEOM, ACWA Power and Air Products have signed a USD5bn deal to develop an integrated green hydrogen facility that will supply approximately 230ktpa of green hydrogen and 1.2mtpa of green ammonia by 2025. Air Products will be the sole offtaker of the green ammonia that is intended for reconversion at end markets. The green hydrogen will go to Aramco's Japan refinery.

### LCOE advantage

Given that cost of electricity is the largest component of LCOH, Saudi Arabia has a distinct advantage: its lowest solar project – the 600MW Al Shuaiba PV IPP – will produce power at a levelized cost of USD10.4/MWh, compared to e.g., USD18.0/MWh in Spain<sup>1</sup>. The NEOM/Air Products/ACWA Power project, even at this early stage, is expected to be competitive notwithstanding transportation costs to the Asian market.

### Ambitious export plans

In August 2021, Saudi Aramco signed an MoU with Germany to explore green hydrogen export, which may materialize in the near term via Germany's H2Global CfD initiative. Germany's energy minister has named Saudi as one of six potential partner countries. Similarly, Aramco this year signed an MOU with Japan's ENEOS to explore the development of blue hydrogen and blue ammonia supply chains. In 2020, Saudi Arabia sent the world's first shipment of blue ammonia (40t) to Japan.



<sup>1</sup> Lowest winning solar tariff EUR15.0/MWh from the January 2021 renewable auction in Spain.