



# **GAS PATHWAYS TO 2050 AND THE INTERPLAY WITH RENEWABLE ENERGY**

September 2019

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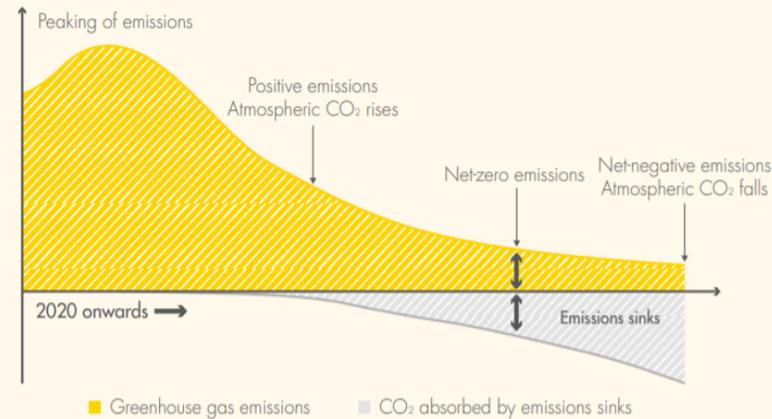
## OUR APPROACH

- The world needs to produce more energy with fewer greenhouse gas emissions if global society is to meet its development and environmental goals.
- Achieving these goals will require significant shifts in the way the world produces and uses energy over the course of this century.
- Shell's long-term success relies on our ability to provide much-needed energy and related products in a way that is commercially competitive as well as socially and environmentally responsible.



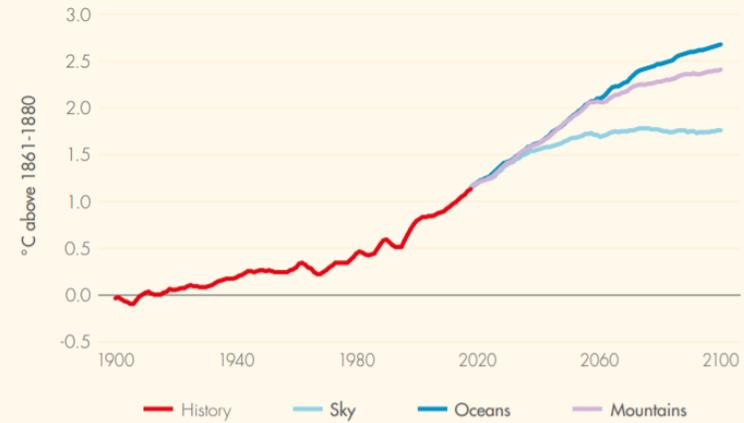
# JOINT FOCUS ON RENEWABLES, GAS TO POWER AND POWER TO GAS IS REQUIRED TO MEET CLIMATE GOALS

THE PARIS AGREEMENT CALLS FOR AN EARLY PEAK IN EMISSIONS, THEN A DECLINE TO NET-ZERO EMISSIONS DURING THE SECOND HALF OF THE CENTURY



Source: Shell schematic

SHELL SCENARIOS COMPARED – GLOBAL AVERAGE SURFACE TEMPERATURE RISE

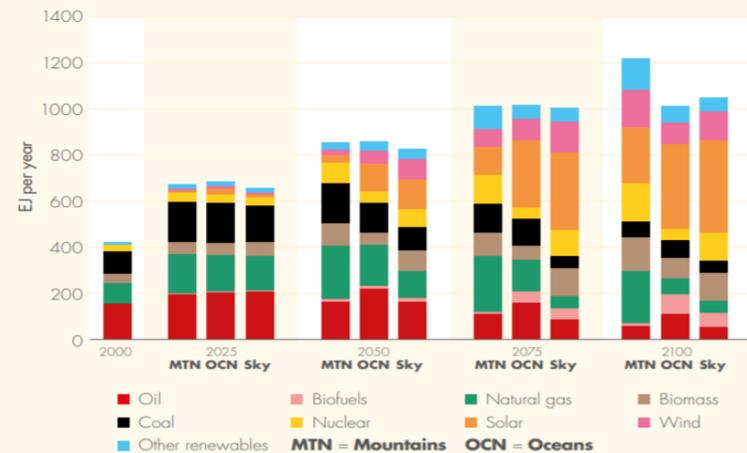


Note: The MIT Joint Program on the Science and Policy of Global Change modelled the climate impacts of Sky in comparison with those of Mountains and Oceans. All series are five-year moving averages.

Source: MIT

- In order to meet the climate goals set out by the Paris Agreement, we recognize the strong role renewables will need to play
- However, given the current challenges with renewables, they alone may not help us achieve these targets in time
- A significant contribution towards decarbonization can also come from natural gas, bio gas and Hydrogen
- In all 3 of Shell's energy scenarios: Oceans, Mountains and Sky, a balanced mix of energy generation concepts will be key for achieving the climate goals whilst cost effectively meeting the energy demand of the future

PRIMARY ENERGY BY SOURCE IN THE THREE SCENARIOS



Source: Shell analysis

SHELL SCENARIOS COMPARED – WORLD ENERGY-RELATED CO<sub>2</sub> EMISSIONS



Source: Shell analysis

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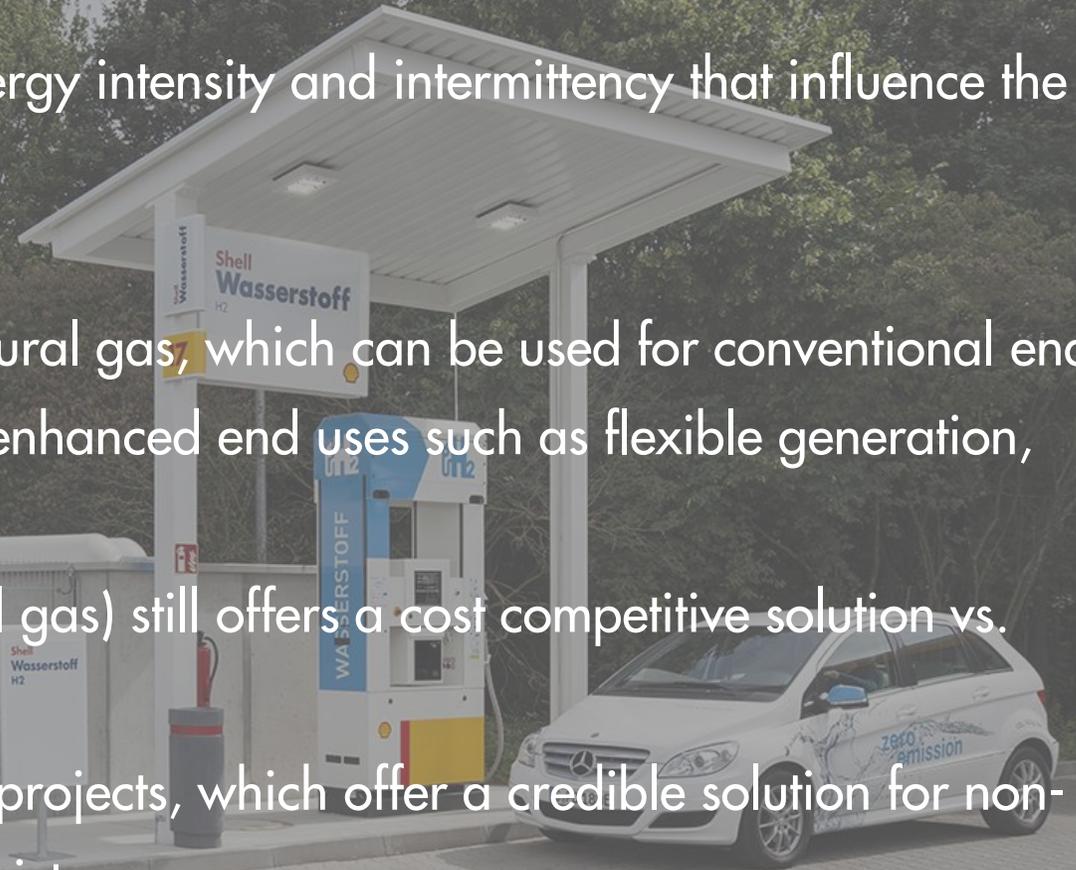


## OUR AREAS OF FOCUS INCLUDE OUR INTEGRATED THINKING ON ENERGY TRANSITION

- **Within the Fence Projects:**
  - **Target :** Reduce GHG footprint of assets; optimize usage of hydrocarbons for own consumption
  - **Examples:** Solar PV project in Oman, Currently studying application of solar PV for off-shore assets and downstream facilities
- **Outside the Fence Projects:**
  - **Target:** Commercial scale energy projects and investments
  - **Key Business Divisions:**
    - **Shell New Energies:** *Offshore Wind; Renewable Power (Onshore Wind & Solar); New Fuels; Digital Business; Nature Based Solutions; Behind the Meter Connector Energy Solutions and Shell Venture*
    - **Shell Energy:** *Power Trading and Marketing*

## ROLE FOR GAS TO POWER & POWER TO GAS IN THE ENERGY MIX

- Whilst the cost of renewables have come down significantly, in some geographies they are still more expensive than conventional fuel
- In addition there are other limiting factors such as energy intensity and intermittency that influence the uptake of renewables
- Bridging role for natural gas:
  - This creates an opportunity space for a role for natural gas, which can be used for conventional end uses (such as district heating and power gen) and enhanced end uses such as flexible generation, load balancing, mass transportation etc.
  - In addition grey Hydrogen (produced using natural gas) still offers a cost competitive solution vs. green and blue Hydrogen
  - Shell is also working on biogas based hybrid energy projects, which offer a credible solution for non-grid connected areas esp. in semi-rural and rural districts



# CRITICAL ENABLERS

- Adoption of legislative structures supporting monetization of de-carbonized gases and supporting incentives are critical enablers

LEGISLATION &  
REGULATORY  
FRAMEWORK

TECHNOLOGY

- Cost effective technical solutions are required to increase the pace of adoption

- Development of supporting infrastructure such as storage and transportation are required to incentivize the market to adopt de-carbonized gases such as blue/green Hydrogen

SUPPORTING  
INFRASTRUCTURE

PILOTS AS  
PROOF  
POINTS

- Demonstration projects esp. for newer concepts such as power to gas and hybrid power gen can act as proof points for the technology and associated commercial model

# NEW ENERGIES

## Investments, Acquisitions and Ventures

2016 SHELL NEW ENERGIES ESTABLISHED

2017

2018

2019

 Blauwwind, Netherlands

 Sense Home Monitor, USA

 Kite Power Systems, UK

NewMotion, NL (HQ)  
Hydrogen Stations, UK & California

 SBI BioEnergy, Canada

IH2, India

 First Utility, UK (HQ)

 SolarNow\*, Uganda (base)  
Steamaco\*, UK (base)

Sunseap, Singapore (HQ)

 Innowatts, USA

Greentown Labs, USA

 Fare Pilot\*\*, UK (HQ)

Connected Freight\*\*, Philippines

 Silicon Ranch\*, USA  
Cleantech Solar\*, Singapore  
Moerdijk, Netherlands

 Atlantic Shores Offshore Wind\*, USA  
Mayflower Wind Energy\*, USA  
TetraSpar\*, Norway

 Light and heavy duty hydrogen stations, USA (California)  
Junction City biogas plant, USA (Oregon)

GI Energy, USA  
 Rheinland Hydrogen Electrolyser, Germany  
Shell Energy Inside\*\*, USA

 Husk Power\*, India (base)  
SunFunder\*, Kenya (base)

HyET, NL  
 Axiom Exergy, USA  
Ample, USA

 WonderBill\*\*, UK

 Greenlots, USA  
W2C, Netherlands

 Makani, Norway  
TetraSpar\*, Norway

sonnen, Germany  
Limejump, UK

 EcoSmart Solutions, USA  
Convergent Energy storage at Shell facilities, Canada

Aurora, USA  
AutoGrid, USA  
 Nordsol, Netherlands  
Sense Photonics, USA  
LO3 Energy, USA  
Maniv Mobility, Israel  
Corvus Energy, Norway  
Asperitas, Netherlands

 Ravin.ai, UK and Israel

 Nature-based Solutions, Australia, Malaysia, Netherlands and Spain

### KEY

 Energy Solutions

 Digital Businesses

 Energy Access

 Wind

 Solar

 New Fuels

 Shell Ventures

 Nature-based Solutions

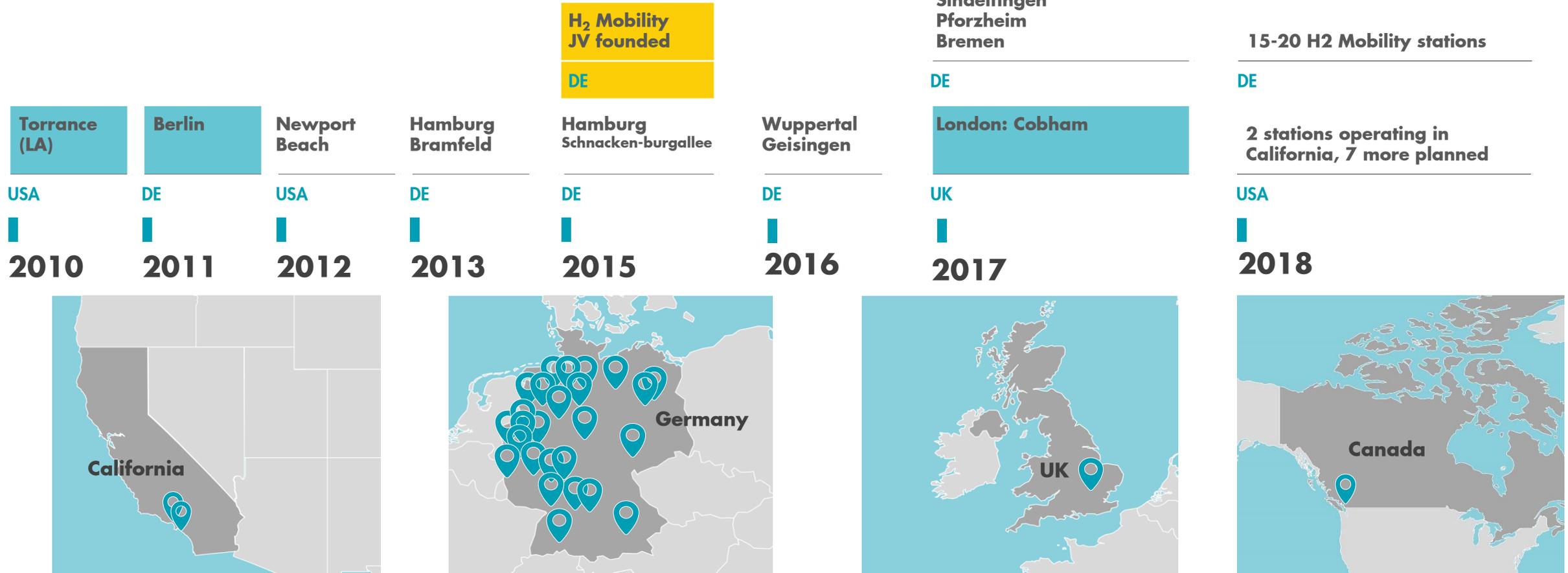
\* Minority investment, JV or consortium

\*\* Product launch date

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# THE SHELL HYDROGEN JOURNEY

Hydrogen stations opening





# SHELL & THE INTEGRATED POWER SYSTEM

Electricity currently makes up 20% of final energy consumption and that figure could increase to as much as 50% by 2060.

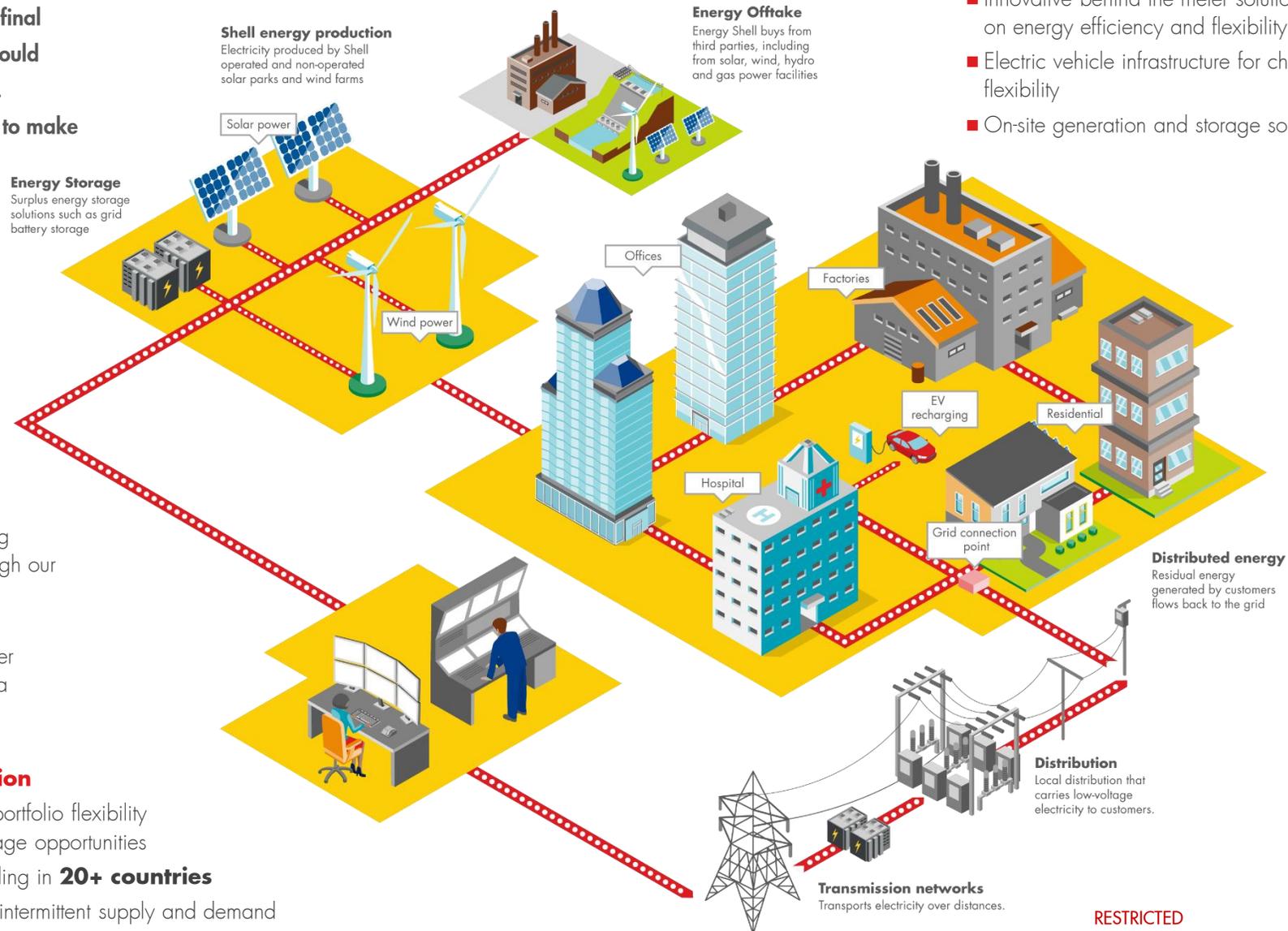
To help meet this demand, Shell aims to make electricity a significant business.

## Supply and generation

- Wind, solar, and selected gas and storage assets
- Third-party offtake agreements to buy power
- **15+** years of experience in wind power
- Interests in wind farms with potential to generate over **5GW** once fully built
- Solar generation capacity – operating and signed – of over **1.6GW** through our Silicon Ranch and Cleantech Solar platforms
- **10K+** megawatts of managed power generation capacity in North America with **1/3+** from renewables

## Optimisation

- Leverage portfolio flexibility and arbitrage opportunities
- Power trading in **20+ countries**
- Analysing intermittent supply and demand



## Customers at the centre

- Commercial, industrial and residential customers
- Innovative behind the meter solutions focused on energy efficiency and flexibility
- Electric vehicle infrastructure for charging flexibility
- On-site generation and storage solutions

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