



Powering Progress Together – Providing More and Cleaner Energy Solutions for a Changing World

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Definitions & cautionary note

The New Lens Scenarios are part of an ongoing process used in shell for 40 years to challenge executives' perspectives on the future business environment. We base them on plausible assumptions and quantification, and they are designed to stretch management to consider even events that may be only remotely possible. Scenarios, therefore, are not intended to be predictions of likely future events or outcomes and investors should not rely on them when making an investment decision with regard to Royal Dutch Shell plc securities.

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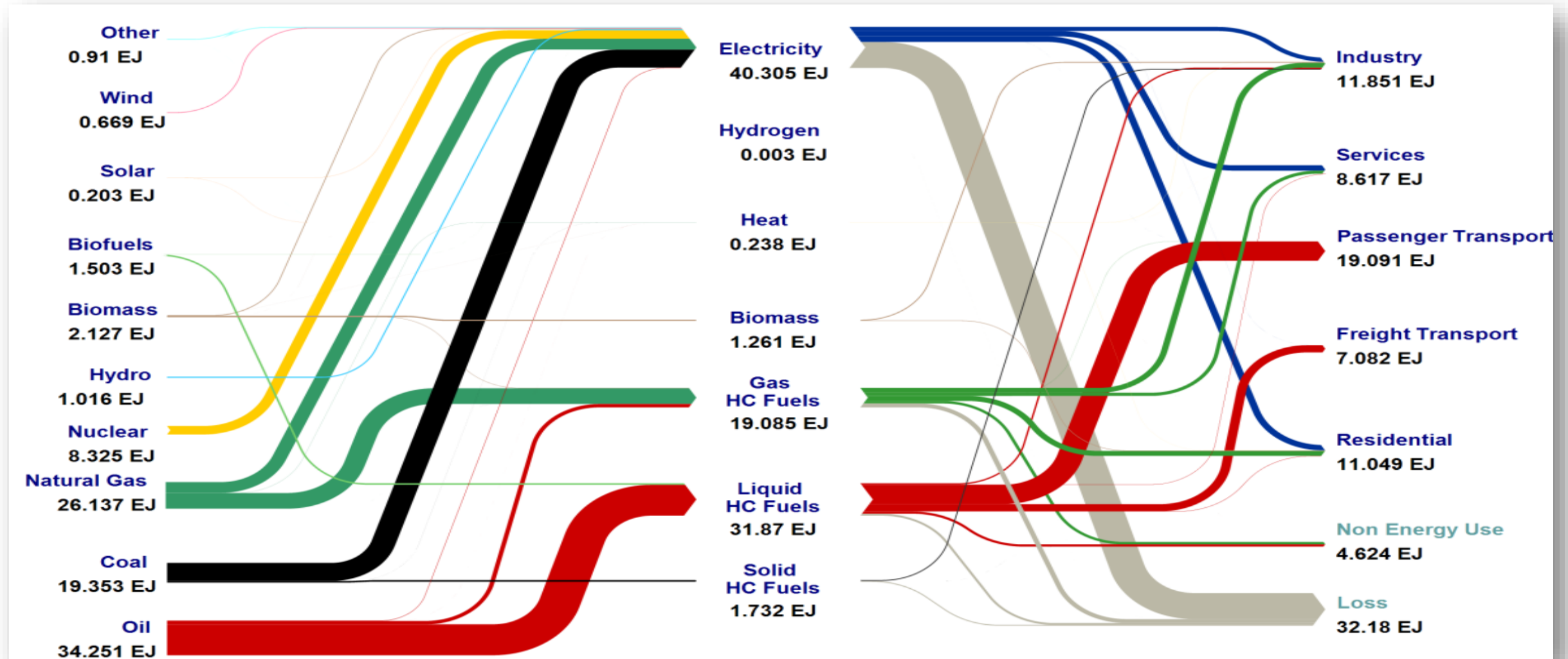
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Energy transitions are nothing new: The U.S. energy system, late 1800s



The energy system in the US (95 EJ) in the 21st century



Projected Energy Future in 2050



Population

9 billion people,
75% living in cities
(2 billion more than today)



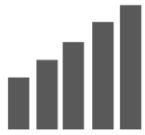
Vehicles

2 billion vehicles
(currently 800 million)



Rising standards

Many millions of people will rise
out of energy poverty; with higher
living standards energy use rises



Demand

Energy demand could double from
its level in 2000...but CO₂
emissions must be half today's to
avoid serious climate change



Efficiency

Twice as efficient, using
half the energy to produce
each dollar of wealth

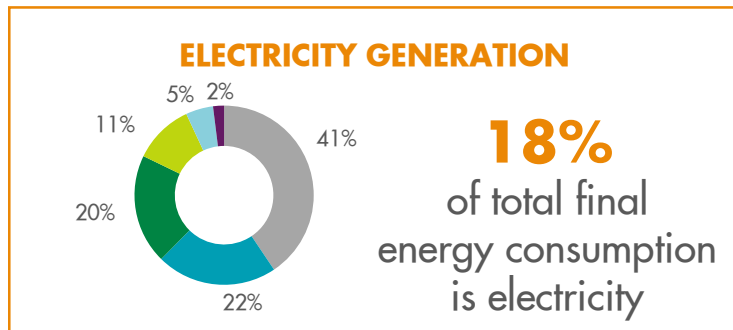
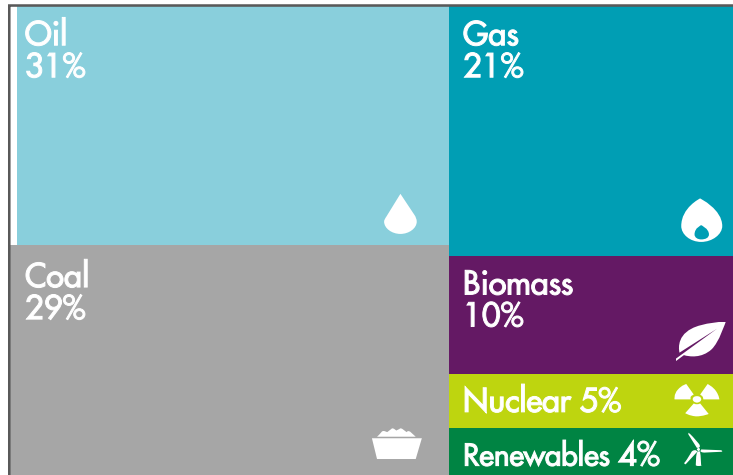


Renewables

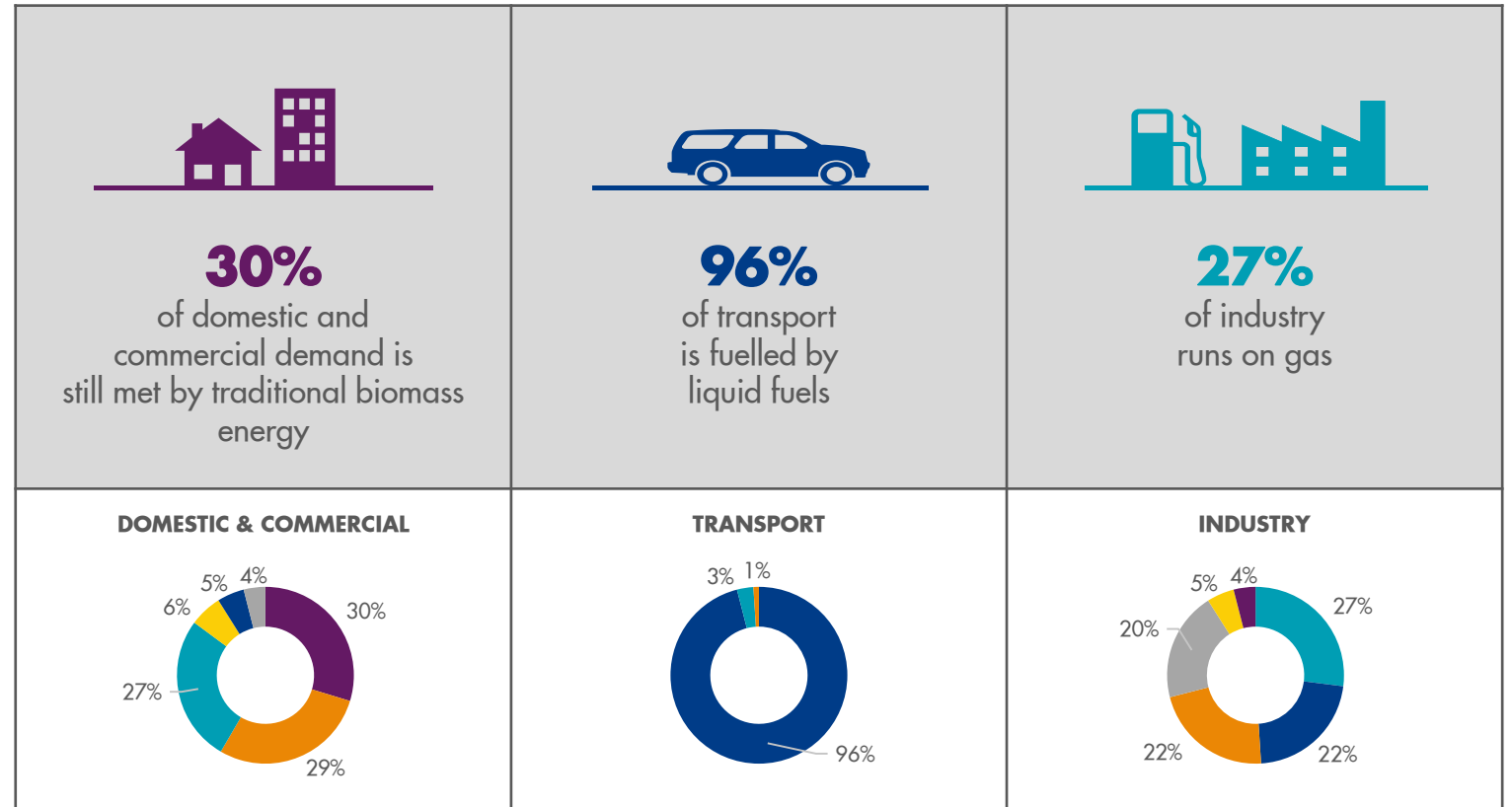
4 times more energy
from renewable sources

Today's Energy Mix

Current Global Energy Demand



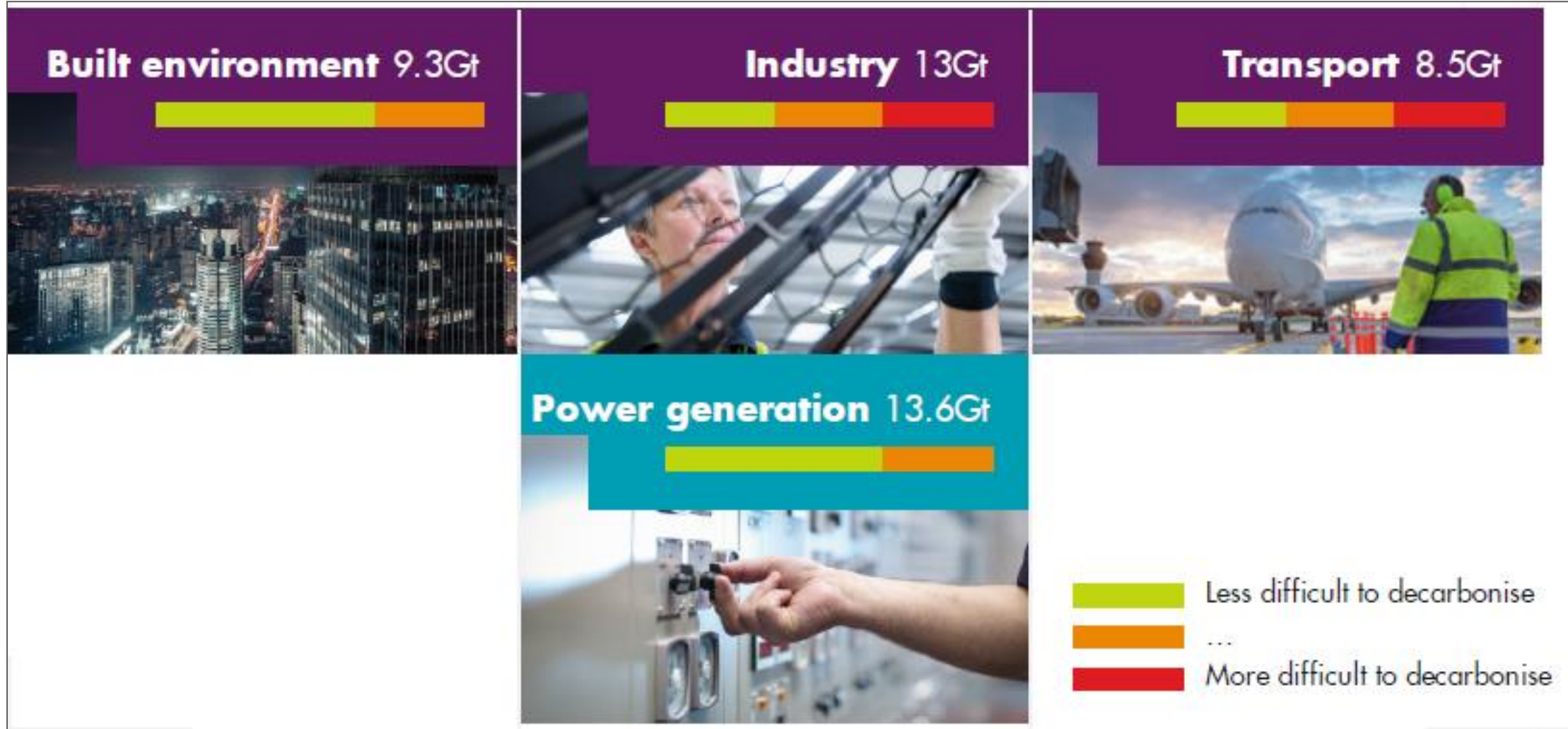
Energy Consumption by Sector and Consumer Trends



Oil Coal Gas Biomass Nuclear Renewables (including hydra) Electricity Heat Liquid fuels (including biofuels)

Source: International Energy Agency, Key world energy statistics 2015 and World energy outlook 2015.

The Pace of Energy Decarbonization will vary by Industry Sector



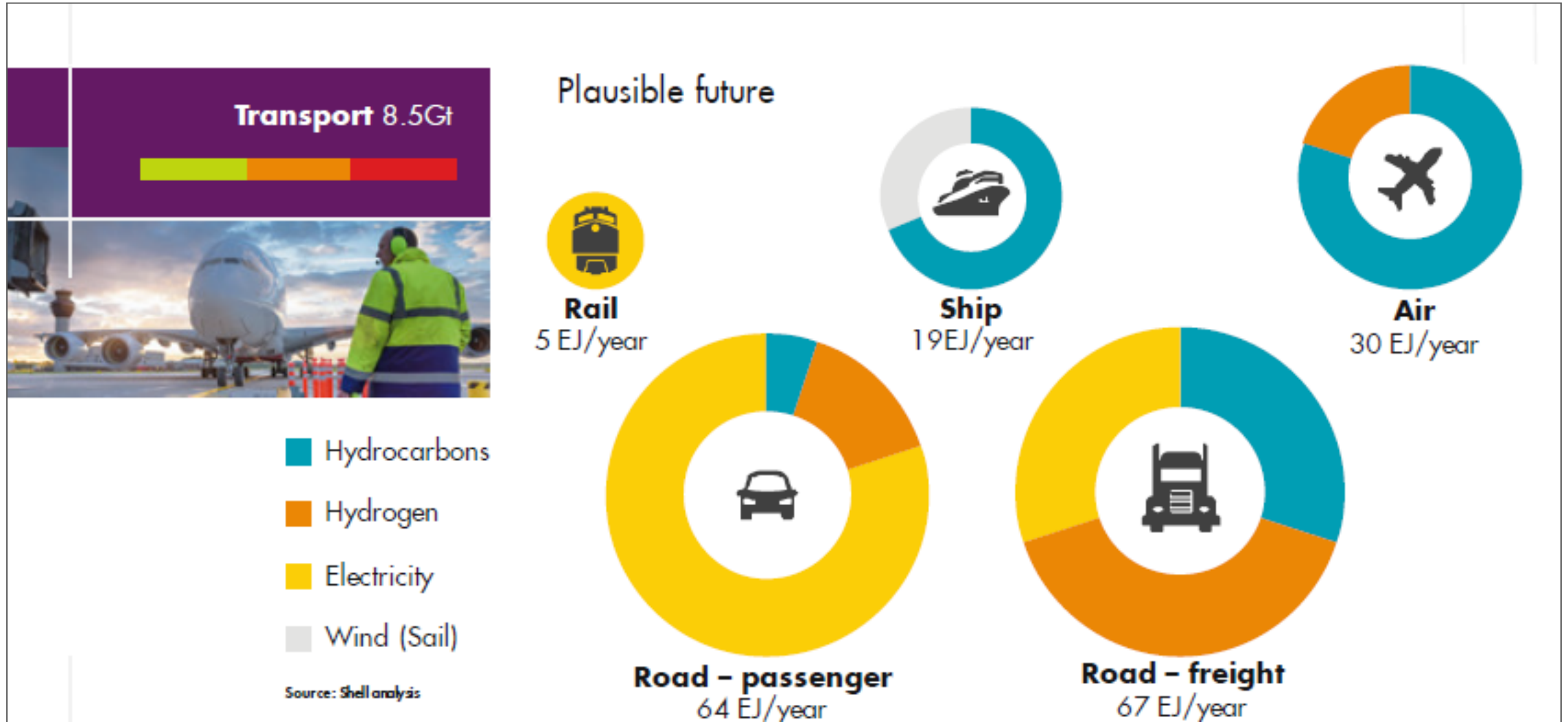
Existing infrastructure will impact the pace of decarbonization

Average infrastructure turnover in years

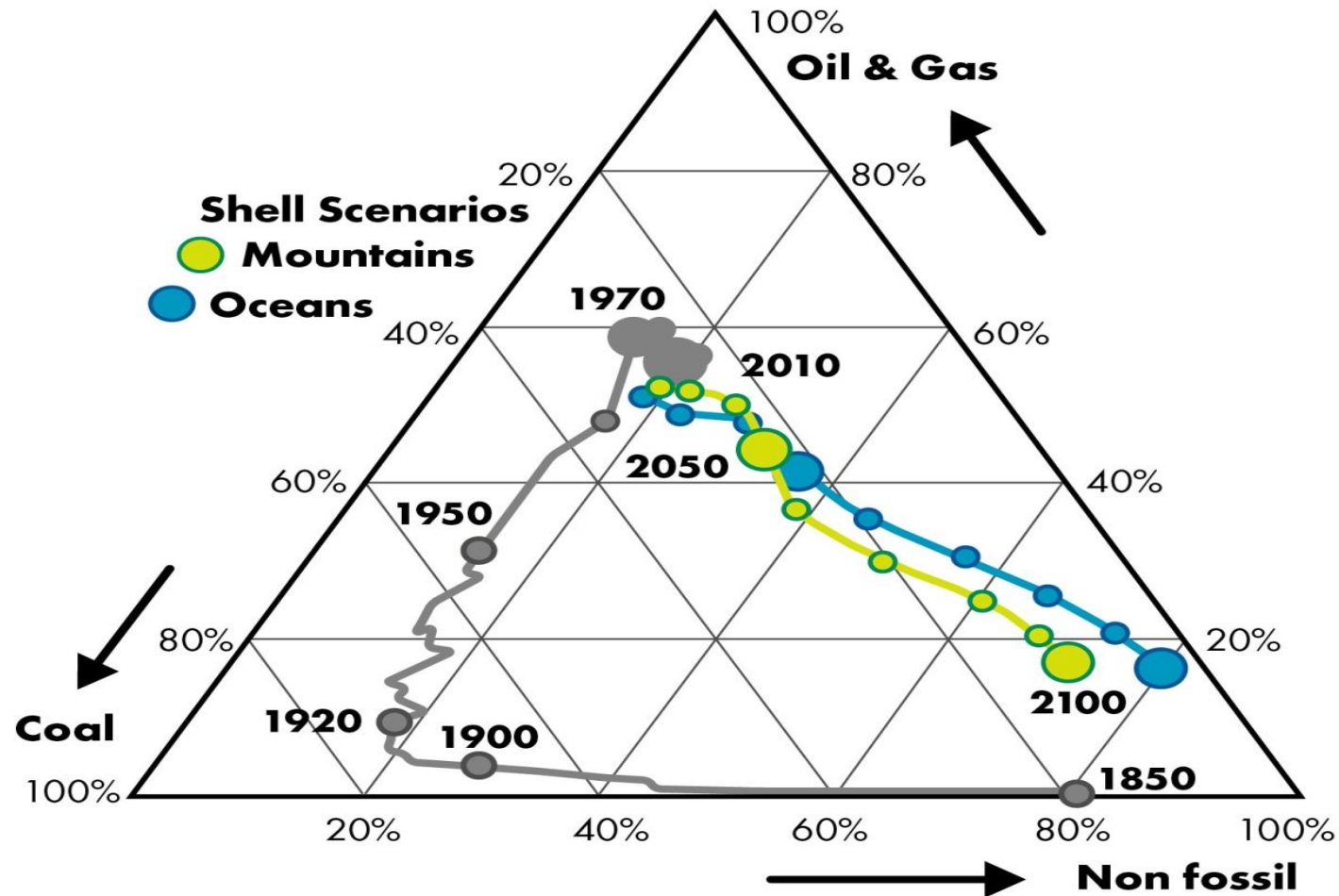


Source: HS Energy © 2015 (Illustrations sourced from Shutterstock by HS)

Aviation, Shipping & Long Distance Transport will still need Liquid Fuels

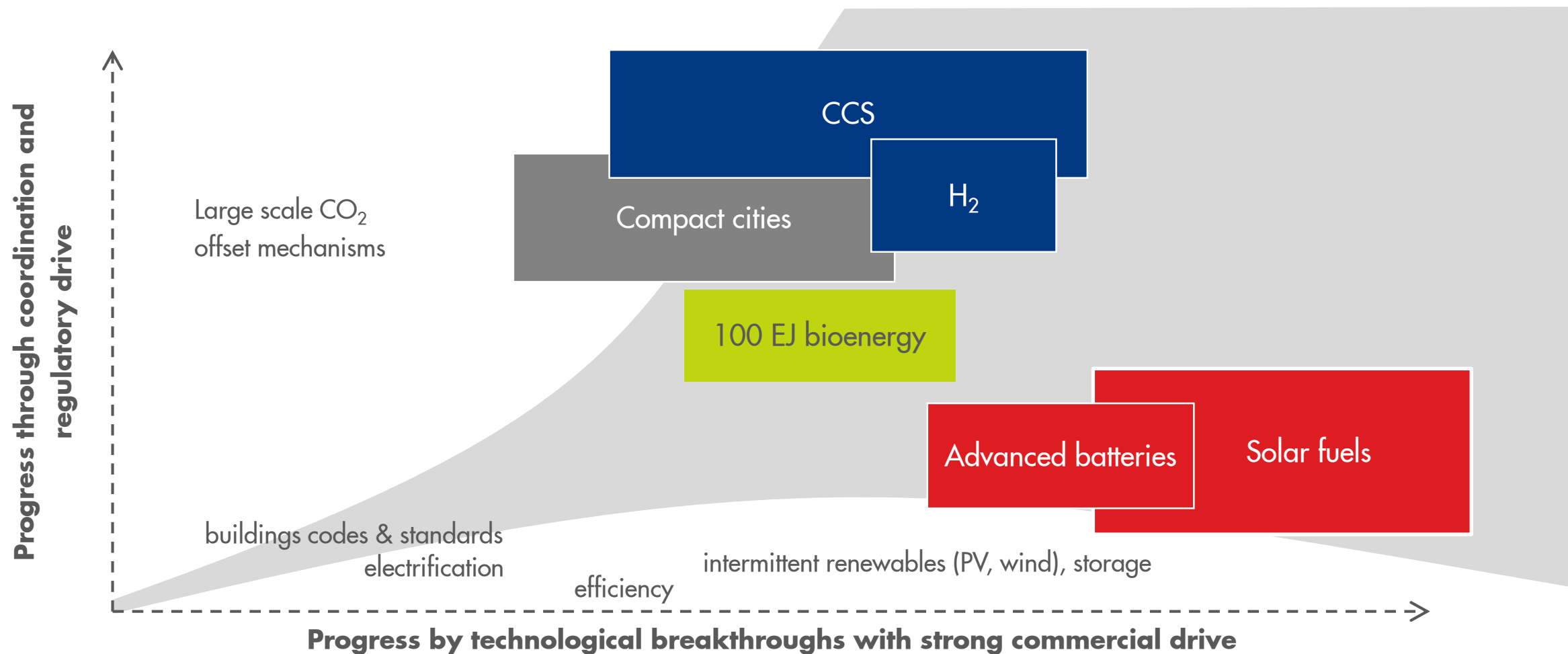


The Energy Transition Coming Full Circle in the Near Future



Policy coordination vs technology

A journey to net-zero emissions



Source: Shell FET analysis

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Long Range Research

Long Range Research (LRR) – Back to Basics and Fundamental R&D



New Energy

- Develop a radically better energy carrier using low cost solar energy combined with novel technologies for energy storage and conversion

Chemicals

- Find new pathways to convert methane to products

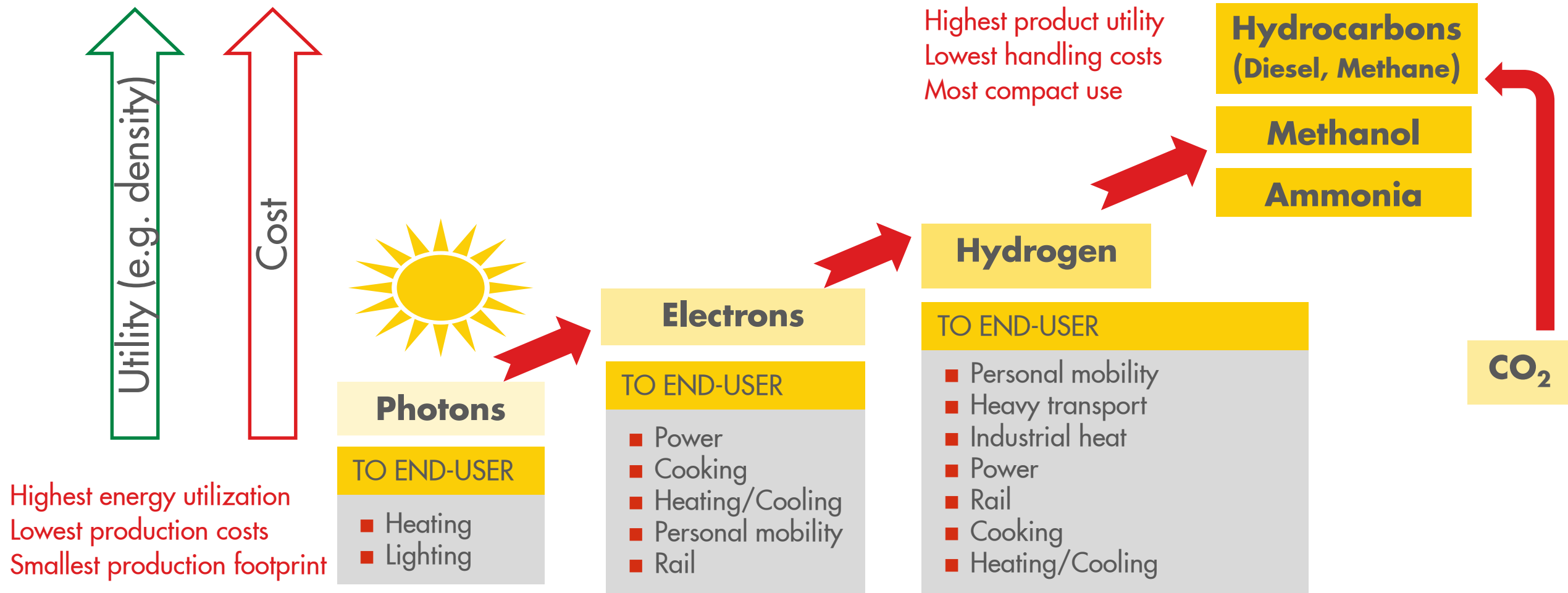


Enabling sciences

- Electrochemistry
- Materials science
- Structured catalysts & interfacial phenomena
- Transport phenomena
- Computational material science & chemistry
- Biosciences

Emphasis on scientific areas where: (i) we want to build capability; (ii) there is significant innovation headroom; (iii) it has impact across multiple applications

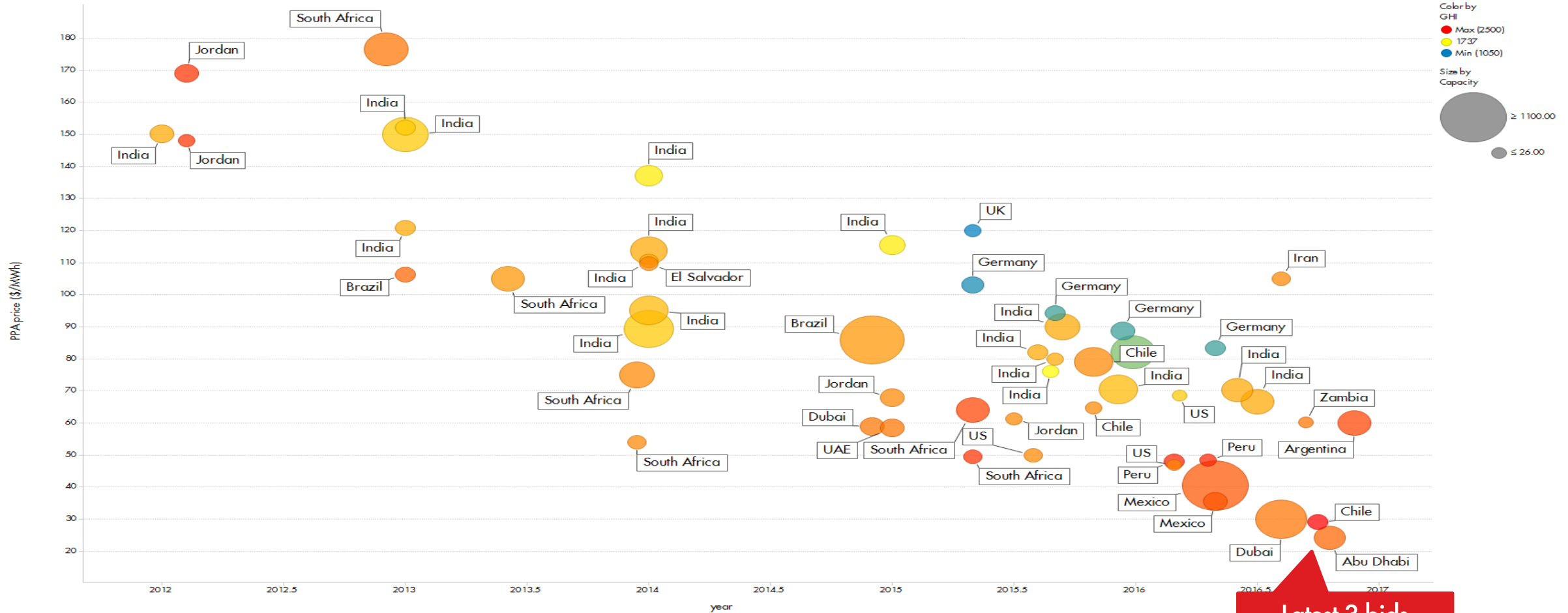
Solar Energy: Pathway to Dense Energy Carriers



Electricity is moving from being one of the most expensive energy carriers to that with the lowest cost, with solar generation offering the highest energy utilization and the smallest footprint.

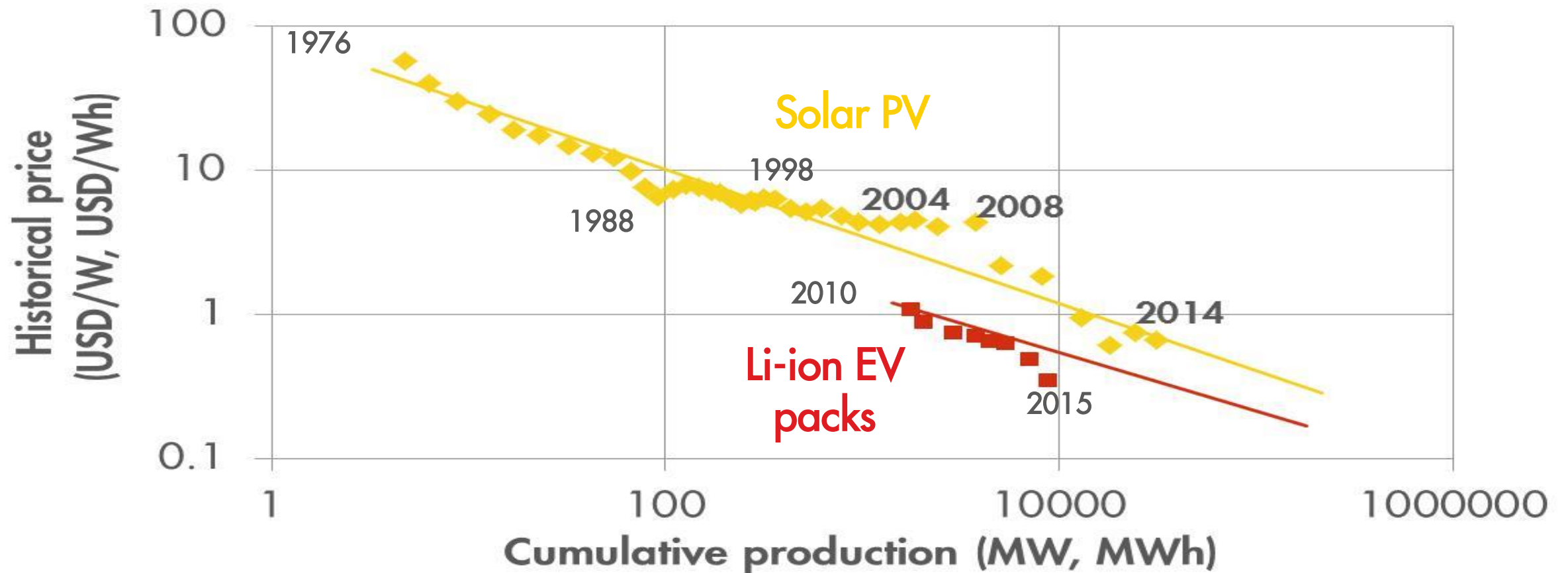
PV Auction Database: PPA prices decline

PPA price (\$/MWh) vs. year



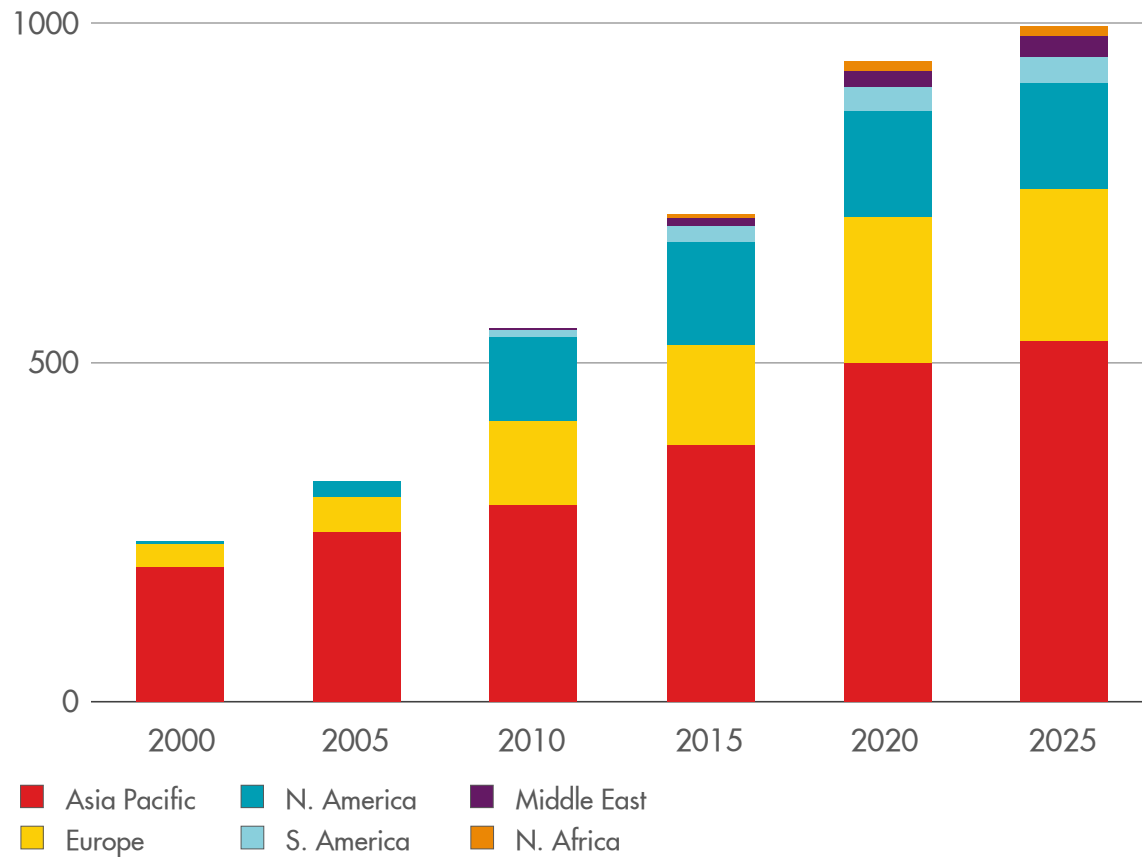
Energy Storage: Rapidly Declining Cost of Lithium-Ion Batteries

*Similar trends for Solar PV & Li-ion EV packs
(~20% cost reductions for every doubling of production)*



The Global Market for Chemicals Continues to Grow

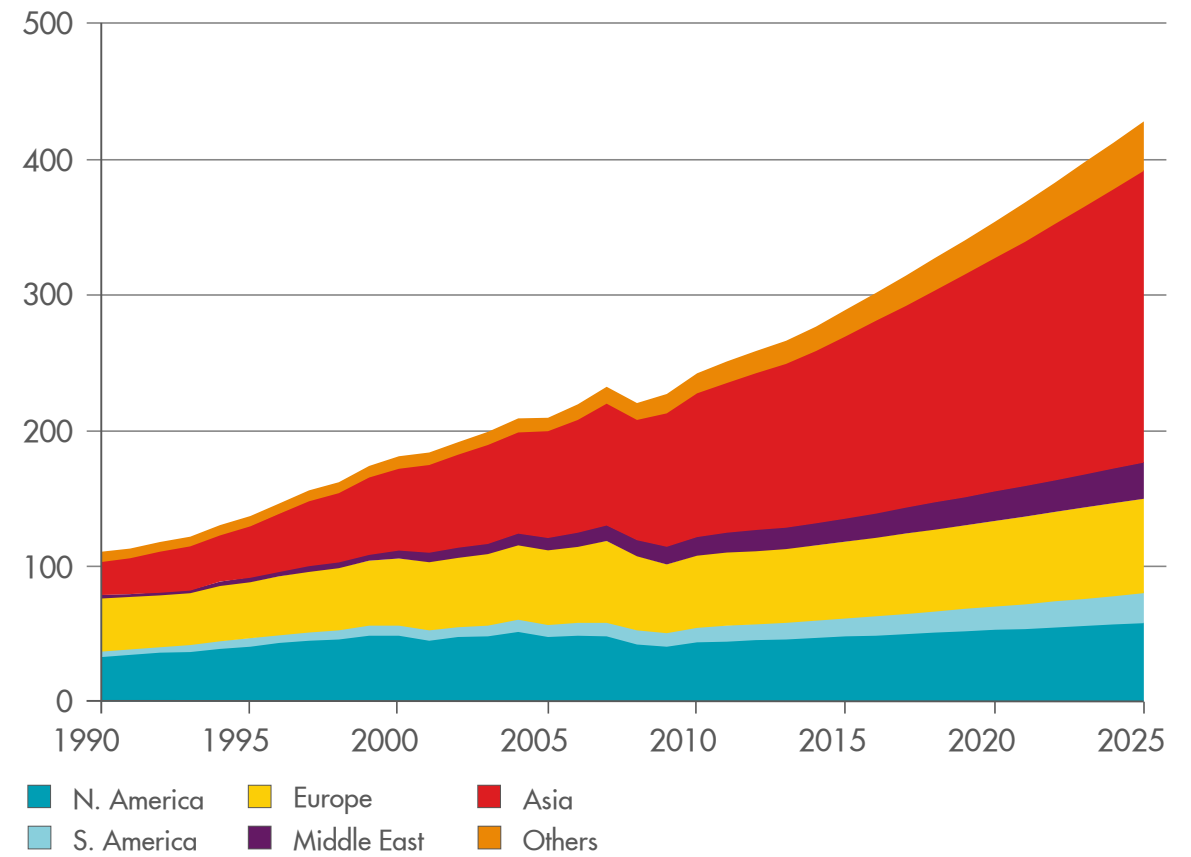
LNG regasification capacity
mln tonnes p.a.



Source: Shell Management Day Nov 2015

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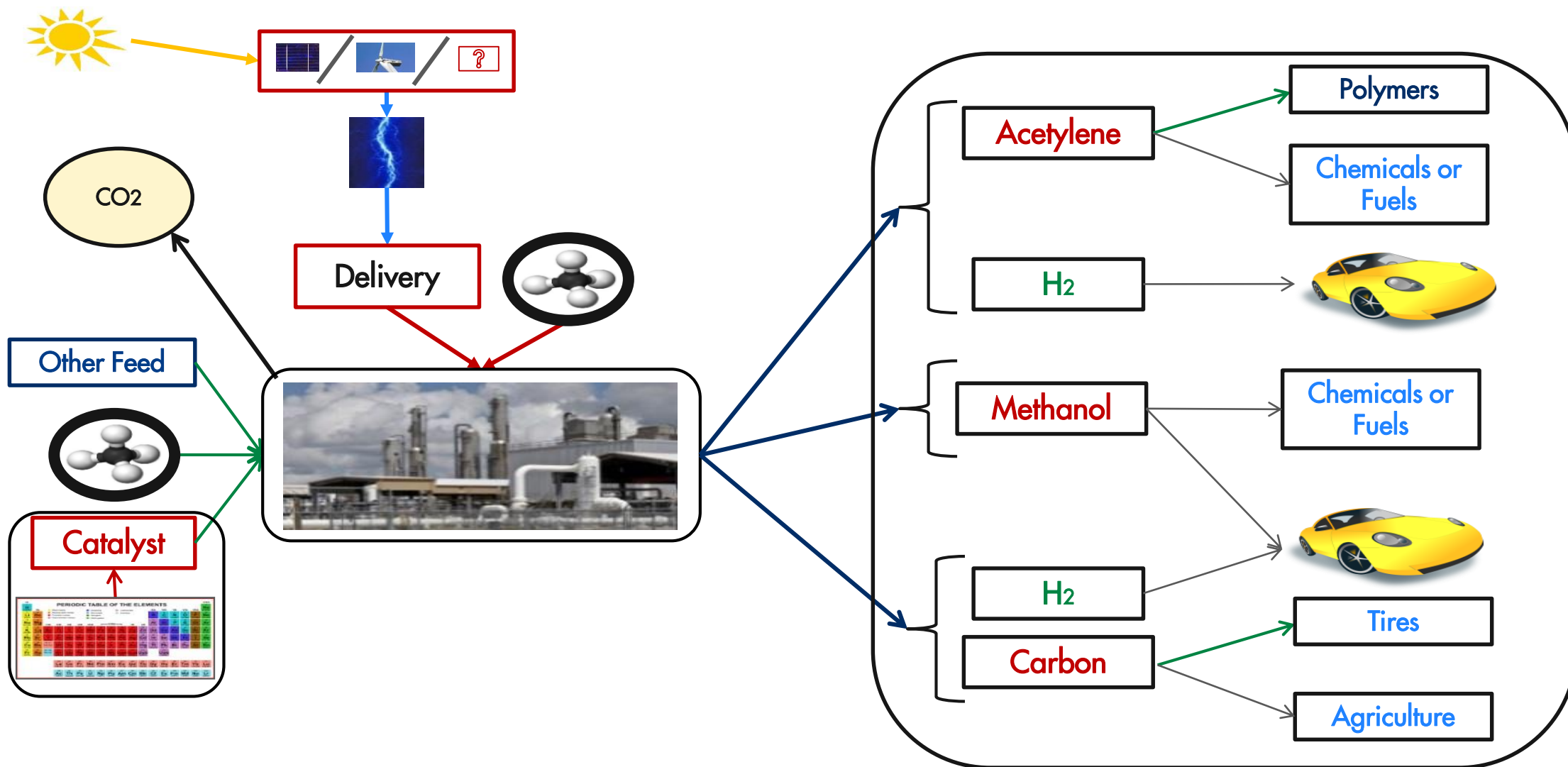
Domestic demand for base chemicals
mln tonnes p.a.



Source: IHS

Long Range Research

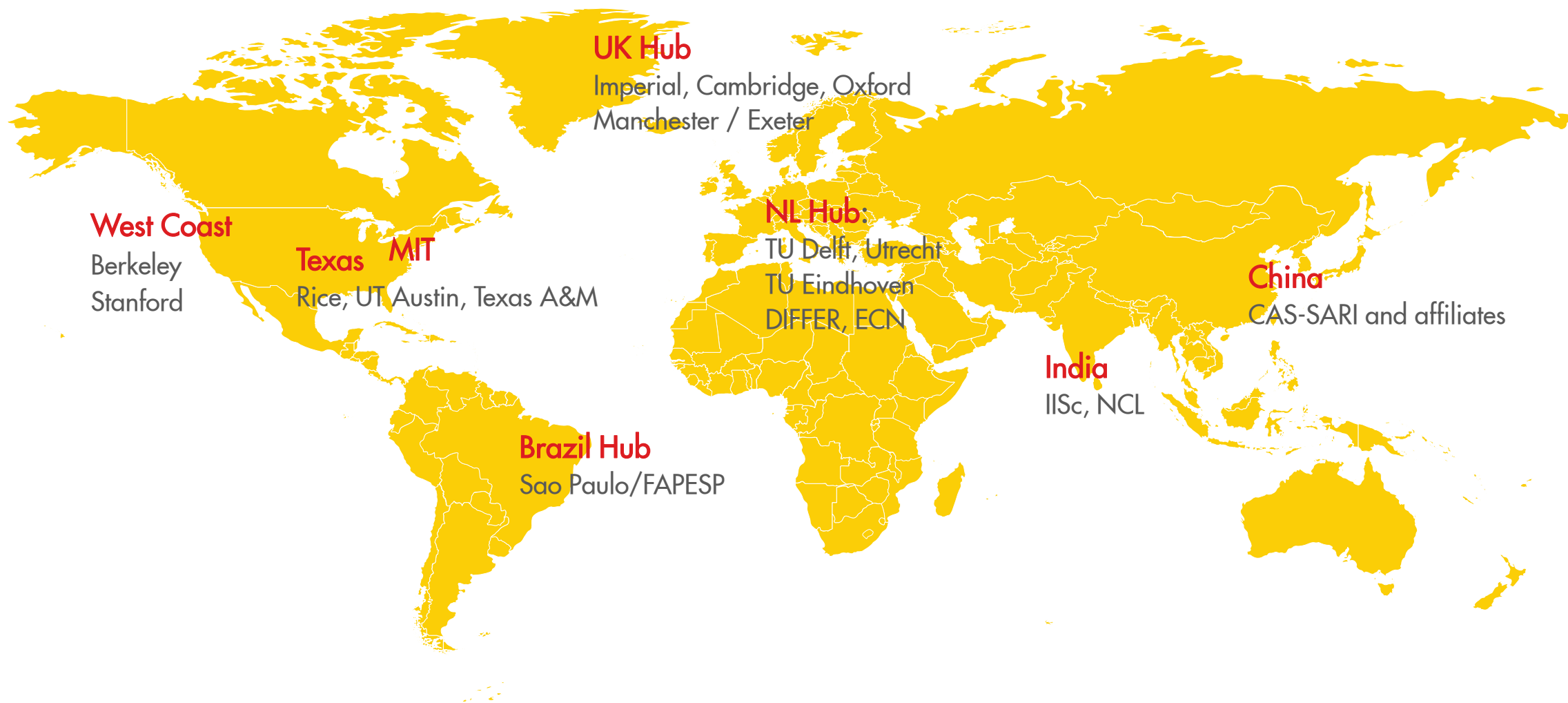
Methane to Products: Development of New Pathways



The Long Range Research Technology Platform

PROGRAMS	DENSE ENERGY CARRIERS (DEC)	ADVANCED ENERGY STORAGE (AES)	METHANE TO PRODUCTS (M2P)
THEMES	Ultra Low Cost High Efficiency Solar PV	Intercalation-based Battery Systems	Integrated System Analysis and Product Choice
	Conversion of Photons to H2	Conversion-based Battery Systems	Chemistry & Catalysis (a) Fundamentals (b) Oxidative Pathways (c) Pyrolytic/Thermal Pathway
	CO2 Direct Air Capture	Electrolytes	Separations
	Novel Routes to Syngas and HC Fuel Synthesis	Novel Approaches (Supercapacitors, Flow Batteries)	Discovering the Unknown
	Artificial Photosynthesis		
ENABLING CAPABILITIES	Computational Material Science & Chemistry		
	Bio-Sciences & Bio-Engineering		
	Exploratory Experimentation		

LRR: Developing Key External Technical Collaborations Globally



Launched a New Energies Business to Explore new Opportunities



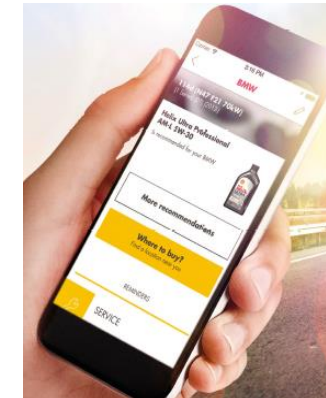
New fuels

- Cleaner transportation
- Biofuels + hydrogen



Integrated energy solutions

- NL + USA wind
- Solar for enhanced oil



Connected customer

- Connected mobility
- Connected energy

A Better Life with a Healthy Planet – Let's Make the Future!

