Transitioning to a Sustainable Future: Unpacking AFRY’s Fossil Detox Report

3 December 2024

HENRIK TEGNÉR AND DR. PATRICK GASSER

AFRY

DISCLAIMERS AND RIGHTS

NOTHING IN THIS WEBINAR IS OR SHALL BE RELIED UPON AS A PROMISE OR REPRESENTATION OF FUTURE EVENTS OR RESULTS. AFRY HAS PREPARED THIS WEBINAR BASED ON INFORMATION AVAILABLE TO IT AT THE TIME OF ITS PREPARATION AND HAS NO DUTY TO UPDATE THIS WEBINAR.

AFRY makes no representation or warranty, expressed or implied, as to the accuracy or completeness of the information provided in this webinar or any other representation or warranty whatsoever concerning this webinar. This webinar is partly based on information that is not within AFRY's control. Statements in this webinar involving estimates are subject to change and actual amounts may differ materially from those described in this webinar depending on a variety of factors. AFRY hereby expressly disclaims any and all liability based, in whole or in part, on any inaccurate or incomplete information given to AFRY or arising out of the negligence, errors or omissions of AFRY or any of its officers, directors, employees or agents. Recipients' use of this webinar and any of the estimates contained herein shall be at Recipients' sole risk.

AFRY expressly disclaims any and all liability arising out of or relating to the use of this webinar except to the extent that a court of competent jurisdiction shall have determined by final judgment (not subject to further appeal) that any such liability is the result of the wilful misconduct or gross negligence of AFRY. AFRY also hereby disclaims any and all liability for special, economic, incidental, punitive, indirect, or consequential damages. **Under no circumstances shall AFRY have any liability relating to the use of this webinar.**

All information contained in this webinar is confidential and intended for the exclusive use of the Recipient. The Recipient may transmit the information contained in this webinar to its directors, officers, employees or professional advisors provided that such individuals are informed by the Recipient of the confidential nature of this webinar. All other use is strictly prohibited.

Our presenters

Henrik Tegnér

HENRIK TEGNÉR
EVP Strategy and Sustainability
henrik.tegner@afry.com
+46 73 058 84 88

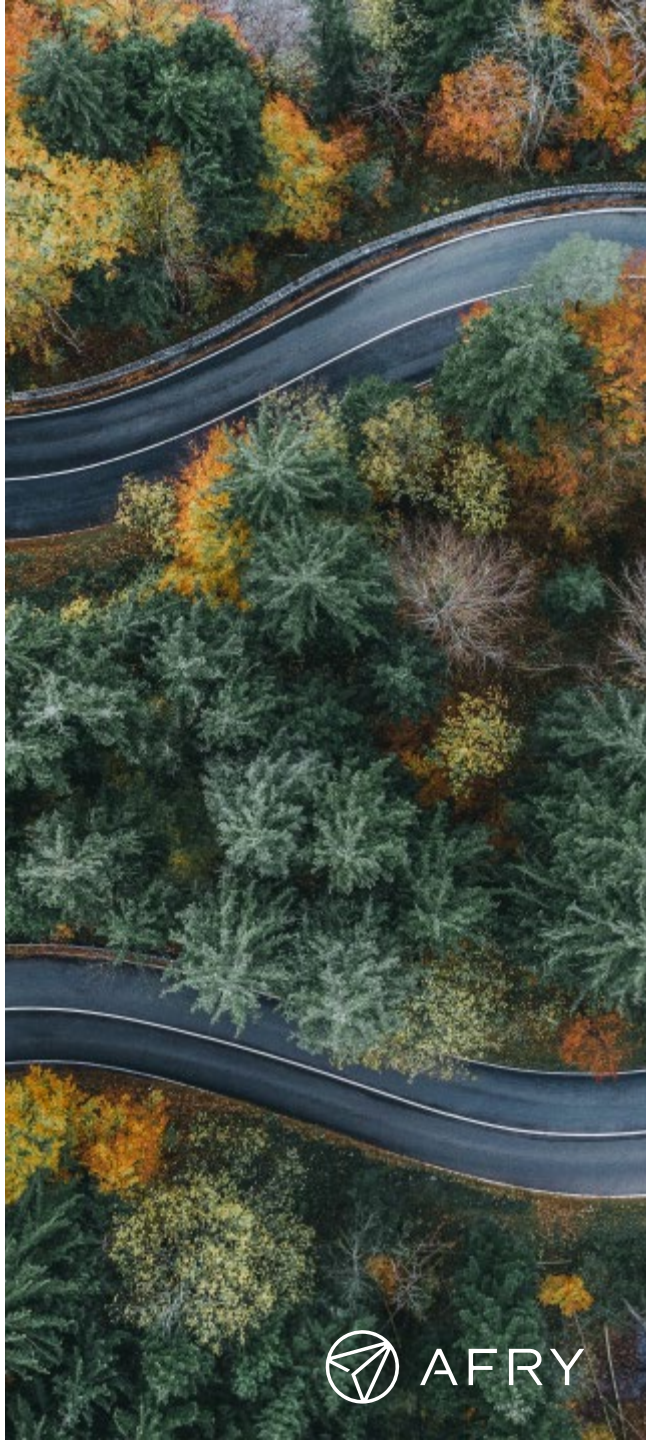
Dr. Patrick Gasser

Dr. PATRICK GASSER
Principal
patrick.gasser@afry.com
+41 76 356 21 37

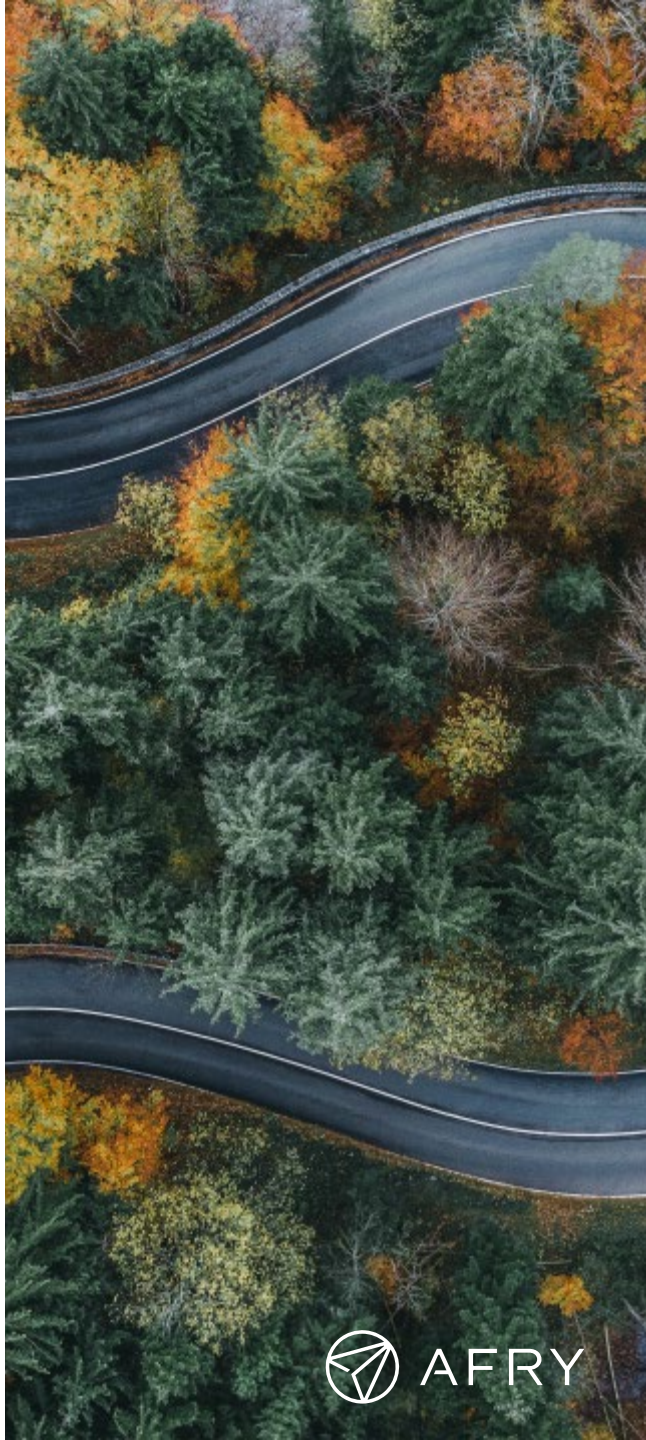
Please **ask questions** throughout the webinar using the question panel – we'll cover as many as we can at the end.

The **slide pack and recording** will be emailed to all attendees as soon as they're available.

Agenda



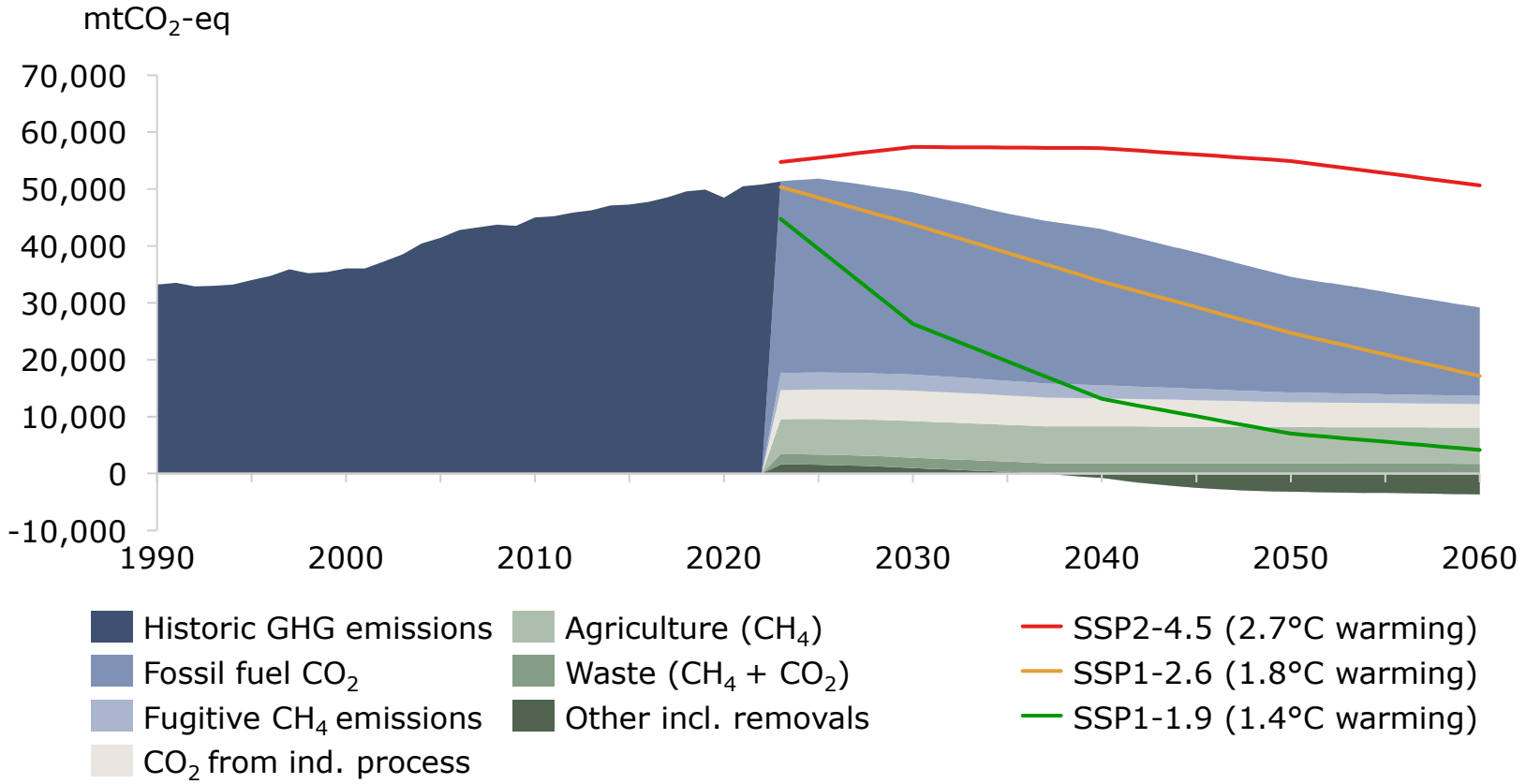
Agenda



CURRENT SITUATION

Greenhouse gas emissions must be reduced significantly to address global warming and reach the 1.5°C target

INDICATIVE TOTAL ANTHROPOGENIC GREENHOUSE GAS EMISSIONS BY ORIGIN VS. CLIMATE CHANGE SCENARIOS

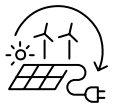


- CO_2 emissions are primary driver of human-induced climate change, and despite increased global attention, they continue to rise
- To meet the goals and net-zero emissions by 2050, as well as the 1.5°C global warming target of the Paris Agreement, actionable plans are necessary
- At COP28 in Dubai, countries committed to phasing out fossil fuels, aiming to triple renewable energy capacity and double annual energy efficiency improvements by 2030

SSP (Shared Socioeconomic Pathways) are reference climate change scenarios as defined in the IPCC Sixth Assessment Report, used to derive climate change and GHG scenarios with different climate policies; Fugitive CH_4 emissions are unintentional methane leaks from fossil fuel operations | Sources: AFRY, IPCC

AFRY aims to become the leading partner in the sustainability transition

RENEWABLE ENERGY

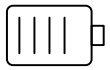


HEATING

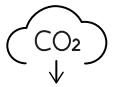
TRANSPORT

ENERGY NETWORKS

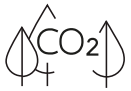
ENERGY STORAGE



CARBON CAPTURE STORAGE

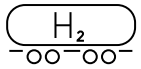


CARBON REMOVALS



NUCLEAR

HYDROGEN



NATURAL GAS AS A TRANSITION FUEL

WOOD-BASED SOLUTIONS

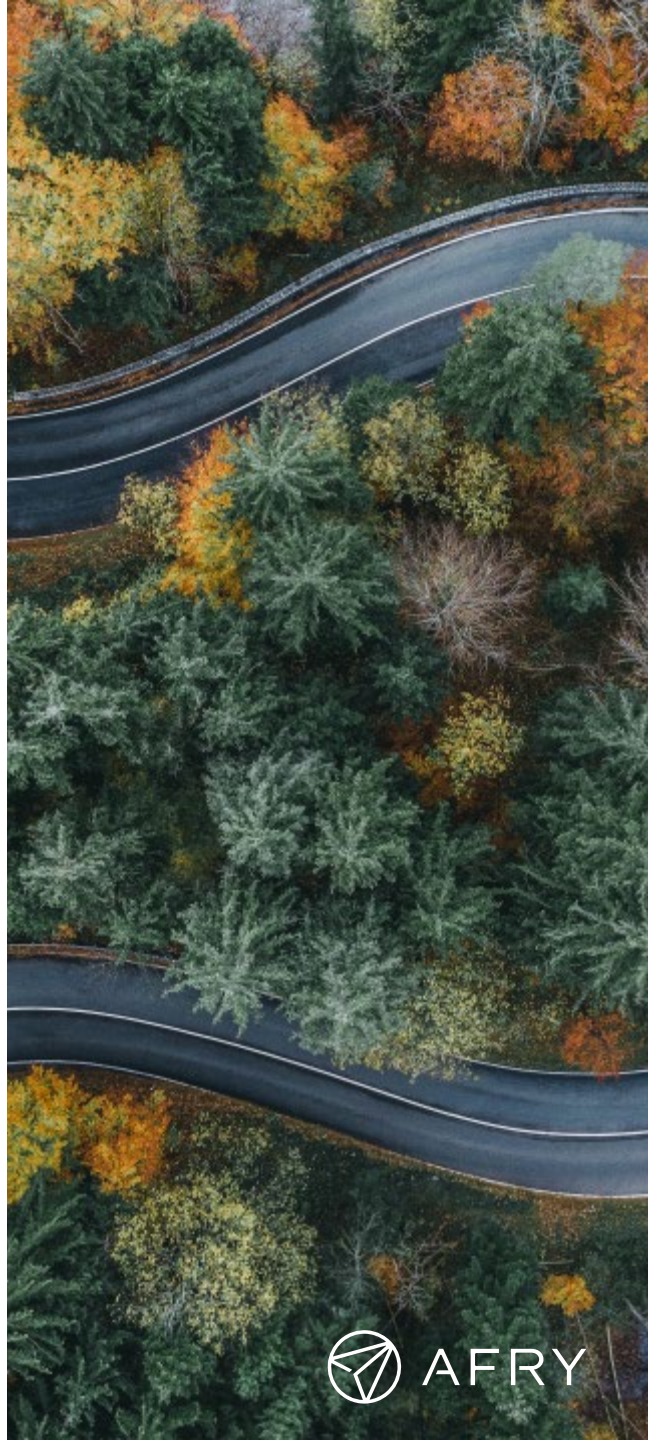
ENERGY EFFICIENCY

RESOURCE OPTIMISATION

Source: AFRY

- AFRY positions itself on key issues related to the energy transition and shift away from fossil fuels and fossil-based materials
- AFRY sees a carefully managed transition as critical, balancing sustainability, affordability, energy security, and social acceptance, amidst global economic and regional challenges
- AFRY formulates actionable enablers and strategic actions that need to be undertaken across multiple levels, from governments and industries to individuals

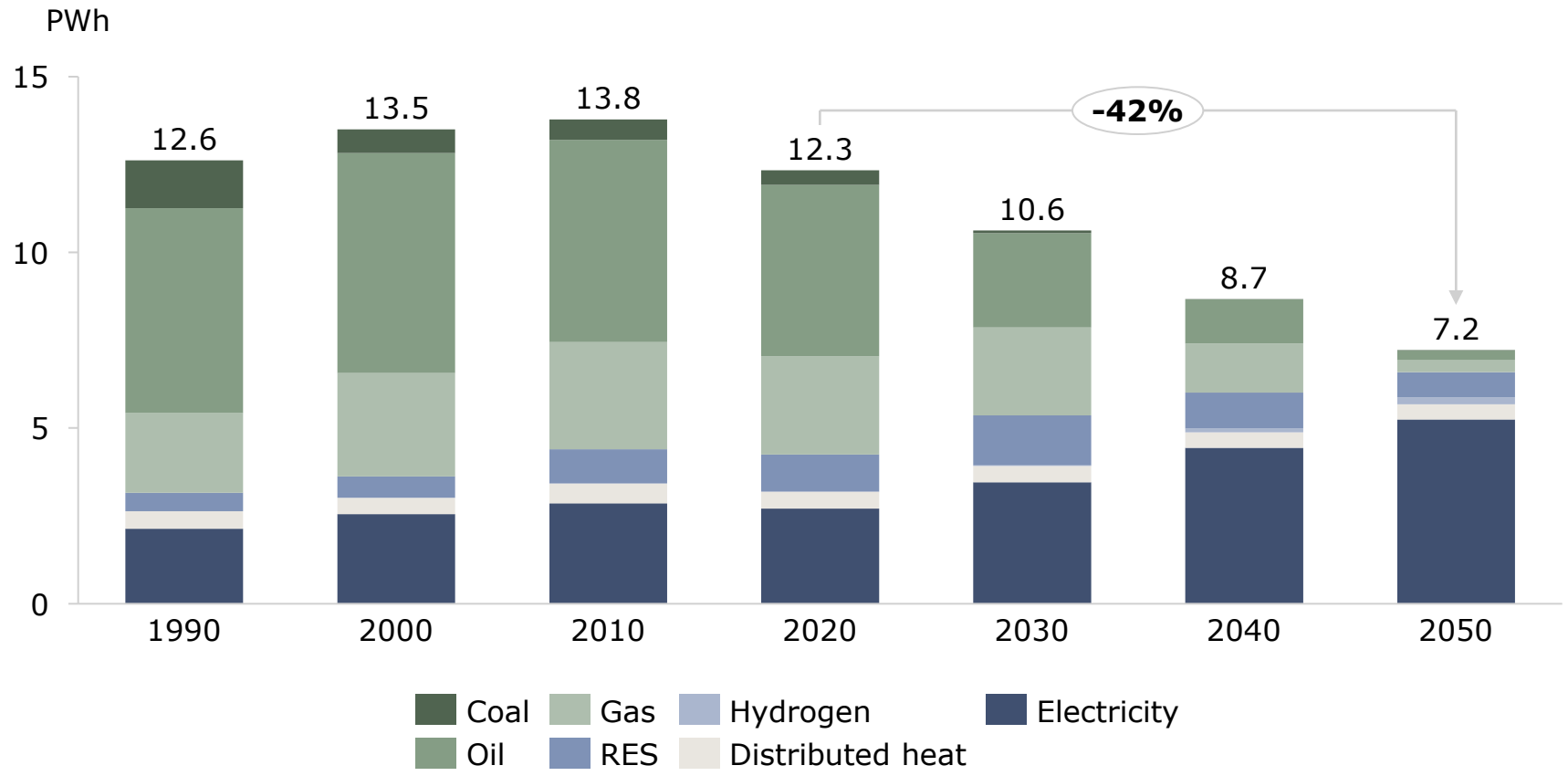
Agenda



ELECTRIFICATION

Electrification will play a pivotal role in the decarbonisation of the energy sector

FINAL ENERGY CONSUMPTION IN EUROPEAN COUNTRIES[1]

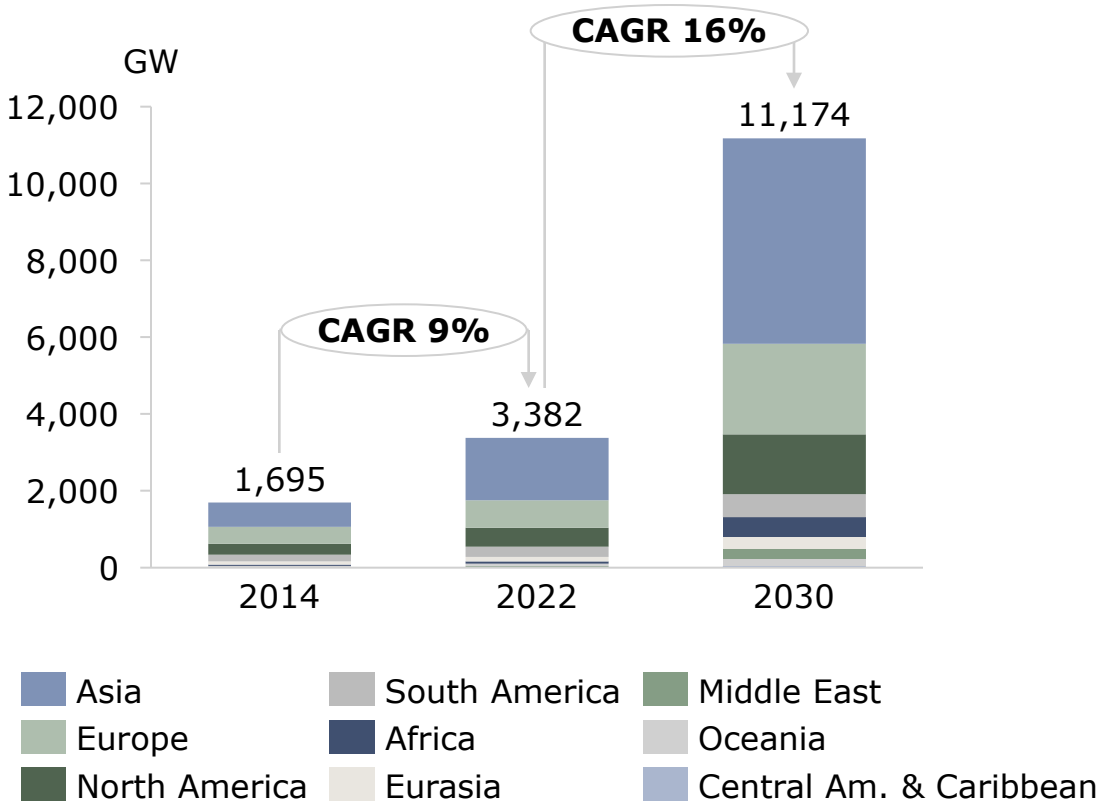


1. EU27 + 3 (CH, UK and Norway); Final energy consumption represents energy used by final consumers (such as households, transport, industry, etc.) for all energy uses; Distributed heat is residual heat from waste-to-energy or CHP plants, or from heat recovery | Source: AFRY, IEA

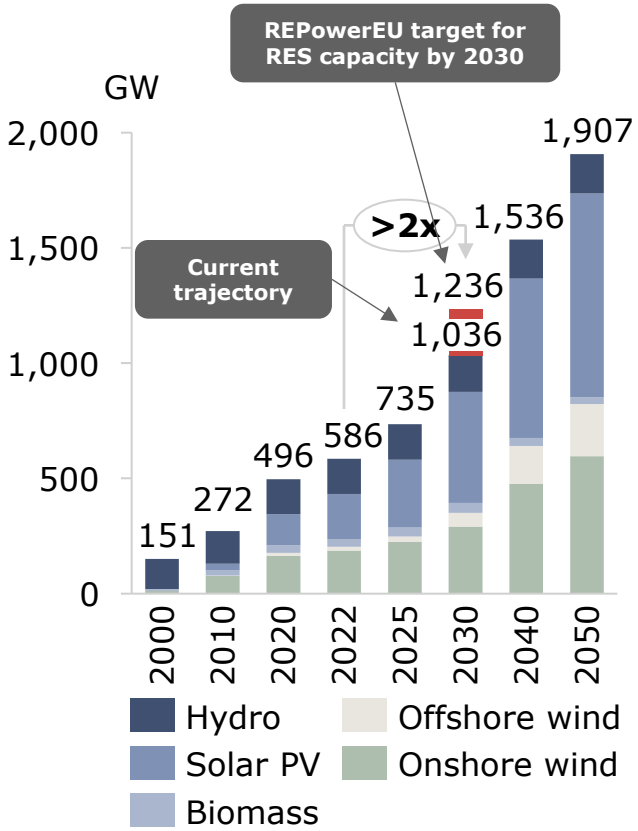
- Final energy consumption is projected to nearly halve by 2050, driven primarily by widespread electrification across sectors
- With uprising importance, demand for electricity is projected to increase significantly, requiring the installation of renewable energies or low-carbon alternatives
- Increasing attention to storage solutions and electricity networks, as backbone for the energy transition

Tripling renewable capacities across markets requires almost doubling historical growth rates

GLOBAL RES CAPACITY TARGETS, GROWTH RATES AND PROJECTED REGIONAL SPLITS



RES CAPACITIES IN EUROPEAN COUNTRIES[1]

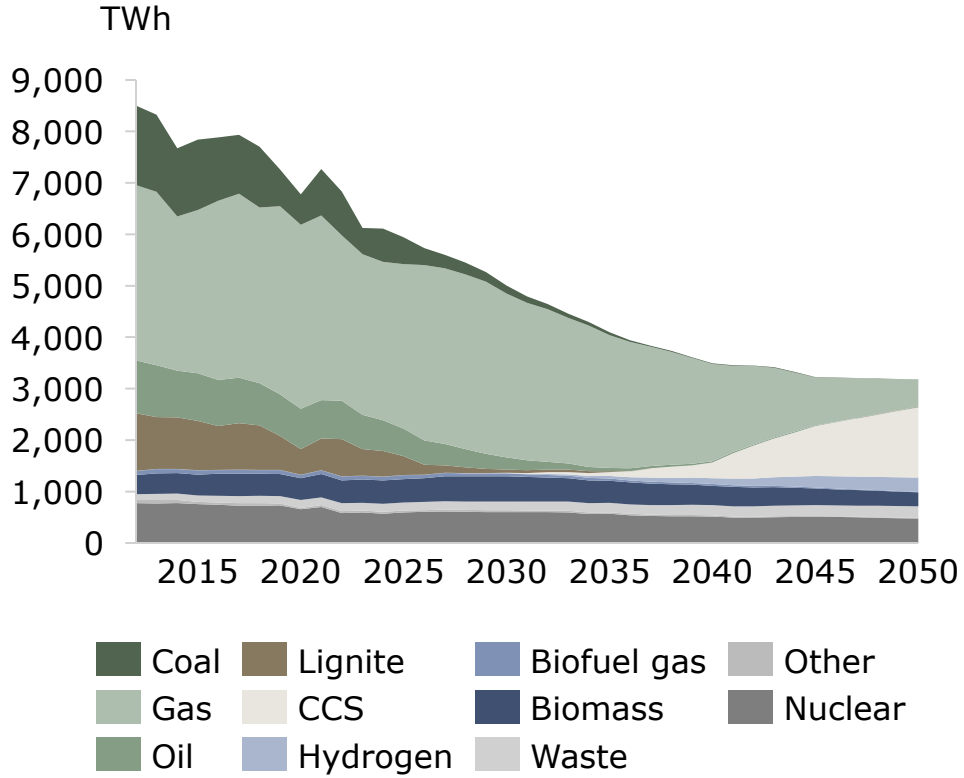


- COP28 represented a tripling of renewable energy systems worldwide until 2030
- Reaching goals requires almost doubling historic growth rates
- Accelerated deployment crucial, along with cost reductions, to enhance market competitiveness of renewable energy
- Investments needed to reduce costs and enhance development, alongside a resilient supply chain and supportive policies to address technological and regulatory challenges

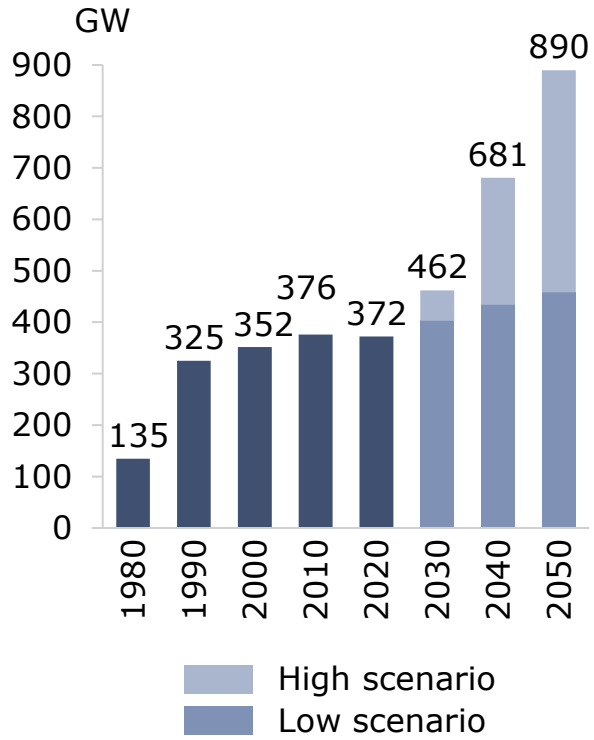
1. EU27; CAGR: Compound annual growth rate; RES: Renewable Energy Sources | Source: IRENA

Role of gas as transitioning technology and uprise in attention for nuclear on the pathway to carbon neutrality

HISTORICAL DEVELOPMENT & PROJECTIONS OF FUEL USE IN POWER & HEAT GENERATION FOR EUROPEAN COUNTRIES[1]



GLOBAL INSTALLED NUCLEAR CAPACITY AND OUTLOOK

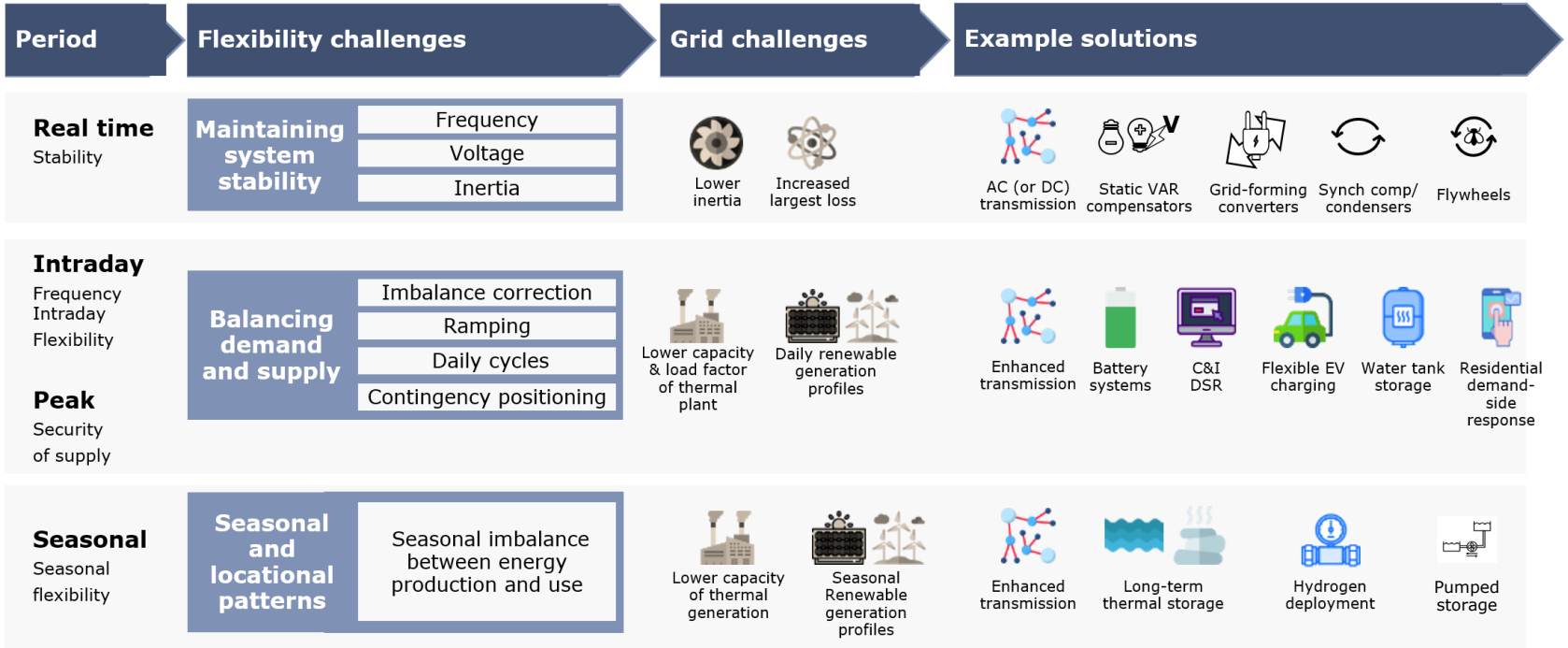


- Gas is increasingly viewed as a lower-carbon transition fuel, replacing coal and oil in power and heat production until 2050
- Gas' rising importance has made it a key influence factor in geopolitics
- Nuclear energy is gaining attention, with over 20 countries pledging to triple capacity by 2050 at COP28, and the EU endorsing it as a low-carbon technology to drive innovation and development

1. EU27 | Sources: AFRY, IAEA

Storage solutions and resilient electricity transmission system indispensable with high renewables penetration

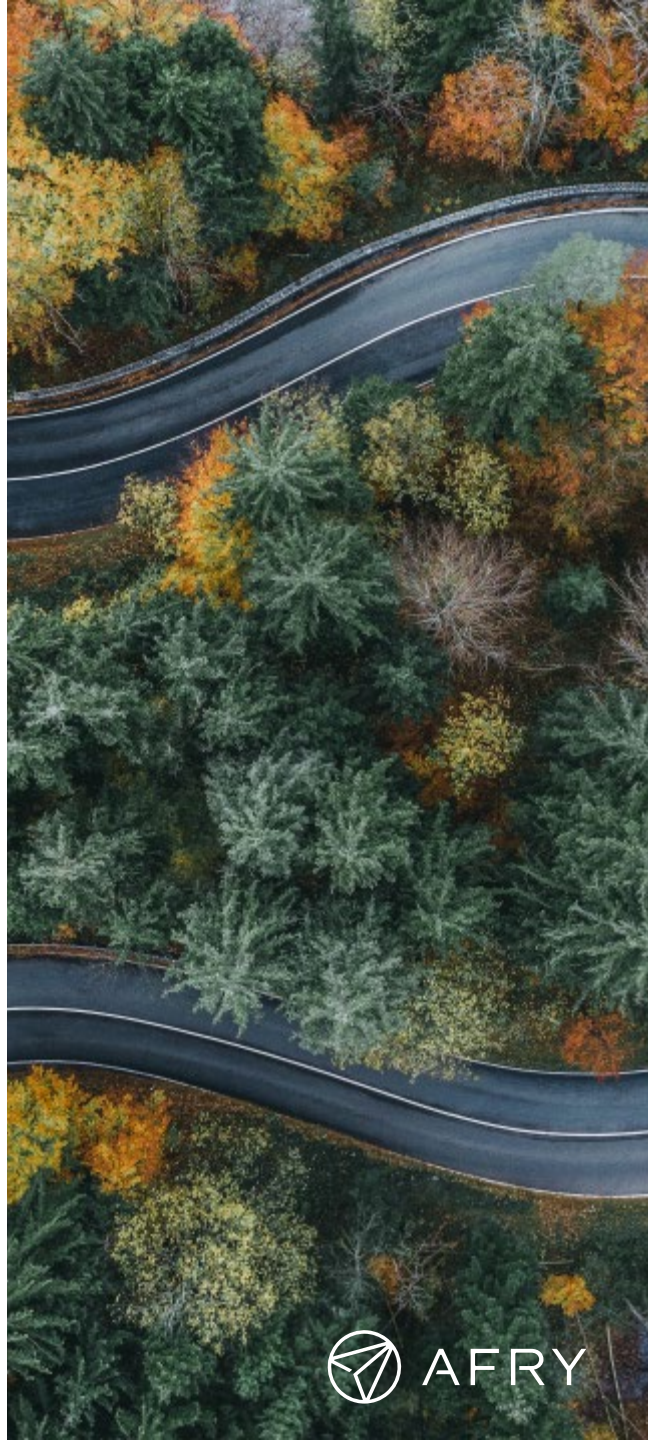
FLEXIBILITY NEEDS FOR DIFFERENT TIMEFRAMES AND POTENTIAL SOLUTIONS



Source: AFRY

- Storage technology is vital for managing electricity fluctuations, with growth anticipated from real time and intraday (batteries) to seasonal (pumped storage) solutions
- Technological advancements, resilient supply chains, and supportive policies are essential for enabling effective storage
- Besides storage, investments in digitising energy infrastructure crucial for optimising grid flexibility, addressing real-time congestion, and managing risks from intermittent power sources

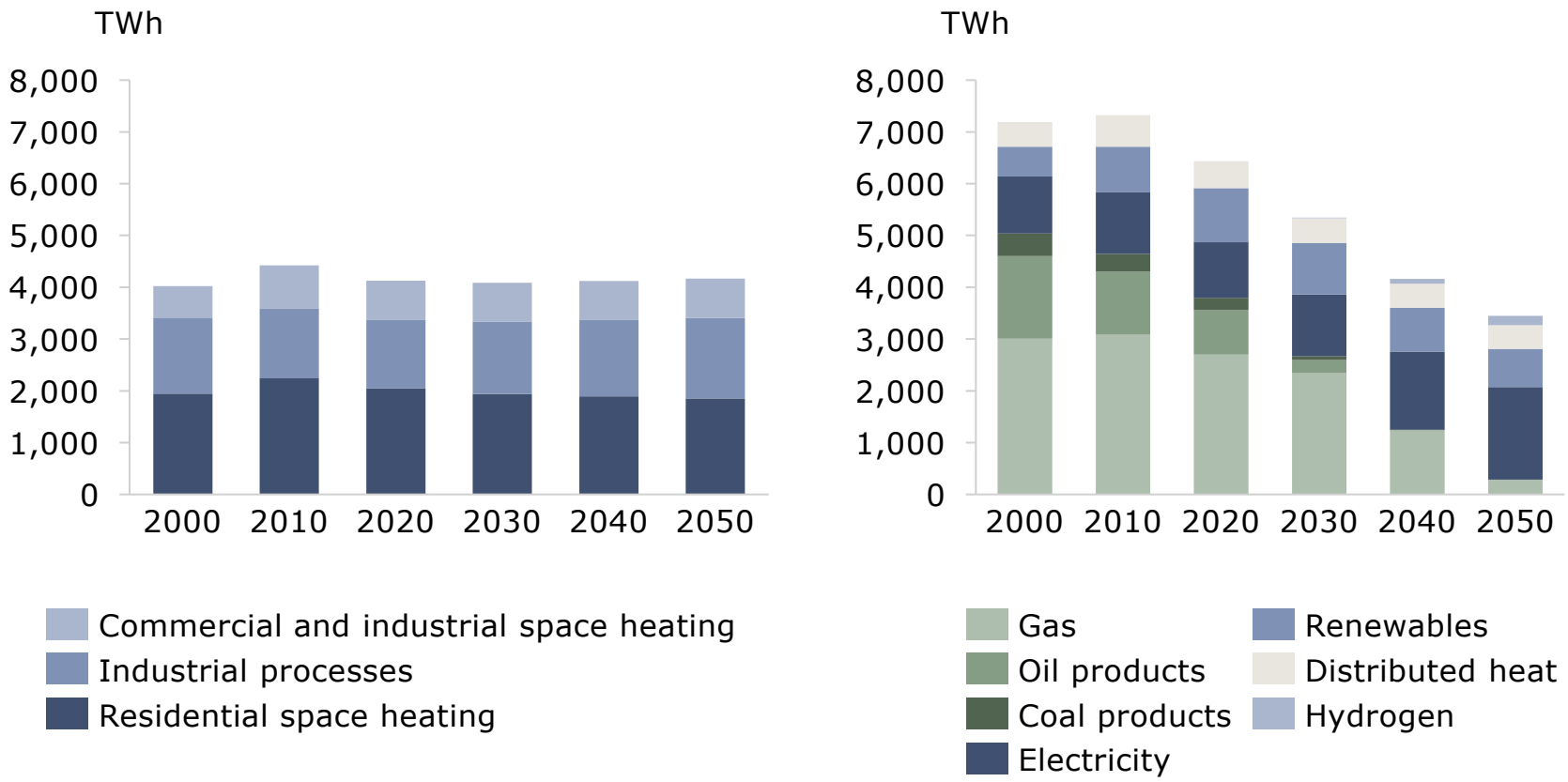
Agenda



HEAD DEMAND BY SEGMENT AND FUEL USE

Transitioning away from fossil necessitates a multitude of solutions in the heating sector

HEAT DEMAND BY SEGMENT AND FUEL USE FOR HEATING IN EUROPEAN COUNTRIES



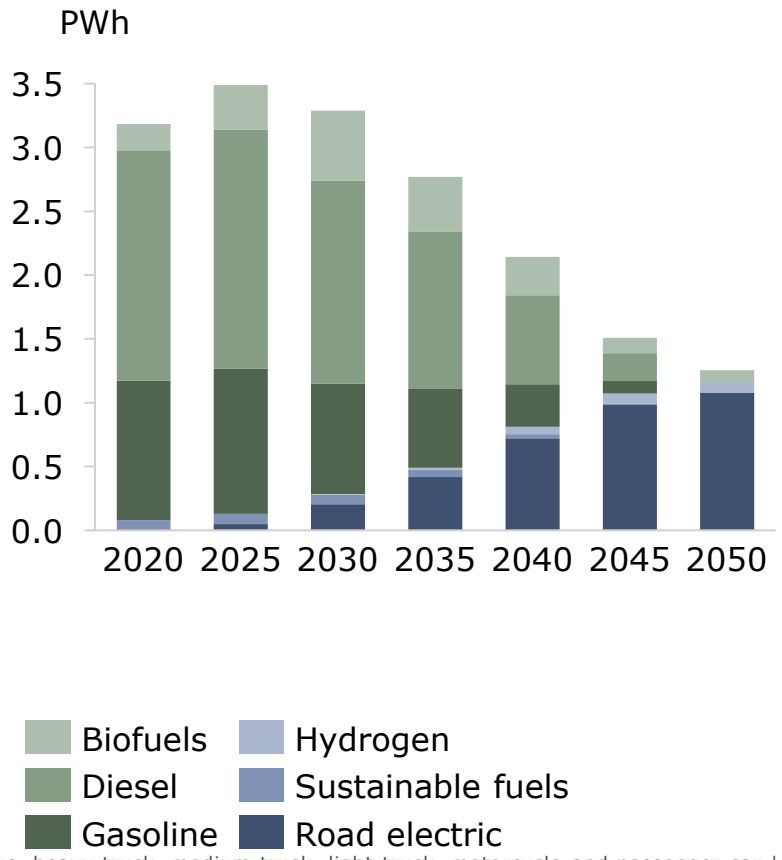
Source: AFRY

- Energy transition involves reducing final energy consumption across sectors
- Heating accounts for 50% of global final energy consumption, predominantly fossil-based
- Multiple solutions needed: electrification, green hydrogen, biomass, solar thermal, geothermal, power-to-heat, and heat storage
- Local technological, economic factors, and supply security are key to identifying optimal heating solutions

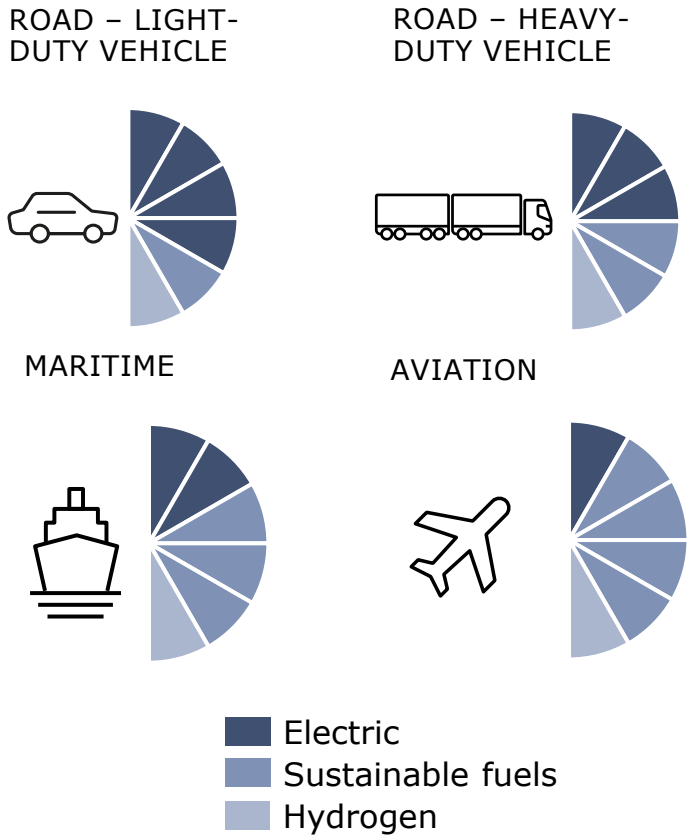
FUEL USE IN TRANSPORTATION SECTOR

There is no one-size-fits-all solution in decarbonising the mobility sector

ENERGY USE IN ROAD TRANSPORT[1] IN EUROPE BETWEEN 2020 AND 2050



FUEL USE BY MODE OF TRANSPORT BY 2050

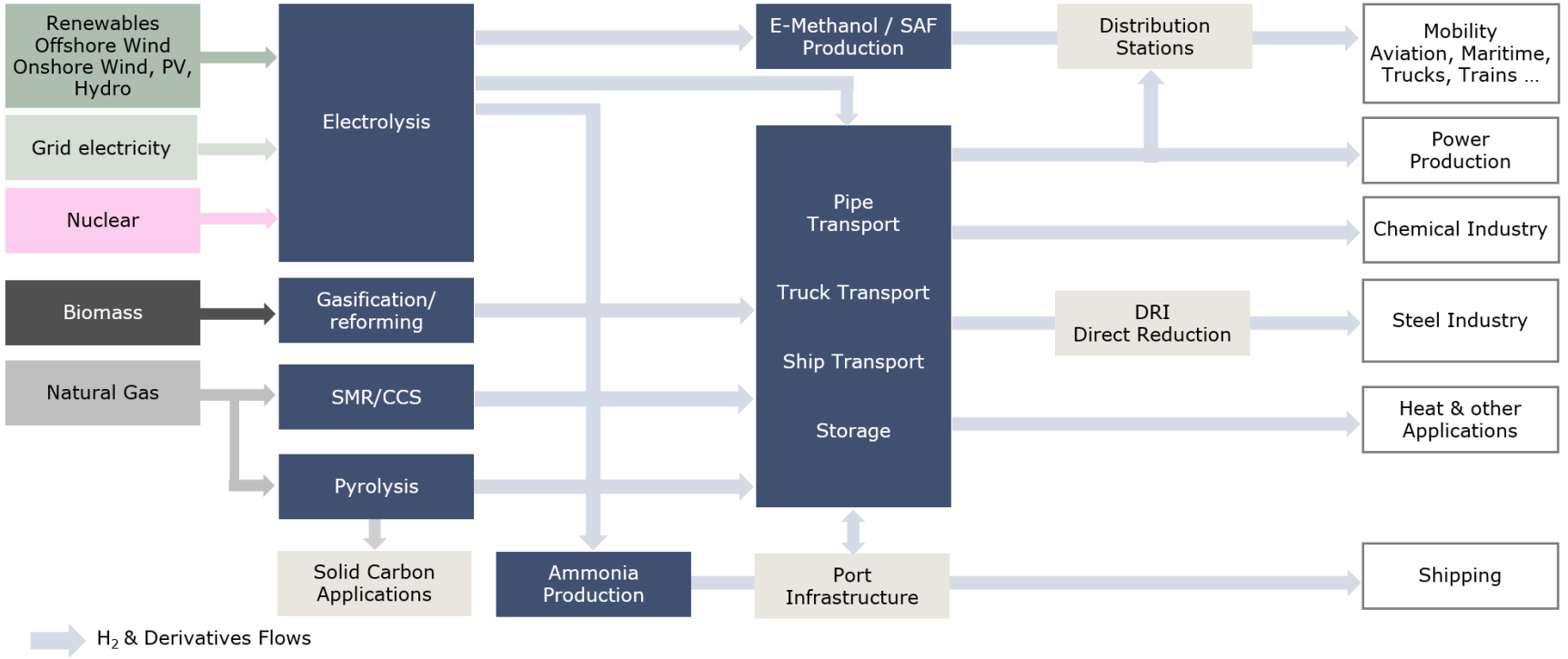


- Decarbonising transport requires diverse, tailored solutions across modes
- Road transport currently accounts for 76% of global CO_2 emissions in transport sector and relies on diesel and gasoline, but will in future mainly rely on electrification
- Maritime and aviation sectors will focus on hydrogen and sustainable fuels
- Success depends on robust infrastructure and renewable energy production capacity

1. Bus, heavy truck, medium truck, light truck, motorcycle and passenger car | Source: AFRY

Hydrogen can be the key enabler for decarbonisation in various applications from industry to transport

HYDROGEN VALUE CHAIN (PRODUCTION – STORAGE/DISTRIBUTION – UTILISATION)



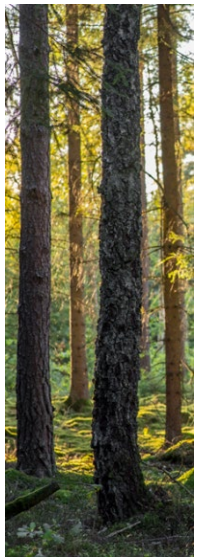
Source: AFRY

- Alternative fuels, particularly hydrogen, are promising technologies for industrial decarbonisation
- The EU aims to produce 4 Mt of renewable hydrogen by 2030 and 20 Mt by 2035, boosting demand and innovation
- Closing cost gap and gaining industrial acceptance crucial for advancing hydrogen adoption
- Support should focus on decarbonising sectors, balancing affordability, and addressing cost challenges

TRANSITIONING AWAY FROM FOSSIL-BASED MATERIALS

Wood is still underutilised as potential key resource to reducing the long-standing dependence on crude oil

EXAMPLES OF WOOD SOURCES AND APPLICATIONS



❶ SAWLOGS

That are processed in sawmills to get:

- Sawnwood
- Wood chips
- Sawdust
- Bark

❷ INDUSTRY RESIDUES

❸ PULPWOOD

❹ HARVESTING RESIDUES

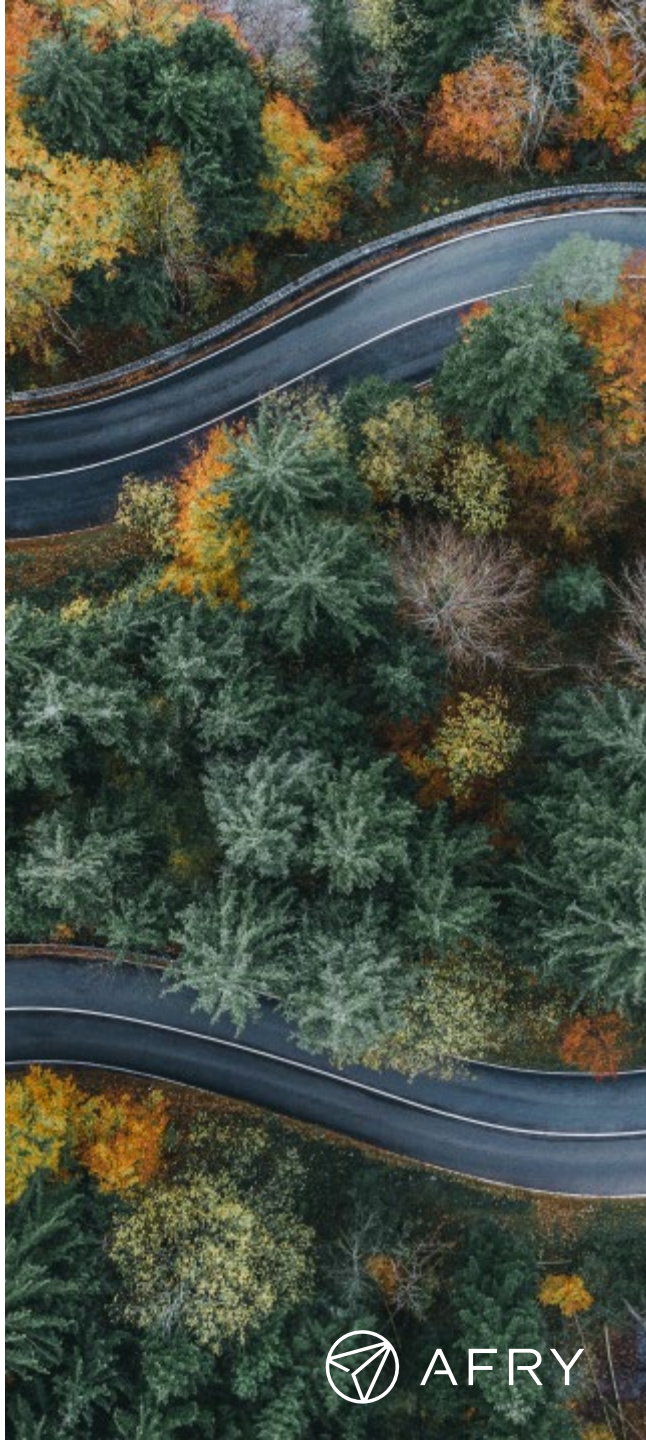
Sawnwood for new wooden buildings, pulpwood for packaging and textile fibres, industry residues for biofuels and chemicals, and harvesting residues for bioenergy

- Wood can play a vital role in replacing fossil-based products
- In 2021, the EU saved 390 million tonnes of CO_2-eq by using wood-based alternatives in construction, packaging, textiles, and fuels, with plans to exceed 500 million tonnes by 2050
- Increased adoption is driven by research and development, consumer awareness, and supportive legislation

Source: AFRY

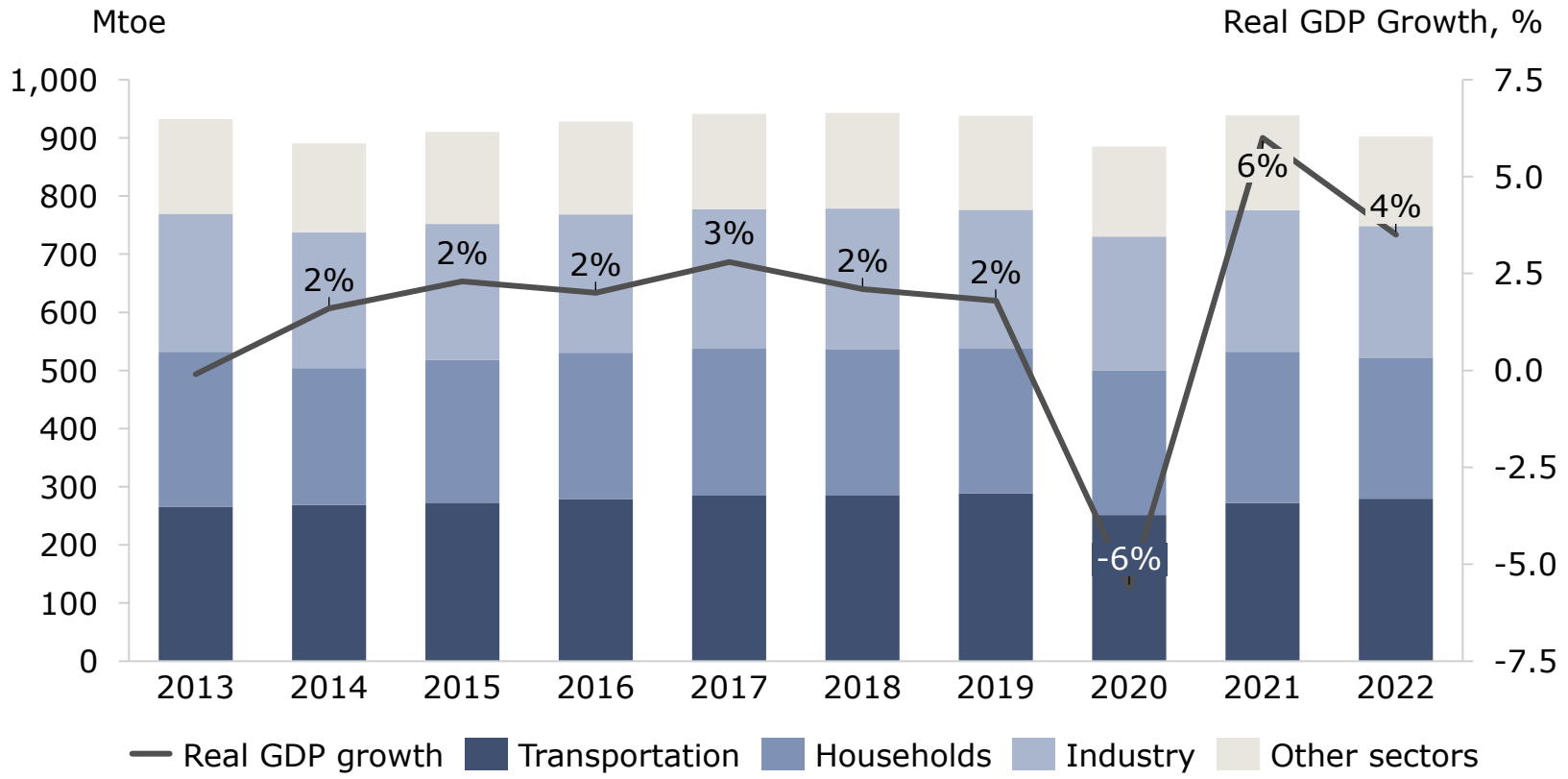
AFRY

Agenda



Energy efficiency increase and optimised resource utilisation are critical to reach decarbonisation goals

FINAL ENERGY CONSUMPTION BY SECTOR COMPARED TO GDP GROWTH IN EUROPEAN COUNTRIES[1]

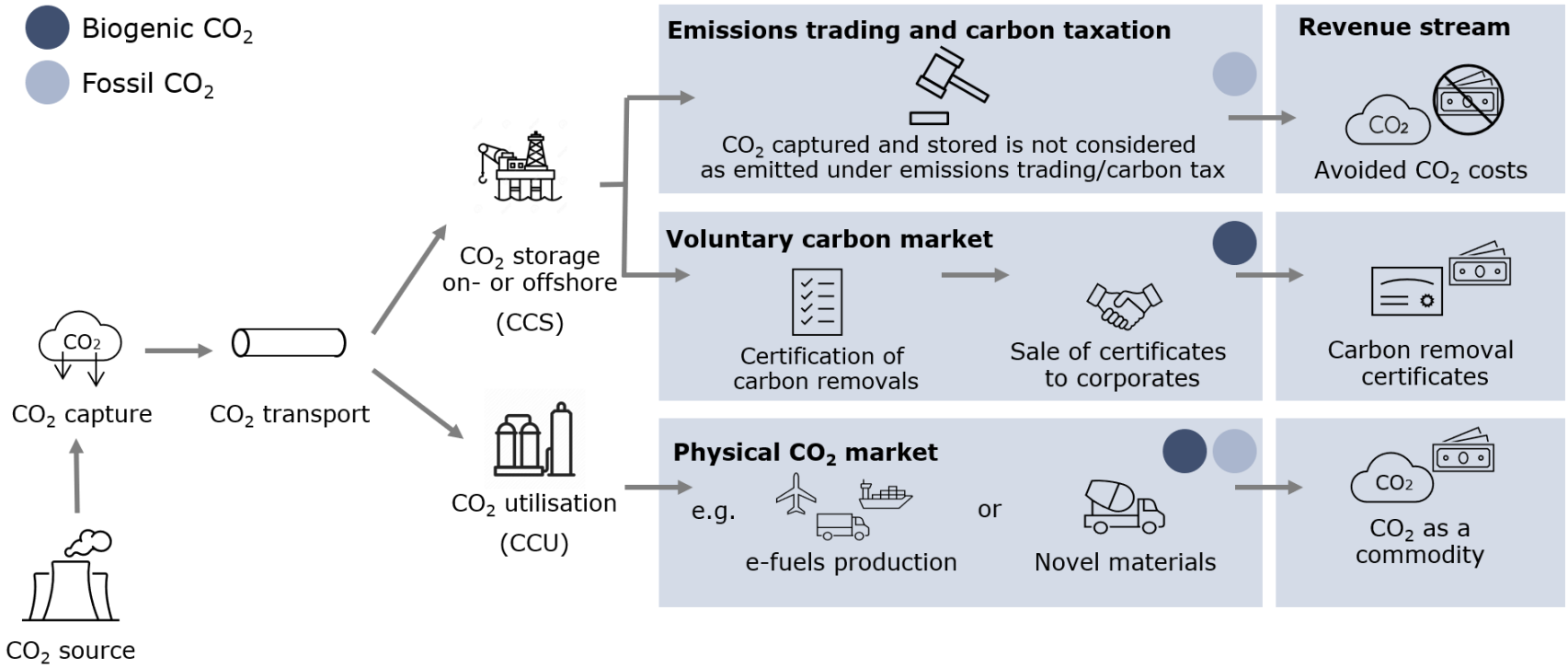


1. EU27; Mtoe = Mega tonnes oil equivalent; GDP = Gross Domestic Product | Source: AFRY, Eurostat

- Despite GDP growth, energy consumption remains stable or slightly declining, reflecting improved energy efficiency
- COP28 targets doubling energy efficiency by 2050
- Focus on circular economy is essential for resource optimisation and avoiding scarcity during the transition
- The EU mandates energy-saving measures and supports efficiency projects through various mechanisms, with policies like CSRD and the EU Taxonomy

Driving the transition to net-zero requires negative emissions particularly in hard-to-abate sectors

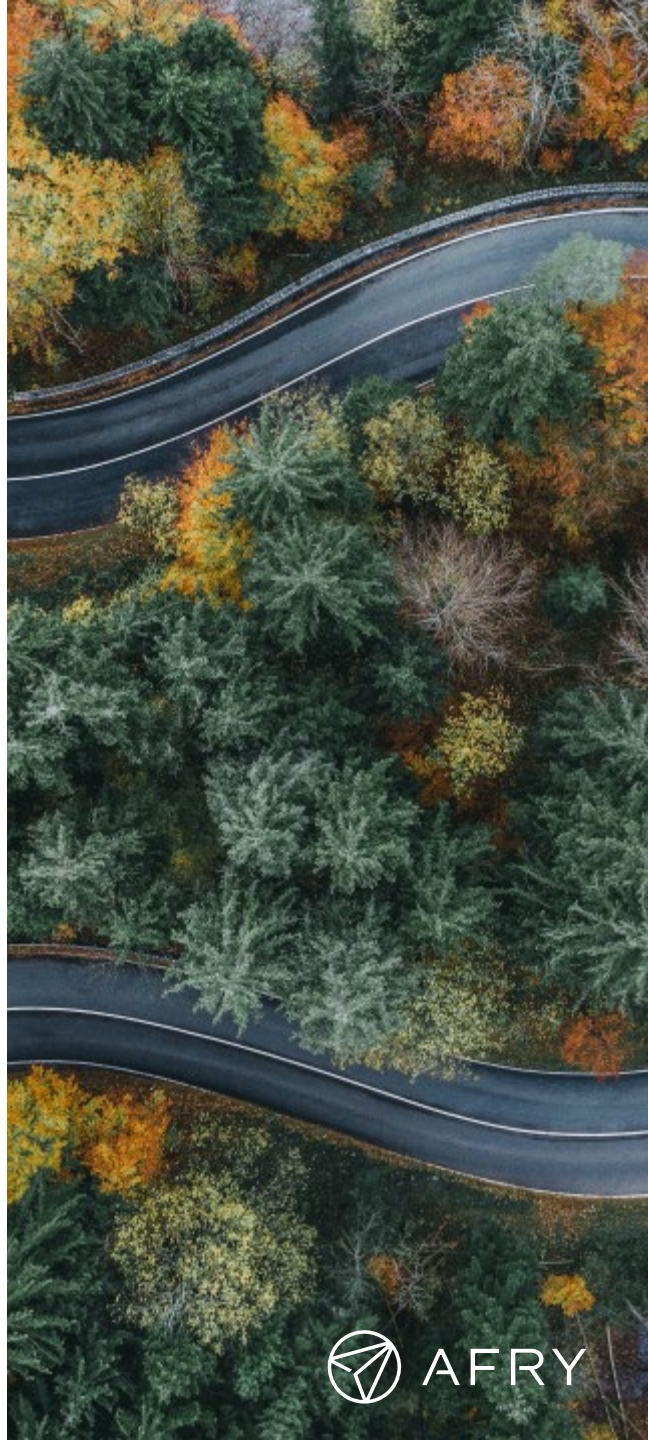
CARBON CAPTURE STORAGE AND UTILISATION PROCESS



Source: AFRY

- Achieving global net zero requires significant CO_2 capture in process industries, carbon dioxide removal to offset emissions, and low-carbon e-fuels to replace fossil fuels in transport
- Carbon capture can generate revenue by avoiding EU ETS costs, using voluntary carbon markets, or through CO_2 sales
- Negative emissions are crucial for net-zero, requiring carbon removal through nature-based or technical methods, currently driven mostly by voluntary market schemes

Agenda



SUMMARY

AFRY outlines key enablers to be undertaken in the transition from fossil fuels and fossil-based materials to a more sustainable future

POLICY

- Set clear long-term targets
- Establish sector-specific strategies
- Support implementation and transition
- Foster cost-efficient CO_2-free technologies

FINANCE

- Align financial incentives with transition strategies
- Implement CO_2 pricing mechanisms

INNOVATION

- Optimise existing energy assets
- Adopt supportive business models
- Innovate hard-to-abate sectors

ABOUT AFRY MANAGEMENT CONSULTING

Leading advisor for the transitions of the energy and bioindustry sectors

Presence	Revenue	Projects	Staff	Backed by
5	1,608 million	>100	800+	19,000
continents	SEK in 2023	countries	management consultants	experts at AFRY

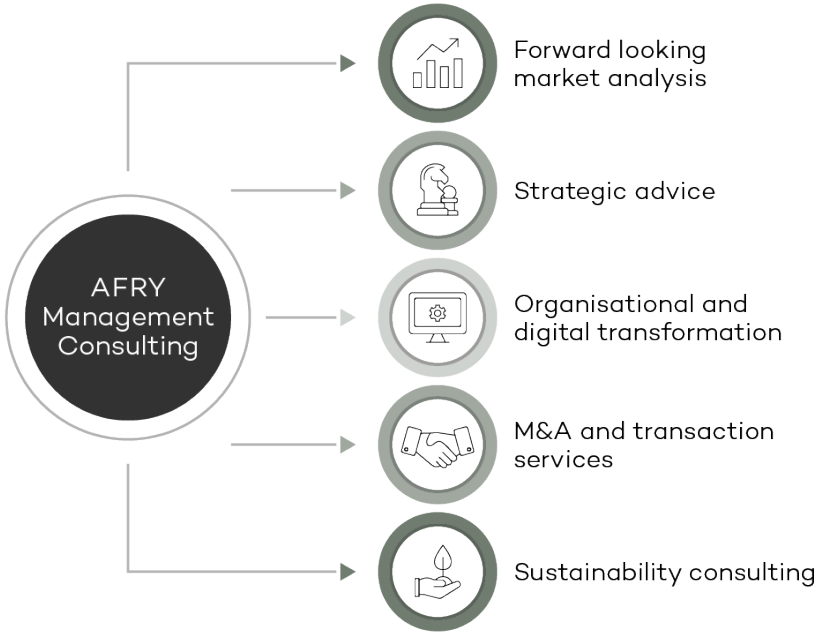
Energy transition

- Global transition towards decarbonised energy system
- Sector integration due to decarbonisation and electrification (e.g. mobility, industries, cities)
- Need for smart infrastructure to enable transition and new decentralised business models

+

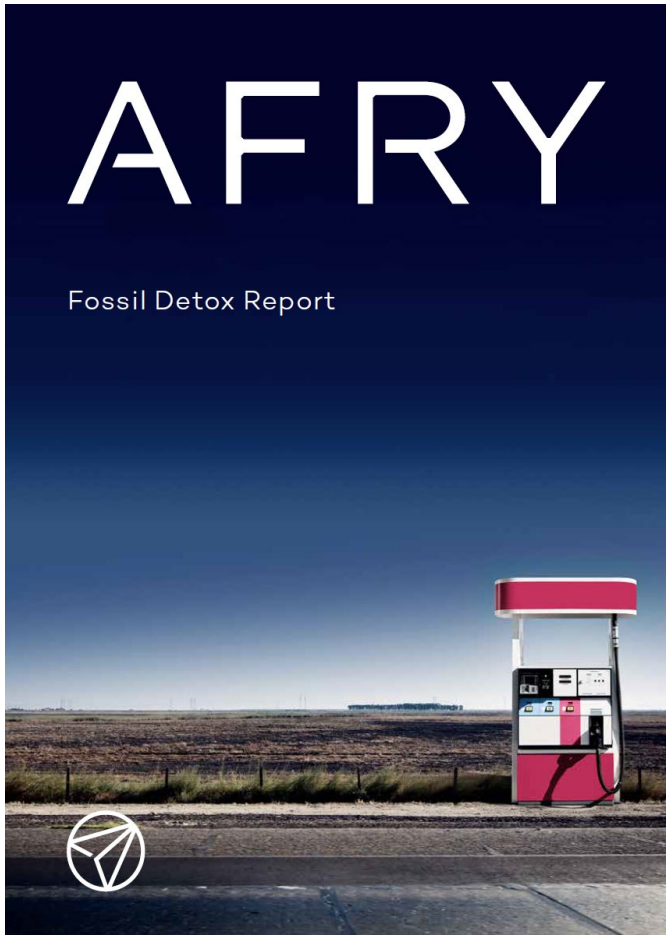
Transition to bioeconomy

- Growing sustainability awareness and commitment
- Global shift in demand and products
- Need for green carbon to ensure full decarbonisation
- Resource scarcity



NEXT STEPS

Feel free to delve into AFRY’s Fossil Detox Report, following the QR code below



CONTACTS & Q&A

Do not hesitate to contact us

- **Reach out** to us for more information:
  henrik.tegner@afry.com
  patrick.gasser@afry.com
  robert.oettmeier@afry.com

- **Topic-specific** contacts:
  - Carbon, capture and storage: stuart.murray@afry.com
  - Carbon removal: mostyn.brown@afry.com
  - Circularity: anna-karin.jonbrink@afry.com
  - Decarbonisation: richard.sarsfieldhall@afry.com
  - Energy efficiency: horst.dulle@afry.com
  - Energy networks: martin.möller@afry.com
  - Energy storage: kostas.theodoropoulos@afry.com
  - Future mobility: steffen.schaefer@afry.com
  - Heating: markus.poehlmann@afry.com
  - Hydrogen and low-carbon fuels: john.williams@afry.com
  - Renewables, gas & nuclear: buelent.mutlu@afry.com
  - Wood-based materials: tomi.amberla@afry.com

- **More webinars** will follow with relevant topics, and any update on the evolving situation.


AFRY