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ENERGY

From Pathways to Sustainable Energy to Carbon Neutrality Project

Item 6: Presentation of results and recommendations of the project “Pathways to Sustainable Energy”

8th session of the Group of Experts on Gas
26 March 2021, Geneva

UNECE Region – Reality Check

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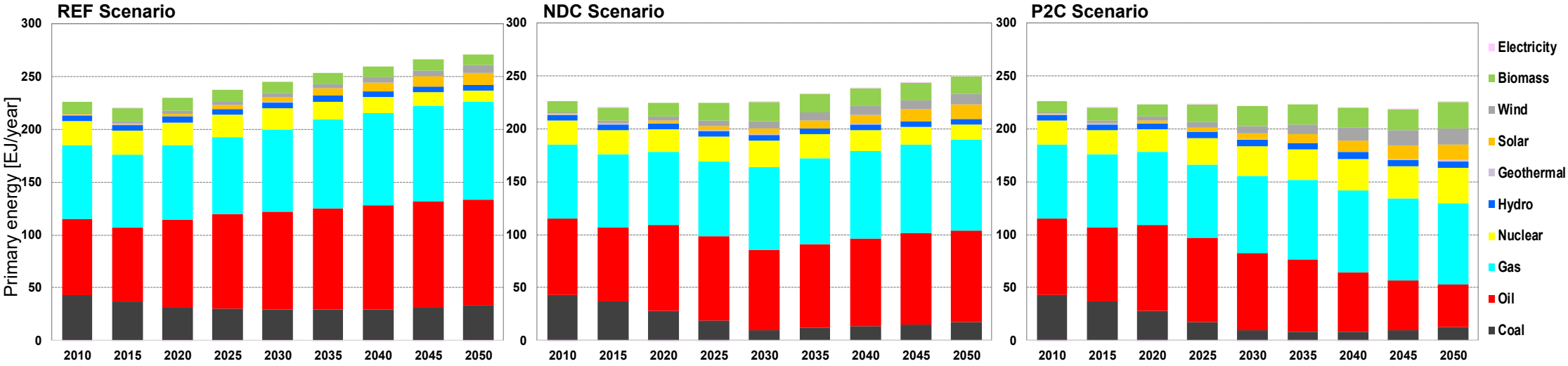
- 80% of today's energy mix in the UNECE region is fossil-based.
- No economically-rational scenario involves a substantial fall in fossil energy.
- Even in a climate change scenario that meets a 2°C target, fossil fuels would account for 56% of primary energy in 2050.
- Dependence on fossil fuels makes achieving carbon neutrality an imperative.



REF Scenario – business as usual, based on the Shared Socio-economic Pathway
NDC Scenario – based on country level NDCs as pledged by countries
P2C Scenario – assumes attainment of the 2°C target by 2100
For more information see project Pathways to Sustainable Energy: https://www.unece.org/energy/pathwaystose.html

Natural gas remains the “king”

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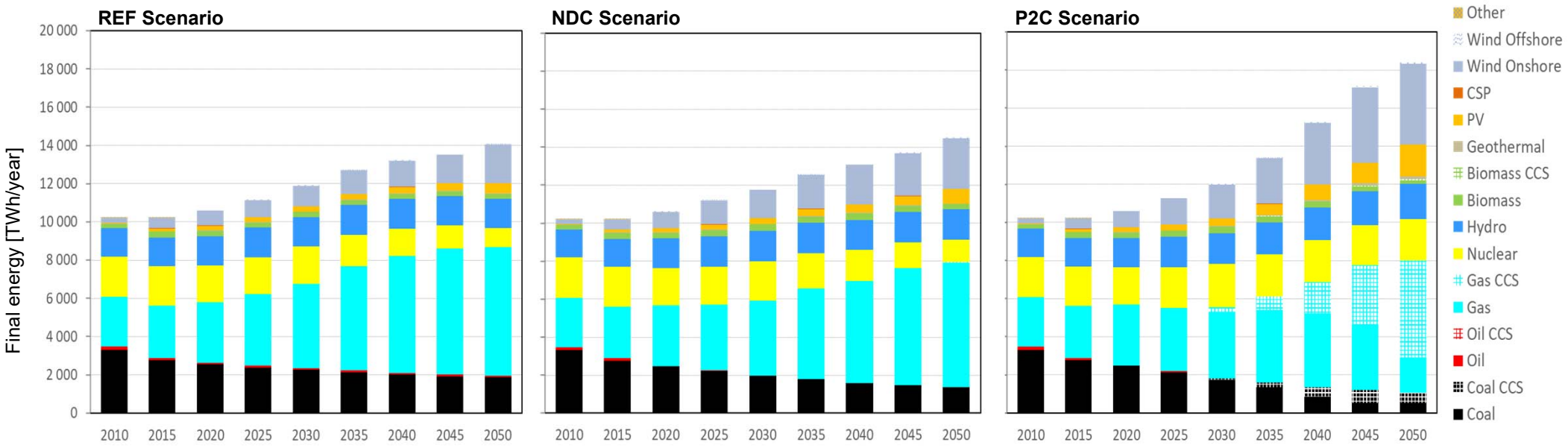
- 30% higher electricity demand is expected by 2050.
- Significant structural changes in electricity generation portfolio across UNECE region.
- Natural gas and hydrogen play key role.



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When you find yourself in a hole, stop digging

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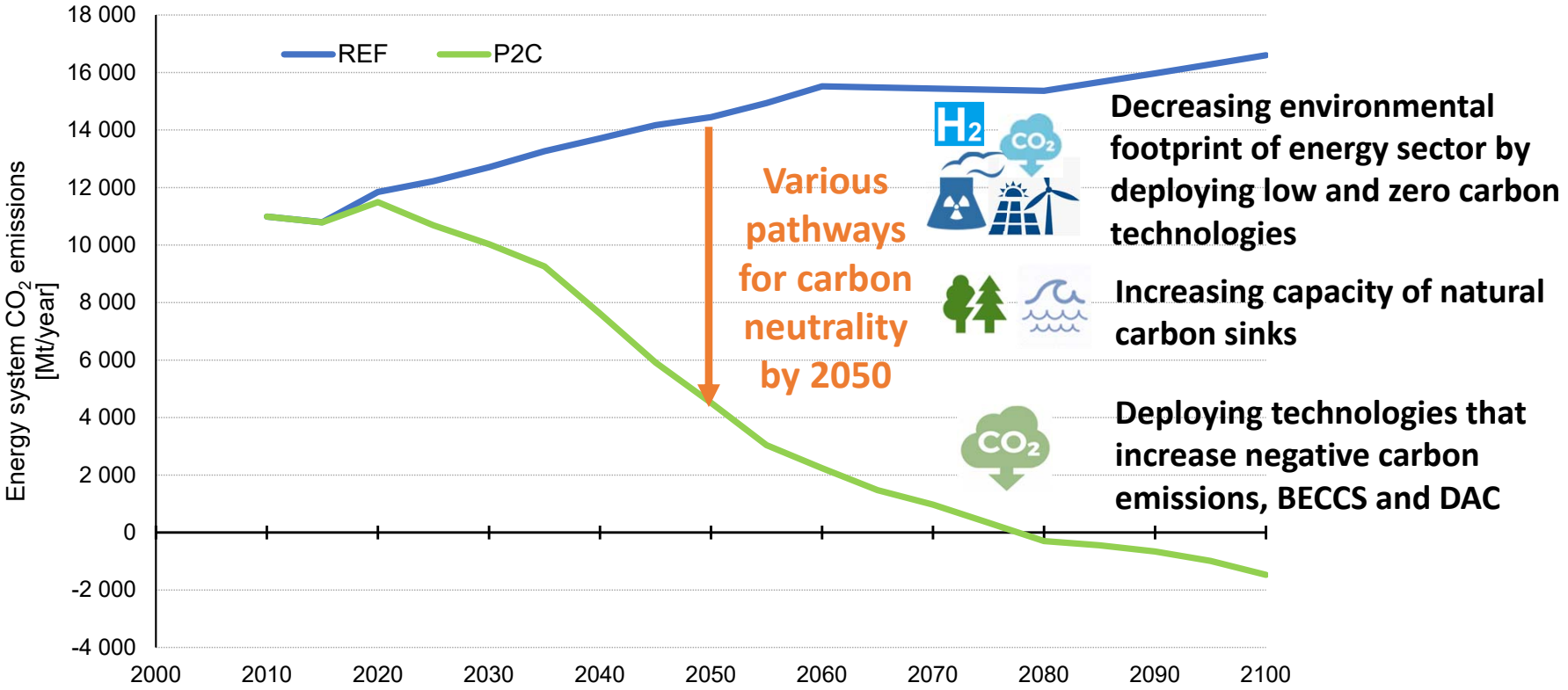
UNECE countries must cut/capture at least 90Gt of CO_2 by 2050 to meet 2°C. There are variety of pathways to attain carbon neutrality in the UNECE region.



Delay is expensive!

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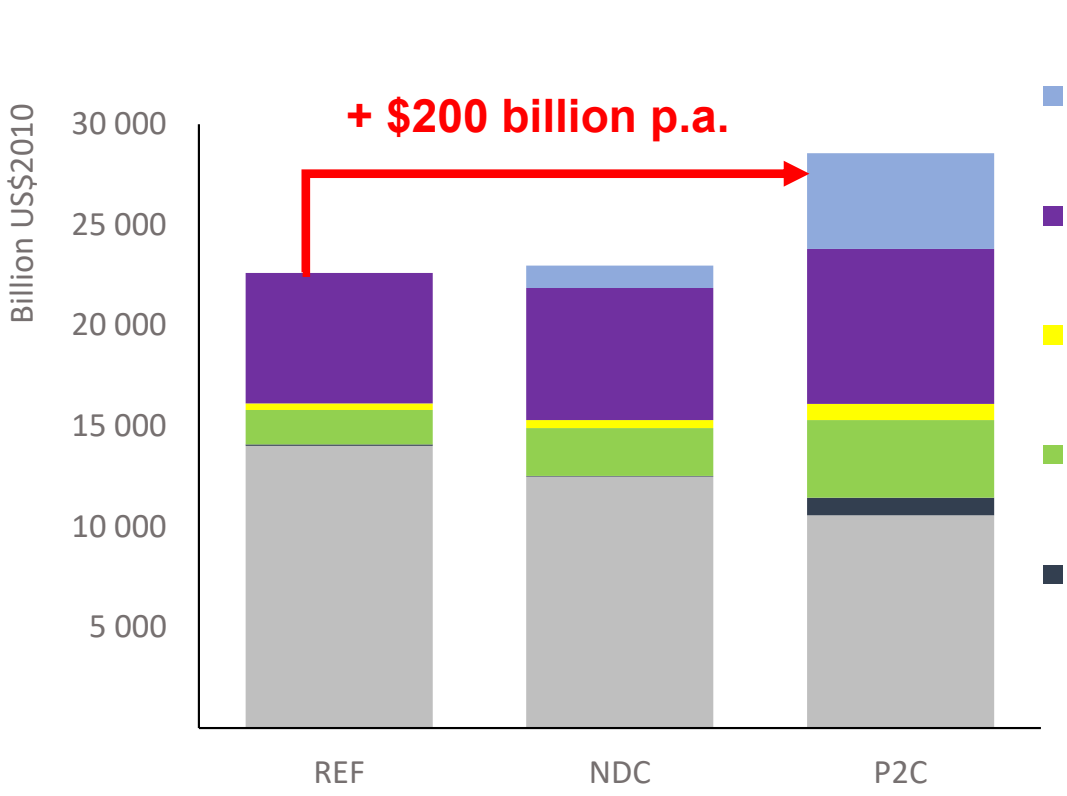
Comparing investment requirements - UNECE REF, NDC and P2C scenarios (2020 – 2050)



<u>Energy transition cost</u> increase to meet 2ºC target is <u>negligible compared to social and health costs.</u> Air pollution ALONE cost $1.8 trillion in 2015 in OECD and BRIICS* combined

- T/D&S: transmission, distribution and storage of electricity and district heat
- CCS: carbon capture and storage

Attaining carbon neutrality is the first step towards achieving sustainable energy

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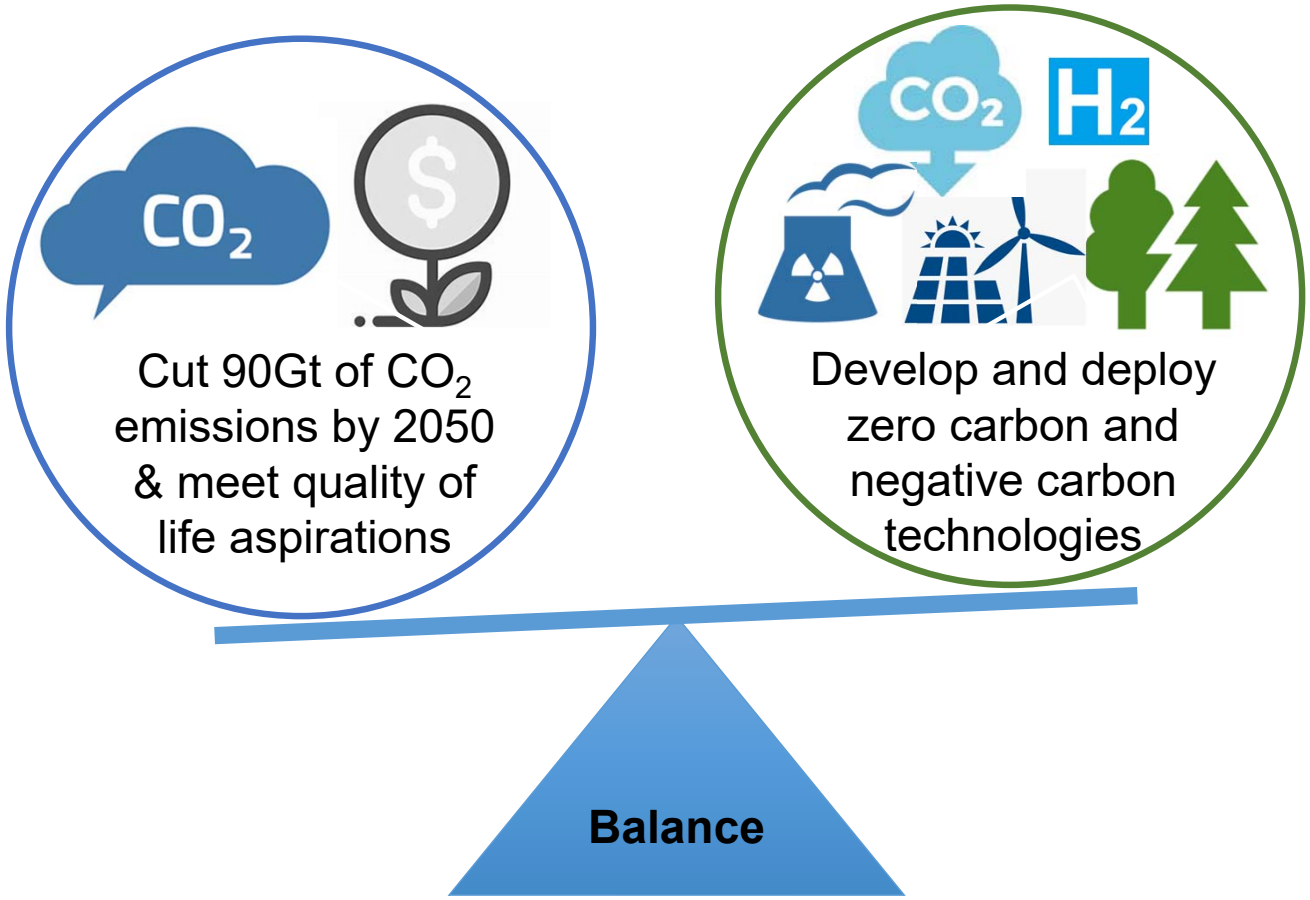
UNECE Group of Experts on Cleaner Electricity Systems initiated a project to explore how to move to carbon neutrality across power and energy intensive industries in the UNECE region.



What are the elements of the carbon neutrality framework? Whole System Approach with Power and Energy Intensive Industry Focus

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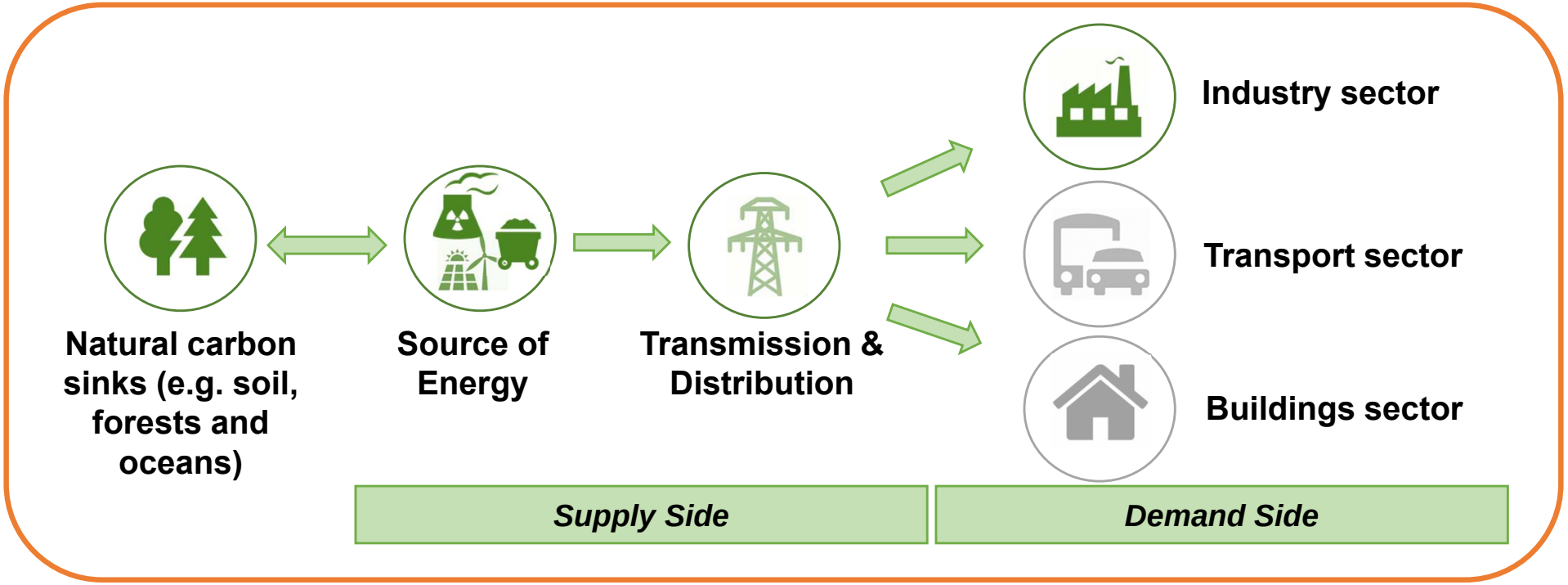
Starting position: Whole System Approach –> Attaining carbon neutrality – balancing emissions with equal carbon removal – through natural systems, sector coupling and integrated approach. Developing a roadmap to 2050 for the UNECE region.



What are the elements of the carbon neutrality framework?

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Attaining carbon neutrality in the UNECE region by 2050 !

Targets for power sector and energy intensive industries to cut carbon emissions

Energy Supply	Energy Infrastructure	Energy Demand	Carbon sinks
KPIs: • Available resources • New technology deployment • Energy self-sufficiency • Diversity of energy supply • Free trade of energy resources • Availability of capital • Standardization • …	KPIs: • Interconnecting infrastructure (pipelines, LNG terminals, HV lines etc.) • State of existing energy infrastructure; 3rd party access • New and planned energy infrastructure projects • Availability of capital • Standardization • …	KPIs: • Energy access • Energy affordability • Monetizing emissions & incentivizing emissions cuts • Efficiency improvements • Post-Covid-19 behavioral changes • …	KPIs: • reforestation • Use of land • Oceans • Sustainable use of biomass • …

Scenarios to attain carbon neutrality based on different technology options and across all UNECE subregions

Technologies

renewable energy **nuclear energy** (incl. SMR, nuclear fusion) **fossil fuel** (coal, gas, oil) **HELE**
CCS/ CCUS **hydrogen** (from RE and fossil fuels w CCS) **energy storage** (batteries, power-to-X, hydro)
biomass w CCS **direct air capture**

CARBON CAPTURE, USE AND STORAGE (CCUS)

CCUS is essential to unlock the full potential of decarbonisation and attain carbon neutrality

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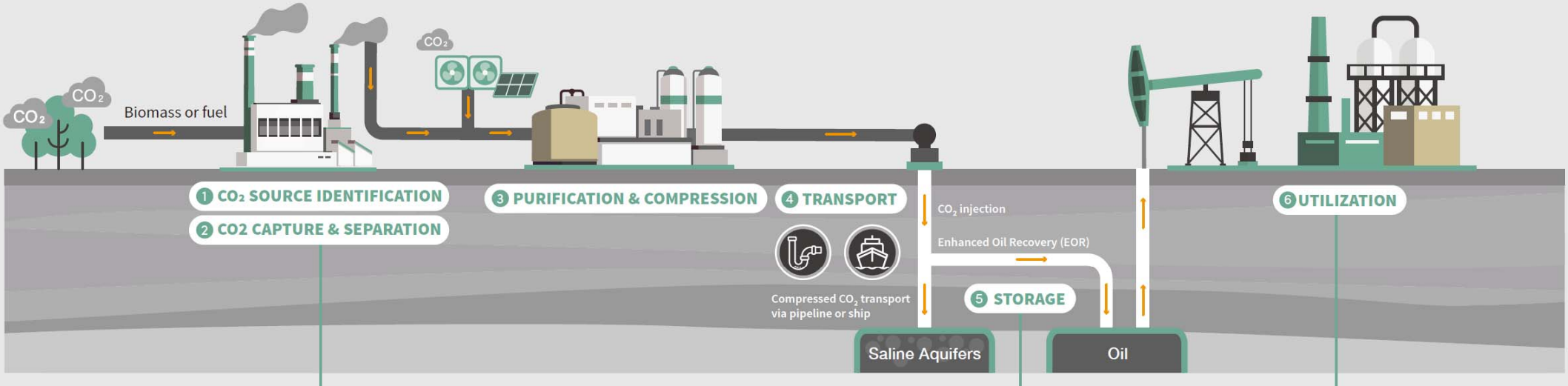
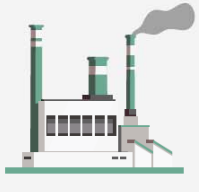


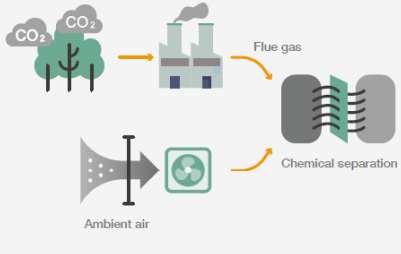
Point Sources of CO_2 in Industry

CO_2 from industries (cement, steel), hydrogen production from fossil fuels, or power generation is captured before it reaches the atmosphere and is then compressed and injected into porous rock layers.



Biomass Energy with Carbon Capture and Storage (BECCS)

Direct Air Carbon Capture and Storage (DACCS)

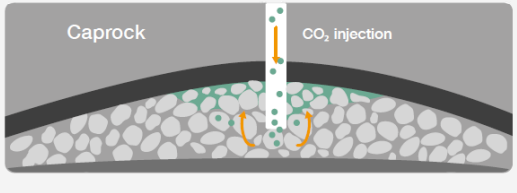


BECCS and DACCS can in effect capture CO_2 from any fossil fuel source anywhere in the world, before or after the fossil CO2 is released.

Also, they are essential for achieving net zero CO_2 emissions, making it more certain and less costly.

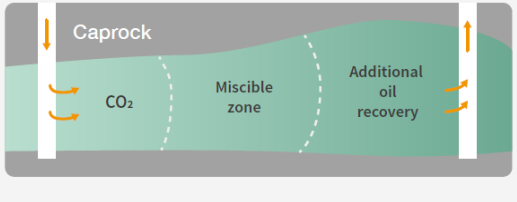
Saline Aquifers for Sequestration of CO_2

Saline aquifers are geological formations containing brine in porous rock at depths over 1km. CO_2 can be pumped down into the rock for sequestration.



Enhanced Oil Recovery (EOR)

EOR is a family of techniques that increases the recovery of oil and gas while storing CO_2. Dependent on operational choices, the volume of CO_2 stored could exceed the CO_2 content of the produced hydrocarbons.



Building Materials
Aggregate, concrete

Chemicals
Methanol, ethanol

Plastics
Polymers

Mineralization
Carbonates

Carbon utilization can unlock the commerciality of CCUS projects for the industrial sector, steel, cement and chemical. Building materials and chemicals produced from CO_2 have great potential to sink CO_2 while the low price of existing products make market penetration challenging.

Awareness
Recognise CCUS as a viable climate mitigation option and consider it when developing national plans.

Acceptance
Develop and integrate policies to allow full commercialisation of CCUS technologies.

Finance
Create a funding mechanism for CCUS and direct investments towards modernization of energy infrastructure.

Designed by Shuyue Li

Eastern UNECE region can play leading role in CO_2 storage

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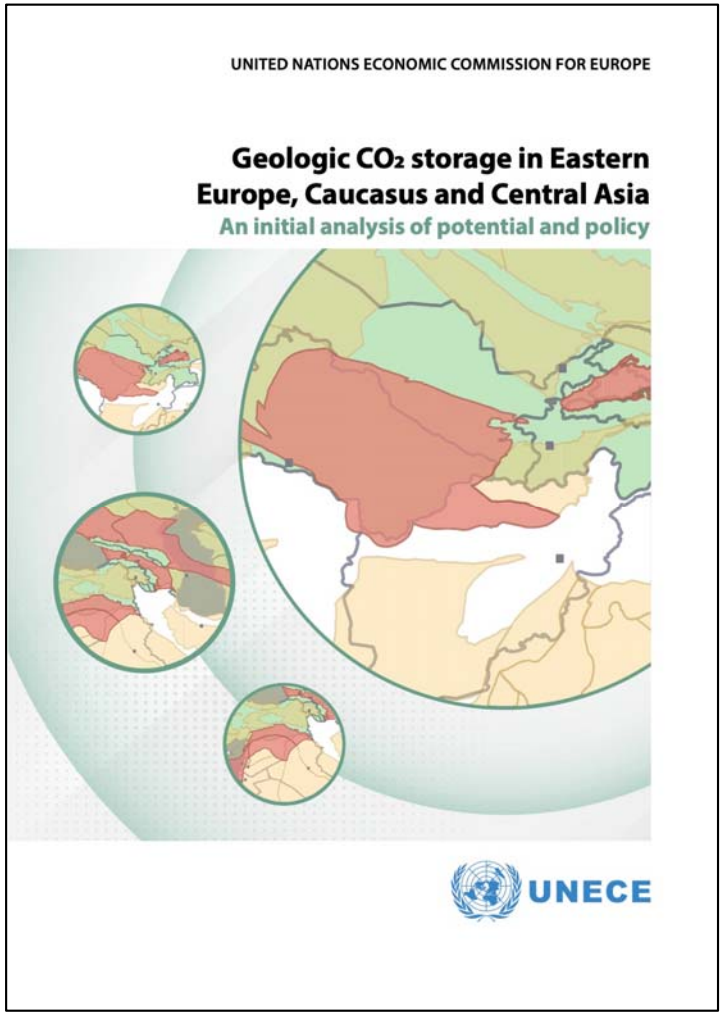
- Storage potential of 62,000 Mt of CO_2, with 56,410 MtCO_2 in Russia. Azerbaijan, Kazakhstan and Turkmenistan follow with smaller suitable carbon sinks.

- The report highlights several tools and methodologies for countries to enact
  - EU's Emissions Trading Scheme
  - United States' tax credit incentives

- A key proposal from the study: certification scheme for carbon storage to facilitate significant CO_2 storage and finance CCUS projects



HYDROGEN VALUE CHAIN

Hydrogen, an innovative solution for achieving carbon neutrality

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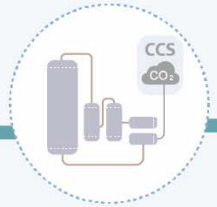
PRODUCTION

FUEL-BASED PRODUCTION

Natural gas
Steam reforming with or without CCS

Coal
Gasification with or without CCS

Biomass
Gasification with or without CCS

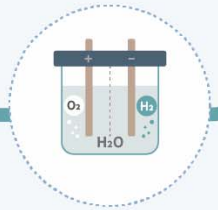


Steam reforming & gasification

ELECTRICITY SYSTEM

Nuclear
Electricity and heat from nuclear power

Renewable energy
Electricity from wind, solar, hydro or geothermal power



Electrolysis

CONVERSION, PROCESSING & TRANSPORTATION

H_2

PURE H_2

PROCESSING

- Liquification & regasification
- Commpression

CONVERSION

- **Haber-Bosch process** ammonia or methanol
- **Methanization** synthetic natural gas

STORAGE

Liquified H_2 in stroage tanks

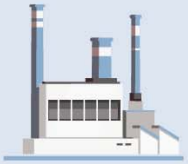
Geological storage in underground salt caverns

USE

TRANSPORT

BUILDINGS

INDUSTRY



POWER

Awareness
Recognise hydrogen as a viable climate mitigation option

Acceptance
Develop and integrate policies to jumpstart hydrogen economy

Finance
Direct public and private investment into clean hydrogen projects

Carbon Neutrality Project Activities

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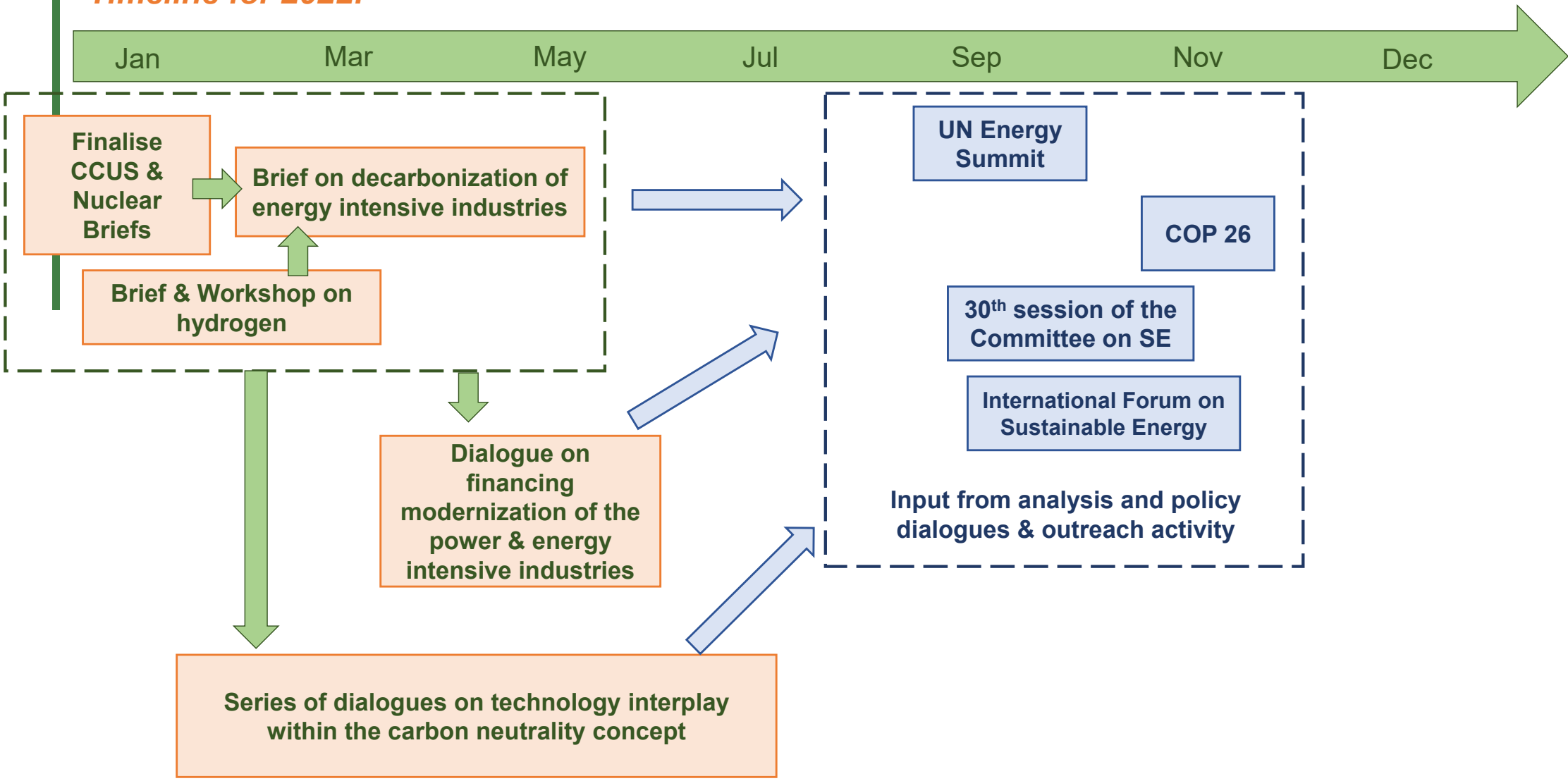
Timeline for 2021:



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Thank you!

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Date 26 I 03 I 2021, Geneva

More Insights

Project Design and Objectives

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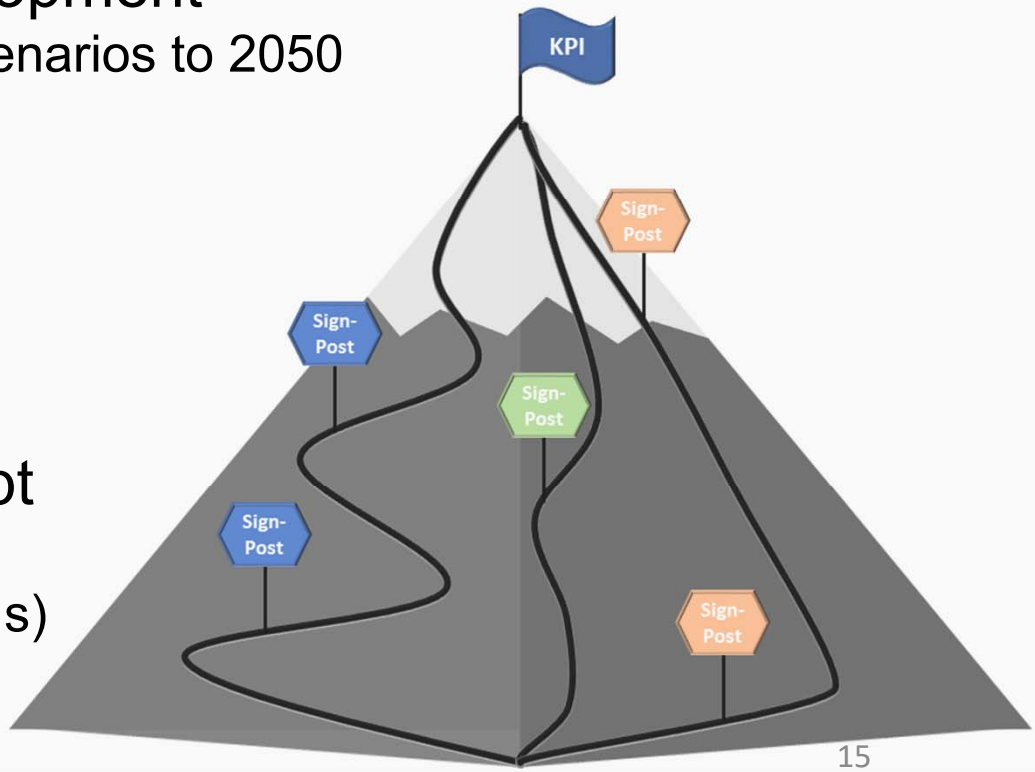
How can the UNECE Region attain Sustainable Energy (SE)?

- Current Phase: May 2017 – Oct 2019
- Outputs
  - Pathways and Scenario Development
    - Sub-regional modelling of SE scenarios to 2050
    - Policy and technology options
  - Policy dialogue
    - Adaptive policy pathways
    - Policy dialogues
    - Sub-regional workshops
  - "Early-warning system" concept
    - SE Targets
    - Key Performance Indicators (KPIs)
    - Signposts



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Defining Sustainable Energy

Three Pillars

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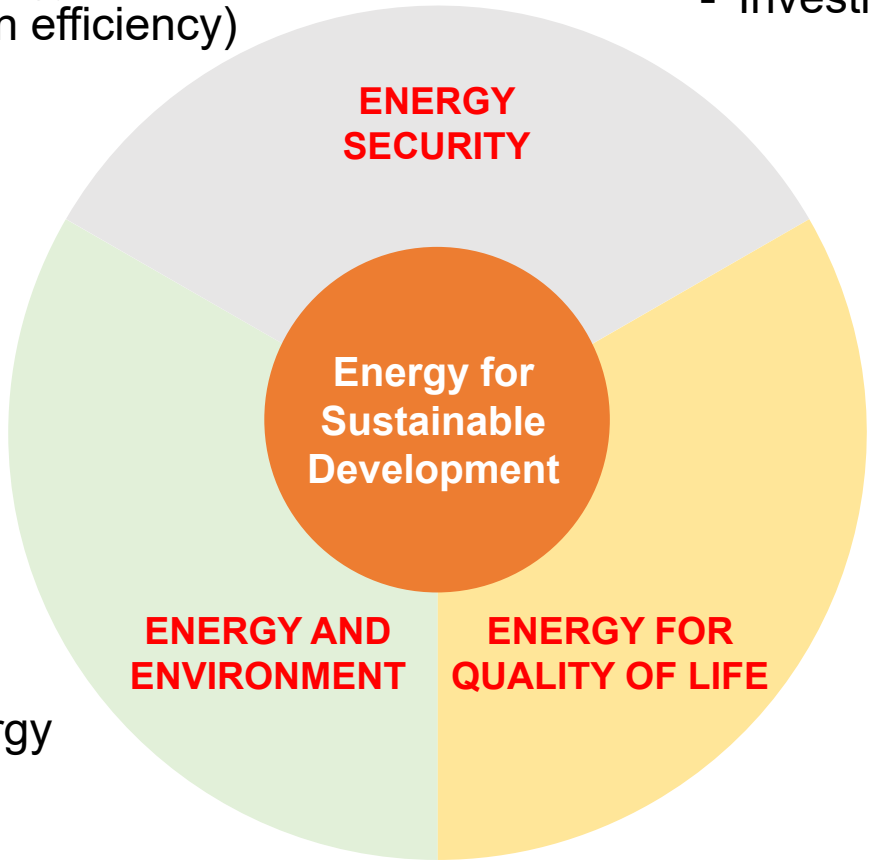
"Secure the energy needed for economic development"

- Energy Efficiency (energy intensity of economy, rate of improvement of energy intensity, conversion efficiency)
- Fuel mix
- Net energy trade
- Investment requirements



"Minimize adverse energy system impacts on climate, ecosystems & human health"

- GHG emissions from the energy system
- Energy-related air pollution, water use & water stress

"Provide affordable energy that is available for all at all times"

- Access to energy services
- Energy affordability
- Food security (biomass use)

Scenario development

Illustration of scenario design

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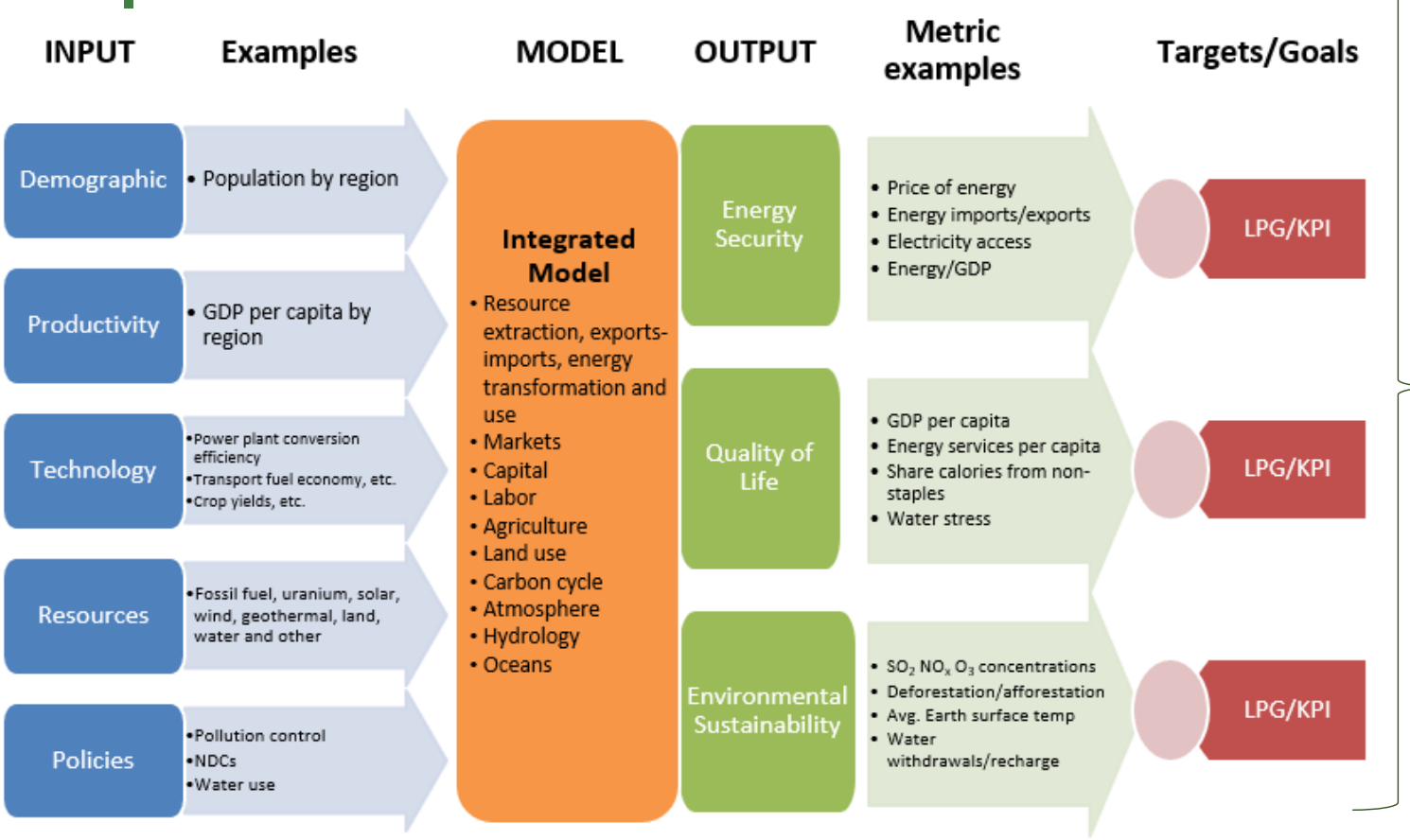

Scenario Analysis

REFERENCE SCENARIO

Based on shared socio-economic pathway

NDC SCENARIO

Implements by 2030 the NDC under the Paris Agreement – NDCs forever

P2C SCENARIO

2-Degree target of the Paris Agreement as the key component of Sustainable Energy