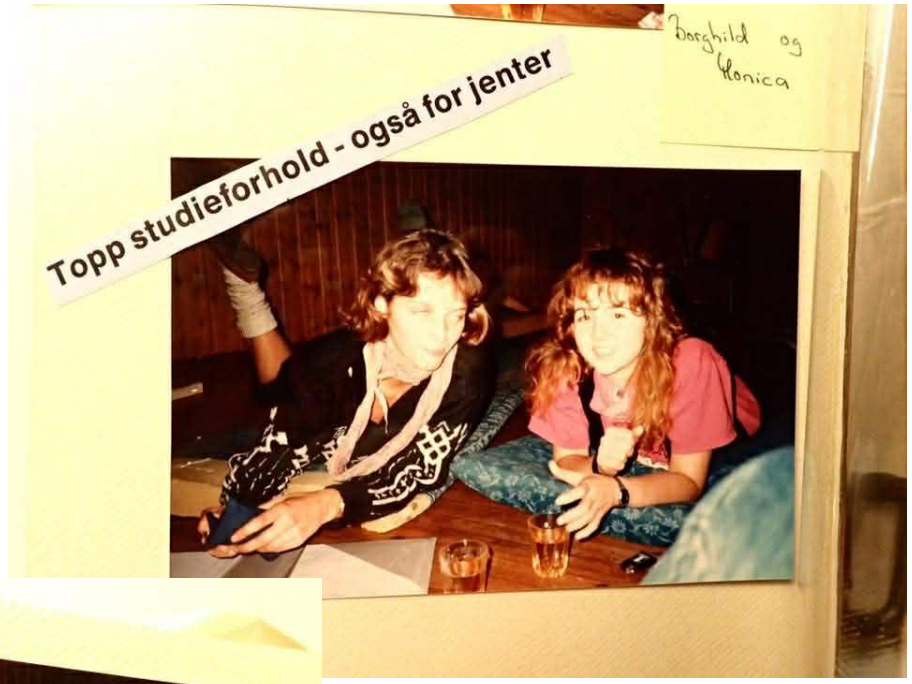

Topp studieforhold - også for jenter
Borghild og Monica


Borghild og Monica

Foto: Colourbox


SPORTS
CENTERET

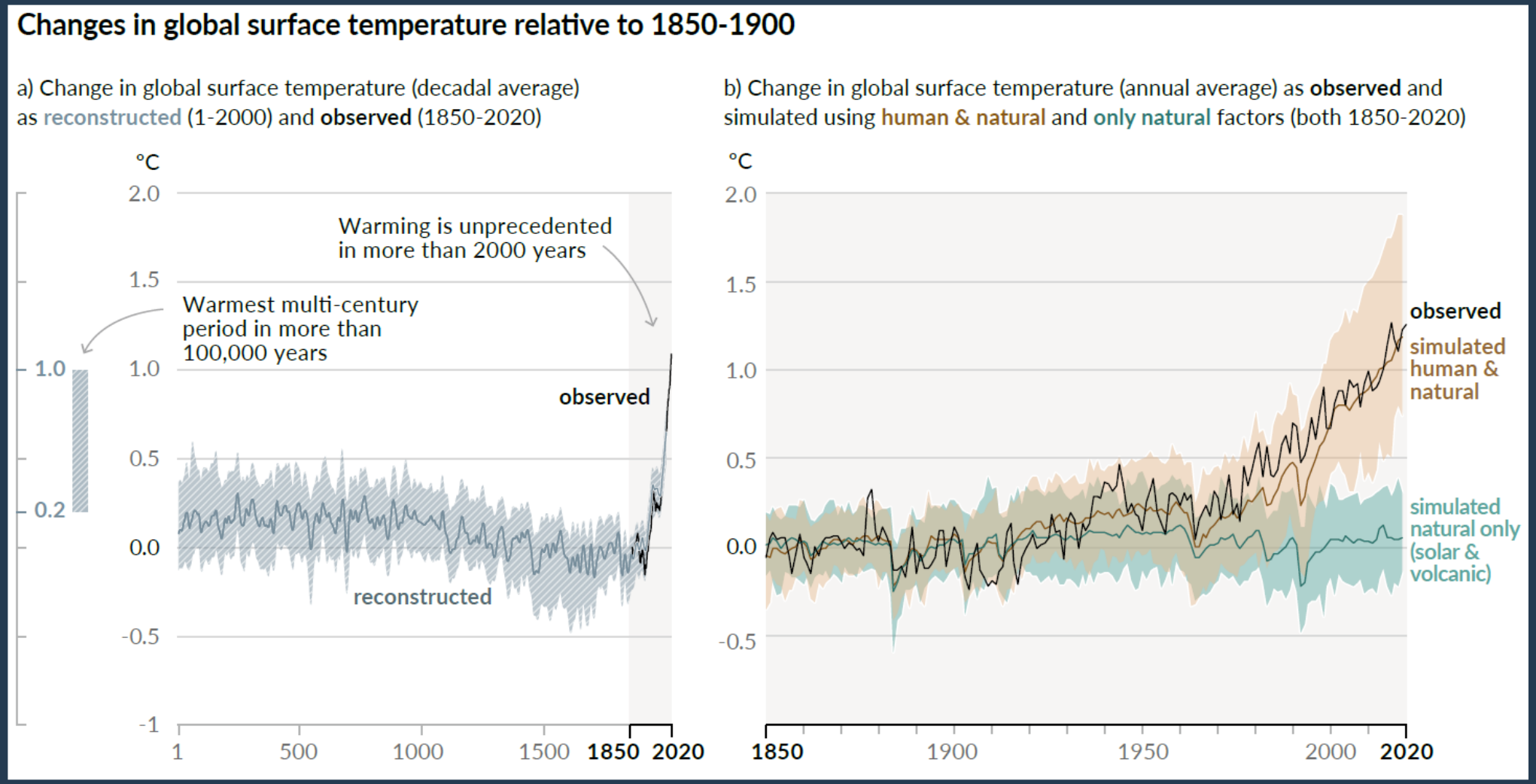

NTNU
CO_2

NTNU | Kunnskap for en bedre verden

Towards an integrated energy transition for the people and the planet

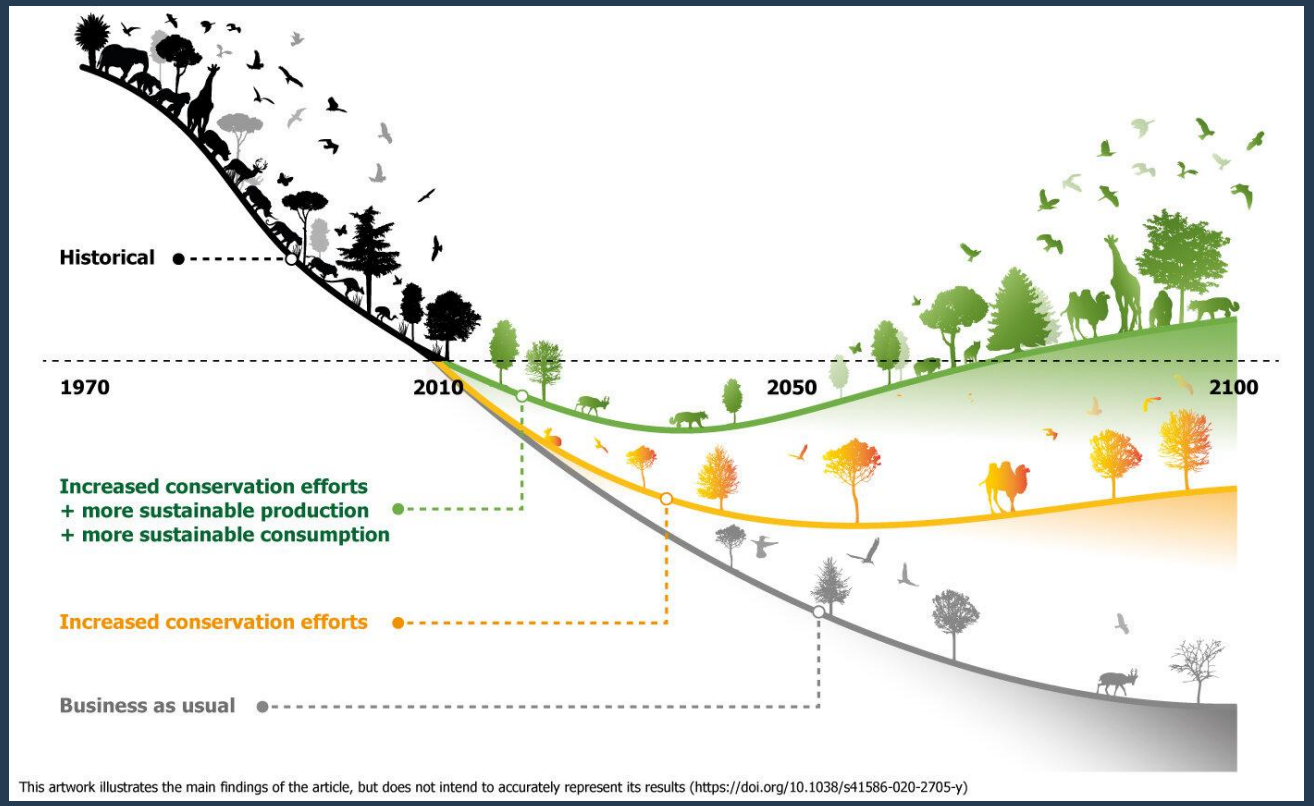
Francesco Cherubini | Industrial Ecology Program, NTNU

Human influence has warmed the climate at a rate that is unprecedented in the last thousands of years



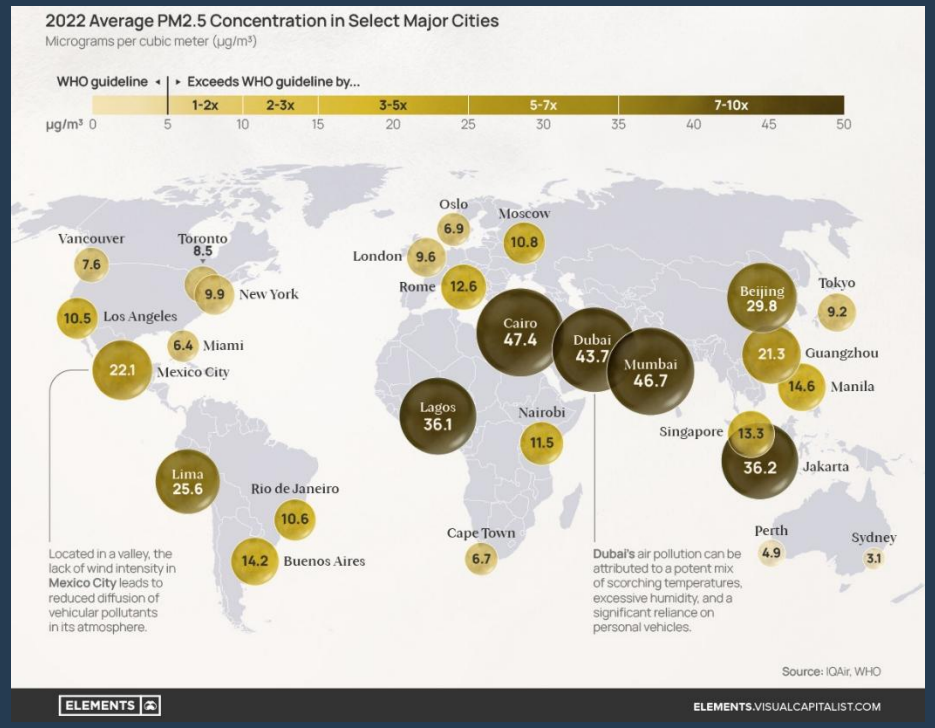
IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Working Group I

Other planetary crises: pollution and biodiversity

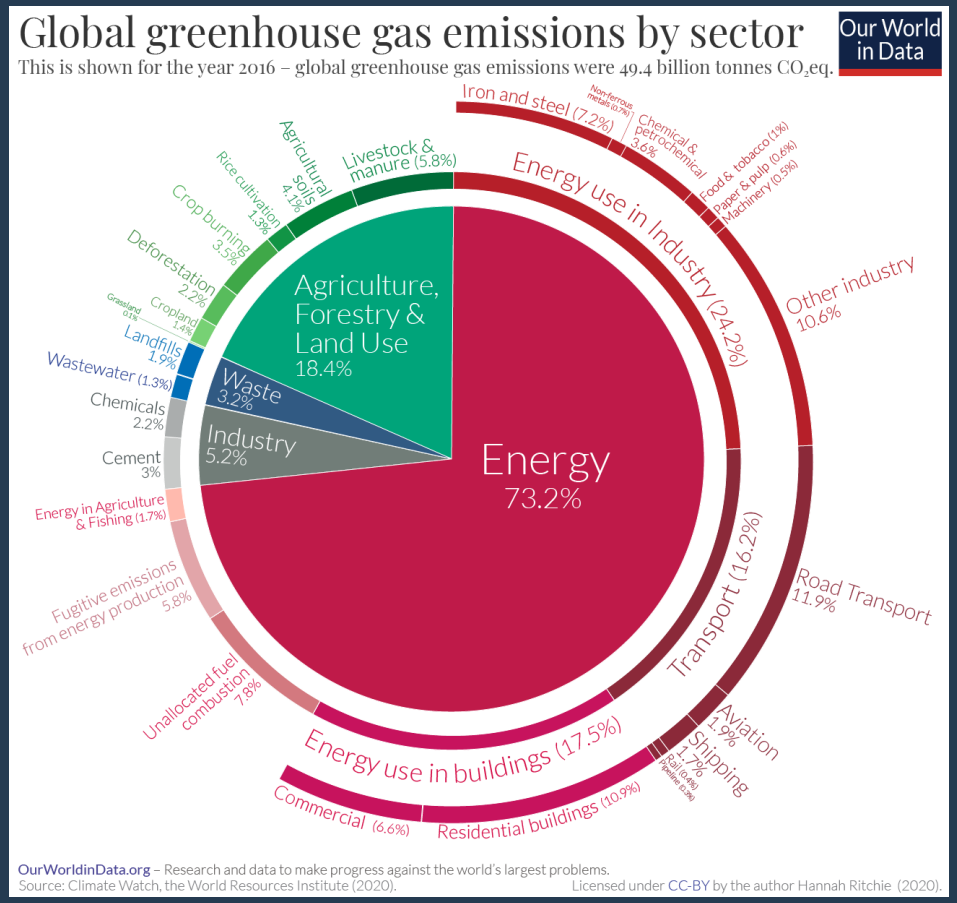


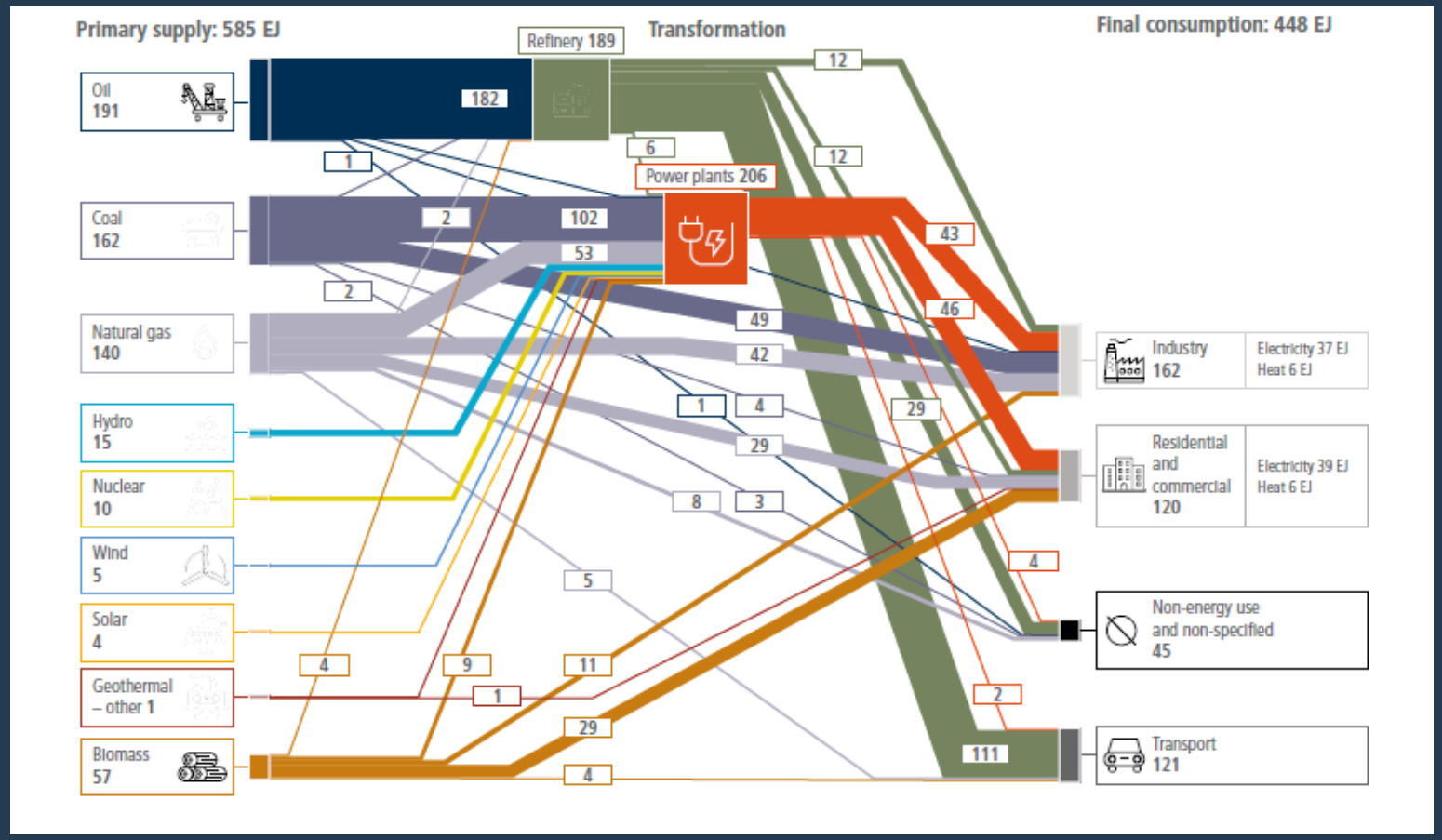
Leclère, D., Obersteiner, M., Barrett, M. et al. Bending the curve of terrestrial biodiversity needs an integrated strategy. Nature 585, 551–556 (2020).

Half the world's population are exposed to increasing air pollution



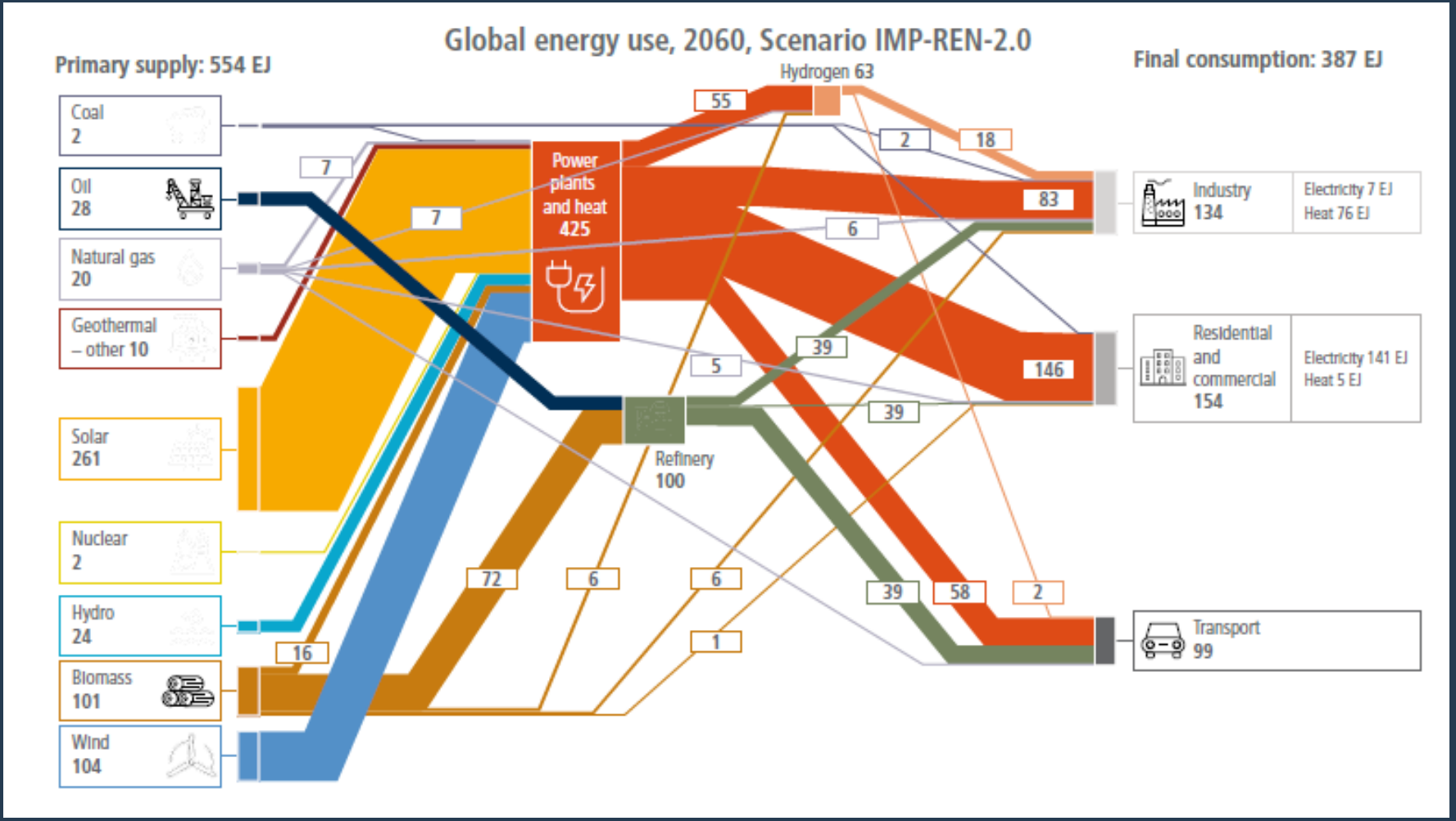
Global energy sector CO_2 emissions





Clarke, L., et al., 2022: Energy Systems. In IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the IPCC [P.R. Shukla, et al. (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA.

Global energy use – Net zero emissions by 2060



Scenario IMP-REN-2.0

Renewable pathway. Energy demand is reduced rapidly in the short-term, though grows later. Growth in renewables is very rapid and squeezes out most all other types of energy. Some biofuel is used to balance renewable variability, and the emissions from this are captured and stored. 2060 is the year of net Zero, 2.0 the RF by 2100

Clarke, L., et al., 2022: Energy Systems. In IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the IPCC [P.R. Shukla, et al. (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA.

The Core Challenges of the Energy Transition

Technical Challenges

- Integration of variable renewables
- Grid flexibility, storage, balancing
- Materials and supply chain constraints
- Avoid burden-shifts of impacts

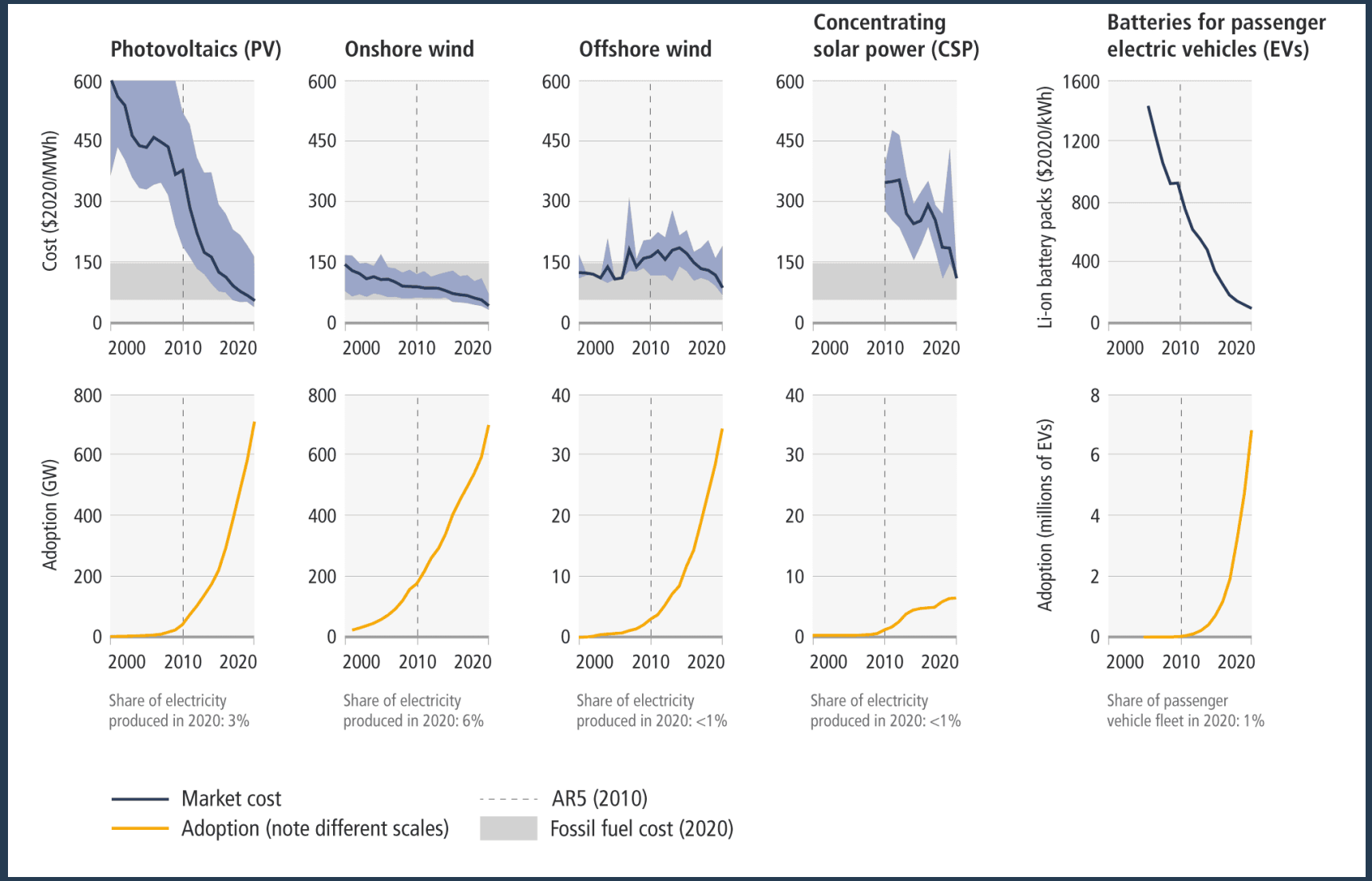
Economic & Policy Challenges

- Misaligned incentives
- Investment risks
- Slow permitting and regulatory inertia
- Political instability

Social & Environmental Challenges

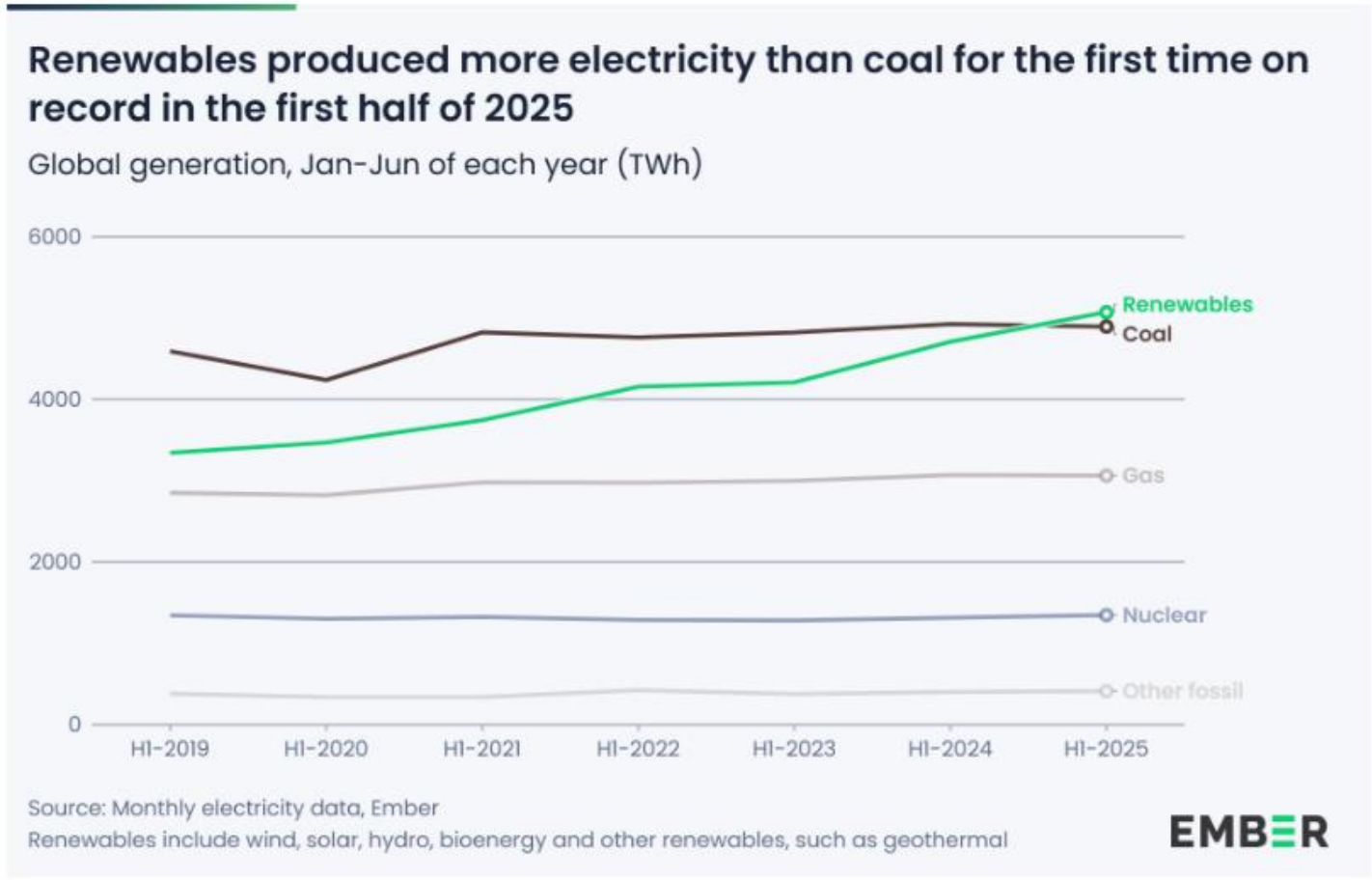
- Public acceptance of infrastructure
- Unequal cost distribution
- Skills shortages and workforce transition
- Barriers to behavioral changes

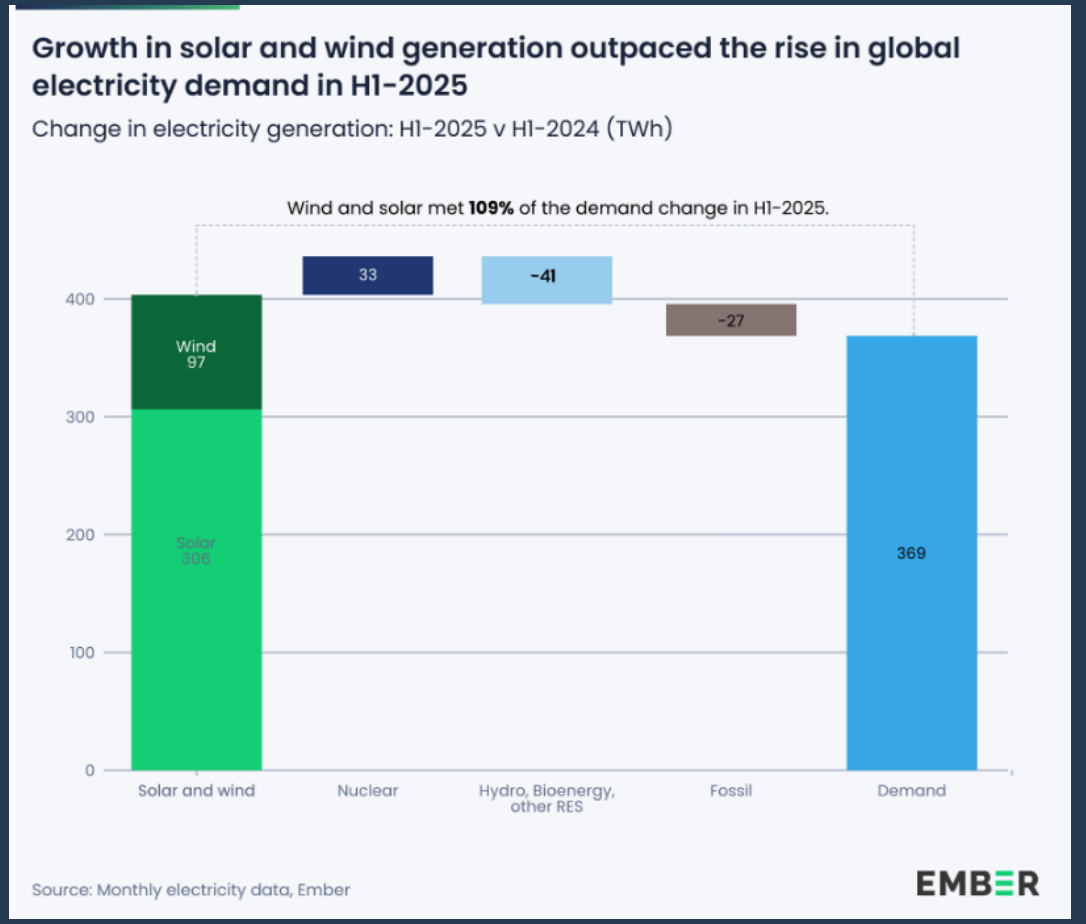
The costs of renewable energy and of batteries for passenger EVs have fallen, and their use continues to rise



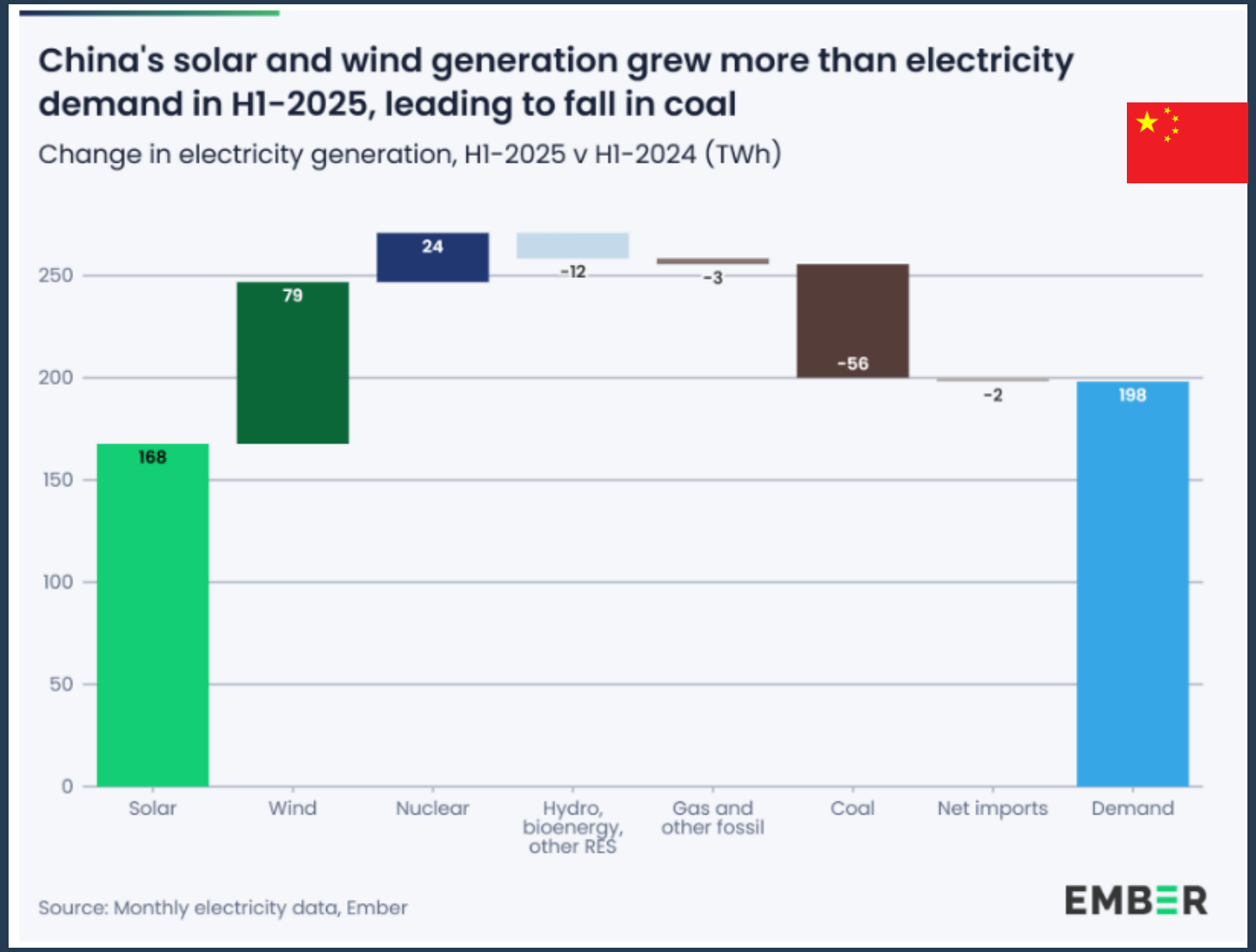
Clarke, L., et al., 2022: Energy Systems. In IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the IPCC [P.R. Shukla, et al. (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA.

What is happening today? Globe

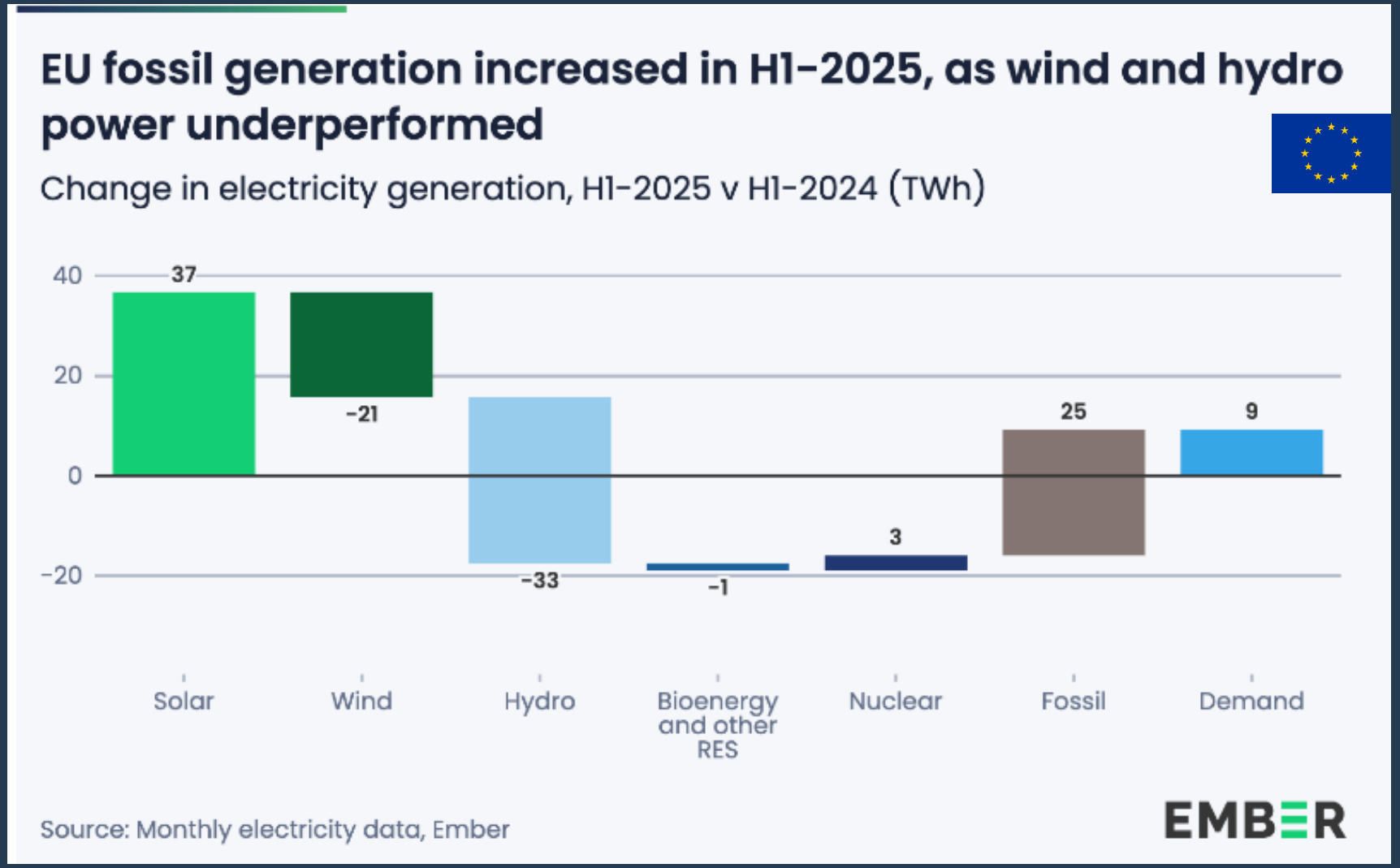




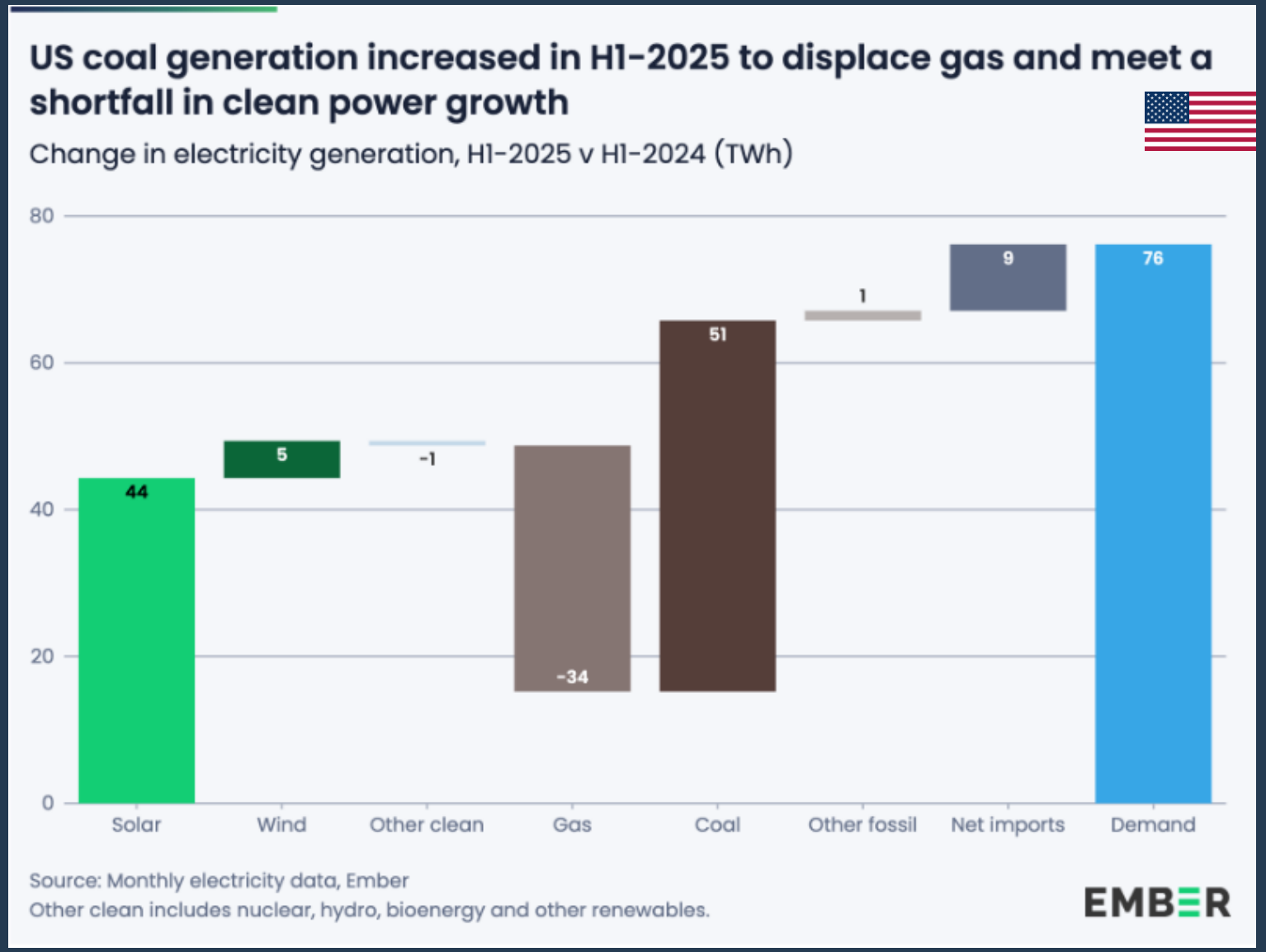
What is happening today? China



What is happening today? Europe



What is happening today? US



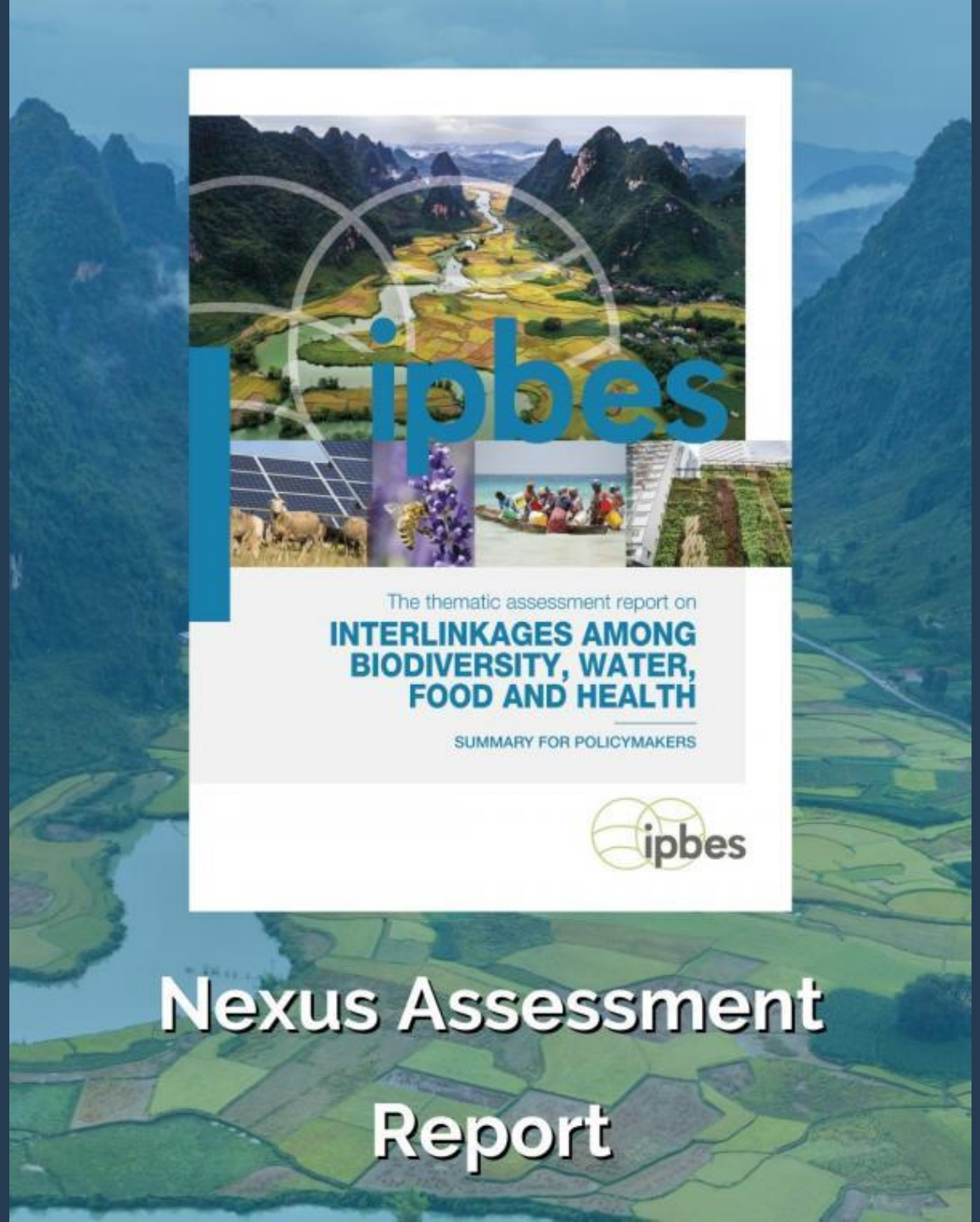
The Science Breakthrough price 2025

- Science Magazine labels the growth of renewable energy, and solar PV in particular, as the Science Breakthrough of the year 2025.
- It is not an invention but the scaling of a technology that’s been around for half a century, and built at such low cost and scaled at levels to change the global energy system.
- The primary step is not to invent something that nobody has thought about before, but to make more accessible what we already have.

The need for a Nexus Approach

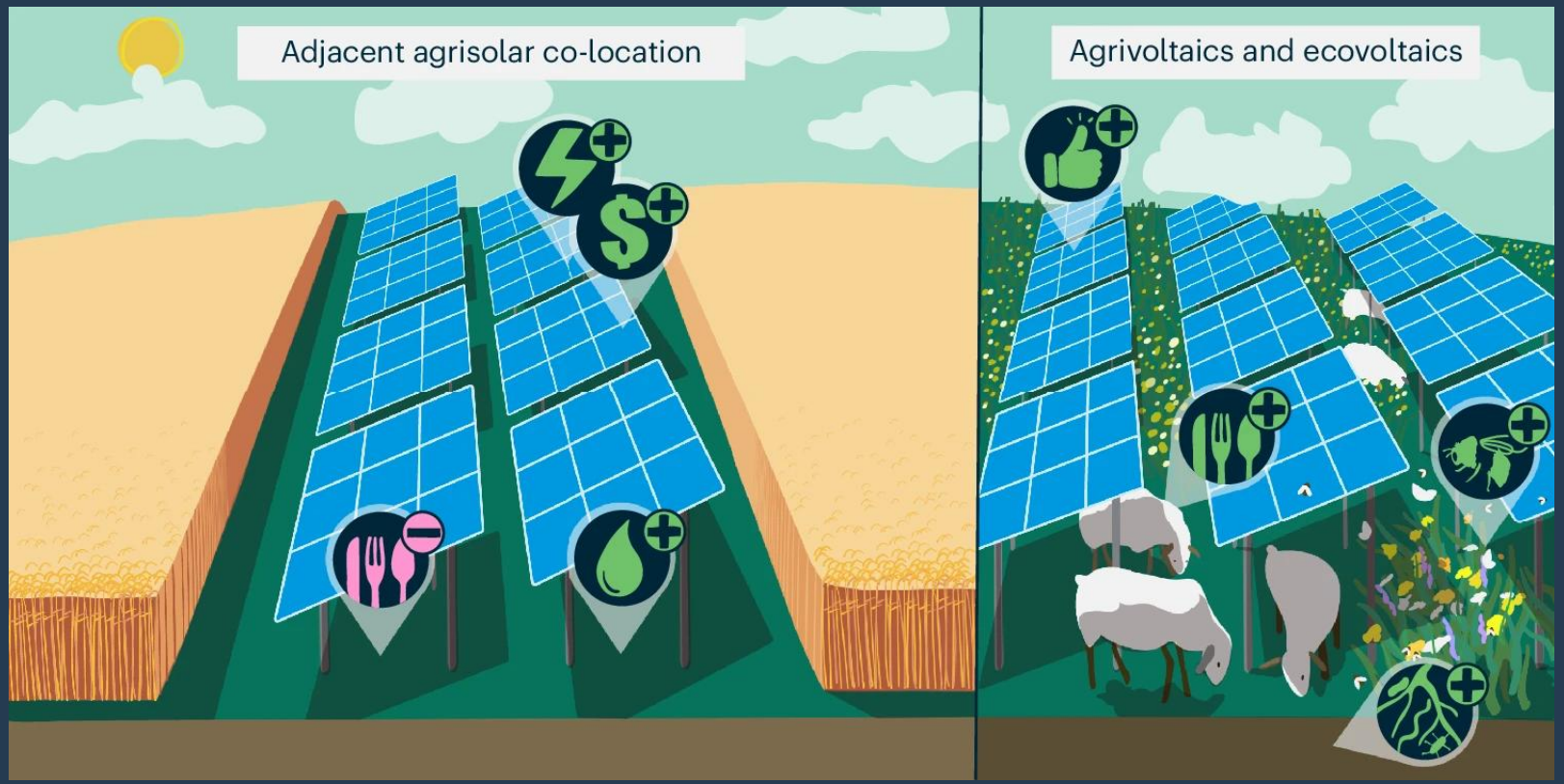
- Identify the solutions to energy and environmental problems that can co-deliver across multiple challanges

- E.g.: renewable energy production while contributing to climate change adaptation, biodiversity conservation, economic development of rural communities, etc.



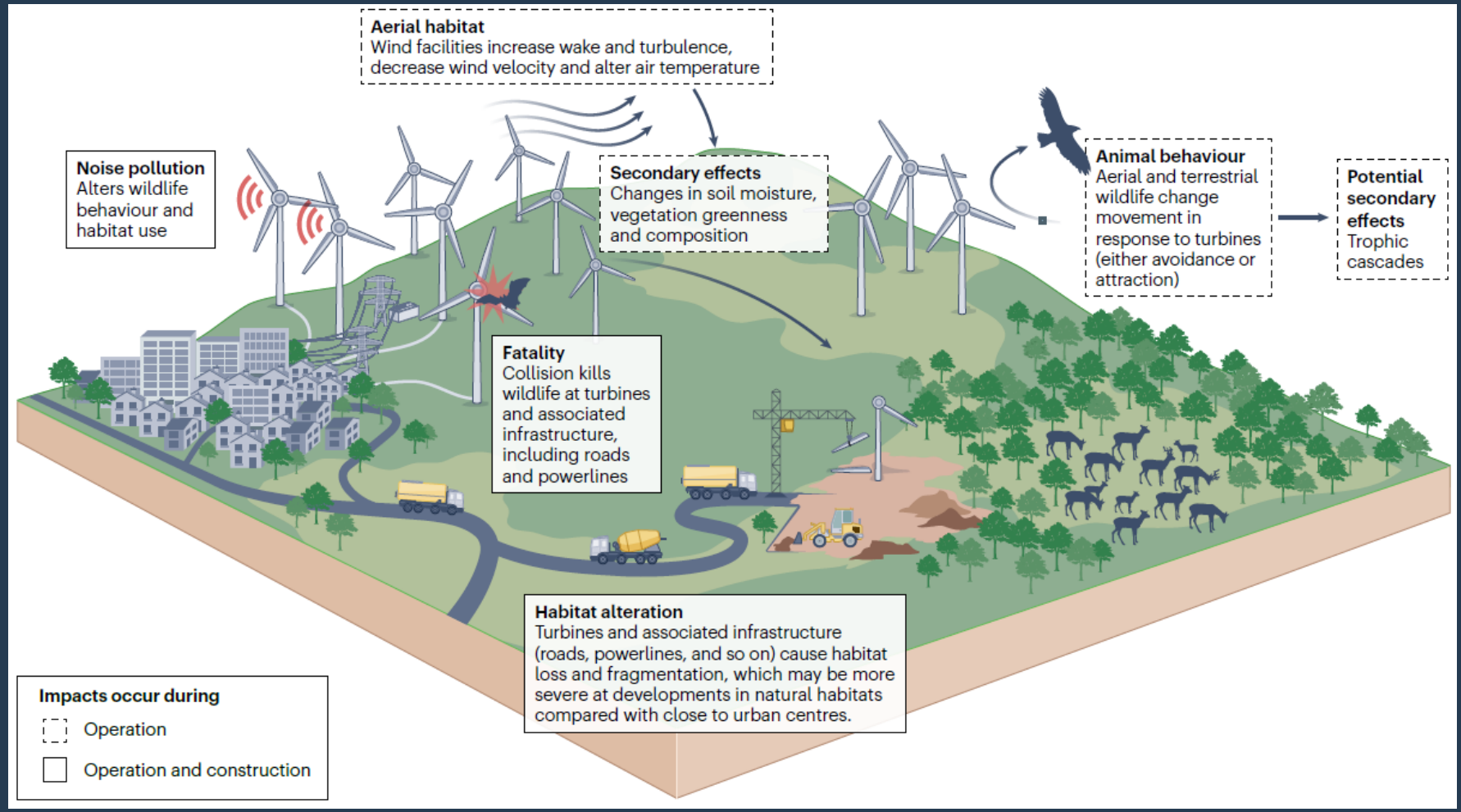
Each energy option has co-benefits and tradeoffs

Goal: maximize co-benefits and minimize trade-offs



Stid, J.T., Shukla, S., Kendall, A.D. *et al.* Impacts of agrisolar co-location on the food–energy–water nexus and economic security. *Nat Sustain* **8**, 702–713 (2025).

Impacts of onshore wind energy production on biodiversity

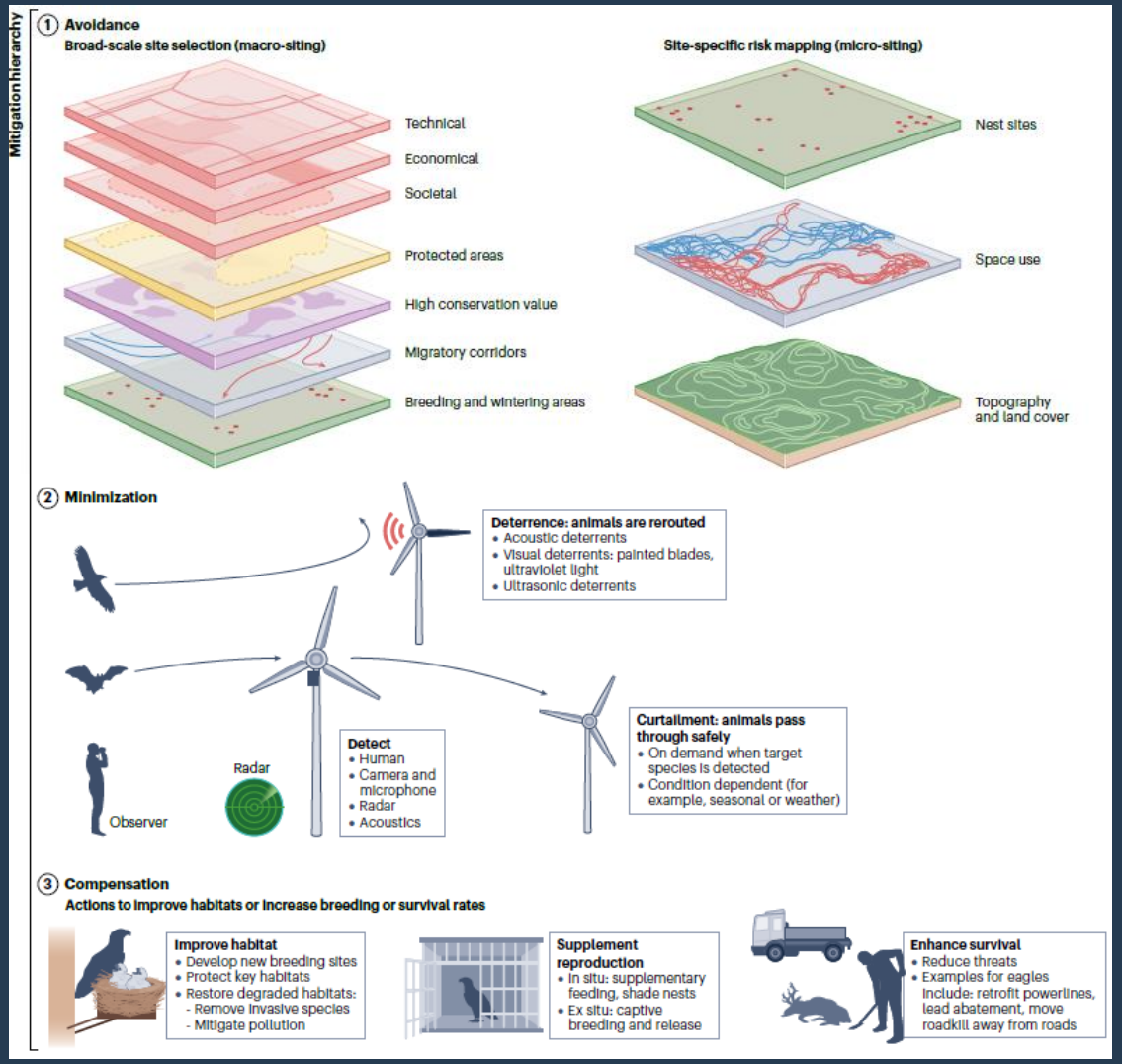


Katzner, T.E., Nelson, D.M., Marques, A.T. *et al.* Impacts of onshore wind energy production on biodiversity. *Nat. Rev. Biodivers.* **1**, 567–580 (2025).

Options to mitigate adverse impacts

Including a multiple-criteria approach in the decision-making process ensures that biodiversity is balanced with technical, economical and societal considerations

Windmills in ‘biodiversity sensitive’ sites (typically protected areas or migratory routes) can be avoided, or specific actions to mitigate adverse impacts can be implemented



Katzner, T.E., Nelson, D.M., Marques, A.T. *et al.* Impacts of onshore wind energy production on biodiversity. *Nat. Rev. Biodivers.* **1**, 567–580 (2025).

How do we get to Net zero?

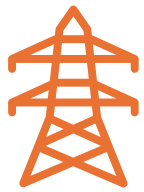
By doing a number of things, of course, but essential energy system transformations are:

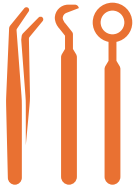
1) Consume less energy, and use it more efficiently
2) Decarbonize the electricity sector
3) Switch to electricity in other sectors (e.g., switch from combustible fuels to electricity in transport vehicles, or buildings)
4) Use cleaner energy sources (biomass, H2) in heavy industry (e.g., cement, metallurgical) and non-road transport (aviation and shipping)
5) Strengthen interdisciplinarity

Single-Disciplinary Approaches have high chances to Fail

- Engineers design optimal systems that policy frameworks cannot implement
- Economists model pathways that neglect grid physics or environmental boundaries
- Policymakers set targets without understanding operational bottlenecks or resource constraints
- Social scientists identify behavioral barriers but rely on technical experts to identify practical solutions

Interdisciplinarity is not an option, but a requirement




Trøndelag
County Authority

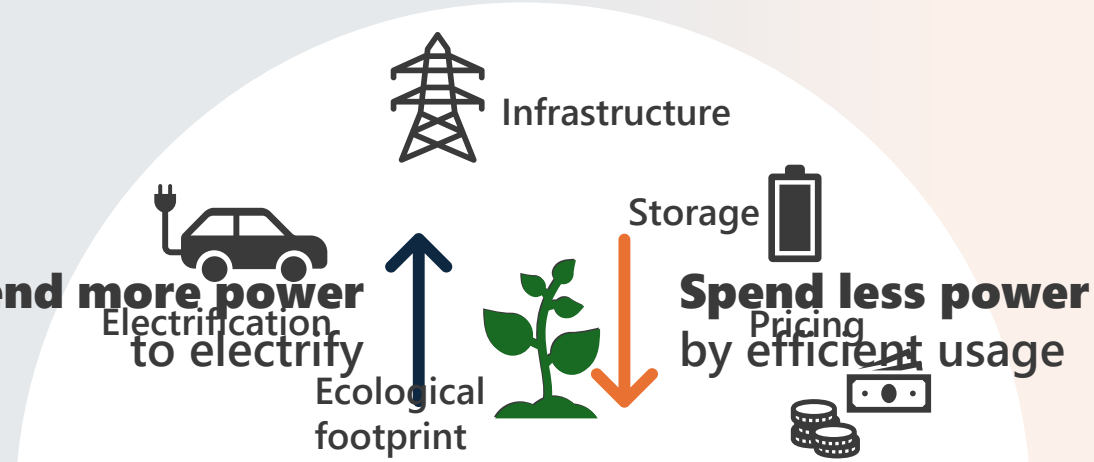
22 TWh

Industry & Agriculture
~7 TWh

Transport
~4 TWh

Households & Services
~6,1 TWh

Surplus heat
~3,8 TWh



Thank you!
And good luck

energy cluster with a 2 bil

Industrial symbiosis of salmon production

Europe’s most advanced energy community

Utilizing excess heat from the industry

SUSTAINABILITY IN REITAN EIENDOM

Jostein Breines - COO, Reitan Eiendom

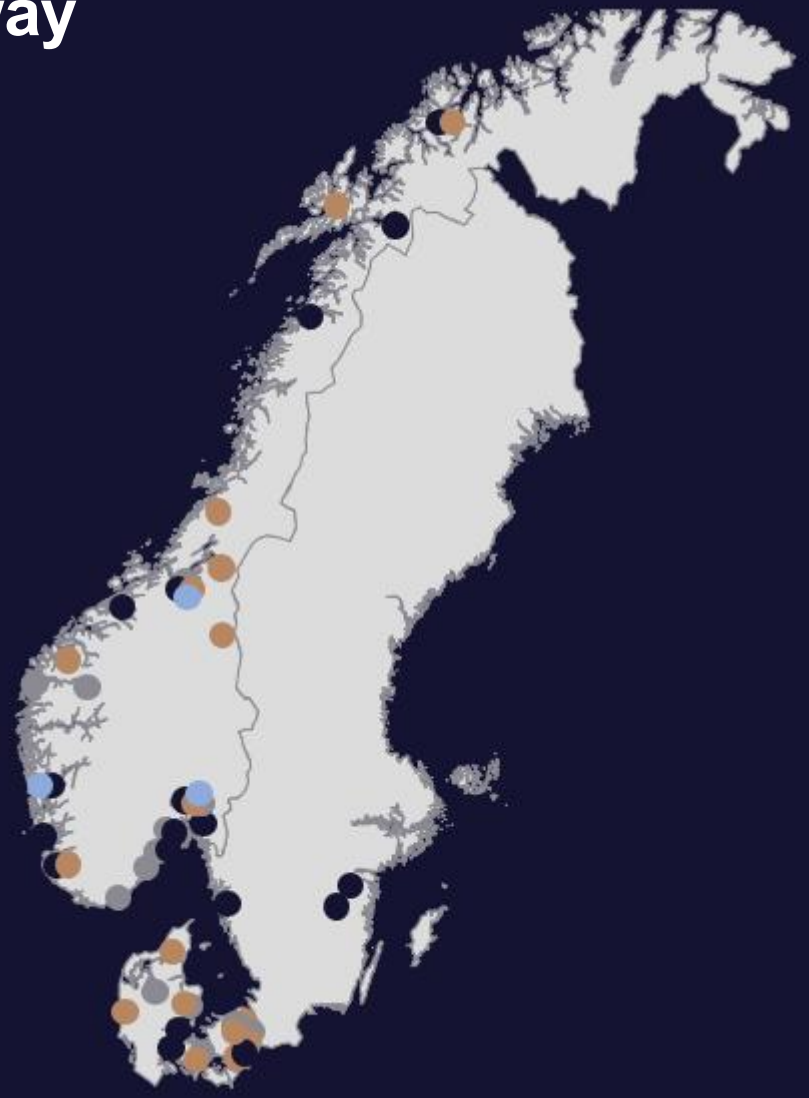
One of the largest real estate companies in Norway

178
EMPLOYEES

355+
PROPERTIES

265+
COMPANIES

2 143 000
SQ.M.



REITAN
EIENDOM

RELOG

E C DAHLS
EIENDOM

VESTENFJELDSKE
EIENDOM

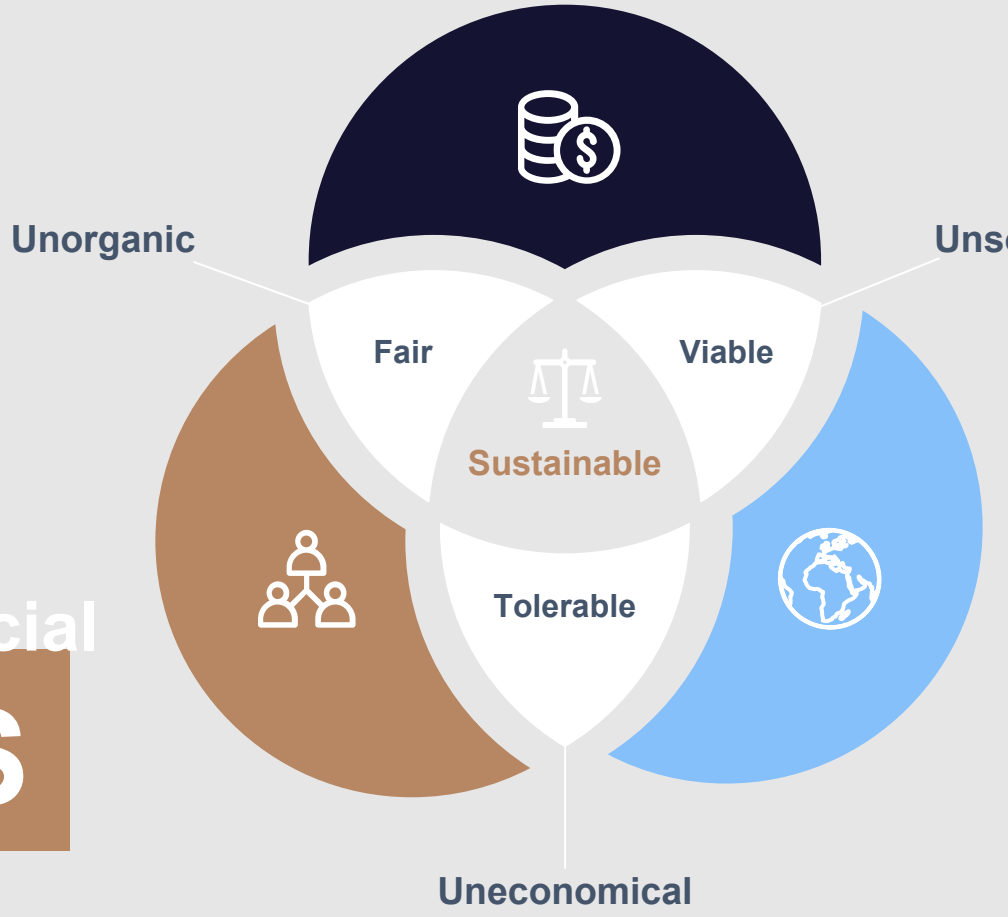
REBUS
HANDELSEIENDOM

dora

CHRISTIANIA
AREAL

G

Economic Governance



In Reitan Eiendom, **ESG** is part of our understanding of sustainability

Social Social

S

Ecological Environment

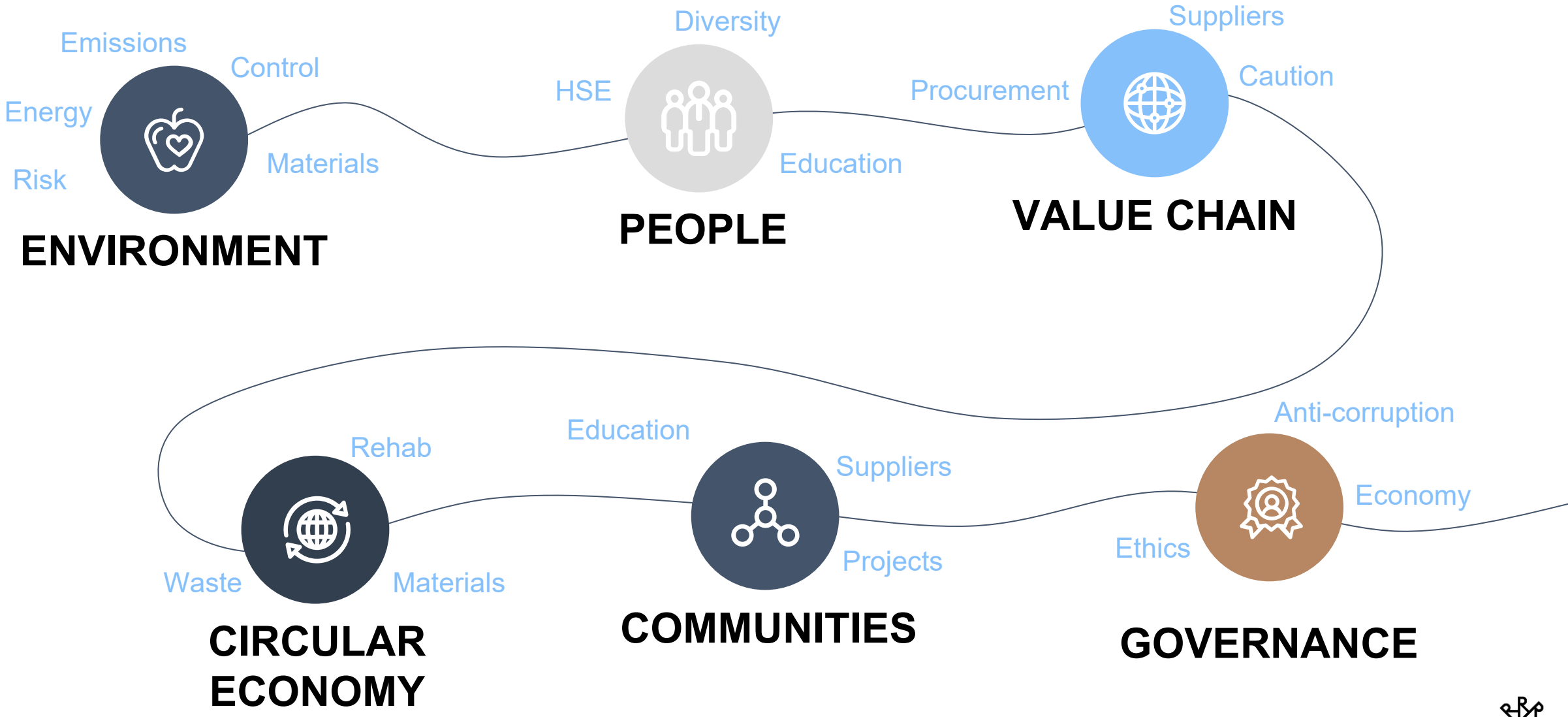
E

WHAT IS **ESG**?

	CORE ISSUES	DISCLOSURES/CALCALC.
E	Emissions of greenhouse gases (GHG); - Land use - Energy use - Waste and ecological vulnerability - Water use	Paris-adjusted GHG emissions: - Reduction in energy - and water use - Air pollution - Circular economy (reuse; recycle, implement, share)
S	Diversity and inclusion: - Age, gender, race - Risk of child - and forced labour - Health Safety and Environment Training	- Human rights - Wage differences - Minimum wage and wage statistics - Local community initiatives and local value creation
G	Financial culture: - Board composition and management - Anti-corruption; - Materiality and stakeholder analysis - Ethical guidelines and notification - Risk and opportunity analysis integrated into business decisions	- Salary levels - Risk and opportunity management - Economic, environmental and social themes in capital allocation - GRI reporting


VISION: REITAN EIENDOM IS LEADING IN NORWAY WITHIN **SUSTAINABLE** REAL ESTATE DEVELOPMENT AND -FACILITIES MANAGEMENT.

REITAN EIENDOM'S MATERIAL TOPICS



METHOD FOR SUSTAINABLE REAL ESTATE DEVELOPMENT AND - FALICITIES MANAGEMENT

A tool to drive innovation and progress towards the Sustainable Development Goals

STEG
01

MAP
We map the project's prerequisites, surroundings and context in order to uncover which value chains affect the project.

...BASED ON MAPPED DATA

STEG
02

ILLUSTRATE
We illustrate mapped data so that everyone has the same picture of the prerequisites, as well as to enable new discoveries from data.

...FROM DISCOVERED OPPORTUNITIES

STEG
03

INNOVATE
We let the facts and data be the foundation for the project's concepts and innovation, and base the project on identified needs.

...WITH THE SOLUTIONS OF THE FUTURE

STEG
04

EXECUTE
We execute the innovation through project management and competent people, and document the results we achieve.

GOOD PROJECTS...

Method for sustainable real estate development and -facilities management

Triple bottom lines

Increased solvency

Rigged for the future

STRATEGY, METHODOLOGY AND REPORT

STRATEGY

THE MAP

Reason and description of where to go

METHODOLOGY

THE VEHICLE

The way and the tools to get there

REPORT

THE VACATION PHOTO ALBUM

Description of the journey and destination

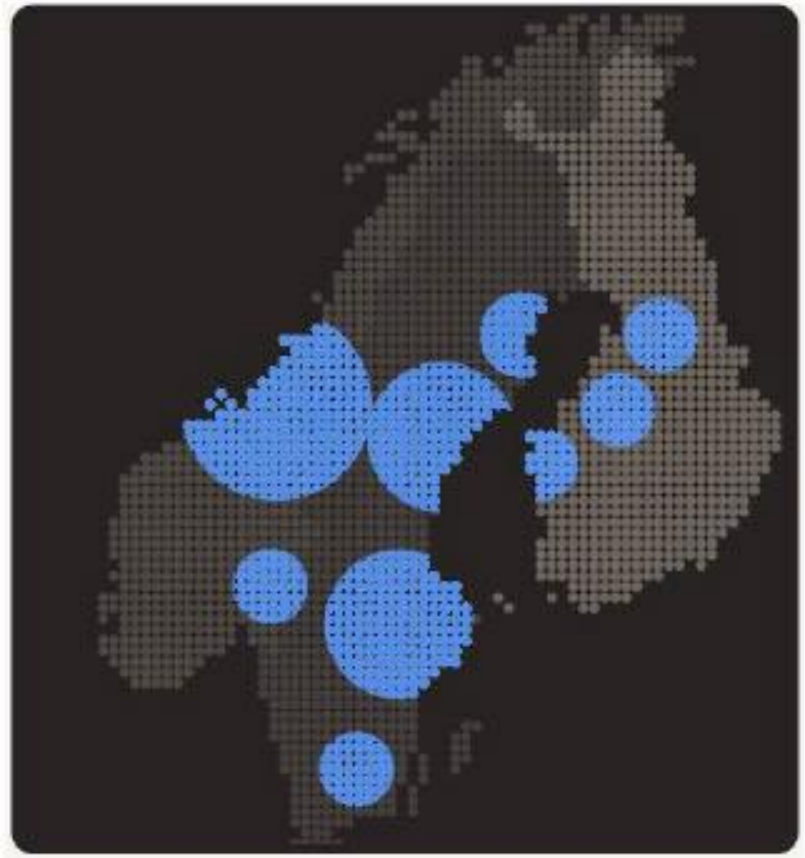
REITAN

EIENDOM


ANEO

About Aneo

- Accelerate the energy transition in Norway/Nordics
- Build and operate more renewable power
- Improve reliability through smarter operations
- Use digital solutions and data to increase efficiency & flexibility
- Support electrification and competitive power prices



Ownership

≈ 76,000 households

Management

≈ 640,000 households

Energy transition: key challenges when building new power

- Higher demand: electrification of industry, transport, society & population growth
- Industry pressure: upgrades need power → competitiveness at risk
- Local impacts: nature, landscapes & biodiversity (decades)
- Fairness & acceptance: “What do we get back — and when?”
- Economy: higher demand → higher prices → weaker local benefits
- Governance: local impact vs national need (municipal influence / veto)

Why EiT?

Multidisciplinary teamwork matters

- Complex system → no single discipline sees the full picture
- Combine perspectives: technology + economy + social sciences + nature + governance
- Define the right problem before solving it
- Utilise everyone: questions are as valuable as answers
- Feedback builds trust, alignment & better decisions
- **Tip 1 in EiT: choose a problem where everyone can contribute**
- **TIP 2 in EiT: respectful feedback turns a group into a team**