WELCOME

CETPartnership Policy Conference

Sustainable Supply Chains for the Energy Sector

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Welcome and introduction

1

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Agenda

10:00 Describing our challenge
Expert talks

10:40 Understanding the challenge
Expert presentations

11:30 Rising to the challenge: Cooperating in Europe and beyond
Panel discussion

12:45 Wrap-up and prospects

13:00 Closing and lunch break

Describing the challenge

2

Co-funded by the European Union

Session overview

Critical materials, innovation and competitiveness
Tae-Yoon Kim, International Energy Agency

Material and processes for sustainability in the built environment
Willem Bulthuis, Better Building Initiative

Transporting energy with limited resources
Marco Marelli, Prysmian Group

Cradle to cradle approaches to sovereignty
Prof. Dr. Michael Braungart, Braungart EPEA

The big challenge for Research, Industry and Society
Dr. Paula Kivimaa, Finnish Environment Institute Syke

Expert talk

Critical materials, innovation and competitiveness

Tae-Yoon Kim

Senior Energy Analyst
International Energy Agency

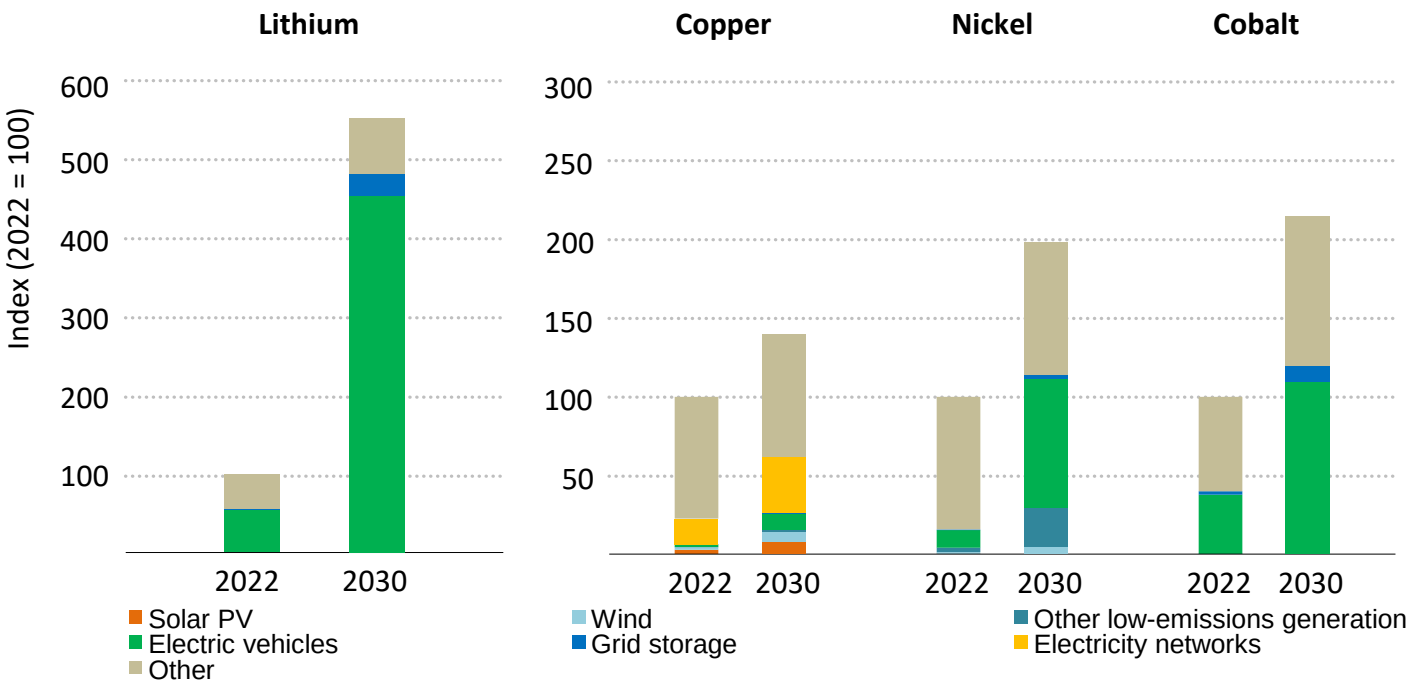
Global perspectives on critical minerals – IEA Critical Minerals Market Review 2023

Tae-Yoon Kim
24 October 2023

International Energy Agency

Meeting climate goals means further rapid growth this decade

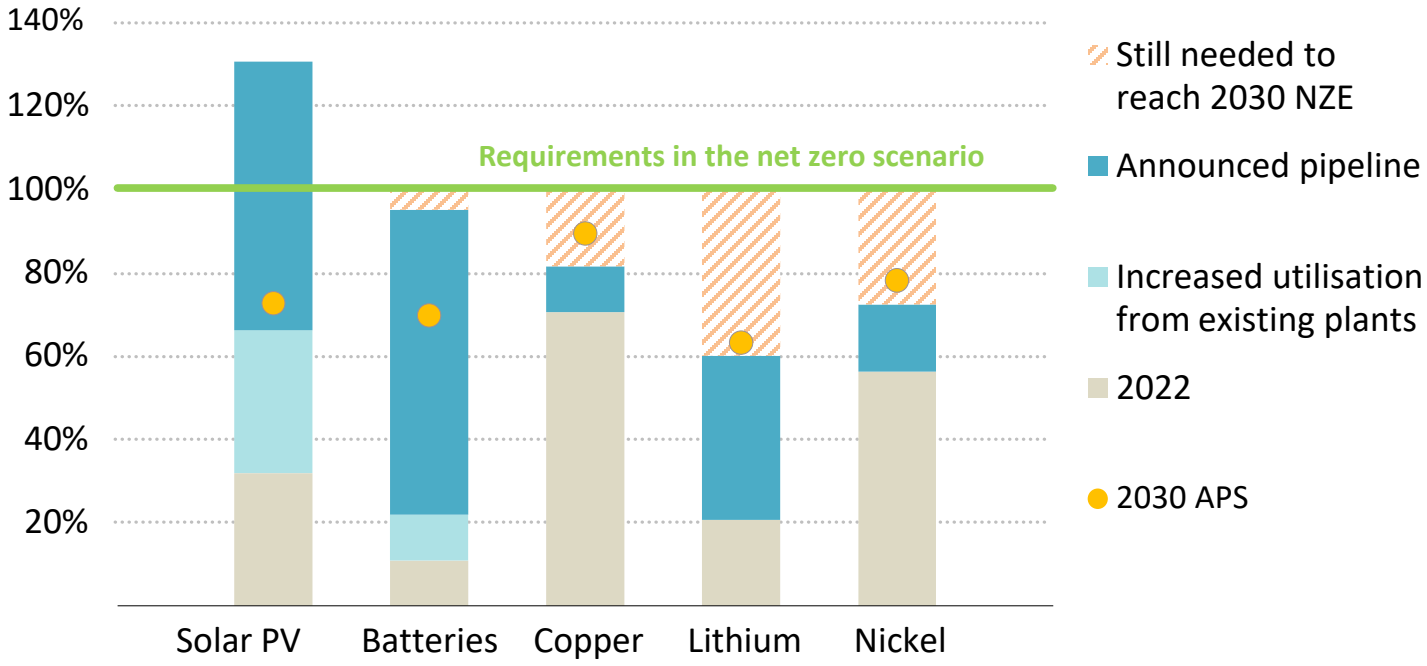
Total demand for key critical minerals in the Net Zero Emissions by 2050 (NZE) Scenario



Getting on track to limit global warming to 1.5°C would mean a further rise in mineral demand for clean energy by up to four times to 2030

Uneven progress for clean energy supply chain developments

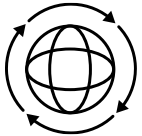
Announced project throughput and deployment and supply needs for key clean energy technologies and minerals in 2030



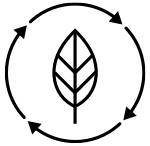
Announced plans to scale up clean energy manufacturing capacity help to put the world on track with a 1.5 °C pathway, but not all parts of the value chain are moving at a similar pace

Three supply-side challenges

Can future supplies keep up with the rapid pace of demand growth in climate-driven scenarios?

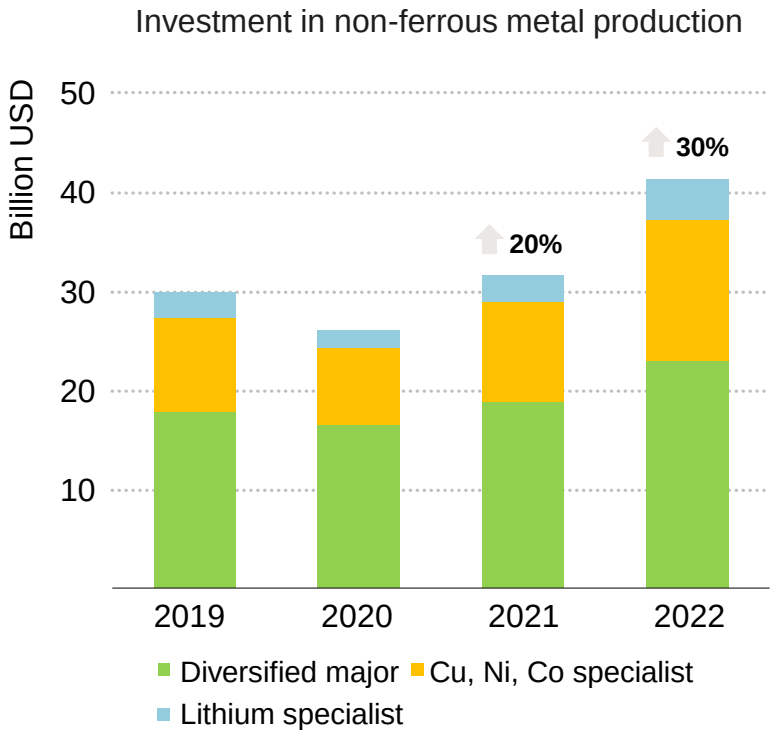


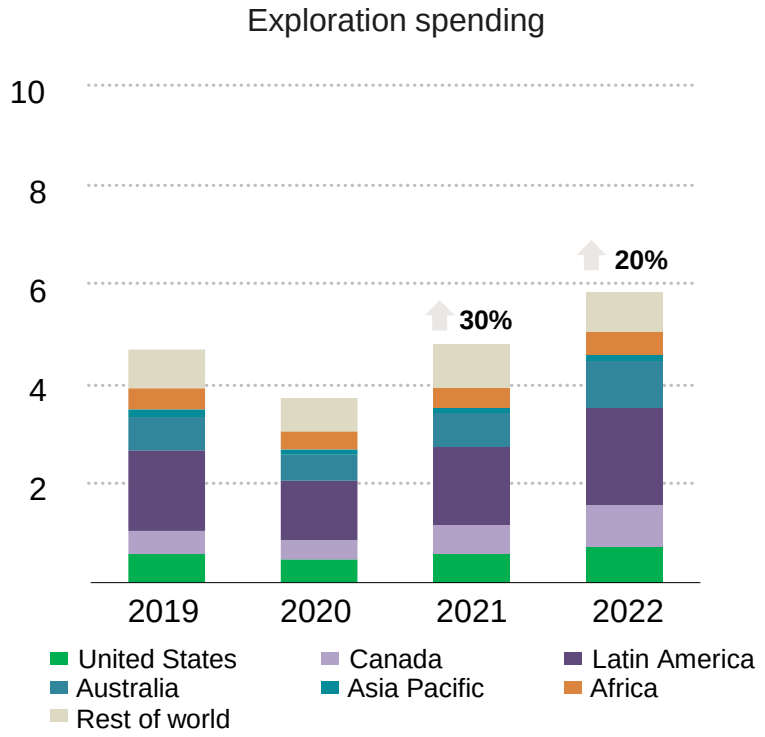
Can those supplies can come from diversified sources?



Can those volumes be supplied from clean and responsible sources?

Investment in critical mineral supplies on the rise

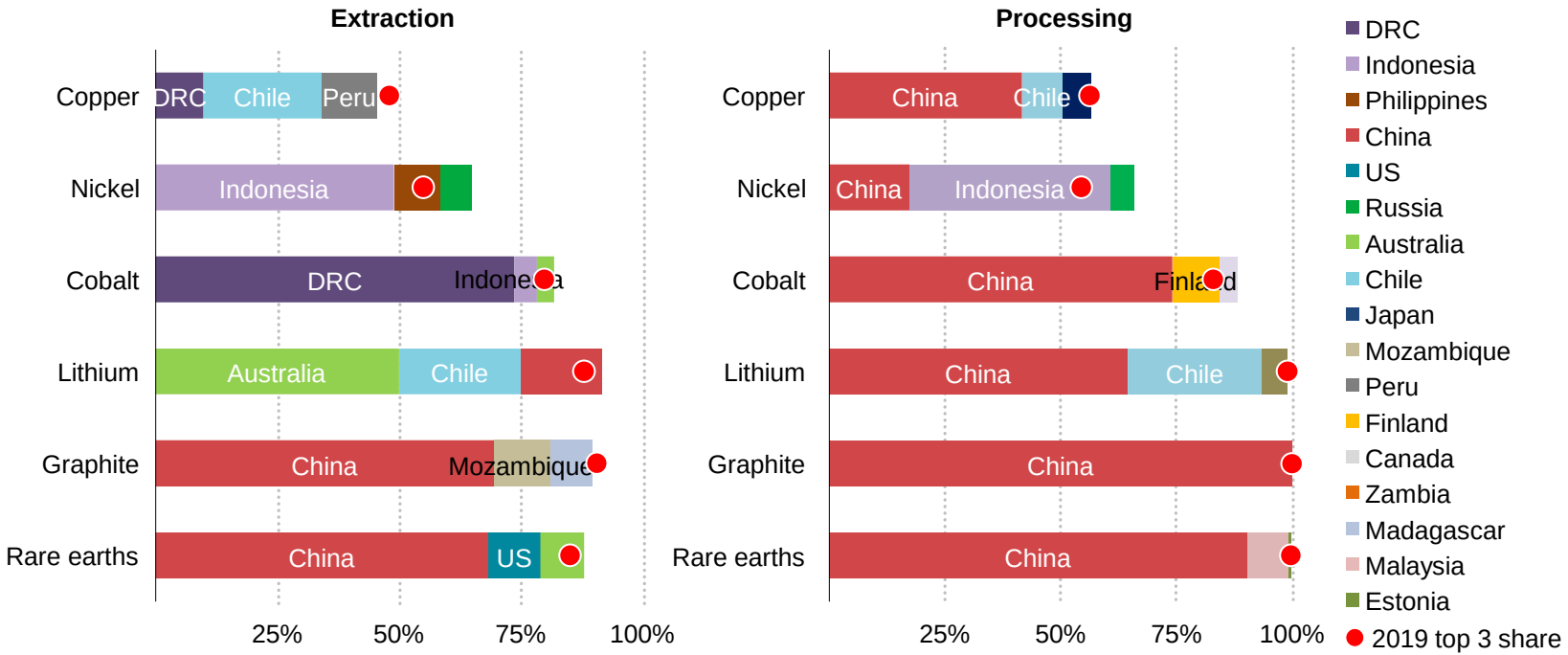




Higher prices & strong expectations for demand have produced new strategies and investments from resource-rich countries – spending on critical minerals exploration and development is up sharply since 2020

But concentration of supply remains high

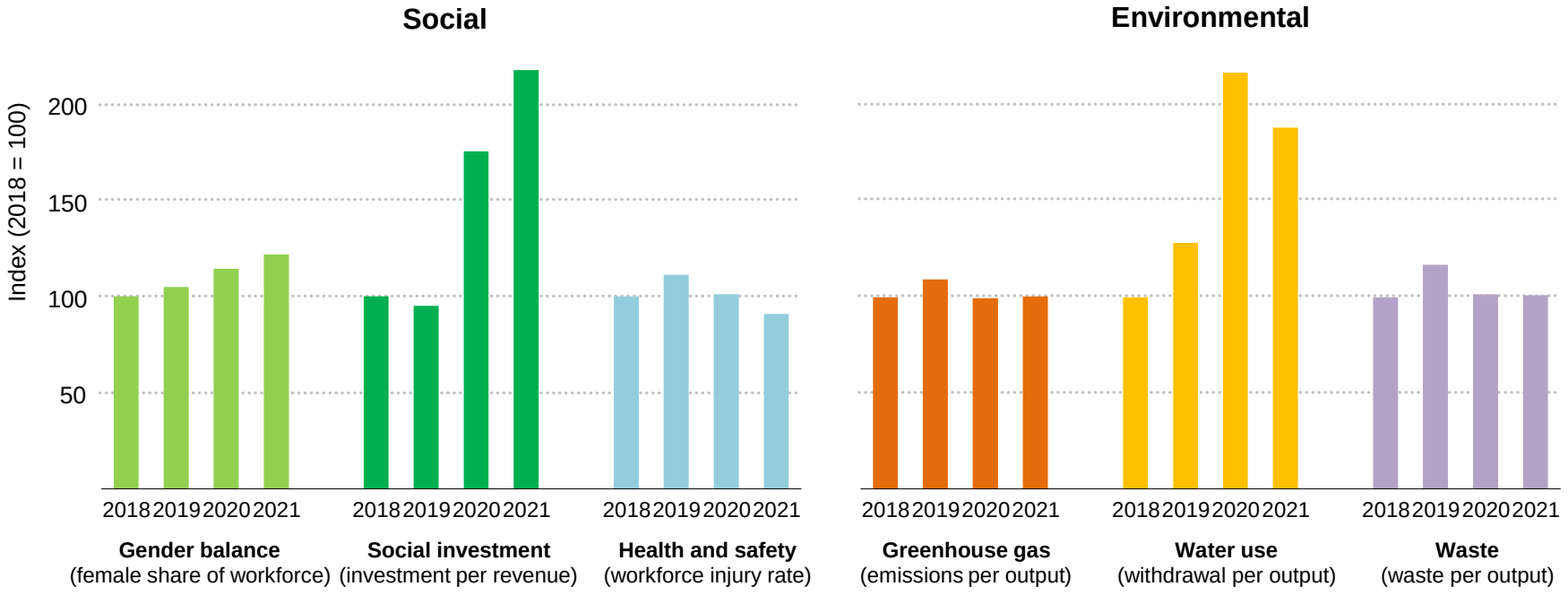
Share of top 3 producing countries in total production for selected resources and minerals, 2022



Limited progress has been made to diversify supply sources in recent years and, in some cases, the level of concentration has risen – announced projects would not change this picture dramatically

Mixed progress towards sustainable and responsible mining

Aggregate social and environmental indicators for major mining companies



There are some signs that responsible social practices are taking hold across the mining industry, but industry-wide progress is still missing in key areas, especially on environmental sustainability

Expert talk

Material and processes for sustainability in the built environment

Willem Bulthuis

Co-Founder Better Building Initiative
CEO Corporate Ventures Advisory

Material and processes for sustainability in the built environment

Sustainability, Resilience and Sovereignty require

Circularity, Deep Supply Chain insights, Design-For-X methodologies

Willem Bulthuis

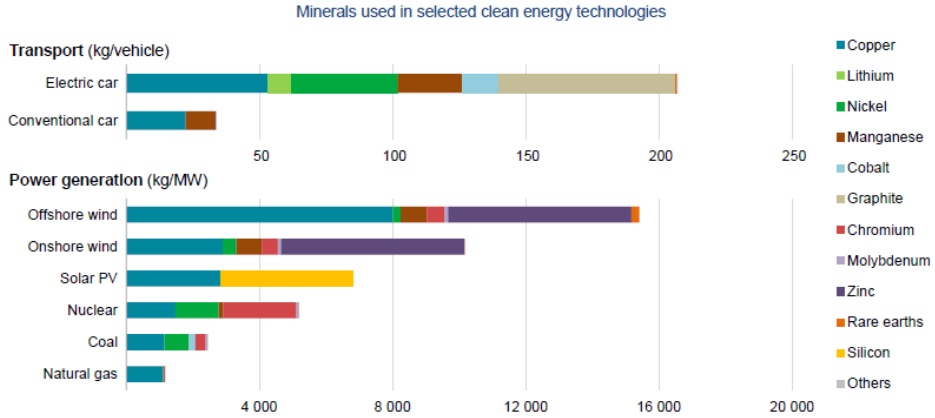
Co-Founder of the Better Building Initiative
CEO of Corporate Ventures Advisory GmbH

THE WORLD NEEDS ENERGY & HOUSING AND THUS CONSTRUCTION

But in a substantially more sustainable and resilient way

Energy Sector: critical materials

The rapid deployment of clean energy technologies as part of energy transitions implies a significant increase in demand for minerals



Construction Sector: raw materials

40% of all materials extracted

35% of all waste generated

30% of all GHG generated

15% of GHG from building materials

Both need cement, steel, chemicals: hard-to-abate Industries

TOWARDS A MORE SUSTAINABLE AND RESILIENT SUPPLY CHAIN

Several challenges have to be addressed – in a very traditional, risk-averse industry

Focus has been on CO2 and Use Phase (scope 1 & 2)	**Supply Chains have been a black box – cost has been the dominating factor**	**(Critical) Material and Sustainability have been an "afterthought" in design**
Holistic approach to sustainability and resilience is needed, incl. circularity	**Deep Supply Chain Insights are needed to manage sustainability and risks**	**Design-for-Sustainability and Design-for-Resilience must become standard**
• (critical) material sources • production & transport • circularity versus waste • deep supply chains	• supply chain discovery • sourcing based on cost, sustainability, resilience • risk analysis, early warnings	• awareness • sustainability & risk info for engineers & developers • 2nd sourcing, alternatives

INNOVATION IS NEEDED TO ENABLE THE SUSTAINABILITY TRANSITION

Methods, Tools, Data, Funding – especially paying Customers

Holistic approach to sustainability and resilience, incl. circularity

- "Real" LCAs (vs. "model-based ") to reflect benefits of innovations
- Environmental Product Declarations and Material / Building Passports
- Innovative Materials, Processes, Designs
- Regulatory adaptation

Deep Supply Chain Insights to manage sustainability and risks

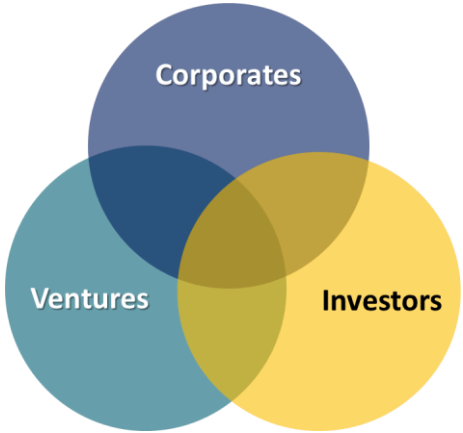
- Supply chain discovery tools
- Tools for "real" supply chain sustainability analysis
- Tools for deep supply chain risk analysis & early warnings
- Legal framework and independent repository of supply chain data (e.g. Virtual Datalake)

Design-for-Sustainability and Design-for-Resilience as standard process

- Awareness of managers
- Education of engineers, developers and purchasers
- Databases and (AI) tools for recommending sustainable materials and process
- Know-how on design-for Disassembly, Re-use, Re-cycle

- Risk-taking (venturing) investors and project developers (public & private)

CORPORATE VENTURES ADVISORY & THE BETTER BUILDING INITIATIVE



Bringing Ventures, Investors and Corporates together

willem@corporate-ventures.com

Better Building Initiative

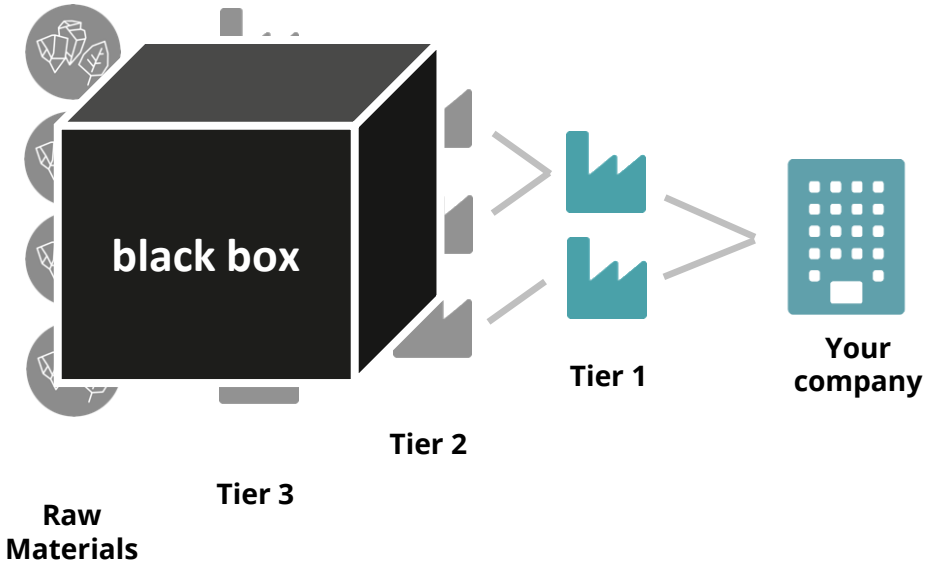
Catalysing sustainable transformation of the construction industry

willem@betterbuilding.world

www.linkedin.com/company/better-building-initiative

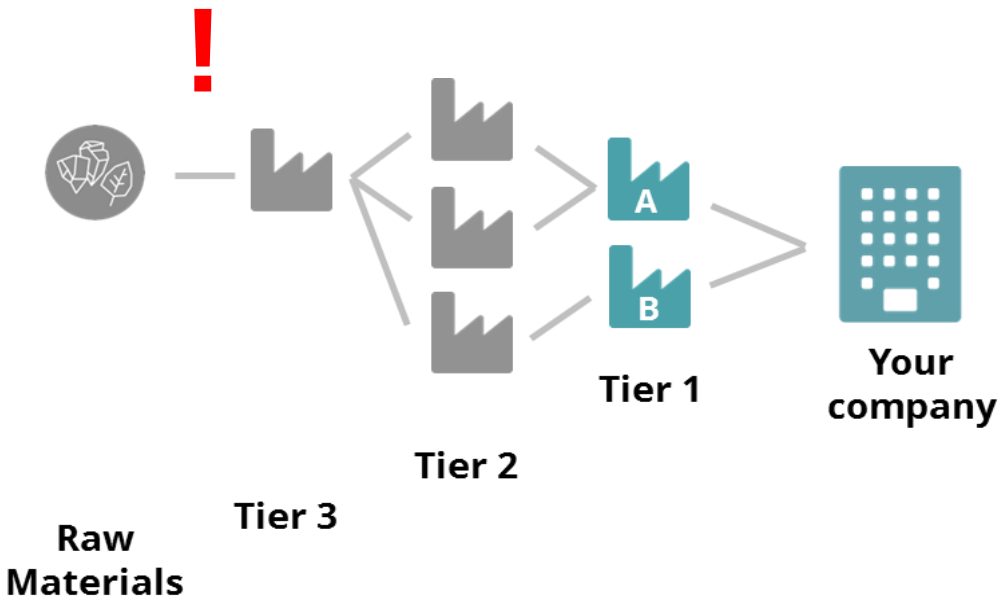
MOST COMPANIES (STILL) HAVE NO INSIGHTS INTO THEIR DEEP SUPPLY CHAIN

Before their Tier-1, the supply chain is a black box



MOST COMPANIES (STILL) HAVE NO INSIGHTS INTO THEIR DEEP SUPPLY CHAIN

So they can't effectively improve sustainability or reduce supply chain risks



THE IMPORTANCE OF RAW AND CRITICAL MATERIALS IS RECOGNISED

So why is it so difficult to address this issue?

"Raw materials are vital for manufacturing key technologies for our twin transition – like wind power generation, hydrogen storage or batteries."

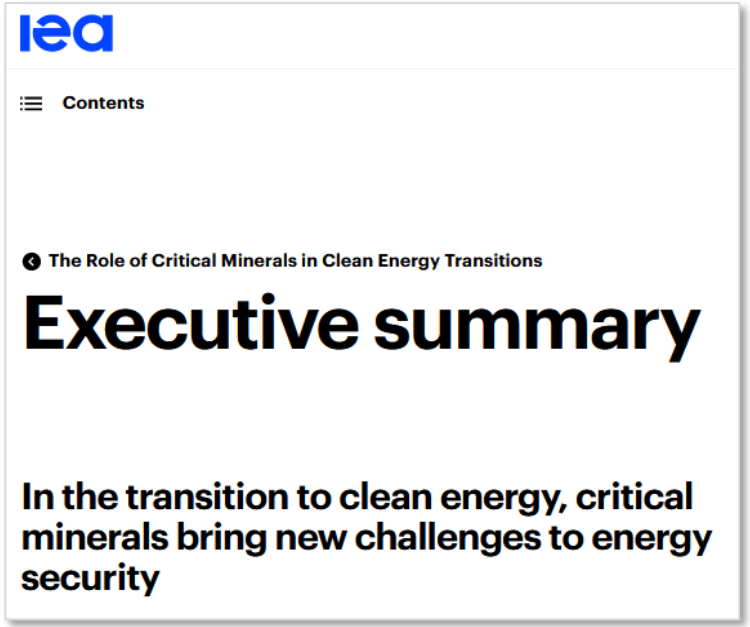
Ursula von der Leyen

in a March 16th, 2023, Press Release on Critical Raw Materials: ensuring secure and sustainable supply chains for EU's green and digital future

"Without a safe and sustainable supply of critical raw materials, there will be no green and industrial transition."

Margrethe Vestager

in a March 16th, 2023, Press Release on Critical Raw Materials: ensuring secure and sustainable supply chains for EU's green and digital future



Expert talk

Transporting energy with limited resources

Marco Marelli and Socrates:

"The secret of change is to focus all your energy not on fighting the old, but on building the new."

Energy transmission for Energy transition

Key enablers for a predictable positive future

CETP 2023 - Marco Marelli

Prysmian Group

Linking the Future

MARKET TRENDS – ELECTRONS WIN

Energy market is growing
Hydrogen is gradually taking some space, mostly replacing oil and gas
Demand for electricity is growing also as complement of other expanding sectors

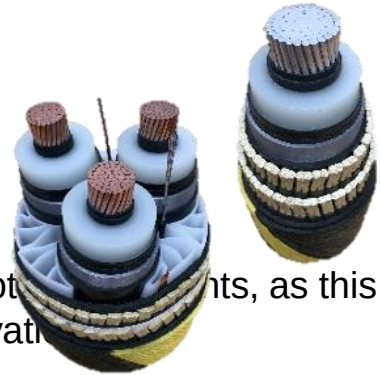
Interconnectors and renewables energy as driver
Submarine cable market to grow 3-5 times in the next 5-10 years

BUILDING THE FUTURE – INVESTING IN CAPACITY

Long term plans and clear regulations are supporting the capacity expansion

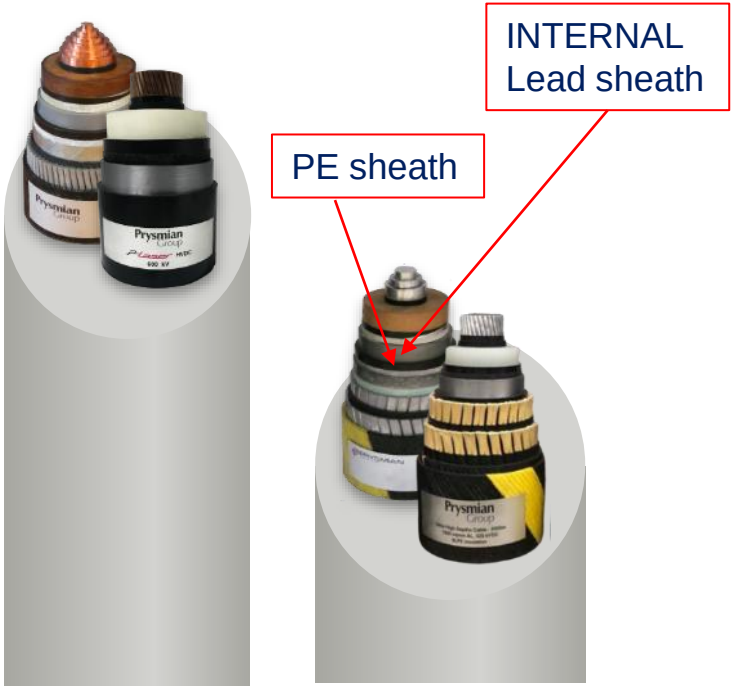
INNOVATION IS CORE FOR ENERGY TRANSMISSION

Innovation enabled and will enable larger voltages and power ratings for the supergrids, installation at deeper depths for the long interconnectors, dynamic cable designs for upcoming floating wind farms, fully recyclable cables.
All them are accelerators for the energy transition



Give more v nts and help prot nts, as this will reinforce t tment of industrial st o invest in innovati

SUSTAINABILITY AS MAIN DRIVER FOR ENERGY TRANSITION



Sustainability is a key target for all, including cable manufacturers. For this purpose, European agencies are requiring also avoidance of certain materials e.g. lead. This is positive but HV submarine cables need INTERNAL LEAD SHEATHING.

Cable industry is not ready yet to change and the risk is to stop making and repairing power cables thus stopping a large part of the energy transition

ONGOING EUROPEAN AUTHORISATION PROCESS REGARDING POSSIBLE RESTRICTIONS FOR USE OF LEAD

ECHA
EUROPEAN CHEMICALS AGENCY

In June 2018
Lead (Pb) metal was identified as SVHC.

In December 2021
ECHA confirmed its intention to propose the Lead (Pb) metal to be included in Annex XIV REACH Regulation.

February to May 2022
Consultation on ECHA's draft recommendation.
Call for information by the European Commission.

Sept to Oct 2022
ECHA reviewed the comments received & amended its recommendation.

Oct 2022 to Feb 23
Discussions between ECHA and Member States (MSC)

European Commission

On the 12th of April 2023 ECHA, confirmed its recommendation to include Lead in Annex XIV to the REACH

2023-2024/25
EC discussion and vote on the ECHA MSC proposal to amend the Authorisation List

Option 1 — No entry into authorisation Annex XIV.

Option 2 — Application of Authorisation for lead to all usages

Option 3 — Delay until new REACH is adopted

Option 4 — Exemption as per Article 58(2) of REACH *)

POTENTIAL OUTCOMES

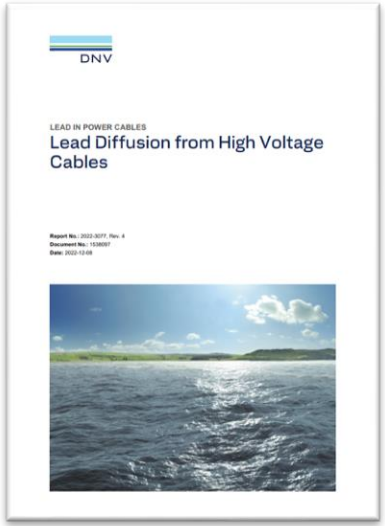
No more manufacturing and installation of power cables with internal lead sheathing possible from 2028.

In principle not allowed to repair power cables with internal lead sheathing from 2028

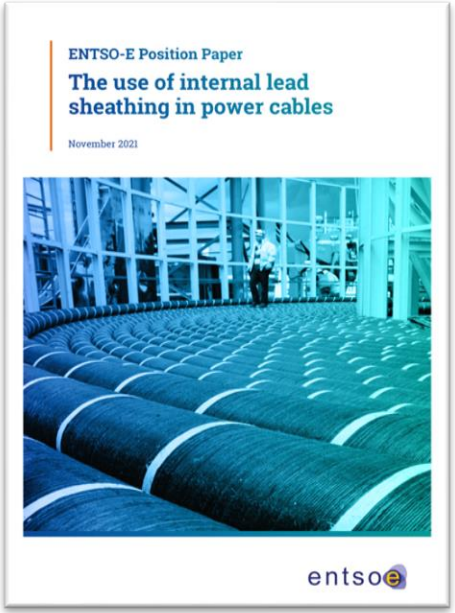
*) uses or categories of uses may be exempted from the authorisation requirement – provided different certainties

REACH *Registration, Evaluation, Authorisation and Restriction of Chemicals*
EC *European Commission*
ECHA *European Chemicals Agency*
SVHC *Substances of Very High Concern*

SUSTAIN THE SUSTAINABILITY



No lead diffusion detectable through PE sheath on cables in service since many years



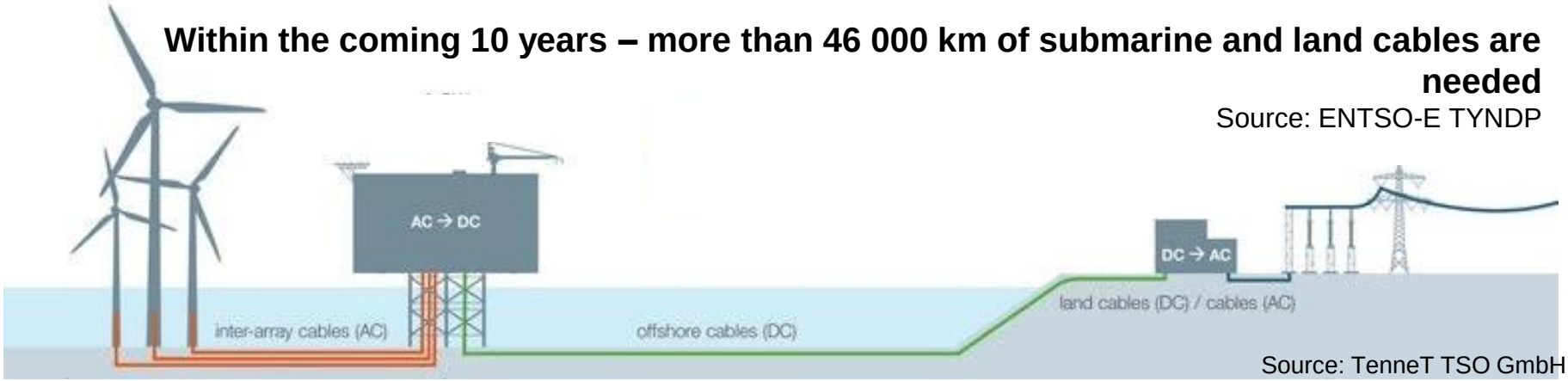
Alternatives to lead not yet available for many power cables applications

ENTSO-E and Europacable recommend granting usage of internal lead sheathing in power cables until alternatives exists

CABLES ARE NEEDED TO ENABLE ENERGY TRANSITION

Within the coming 10 years – more than 46 000 km of submarine and land cables are needed

Source: ENTSO-E TYNDP



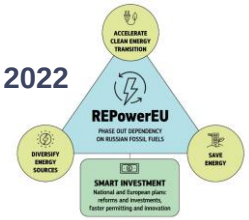
Source: TenneT TSO GmbH

A large amount of power cables with internal lead sheathing are necessary today to deliver on the upcoming needs

GREEN DEAL

December 2019

May 2022



European Commission

Net Zero Industry Act 16th of March 2023

Oostende Declaration 24th of April 2023

Thank you

Credits: Europacable, Entso-E, Carl Erik Hillesund (Statnett)

Expert talk

Cradle to cradle approaches to sovereignty

Prof. Dr. Michael Braungart

"To compensate for the down-cycling loss of non-ferrous metals, we would need many more meteorite impacts on earth."

Expert talk 5

The big challenge for research, industry and society

Dr. Paula Kivimaa

“Just transitions are complex, because they involve value judgements.”

Moving towards a new climate-energy-security nexus

Paula Kivimaa, Research Professor

Policies and Risks Group, Climate Solutions Unit, SYKE

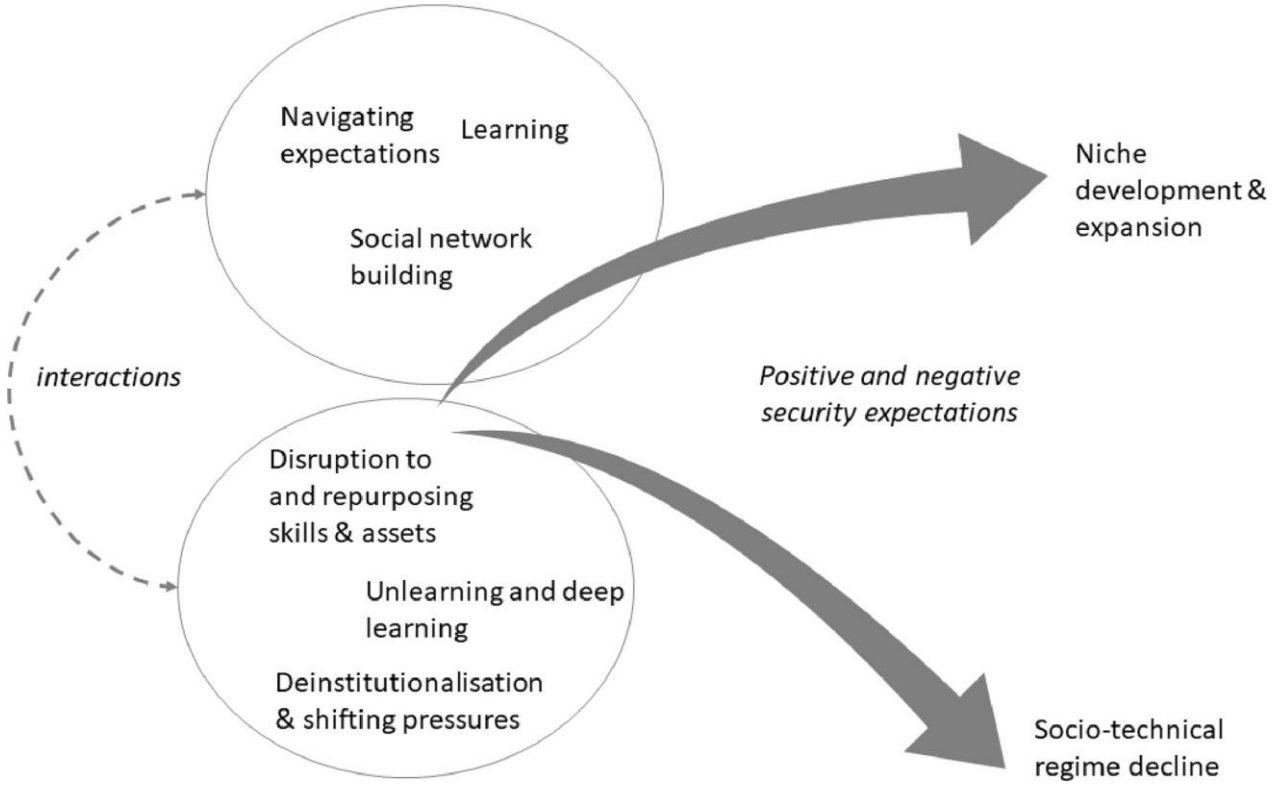
Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

Climate security & zero-carbon energy transitions are connected

- Contribution to future climate security
- Resilience of critical infrastructure
- Effects on trade and supply chains
- Combined pressure on land use

Security implications of zero-carbon energy transitions are complex and interlinked

- **Negative security**: Focus on threats and security from the appearance of threats (Gjorv, 2012)
- **Positive security**: Freedom from insecurity, emancipation and enabling communities (Booth, 2007; Gjorv, 2012; Gjorv & Bilgic 2022)
- Security developments intertwine with questions of national defence, global security and justice, and local and regional developments



Kivimaa & Sivonen, 2023 *Environmental Innovation and Societal Transitions* (journal)

Security implications of energy transitions

- Impacts of large-scale transformations to global power balance & stability (geopolitics)
- From old to new dependencies (security of supply of critical materials & technological components)
- Decentralisation likely to lead to smaller disruption in electricity systems but intermittency increases price variation
- Cross-European grid communities
- Positive impacts on peace building and local communities
- Perceptions of justice, polarisation of views, populism – impact on local & global stability
- Tensions and conflicts related to land use (environmental effects)
- Increased digitalisation and cyber security

Photo: http://www.industriall-union.org/

Photo: elonkapina.fi

From stockpiling fossil fuels to new kind of energy security?

Infrastructure

Institutions and agreements

Business models

International grid connections

International energy collaboration

Tight public-private collaboration

Distributed smart grids

Electricity storage

Preparing for disturbances

Demand response

How to integrate broader questions of environmental protection, biodiversity loss and climate change?

Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

Conclusions

- Climate change, and its cascading effects will radically change the operational environment
- Energy transition disrupts existing practices but create new solutions for improved security

- **Solutions needed**
- Technical advancements in energy storage, demand response and energy efficiency
- Tightening public-private collaborations (including social innovations in energy production and use)
- Increasing systemic and transformative thinking (also how different systems intertwine)
- Taking into account positive security (exploration on how to increase resilience)
- Institutional change and experimentation (e.g. policy experiments)
- Defence forces' and militaries' increasing attention on climate security (new RTD on alternative fuels and early warning systems)

Understanding the challenge

3

Co-funded by the European Union

Session overview

Vanilla Flow
Dr. Stefan Spirk, Vanilla Flow, Technical University Graz

Heat pads for the wall
Dr. Felix Marske, Nanolope

Galeries to Calories
Hester Clardige, TownRock Energy

Heatstore for electricity
Dorien Dinkelman, TNO Energy Transition

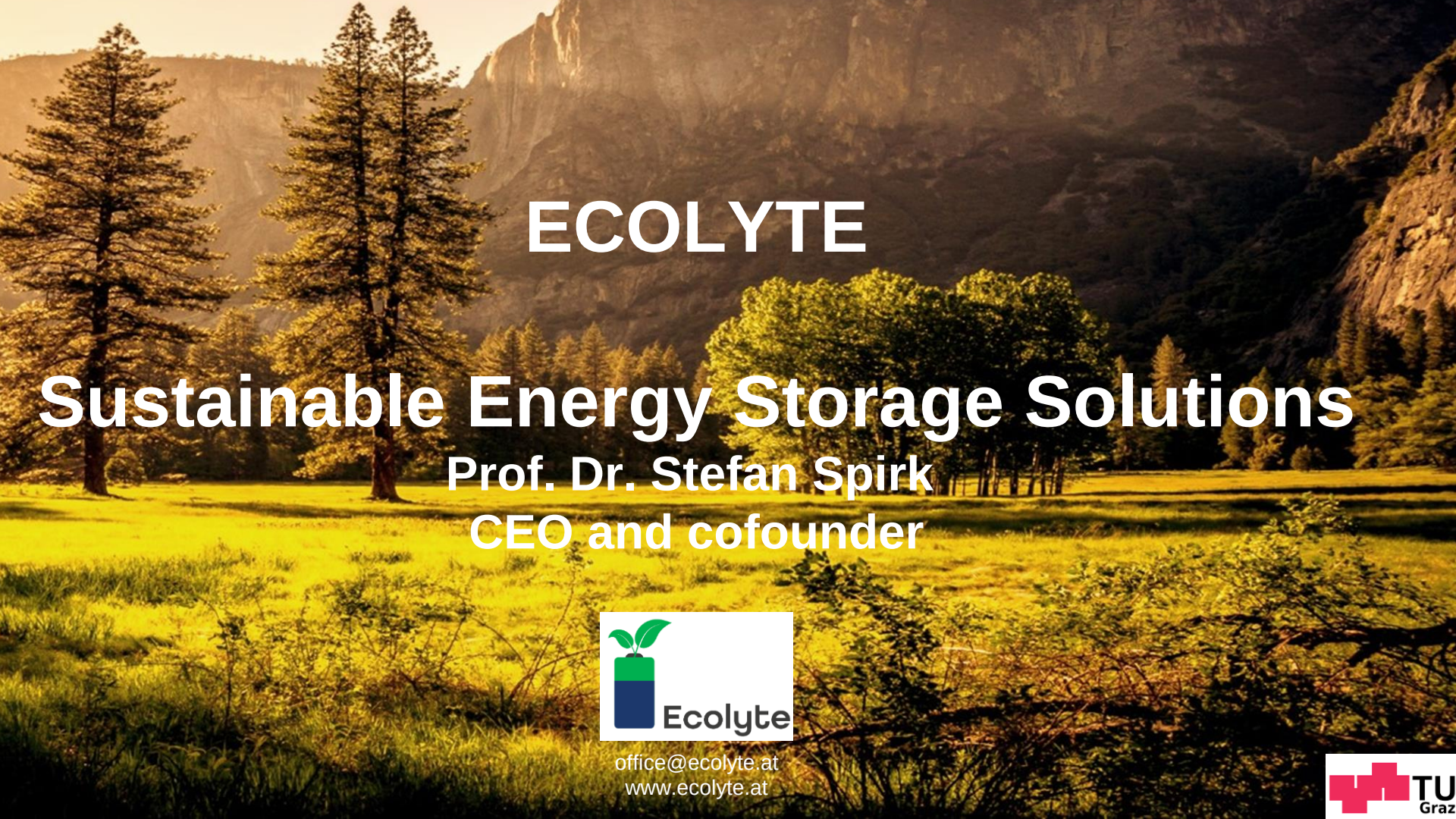
Systematics for systems
Bruno Cova, CESI

Expert presentation

Vanilla Flow

Prof. Dr. Stefan Spirk

CEO & Founder of Ecolyte GmbH



ECOLYTE

Sustainable Energy Storage Solutions

Prof. Dr. Stefan Spirk
CEO and cofounder

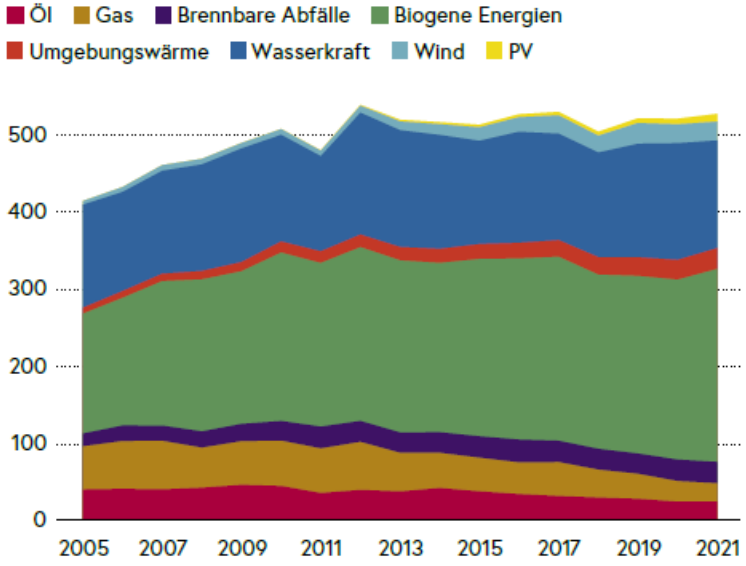
Ecolyte

office@ecolyte.at
www.ecolyte.at

TU Graz

Grand challenge - sustainable electricity supply (case Austria)

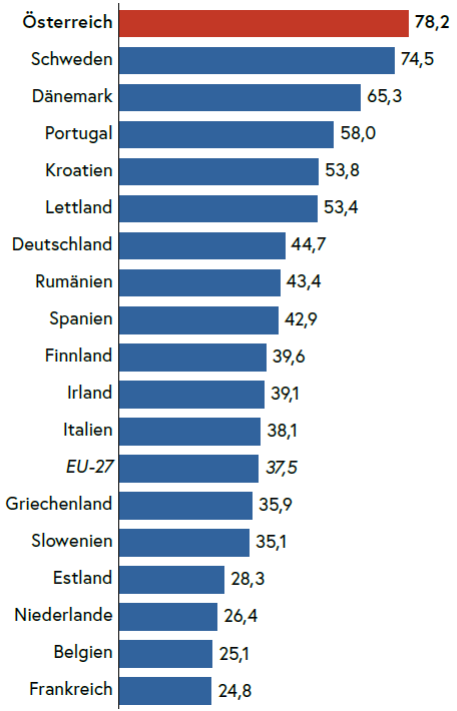
Abb. 10: Inländische Primärenergieerzeugung
nach Energieträgern in Petajoule 2005–2021



Wachstum und Rückgang
der Energieträger

p.a. 2005–2021		2020–2021
+35,8 %	PV	+37,5 %
+10,7 %	Wind	-0,8 %
+8,1 %	Umgebungswärme	+5,5 %
+3,0 %	Biogene Energien	+7,3 %
+0,3 %	Wasserkraft	-7,7 %
+3,2 %	Brennbare Abfälle	-0,9 %
-5,2 %	Gas	-10,4 %
-3,1 %	Öl	-0,1 %

+1,5 % p. a.
Gesamterzeugung 2005–2021

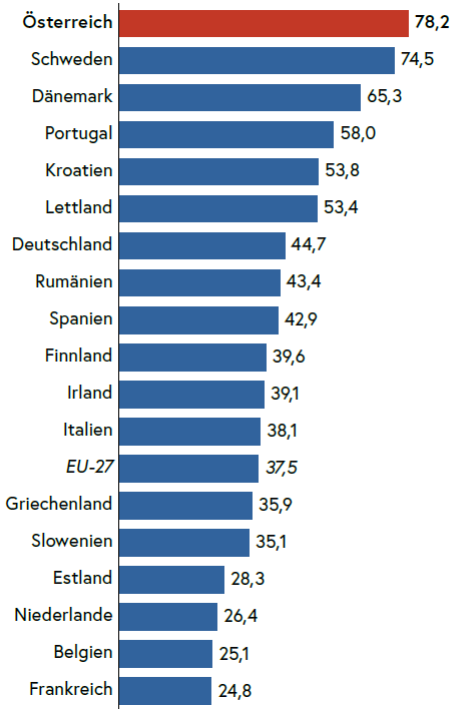


Goal: 100% renewable by 2030

Source: Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology & EUROSTAT, 03/2022

Grand challenge - sustainable electricity supply (case Austria)

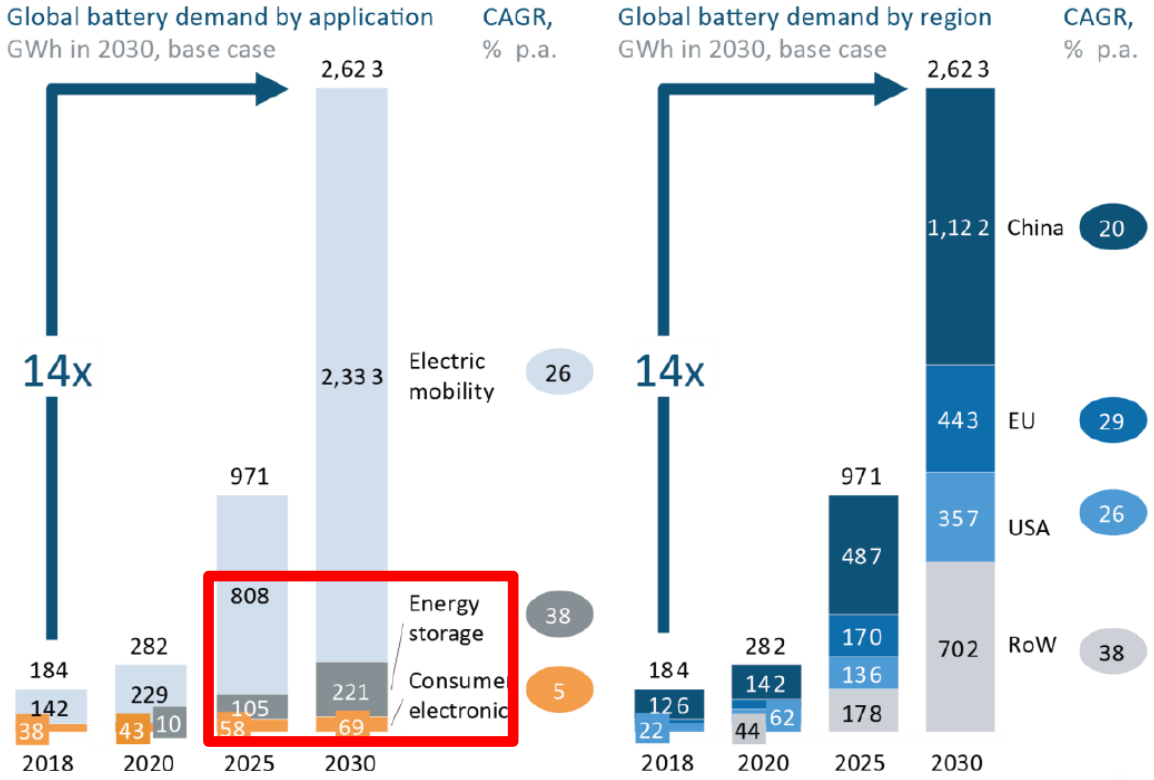
- Backup storage is highly needed
- New hydropower plants not available in mid-term
- Back-up plants based on coal, nuclear and gas
- Energy storage (physical, mechanical, chemical)



Stationary energy storage technologies

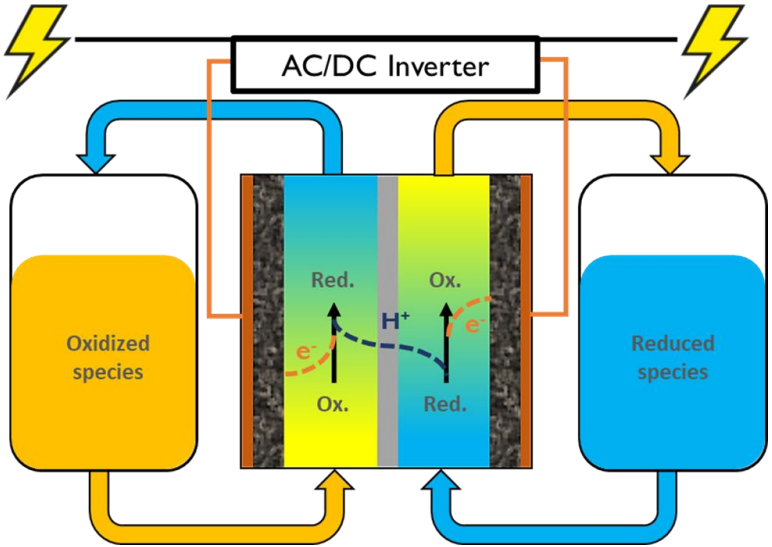
Source: Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology & EUROSTAT, 03/2022

Expected battery storage capacity by 2030



Source: Batteries Europe, European Commission, 2018

Assets of flow battery technology



Advantages:

| Independent design of power & storage capacity
| Easy scalability to MW regime
| No self discharge
| No capacity fading during cycling
| Long lifetime (20 years+)
| Long discharge times (4-8 h)

Current technology:

Vanadium flow battery (90%)
Toxic, non available, expensive, non-renewable, transport,

→**critical raw material**

Philosophy and vision

- We need regional renewable materials to store renewable energy
- New regional value chains, less CO_2 emissions, new opportunities
- Reduce dependencies on politically instable regions while securing electricity supply

Patented ecolyte Technology

Lignin

Vanillin

|>ecolyte

Patent #1 checked and filed (PCT), Topic: electrolyte stabilization

Patent#2 checked and on hold
Topic: continuous process for electrolyte production (competitive advantage)

Patent#3 filed (EP)
Topic: paper based membranes for flow batteries

| Green chemistry

| Tailor-made continuous flow reactors

| Regionally available and renewable

| Safe handling and recycling

| Compatible with current battery technology

Challenges in sustainable vanillin production

Only a single company produces vanillin from lignosulfonate (Borregard, ca 15,000 tons/year)
Disadvantage: Copper catalysts, low yields, old process, lignosulfonate minor lignin source
Biotechnological approaches (expensive, ca 500 t/year)

Kraft lignin/black liquor as source – no commercial suppliers
Many reports in scientific literature, mostly in **small scale** (grams)

Challenge:

- **Scale-up** and process development, investments of large
- **‚Valley of death‘** (too early to be convincing to industry, too advanced for basic research)
- In LignoFracStore (FFG), **kg scale** but follow up project will be difficult
- **Need for programs** bridging the gaps also in process developments

THANK YOU

Ecolyte Team

D. Wickenhauser
Bernhard Marius
Alexander Hutter
Reyhan Yagmur
Georg Rudelstorfer
Werner Schlemmer
Dieter Wurm
Wolfgang Zitz

TU Graz BPTI

M. Anzengruber
A. Kaufmann
Elias Klein
Janine Maier
Lukas Pachernegg
Jana Schaubeder
Julian Selinger
Alexa Scheer

TU Graz

W. Bauer
Anna Colite
U. Hirn
Roman Kern
M. Kienberger
Susanne Lux
Robert Peharz
M. Siebenhofer
G. Trimmel

Slido Poll 1

Would you prefer to see vanilla in…