

FRDO/CFDD, Seminar Metals and Transition
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Metals for Clean Energy:

Pathways to solving Europe's raw materials challenge

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The energy transition is a commodities transition

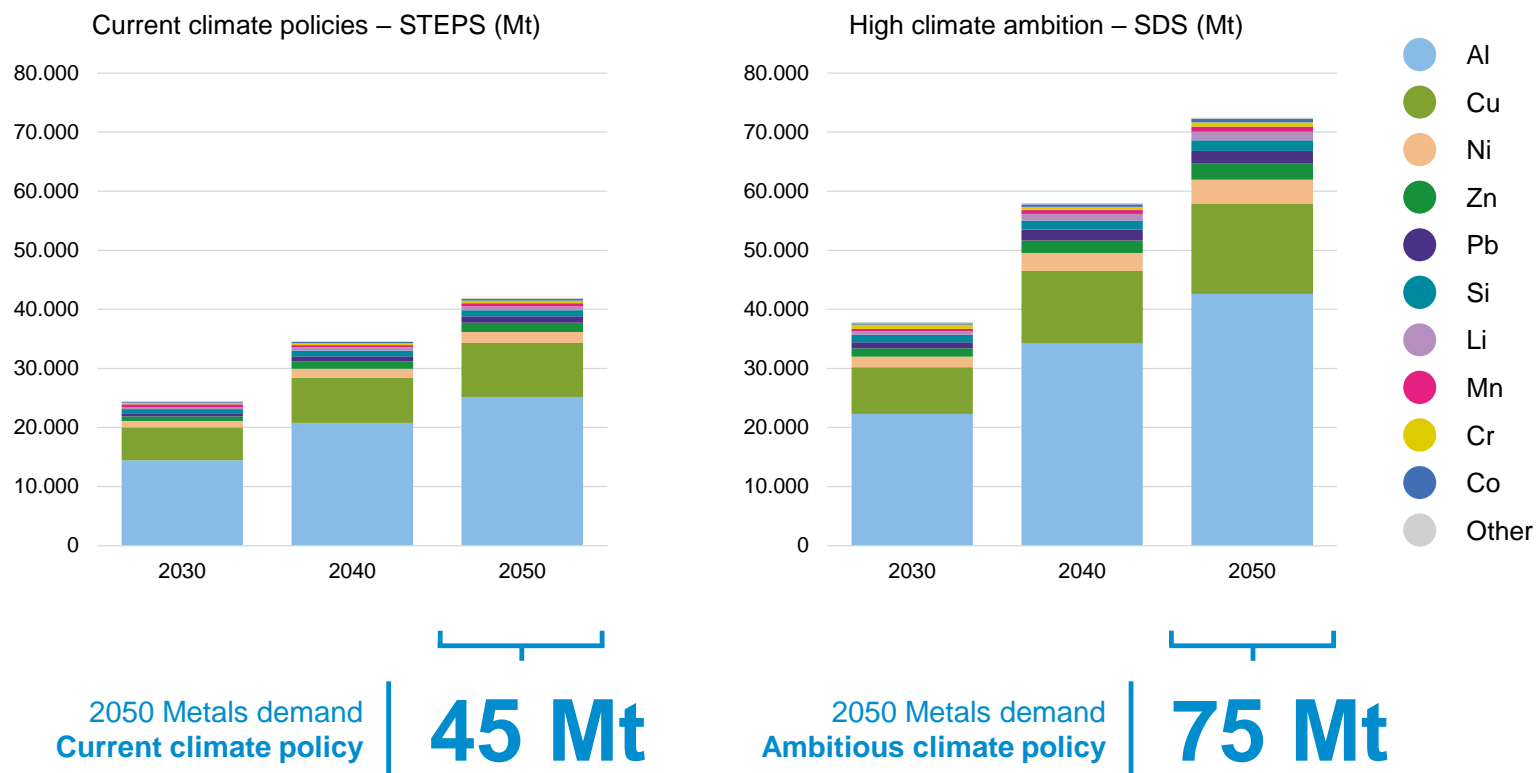
Fact

The faster the world decarbonises, the higher its metals requirements

Question

By how much?

Total metal demand by commodity in a STEPS and SDS scenario respectively (Mt)



New clean energy demand will transform several global metals markets

Fact

All based on metals:
Batteries, Electric
Cars, Solar Panels,
Wind Turbines,
Hydrogen

Question

How will global demand
for metals shift?

% metal required in 2050 for clean energy technologies
vs. 2020 overall use (SDS ambitious climate scenario).

| | | | | |
|------------------------|-------|----------------------|-----|---|
| Li Lithium | 2109% | Si Silicon | 62% | Aluminium Copper Zinc Silicon |
| Dy Dysprosium | 433% | Tb Terbium | 62% | |
| Co Cobalt | 403% | Cu Copper | 51% | |
| Te Tellurium | 277% | Al Aluminium | 43% | |
| Sc Scandium | 204% | Sn Tin | 28% | Lithium Nickel Cobalt |
| Ni Nickel | 168% | Ge Germanium | 24% | |
| Pr Praseodymium | 110% | Mo Molybdenum | 22% | |
| Ga Gallium | 77% | Pb Lead | 22% | |
| Nd Neodymium | 66% | In Indium | 17% | Dysprosium Neodymium Praseodymium |
| Pt Platinum | 64% | Zn Zinc | 14% | |
| Ir Iridium | 63% | Ag Silver | 10% | |

What about demand in Europe?

Until now,
batteries, solar
panels,
magnets have
been built
elsewhere...



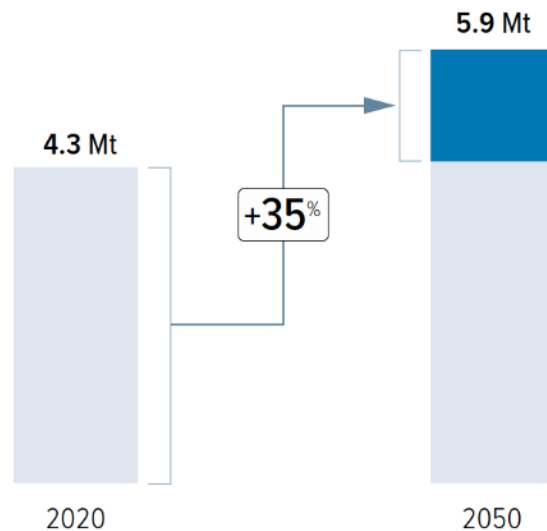
...But Europe
has concrete
industrial plans
to build its own
technologies



Demand increase (Europe)

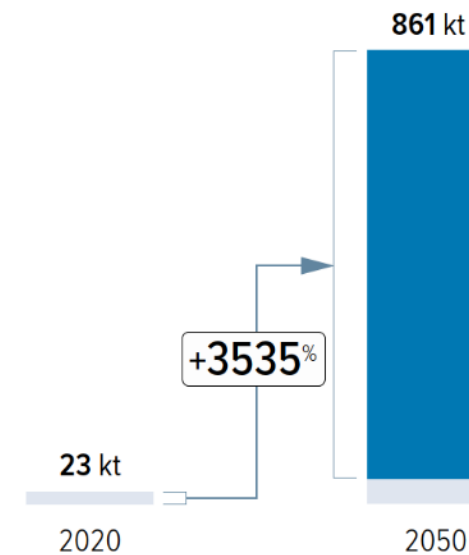
● Energy transition uses ● Other uses

Copper (Mt)



Top transition uses: EVs Electricity networks Wind

Lithium (kt, LCE)



Top transition uses (all battery metals): EVs Battery storage

Europe must replace its problematic fossil fuels dependency with a secure and responsible metals supply

Challenge 1

Without urgent action now, Europe's ability to secure the right level of strategic autonomy for energy transition metals beyond 2030 is at risk

Challenge 2

Meeting the energy transition's metals demand only with increased imports from lower regulatory regimes and uncertain partners isn't compatible with the EU's Green Deal sustainability values

Question

How can Europe bridge this real supply gap?

Bridging Europe's energy transition metals supply gap

STARTING POINT

NOW

- Acceleration of clean energy transition
- Aim to improve strategic autonomy for energy

END POINT

2050

- Clean energy system with higher level of strategic autonomy & right level of sustainability



Five necessary pillars for Europe's metals & clean energy bridge

STARTING
POINT

NOW

- Acceleration of clean energy transition
- Aim to improve strategic autonomy for energy

STRONGEST IMPACT: NOW → 2040

PILLAR 1

Fulfil domestic mining potential

PILLAR 2

Maintain and increase domestic refining output

PILLAR 3

Secure sustainable imports from reliable partners

2035 ONWARDS

PILLAR 4

Maximise recycling, including new streams

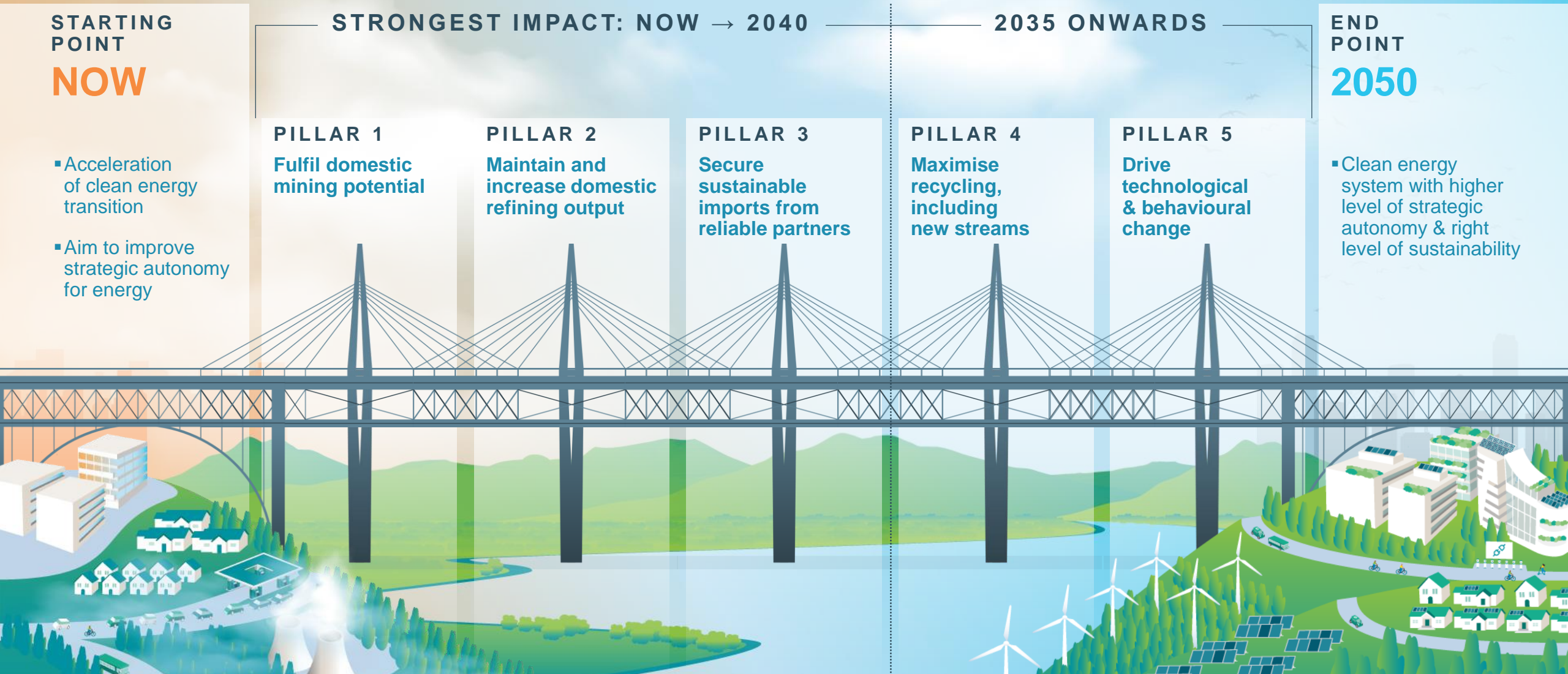
PILLAR 5

Drive technological & behavioural change

END
POINT

2050

- Clean energy system with higher level of strategic autonomy & right level of sustainability



New primary supply is needed between now and 2035

STRONGEST IMPACTS → 2040

PILLAR 1

Fulfilling
domestic mining
potential

PILLAR 2

Maintain and
increase domestic
refining output

PILLAR 3

Securing
sustainable
imports from
reliable partners

Early stages of energy
transition

Primary metals needed
for new technologies



Will be available for
recycling in 15 years

Pillar 1: Fulfil domestic mining potential

STARTING
POINT

NOW

- Acceleration of clean energy transition
- Aim to improve strategic autonomy for energy

PILLAR 1

**Fulfilling
domestic mining
potential**

END
POINT

2050

- Clean energy system with higher level of strategic autonomy & right level of sustainability



Europe has high ambitions for mining new energy commodities

Mature markets struggle to keep up with depletion (1/2)

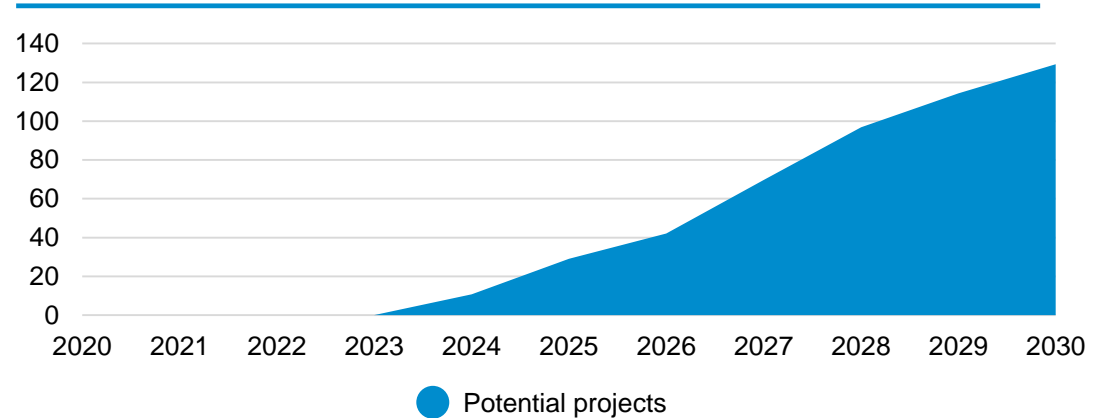
New energy commodities

Lithium, rare earth elements

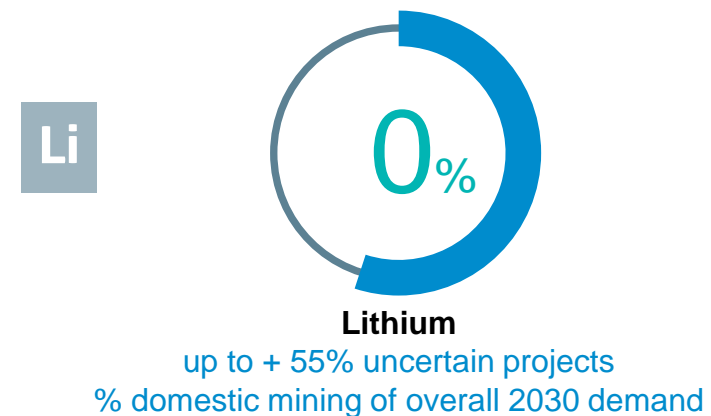
- Large project pipelines, but with a high level of uncertainty
- Potential for up to 55% (lithium) and 80% (dysprosium) self-sufficiency rates by 2030*

European mining projects have several challenges: local opposition, challenging economics, permitting, untested technologies

European mine output (kt)



European self-sufficiency rate



Europe has high ambitions for mining new energy commodities

Mature markets struggle to keep up with depletion (2/2)

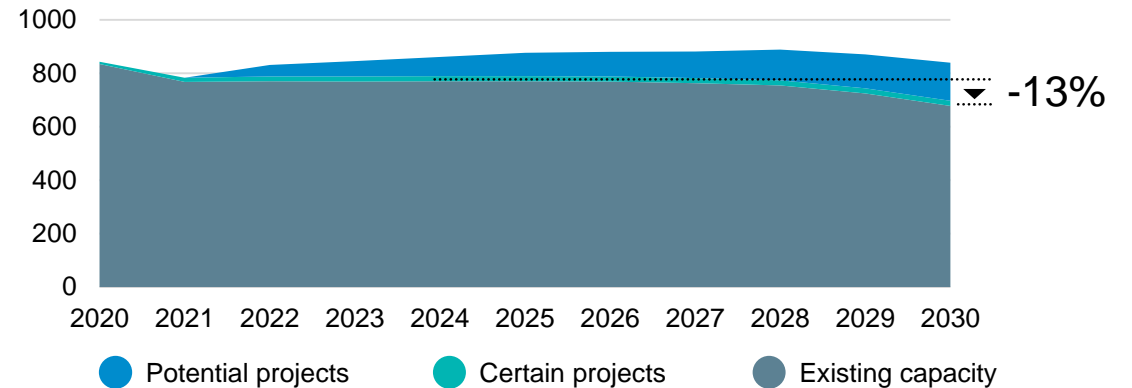
Mature markets

Copper, nickel, cobalt, zinc

- Thinner project pipelines, with mixed certainty
- Limited 2030 self-sufficiency rate (4-25%)
- Depletion ranges from 0% to 19%

Mining projects have several challenges: local opposition, challenging economics, permitting, untested technologies

European mine output



European self-sufficiency rate



Pillar 1: Fulfil domestic mining potential

STARTING
POINT

NOW

- Acceleration of clean energy transition
- Aim to improve strategic autonomy for energy

PILLAR 1

Fulfilling domestic mining potential

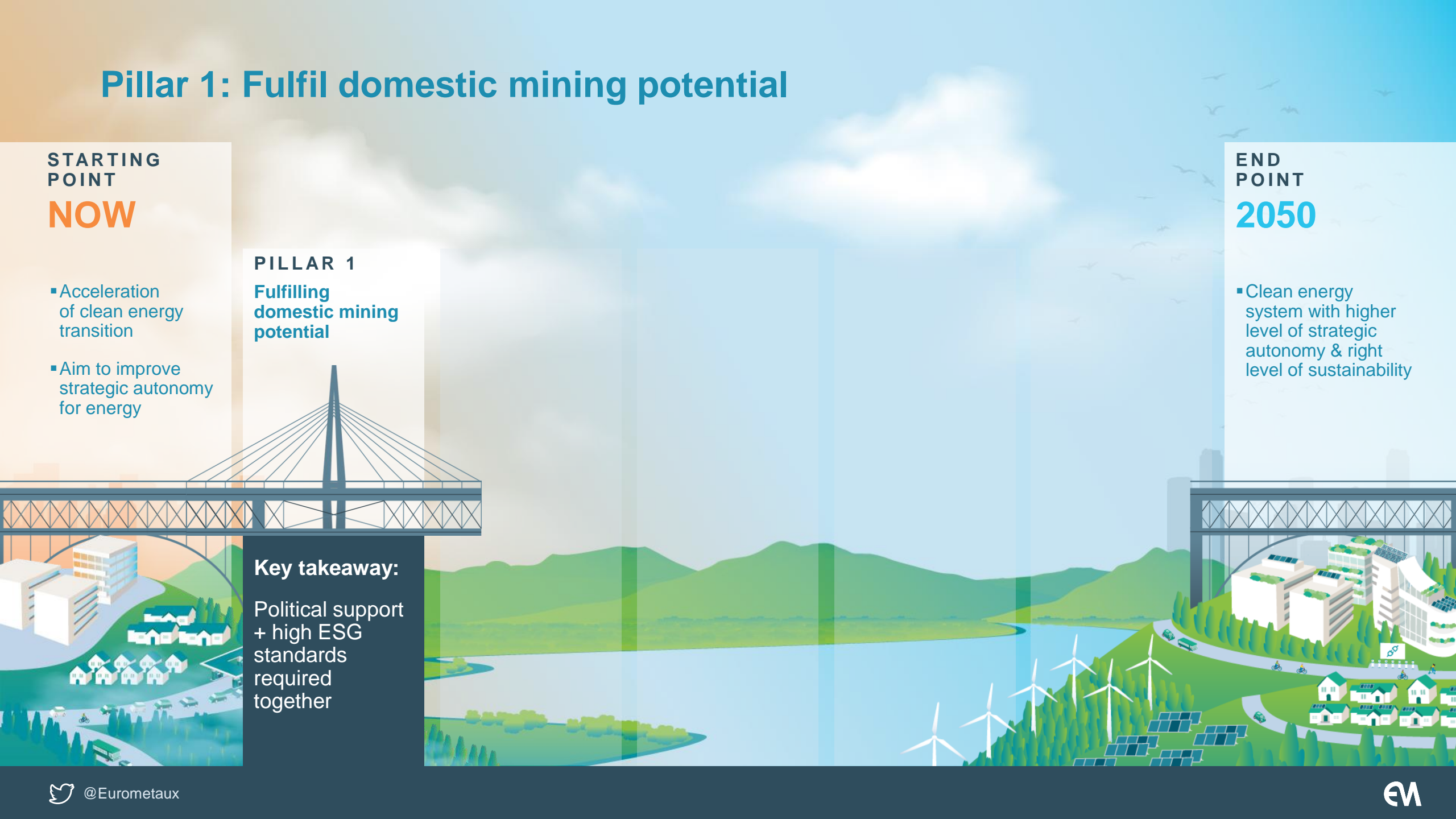
Key takeaway:

Political support
+ high ESG
standards
required
together

END
POINT

2050

- Clean energy system with higher level of strategic autonomy & right level of sustainability



Pillar 2: Maintain and increase domestic refining output

STARTING
POINT

NOW

- Acceleration of clean energy transition
- Aim to improve strategic autonomy for energy

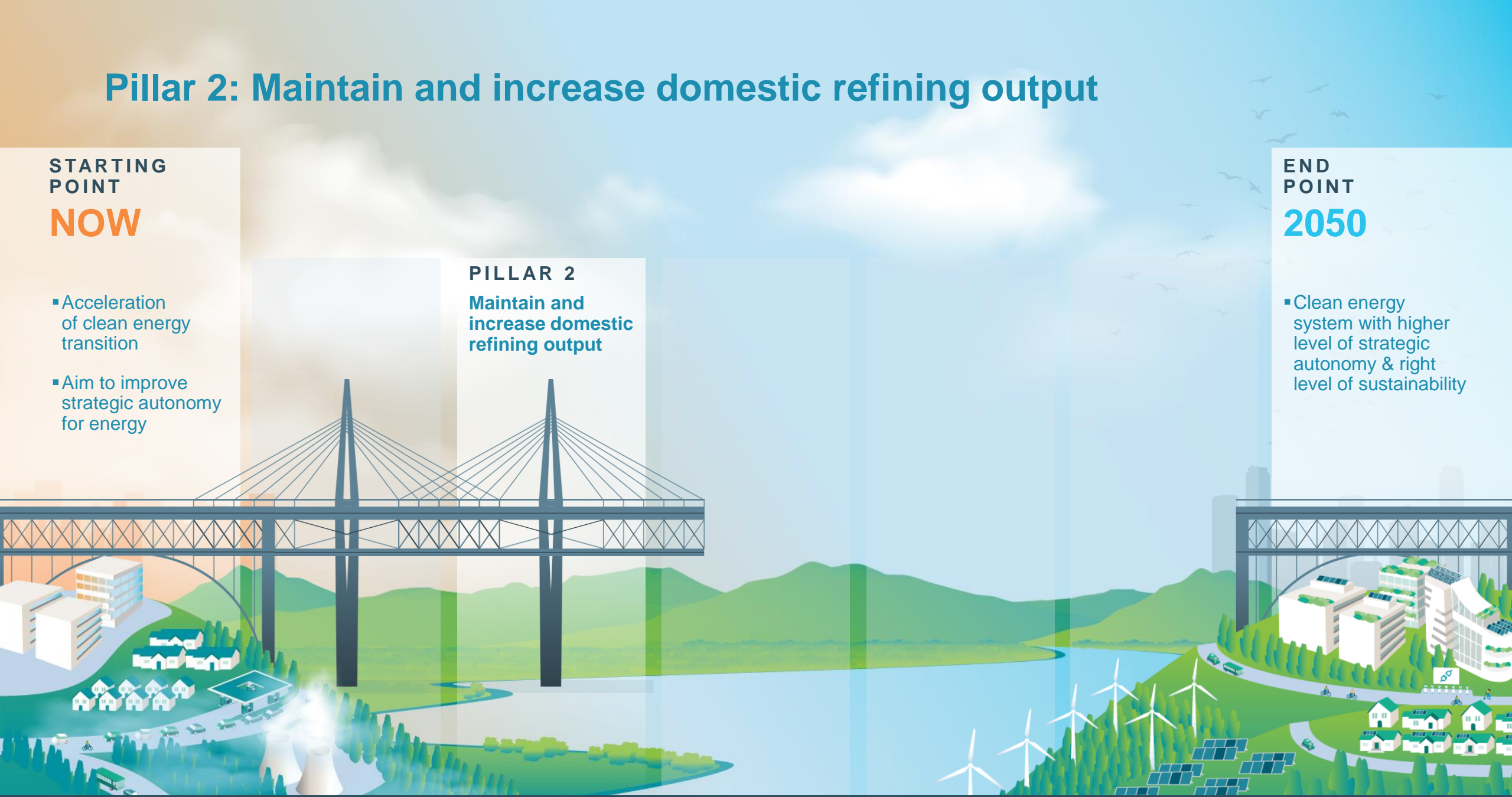
PILLAR 2

Maintain and increase domestic refining output

END
POINT

2050

- Clean energy system with higher level of strategic autonomy & right level of sustainability



European smelting and refining operations are struggling

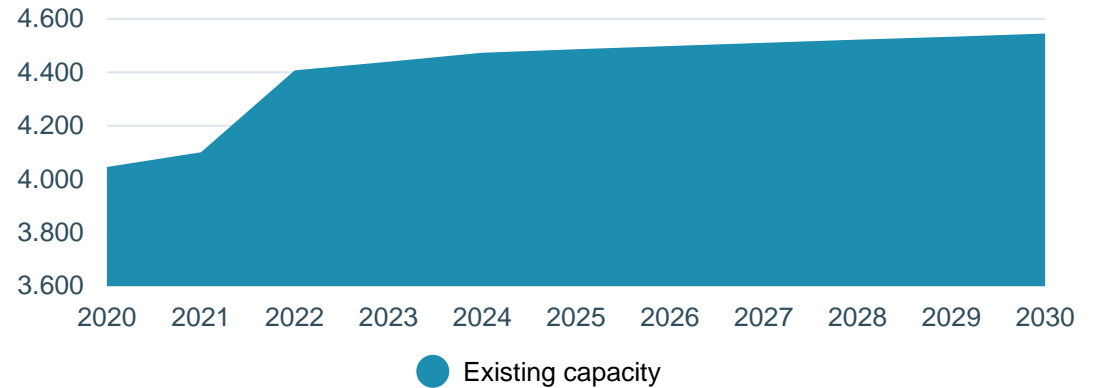
There are no real growth prospects, only few exceptions

Struggling markets

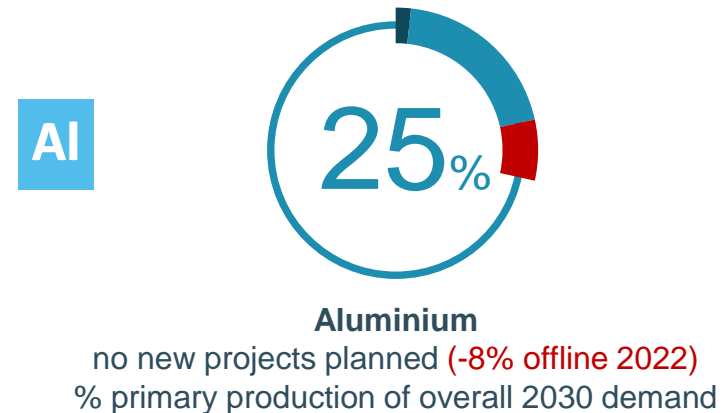
Aluminium, zinc, silicon

- High energy prices have big impact on power intensive smelters, leading to temporary closures (10-40%)
- Low-cost and subsidized imports, leading to trade defence measures

European metal outlook



European self-sufficiency rate



Impact on environment

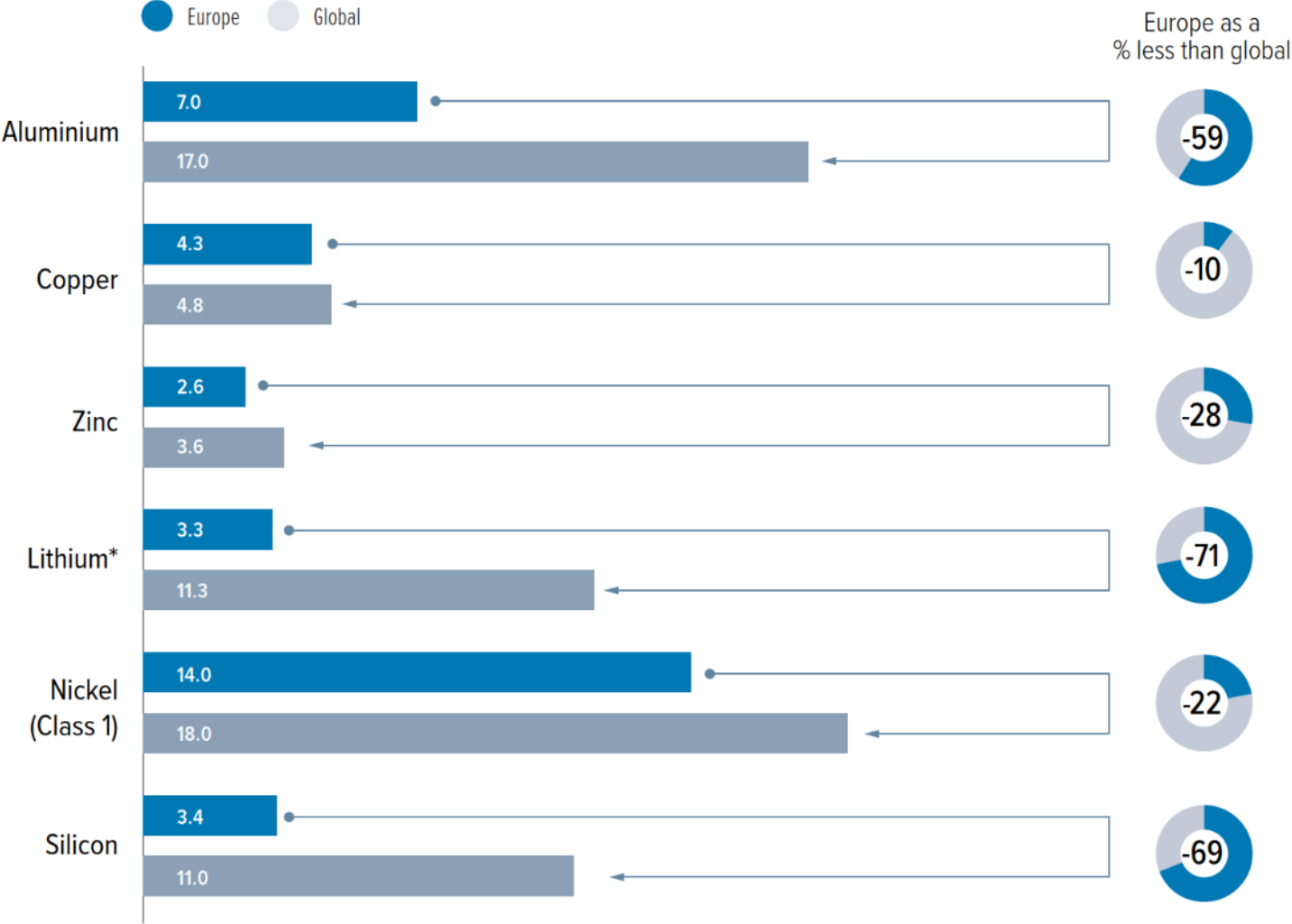


Figure 176. CO₂ footprint for primary metal production, European values vs global average (European values are defined by combining the carbon footprint of domestic mining and domestic metal/chemical making)

Pillar 2: Maintain and increase domestic refining output

STARTING
POINT

NOW

- Acceleration of clean energy transition
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PILLAR 2

Maintain and increase domestic refining output

Key takeaway:

New capacity will require stronger business conditions

END
POINT

2050

- Clean energy system with higher level of strategic autonomy & right level of sustainability

Pillar 3: Secure sustainable imports from reliable partners

STARTING
POINT

NOW

- Acceleration of clean energy transition
- Aim to improve strategic autonomy for energy

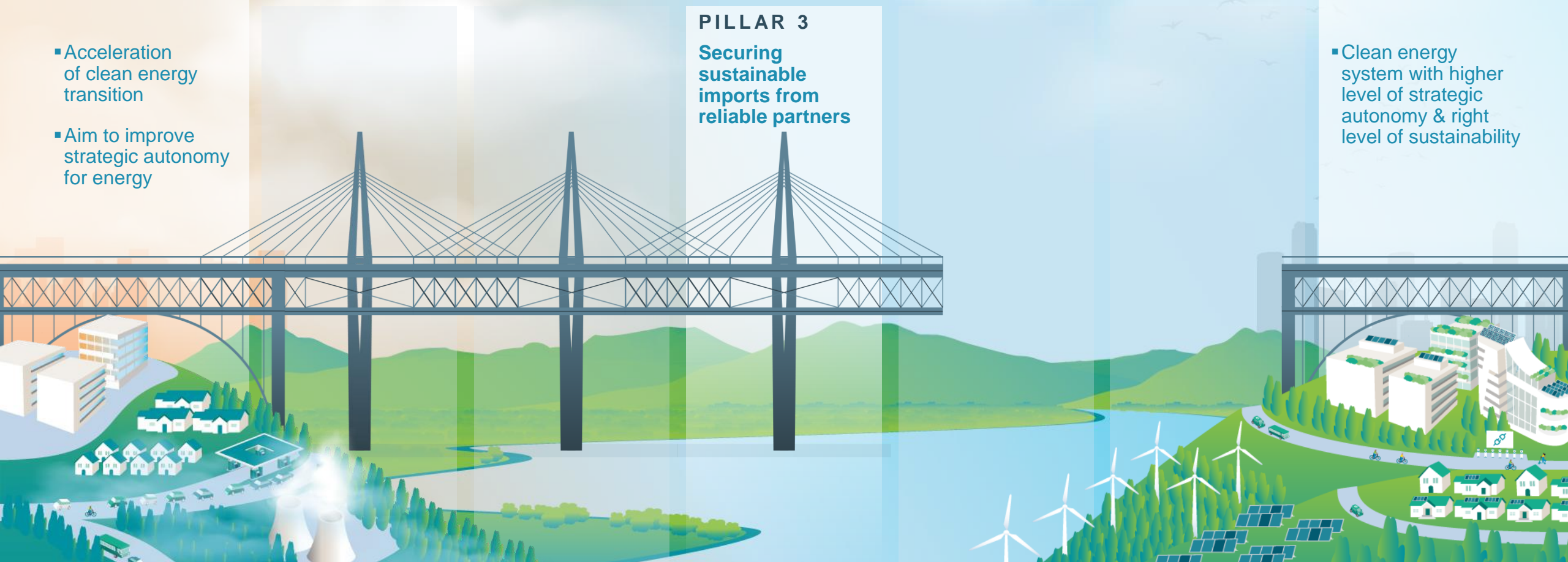
PILLAR 3

**Securing
sustainable
imports from
reliable partners**

END
POINT

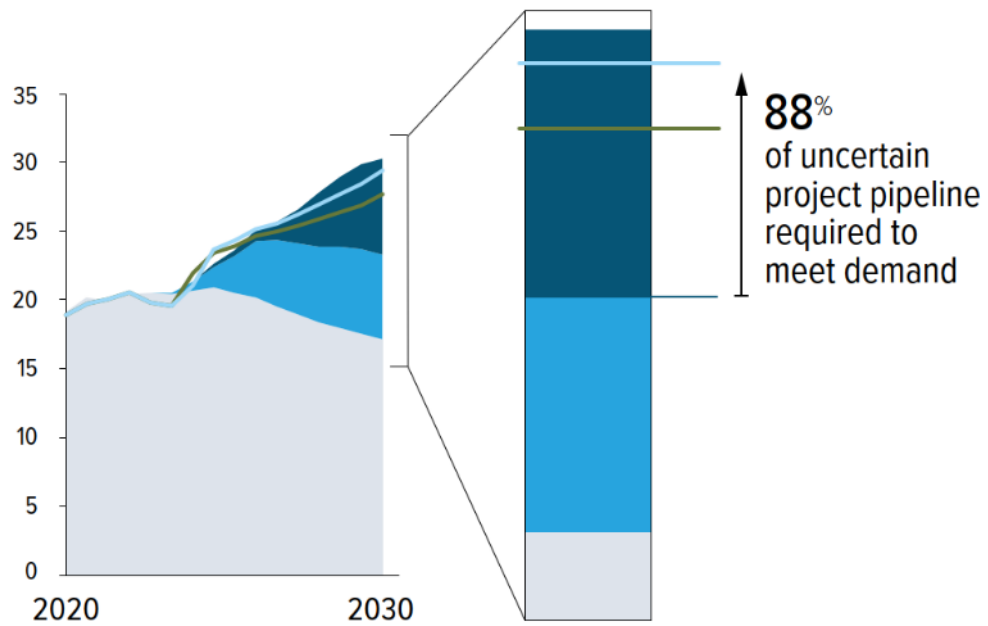
2050

- Clean energy system with higher level of strategic autonomy & right level of sustainability

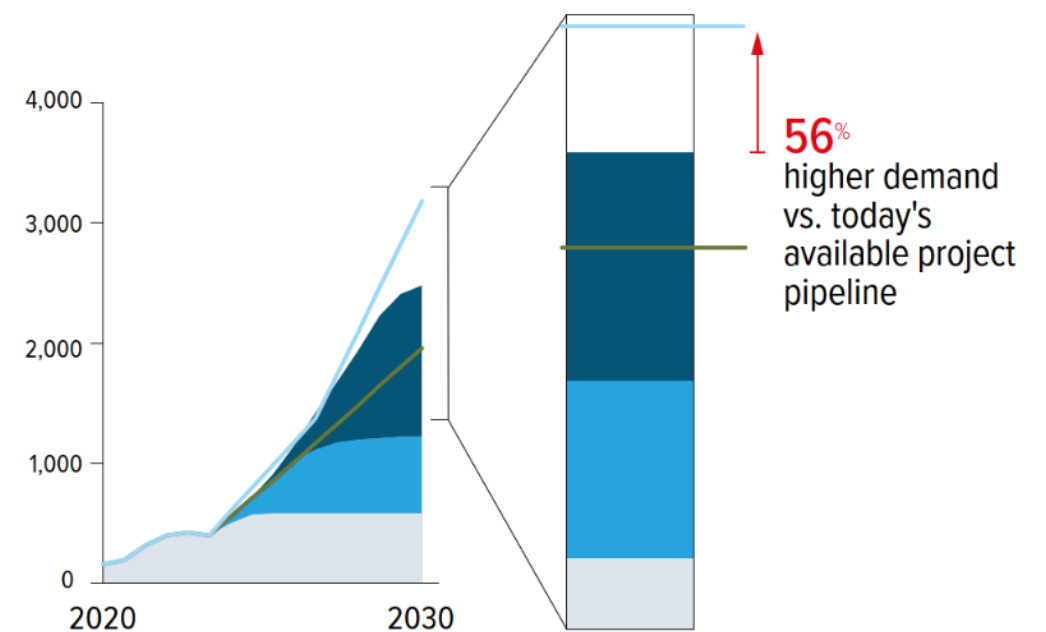


Does (projected) supply match the demand (globally)?

Global copper demand-supply outlook (Mt)



Global lithium demand-supply outlook (kt, LCE)



● Operating mines ● Likely additions ● Uncertain additions — Current climate policies — Ambitious climate policies

Relying on import?

-  Share of import dependency (ore and/or metal). The colour indicates the global market tightness.
-  Not enough projects announced to meet demand
-  Base case supply insufficient, project pipeline sufficient. Innovation and investments needed
-  No issues expected, supply potential sufficient

Very strong import dependency (short term)

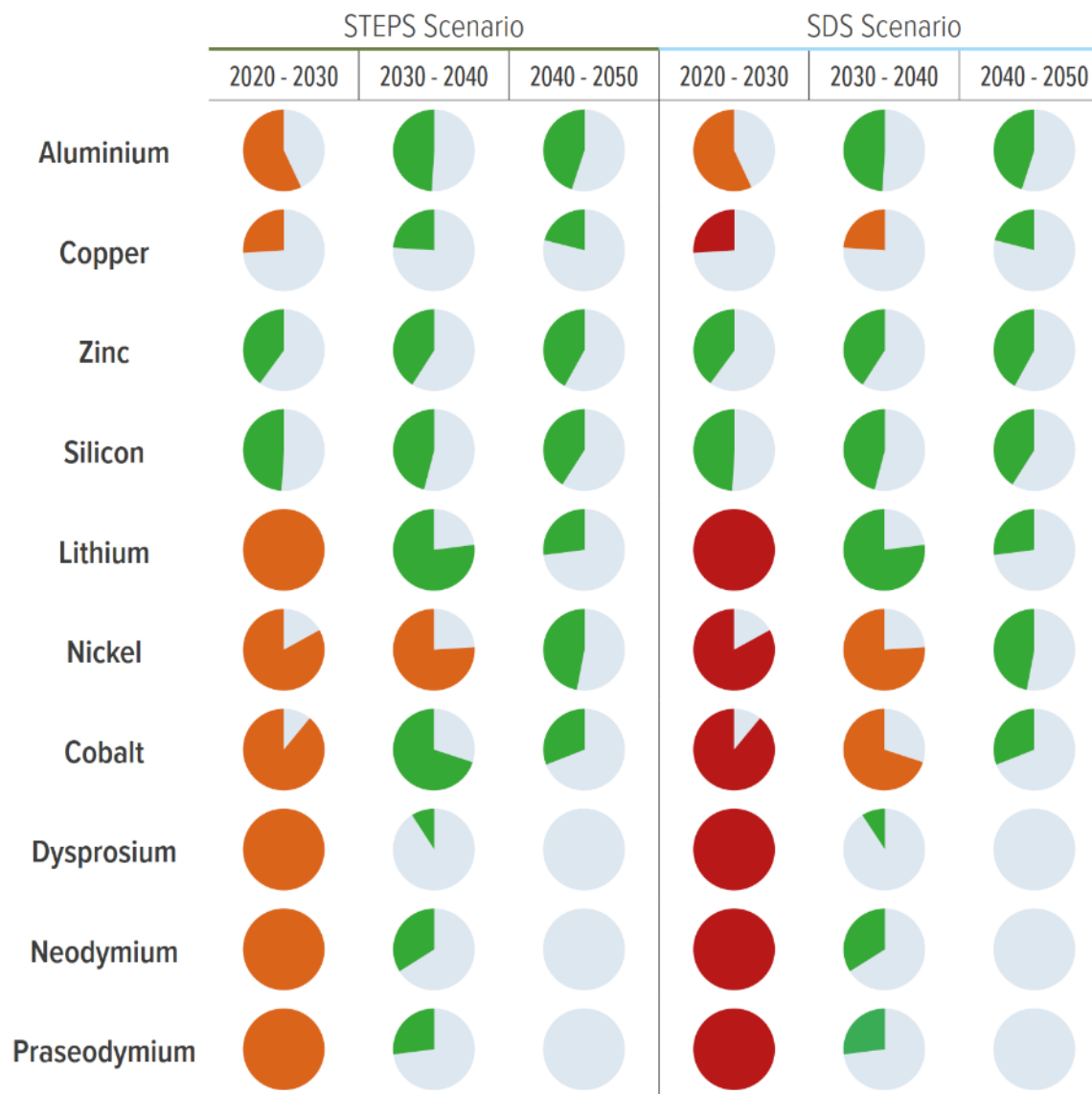


Figure 117. European expected import rates compared to expected global market supply-demand situation

Geopolitics...

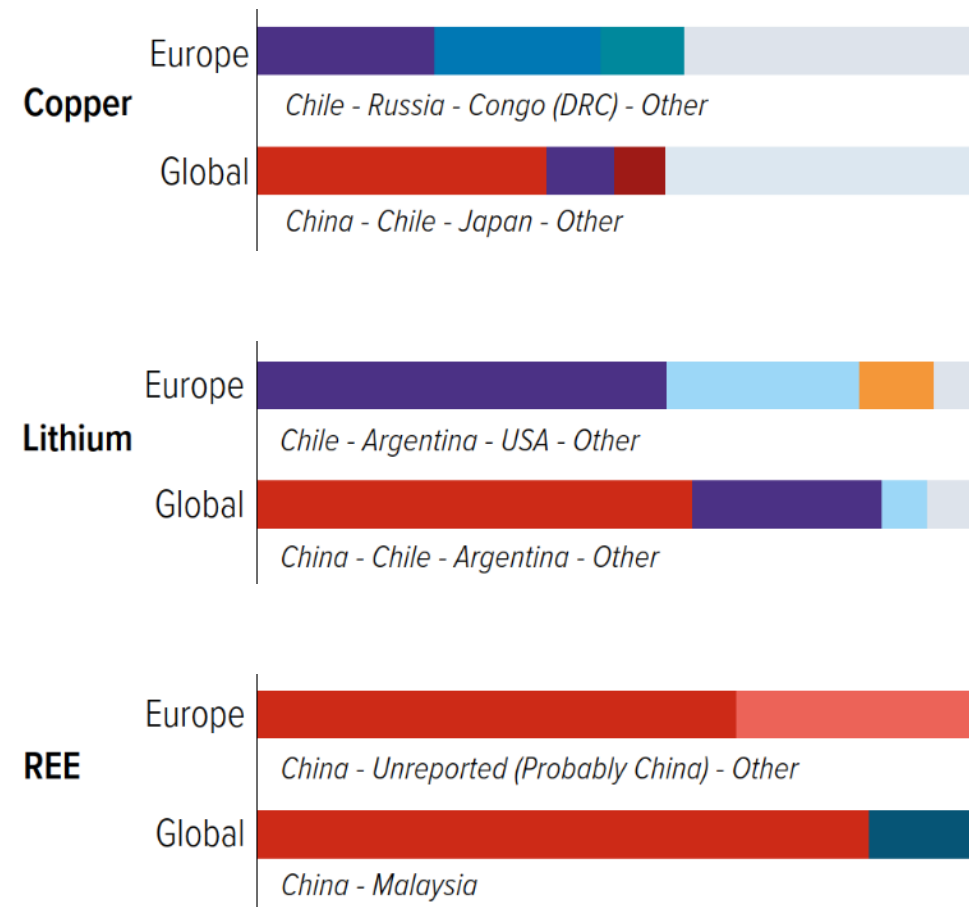
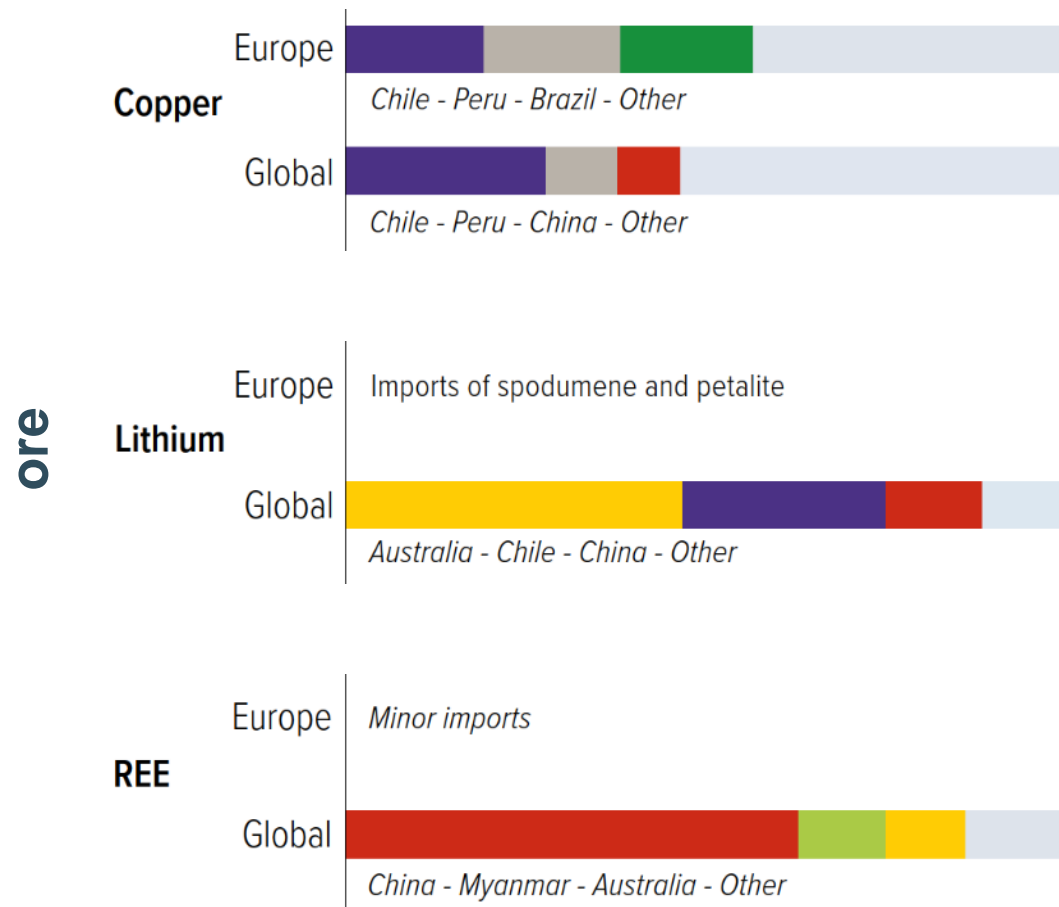
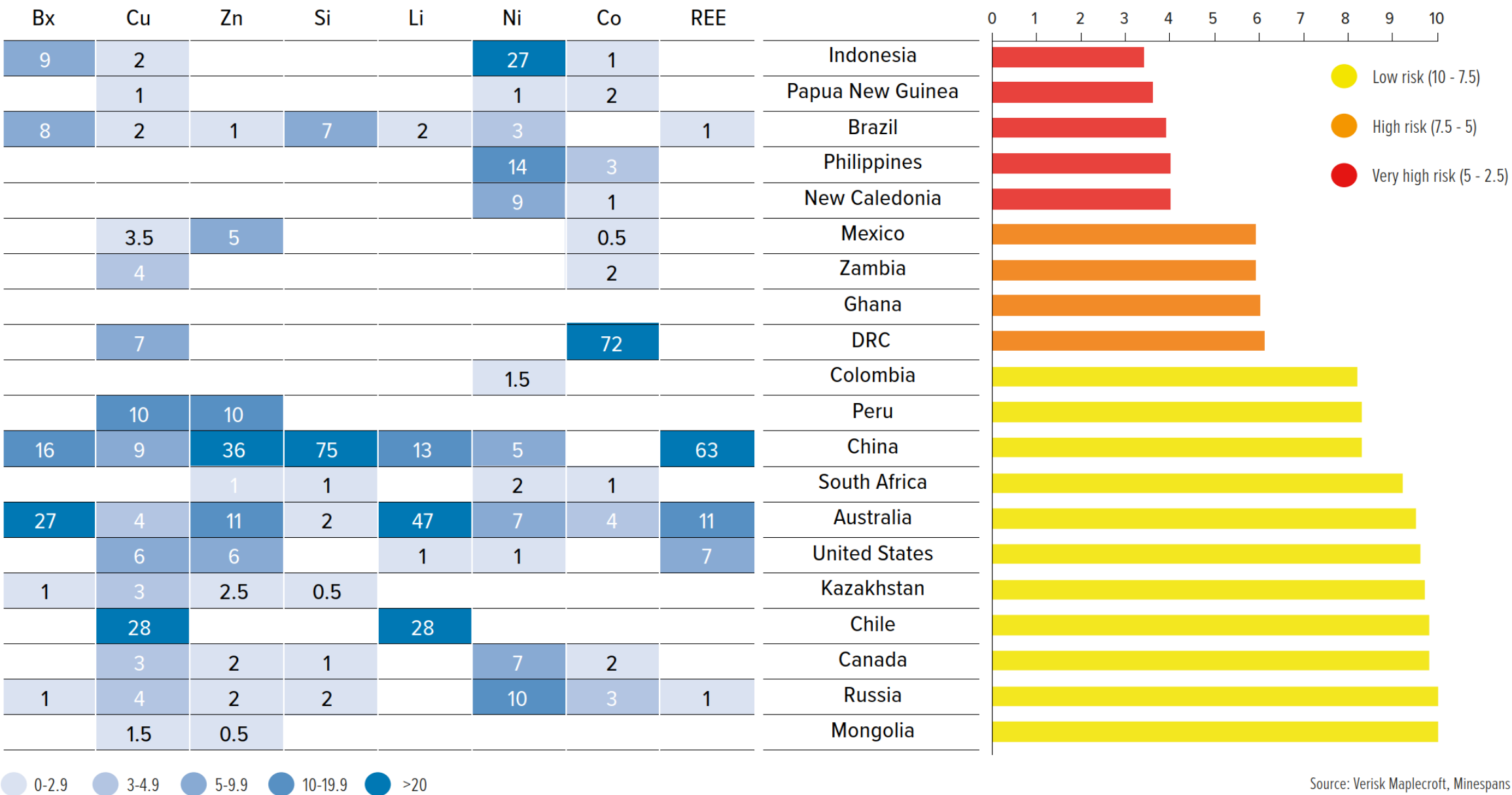


Figure 6. Biodiversity risk map and correlation to commodity production (% of total mine output for each commodity)



0-2.9

3-4.9

5-9.9

10-19.9

>20

Source: Verisk Maplecroft, Minespans

Securing sustainable imports from reliable partners

Key challenges: availability, sustainability, diversification



Availability

Can Europe secure the imported metals its energy transition needs?

Risk of 2030 supply bottlenecks for copper, lithium, nickel, cobalt, rare earths



Sustainability

Do we want to swap existing fossil fuel dependencies for new metals dependencies at low sustainability standards?

Certified responsible import partners needed



Diversification

Can Europe maintain its currently high diversification as metals requirements increase?

Risk of growing dependency on China, Russia

Pillar 3: Secure sustainable imports from reliable partners

STARTING
POINT

NOW

- Acceleration of clean energy transition
- Aim to improve strategic autonomy for energy

PILLAR 3

Securing sustainable imports from reliable partners

Key takeaway:

EU challenged to secure sustainable & diversified imports in tight global markets

END
POINT

2050

- Clean energy system with higher level of strategic autonomy & right level of sustainability

Pillar 4: Maximise recycling, including new streams

STARTING
POINT

NOW

- Acceleration of clean energy transition
- Aim to improve strategic autonomy for energy

PILLAR 4

Maximise recycling, including new streams

END
POINT

2050

- Clean energy system with higher level of strategic autonomy & right level of sustainability



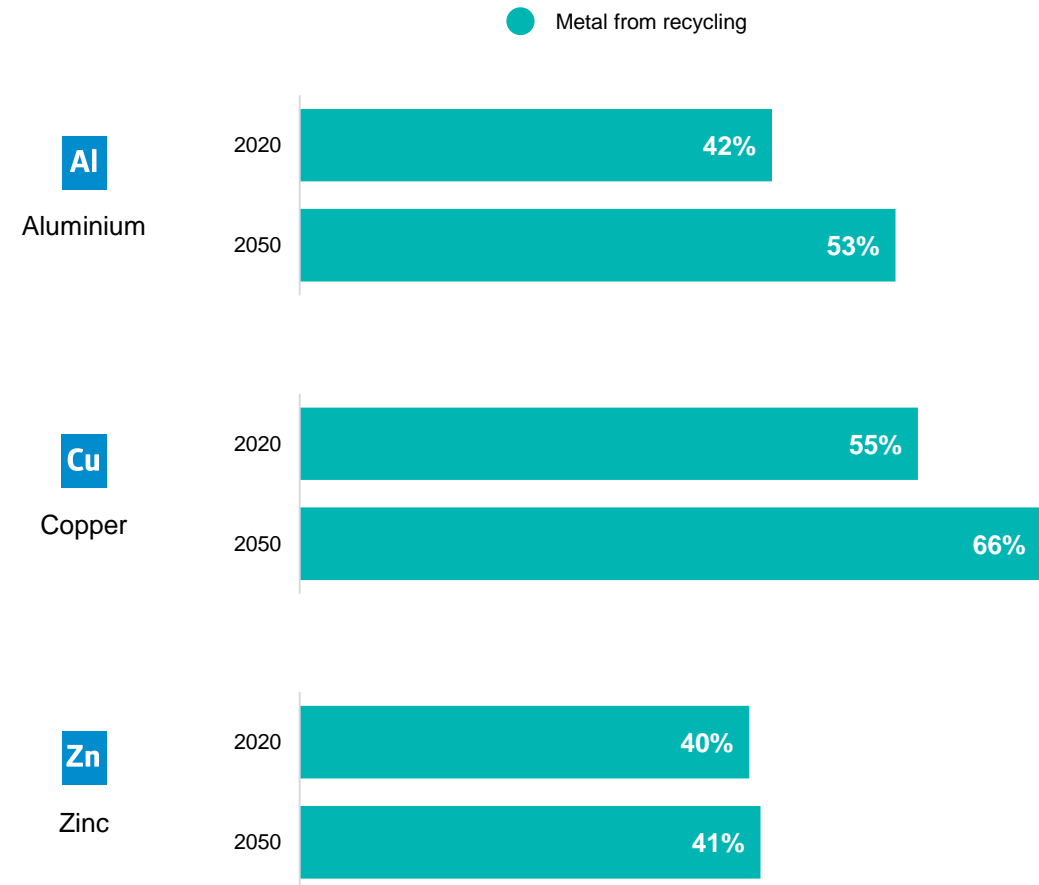
Recycling is Europe's key driver in creating strategic autonomy

Massive potential after 2040 for new energy commodities (1/2)

Mature markets

Aluminium, Copper, Zinc

- Recycling can supply 40-65% of Europe's base metals demand in 2050
- Addressing recycling bottlenecks will further raise rates:
 - Improved collection and sorting systems
 - Smarter product design
 - Control of scrap leakage



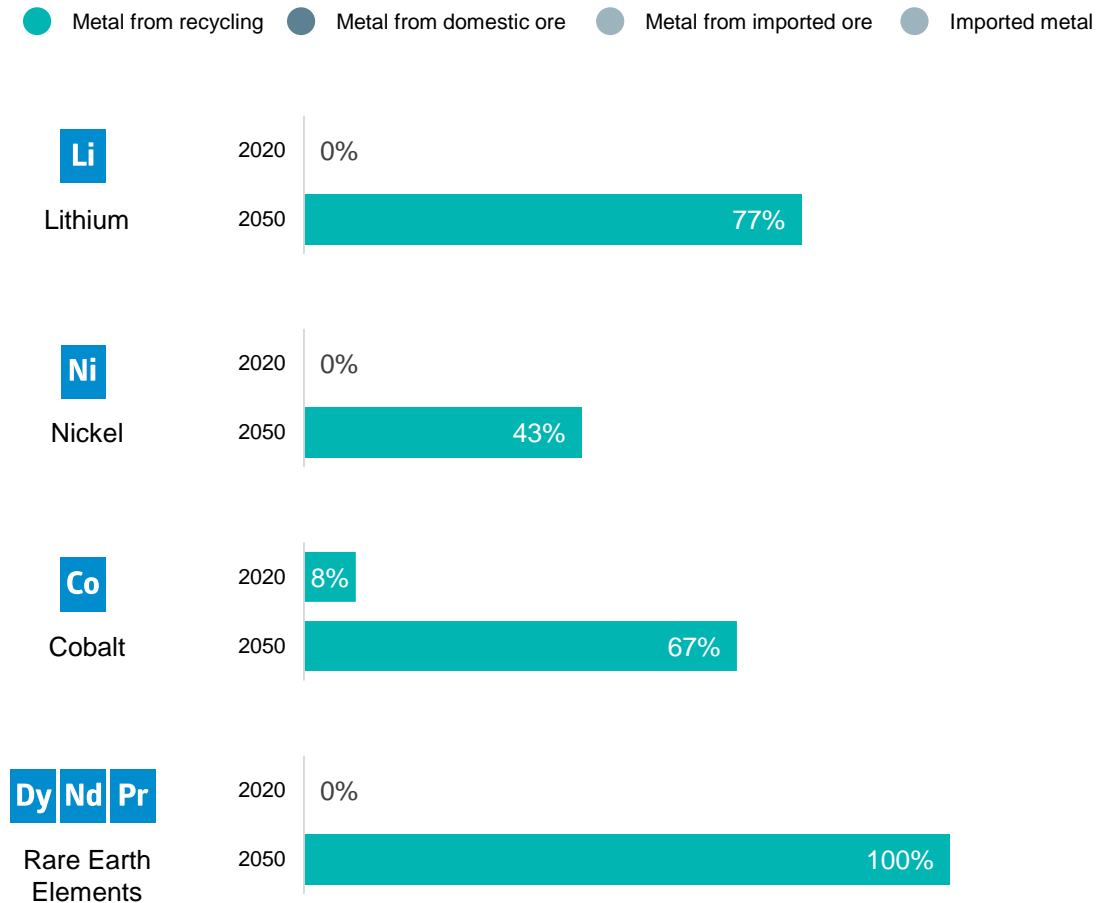
Recycling is Europe's key driver in creating strategic autonomy

Massive potential after 2040 for new energy commodities (2/2)

New energy commodities

Lithium, cobalt, nickel, rare earth elements

- Recycling volumes will rise after 2040, with potential for:
 - 65-75% of Europe's 2050 battery cathode needs*
 - 200% of Europe's 2050 rare earths needs*
- High supply from electric vehicles with 15 years expected lifetime
- Required:
 - New recycling capacity
 - Process improvements
 - Economic viability



Recycling potential?

European secondary supply potential

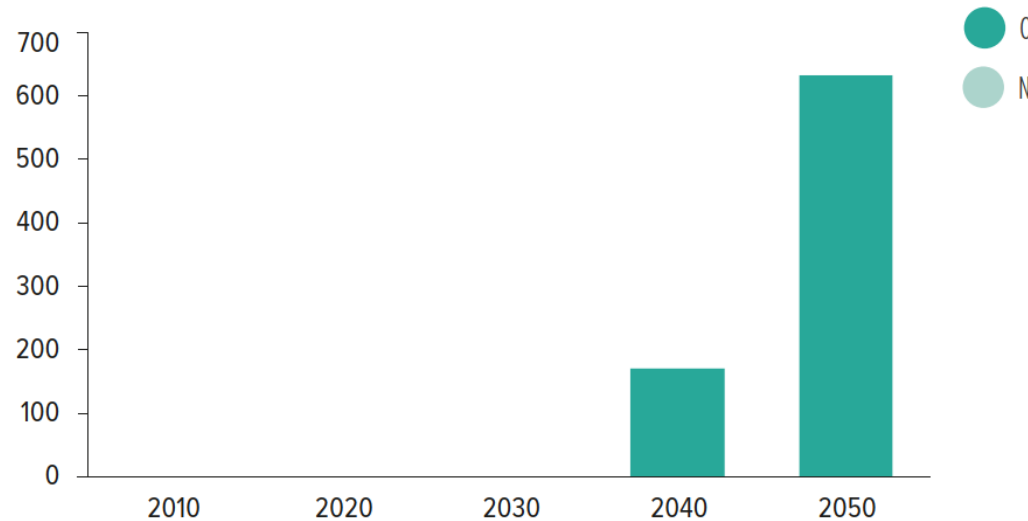


Figure 101. European lithium secondary supply outlook (old scrap) (kt)

Impact on European primary demand

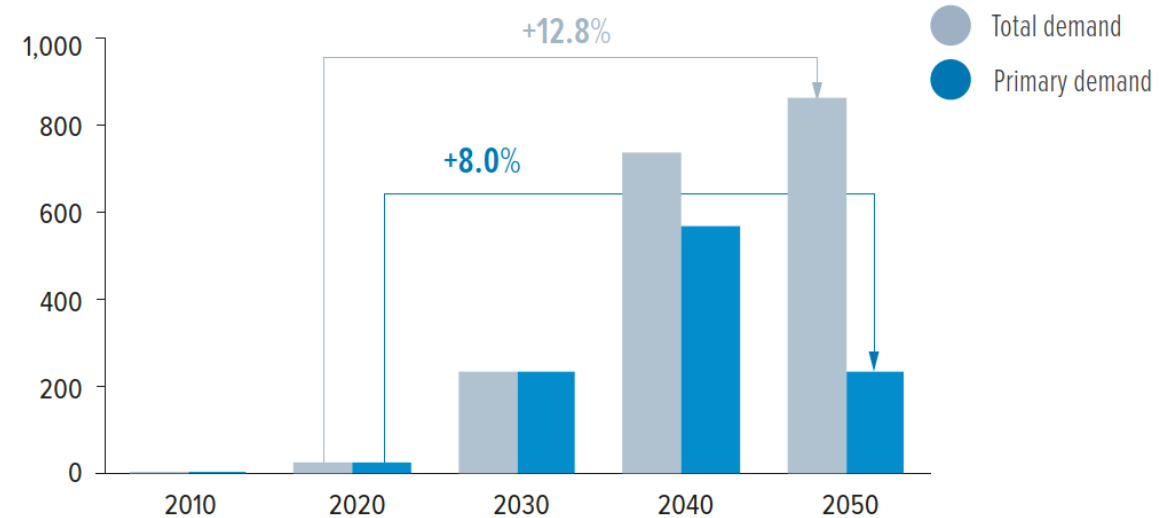
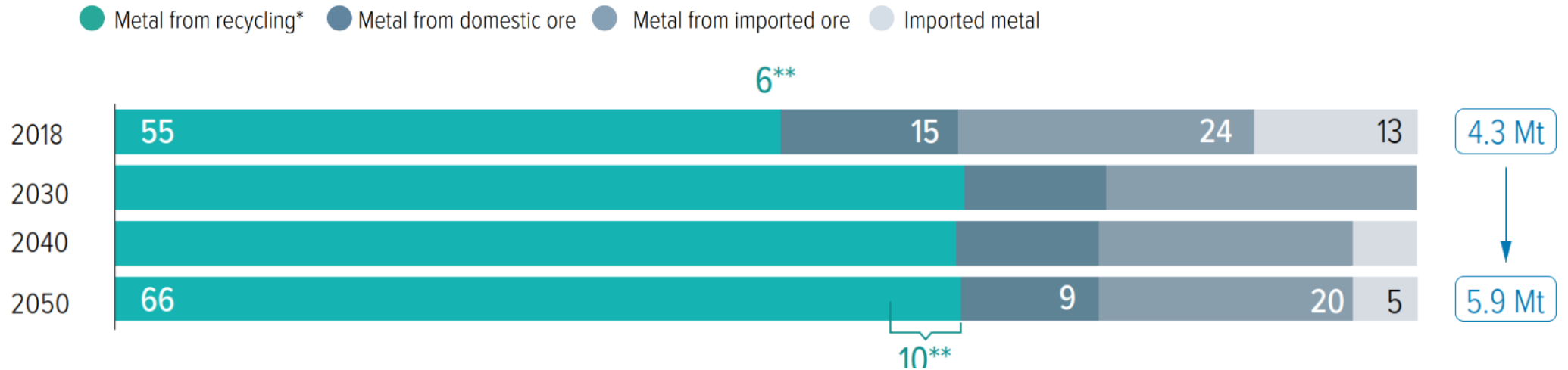


Figure 103. European total and primary lithium demand outlook (STEPS) (kt)

Scenarios for supply



Copper



Lithium



Pillar 4: Maximise recycling, including new streams

STARTING
POINT

NOW

- Acceleration of clean energy transition
- Aim to improve strategic autonomy for energy

PILLAR 4

Maximise recycling, including new streams

Key takeaway:

Recycling is Europe's major long-term self sufficiency potential, requiring action now

END
POINT

2050

- Clean energy system with higher level of strategic autonomy & right level of sustainability

Pillar 5: Drive technological and behavioural change

STARTING
POINT

NOW

- Acceleration of clean energy transition
- Aim to improve strategic autonomy for energy

END
POINT

2050

PILLAR 5

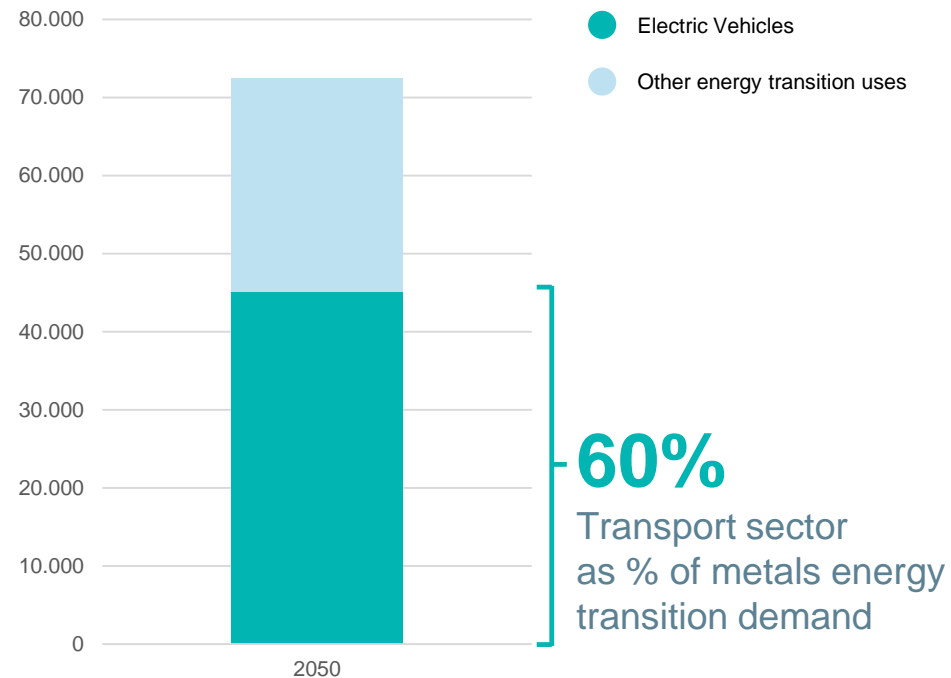
**Driving
technological
& behavioural
change**

- Clean energy system with higher level of strategic autonomy & right level of sustainability



Technological and behavioral change can reduce our demand

Time is needed to achieve measurable impact



Impacts will be longer term



Innovation and substitution

- Europe: frontrunner in R&D to reduce metals intensities in products
- Substitution in focus: cobalt in batteries, non-rare earth magnets



Behavioral change

- Transport sector represents 60% of metals demand + big supply risks
- Shared economy can here make a real difference (but not quantified)

Conclusion: 10 EU actions to bridge its looming metals supply gap

STARTING
POINT

NOW

- Acceleration of clean energy transition
- Aim to improve strategic autonomy for energy

NOW → 2040

PILLAR 1

Fulfil domestic mining potential

- Take forward viable mining projects
- Set high ESG standards

PILLAR 2

Maintain and increase domestic refining output

- Prevent further closures of existing capacity
- Support new refineries for battery metals & rare earths

PILLAR 3

Secure sustainable imports from reliable partners

- Diversify trade partners while driving ESG
- Source from certified, responsible suppliers

PILLAR 4

Maximise recycling, including new streams

- Remove current bottlenecks on collection, sorting and retention
- Invest into new recycling for batteries, PV, magnets

PILLAR 5

Drive technological & behavioural change

- Ensure continued R&D leadership on optimisation
- Investigate how to evolve consumption patterns in the transport sector

2035 ONWARDS

END
POINT

2050

- Clean energy system with higher level of strategic autonomy & right level of sustainability



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Read more!



www.eurometaux.eu/metalscleanenergy



is acknowledged for financing the project

<https://www.mtm.kuleuven.be/english/research/SEMPER/sustainability-assessments-of-material-life-cycles>

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