

AMIGDALA Scenario Webinar

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AMIGDALA



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What we offer

1. **Structured framing** of plausible futures of EU industries and the energy system.
2. Presentation of a **scenario space** (≈ 20 archetypes) linking external influences and policy levers
3. Translation of abstract narratives into **model-relevant inputs**

What we ask

1. Have we **missed** anything?
2. Do you think our **selection** of scenario narratives will **answer your questions?**
3. Are there any **other sensitivities** we should include?

Agenda

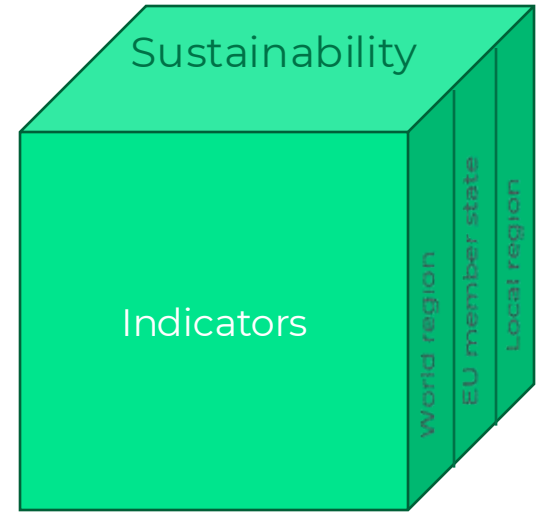
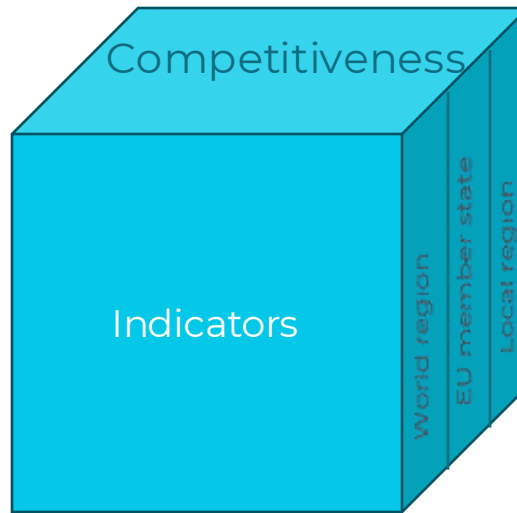
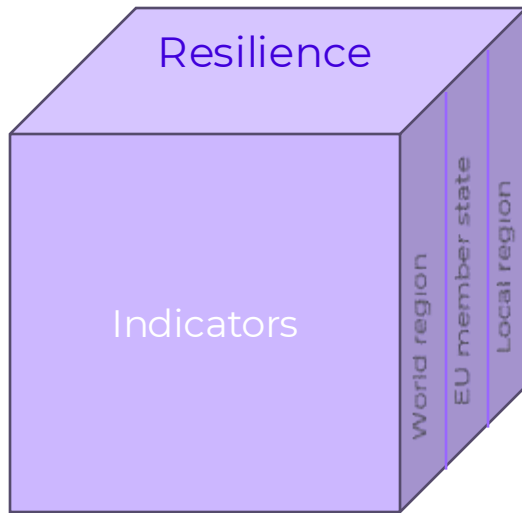
1. AMIGDALA project and this webinar
2. Method to build scenario narratives
3. Scenario narratives (~ 20 archetypes)
4. 5 selected scenarios
5. Translation of narratives into model inputs
6. Q&A (15 minutes)



The AMIGDALA Project in brief

The problem: uncertainty to decarbonize the European process industries...

...while maintaining competitiveness and resilience/strategic autonomy



3 competing policy objectives, interacting at 3 different levels

AMIGDALA provides answers

AMIGDALA

“Modelling **industry transition** to **climate neutrality**,
sustainability and **circularity**”

For policy makers about industry

Alliance for **M**odeling **I**ndustries towards the **G**reen **D**eal's
objective **A**nd circu**L**arity



We have 5 key objectives



Place stakeholders' needs at the centre



Understand decision parameters and control options



Improve transparency for decisionmakers in government and industry



Integrate established models of economy, trade, energy and industrial production



Identify and evaluate pathways towards sustainability by deploying the integrated model.

We cover 7 “sectors”



Steel



Non-ferrous



Cement



Chemicals



Fuel manufact.



Glass



Paper

AMIGDALA Who we are

AMIGDALA

A consortium of leading European research institutes, industrial associations, and expert consultancies



TNO innovation
for life

 **vito**


european**research**services
gmbh

 **DECHEMA**

ENEA

 **GreenDecision**

Bfi

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services



KU LEUVEN

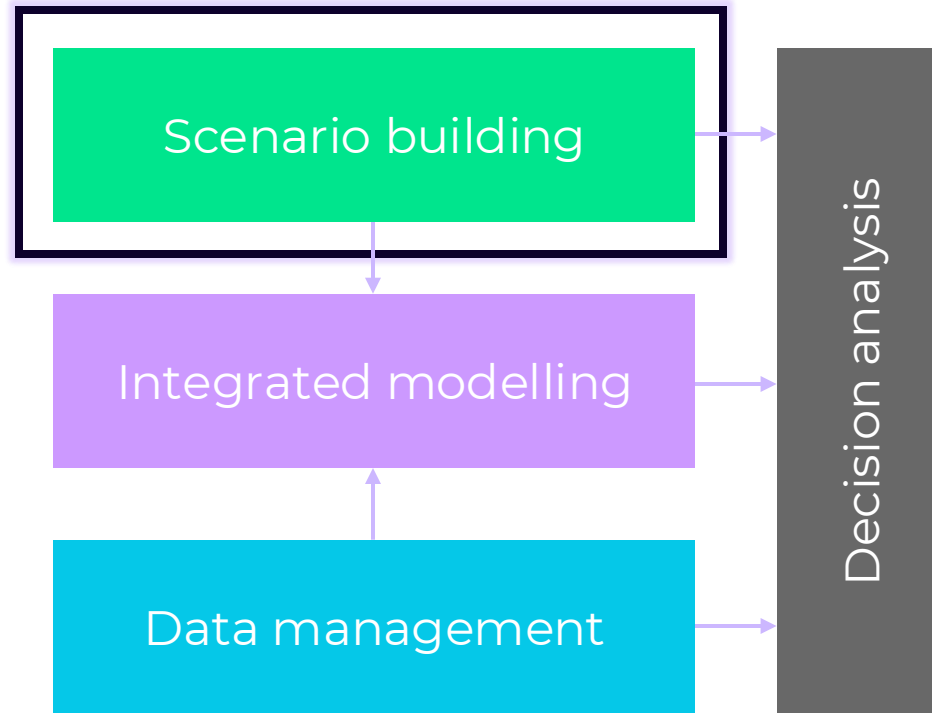
POLICY LAB

Deloitte.

 **Sustainable
INNOVATIONS**

IIASA

We combine 4 expertise areas





Method to build scenario narratives

Scenario narratives: what & why?

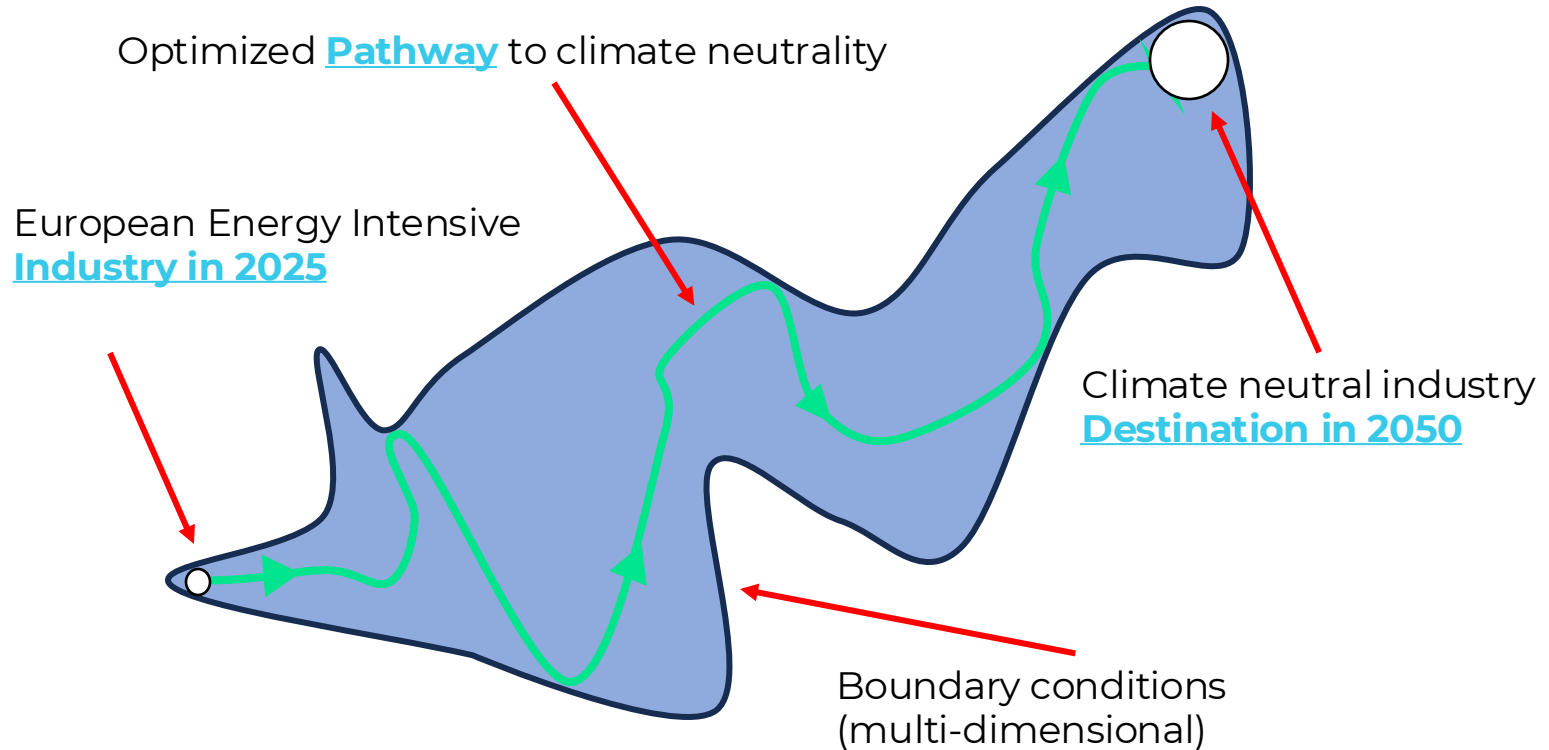
What?

- A **qualitative, structured narrative** describing a **plausible** future, capturing **key drivers** and **assumptions** to inform **modelling** and **decision-making** under uncertainty.

Why?

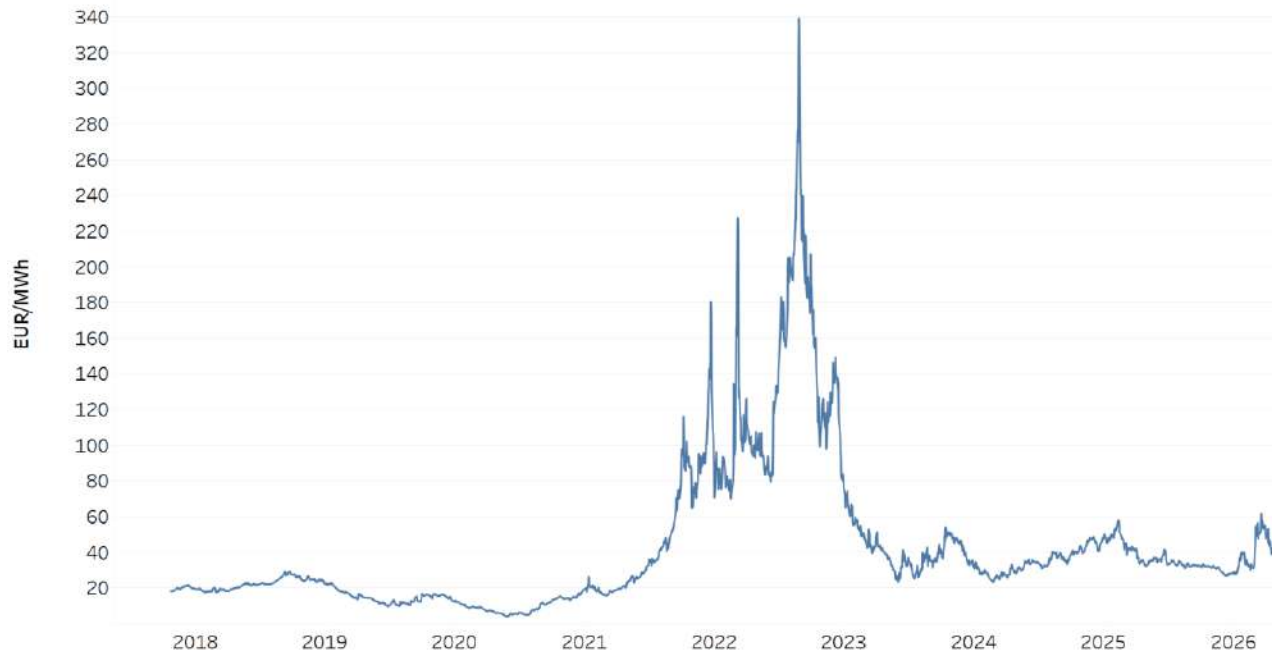
- Reveal **challenges, risks**, and **opportunities**
- Identify **key drivers, uncertainties** (we cannot foresee everything), and **system relationships**
- Support **robust decisions** under uncertainty

Scenario narratives illustrated



We cannot foresee everything

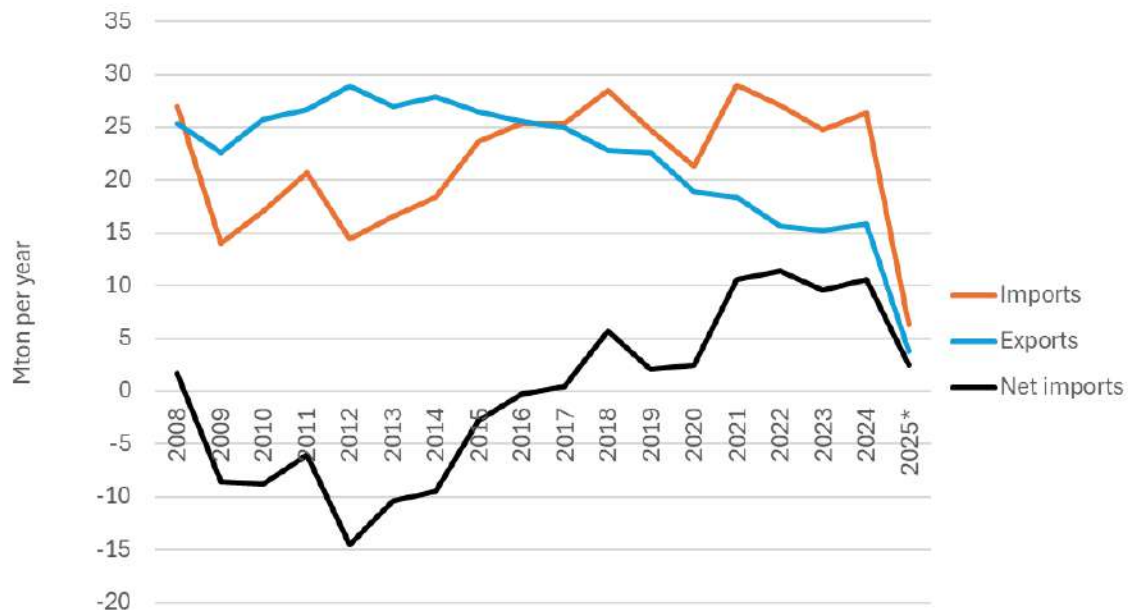
Gas prices (€/MWh) between 2018 & today



Basis: Dutch TTF
Natural Gas

We cannot foresee everything

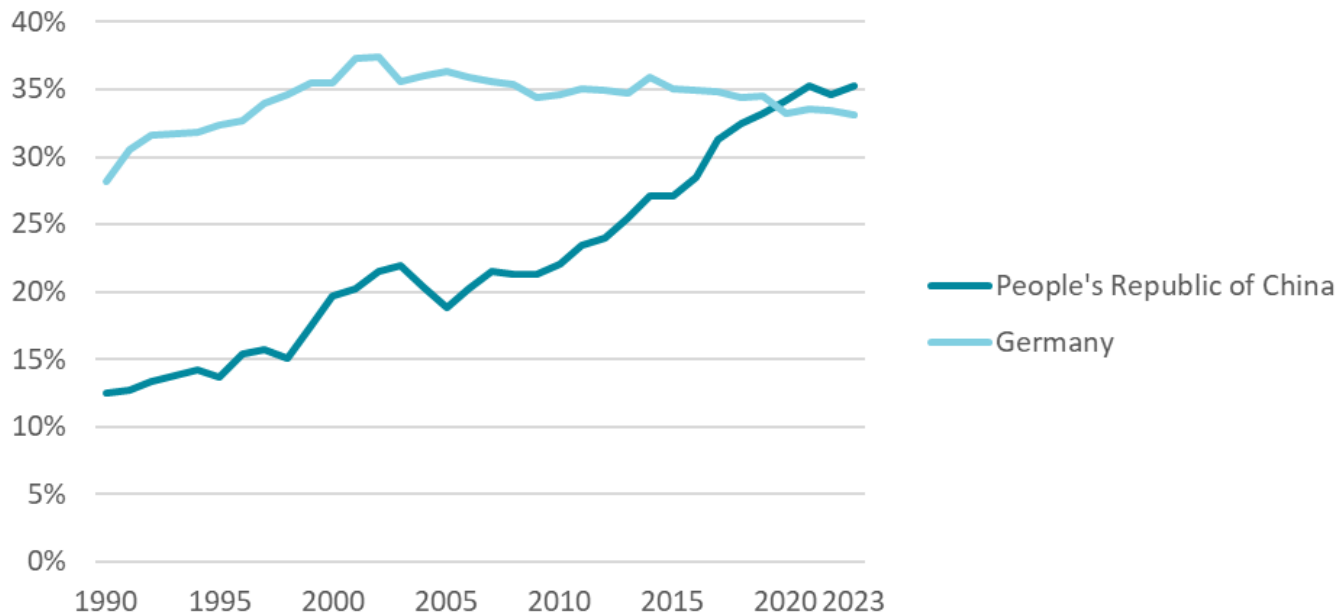
*Global excess capacity is expected to increase to 721 million tons by 2027.
For anti-dumping, EU transitioned from selective trade defence before 2018
to near-universal import control to safeguard steel*



*Data from Eurofer, all qualities steel products less stainless
* 2025 data not complete
Largest group: flat-rolled products of iron or non-alloy steel.*

The rest of the world is changing fast

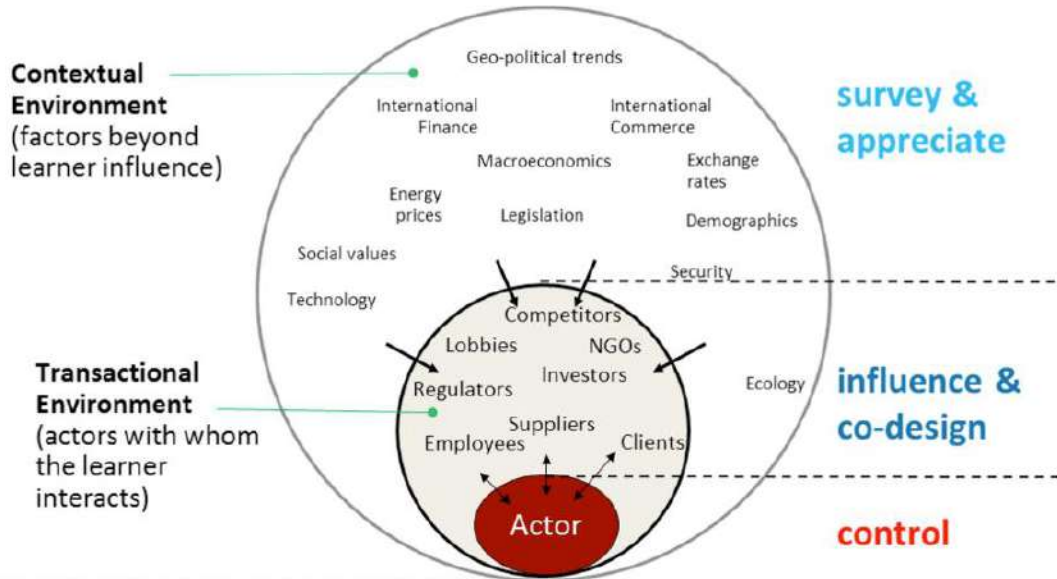
Electrification of industries - share of energy use



Data from IEA World Energy Balances up to 2023
Excluding non-energy uses.

Our scenario approach is based upon the Oxford scenario planning approach

Oxford Scenario Planning Approach Contextual and Transactional Environment



Source: Ramirez & Mannervik (2016) - collaborative Strategy to Shift the Transactional /Contextual Environment

While we apply the concept, we use different terms

- Contextual environment = **Background**

- Transactional environment = **Foreground - control**

EU industry at a tipping point amid global drivers (1/2)

Existing background and EU policies as a starting point to identify key industrial influences

| Year | Background | EU control levers |
|------|---|---|
| 2019 | | Green Deal |
| 2020 | COVID-19 pandemic | |
| 2021 | China: 14th 5-Year Plan - Industrial + clean tech strategy | Climate Law adopted |
| 2022 | <ul style="list-style-type: none">February - Russian invasion of UkraineUS: Inflation Reduction Act (Aug.)EU energy cost shockChina: industrial & hydrogen plans | REPowerEU (May) |
| 2023 | | <ul style="list-style-type: none">Commission mandate to DraghiGreen Deal Industrial PlanNet Zero Industry Act |
| 2024 | | <ul style="list-style-type: none">Antwerp DeclarationEuropean Industrial Alliance on SMRs2040 Climate Target proposalEcodesign for Sustainable Products RegulationDraghi Report |

EU industry at a tipping point amid global drivers (2/2)

Existing background and EU policies as a starting point to identify key industrial influences

| Year | Background | EU control levers |
|------|--|---|
| 2025 | <ul style="list-style-type: none">• Trump second term• China announces plans on ETS expansion to heavy industry• “Liberation day”: Shift to structured protectionism (tariffs)• US: IRA rollback | <ul style="list-style-type: none">• Clean Industrial Deal• EU: steel safeguards extended and tightened (import protection response to persistent overcapacity)• Expansion of ETS State aid: compensation for indirect carbon costs in electricity prices |
| 2026 | <ul style="list-style-type: none">• China: 15th 5-Year Plan - State-driven industrial upgrading + tech self-reliance | <ul style="list-style-type: none">• CBAM definitive phase• Industrial Accelerator Act• Climate Law: 2040 target adopted• Clean Energy Investment Strategy• Upcoming Electrification Action Plan• Upcoming Circular Economy Act |
| | <ul style="list-style-type: none">• Middle East crisis | <ul style="list-style-type: none">• Adopted temporary State Aid Framework |

We use 3 types of sources to select our background and foreground control levers

1. Academic literature and policy reports

Shared Socioeconomic Pathways Scenario Database (SSP)

Sixth Assessment Report

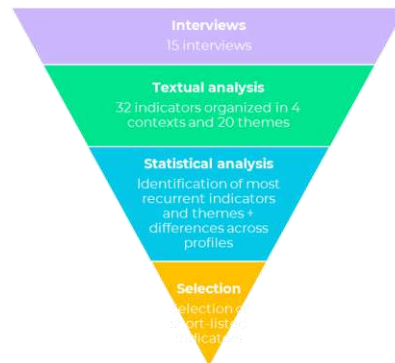
The Working Group I contribution was released on 8 August 2021. The Working Group II and III contributions were released on 28 February and 4 April 2022 respectively. The Synthesis Report was released on 20 March 2023.

openENTRANCE

open ENergy TRansition ANalyses for a low-Carbon Economy

... is developing, using and disseminating an open, transparent and integrated modelling platform for assessing low-carbon transition pathways in Europe.

2. Stakeholders input



3. Systematic review exploiting AI

What matters? The top 10 "most mentioned" indicators are from the "economic" context - irrespective of profile AMIGALA

| Context | Theme | Indicator name | Indicator description | Year | Policy makers (%) | Industrial Decision makers (%) |
|----------|---------------|---------------------------------|---|------|-------------------|--------------------------------|
| Economic | Energy | Energy use | What is the level of energy use relative to the 2010 level? | 2010 | 100% | 100% |
| Economic | Technology | Location of technology use | What is the location of the most advanced technology use? | 2010 | 100% | 100% |
| Economic | Energy | Availability of energy services | What is the availability of energy services? | 2010 | 100% | 100% |
| Economic | Carbon | Carbon use | What is the quantity of carbon dioxide emissions? | 2010 | 100% | 100% |
| Economic | Non-renewable | Non-renewable energy | What is the quantity of non-renewable energy use? | 2010 | 100% | 100% |
| Economic | Demography | Population change | What is the population change? | 2010 | 100% | 100% |
| Economic | Non-renewable | Non-renewable energy | What is the quantity of non-renewable energy use? | 2010 | 100% | 100% |
| Economic | Non-renewable | Non-renewable energy | What is the quantity of non-renewable energy use? | 2010 | 100% | 100% |
| Economic | Trade | Trade in goods | What is the quantity of trade in goods? | 2010 | 100% | 100% |
| Economic | Trade | Trade in services | What is the quantity of trade in services? | 2010 | 100% | 100% |

We use a 3 stage approach to define scenarios

1

Determine what **background** and EU **control levers** are important for the development of clean and competitive EU industries for a strategically autonomous European economy?



2

Combine background and control levers, including the split Strategic commodities + Strategic net-zero tech industries = Dual industries



3

Select scenario narratives for modelling



Scenario narratives and the 5 selected scenarios

Our critical scenario background and control levers

- 
- Global climate ambition
 - Fossil fuel prices
 - Global cleantech innovation pace & global race in low-carbon industry
 - Geopolitical open vs fragmented and protectionist trade
 - Climate risks and environmental shocks
 - Consumer trends & low-carbon preferences (sustainability awareness)



Environmentally sustainable

- Develop **climate neutral** EU process industries
- Develop **circular** EU process industries

Viable EU process industries

- Strive for **competitive production costs**, particular energy
- Boost **domestic clean energies**
- Support clean production in **strategic commodities**
- Spur **demand for low carbon and circular products** in the EU (create markets)

Resilience

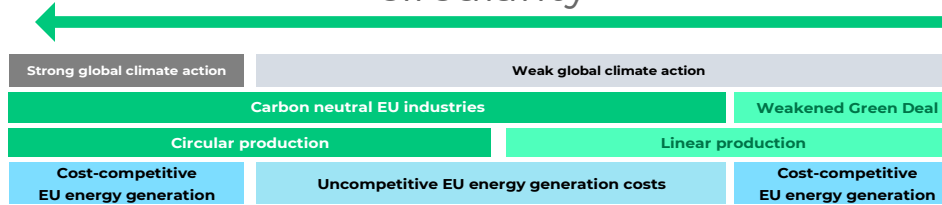
- Reduce **dependence on energy** imports
- Secure diversified **imports of clean energies**

Other

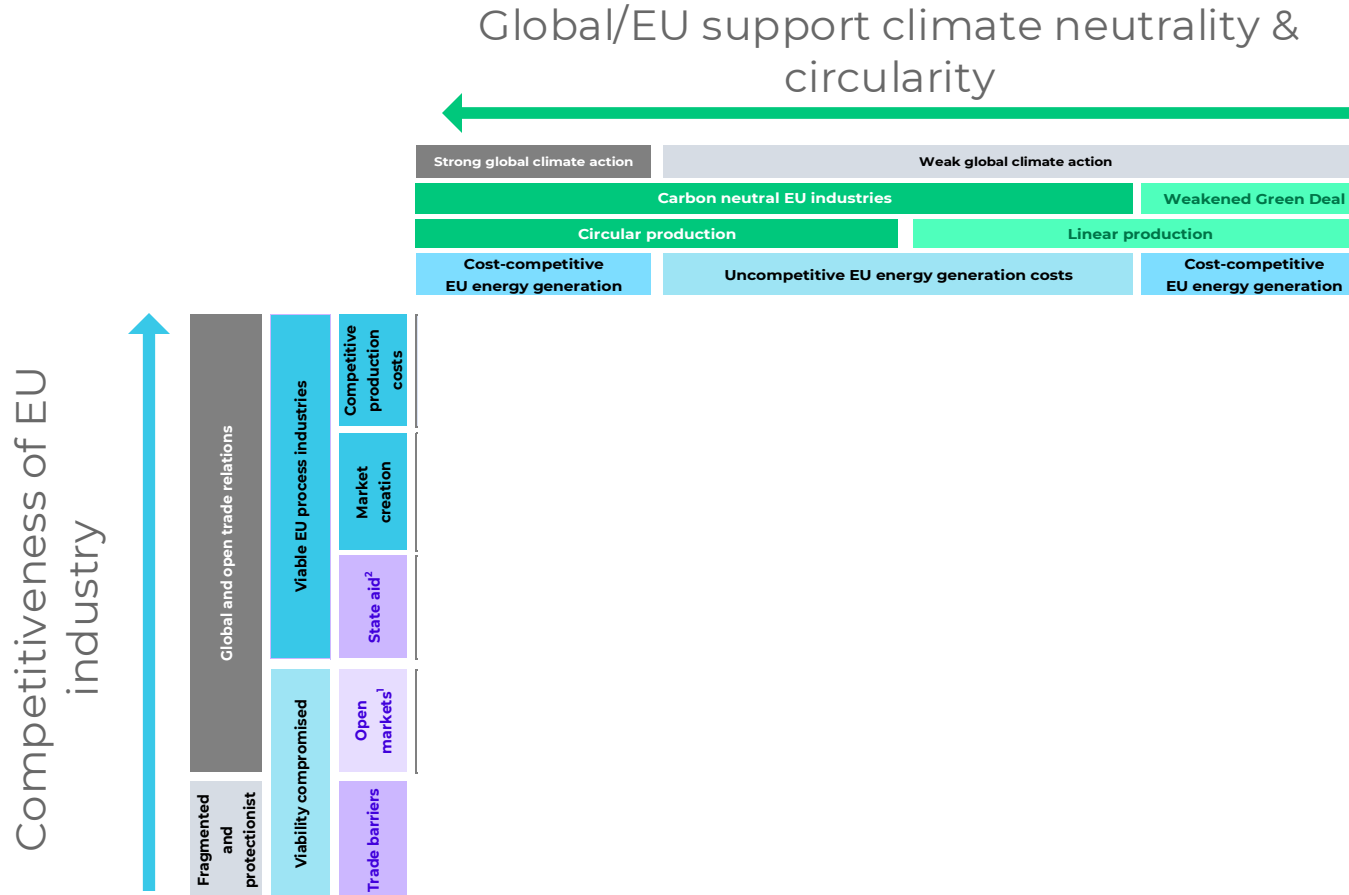
- Spur investment for the production of **net-zero technologies** required for the energy transition

Our 2 dimension multicriteria matrix for scenario design (1/2)

Global/EU support climate neutrality & circularity



Our 2 dimension multicriteria matrix for scenario design (2/2)



1) Minimum criteria for EU market access

2) Industry policy: support for the transition

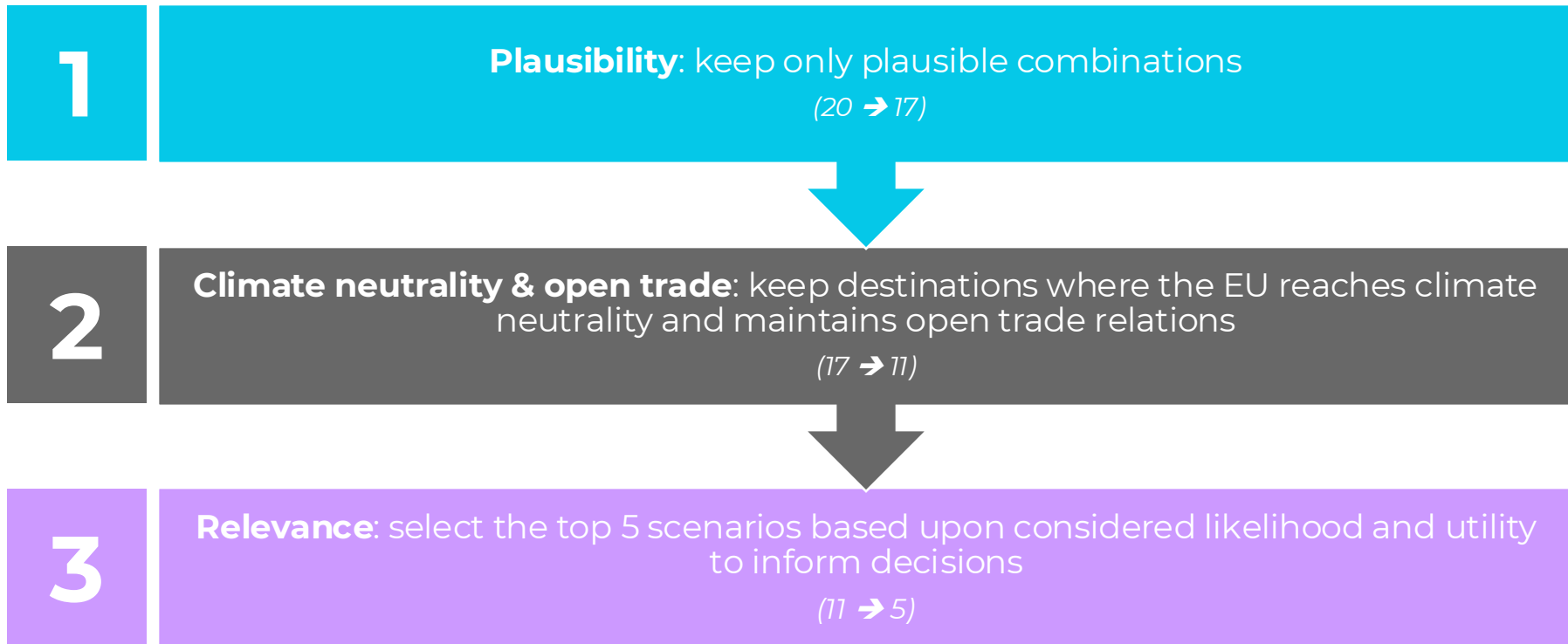
Produces 17 potential combinations

| | | Strong global climate action | | Weak global climate action | | |
|---------------------------------|------------------------------|---|--|---|--|--------------------------------------|
| | | Carbon neutral EU industries | | Weakened Green Deal | | |
| | | Circular production | | Linear production | | |
| | | Cost-competitive EU energy generation | Uncompetitive EU energy generation costs | | Cost-competitive EU energy generation | |
| Global and open trade relations | Viable EU process industries | Competitive production costs | Global Green Industries Competitive Green Process industries | Not plausible ? (Competitive production costs with circular EU in a world not striving for net-zero) | Competitive with New Dependencies | Race to the Bottom |
| | | Market creation | <i>Lagging Europe - green standards (dual industries)</i> | Standards for Strategic Commodities Standards Driven Dual Industries | << Sensitivity with low circularity | Not consistent (weakened Green Deal) |
| | | State aid ² | <i>Lagging Europe - subsidy addicted (dual industries)</i> | Support Strategic Commodities Support Driven Dual Industries | << Sensitivity with low circularity | Autonomy without Transition |
| | Viability compromised | Open markets ¹ | <i>Green relocation and sufficiency</i> | Sensitivity with high circularity >> | Industry relocation Net-Zero Tech Autonomy | <i>Deindustrialisation after all</i> |
| Trade barriers | | Not consistent (global climate cooperation) | Net-Zero Tech Fortress | << Sensitivity with low circularity | Similar to Autonomy without Transition | |
| Fragmented and protectionist | | | | | | |

1) Minimum criteria for EU market access

2) Industry policy: support for the transition

3 filters were applied to select scenarios



| | | Strong global climate action | Weak global climate action | |
|---------------------------------|------------------------------|---------------------------------------|--|---|
| | | Carbon neutral EU industries | | |
| | | Circular production | | Linear production |
| | | Cost-competitive EU energy generation | Uncompetitive EU energy generation costs | |
| Global and open trade relations | Viable EU process industries | Competitive production costs | Global Green Industries Competitive Green Process industries | Competitive with New Dependencies |
| | | Market creation | <i>Lagging Europe - green standards (dual industries)</i> | Standards for Strategic Commodities Standards Driven Dual Industries << Sensitivity with low circularity |
| | | State aid ² | <i>Lagging Europe - subsidy addicted (dual industries)</i> | Support Strategic Commodities Support Driven Dual Industries << Sensitivity with low circularity |
| | Viability compromised | Open markets ¹ | <i>Green relocation and sufficiency</i> | Sensitivity with high circularity >> Industry relocation Net-Zero Tech Autonomy |

Our 5 main, differentiated, scenario destinations

| | Global Climate Ambition | EU ambition climate neutral industries | EU circularity ambition | Policies for domestic clean energies | Policies for importing clean energies | >> | Competitive commodity production costs | Support process industries | >> | Viability EU process industries | Import intermediate industrial products |
|--|-------------------------|--|-------------------------|--------------------------------------|---------------------------------------|----|--|----------------------------|----|---------------------------------|---|
| 1 Support for Strategic Commodities | Low | High | High | High | Low | | No | Financial | | High | Low |
| 2 Standards for Strategic Commodities | Idem | | | | | | No | Low carbon product markets | | Idem | |
| 3 Competitive with New dependencies | Low | High | Low | Low | High | | Yes | Not needed | | High | High |
| 4 Industry relocation | Low | High | Low | Low | Low | | No | Low | | Low | High |
| 5 Global Green Industries** | High | High | High | High | Low | | Yes | Not needed | | High | Low |

* The scenario Global Green Industries has the highest EU energy tech production = tech related to the energy transition (as in NZIA)

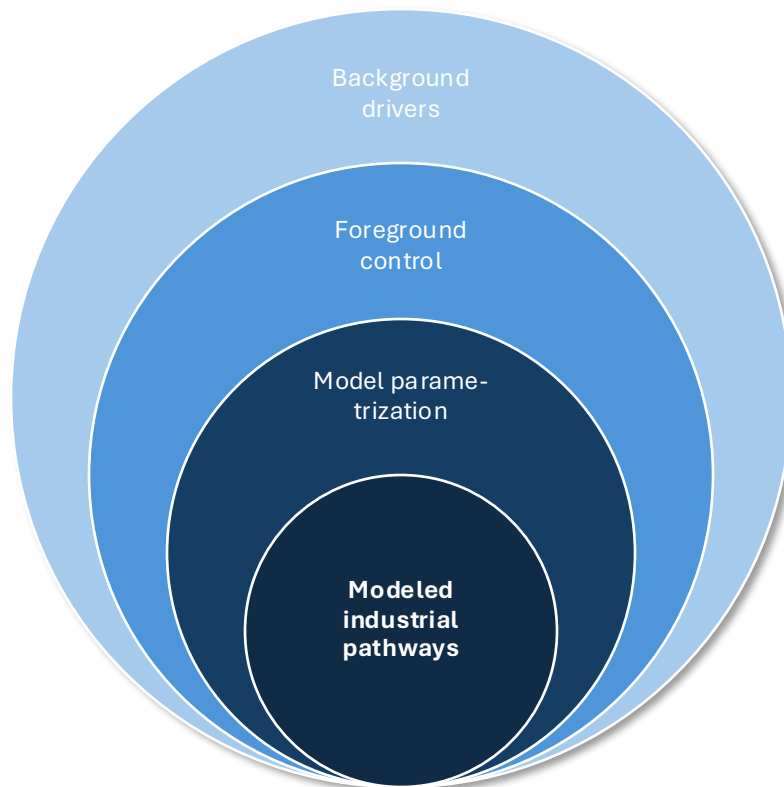
5 scenario destinations to answer 5 different questions

| Scenario name | Key question |
|--|---|
| Support for Strategic Commodities | What if the green industrial transformation works due to green investment and sustained financial support ? |
| Standards for Strategic Commodities | What if the green industrial transformation works due to obligatory standards for green commodity use ? |
| Competitive with New Dependencies | What if EU reaches competitive production costs but relying on the import of cheap green renewable energy ? |
| Industry Relocation | What if EU process industries would partially relocate , being unable to reconcile climate targets with global competitiveness ? |
| Global Green Industries | What if effective policies help EU industry to lead the world to a climate-neutral and circular future ? EU industry becomes a highly competitive player in the world of green commodities and technologies . |

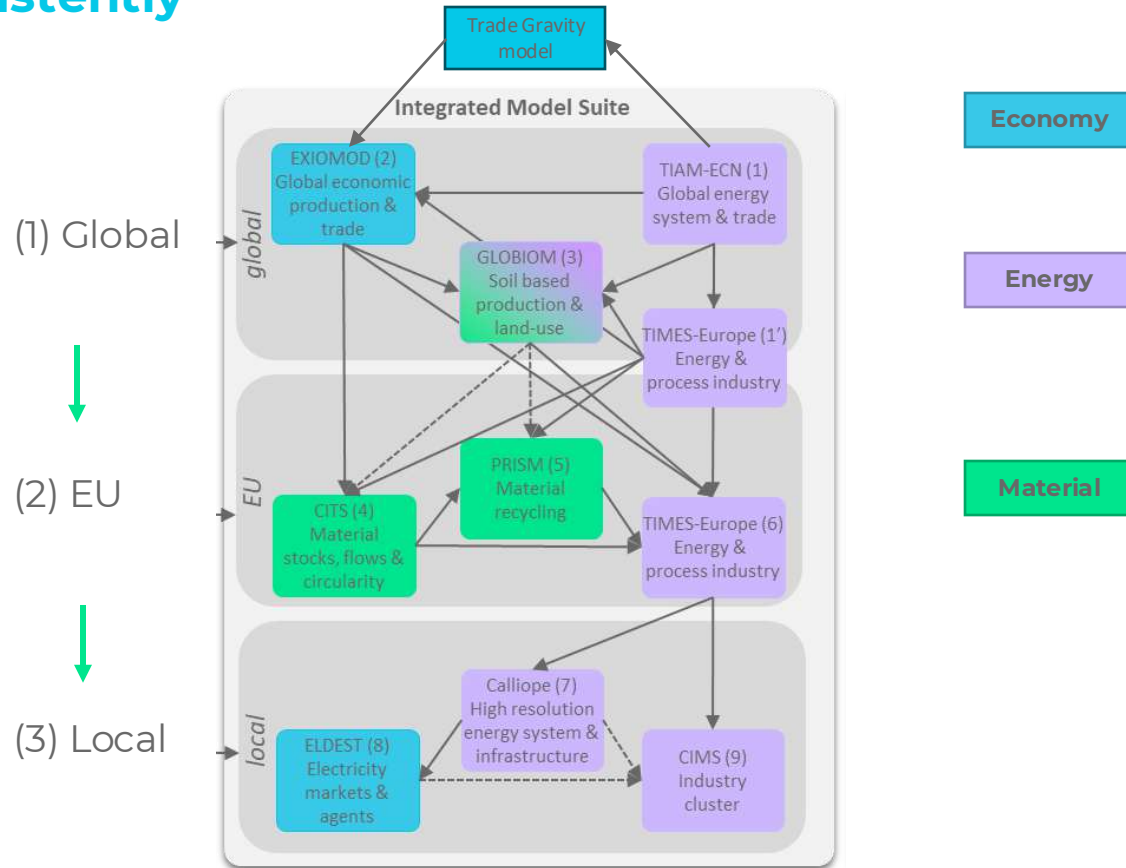


Modelling translation & sensitivities

Translation of narratives into model parameters is a key step



All models use the same scenario narratives consistently



Snapshot of translation into model inputs

| | 1.Support/ 2. Standards for Strategic Commodities | 3. Competitive with New dependencies | 4. Industry relocation | 5. Global Green Industries | Low | High |
|---|--|--|---------------------------|----------------------------------|--|---|
| Global climate ambition | Low | Low | Low | High | Temperature ambition 2.4°C ; transformed to global GHG budget | IEA NZE: Net-Zero global cooperation 1.5°C (after overshoot) |
| Global cleantech innovation pace, clean technology costs | | | | | Default values | Lower technology costs (novel green tech, including circularity related) -25% on CAPEX and FIXOM as from 2035 |
| EU CO2 emission for the Energy system (including industrial removals and int transport) | High | High | High | High | | Assume S2 from Climate target 2040 for the EU: CO2: -45% in 2030 compared to 2015 -84% in 2040 -100% in 2050 -130 Mt in 2070 |
| Circularity - System elements | High | Low | Low | High | CO2 storage in EU 400 Mt/a | CO2 storage in EU 250 Mt/a |
| Circularity - Recycling quota | | | | | Keep current circularity standards (e.g., for packaging). | Recyclate quota constraint – first run assumption: Plastics: 50% target by 2050 Container glass: 90% Flat glass to flat glass: 20% Flat glass to 'other': 50% Steel: 60% |
| EU Clean energy production through constraints on share of imported energy (non-EU) | High | Low | High | High | 50% of energy imported from non-EU (equal to 2030 values from Impact Assesment) Additional expansion of power grids to Northern-Africa; Additional ammonia and H2 import from NA and Middle-East | Max energy imported from non-EU 2040: 29% 2050: 15% 2070: 15% |

Additional assumptions for the Industry relocation scenario at different levels

| | | (Primary) steel | Olefins | Ammonia |
|--------------------|-------------------|---|---|--|
| Shallow relocation | Production volume | Steel production remains | 40% reduction compared to current production levels | 50% of projected N-Fertilizer demand (4,5 Mt N) |
| | Intermediates | 50% of primary steel from HBI | Remaining production based 50% on imported methanol | No |
| | Imports to EU | HBI | Methanol Embedded ethylene products | Fertilizer to cover demand Ammonia to cover additional uses |
| Deep relocation | Production volume | Imports double to 50Mt (20% production decline) [plus small demand reduction due to decline in automotive?] | Limited production (10%?) in innovative niches | No production |
| | Intermediates | 50% of primary steel from HBI | N.a. | No |
| | Imports to EU | HBI Steel Cars | Embedded ethylene products | Full scale import of fertilizer and ammonia for all other uses |

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Q&A

- Have we missed anything?
- Did we do a good selection of scenario narratives to be modeled?
- Are there other sensitivities to be included?



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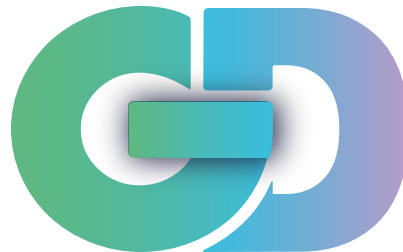
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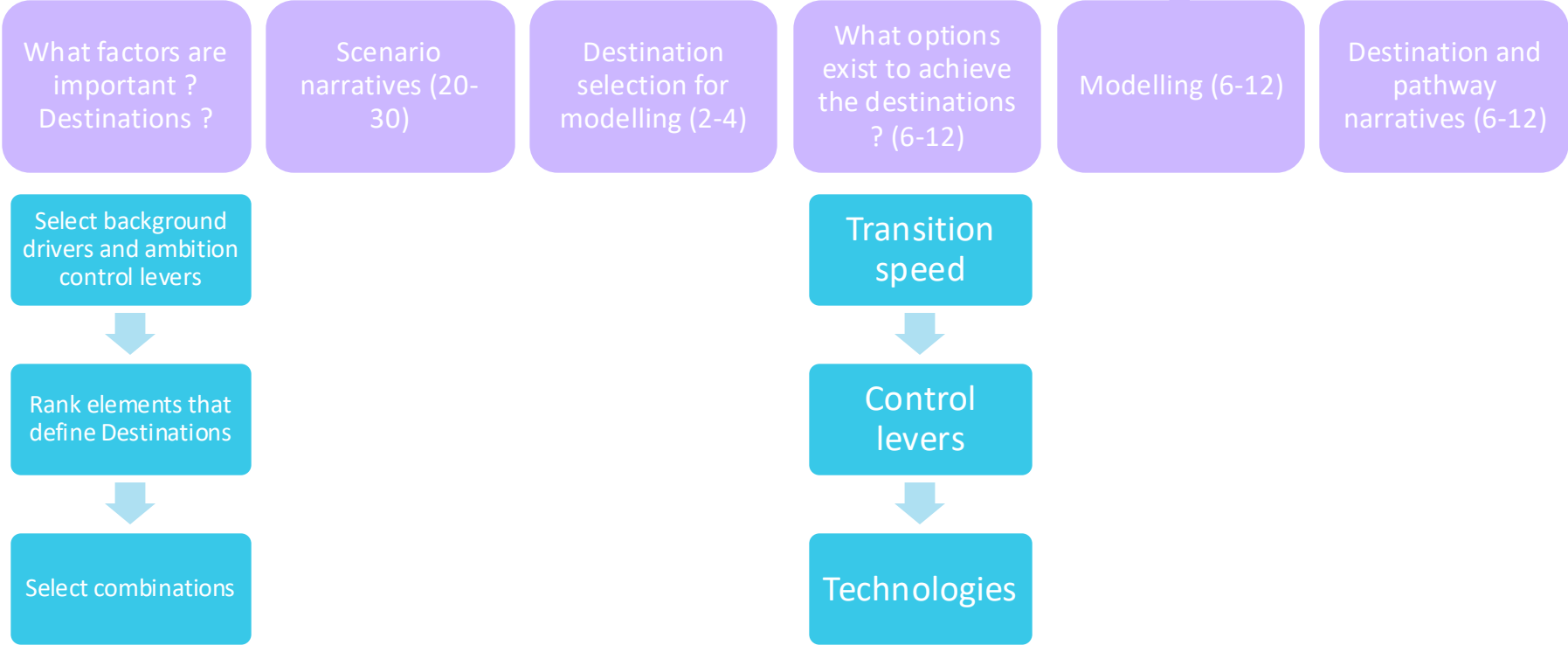


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Scenario overview



Destinations

- **Trade aspects** (including fair/unfair competition aspects) - in PURPLE - referring to the strategic autonomy and resilience dimension
- Combination of **industry (protection) policies** - PURPLE, and **competitiveness** - BLUE
- **Cost-competitive energy** - BLUE:
- We separate
 - EU ambitions/destinations and
 - Policies and use of EU instruments

“...Modelling exercises can set the **framework conditions** and project market uptake of transformative solutions and products.”
(outcome 5)

| | | Global climate action and fossil fuel prices | | EU economic development and consumer trends | | Geopolitical stability and global trade liberalisation | Environmental sustainability ambitions | | Viable EU process industries | | | | EU energy tech production* | EU clean energy production |
|-----|--|--|--------------------|---|--|--|--|------------------------|--|--|---|------|--|--|
| | | Global Climate Ambition | Fossil Fuel Prices | General EU economic growth | Consumer trends: Low-carbon preferences and sustainability | Global trade liberalisation | EU Climate neutral industries | EU circular industries | RESULT | How to reach viable EU process industries | | | Domestic production in strategic net-zero technologies | EU share of domestically produced clean energy |
| | | | | | | | | | Competitive commodity production costs | Low carbon product markets (product standards) | Supported production in strategic commodities (state aid) | | | |
| Num | Destination name | | | | | | | | | | | | | |
| 1 | Global Green Industries | High | Low | High | Low | High | High | High | Yes | Yes | No | NA | High | High |
| 2 | Competitive Green Process Industries | High | Low | High | Low | High | High | High | Yes | Yes | No | NA | Low | High |
| 3 | Standards Driven Dual Industries | Low | High | High | High | High | High | High | Yes | No | Yes | NA | High | High |
| 4 | Standards for Strategic Commodities | Low | High | High | High | High | High | High | Yes | No | Yes | NA | Low | High |
| 5 | Support Driven Dual Industries | Low | High | High | Low | High | High | High | Yes | No | No | High | High | High |
| 6 | Support Strategic Commodities | Low | High | High | Low | High | High | High | Yes | No | No | High | Low | High |
| 7 | Support Driven New dependencies | Low | High | High | Low | High | High | High | Yes | No | No | High | Low | Low |
| 8 | Competitive with New dependencies (Low circularity) | Low | High | High | Low | High | High | Low | Yes | Yes | No | NA | Low | Low |
| 9 | Support Driven Dual Industries (Low circularity) | Low | High | High | Low | High | High | Low | Yes | No | No | High | High | High |
| 10 | Support Strategic Commodities (Low circularity) | Low | High | High | Low | High | High | Low | Yes | No | No | High | Low | High |
| 11 | Race to the Bottom | Low | High | High | Low | High | Low | Low | Yes | Yes | No | NA | Low | Low |
| 12 | Autonomy without Transition | Low | High | High | Low | High | Low | Low | Yes | No | No | High | Low | Low |
| 13 | Net-Zero Tech Autonomy (Low circularity) | Low | High | High | Low | High | High | Low | No | No | No | Low | High | High |
| 14 | Net-Zero Tech Fortress (Low circularity) | Low | High | High | Low | Low | High | Low | No | No | No | Low | High | High |
| 15 | Industry relocation (Low circularity) | Low | High | High | Low | High | High | Low | No | No | No | Low | Low | Low |
| 16 | Lagging Europe - Green Standards (dual ind) | High | Low | Low | High | High | High | High | Yes | No | Yes | NA | High | High |
| 17 | Lagging Europe - Subsidy addicted (dual ind) | High | Low | Low | High | High | High | High | Yes | No | No | High | High | High |
| 18 | Support Driven Dual Industries in Low growth | Low | High | Low | Low | High | High | High | Yes | No | No | High | High | High |
| 19 | Support Driven Dual Industries in Low growth (Low circularity) | Low | High | Low | Low | High | High | Low | Yes | No | No | High | High | High |
| 20 | Stagnation without Transition | Low | High | Low | Low | High | Low | Low | Yes | No | No | High | Low | Low |
| 21 | Green Relocation and sufficiency | High | Low | Low | High | High | High | High | No | No | No | Low | Low | Low |
| 22 | Net-Zero Tech Fortress in Low growth | Low | High | Low | Low | Low | High | High | No | No | No | Low | High | High |
| 23 | Minimalist Transition | Low | High | Low | Low | High | High | Low | No | No | No | Low | Low | Low |
| 24 | Deindustrialisation after all | Low | High | Low | Low | High | Low | Low | No | No | No | Low | Low | Low |

Model inputs: is Europe self-sufficient in steel?

- More or less ...
- Total production: 130 Mt crude (~70Mt primary) / 118 Mt finished
- Trade balance: -16 Mt (~9% of total production)

TOTAL EXPORTS FROM THE EU

All qualities in metric tonnes

The EU exported 16.7 million tonnes of finished steel products in 2024

MAP = 2024

SOURCE: EUROFER



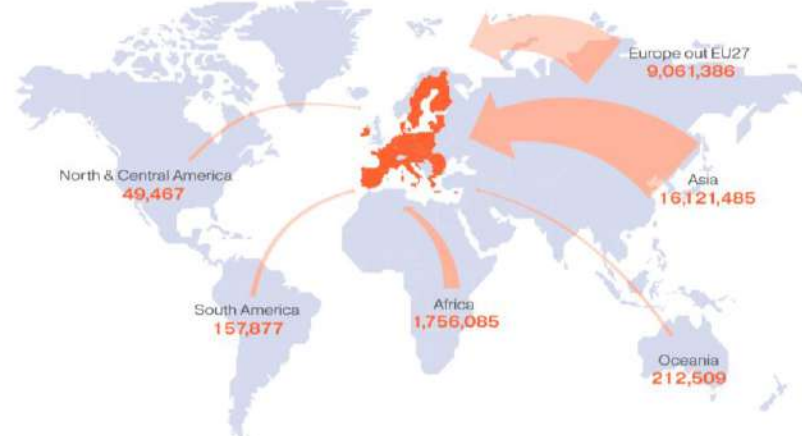
TOTAL IMPORTS INTO THE EU

All qualities in metric tonnes

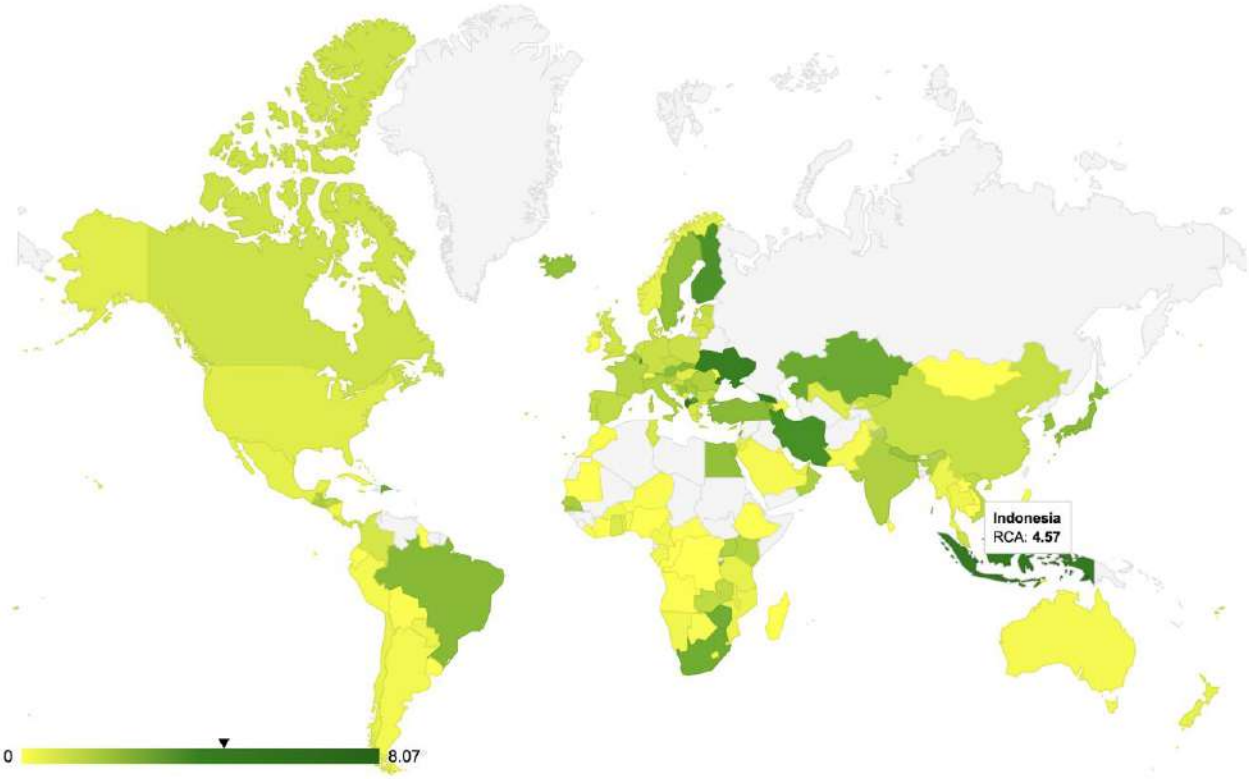
The EU imported 27.4 million tonnes of finished steel products in 2024

MAP = 2024

SOURCE: EUROFER



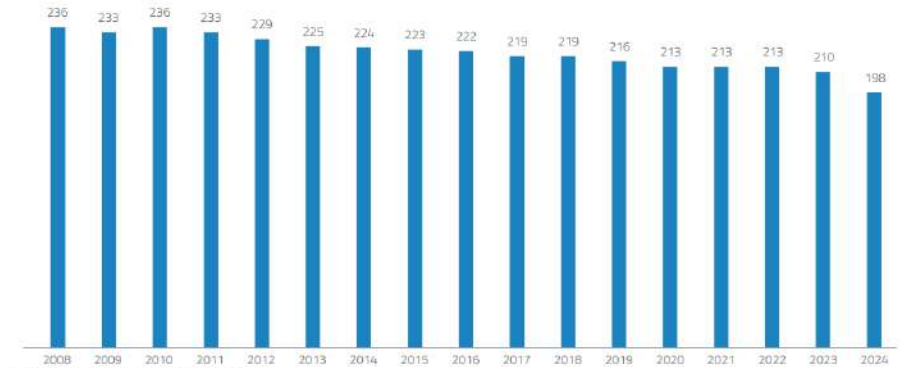
Trade competitiveness in iron & steel (HS72)



Steel global overcapacity

Three quotes (EC, 2025):

- Substantial increases in capacity are planned worldwide over the next three years [...] despite only modest global steel demand growth.
- Government support for the steel sector [...] in regions [with] rapidly expanding capacity → Middle East, North Africa, ASAN, China.
- Global excess capacity is expected to increase to **721 million tons** by 2027



CAPACITY UTILISATION
Percentage of total operating capacity

GRAPH • 2008-2024
SOURCE: EUROFER



Industry relocation elements

| | | (Primary) steel | Olefins | Ammonia |
|----------------------|------------------------------------|-------------------------------|--|---------------------------|
| Main characteristics | Production of finished steel | 118 Mt | ~14 Mt operational capacity | ~11Mt (2023) |
| | Consumption | 134 Mt | | ~13 Mt |
| | Trade balance | -16 Mt | Negative | ~9 Mt for fertiliser |
| | Share import / consumption | 20% | 31% (all chemicals) | -2Mt |
| | Utilization factor | 65% | 74% (all chemicals) | 17% |
| | Global competition | Large global overcapacity | Uncompetitive, ageing naphtha-based cracker capacity | ~40% for fertilizer |
| | Renewable pull* | 13-18% (Primary) | 36-38% | 74% (all chemicals) |
| | Main intermediates (exc. Hydrogen) | HBI | Methanol | Gas price differentiation |
| | Intermediates global market | No | Yes, but limited | 25-32% |
| | Commodity embedded products | Cars and other steel products | Polyethylene and plastics | - |
| | Trade protection | High: Tariff-Rate-Quotas | Low: Standard or no tariffs | Fertilizer |
| | CBAM | Yes | No | Low: Standard tariffs |
| | | | Yes | |