Deliverable 4: Assessment of minimum response capacities

Technical Support Instrument

Supporting reforms in 27 Member States

Funded by the European Union

GOBIERNO DE ESPAÑA
MINISTERIO DE INDUSTRIA, COMERCIO Y TURISMO

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Contents

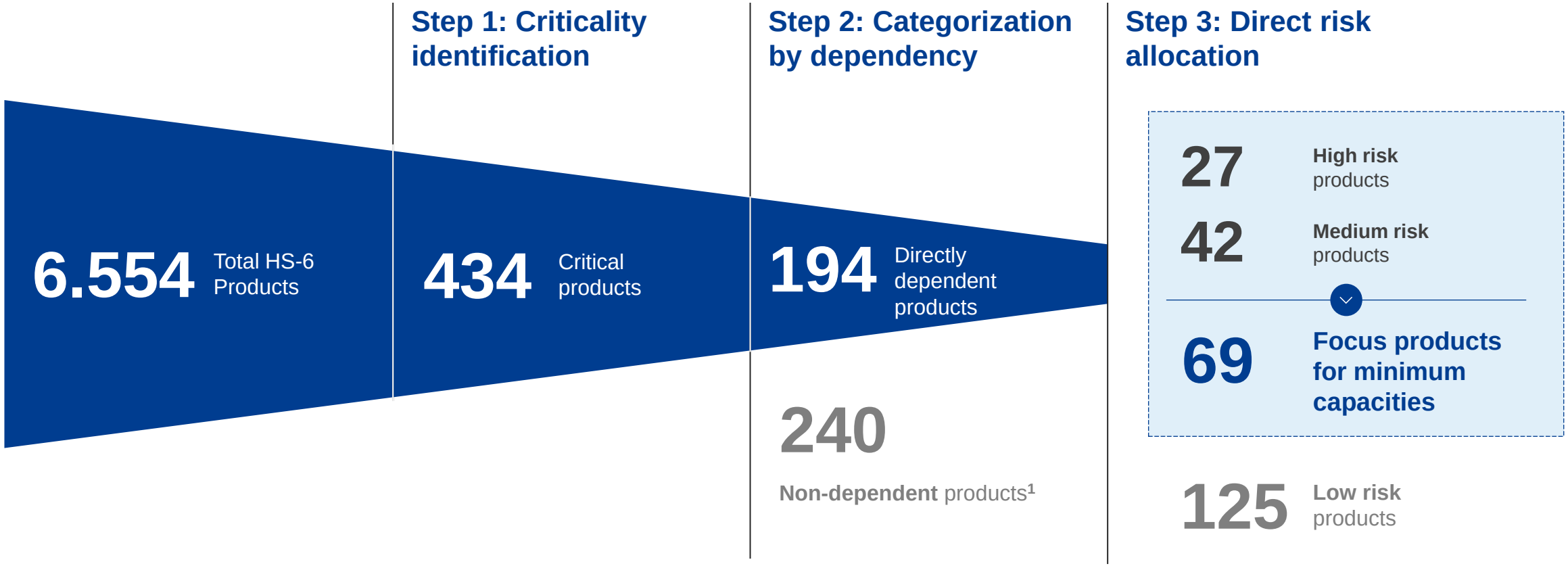
Executive Summary – [RECAP] Deliverable 3 results

- As part of **Deliverable 3**, a **methodology** was developed to **identify critical products** and the **level of supply risk** associated. The methodology is divided in **three main steps**:
  1. **Identification of critical products**, centered around the core concepts of **individual survival**, **national survival** and **economic importance**
  2. **Analysis of foreign dependence**, understood as the share of **national consumption** dependent on **foreign imports**
  3. **Analysis of direct supply risk**, defined as the intersection between **supply origin** (level of economic integration between Spain and the country of origin) and **supply concentration** (number of supplier countries and respective share of total imports) of foreign imports
- This methodology was applied to **4 strategic sectors**: **Defense**, **Energy**, **Health** and **Agriculture**. Using **international trade data**, the results (out of the **6.554 products**[1]) were the following:
  1. **434 critical** products identified; of which
  2. **194 directly dependent** products; of which
  3. **27 high risk** products, **42 medium risk** products and **125 low risk** products
- The **focus of the current deliverable** will be in quantifying the **national consumption** that is **at risk** for the **69 critical products of high/ medium risk** (27 high risk + 42 medium risk) and establishing a series of **mechanisms** to **increase resilience**

1. Total products in Harmonized System trade/ customs classification

[RECAP] The application of methodology results in 194 dependent products and 69 with high to medium direct supply chain risk

Application of methodology and #HS6 products



1. The 240 non-dependent products include 77 products for which there is no data and direct risk analysis could not be performed

Contents

Executive Summary – National consumption at risk approach

- With the goal of **quantifying the risk associated to the supply** of the 69 critical products of high/ medium risk, **a "national consumption at risk approach"** has been developed
- **National consumption at risk** is understood as the amount of **domestic consumption that Spain could stop having access to** in case of supply chain disruption
- **The quantification of the national consumption at risk allows** to **measure Spain's dependency** for the 69 critical products of high/ medium risk and helps **prioritizing** efforts in Spain's to reduce detected dependencies and increase resilience
- The national consumption at risk **approach** consists of **3 key steps**:

0. Identification and geolocalization of existing industrial capacities: the potential manufacturers of critical products of high/ medium risk have been geo-localized within Spain. This could help in case actions such as reinforcement or reconversion of manufacturing capacity for these products are considered

1. Calculation of consumption at risk: the amount of Spain's consumption that could be at risk in case of supply chain disruption has been quantified, considering imports of high/ medium risk (from now on "imports at risk") vulnerable. The process for calculating national consumption at risk for each specific product is as follows:

- In case imports at risk are lower than net imports, national consumption at risk is equal to imports at risk
- In case imports at risk are greater than net imports, national consumption at risk is equal to net imports

The calculation results in 42 Bn€ of consumption at risk (for the 69 products of high/ medium risk), out of which:

- **4 products, representing 33 Bn€ of consumption at risk, are not the object as this project** as they refer to oil and natural gas-related products (i.e. industrial manufacturing capacities not replicable in Spain)
- **65 products, representing 9 Bn€ of consumption at risk, are the focus for the application of the resilience mechanism framework** defined in next section of this document

2. Preparation of ranking based of national consumption at risk: 65 products have been ordered according to consumption at risk in order to represent Spain's dependance for each critical product of high/ medium risk

3-step framework for determining national consumption at risk

x *Detailed next*

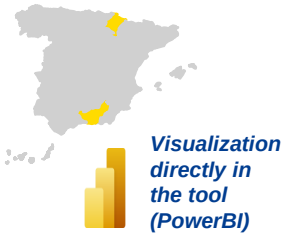
0 **Identify and geolocate existing industrial capacities**
Identify who and where in Spain critical products are manufactured

1 **Calculate “consumption at risk” (i.e., net imports at risk)**
Quantify dependency on risky net imports for national consumption

2 **Prepare a *ranking* based on the quantification of “consumption at risk”**
Establish an order of priority according to net imports at risk

0 Methodology for geolocation of existing industrial capacities

ILLUSTRATIVE

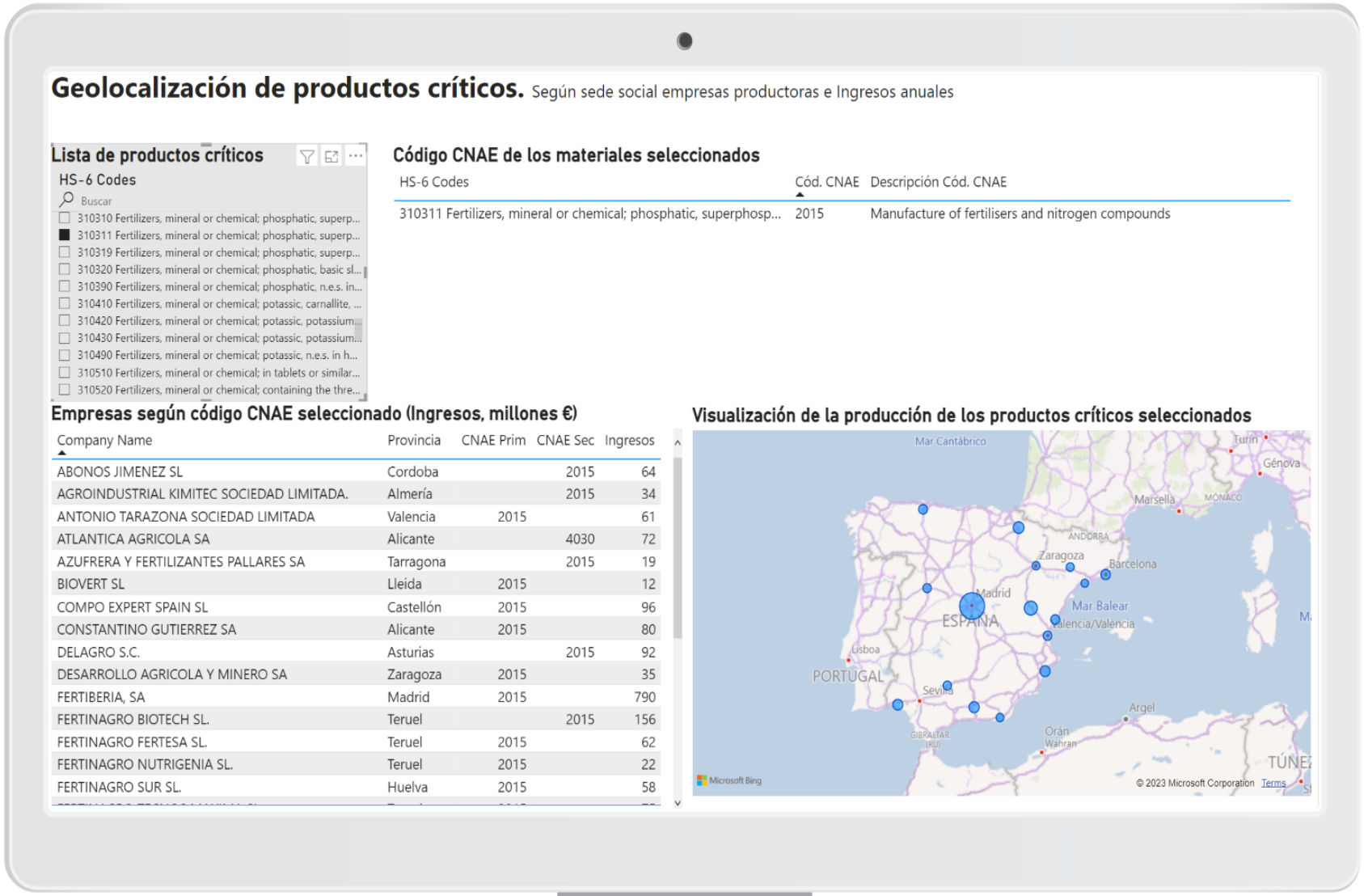
	Selection of a **critical material**	**Matching** with **CNAE codes**	**Identification** of **companies** with such **CNAE codes**	**Geolocation** of **companies** through their **headquarters**
Source	Methodology of Deliverable 3	Expert input	SABI – *Registro Mercantil*[1]	
Illustrative example	Fertilizers	2015 - Manufacture of fertilizers	• TIMAC Agro España • Herogra Fertilizantes SA	 *Visualization directly in the tool (PowerBI)*

- **Each critical material is considered manufactured** at the **headquarters** locations of the **companies** that **perform the economic activity (CNAE code)** to which **such material has been matched**
- **Approximate estimation** to identify **existing companies** producing similar products which **could be reinforced to create additional capacities**

1. Spain's public, commercial database

Source: SABI, Expert input

0 Geolocalization of existing industrial capacities in Spain



Dynamic visualization in PowerBI tool

Visualization directly in the tool available

❶Consumption at risk approach for prioritizing high risk critical products

Context

The consumption at risk approach focuses on the **amount of imports** that **Spain may stop having access to** in case of supply chain disruption

Imports coming from **high-risk countries** are considered **vulnerable** and act as the **main driver** for national consumption at risk

Consumption at risk (C_{risk}) approach

Formula

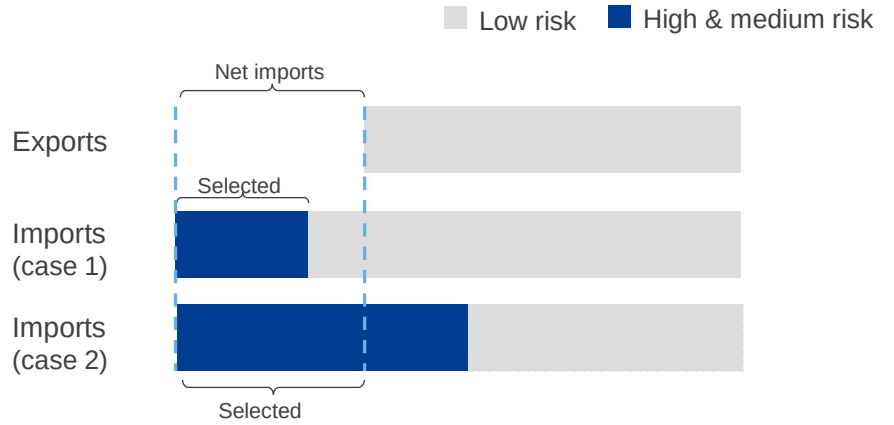
$$\text{If } \begin{cases} \text{Imports}_{\text{H/M}} < \text{NI} \rightarrow \text{C}_{\text{risk}} = \text{Imports}_{\text{H/M}} \\ \text{Imports}_{\text{H/M}} > \text{NI} \rightarrow \text{C}_{\text{risk}} = \text{NI} \end{cases}$$

where $\text{Imports}_{\text{H/M}}$ *is imports of high or medium risk and NI are net imports*

Key assumption

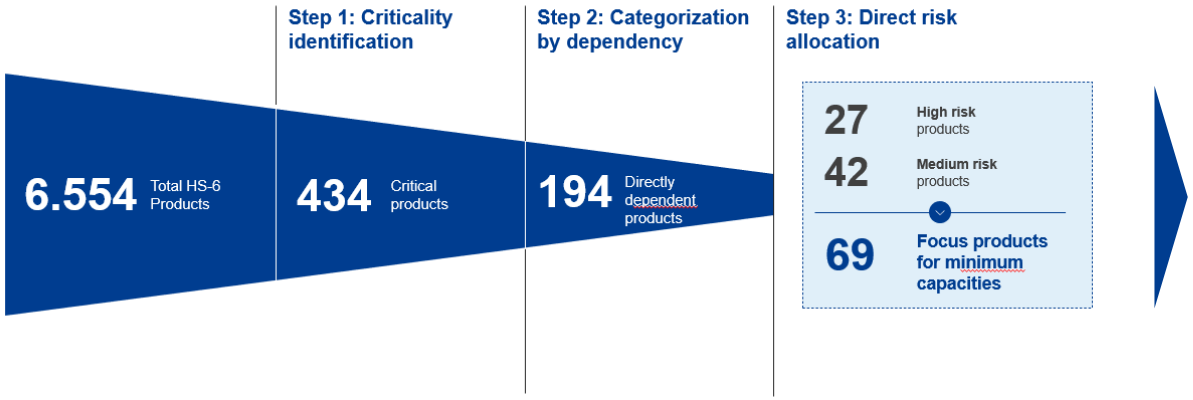
Exports' risk profile is independent from imports' risk profile

Graphic representation



1 Consumption at risk approach results

Classification and quantification process ...



... and results obtained

xx % over total imports 2021

Focus

42Bn€ ~12%

Total consumption at risk

69 products

33Bn€

- Oil & Derivatives
- Natural gas

4 products

9Bn€ ~3%

Other products:

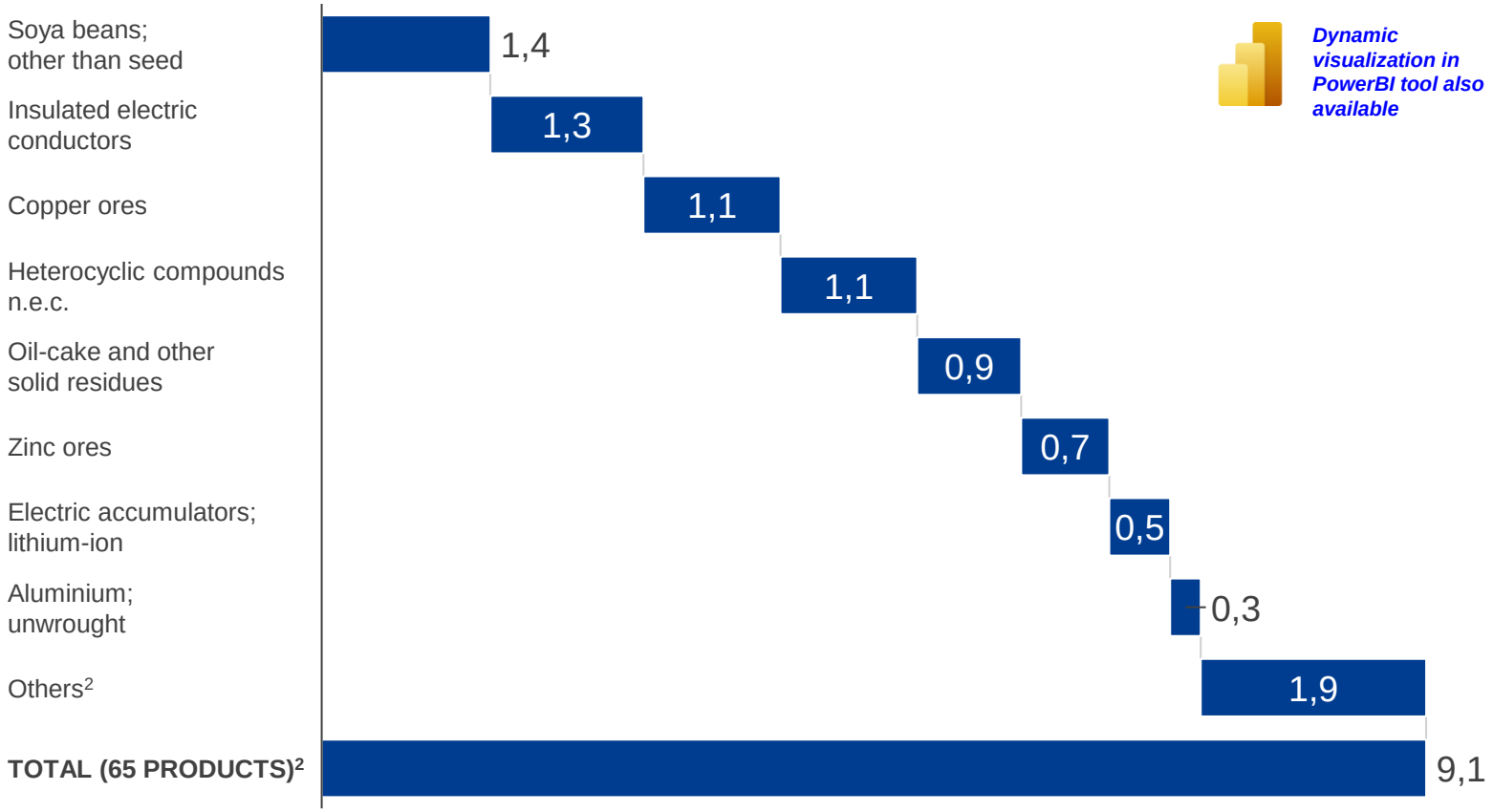
- Fertilizers
- Minerals
- Batteries
- …

65 products

Note: Oil and derivatives and natural gas will not be addressed due to the impossibility to build national capacities on them in Spain

2 Ranking based on consumption at risk

Consumption at risk[1], Bn€



Dynamic visualization in PowerBI tool also available

Total consumption at risk (~9B€) of 65 critical high/ medium risk **products must be addressed through resilience mechanisms** such as diversification, stockpiling or building of national capacities

1. Calculated as weighted average of 2018, 2019 and 2021 consumption
2. Includes critical 57 products

Note: Excludes oil and derivatives and natural gas (4 products) due to the impossibility to build national capacities on them in Spain. Names have been shortened due to representation purposes

Source: UN Comtrade, DataComex

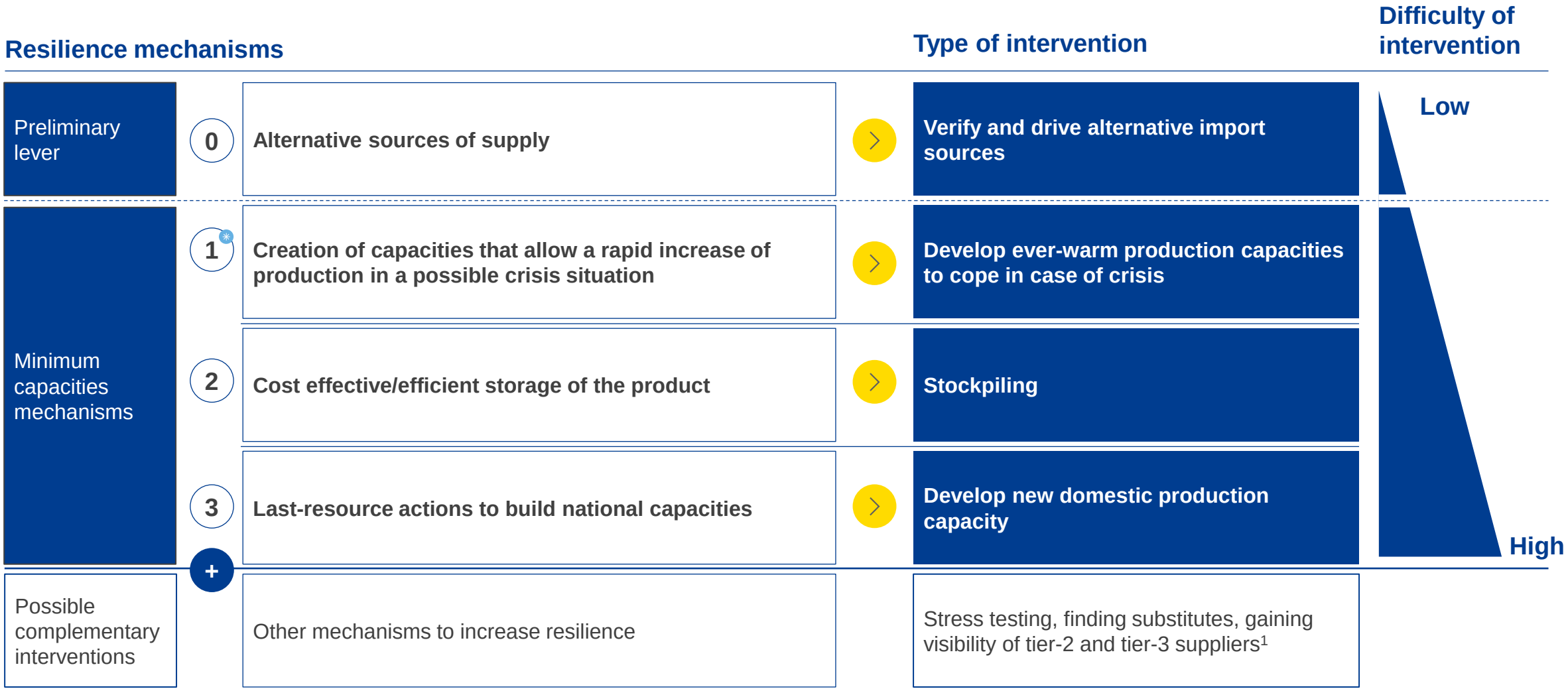
Contents

Executive Summary – Resilience mechanisms framework

- **A resilience mechanisms framework has been developed** in order to evaluate **potential lines of action that could be taken to reduce the national consumption at risk** (9.100 M€) of the 65 critical products of high/ medium risk identified in the previous section
- The **framework** includes:
  - **Preliminary lever,** namely: **Alternative sources of supply**
    - Prior to putting in place minimum capacities mechanisms, a **diversification** analysis is carried out, as **Spain could reduce national consumption at risk by merely starting to import** (or promoting further imports) **from lower-risk countries**
  - **Minimum capacities mechanisms**: for those products for which diversification is not enough (i.e. products that continue being high or medium risk after diversification potential), minimum capacities mechanisms must be put in place, these are (ordered by difficulty of intervention):
    1. **Capacities that allow a rapid increase of production** in a possible crisis situation (i.e. develop **ever-warm production lines)**
    2. **Cost effective/efficient storage** of the product (i.e. **stockpiling**)
    3. **Last-resource actions** to build national capacities (i.e. **develop new domestic production / factories** of critical products of high/ medium risk)
  - **Possible complementary interventions**: additionally to preliminary lever and minimum capacity mechanisms, other actions to increase national resilience could be taken (e.g. stress testing, finding substitutes). These interventions are not object of this document

Methodology for the selection of interventions that could increase the resilience of the supply chain in Spain

✳ This resilience mechanism will be covered in Deliverable 9



1. Not exhaustive

Contents

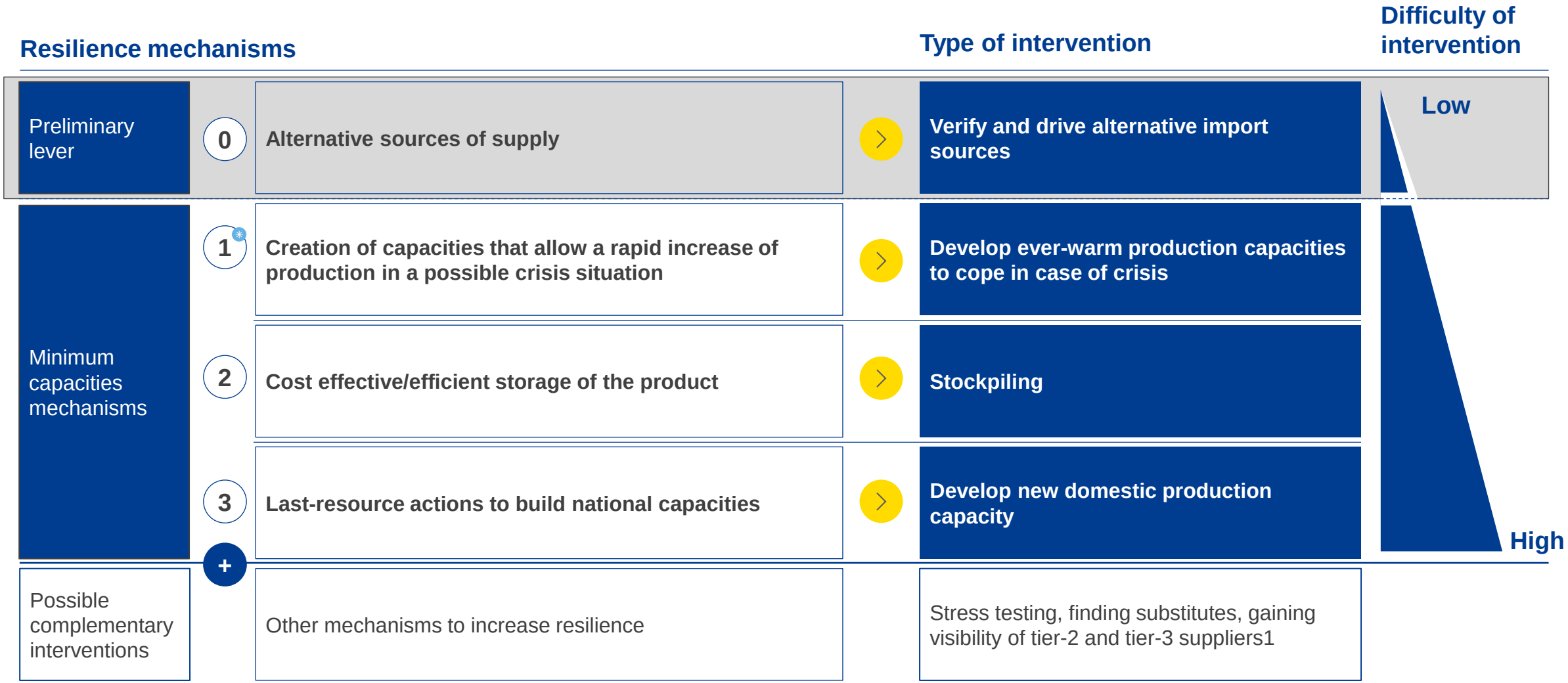
Executive Summary – Application of resilience mechanisms framework: Preliminary lever

- **Prior to building minimum capacities in Spain, alternatives sources of supply must be verified** to identify cases in which risk of supply of critical products can be reduced by promoting further imports from lower-risk countries
- For that end, **it has been assumed that the risk profile of global exports can be achieved**. This means that risk associated to origin and concentration of Spain's global imports can match that of global exports
- **Diversification analysis has been carried out for the 65 critical products of high/ medium risk (9.100 M€)** following the rationale described above. After that, products have been re-categorized again as high, medium or low risk (following the same logic as in Deliverable 3) taking into account the potential for diversification
- **Results obtained** are:
  - **18 out of 65 products become low risk**. This means that diversification would allow to reduce the risk enough for those products to be considered low risk. National consumption at risk of these 18 products is **3.800 M€**
  - **47 out of 65 products continue being high or medium risk**. This means that diversification would not allow to reduce the risk enough for those products to be considered low risk and other resilience mechanisms must be considered. National consumption at risk of these 47 products is **5.300 M€**
- **Products that continue being high or medium risk** (47) can be classified into several product categories (e.g., starch, primary batteries, nitrogenous fertilizers). **1 product category per strategic sector will be analyzed in-depth in order to provide a detailed example of how minimum capacities mechanisms could work**. These product categories are **Batteries** (Energy sector), **Printed circuits** (Defense sector), **Antibiotics** (Health sector) and **Fertilizers** (Agriculture sector)
- **Even though some mechanisms by themselves could be enough to reduce the risk for some products** (e.g., stockpiling fertilizers would allow Spain to have minimum capacities), **all mechanisms will be analyzed** to provide an end-to-end assessment

Methodology for the selection of interventions that could increase the resilience of the supply chain in Spain

Focus of this section

This resilience mechanism will be covered in Deliverable 9



1. Not exhaustive

Diversification could allow a reduction of ~4B€ in net imports of high/ medium risk products

DETAILEX NEXT

Approach

A product is considered diversifiable in case that its **exports' global distribution** is **more favorable** (i.e. more secure) than **Spain's imports distribution** for that product

For every diversifiable product, it is assumed that a **profile similar to that of global exports** (in terms of risk of origin and concentration) **is achievable**

Results

		Number of products, #	Total net imports, M€
A	**Products that become low risk**	18	3.800
B	**Products that continue being high and medium risk**[1]	47[2]	5.300[2]
		65[2]	**9.100**[2]

1. For some of them it is possible to diversify, but the risk is not reduced enough to be placed in the low-risk area of the matrix
2. Excludes 4 products (oil and derivatives and natural gas) worth 33B€

A Products that become low risk after diversification (1/2)

NOT EXHAUSTIVE

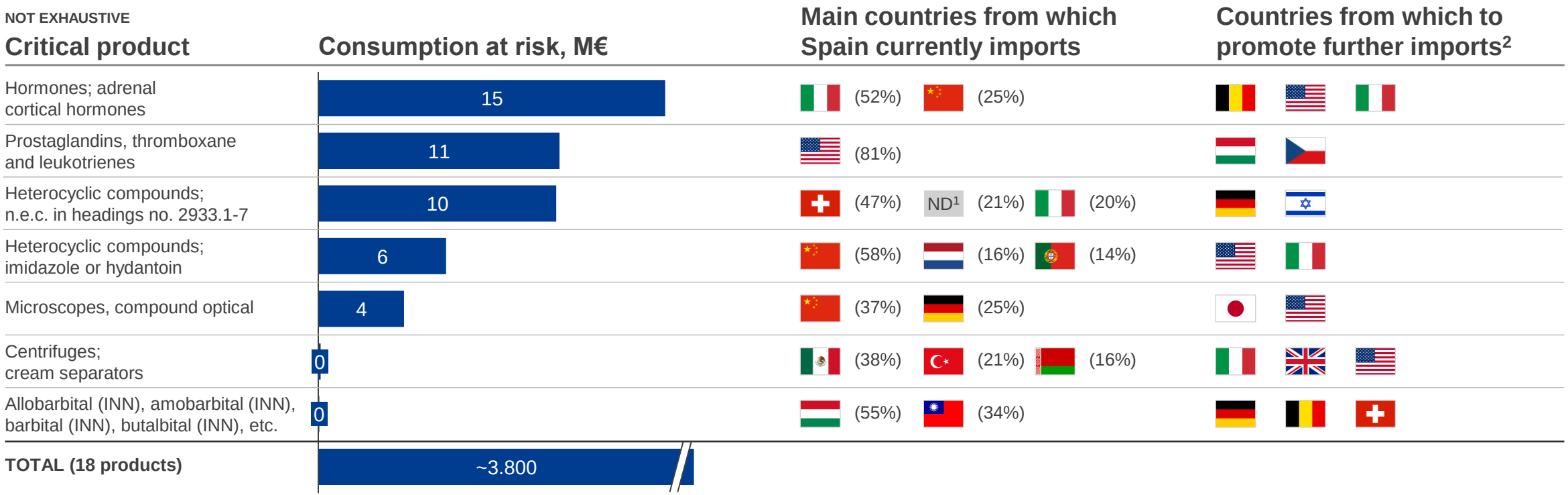
Critical product	Consumption at risk, M€	Main countries from which Spain currently imports	Countries from which to promote further imports[2]
Insulated electric conductors	1.262	(82%)	
Heterocyclic compounds; n.e.c. in headings no. 2933	1.127	ND[1] (33%) (31%) (14%)	
Zinc ores	726	(30%) (14%)	
Heterocyclic compounds; lactams	133	(77%)	
Antibiotics; n.e.s.	119	ND[1] (30%) (26%)	
Kaolin	106	(64%)	
Glands; heparin	78	(35%) (24%) (17%)	
Rubber; vulcanized	69	(64%) (15%)	
Aircraft and spacecraft; under-carriages	45	(38%) (24%) (17%)	
Fertilizers, mixtures of urea and ammonium	29	(56%)	
Heterocyclic compounds; containing pyrimidine, piperazine or nucleic acids	26	(32%) (30%) (21%)	

1. Countries not determined
2. Based on analysis of global exports

Source: UN Comtrade, DataComex

A Products that become low risk after diversification (2/2)

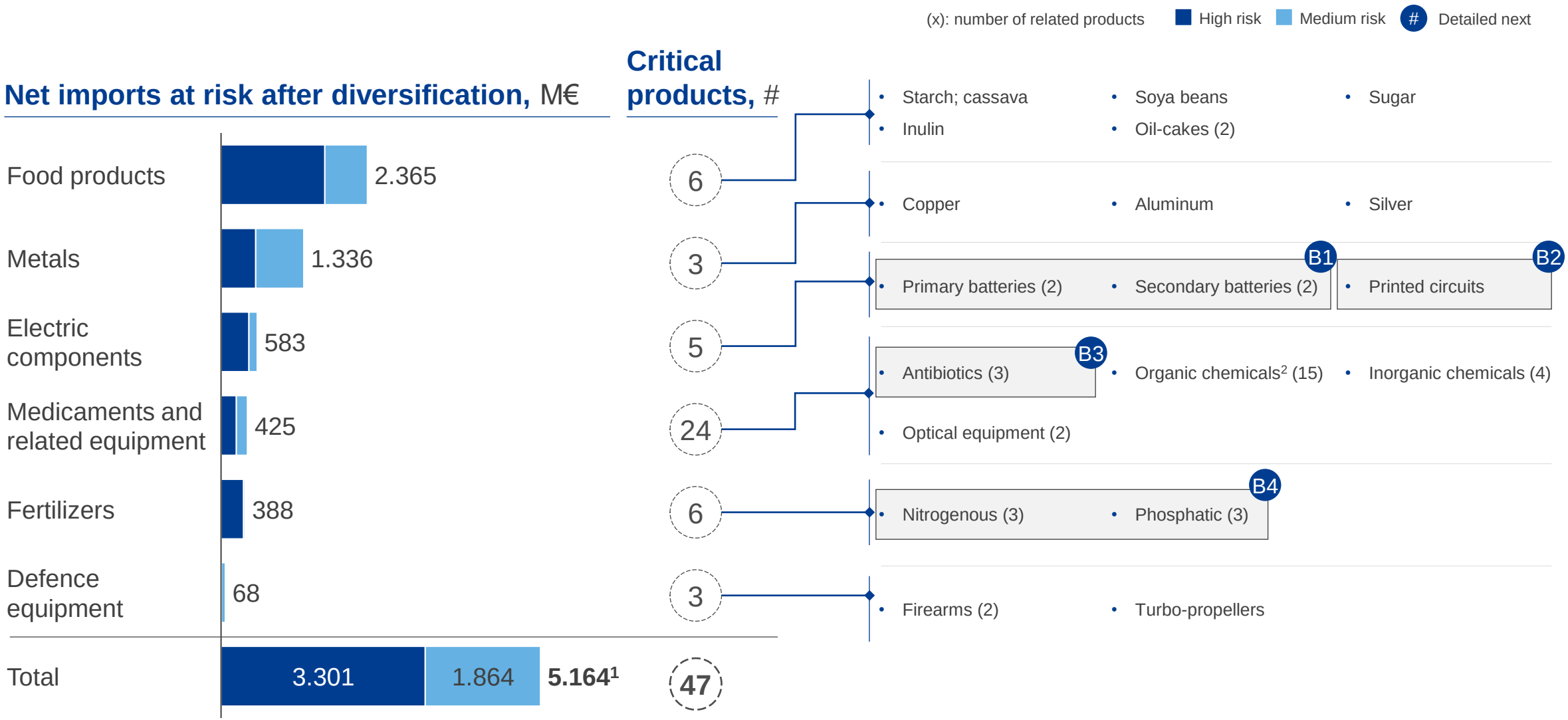
NOT EXHAUSTIVE



1. Countries not determined
2. Based on analysis of global exports

Source: UN Comtrade, DataComex

B Products that continue being high or medium risk after diversification



1. Does not include ~150M€ of consumption at risk that can be diversified
2. Other than antibiotics

Out of these products, the minimum capacities mechanisms will be analyzed in depth for one product category per strategic sector

Product categories to be considered for minimum capacities mechanisms

Strategic sector	Product category to be analyzed	Rationale
Energy	B1 Batteries	▪ **Sustainable substitute** for fossil fuels (e.g., oil for EV[1]) ▪ Global **demand** is **highly increasing** – expected to x7 from 2022 to 2030[2]
Defense	B2 Printed circuits	▪ **Essential role in telecommunications** (among others), key in the defense sector ▪ **Product** is object of **concern** due to **China's huge dominance**
Health	B3 Antibiotics	▪ **Representative example** of a class of medicaments
Agriculture	B4 Fertilizers	▪ **Essential** for improving **plant growth and yields** ▪ **Increasing importance** as population continues growing

These product categories will be **analyzed in-depth** for **all minimum capacities mechanisms**

However, in practice, **special attention** must be paid to the **difficulty** of implementation, **costs** and **potential blocks** before choosing the preferred mechanism

1. Electric vehicles
2. Considers lithium-ion batteries. Source: Battery 2030: Resilient, sustainable, and circular (McKinsey & Company, January 2030)

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Executive Summary – Application of resilience mechanisms framework: Minimum capacities

- **Once diversification analysis has been carried out**, **products that continue being high or medium risk must be considered for minimum capacities mechanisms** (i.e., ever-warm lines, stockpiling and/or domestic production)
- As explained in the previous section, **4 product categories** (batteries, printed circuits, antibiotics and fertilizers) are the **object of the minimum capacities mechanisms assessment in this section** due to their relevance in 4 strategic sectors (Energy, Defense, Health and Agriculture respectively)
- In relation to **stockpiling**, it has been concluded that **both antibiotics and fertilizers can be stockpiled**, while storing batteries and/ or printed circuits seems to be technically difficult and highly costly
- Regarding **domestic production**, **the analysis includes**:
  - **Overview of fundamentals**: summary of product description, types and main trends
  - **Dependency results and market assessment**:
    - Identification of specific products within the product category: e.g., urea fertilizer within 'Fertilizers' product category
    - Adjustment of criticality of some products (e.g., chloramphenicol antibiotic was initially considered a critical product of high risk according to methodology, but expert input suggests excluding it as its use is decreasing)
    - Overview of main global exporters and Spain's importers
  - **Calculation of costs (Capex and Opex) that would be necessary to cover 100% of national consumption at risk**. Results are:

    - Batteries: CAPEX of ~3.300-4.600 M€ and annual OPEX of ~4.800-7.300 M€

    - Printed circuits: building of domestic production seems unlikely due to the specificities of the manufacturing process– other resilience mechanisms should be considered

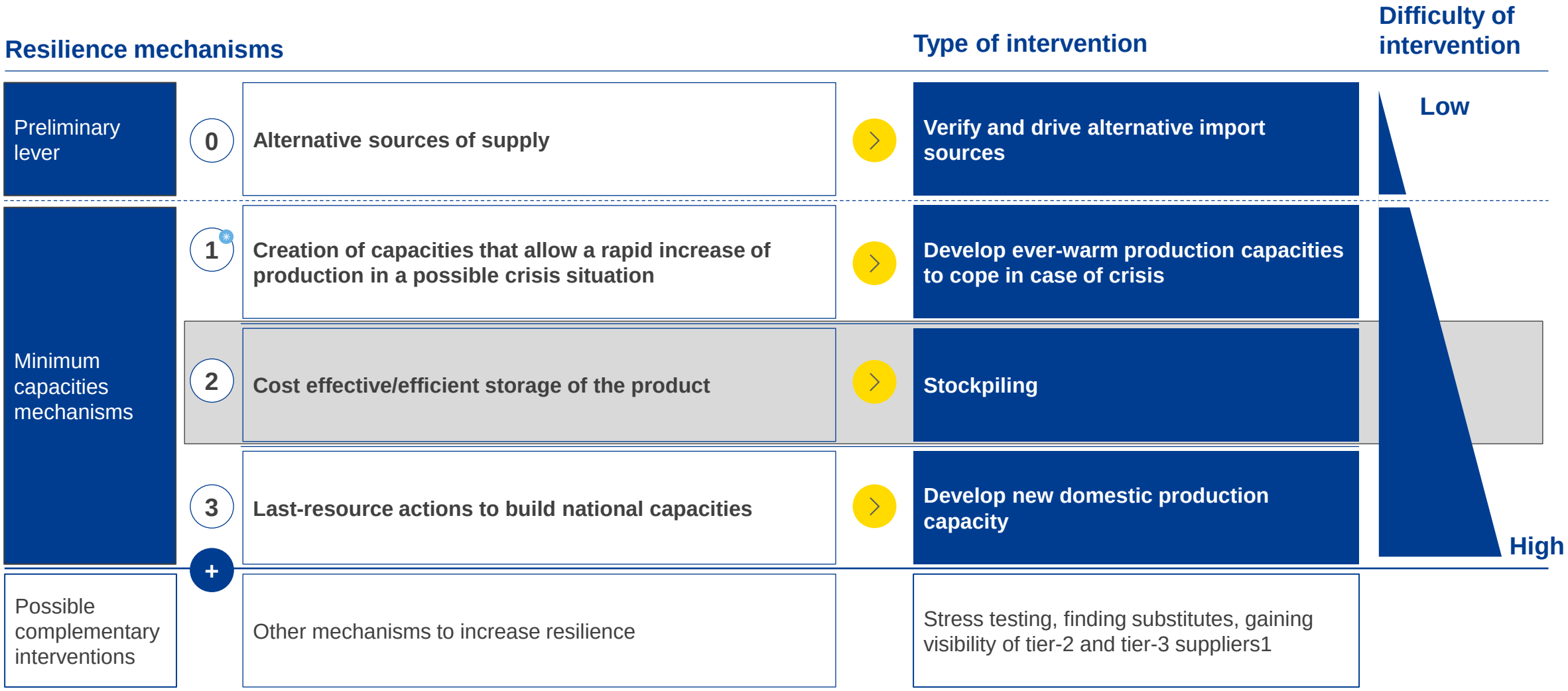
    - Antibiotics: TBD

    - Fertilizers: CAPEX of ~2.100-2.500 M€ and annual OPEX of ~500-700 M€

Methodology for the selection of interventions that could increase the resilience of the supply chain in Spain

Focus of this section

This resilience mechanism will be covered in Deliverable 9



1. Not exhaustive

Antibiotics and fertilizers could be stored at public or private facilities to increase resilience against supply chain disruptions

Product	Technical feasibility		Cost		Stockpiling overall feasibility
B1 **Batteries**	Low	• High **obsolescence** rate due to a **short shelf life** (<3 months) • High **risk of accidents** – release of flammable gases from batteries carries risk of explosion	High	• **Self-discharge** occurs when storing batteries – **continuous charging is required** to maintain maximum capacity • **No existing facilities or competitive advantage** to leverage	✗
B2 **Printed circuits**	Low	• **High obsolescence** rate due to a **short life span** (3 years from design to EOL[1]) • Very **delicate** - semiconductors must be **stored in dedicated areas** with controlled **temperature, vibrations and static electricity** levels	High	• **Required investment** to create **dedicated facilities** and **monitor stockpile** is very high • **Technology players** can leverage **existing facilities and competitive advantage** (e.g., Huawei, Toyota, have chips stockpiles) but **public incentives** must meet the cost requirements	✗
B3 **Antibiotics**	High	• Antibiotics **can be stored for a long time** (e.g., tetracycline has a shelf life of ~4 years if stored at -20C) • **Many EU countries have already created** dedicated medicines **stockpiles**	Mid	• **EU initiatives** dedicated to the creation and funding of **medical stockpiles** can be **leveraged**. For example, **RescEU stockpiles** are owned and hosted in Member States and **co-financed by the EU Commission**	✓
B4 **Fertilizers**	High	• Fertilizers **can be stored for ~1 year** at room temperature	Low	• **No extraordinary conditions or facilities** are required for storage	✓

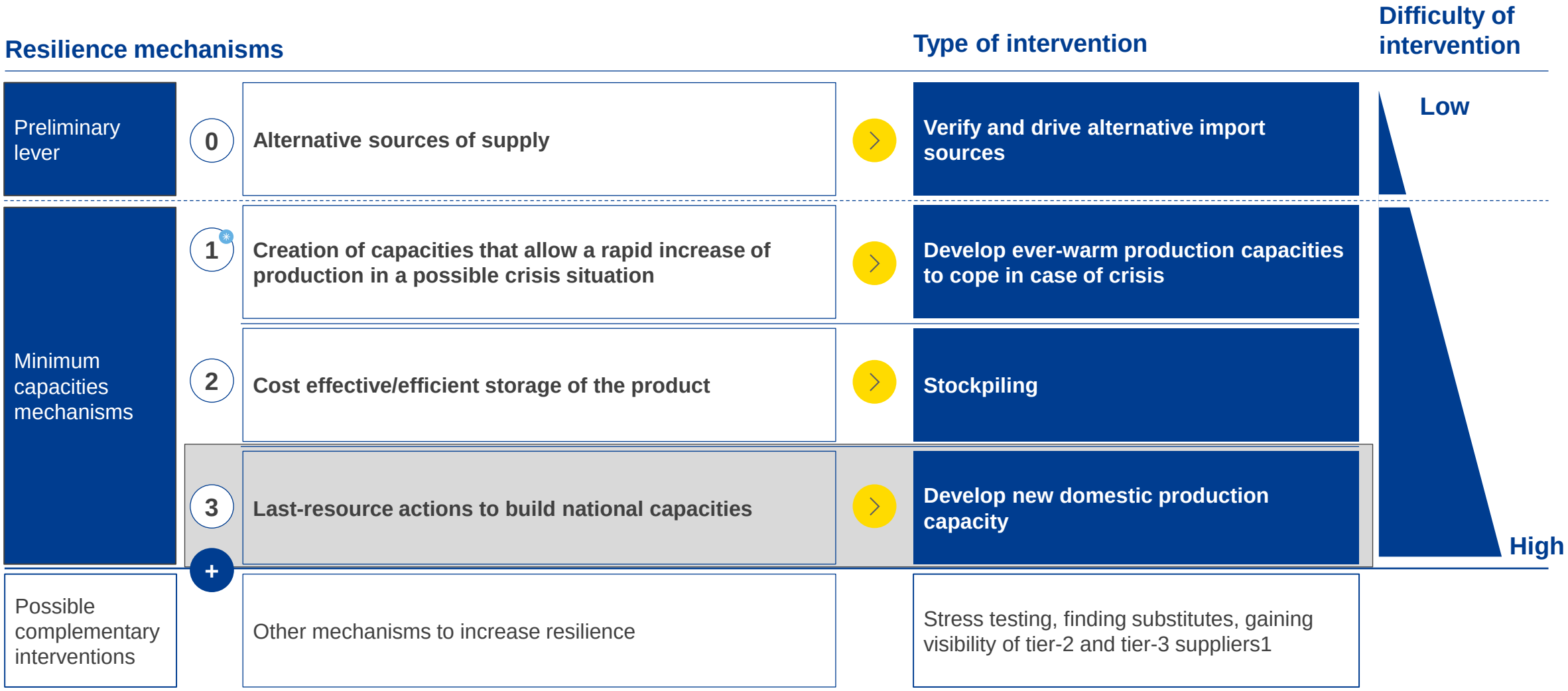
1. End of Life

Source: Expert input

Methodology for the selection of interventions that could increase the resilience of the supply chain in Spain

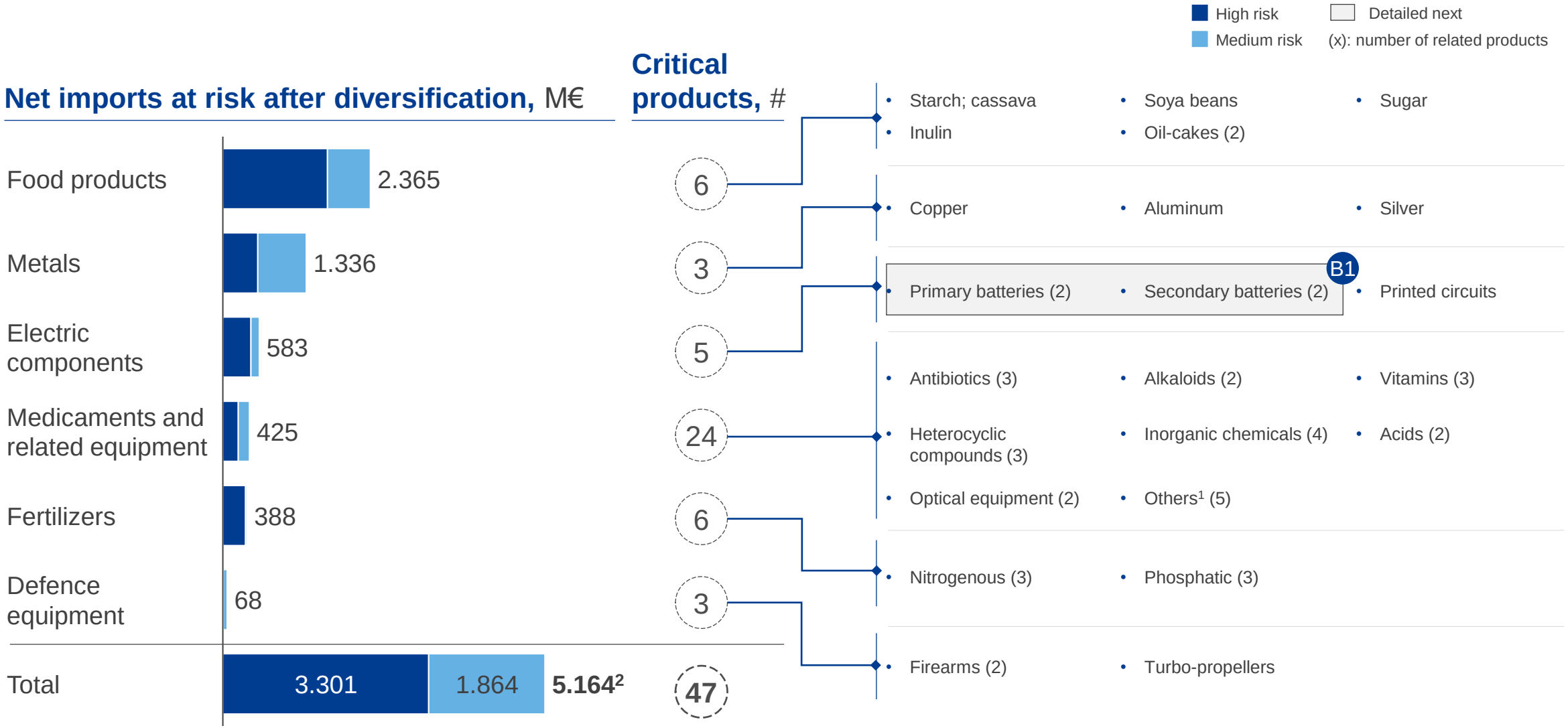
Focus of this section

This resilience mechanism will be covered in Deliverable 9



1. Not exhaustive

The +5Bn€ of imports that continue being high or medium risk after diversification can be categorized in 6 different groups



1. Includes cuclic amides, phenol, allorbabital, glycosides and cortisone hormone
2. Does not include ~150 M€ of consumption at risk that can be diversified

B1 Domestic production – Batteries

Overview of batteries fundamentals

Dependency results and market assessment

Development of domestic production

B1 Overview of batteries fundamentals

What are batteries?

Devices that convert chemical energy into electric energy by chemical reactions

Why are batteries so important?

Batteries are a sustainable and efficient solution to fossil fuels used in mobility and energy storage

What types of batteries are there?

Batteries can be classified into 3 different groups: lithium-ion, lead acid and others

B1 There are three main types of batteries, but only lithium-ion batteries are considered critical due to their high energy density and use in critical areas of mobility and storage

Focus of this document ✓ Typically used ✓ Technically feasible

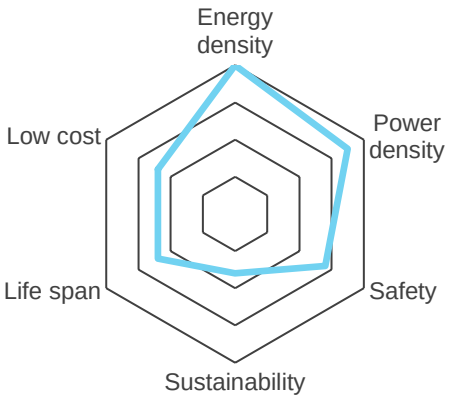
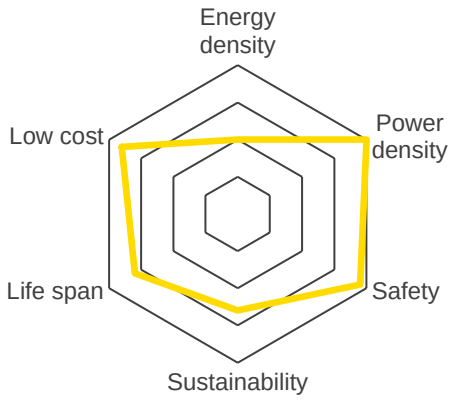
Types of batteries		A Lithium-ion					B Lead acid	C Others
		LFP	NMC	NCA	LCO	LMO		
Year First Commercialized		1996	2008	1999	1991	1996	1859	1889-1899
Mobility (Evs)		✓	✓	✓				
Primary applications	Stationary Storage	✓	✓				✓	✓
	Consumer Electronics			✓				
	Others					✓	✓	✓
Energy density (Wh/kg)		120-180	200 - 275	200 - 280	150 - 200	120 - 150	30 - 50	45 - 120

Li-Ion batteries - and particularly LFP, NMC and NCA types – are the dominating solution used in the **critical areas of mobility and storage**

Source: McKinsey Battery Insights, Expert Interviews, Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study

B1 Within lithium-ion batteries, NMC and LFP are expected to dominate the market in the coming years

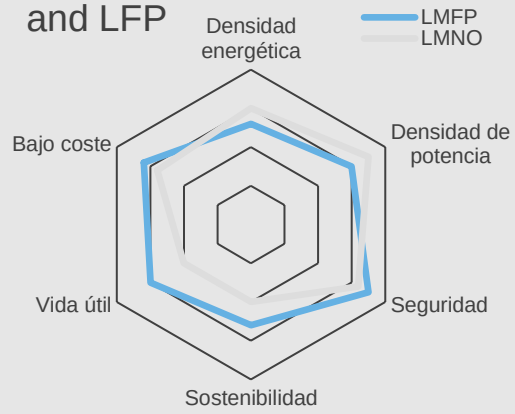
Detail next

	NMC **Nickel Manganese Cobalt**	LFP **Lithium-iron phosphate**
Chemistry		
Key advantages	High capacity and high power Suitable for long-range EVs and mid/high-end industrial or medical applications	Low-cost chemistry with high intrinsic safety, longer life-span Tailored for ESS and short-range/entry-level EVs
Key disadvantages	High-cost chemistry due to materials Exposure to supply constraints (geopolitical risk)	Lower capacity and power Less financially viable recycling scheme
Europe's perspective	**Easier market to entry** due to possibility of competing on price with China **Huge increase in number of announcements** of plants creation	**Highly competitive market** with China being the top player **Only 2 announcements** of plant creations in Europe

Source: McKinsey Battery Insights

Key takeaways

- There are **different NMC cells** e.g., NMC 9.5.5, NMC 8.1.1, NMC 7.3.0 which represent the **share of materials in the cathode**
- **LMFP,** lithium manganese iron phosphate and **LMNO** lithium manganese nickel oxide have potential to be an **optimal compromise** between NMC and LFP



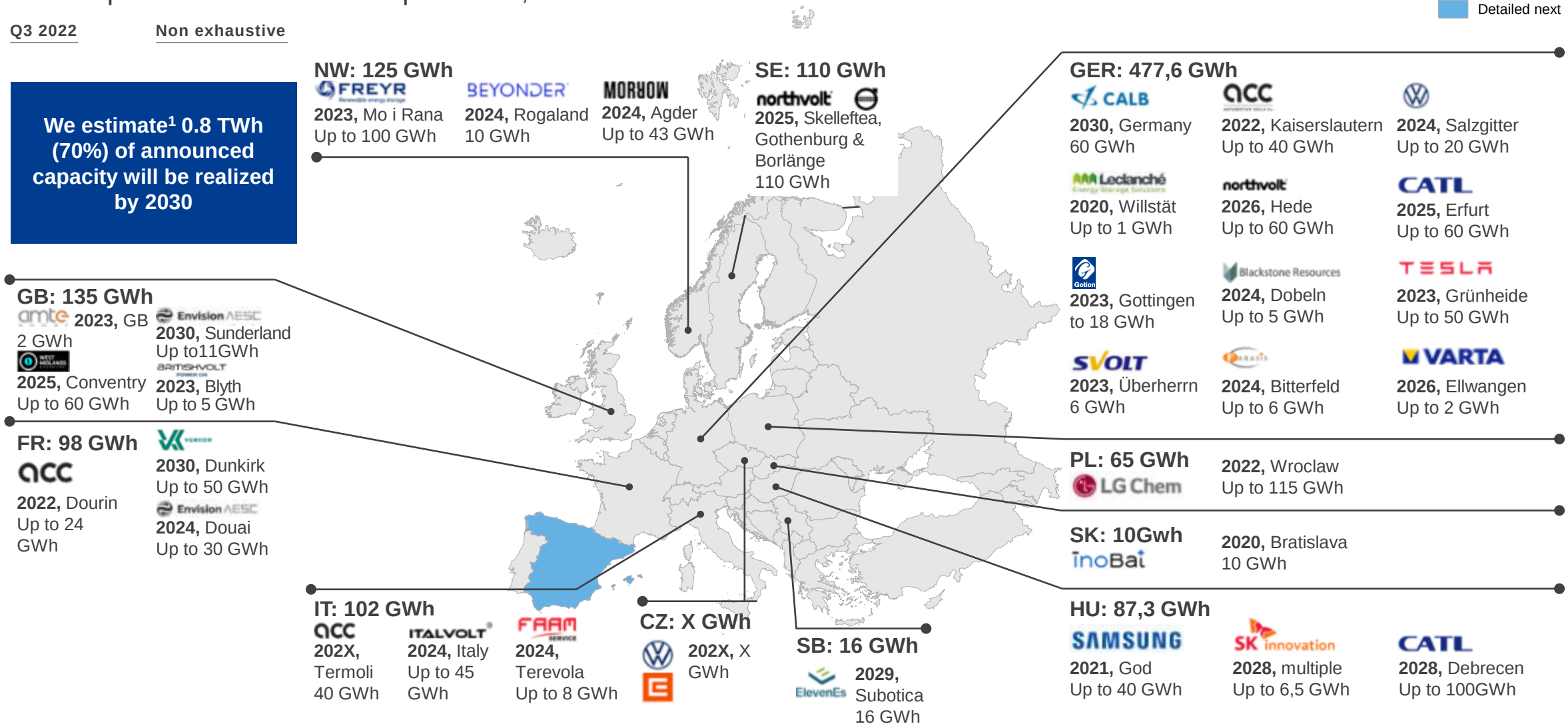
B1 As a result, many European countries have announced the creation of NMC and LFP battery plants

EU cell plant announcements up to 2030, in GWh

Q3 2022 Non exhaustive

Detailed next

We estimate[1] 0.8 TWh (70%) of announced capacity will be realized by 2030



NW: 125 GWh
- FREYR — **2023,** Mo i Rana, Up to 100 GWh
- BEYONDER — **2024,** Rogaland, 10 GWh
- MORROW — **2024,** Agder, Up to 43 GWh

SE: 110 GWh
- northvolt — **2025,** Skelleftea, Gothenburg & Borlänge, 110 GWh

GER: 477,6 GWh
- CALB — **2030,** Germany, 60 GWh
- ACC — **2022,** Kaiserslautern, Up to 40 GWh
- VW — **2024,** Salzgitter, Up to 20 GWh
- Leclanché — **2020,** Willstät, Up to 1 GWh
- northvolt — **2026,** Hede, Up to 60 GWh
- CATL — **2025,** Erfurt, Up to 60 GWh
- Gotion — **2023,** Gottingen to 18 GWh
- Blackstone Resources — **2024,** Dobeln, Up to 5 GWh
- TESLA — **2023,** Grünheide, Up to 50 GWh
- SVOLT — **2023,** Überherrn, 6 GWh
- Parabel — **2024,** Bitterfeld, Up to 6 GWh
- VARTA — **2026,** Ellwangen, Up to 2 GWh

GB: 135 GWh
- amte — **2023,** GB, 2 GWh
- Envision AESC — **2030,** Sunderland, Up to11GWh
- West Midlands — **2025,** Conventry, Up to 60 GWh
- Britishvolt — **2023,** Blyth, Up to 5 GWh

FR: 98 GWh
- ACC — **2022,** Dourin, Up to 24 GWh
- Verkor — **2030,** Dunkirk, Up to 50 GWh
- Envision AESC — **2024,** Douai, Up to 30 GWh

PL: 65 GWh
- LG Chem — **2022,** Wroclaw, Up to 115 GWh

SK: 10Gwh
- InoBat — **2020,** Bratislava, 10 GWh

IT: 102 GWh
- ACC — **202X,** Termoli, 40 GWh
- ITALVOLT — **2024,** Italy, Up to 45 GWh
- FAAM — **2024,** Terevola, Up to 8 GWh

CZ: X GWh
- VW — **202X,** X GWh
- Škoda

SB: 16 GWh
- ElevenEs — **2029,** Subotica, 16 GWh

HU: 87,3 GWh
- SAMSUNG — **2021,** God, Up to 40 GWh
- SK Innovation — **2028,** multiple, Up to 6,5 GWh
- CATL — **2028,** Debrecen, Up to 100GWh

1. Estimation based on project financing, announced partnership with upstream and downstream supply chain and company's intellectual property

Source: McKinsey Battery Insights, Press search

B1 Domestic production – Batteries

Overview of batteries fundamentals

Dependency results and market assessment

Development of domestic production

B1 After applying our methodology, 4 types of batteries have been identified as critical and with high or medium risk of supply for Spain

Process followed for each product:

- **Identified as critical**
- Assigned **high or medium supply risk**
- Calculated **potential of diversification, which is not enough as resilience mechanism** due to worldwide market structure

Critical batteries of high/ medium risk	HS6 code
1 **Cells and batteries; primary, manganese dioxide**	850610
2 **Cells and batteries; primary, silver oxide**	850640
3 **Electric accumulators; nickel-iron, including separators**	850740
4 **Electric accumulators; lithium-ion, including separators**	850760

B1 However, we have adjusted the dependency methodology results for batteries to incorporate forward-looking expert input

Process

Process followed for batteries:

- **All types of batteries identified as critical in principle**
- Assigned **high or medium supply risk based on dependency and origin of imports, and applied potential of diversification[1]**
- **Incorporated expert input** on battery market and outlook

Results

Not considered for minimum capacities assessment | Considered for minimum capacities assessment | Focus next

Batteries	Critical and H/M[2] risk according to methodology?	Expert based adjustment	Final result
1 **Cells and batteries; primary, manganese dioxide**	YES	▪ Mainly **used in wristwatches and calculators** ▪ **Non-rechargeable**	✗
2 **Cells and batteries; primary, silver oxide**	YES	▪ Mainly **used in watches, photoelectric exposure devices and hearing aids** ▪ **Non-rechargeable**	✗
3 **Electric accumulators; nickel-iron, including separators**	YES	▪ Mainly **used in railroad signaling, trucks/forklifts and mines**	✗
4 **Electric accumulators; lithium-ion, including separators**	YES	▪ Global **demand** is **highly increasing** – expected to x7 from 2022 to 2030[3], with **mobility** as the **main driver**	✓

1. Potential of diversification not enough as a resilience mechanism due to worldwide market structure
2. High or medium risk
3. Source: Battery 2030: Resilient, sustainable, and circular (McKinsey & Company, January 2030)

B1 Lithium-ion batteries present a highly concentrated market, with China being the main worldwide exporter

Products	Concentration assessment	Key worldwide exporters[1], 2018-2021	Origin of imports (Spain), 2018-2021
4 **Electric accumulators; lithium-ion, including separators**	**Highly concentrated market** – China exports ~40% of product globally	• China (39%) • Republic of Korea (11%)	• China (47%) • USA (11%) • Germany (10%)

1Note: HS does not differentiate among different types of Li-Ion batteries

B1 Domestic production – Batteries

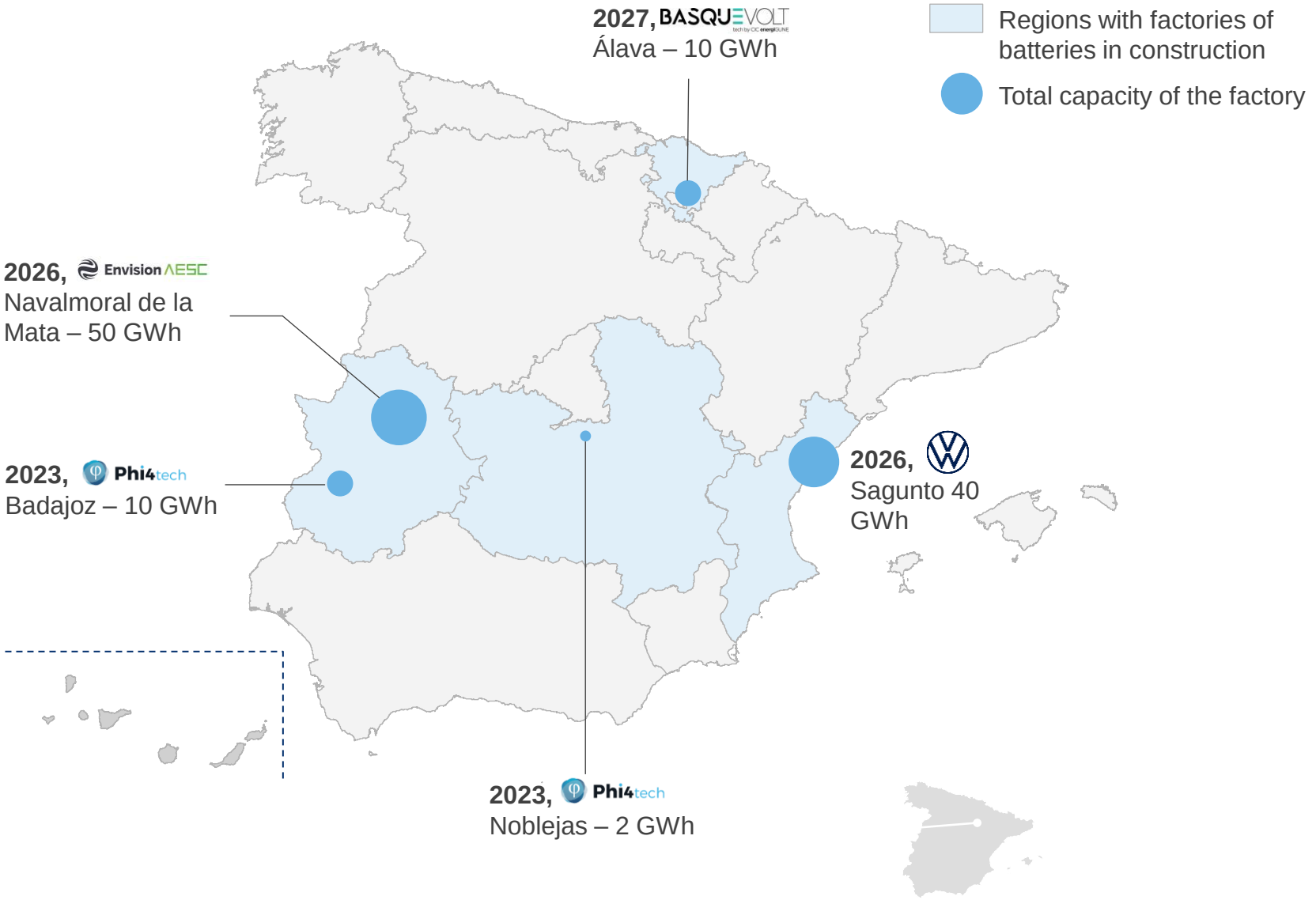
Overview of batteries fundamentals

Dependency results and market assessment

Development of domestic production

B1 Overview of Spain's national capacities on lithium-ion batteries

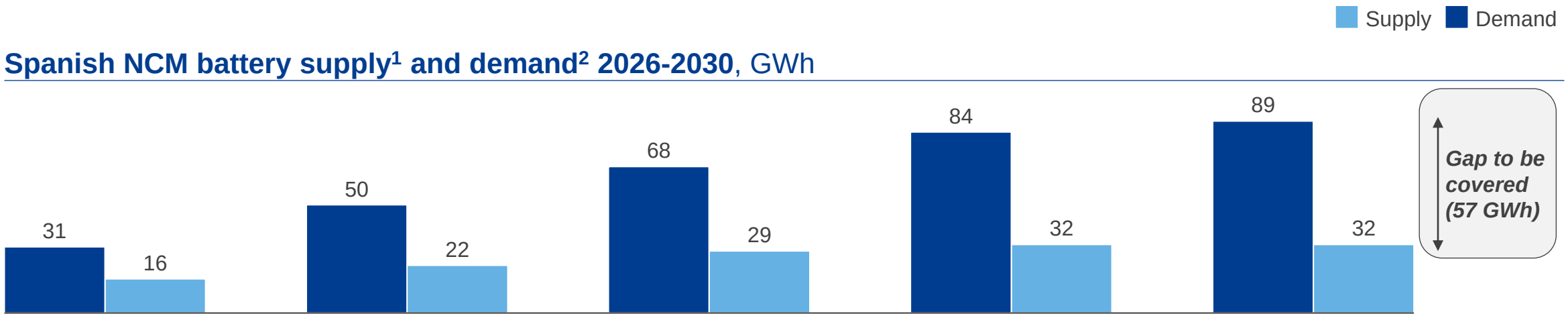
Ongoing projects and year of start of operations



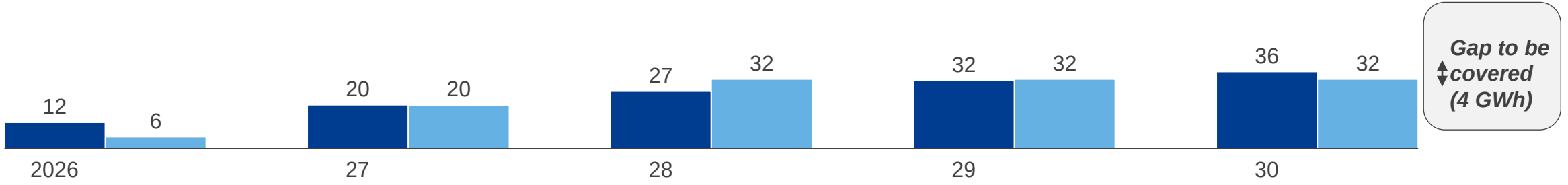
- There are currently **5 factories under construction**, with a total **capacity of ~110GWh** expected by **2027**
- **Spain's 2027 demand** is expected to be **~50GWh**
- **Spain-based companies** (Phi4tech and Basquevolt) **only represent 22GWh (20%** of total expected capacity)

B1 While Spain is expected to cover most of the LFP batteries demand, it is expected to meet only ~40% of 2026-2030 NCM batteries demand

Spanish NCM battery supply[1] and demand[2] 2026-2030, GWh



Spanish LFP battery supply[1] and demand[2] 2026-2030, GWh



1. Expected effective supply based on public announcements
2. Excluding consumer electronics demand

Source: McKinsey Battery Insights, Team analysis

B1 Initial and annual operating costs for the batteries factories necessary to cover the lack of offer in Spain

4 Electric accumulators; lithium-ion, including separators

		NMC	LFP
Key raw materials		Lithium, Iron, Manganese, Aluminum, Cobalt and Nickel	
Consumption to cover, GWh/year		57	4
CAPEX (Initial cost)	**Mill. € / GWh**	55-75	55-75
	Mill. € to cover 100% of imp. net at risk	3.100-4.300	200-300
OPEX (Annual operating cost)	**Mill. € / GWh / year**	80-120	80-120
	Mill. € / year to cover 100% of imp. net at risk	4.500-6.800	300-500
Construction time		3 years	

Additionally, it would be necessary to secure agreements with key *input* producers from low-risk countries in the long term (*detail below)*

Note 1: In case of wanting to calculate CAPEX to cover only a part of the imports at risk, economies of scale and other factors that may affect should be considered
Note 2: This scenario describes the largest investment needed as it considers factory building from scratch. Other methods such as (e.g., creating *ever-warm* lines) would have a lower cost

B1 Additionally, securing access to the different materials used in Li-Ion batteries is critical

Type of battery	Cathode material	Overview	Regions of main reserves
LFP	3 Li Lithium 6.94	Lithium is part of the cathode in **LFP, Lithium-iron phosphate** batteries. Of the total lithium demand in 2030 batteries are expected to account for >90%	Australia, China, Chile, Argentina
	26 Fe Iron 56.845	Iron is used in the **LFP, Lithium-iron phosphate cathode.** It is an abundant resource and make up approx. half of the material in the cathode	Australia, Brazil, India, China
NMC and NCA	25 Mn Manganese 54.93	Manganese is the material used in **NMC, Nickel Manganese Cobalt** cathode chemistry and is one of the most abundant resources	Australia, China, India, Gabon
	13 Al Aluminium 26.98	Aluminum is part of the **NCA, Nickel Cobalt Aluminum** cathode chemistry and is derived from Bauxite ore considered an abundant resource	Australia, China, Guinea, Brazil
	27 Co Cobalt 58.93	Cobalt is used in the **NMC** and the **NCA** cathode and is one of the more debated materials due to its social responsibility challenges	Congo, Australia
	28 Ni Nickel 58.69	Nickel, specifically Nickel class 1 is one of the materials in the **NMC** and the **NCA** cathode, and represent largest share of material in the cathode	Indonesia, Australia, Russia, Brazil

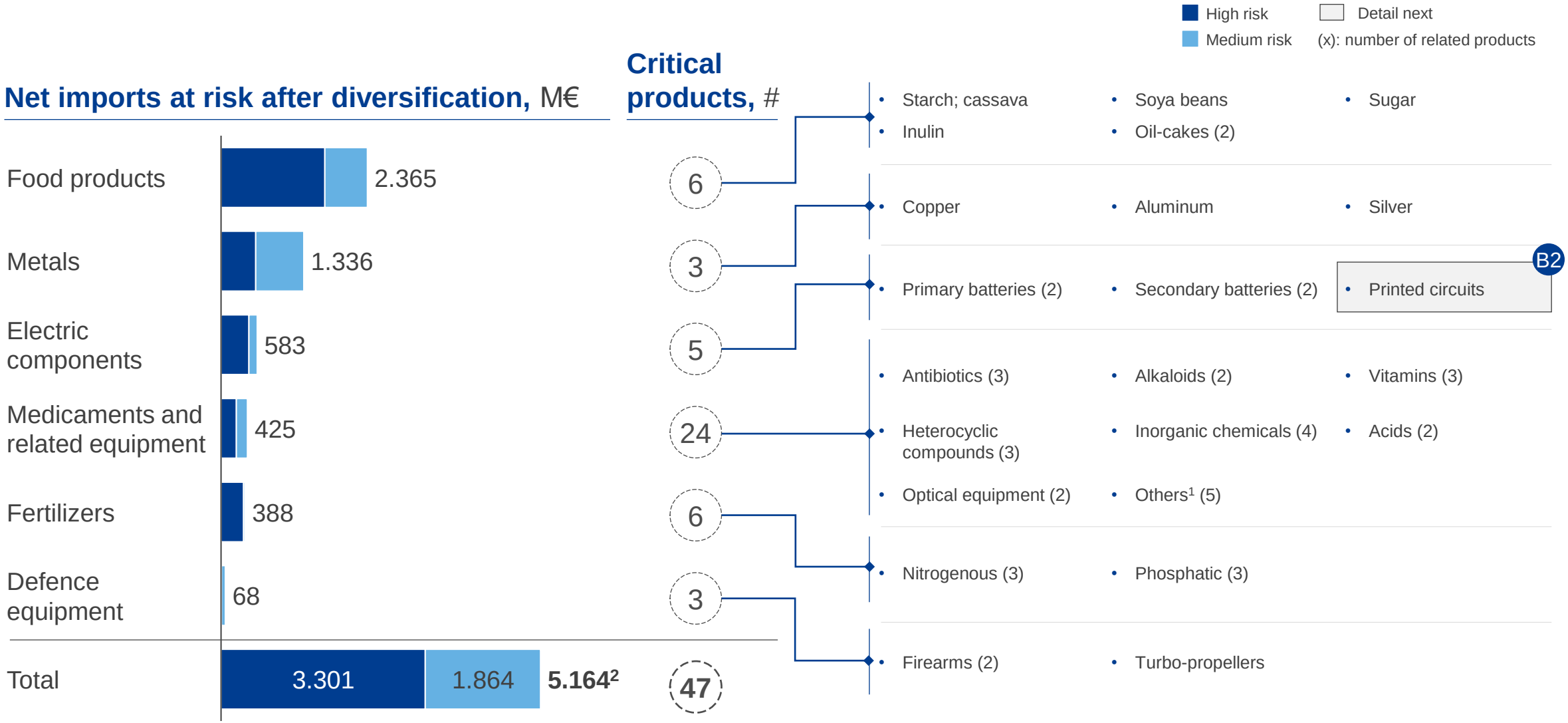
Source: Expert interviews, Press search, Statista

B1 Spain should also increase resiliency on key battery input materials

Products	Concentration assessment	Key worldwide exporters[1], 2018-2021	Origin of imports (Spain), 2018-2021	Covered by CRMA
3 Li Lithium 6.94	**Concentrated market – 3 players export ~ 50%** of the total product	China (32%), USA (15%) and Singapore (11%)	France (19%), China (19%) and Germany (10%)	✓
26 Fe Iron 56.845	**Concentrated market – 2 players export ~85%** of the total product	Australia (63%) and Brazil (22%)	Brazil (62%) and Canada (28%)	✗
25 Mn Manganese 54.93	**Highly concentrated market – S. Africa exports ~80%** of the total product	South Africa (80%)	South Africa (51%) and Gabon (37%)	✓
13 Al Aluminium 26.98	**Concentrated market – 4 players export ~ 80%** of the total product	India (39%), Canada (14%), Russia (14%) and Australia (10%)	Mozambique (42%), United Kingdom (14%) and Bahrein (11%)	✓
27 Co Cobalt 58.93	**Highly Concentrated market – Congo exports ~ 95%** of the total product	Democratic Republic of the Congo (95%)	United Kingdom (50%) and Netherlands (41%)	✓
28 Ni Nickel 58.69	**Concentrated market – 3 countries export +60%** of the total product	Philippines (27%), Zimbabwe (22%) and Indonesia (12%)	*Data non available*	✓

1Note: HS does not differentiate among different types of Li-Ion batteries

The +5Bn€ of imports that continue being high or medium risk after diversification can be categorized in 6 different groups



1. Includes cuclic amides, phenol, allorbabital, glycosides and cortisone hormone
2. Does not include ~150 M€ of consumption at risk that can be diversified

B2 Domestic production – Printed circuits

Overview of printed circuits fundamentals

Dependency results and market assessment

Development of domestic production

B2 Overview of printed circuits fundamentals

What are printed circuits?

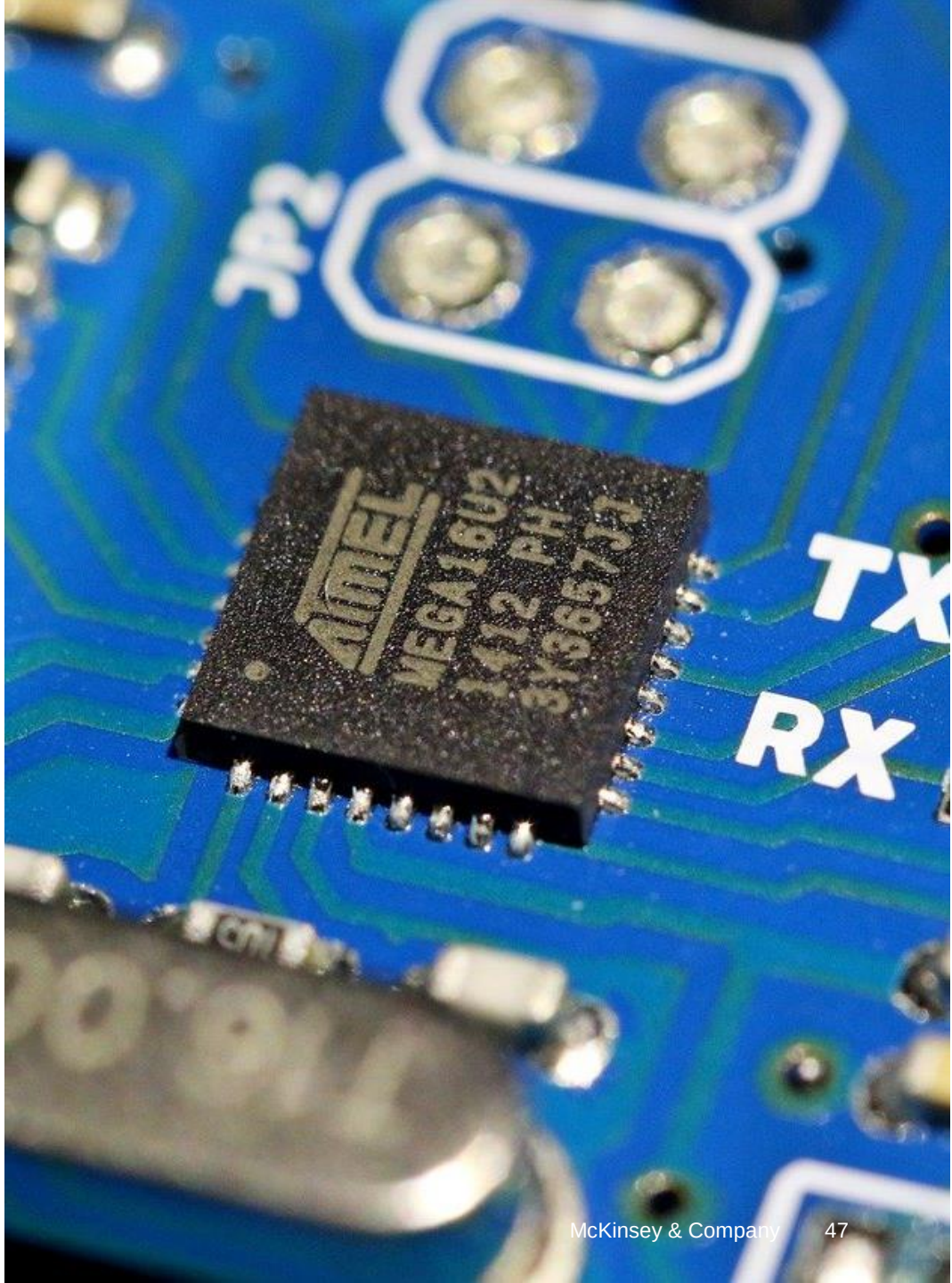
Boards to which integrated circuits (i.e., million of semiconductors combinations) are soldered

Why are printed circuits so important?

Printed circuits can be found in almost every electronic device

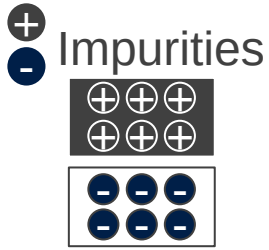
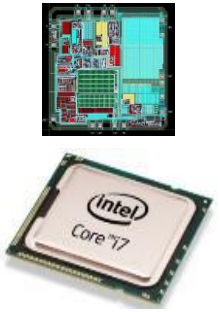
What types of printed circuits are there?

Printed circuits can be classified into several types according to semiconductors used, which will be the focus of this document



B2 Printed circuits are a combination of millions of extrinsic semiconductors, which will be the focus of this document

Focus of this document

	Natural semiconductor materials	Extrinsic semi-conductor	Circuit elements	Integrated circuits	Wafer
Description	**Pure elements such as silicon and germanium** which have natural electrical conductivity	Components that consist of **pure elements doped with impurities** such as Boron or Arsenic	**Combinations of extrinsic semiconductor** make circuit elements (e.g., diodes, transistors)	**Combination of millions of circuit elements** on a chip	**Numerous chips** integrated on a wafer
Examples					

Silicon based extrinsic semiconductors are most used in the semiconductor industry

Other semiconductors such as Gallium Arsenide (GaAs) are used for specific applications

B2 Before diving into semiconductors, it is important to understand conductors and insulators

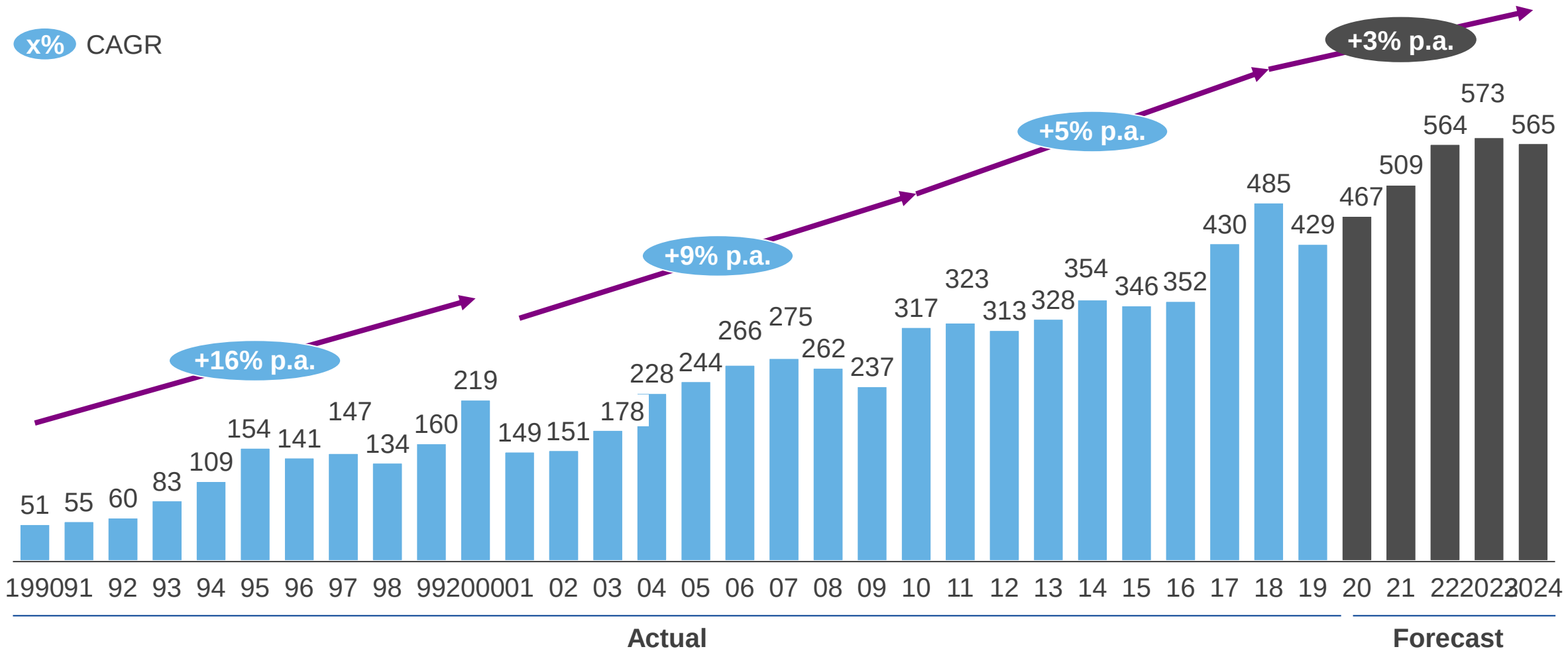
Device	Description
Conductors	Materials which allow **free flow of current (and electrons)**. For example, metals (e.g., copper wire used in common electrical fittings, gold wire)
Insulators	Materials which **always block current flow** (e.g., wood, pure water)
Semiconductors	Materials which can act as **both conductor and insulator**. Common semiconductor materials include Silicon (Si) and Germanium (Ge)

Why are semiconductors important?

The **electrical conductivity of semiconductor materials can be modulated** (e.g., by applying voltage or by altering chemical composition) thus **providing a way to control flow** of electrical current

B2 Semiconductor industry growth is slowing down as the industry matures

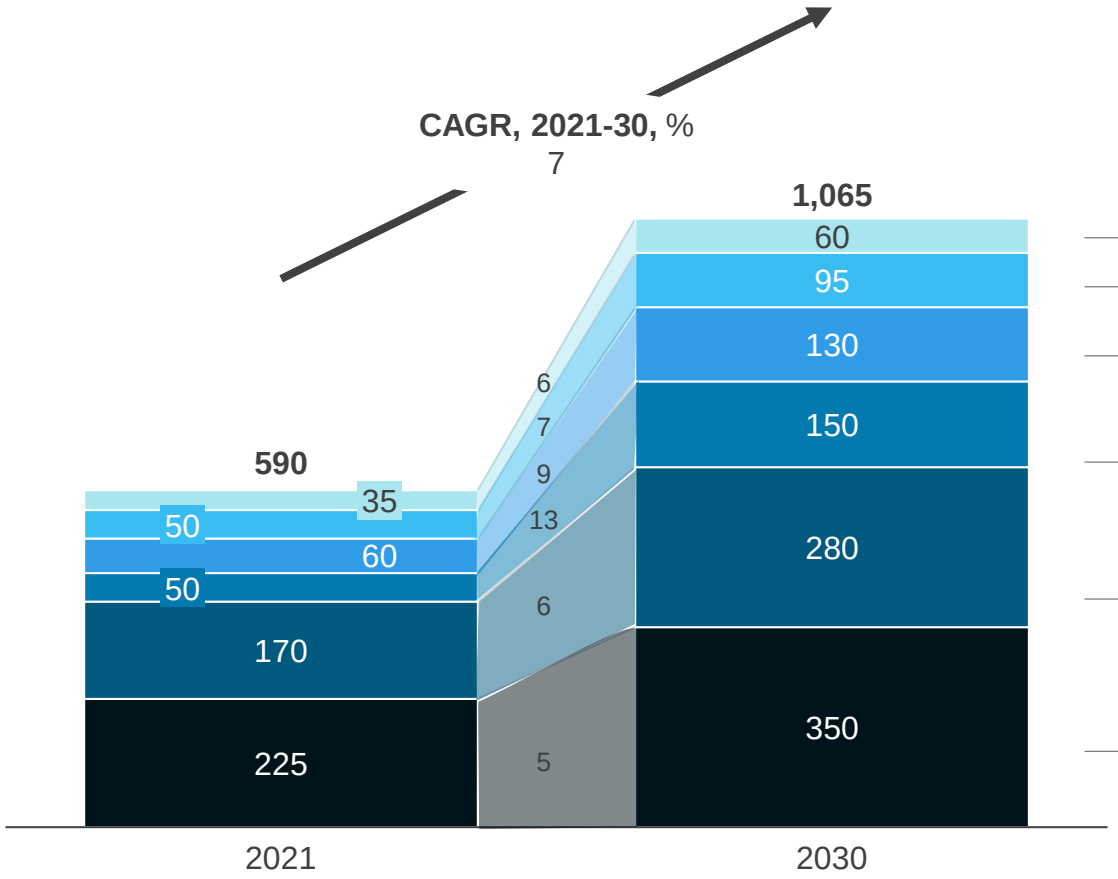
USD Billions



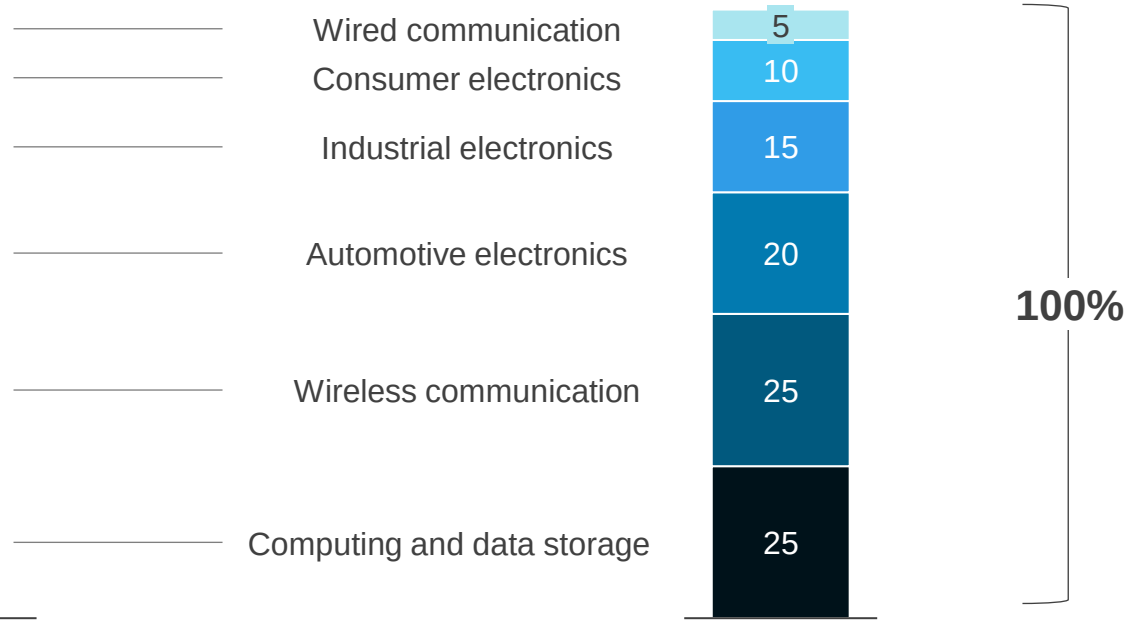
SOURCE: IC Insights, IHS (2020)

B2 The overall growth in the global semiconductor market is driven by the automotive, data storage, and wireless industries

Global semiconductor market value by vertical, indicative, $ billion



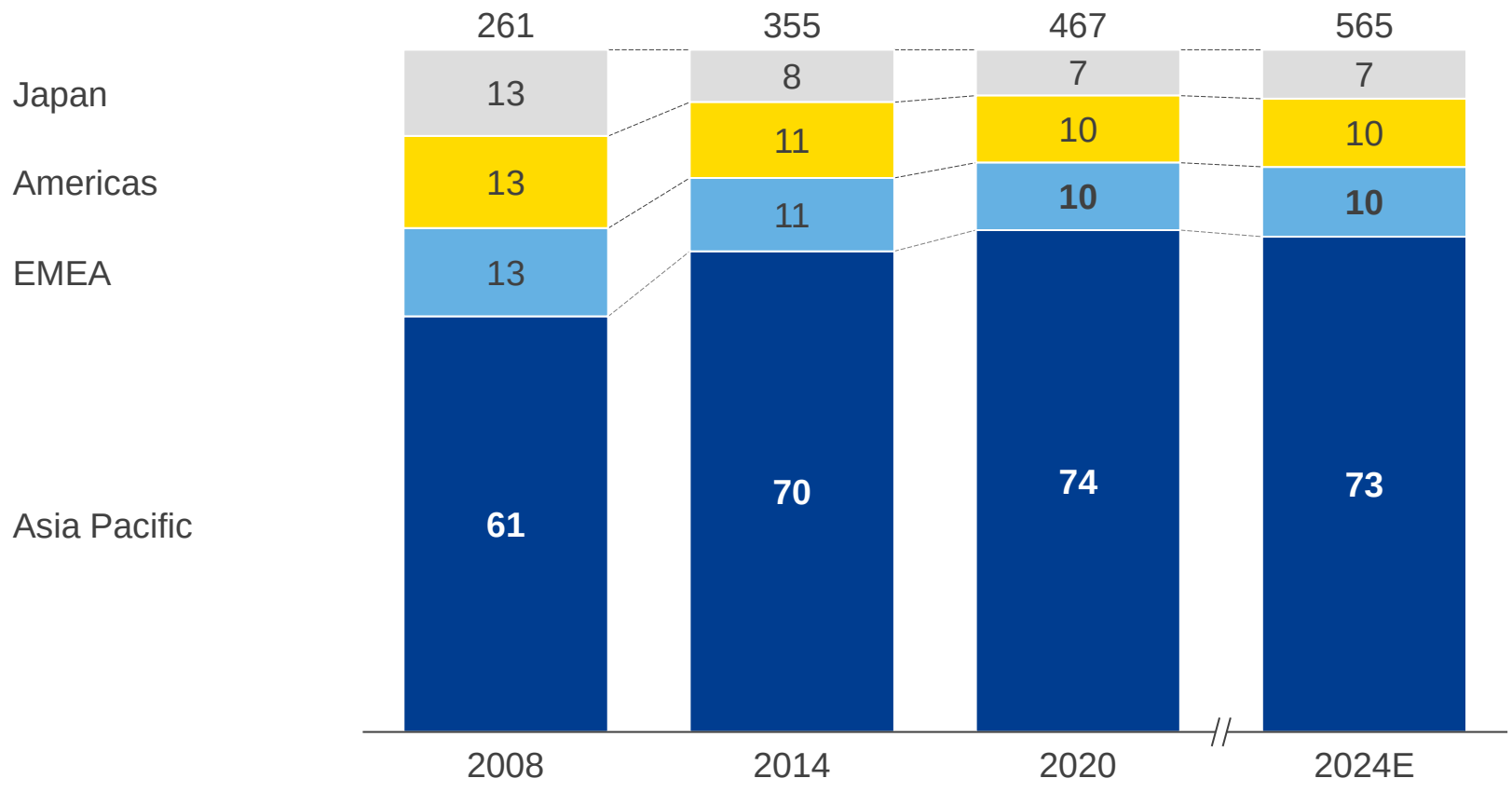
Growth contribution per vertical, 2021-30, %



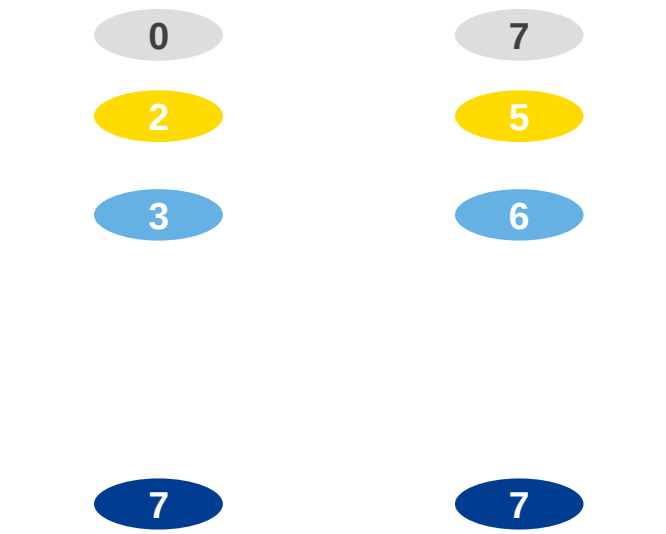
Note: Figures are approximate

B2 In the past decade, the Asia-Pacific region has become the global focus of semiconductor sales

Distribution of worldwide semiconductor revenues by application, $ bn, %



Absolute growth rates, CAGR, %



Note: Numbers may not add up due to rounding

SOURCE: IHS (2020)

B2 Europe has already taken steps towards greater autonomy in the manufacturing of semiconductors

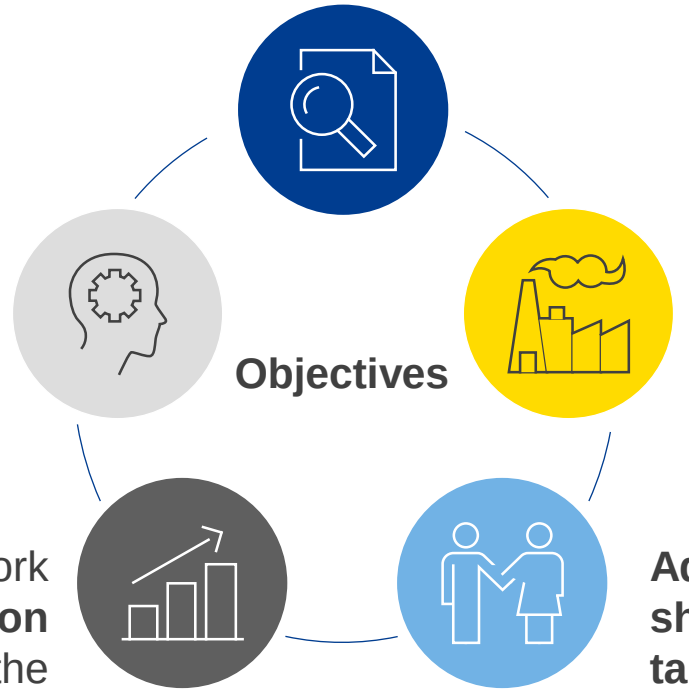
Measures taken

The **European Chips Act** aims to **boost the competitiveness and resilience** of Europe in **semiconductor technologies and applications**

43 Bn€ will be mobilized to implement **preparedness, anticipation and response** measures for supply chain disruptions

Objectives

Strengthen Europe's research and technology leadership towards smaller and faster chips



Develop an in-depth understanding of the global semiconductor supply chains

Build and reinforce capacity to innovate in the **design, manufacturing and packaging** of advanced chips

Put in place a framework to **increase production capacity to 20%** of the global market **by 2030**

Address the skills shortage, **attract new talent and support** the emergence of a skilled **workforce**

B2 Domestic production – Printed circuits

Overview of printed circuits fundamentals

Dependency results and market assessment

Development of domestic production

B2 After applying our methodology, printed circuits have been identified as critical and with high or medium risk of supply for Spain

Process followed for each product:

- **Identified as critical**
- Assigned **high or medium supply risk**
- Calculated **potential of diversification, which is not enough as resilience mechanism** due to worldwide market structure

Critical circuits of high/ medium risk	HS6 code
1 **Circuits; printed**	853400

B2 We have adjusted the dependency methodology results for printed circuits to incorporate forward-looking expert input

Process

Process followed for semiconductors:

- **All semiconductor-related products identified as critical in principle**
- Assigned **high or medium supply risk based on dependency and origin of imports, and applied potential of diversification**[1]
- **Incorporated expert input** on semiconductor market and outlook

Results

Not considered for minimum capacities assessment

Considered for minimum capacities assessment

Semiconductor-related products	Critical and H/M² risk according to methodology?	Expert based adjustment	Final result
1 Processors and controllers	NO	***Products not identified as high or medium risk according to methodology due to high relevance of re-exports – however, they should be considered critical and high risk***, *as China and Hong Kong dominate the exports market (detailed on next slide)*	✓
2 Memories	NO		✓
3 Amplifiers	NO		✓
4 Other integrated circuits elements	NO		✓
5 Parts of electrical goods	NO		✓
6 Circuits; printed	YES	N/A	✓

1. Potential of diversification not enough as a resilience mechanism due to worldwide market structure
2. High or medium risk

B2 Semiconductors have a very concentrated market, where East Asian countries concentrate global exports (1/2)

Products	Concentration assessment	Key worldwide exporters[1]	Origin of imports (Spain)
1 **Electronic integrated circuits; processors and controllers**	**Highly concentrated market** - 3 countries export ~60%	• China and Hong Kong (35%) • Singapore (11%) • Malaysia (10%)	• Germany (29%) • Japan (17%) • Netherlands (15%)
2 **Electronic integrated circuits; memories**	**Highly concentrated market** - 2 countries export ~75%	• China and Hong Kong (43%) • South Korea (31%)	• Germany (21%) • Netherlands (19%) • Japan (17%)
3 **Electronic integrated circuits; amplifiers**	**Highly concentrated market** - China and Hong Kong export ~50% and, with Singapore and US, ~80%	• China and Hong Kong (47%) • Singapore (19%) • USA(13%)	• Netherlands (30%) • USA (19%) • Germany (17%)

1. Share of world exports greater than 10%

B2 Semiconductors have a very concentrated market, where East Asian countries concentrate global exports (2/2)

Products	Concentration assessment	Key worldwide exporters[1]	Origin of imports (Spain)
4 **Electronic integrated circuits; n.e.c.1 in heading 8542**	**Highly concentrated market** - 3 countries export ~60%	• China and Hong Kong (41%) • Singapore (20%)	• Germany (34%) • Netherlands (19%) • China (12%)
5 **Electronic circuits and microassemblies; parts of the electrical goods of 8542**	**Highly concentrated market** - 3 countries export ~60%	• Malaysia (26%) • China and Hong Kong (24%) • Japan (17%)	• Germany (33%) • France (21%) • China (13%)
6 **Circuits; printed**	**Highly concentrated market** - 3 countries export ~60%	• China and Hong Kong (59%) • South Korea (11%)	• China (59%)

1. Share of world exports greater than 10%

B2 Analysis of Spain's world exports and imports for critical semiconductors inputs

In addition, it would be necessary in the long term to **secure agreements with key input producers in low-risk countries** to complement industrial production capacity

Products	Concentration assessment	Key world exporters[1], 2018-2021	Origin of imports (Spain), 2018-2021	Covered by CRML[2]
Silicon	**Concentrated market – 3 countries** export **+70%**	China (47%), Norway (13%) and Brazil (12%)	China (52%), Netherlands (16%) and Germany (10%)	✓
Germanium	*Data non available*			✓
Chemical elements; doped for use in electronics	**Concentrated market – 2 countries** export **~50%**	Japan (27%) and China (21%)	China (28%), Poland (21%) and Hungary (11%)	✗

1. Exporters with a market share of global exports greater tan 10%
2. *Critical Raw Materials List* published in 2023 by the European Commission

B2 Domestic production – Printed circuits

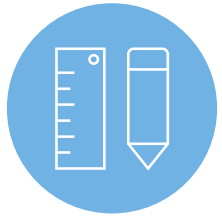
Overview of printed circuits fundamentals

Dependency results and market assessment

Development of domestic production

B2 While it is highly complicated to build national capacities on semiconductors, Spain could take other actions to increase resilience

Difficulty in building national capacities from scratch…



High precision is required and hence chips must be bult by specific machinery

Clean environments are needed, as even a single speck of dust can damage a chip

Expensive facilities, requiring investment up to ~25 B€ due to e.g., machinery, electrical and hydraulic installations

Long manufacturing times – 3 months to engrave and transform wafers into semiconductors and years to get new factories

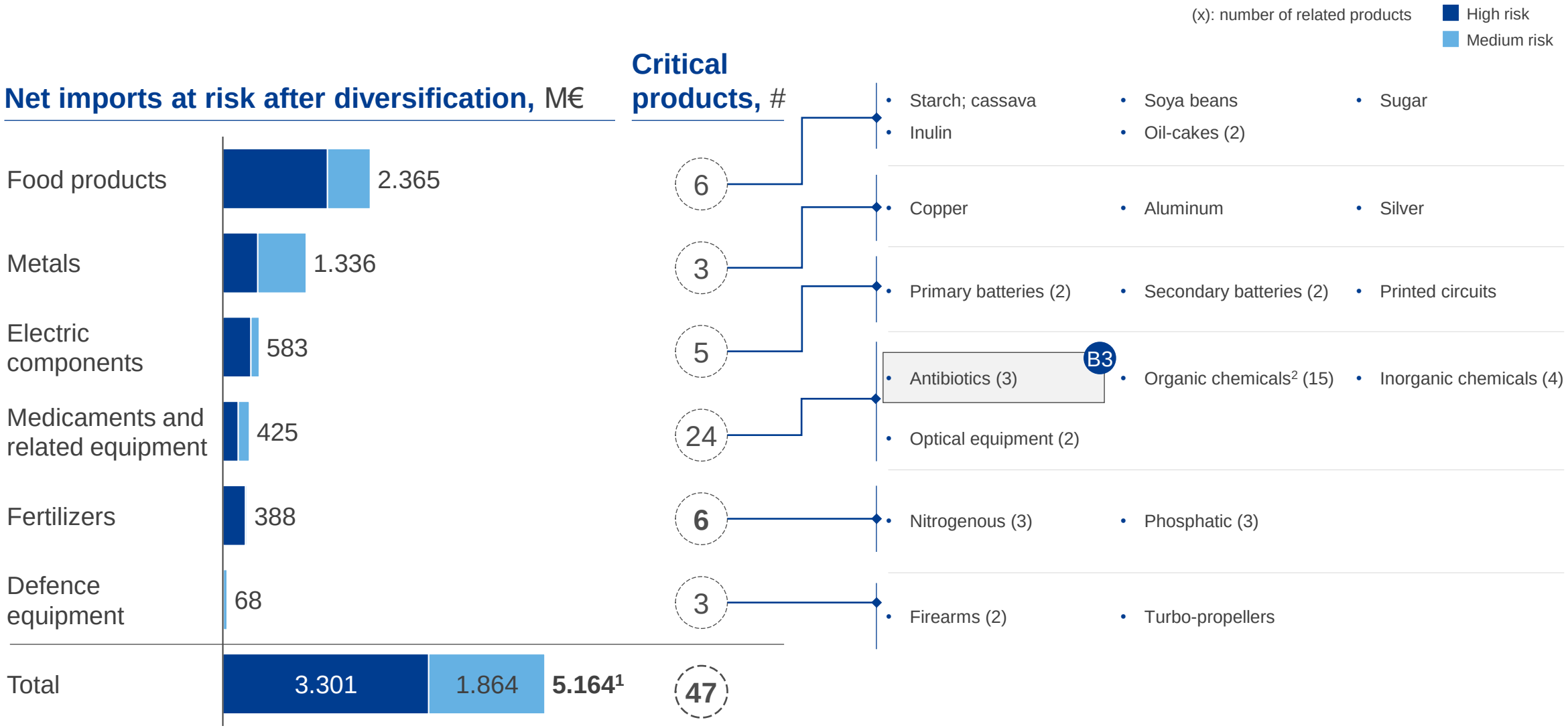
…but Spain can take measures to reduce dependency on high-risk countries

1 **Stockpile spare parts of critical devices that include semiconductors** (e.g., critical devices at hospitals)

2 **Participate in European Chips Act initiatives** to gain independence in chips manufacturing

3 **Intensify relationship with semiconductors producers**

Products that continue being high or medium risk after diversification



1. Does not include ~150M€ of consumption at risk that can be diversified
2. Other than antibiotics

B3 Domestic production – Antibiotics

Overview of antibiotics fundamentals

Dependency results and market assessment

Development of domestic production

B3 Overview of antibiotics fundamentals

What are antibiotics?

Medicines used to treat or prevent some types of bacterial infection by killing them or preventing them from spreading

Why are antibiotics so important?

Antibiotics treat infections and have saved millions of lives throughout history

What types of antibiotics are there?

Antibiotics can be classified into 32 different classes (detailed next)

B3 Antibiotics value chain

Logistics Procurement

Most vulnerable steps

Commodities

Simple molecules, reagents and solvents. Produced in continuous processes at high volumes. Low cost compared to other steps

Intermediates

Precursor to APIs, Can be divided into "fare and "advanced“ intermediates. The latter require GMPI compliance

API manufacturing

Active pharmaceutical Ingredients (APIs) refer to portion of finished drug to have pharmacological effect or other impact on body function, Requires cGMP[1] compliance

Formulation/ filling

Formulation; Powders, liquids, suspensions, emulsions Filling: Consumable capsules, tablets or vials

Secondary pack

Packaging into stock-keeping unit (SKU), this can be a box of vials, blisters in a carboard box with leaflet in country language

Drug product manufacturing

Wholesale distributors

Wholesalers buy the drugs from manufacturers or suppliers in large quantities and sell them at wholesale prices to pharmacists

Community hospital pharmacy

Pharmacies sell to the end customer and can be community or hospital

Source: HERA AMR feasibility study on stockpiling

B3 According to HERA, critical antibiotics can be categorized in 32 different classes and comprise +95% of the EU antibiotic market

Classes of antibiotics

Focus of this document (detail on slide 63)

1. Narrow-spectrum penicillins (penicillin G)
2. Aminopenicillins, without ß-lactamase inhibitors (ampicillin)
3. Aminopenicillins with ß-lactamase inhibitors (ampicillin/sulbactam)
4. Ant-staphylococcal penicillins (flucloxacillin)
5. Carboxy-/Ureidopenicillins with ß-lactamase inhibitors (piperacillin/tazobactam)
6. First/second-generation cephalosporins (cefazolin)
7. Third/fourth- generation cephalosporins (cefotaxime)
8. Fifth-generation cephalosporins (ceftobiprole)
9. Siderophore cephalosporins (cefiderocol)
10. Cephalosporins, with ß-lactamase inhibitors (ceftazidime/avibactam)
11. Carbapenems, without ß-lactamase inhibitors (meropenem)
12. Carbapenems, with ß-lactamase inhibitors (meropenem/vaborbactam)
13. Polymyxins (colistin)
14. Phosphonic acid derivates (Fosfomycin)
15. Substances solely used for treatment of TB (pyrazinamide)
16. Glycopeptides (vancomycin)
17. Lipopeptides (daptomycin)
18. Oxazolidinones (linezolid)
19. Macrolides (azithromycin)
20. Macrocycles (fidaxomicin)
21. Tetracyclines (doxycycline)
22. Eravacycline
23. Glycylcycline (tigecycline)
24. Sulfonamide-Trimethoprim derivates combinations (sulfamethoxazole- trimethoprimco-trimoxazole)
25. Nitroimidazole (metronidazole)
26. Riminophenazines (clofazimine)
27. Sulfones (dapsone)
28. Fluoroquinolones (ciprofloxacin)
29. Rifamycins (rifampicin)
30. Aminoglycosides (gentamicin)
31. Lincosamides (clindamycin)
32. Monobactams (aztreonam)

Source: HERA AMR feasibility study on stockpiling

B3 Domestic production – Antibiotics

Overview of antibiotics fundamentals

Dependency results and market assessment

Development of domestic production

B3 After applying our methodology, 3 antibiotics have been identified as critical and with high or medium risk of supply for Spain

Process followed for each product:

- **Identified as critical**
- Assigned **high or medium supply risk**
- Calculated **potential of diversification, which is not enough as resilience mechanism** due to worldwide market structure

Critical antibiotics of high/ medium risk	HS6 code
1 **Antibiotics; streptomycins and their derivatives; salts thereof**	294120
2 **Antibiotics; tetracyclines and their derivatives; salts thereof**	294130
3 **Antibiotics; chloramphenicol and its derivatives; salts thereof**	294140

B3 However, we have adjusted the dependency methodology results for antibiotics to incorporate forward-looking expert input

Not considered for minimum capacities assessment | Considered for minimum capacities assessment | Focus next

Process

Process followed for batteries:

- **Antibiotics** identified as **critical** according to **AEMPS**[1] list of **critical medicines**
- Assigned **high or medium supply risk based on dependency and origin of imports, and applied potential of diversification**[2]
- **Incorporated expert input** on battery market and outlook

Results

Critical products	Critical and H/M[3] risk according to methodology?	Expert based adjustment	Final result
1 **Antibiotics; streptomycins and their derivatives**	YES	▪ **Low priority** from a clinical standpoint ▪ **Mainly used** for **tuberculosis** ▪ **Construction of facilities is not worth it – stockpiling** and/ or **agreement with GFD**[4] should be addressed	✓
2 **Antibiotics; tetracyclines and their derivatives**	YES	▪ Tetracycline is an **intermediate** for production of **doxycycline, which should be the focus**	✓
3 **Antibiotics; chloramphenicol and its derivatives**	YES	▪ **Old antibiotic** with very **severe** side **effects** ▪ **Essential** only in **low-incomes countries** with no alternatives	✗

1. *Asociación Española de Medicamentos y Productos Sanitarios*
2. Potential of diversification not enough as a resilience mechanism due to worldwide market structure
3. High or medium risk
4. Global Drug Facility: UN-supported partnership which operates a globally distributed stockpiling system for humanitarian supply of tuberculosis medicines such as streptomycins

B3 The 2 high and medium risk critical antibiotics identified belong to the groups of aminoglycosides and tetracyclines

Critical high and medium risk products	Class of antibiotic	
	30. Aminoglycosides	21. Tetracyclines
1 Antibiotics; streptomycins and their derivatives	✓	
2 Antibiotics; tetracyclines and their derivatives		✓

Source: HERA AMR feasibility study on stockpiling

B3 Antibiotics present a highly concentrated market, where China concentrates +60% of global exports

Focus

Products	Concentration assessment	Key worldwide exporters	Origin of imports (Spain)
1 **Antibiotics; streptomycins and their derivatives**	Highly concentrated market – **China concentrates ~74% global exports**	• China (74%) • Netherlands (11%) • USA (7%)	• Chine (65%) • Netherlands (15%) • France (14%)
2 **Antibiotics; tetracyclines and their derivatives**	Highly concentrated market – **China concentrates ~62% global exports**	• China (62%) • Italy (9%) • Portugal (6%)	• China (86%) • Germany (8%) • Netherlands (3%)

B3 Domestic production – Antibiotics

Overview of antibiotics fundamentals

Dependency results and market assessment

Development of domestic production

B3 Initial and annual operating costs for the antibiotics factories necessary to cover the lack of offer in Spain

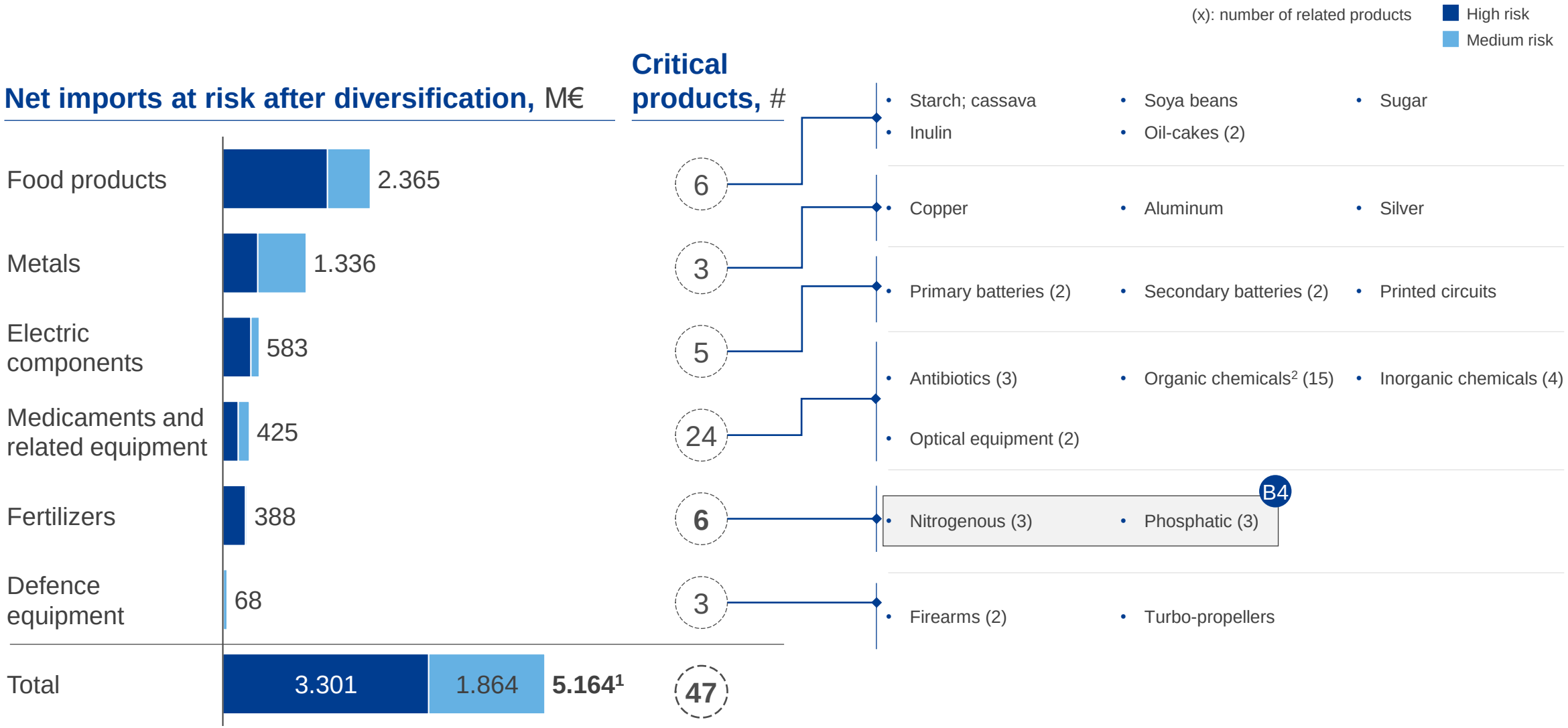
		Class of antibiotic: Tetracyclines	Class of antibiotic: Aminoglycosides
Key raw materials		TBD	N/A
Consumption to cover, M€/ year		22	1
CAPEX (Initial cost)	**M€/ ton**	TBD	Based on other EU countries actions, **most feasible resilience solution** would consist of **reserving access to GDF[1] stockpile**, with an **annual cost of ~700 k€[2]** in case of covering 100% of net imports at risk
	M€ to cover 100% of net imp. at risk	TBD	
OPEX (Annual operating cost)	**M€/ ton/ year**	Preliminary – Pending data confirmation	
	M€/ year to cover 100% of net imp. at risk	TBD	
Construction time		TBD	N/A

Additionally, it would be necessary to secure agreements with key *input* producers from low-risk countries in the long term

1. Global Drug Facility: UN-supported partnership which operates a globally distributed stockpiling system for humanitarian supply of tuberculosis medicines such as streptomycins
2. Assumes daily doses of 0,07 per 1.000 people (*Plan Nacional Resistencia Antibióticos*, data from 2021) and dose price of 0,57€ (Global Drug Facility catalogue)

Note 1: In case of wanting to calculate CAPEX to cover only a part of the imports at risk, economies of scale and other factors that may affect should be considered
Note 2: This scenario describes the largest investment needed as it considers factory building from scratch. Other methods such as (e.g., creating *ever-warm* lines) would have a lower cost

Products that continue being high or medium risk after diversification



1. Does not include ~150M€ of consumption at risk that can be diversified
2. Other than antibiotics

B4 Domestic production – Fertilizers

Overview of fertilizers fundamentals

Dependency results and market assessment

Development of domestic production

B4 Overview of fertilizers fundamentals

What are fertilizers?

Chemical or natural substances added to soil or land to provide nutrients for plants to grow and thrive

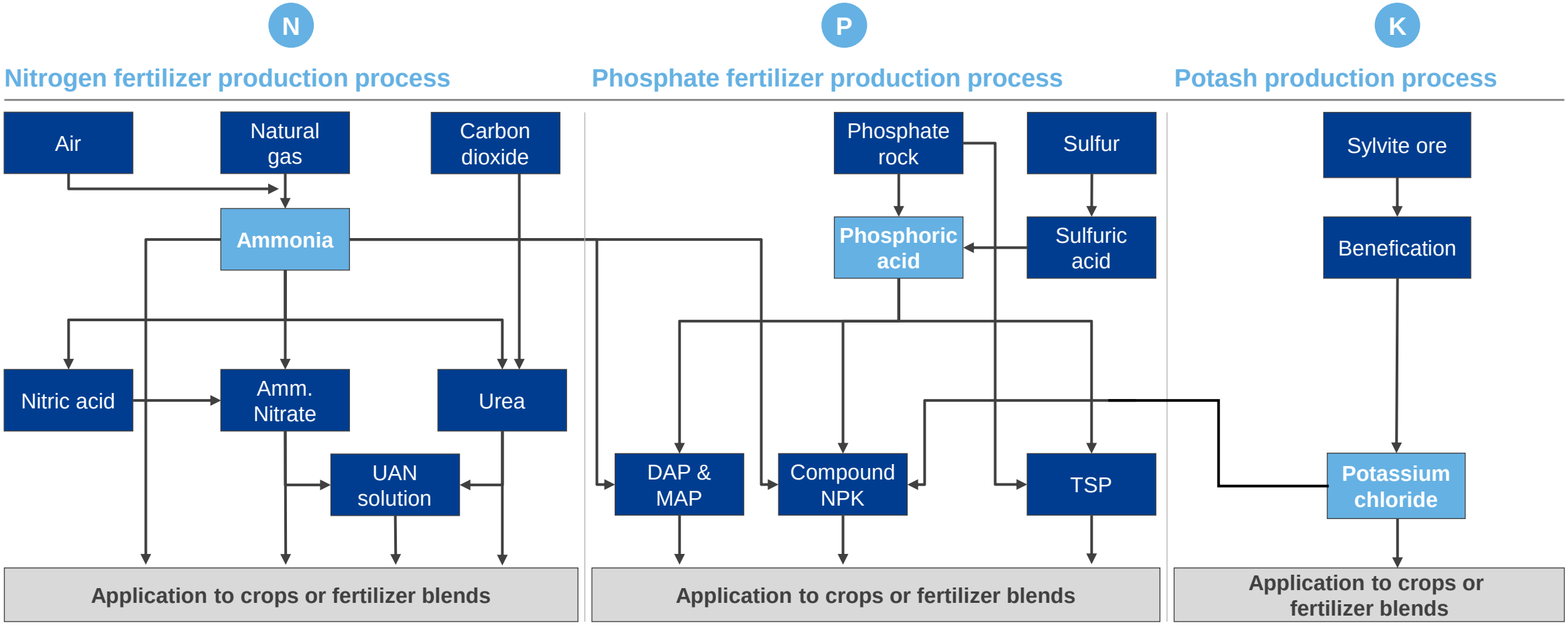
Why are fertilizers so important?

Antibiotics treat infections and have saved millions of lives throughout history

What types of fertilizers are there?

Fertilizers can be classified into 3 different groups according to the main input used: nitrogen (N), phosphate (P) or potash (K)

B4 Fertilizers are classified in 3 main types according to the main input used for their production



Source: IHS Chemical SRI PEP

B4 Domestic production – Fertilizers

Overview of fertilizers fundamentals

Dependency results and market assessment

Development of domestic production

B4 After applying our methodology, 6 fertilizers have been identified as critical and with high or medium risk of supply for Spain

Process followed for each product:

- **Identified as critical**
- Assigned **high or medium supply risk**
- Calculated **potential of diversification, which is not enough as resilience mechanism** due to worldwide market structure

Fertilizer products	HS6 code
1 **Fertilizers; nitrogenates, urea**	310210
2 **Fertilizers; nitrogenous, sodium nitrate**	310250
3 **Fertilizers; nitrogenous, double salts and mixtures of calcium nitrate and amm. nitrate**	310260
4 **Fertilizers; phosphatic, superphosphates**	310311
5 **Fertilizers; diammonium hydrogenorthophosphate**	310530
6 **Fertilizers; ammonium dihydrogenorthophosphate**	310540

Note: Products ordered according to total consumption at risk

B4 The 6 high and medium risk critical fertilizers identified belong to the groups of nitrogen and phosphate fertilizers

Critical high and medium risk products	Nitrogen fertilizers	Phosphate fertilizers
1 Fertilizers; nitrogenates, urea	✓	
2 Fertilizers; diammonium hydrogenorthophosphate		✓
3 Fertilizers; ammonium dihydrogenorthophosphate		✓
4 Fertilizers; nitrogenous, double salts and mixtures of calcium nitrate and amm. nitrate	✓	
5 Fertilizers; phosphatic, superphosphates		✓
6 Fertilizers; nitrogenous, sodium nitrate	✓	

Note: Products ordered according to total consumption at risk

B4 Fertilizers present a highly concentrated market, with countries such as China, Russia or Morocco playing an important role (1/2)

Products	Concentration assessment	Key worldwide exporters[1]	Origin of imports (Spain)
1 **Mineral or chemical fertilizers; nitrogenates, urea**	**Concentrated market**– 3 countries export ~40% and 12 countries ~80%	• Russia (16%) • China (12%) • Saudi Arabia (11%)	• Argel (30%) • Egypt (24%) • Russia (10%)
2 **Fertilizers, mineral or chemical; diammonium hydrogenorthophosphate**	**Highly concentrated market** – 2 countries concentrate ~65% of global exports	• China (43%) • Morocco (21%)	• Morocco (65%)
3 **Fertilizers, mineral or chemical; ammonium dihydrogenorthophosphate**	**Highly concentrated market** – 4 countries concentrate ~90% of global exports	• Morocco (25%) • China (23%) • Russia (20%) • USA (20%)	• Morocco (37%) • Belgium (30%) • Russia (13%) • China (10%)

1. Exporters with +10% of global exports share

B4 Fertilizers present a highly concentrated market, with countries such as China, Russia or Morocco playing an important role (1/2)

Products	Concentration assessment	Key worldwide exporters[1]	Origin of imports (Spain)
4 **Fertilizers; nitrogenous, double salts and mixtures of calcium nitrate and amm. nitrate**	**Highly concentrated market** – 2 countries concentrate +50% of global exports	• China (39%) • South Africa (14%)	• Norway (68%) • Portugal (15%)
5 **Fertilizers, mineral or chemical; phosphatic, superphosphates**	**Highly concentrated market** – 3 countries concentrate +80% of global exports	• China (33%) • Morocco (32%) • Israel (16%)	• Morocco (58%) • Israel (27%)
6 **Fertilizers; nitrogenous, sodium nitrate**	**Highly concentrated market** – 2 countries concentrate +50% of global exports	• Chile (45%) • China (10%)	• Chile (84%) • Germany (15%)

1. Exporters with +10% of global exports share

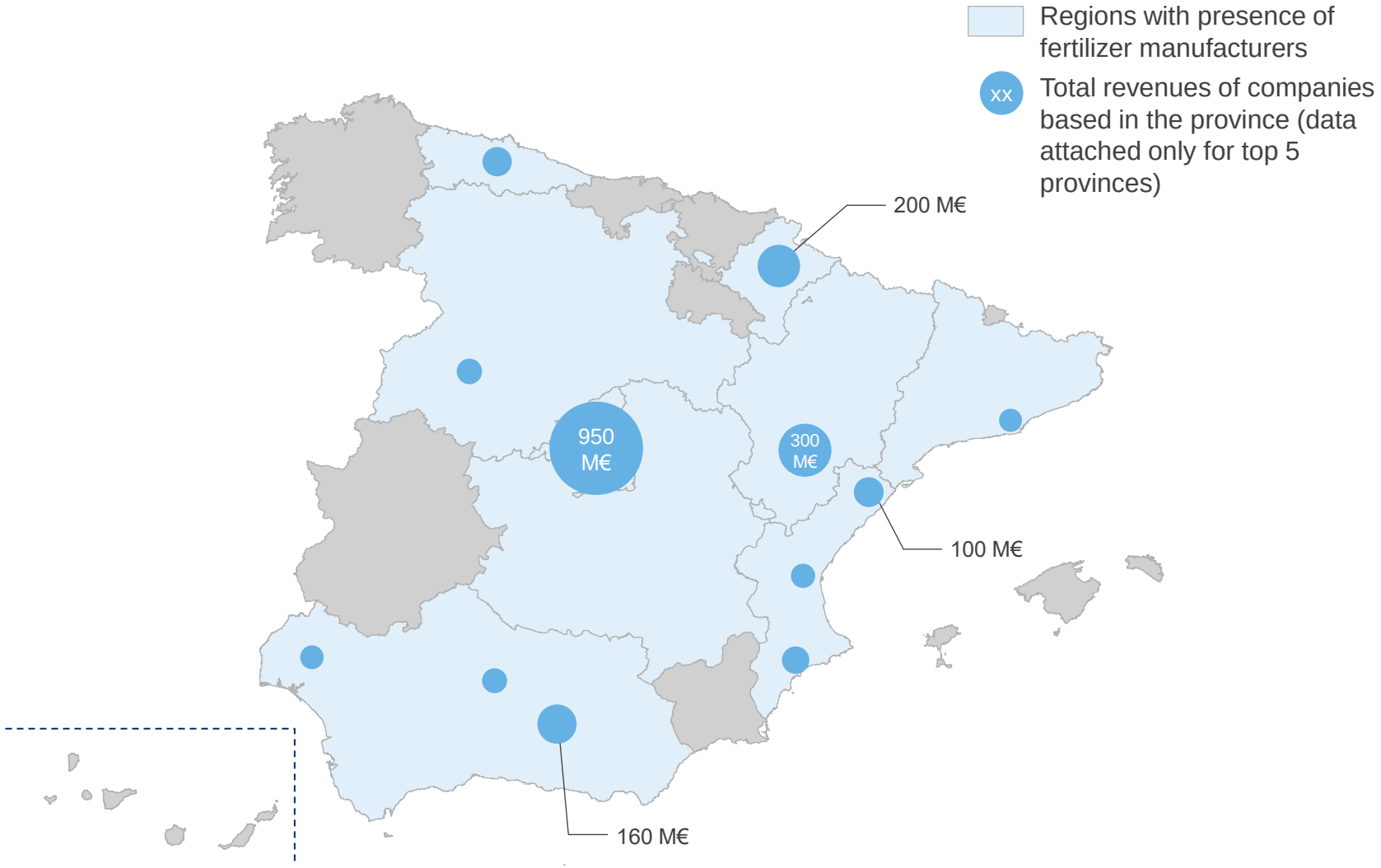
B4 Domestic production – Fertilizers

Overview of fertilizers fundamentals

Dependency results and market assessment

Development of domestic production

B4 Although Spain imports most of its fertilizers there is productive capacity in the country that could be reinforced



- **Productive capacity refers to production of any fertilizer**
- **Madrid is the province with highest fertilizer production,** with Fertiberia generating ~30% of national revenue coming from fertilizers sales
- **Production is decentralized,** as Fertiberia has ~15 production facilities and rest of companies are distributed throughout the country

B4 Building national capacities to cover high and medium risk imports would entail +2B€ CAPEX and a +500M€ annual OPEX

Detailed next

ESTIMATIONS BASED ON OUTSIDE-IN AVAILABLE INFO

	1 Fertilizers; nitrogenous, urea	2 Fertilizers; diamm. hydro-genorthoph.	3 Fertilizers,; amm. dihydro-genorthoph.	4 Fertilizers; nitrogenous, double salts	5 Fertilizers; phosphatic, superph.	6 Fertilizers; nitrogenous, sodium nitrate	**TOTAL**
Key raw materials	Natural gas	Phosphate rock	Phosphate rock	Natural gas	Phosphate rock	Natural gas	
Net imports at risk, M€	223	101	41	21	2	1	**389**
CAPEX **€/ TN**	~1.900	~2.600	~2.600	~1.900	~2.600	~1.900	
M€ to cover 100% of net imports at risk	~1.200-1.300	~550-650	~150-250	~200-300	~10-20	~5-10	~2.100-2.400
OPEX **€/ TN/ year**	~600	~700	~700	~600	~400	~600	
M€/ year to cover 100% of net imports at risk	~300-400	~100-200	~25-75	~50-70	~1-3	~1-2	500-700
Building time	3-4 years						

Note 1: Assumes that CAPEX and OPEX of double salts and sodium nitrate fertilizers are the same as those of urea
Note 2: In case of calculating CAPEX for covering only a part of net imports at risk, other factors such as economies of scale must be included
Nota 3: This scenario shows the highest possible investment, as it considers greenfield time and costs

B4 Analysis of world exports and imports from Spain for critical fertilizer inputs

Additionally, it would be necessary in the long term to ensure agreements with key input producers from low-risk countries that complement industrial production capacity

Products	Concentration assessment	Key world exporters[1], 2018-2021	Origin of imports (Spain), 2018-2021	Covered by CRML[2]
Liquefied natural gas	**Concentrated market - 3 competitors export ~ 60%** of total product	Australia (32%), USA (16%) and Qatar (12%)	France (19%), China (19%) and Germany (10%)	✗
Phosphate rock	**Concentrated market - 3 competitors export ~85%** of total product	Israel (44%), Kazakhstan (29%) and Vietnam (12%)	Morocco (59%), Israel (10%) and Egypt (10%)	✓

1. Exporters with a market share greater than 10%
2. *Critical Raw Materials List* published in 2023 by the European Commission

B1 B2 B3 B4

Minimum capacities – Conclusions

Summary of conclusions for batteries, printed circuits, antibiotics and fertilizers

Product	Stockpiling	Domestic production			Conclusion
		CAPEX[1], M€	OPEX[1], M€/ year	Building time, years	
B1 Batteries	✗	7.000-11.000	500-800	3	**Building national** batteries **factories** is a **key line action** to consider
B2 Printed circuits	✗	**N/A** (Spain is not able to build domestic production of printed circuits/ semiconductors)			**Building national capabilities** may be **costly** and **technically difficult**
B3 Antibiotics	✓	TBD	TBD[1]	TBD	**Stockpiling**[2] and **building national factories** are **main lines of action** to consider
B4 Fertilizers	✓	2.100-2.400	500-700	3-4	**Stockpiling** and **building national factories** are **main lines of action** to consider

1. Estimated for scenario where 100% of consumption at risk is covered
2. Includes ~1 M€ of annual cost of reserving access to GDF stockpiling for streptomycins
3. Includes both national stockpiling and GDF stockpiling

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