# Product Relatedness and Latent Production Potential of Green Goods in the EU: Evidence from International Trade Flows

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# Introduction

**The Context**

- Current policy debates revolve around European "industrial policy" and how to "achieve" the green transition (Green Deal, NZIA, etc.).
- Renewed interest in reshoring and securing some supply chains.

**Main Issues**

- Fiscal and political constraints.
- Heterogeneity across member states - not all are equally positioned to develop the same comparative advantages.

**Takeaways**

- Methodological tool to identify "low-hanging fruits" across sectors and industries.
- Better distribution and concentration of resources rather than "one-fit-all" policies.



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# The Premises of Our Work

From last year's EIB Investment Report (European Investment Bank (2025); European Investment Bank and EU DG GROW (2025)), we know that:

- EU member states have improved their international competitiveness in low-carbon technologies (LCT) goods and are now well-placed internationally.
- "Green" exports have been, on average, the fastest growing "sectors" in recent years $\Rightarrow$ promise for future growth.
- LCT goods tend to be more "sophisticated", higher technological content $\Rightarrow$ potential for spillovers

In this year's report, we wanted to establish a method and a rationale to evaluate industrial policy opportunities at a granular level.



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# Research Questions

1. How do you systematically track and evaluate supply chains and production networks?
2. How do you define and calculate production potential?
3. Is production potential a promise for future competitiveness?
4. What are the main upside potentials of EU industrial policy?



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# Methodology

1. Formulation of what latent production potential is.
2. Description of product "proximity" with first-degree production nodes and production linkages.
3. Use of trade flows to track international competitiveness across products, countries and time.
4. Construct two measures of latent production potential across and along supply chains.
5. Test these measures ex-post against realized competitiveness gains.
6. Analyse the status-quo of EU production networks and discuss policy questions.



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# Latent Production Potential

- We generally define **production potential** for any product $p$ as being "capable" in the production of upstream inputs.
- **Competitiveness**: revealed comparative advantages using Balassa's index (Balassa (1965)).

$$RCA_{ip} = \frac{\frac{x_{ip}}{\sum_j x_{ip}}}{\frac{x_{ip}}{\sum_i \sum_j x_{ip}}} \quad (1)$$

- **Production Linkages**: upstream and downstream nodes in the AIPNET dataset (Fetzer et al. (2024)).
- Both classified by 6-digit HS codes, high granularity.



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# Proximity

Goods across supply chains can be considered "proximate" across and along supply chains. Thus, we define 'proximity between any pair of products in the AIPNET in two ways:

1. Whether product $j$ is an input of product $p$ (vertical proximity).
2. How similar are inputs for product $j$ and $p$ (horizontal proximity).

$$\phi_{p,j} = \frac{|I(p) \cap I(j)|}{\max\{|I(p)|, |I(j)|\}} \tag{2}$$



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# Vertical and Horizontal Product Proximity

Figure: Vertical Proximity - Binary Relationship

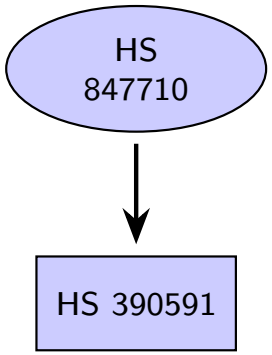
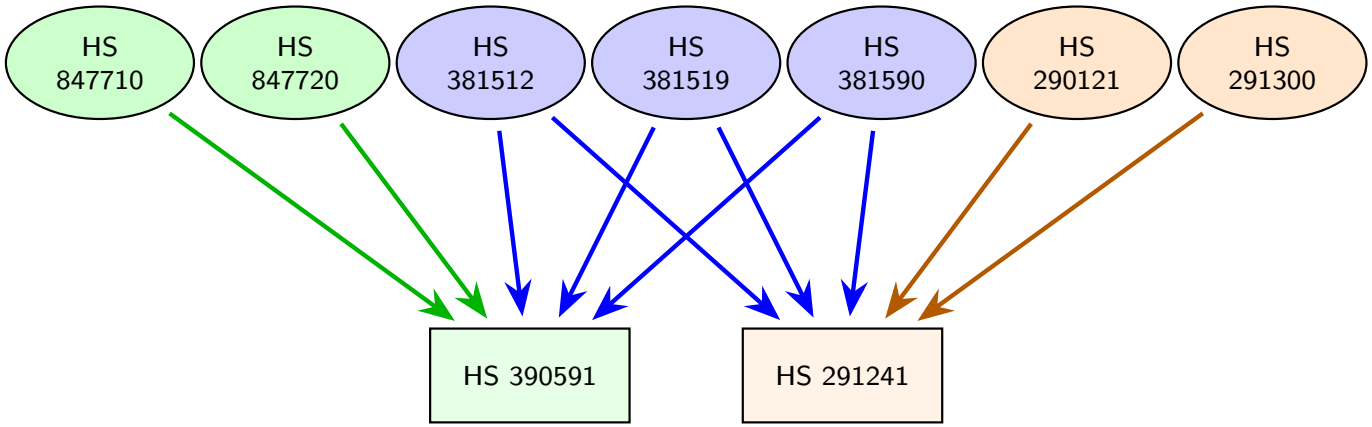



Figure: Horizontal Proximity - Unit Relationship



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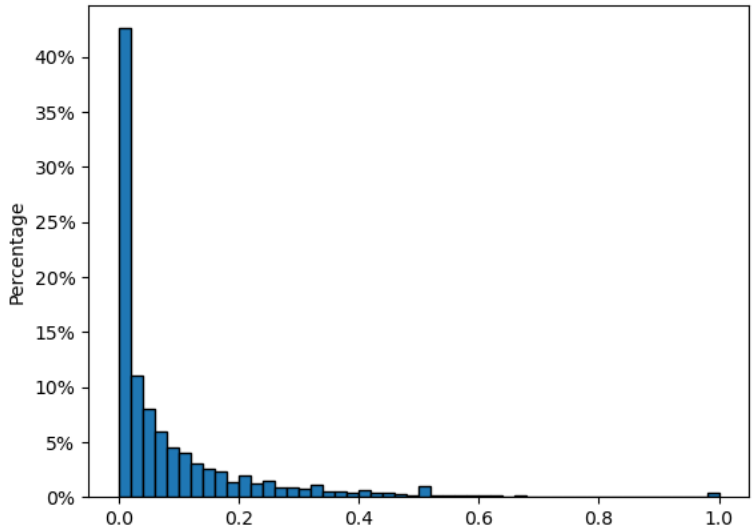
# Vertical Latency

$$L^{v}_{p,c,t} = \frac{1}{|U(p)|} \sum_{u \in U(p)} \mathbf{1}\{RCA_{u,c,t} > 1\} \tag{3}$$

- Calculates the percentage of upstream products of product $p$ in which country $c$ is competitive.
- Each product scores between 0 and 1, with 1 indicating that a country already competitively produces all inputs of product $p$.
- The score shows how capable a country is to move vertically to develop new "green" industries.



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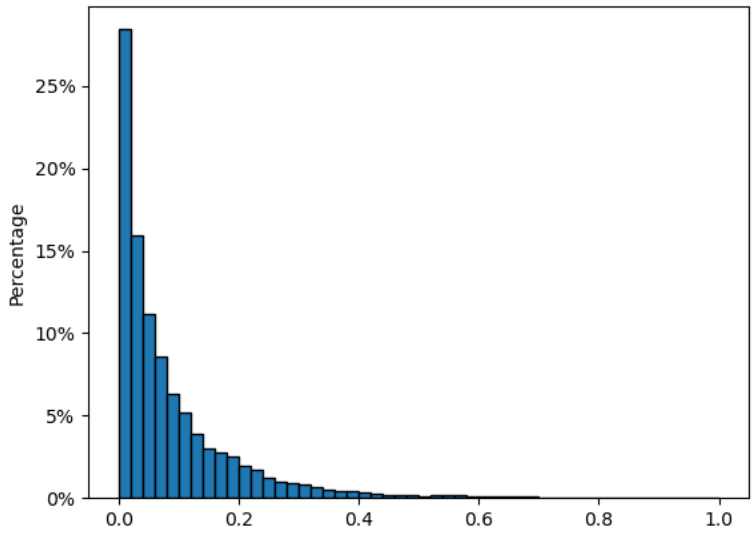
# Horizontal Latency

$$L^{h}_{p,c,t} = \frac{\sum_{j \neq p} \phi_{p,j} \cdot \mathbf{1}\{RCA_{j,c,t} > 1\}}{\sum_{j \neq p} \phi_{p,j}} \tag{4}$$

- Calculates the proximity-weighted average of RCAs for the whole product-space of any product $p$ in country $c$.
- Each product scores between 0 and 1, with 1 indicating that a country already competitively produces all products that share at least one input with product $p$.
- The score shows how capable a country is to diversify horizontally to produce new "green" products.



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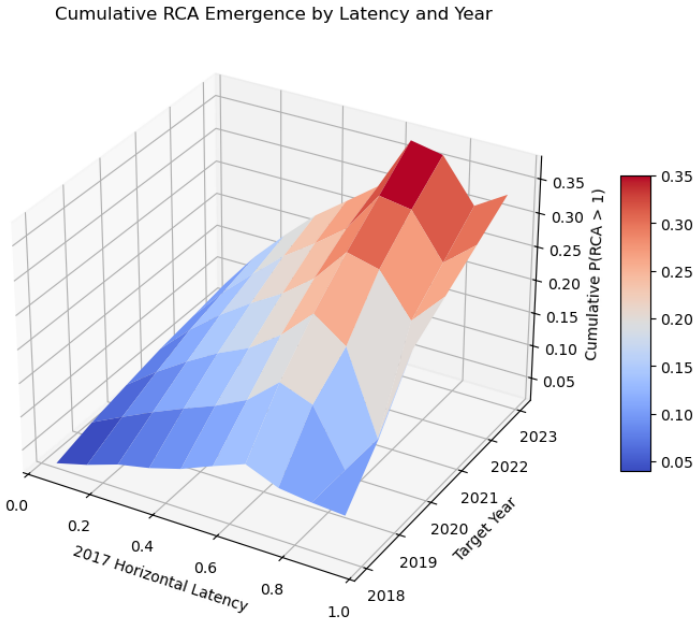
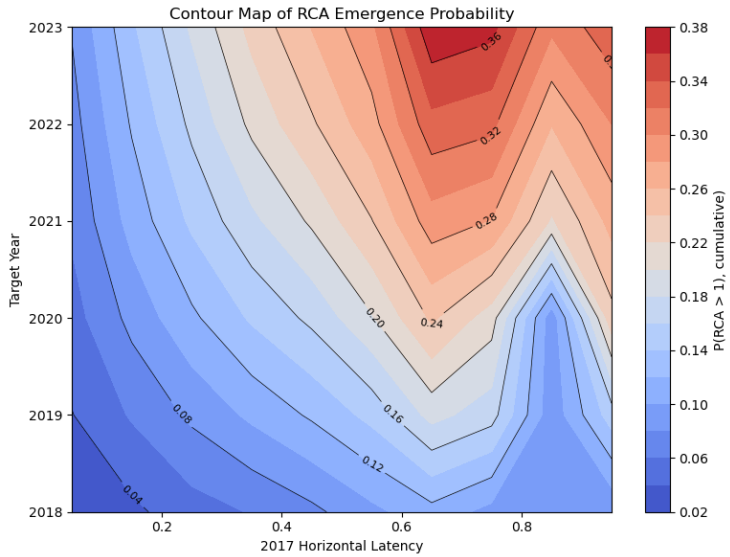
# Production Potential as a Promise for Competitiveness?

- Ex-post analysis of our scores to assert whether high potential scores are associated with the realization of competitive advantages.
- Estimate cumulative probability curves for any product pair with $RCA < 1$ in 2017 to reach $RCA \geq 1$ any year between 2018 and 2023.

$$\mathbb{P}(RCA_{i,p,1:T} > 1) = \mathbb{P}\left(\bigcup_{t=1}^{T}\{RCA_{i,p,t} > 1\}\right) = 1 - \prod_{t=1}^{T}[1 - P_t] \quad (5)$$



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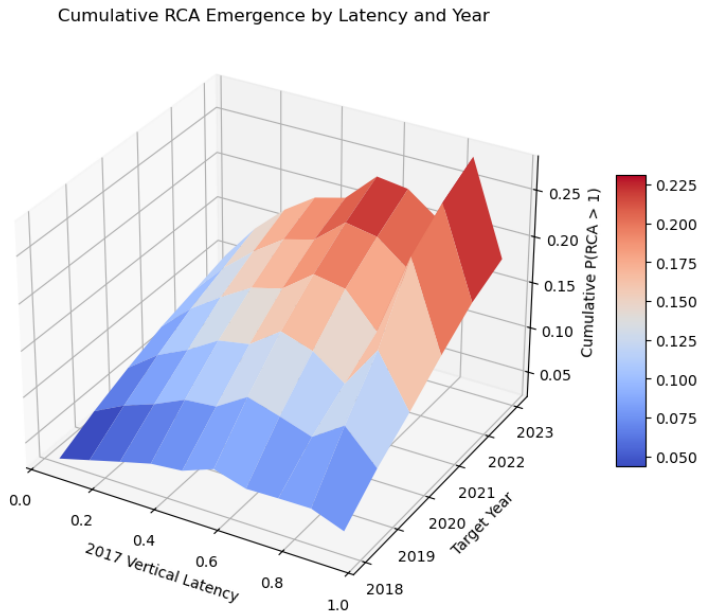
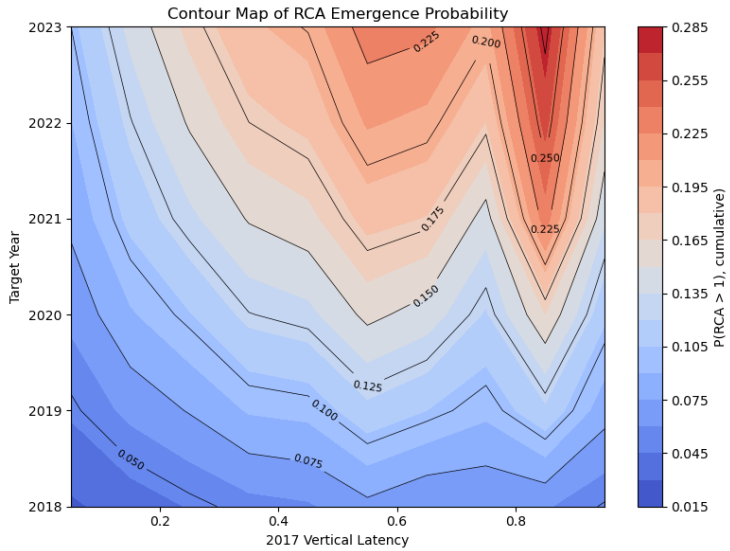
# Production Potential as a Promise for Competitiveness?



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# EU Potentials across Some Key LCTs

| | Vertical Potential | | | Horizontal Potential | | |
|---|---|---|---|---|---|---|
| | EU | USA | Median | EU | USA | Median |
| Lithium-ion Battery Pack | 0.50 | 0.33 | 0.33 | 0.454 | 0.389 | 0.239 |
| Electric Motor | 0.51 | 0.33 | 0.28 | 0.692 | 0.321 | 0.189 |
| Charging Port & EVSE | 0.44 | 0.34 | 0.29 | 0.583 | 0.406 | 0.186 |
| High-Voltage Cables | 0.51 | 0.44 | 0.25 | 0.612 | 0.415 | 0.205 |
| Solar panel (Photovoltaic cells assembled in..) | 0.34 | 0.38 | 0.19 | 0.482 | 0.399 | 0.209 |
| Photovoltaic cells not assembled | 0.29 | 0.46 | 0.19 | 0.478 | 0.404 | 0.211 |
| Led | 0.30 | 0.37 | 0.20 | 0.492 | 0.413 | 0.217 |
| Silicon Wafers | 0.33 | 0.46 | 0.13 | 0.555 | 0.370 | 0.170 |
| Other (Led/photovoltaic cells) | 0.29 | 0.39 | 0.19 | 0.479 | 0.401 | 0.208 |
| Permanent Magnets | 0.39 | 0.70 | 0.17 | 0.544 | 0.310 | 0.157 |
| Heatpump | 0.59 | 0.38 | 0.28 | 0.618 | 0.372 | 0.192 |
| Compressor | 0.76 | 0.36 | 0.23 | 0.658 | 0.315 | 0.199 |
| Car battery | 0.50 | 0.33 | 0.33 | 0.454 | 0.389 | 0.239 |
| Complex fluorides | 0.20 | 0.60 | 0.20 | 0.283 | 0.412 | 0.170 |
| Other fluorides | 0.00 | 1.00 | 0.00 | 0.185 | 0.442 | 0.138 |
| Graphite-based preparations | 0.38 | 0.38 | 0.13 | 0.464 | 0.360 | 0.194 |
| Lithium hydroxide | 0.00 | 0.67 | 0.33 | 0.273 | 0.502 | 0.146 |
| Cobalt oxides and hydroxides | 0.25 | 0.75 | 0.00 | 0.822 | 0.381 | 0.207 |
| Manganese sulfate | 0.38 | 0.25 | 0.25 | 0.476 | 0.325 | 0.138 |
| Nickel, unwrought | 0.20 | 0.40 | 0.20 | 0.501 | 0.431 | 0.129 |
| Nickel powders and flakes | 0.17 | 0.50 | 0.17 | 0.661 | 0.423 | 0.143 |
| Manganese dioxide | 0.38 | 0.00 | 0.06 | 0.307 | 0.286 | 0.211 |
| Nickel chloride | 0.33 | 0.00 | 0.00 | 0.478 | 0.341 | 0.161 |
| Cobalt chloride | 0.50 | 0.17 | 0.17 | 0.445 | 0.313 | 0.122 |
| Phosphoric acid | 0.25 | 0.08 | 0.08 | 0.404 | 0.266 | 0.123 |
| Aluminum foil | 0.79 | 0.32 | 0.23 | 0.470 | 0.309 | 0.208 |



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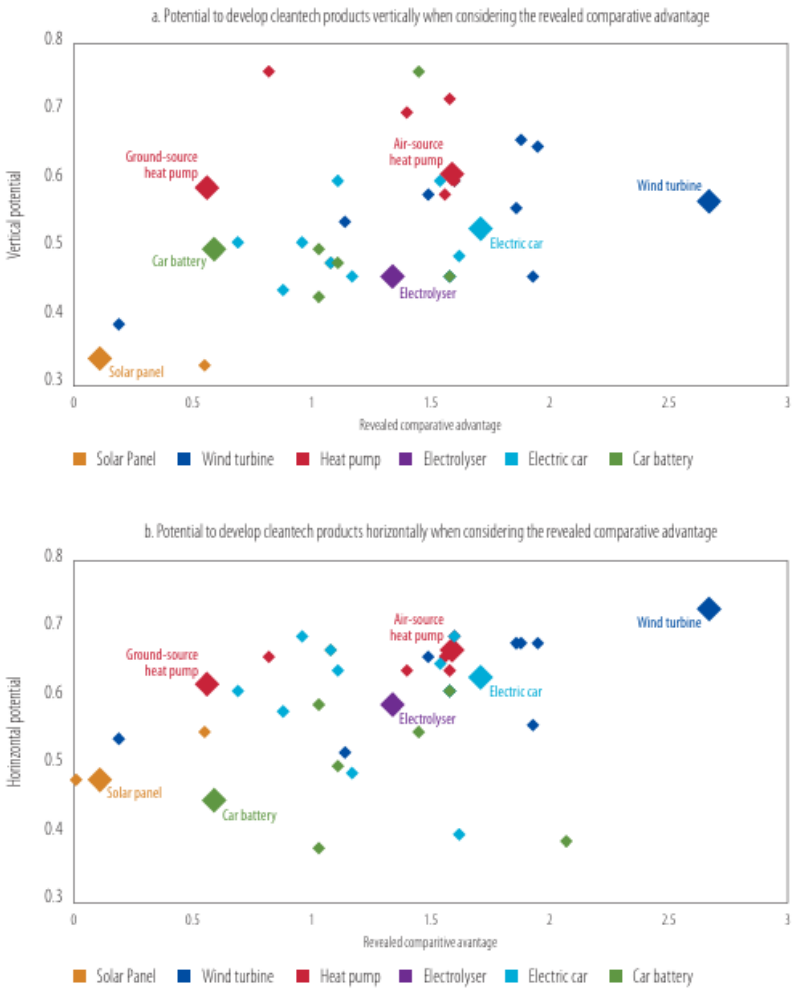
# EU Potentials and RCA in selected products

**Horizontal and vertical potential** (index), **by clean technology**




*Source:* *EIB staff calculations based on Comtrade.*
*Note:* *Big diamonds indicate final products, while small diamonds designate some of their key components.*



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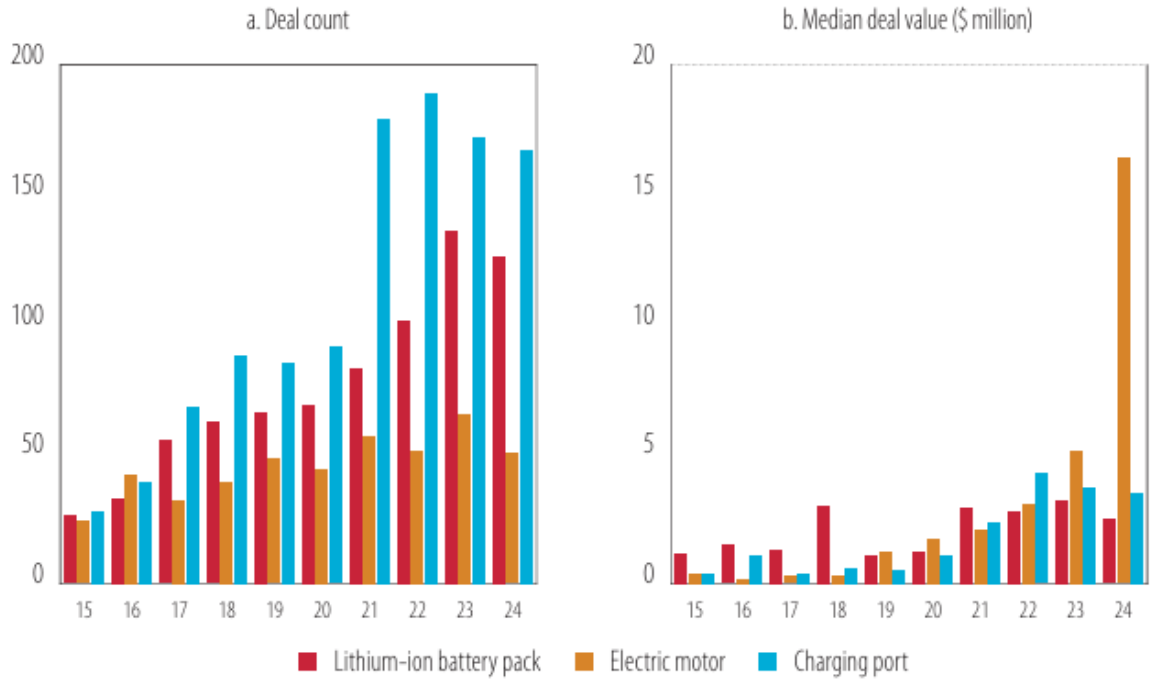
# Business dynamism (from PitchBook) in selected products

**Capital investment supporting EU innovation in selected electric vehicles components, 2015-2024**




*Source:* *EIB staff calculations based on Pitchbook database.*
*Note:* *Pitchbook database covers initial public offerings, mergers and acquisitions and venture capital transactions. A keyword-based classification system, supported by AI tools, was used to identify both EU-based and global companies active in each product.*



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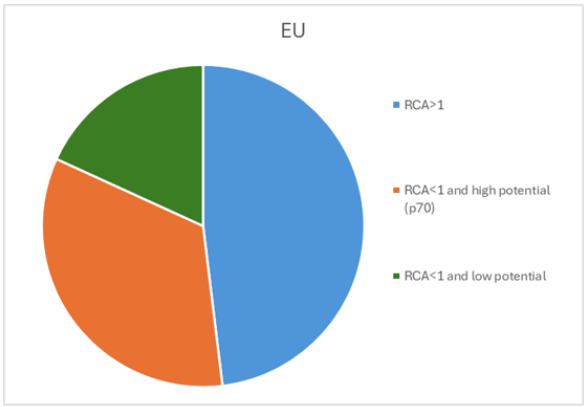
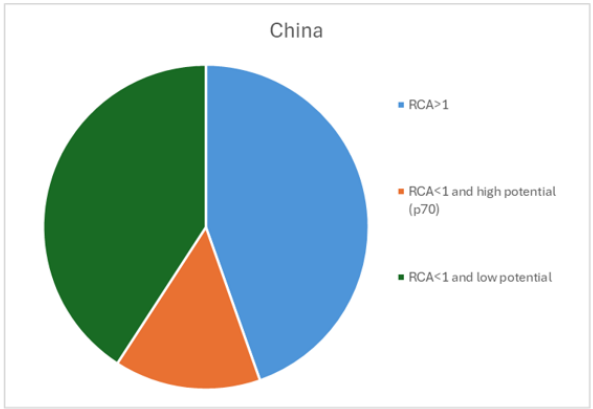
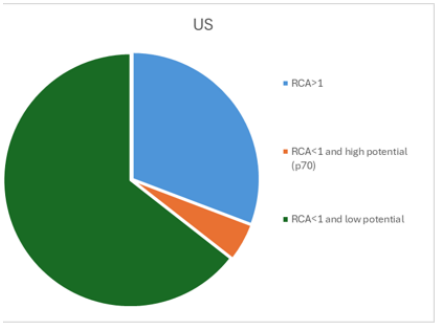
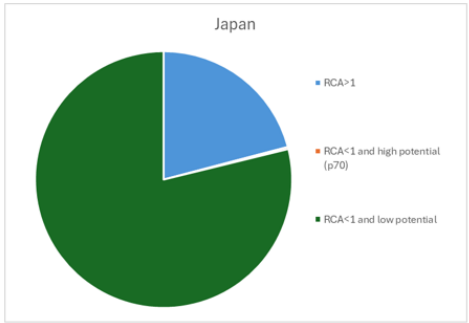
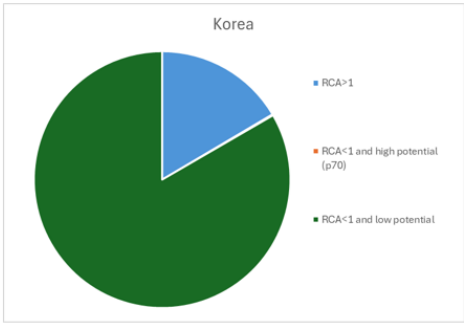
# RCAs and Potential in larger exporters



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# RCA and Potential in some HS codes related to biotech

| reporter_i | cmdcode | horizontal_latency | vertical_latency | year | rca | avg_hr | avg_vr | pc80_hr | pc80_vr | pc70_hr | pc70_vr | du70 | du80 | x_ci | x_i | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EUR | 300212 | 0.77 | 0.83 | 2024 | 2.7 | 0.29 | 0.28 | 0.77 | 0.83 | 0.48 | 0.50 | 0.0 | 0.0 | 14732244992 | 34038606141 | 43% |
| EUR | 300213 | 0.91 | 1.00 | 2024 | 0.6 | 0.33 | 0.33 | 0.91 | 1.00 | 0.52 | 0.57 | 1.0 | 0.0 | 278911360 | 3116323991 | 9% |
| EUR | 300214 | 0.77 | 0.86 | 2024 | 3.1 | 0.30 | 0.30 | 0.77 | 0.86 | 0.51 | 0.57 | 0.0 | 0.0 | 13524792320 | 27422717847 | 49% |
| EUR | 300215 | 0.77 | 0.75 | 2024 | 2.6 | 0.30 | 0.32 | 0.77 | 0.75 | 0.39 | 0.50 | 0.0 | 0.0 | 63117262848 | 149478048858 | 42% |
| EUR | 300241 | 0.74 | 0.68 | 2024 | 4.3 | 0.27 | 0.31 | 0.55 | 0.68 | 0.46 | 0.44 | 0.0 | 0.0 | 24099528704 | 34604372496 | 70% |
| EUR | 300242 | 0.74 | 0.75 | 2024 | 3.4 | 0.27 | 0.29 | 0.61 | 0.75 | 0.44 | 0.45 | 0.0 | 0.0 | 1790207104 | 3243973496 | 55% |
| EUR | 300249 | 0.77 | 0.86 | 2024 | 4.3 | 0.29 | 0.37 | 0.76 | 0.86 | 0.51 | 0.86 | 0.0 | 0.0 | 7329171456 | 10539131313 | 70% |
| EUR | 300251 | 0.77 | 0.76 | 2024 | 1.0 | 0.30 | 0.29 | 0.68 | 0.71 | 0.53 | 0.47 | 0.0 | 0.0 | 194089344 | 1157731178 | 17% |
| EUR | 300259 | 0.77 | 0.75 | 2024 | 3.7 | 0.30 | 0.31 | 0.73 | 0.75 | 0.55 | 0.50 | 0.0 | 0.0 | 241914496 | 404927711 | 60% |
| EUR | 300290 | 0.81 | 0.92 | 2024 | 0.4 | 0.28 | 0.38 | 0.65 | 0.92 | 0.51 | 0.75 | 1.0 | 0.0 | 136503232 | 2165415087 | 6% |
| EUR | 300331 | 0.65 | 0.56 | 2024 | 0.4 | 0.26 | 0.27 | 0.46 | 0.52 | 0.34 | 0.41 | 1.0 | 1.0 | 661566 | 10938053 | 6% |
| EUR | 300431 | 0.63 | 0.50 | 2024 | 3.9 | 0.26 | 0.26 | 0.44 | 0.50 | 0.34 | 0.46 | 0.0 | 0.0 | 1923155584 | 3027497611 | 64% |

| | |
|---|---|
| 3002.12 | -- Antisera and other blood fractions |
| 3002.13 | -- Immunological products, unmixed, not put up in measured doses or in forms or packings for retail sale |
| 3002.14 | -- Immunological products, mixed, not put up in measured doses or in forms or packings for retail sale |
| 3002.15 | -- Immunological products, put up in measured doses or in forms or packings for retail sale |
| 3002.41 | -- Vaccines for human medicine |
| 3002.42 | -- Vaccines for veterinary medicine |
| 3002.49 | -- Other |
| | - Cell cultures, whether or not modified : |
| 3002.51 | -- Cell therapy products |
| 3002.59 | -- Other |
| 3002.90 | - Other |



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# RCA and Potential in some HS codes related to Semiconductors

| reporter_i | cmdcode | horizontal_latency | vertical_latency | year | rca | pc70_hr | pc70_vr | du70 | du80 | x_ci | x_i | Share |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EUR | 381800 | 0.48 | 0.33 | 2024 | 0.73 | 0.43 | 0.41 | 0 | 0 | 1371231744 | 11672666512 | 11.7% |
| EUR | 848610 | 0.57 | 0.55 | 2024 | 1.41 | 0.35 | 0.52 | 0 | 0 | 674954176 | 2970026161 | 22.7% |
| EUR | 848620 | 0.57 | 0.52 | 2024 | 1.87 | 0.36 | 0.51 | 0 | 0 | 21291651072 | 70621321534 | 30.1% |
| EUR | 848640 | 0.62 | 0.59 | 2024 | 0.56 | 0.33 | 0.44 | 1 | 1 | 929805504 | 10349615459 | 9.0% |
| EUR | 848690 | 0.62 | 0.60 | 2024 | 0.87 | 0.35 | 0.43 | 1 | 1 | 3458312192 | 24586804491 | 14.1% |

| | | |
|---|---|---|
| **38.18** | 3818.00 | **Chemical elements doped for use in electronics, in the form of discs, wafers or similar forms; chemical compounds doped for use in electronics.** |
| **84.86** | | **Machines and apparatus of a kind used solely or principally for the manufacture of semiconductor boules or wafers, semiconductor devices, electronic integrated circuits or flat panel displays; machines and apparatus specified in Note 11 (C) to this Chapter; parts and accessories.** |
| | 8486.10 | - Machines and apparatus for the manufacture of boules or wafers |
| | 8486.20 | - Machines and apparatus for the manufacture of semiconductor devices or of electronic integrated circuits |
| | 8486.30 | - Machines and apparatus for the manufacture of flat panel displays |
| | 8486.40 | - Machines and apparatus specified in Note 11 (C) to this Chapter |
| | 8486.90 | - Parts and accessories |



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# Conclusion

- The transition to a green economy is both a technological and strategic challenge.
- By combining **production networks**, **proximity**, and **RCA**, we can measure how far the EU (and individual countries) are from producing competitively key low-carbon technologies.
- **Vertical latency** highlights readiness to move up value chains; **horizontal latency** shows diversification potential across related products.

Policy tools? Targeted tools may be more effective.

- Promote innovation around the development of clean technologies in potentially competitive green goods.
- Carefully designed procurement may help pushing the competitive production of green goods with high potential.
- At the EU level, exploit heterogeneities across countries and the potential emergence of EU wide green value chains.



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# Appendix: Descriptive Statistics of Probability Curves

Table 1: Vertical Latency, 10-bin, Probabilities

| Bin | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|
| 0.1 | 0.0276 | 0.0471 | 0.0636 | 0.0785 | 0.0890 | 0.0997 |
| 0.2 | 0.0368 | 0.0641 | 0.0881 | 0.1088 | 0.1240 | 0.1394 |
| 0.3 | 0.0459 | 0.0761 | 0.1041 | 0.1314 | 0.1520 | 0.1698 |
| 0.4 | 0.0547 | 0.0914 | 0.1244 | 0.1514 | 0.1749 | 0.1923 |
| 0.5 | 0.0581 | 0.0945 | 0.1304 | 0.1601 | 0.1839 | 0.2011 |
| 0.6 | 0.0708 | 0.1154 | 0.1543 | 0.1853 | 0.2117 | 0.2333 |
| 0.7 | 0.0606 | 0.1050 | 0.1430 | 0.1791 | 0.2055 | 0.2287 |
| 0.8 | 0.0613 | 0.0936 | 0.1181 | 0.1426 | 0.1794 | 0.2040 |
| 0.9 | 0.0616 | 0.1164 | 0.1644 | 0.2329 | 0.2603 | 0.2808 |
| 1.0 | 0.0485 | 0.0813 | 0.1081 | 0.1372 | 0.1633 | 0.1805 |

Table 2: Vertical Latency, 10-bin, Counts

| Bin | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|
| 0.1 | 129116 | 129116 | 129116 | 129116 | 129116 | 129116 |
| 0.2 | 57673 | 57673 | 57673 | 57673 | 57673 | 57673 |
| 0.3 | 32253 | 32253 | 32253 | 32253 | 32253 | 32253 |
| 0.4 | 18028 | 18028 | 18028 | 18028 | 18028 | 18028 |
| 0.5 | 9488 | 9488 | 9488 | 9488 | 9488 | 9488 |
| 0.6 | 3300 | 3300 | 3300 | 3300 | 3300 | 3300 |
| 0.7 | 1563 | 1563 | 1563 | 1563 | 1563 | 1563 |
| 0.8 | 657 | 657 | 657 | 657 | 657 | 657 |
| 0.9 | 146 | 146 | 146 | 146 | 146 | 146 |
| 1.0 | 1365 | 1365 | 1365 | 1365 | 1365 | 1365 |

Table 3: Horizontal Latency, 10-bin, Probabilities

| Bin | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|
| 0.1 | 0.0228 | 0.0392 | 0.0517 | 0.0635 | 0.0720 | 0.0811 |
| 0.2 | 0.0356 | 0.0622 | 0.0861 | 0.1074 | 0.1222 | 0.1366 |
| 0.3 | 0.0514 | 0.0841 | 0.1160 | 0.1440 | 0.1646 | 0.1832 |
| 0.4 | 0.0612 | 0.1043 | 0.1429 | 0.1753 | 0.2048 | 0.2263 |
| 0.5 | 0.0752 | 0.1231 | 0.1648 | 0.2033 | 0.2371 | 0.2608 |
| 0.6 | 0.0947 | 0.1464 | 0.1981 | 0.2391 | 0.2725 | 0.2957 |
| 0.7 | 0.1129 | 0.1869 | 0.2434 | 0.2910 | 0.3333 | 0.3757 |
| 0.8 | 0.0930 | 0.1686 | 0.2093 | 0.2791 | 0.3256 | 0.3663 |
| 0.9 | 0.0870 | 0.0870 | 0.0870 | 0.2174 | 0.2609 | 0.3043 |
| 1.0 | 0.0833 | 0.1500 | 0.2333 | 0.2667 | 0.3000 | 0.3333 |

Table 4: Horizontal Latency, 10-bin, Counts

| Bin | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|
| 0.1 | 111396 | 111396 | 111396 | 111396 | 111396 | 111396 |
| 0.2 | 74637 | 74637 | 74637 | 74637 | 74637 | 74637 |
| 0.3 | 41442 | 41442 | 41442 | 41442 | 41442 | 41442 |
| 0.4 | 17245 | 17245 | 17245 | 17245 | 17245 | 17245 |
| 0.5 | 5968 | 5968 | 5968 | 5968 | 5968 | 5968 |
| 0.6 | 2075 | 2075 | 2075 | 2075 | 2075 | 2075 |
| 0.7 | 569 | 569 | 569 | 569 | 569 | 569 |
| 0.8 | 172 | 172 | 172 | 172 | 172 | 172 |
| 0.9 | 23 | 23 | 23 | 23 | 23 | 23 |
| 1.0 | 61 | 61 | 61 | 61 | 61 | 61 |



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