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Policy Evaluation



The Economic Impact of Neonicotinoid Restrictions on the EU Crop Sector

A comparative analysis of rapeseed, potatoes, and winter barley from 2010 to 2023

2026

This study was conducted by:
IPE Institute for Policy Evaluation GmbH, Oskar-von-Miller-Strasse 16
60314 Frankfurt, info@ipe-evaluation.de

www.ipe-evaluation.de



Abstract

The EU's neonicotinoid restrictions were introduced to protect ecosystems, yet the evidence reveals a policy that has imposed heavy economic costs while failing to deliver its global environmental promise. Using a Difference-in-Differences framework, this study identifies a sharp regulatory break where EU crop output collapsed while global competitors expanded. By 2023, this divergence resulted in a missing volume of approximately 10 million tons of rapeseed and 6.2 million tons of potatoes.

Valued at representative producer prices, this shortfall translates to a direct economic loss of over **EUR 5.9 billion in 2023 alone**. Crucially, this contraction has not reduced the global environmental burden. Instead, the EU has offset

domestic losses by increasing imports from regions with lower regulatory standards, effectively outsourcing its pesticide use and

subsidizing foreign competitors. The findings demonstrate that unilateral restrictions without global alignment jeopardize European economic resilience for no net ecological gain.

LOSS OF OVER
**5.9 BILL
EUR**
IN 2023 ALONE

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Introduction



Over the past decade, European agriculture has undergone a fundamental transformation as pesticide regulation has become one of the most contested and consequential areas of EU policy given its direct implications for crop yields, market structures, and Europe's long-term supply security. In an effort to protect pollinators, ecosystems, and human health^{1,2}, the European Commission began restricting the use of neonicotinoid seed treatments in 2013. At that stage, only certain crops (particularly rapeseed and other flowering oilseeds) were directly affected. For other crops, such as potatoes, the impact came later, when the ban was expanded to all outdoor uses in 2018. Some crops, including winter barley, remained largely untouched because they are typically sown outside the main pollination period and depend less on chemical seed treatments.

This staggered timeline provides a valuable framework for examining how stricter pesticide policies have reshaped European farming. Rapeseed, which was among the first to lose access to neonicotinoids, offers a clear case of how regulation can affect yields, costs, and international competitiveness. Potatoes, impacted several years later, illustrate delayed but similar pressures. Winter barley serves as a counterexample, showing that, where pest control requirements are lower, production growth matches world market trends. While winter barley differs agronomically from root crops or oilseeds, it shares the same general climatic exposure across the EU. This makes it a critical variable for distinguishing between

yield losses caused by regional weather events (which would affect barley) and losses caused by crop-specific regulatory restrictions (which do not).

The topic reaches far beyond these three crops. It raises questions about how environmental regulation interacts with food production, economic resilience, and trade. In practice, these rules determine not only how Europe farms, but increasingly also where Europe sources its food. The EU's move toward an increasingly precautionary pesticide policy also carries strategic implications: by limiting farmers' access to crop protection tools, Europe risks eroding its own supply security in times of crisis. This trend directly undermines the objective of „Open Strategic Autonomy”, as identified in the recent Strategic Dialogue on the Future of EU Agriculture³. By depressing domestic yields of essential commodities like oilseeds, the current regulatory framework inadvertently increases Europe's exposure to volatile global supply chains and geopolitical shocks. At the same time, tighter restrictions at home have often been accompanied by rising imports from regions with lower standards, leaving the EU more dependent on external suppliers while shifting environmental burdens abroad. This concern will likely intensify from 2026 onward, when new import restrictions on products containing residues of pesticides banned in the EU will come into force. These changes could further influence global supply chains, competitiveness, and the balance between sustainability and self-sufficiency in European agriculture.

¹ Zhang et al. (2022): Human exposure to neonicotinoids and the associated health risks: A review

² National Toxicology Program (2020): NTP Research Report on the Scoping Review of Potential Human Health Effects Associated with Exposures to Neonicotinoids Pesticides

³ European Commission (2024): Strategic Dialogue on the Future of EU Agriculture



Background and Regulation

The debate over neonicotinoids intensified in the late 2000s, when growing scientific evidence linked their widespread use to the decline of pollinator populations. These systemic insecticides, originally valued for their effectiveness and low application frequency, were shown to persist in soil and water and to harm bees and other beneficial insects. In 2013, the European Commission introduced the first restrictions on three major neonicotinoids (clothianidin, imidacloprid, and thiamethoxam) covering pollinator-attractive crops such as rapeseed, sunflower, and maize. Five years later, in 2018, the measures were expanded to include all outdoor uses, extending their impact to additional crops such as potatoes, which had not been affected previously⁴.

This step marked a clear policy shift within the EU. It reflected a move toward more precautionary and sustainability-oriented regulation under the Common Agricultural Policy (CAP), placing greater emphasis on environmental and health considerations in crop protection. Member states were required to update their national approval systems and strengthen monitoring, while farmers had to reorganize pest management with a reduced range of chemical options. The effects differed markedly across crops due to the timing and relevance of the neonicotinoid bans. Rapeseed was directly affected by the 2013 restrictions on seed treatments, leading to immediate increases in pest pressure and production losses. Potatoes were only impacted after the full outdoor ban in 2018, which also led to declining production. Winter barley, by contrast, was minimally affected because it relies only marginally on

neonicotinoid seed treatments. As a result, its output even expanded during the observed period.

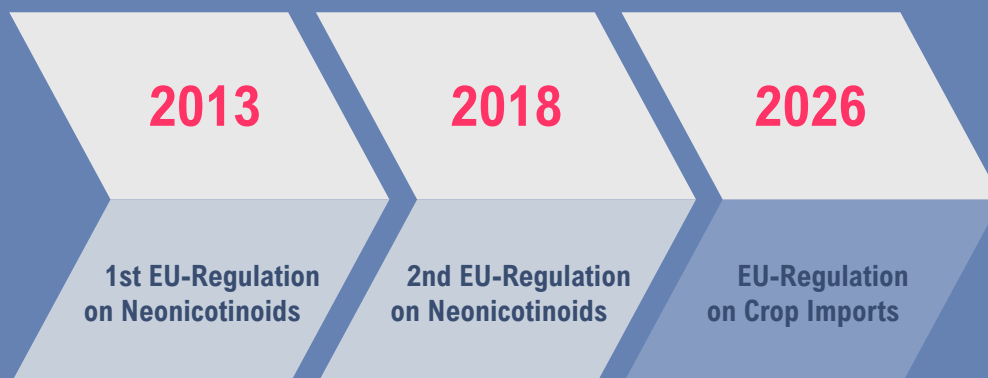
Over the past years, these regulatory changes altered production dynamics and trade patterns across the EU. For example, domestic rapeseed output declined in several member states, while imports from major exporters such as Australia, Canada, and Ukraine increased significantly⁵. These origins often benefit from lower regulatory costs, giving them a comparative advantage in global oilseed markets.



The resulting shifts have reshaped not only the economic structure of the EU's oilseed sector but also its position in international trade, underscoring the broader challenge of maintaining competitiveness under increasingly restrictive environmental regulations.

⁴ European Commission (2025): Neonicotinoids

⁵ Ufop (2025): Higher demand for rapeseed imports due to smaller EU harvest





Methodological Approach

To estimate the economic impact of the EU's neonicotinoid restrictions on rapeseed and potato production, the analysis applies a Difference-in-Differences (DiD) model. The basic idea is to compare how production in the European Union evolved before and after the regulatory changes, relative to how global production of the same crops developed over the same period. The world market serves as the counterfactual benchmark: it represents the growth path the EU might have followed in the absence of the neonicotinoid restrictions. This approach is well suited to isolating regulatory effects because global production trends are driven by comparable technological, climatic, and market developments, but are not directly exposed to EU legislation. We employ a global benchmark as a conservative proxy for the technological frontier. This measure captures yield gains driven by genetic improvements and machinery that EU farmers could theoretically access. By aggregating diverse growing regions into the 'Rest of the World' category, many of which face more severe climatic challenges than Europe, the model avoids overstating the EU's potential performance. With long, consistent Eurostat⁶ and FAO⁷ time series now available up to 2023, the data allows a clearer identification of the regulatory impact than in earlier analyses.

Once the production differences between the EU and the counterfactual global trend are established, the resulting quantity gaps are monetized using average world market prices for each crop.

For rapeseed, the effective treatment year is set to 2014, reflecting the point at which the 2013 restrictions on neonicotinoid seed treatments began to have an agronomic impact. EU production levels up to 2014 are compared with those after 2014, while global production (excluding the EU) serves as the untreated „comparison group". This Difference-in-Differences approach identifies how much of the

post-2014 divergence between EU and global output can be attributed to the regulation rather than to general market or climatic trends. Focusing on 2014, rather than the year of formal adoption, is important because farmers were still able to use existing seed stocks and, in some cases, emergency authorizations during the transition phase.

For potatoes, the same logic is applied with 2019 defined as the effective treatment year. While the regulatory decision to extend the ban to all outdoor uses was taken in 2018, the prohibitions on the three key neonicotinoids relevant for potatoes only became binding in practice from 2019 and 2020 onwards⁸. EU potato production until 2019 is therefore contrasted with production after 2019, again using global output as the comparison benchmark, to capture the period in which the new rules started to influence agronomic decisions and observed yields.

Once the production differences between the EU and the counterfactual global trend are established, the resulting quantity gaps are monetized using average world market prices for each crop. This produces an estimate of the annual economic loss: the value of the output the EU would likely have produced if its crop production had grown at the same rate as the global market. The result reflects the direct production-side loss attributable to the regulatory change, independent of secondary factors such as trade flows, substitution effects, or processing margins. Consequently, the financial estimates presented here should be interpreted as a lower-bound baseline. They reflect only the gross primary production value, excluding the multiplier effects on the processing industry and the increased costs of sourcing replacement imports.

To validate that the observed divergence is regulation-driven rather than a result of general regional factors (e.g., broad European weather patterns), the study employs Winter Barley as a 'negative control'. Since Winter Barley was minimally exposed to the neonicotinoid restrictions, its continued alignment with global trends serves as a falsification test, confirming that the collapse in rapeseed and potato output is specific to the treated crops.

⁶ Eurostat (2025)

⁷ FAO (2025)

⁸ European Commission (2025): Neonicotinoids



Results

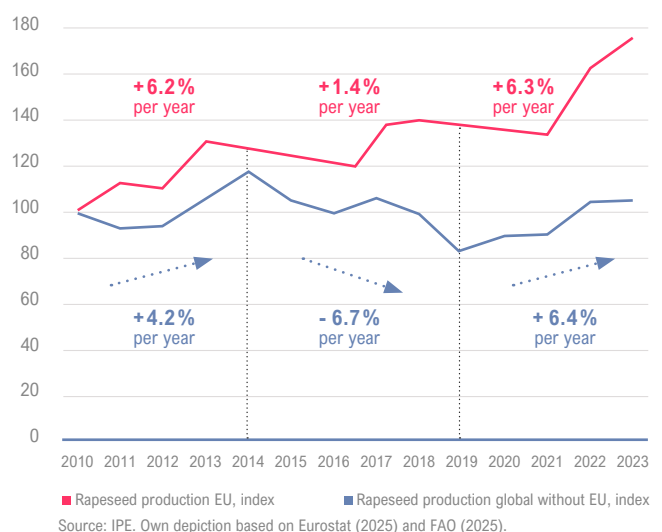
The counterfactual analysis compares the development of crop production in the European Union with that of the global market (excluding the EU) to estimate how much the EU's output of rapeseed and potatoes would have increased in the absence of the neonicotinoid restrictions. The comparison is made over the period in which the regulations became agronomically effective: from 2014 onward for rapeseed and from 2019 onward for potatoes. A similar counterfactual approach has been used in earlier work, including the analysis by Noleppa (2017)⁹, which also compared EU rapeseed production trends with hypothetical productivity paths in the absence of the ban on neonicotinoids. However, that study was carried out only a few years after the first restrictions, at a time when the economic consequences had barely begun to unfold. It was therefore unable to capture the long-term effects of the regulation. With a decade of additional data now available, the full impact can be assessed far more accurately and comprehensively.

1. Rapeseed

From 2010 to 2014, EU rapeseed production grew by 18 percent, while global production outside the EU rose by 27 percent, reflecting robust growth in both markets. Between 2014 and 2023, global rapeseed production excluding the EU increased by 32.8 percent. Over the same period, EU rapeseed output declined by 9.7 percent. Much of this decline occurred between 2014 and 2019, when EU production fell sharply, before stabilizing and growing again after 2019. However, this recovery did not translate into any meaningful catch up relative to the world market. The gap that opened in the first post regulation years remained in place until today. This divergence indicates that the EU did not follow the global growth trajectory and instead experienced a structural contraction of its rapeseed sector. Applying the global growth rate to the EU's 2014 production level shows that EU rapeseed output in 2023 would have been roughly 10 million tons higher under the counterfactual scenario. In reality, the EU harvested approximately 19.6 million tons of rapeseed in 2023, meaning that the „missing output“ corresponds to about half of the actual production that year. Valued at a representative producer price of EUR 480 per ton¹⁰, this implies an economic loss of around EUR 4.8 billion for 2023 alone.

This estimate captures only the primary production effect and does not include downstream impacts on processing margins, the biodiesel sector, or the feed industry, which would likely amplify the overall economic burden.

Figure 1: Relative change in the production of rapeseed, EU vs. Rest of the World (tons in 1,000), 2010 – 2023



⁹ Noleppa (2017): Banning neonicotinoids in the European Union: An ex-post assessment of economic and environmental costs

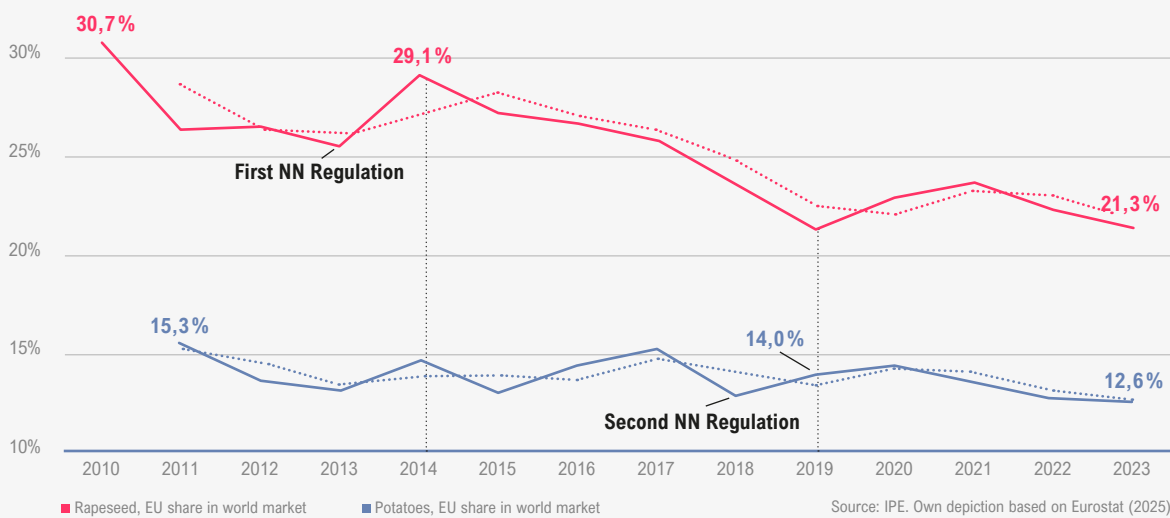
¹⁰ Raiffeisen (2025): Rapspreis in €/t

2. Potatoes

A similar pattern emerges for potatoes, albeit with a shorter post-ban period. In the years preceding the ban on neonicotinoids, production remained relatively stable within the EU as well as the rest of the world. Between 2019 and 2023, global potato production (excluding the EU) increased by 6.4 percent, whereas EU production fell by 5.8 percent. Using the same counterfactual logic as for rapeseed, the EU would

have produced an estimated 6.2 million tons more potatoes in 2023 had it followed the global growth path. Compared with the EU's actual potato production of 48.1 million tons in 2023, this represents a shortfall of roughly 13 percent. At an estimated average producer price of around EUR 180 per ton¹¹, the value of this lost output amounts to approximately EUR 1.1 billion for the year 2023.

Figure 2: Rapeseed and Potatoes, EU Share in World Market, 2010/11 - 2023



3. Interpretation

Taken together, these results suggest that the neonicotinoid restrictions contributed to a meaningful divergence between EU and global production trends for both rapeseed and potatoes. While the exact magnitude of the regulatory effect cannot be fully isolated from other factors such as weather variability, input prices, and broader structural challenges in European agriculture, these influences do not change the overall conclusion. The counterfactual comparison shows that the EU would likely be producing substantially more of both crops today without the regulatory shocks of 2013 and 2018. As highlighted in the 2024 Draghi Report on European Competitiveness¹², such regulatory burdens stifle productivity and create

a significant investment gap. The divergence in rapeseed and potato output observed here is a prime example of this phenomenon, where precautionary constraints effectively act as a tax on domestic innovation, rendering European producers structurally less competitive than their global peers. This is further supported by the fact that the EU substantially lost in terms of world market share for both rapeseed and potatoes after the respective regulation was passed (*see figure 2*). The findings also highlight the broader implications for agricultural competitiveness and supply security, particularly considering the stricter import rules on pesticide residues that will take effect from 2026 onward. The analysis also considered winter

¹¹ Raiffeisen (2025): Kartoffelpreis in EUR/dt

¹² EU Commission (2024): The Future of European Competitiveness - a Competitiveness Strategy for Europe

barley as an unaffected comparison crop, since it is typically sown outside the main pollination period and relies only marginally on neonicotinoid seed treatments. Between 2010 and 2023, EU winter barley production increased by 39.7 percent. provides strong evidence against the hypothesis of general productivity decline in EU agriculture. Instead, the timing and pattern of divergence strongly suggest that the neonicotinoid restrictions themselves were the decisive factor.

In addition to the economic implications, the results also point to an environmental dimension that is often overlooked in the policy debate. Because the decline in EU production has been offset by increasing imports from regions with lower regulatory standards and, in many cases, lower yields per hectare, the net effect is likely an increase in the global environmental footprint of these crops. This „environmental leakage” implies that strict domestic restrictions do not necessarily reduce global pesticide use or land pressure; instead, they may simply shift production to areas where environmental impacts per ton produced are higher. This outcome represents a classic case of ‚regulatory leakage’, creating a ‚green illusion’ where the EU reduces local inputs only to drive up global emissions through less efficient foreign production. In effect, the policy has not reduced the ecological footprint of European consumption; it has merely outsourced it. Specifically, this substitution effect replaces domestic production with imports from jurisdictions where neonicotinoids or similar chemistries often remain authorized, thereby neutralizing the intended global reduction in active substance load.

Besides leakage effects, moving from domestic production to long-distance imports adds an unaccounted secondary carbon cost under current regulations. Importing rapeseed or other crops from regions such as Australia or Canada adds substantial maritime transport emissions to the overall lifecycle of these commodities. As a result, the net climate impact of the EU’s regulatory approach may be higher than expected, even if domestic pesticide use declines.





Conclusion and Outlook



This study has explored how the EU's restrictions on neonicotinoid seed treatments have affected the production of rapeseed and potatoes, using global market developments as a counterfactual to estimate what European output might have looked like under different regulatory conditions. The comparison shows a clear and growing gap. While global production expanded by 32.8 percent for rapeseed since 2014 and by 6.4 percent for potatoes since 2019, EU output moved in the opposite direction. By 2023, the resulting shortfalls amounted to around 10 million tons of rapeseed and 6.2 million tons of potatoes. Valued at representative producer prices, this translates into about EUR 4.8 billion and EUR 1.1 billion in lost production value for that year. Although these figures capture only the primary production effect and not downstream impacts on processing or trade, they illustrate the scale of the economic adjustment that has taken place. This valuation serves as a measure of gross market potential. While it does not account for variable input costs or the potential price-dampening effects of higher supply, it similarly excludes the substantial secondary costs

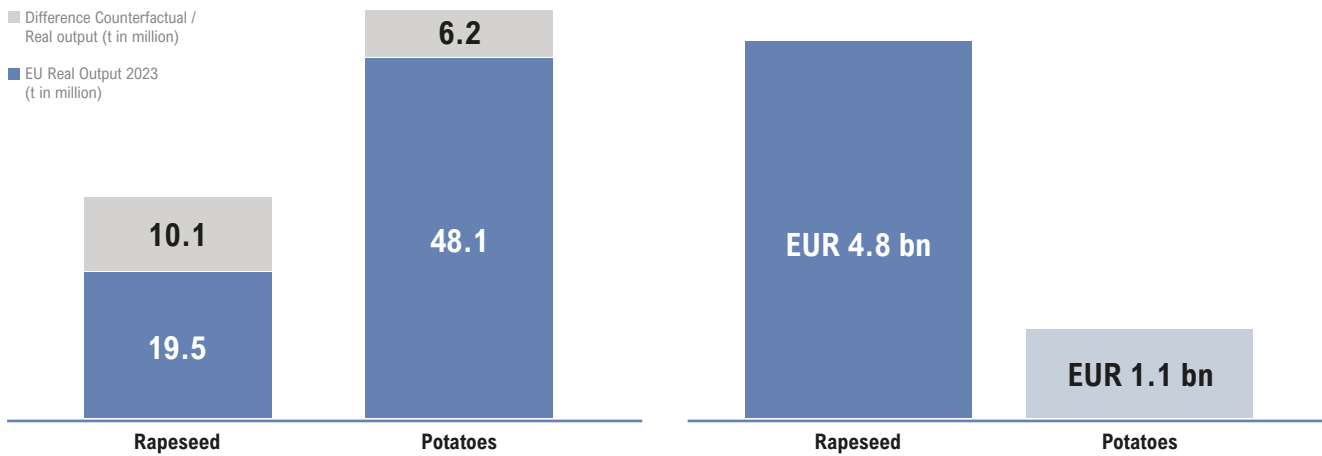
incurred by the EU processing and livestock sectors due to raw material scarcity.

These results highlight a wider challenge for agricultural policy in the EU. Over the past decade, the EU has effectively subsidized foreign competitors by handicapping its own producers, yet without achieving measurable improvements in global environmental health. In many cases, Europe has simply outsourced production to regions with lower standards, higher land use intensity, and greater transport emissions without reducing global pesticide use. While pesticide restrictions pursue important objectives related to environmental protection, biodiversity, and public health, they also affect the capacity of European agriculture to maintain output, remain competitive, and ensure a reliable supply of key commodities. The tension between ecological ambition and economic resilience is therefore central to the design of EU policy, a trade-off that is well-documented in economics and increasingly central to the EU's strategic autonomy debate^{13,14}. In an era of increasing geopolitical instability, food

¹³ European Commission (2025): Protecting the Environment and Economic Growth: Trade-off or Growth-enhancing Structural Adjustment?

¹⁴ Zhang et al. (2025): Bridging resilience and sustainability: a reconciled framework for navigating social-ecological systems | Regional Environmental Change

Figure 3: EU Production Loss for Rapeseed and Potatoes (left, tons in million) and Resulting Economic Loss (right) for 2023.



Source: IPE. Own depiction based on Eurostat (2025) and FAO (2025)

security cannot be decoupled from economic resilience. A regulatory approach that consistently prioritizes hazard avoidance over yield stability erodes the primary production base that serves as Europe’s ultimate safety net against global food crises. Moreover, this challenge is not limited to neonicotinoids: it emerges across many areas of agriculture and fisheries, where increasingly strict rules place additional costs on EU producers and shape Europe’s competitiveness in global markets.

The outlook is shaped by upcoming regulatory changes. The EU plans to introduce more demanding rules for imports that contain residues of pesticides no longer authorized within the Union. These measures are likely to increase import prices and may raise costs for processors and consum-

ers. At the same time, they could strengthen the competitive position of EU farmers by bringing imported products under closer alignment with domestic standards. In this sense, the new rules have the potential to reduce some of the competitive disadvantages created by earlier regulatory decisions while still pursuing high environmental and health objectives. From the perspective of EU farmers, however, it probably remains difficult to understand why there should be a gap of 6 and 13 years respectively between the restrictions applied to domestic production and those applied to imported products. This lag has created a decade-long period in which European producers operated under significantly tighter rules than their global competitors. This imbalance has reshaped supply chains and left a lasting imprint on the EU’s level of self-sufficiency.



Overall, the findings suggest that future policy making will need to carefully balance the pursuit of sustainability with the need to maintain a productive and resilient agricultural sector. Ensuring environmental protection and food security at the same time requires transparent assessments, coherent trade policies, and a clear understanding of how regulatory interventions shape incentives across the entire value chain. Without such balance, the EU risks achieving neither its environmental goals nor its economic ones, while becoming more dependent on external suppliers along the way.



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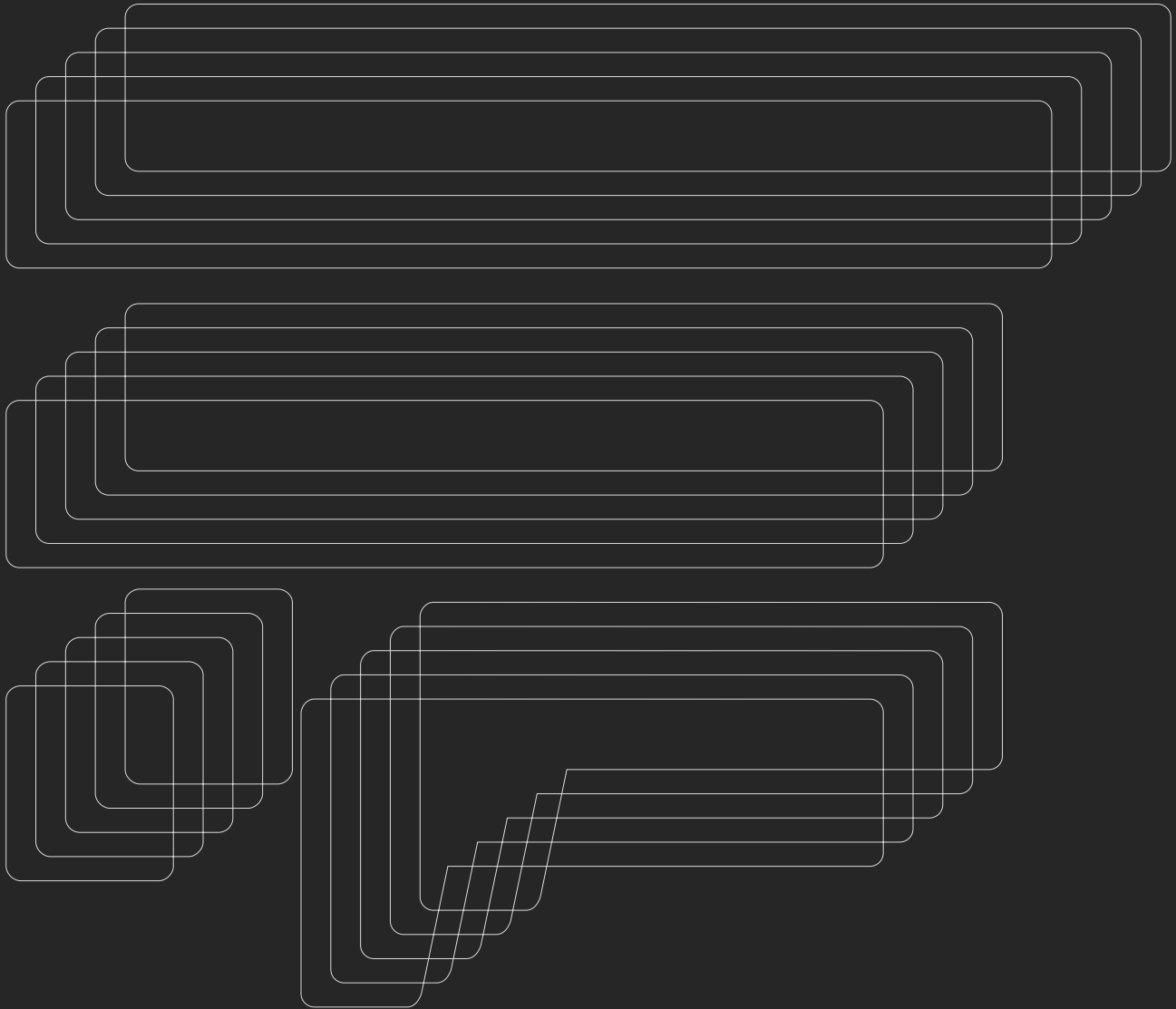
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*Institute for
Policy Evaluation*



IPE Institute for Policy Evaluation GmbH

Oskar-von-Miller-Strasse 16
60314 Frankfurt

Telefon: +49 69 67808053

Telefax: +49 69 67808108

E-Mail: info@ipe-evaluation.de

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