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I.
DESCRIPTION

"An industrial agenda to increase Germany's energy resilience" is a policy paper resulting from EPICO's Policy Accelerator workshops respectively focusing on direct electrification and indirect electrification, which were held at Siemens Energy in Berlin between 9 and 12 January 2024. Conceived by EPICO, the Policy Accelerator workshops adopt an interactive bottom-up approach, including diverse key stakeholders on an operative and decision-making level to jointly develop narratives and concepts using an agile design thinking process.

Participants that developed ideas to establish an industrial agenda to increase Germany's energy resilience throughout the series of workshops:

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II.
EXECUTIVE SUMMARY

Germany and the European Union (EU) are navigating a complex landscape marked by challenges such as Russia's aggression in Ukraine, energy and supply crises, and geopolitical shifts. Major economies such as the USA and China are promoting clean energy and technology development to assert leadership in the green industrial revolution, highlighting the need for a comprehensive EU industrial policy approach beyond the European Green Deal. Amidst these challenges, the imperative for energy resilience has never been greater, particularly as the EU imports more than half of its energy needs, most notably natural gas. A holistic energy resilience framework that reflects the role energy systems play and the services they provide for our transformation in an increasingly geopoliticised economy entails two layers. First, the sufficient and reliable supply of materials, fuels, technologies, and skills needed to maintain the pace and scope of planned energy systems transformation. Second, meeting the projected primary energy demand, and the ability of the system to produce and enable use of (affordable and clean) energy services for industries and households, in a secure, flexible, and efficient manner, at all times.

This policy paper presents a comprehensive strategy to enhance energy resilience while driving towards climate neutrality, focusing on industry challenges, the value of resilience, guiding principles, and a new industrial policy framework.

Energy-intensive industries face significant hurdles in transitioning to green energy sources, particularly those reliant on internationally traded commodities. Direct electrification is favoured for efficiency, but renewable hydrogen will be necessary in targeted cases. The main problem for the implementation of direct electrification on a large scale is the lack of renewable electricity and uncertainty about the short- to medium-term trajectory of electricity prices as countries embark on ambitious energy transitions. Uncertainty in energy markets and supply chains poses risks to industries and downstream markets. A strategy for "green lead markets" is essential to address competitiveness concerns and ensure societal resilience.

This policy paper suggests ten principles to guide energy policymaking, emphasising energy efficiency, market mechanisms, and innovation. It depicts the need for enhanced German and EU-level action and integration of energy policy and markets to boost investment and innovation.

Recommendations for a 'New Industrial Policy Framework' include reforms in three innovation dimensions, "markets", "regulation" and "financial incentives". The paper opts for a gradual and pragmatic reform of the German electricity market design including the introduction of an innovation-oriented, technology-neutral capacity mechanism seizing the potential of flexibility and storage instead of only focusing on big power plants. To accelerate the adoption of new technologies and develop a leaner regulatory framework, "sandboxes" should be leveraged to allow testing, scaling and innovation-oriented regulatory reforms. Instead of introducing new permanent subsidies, more cost-efficient tax incentives, public guarantees and regressive grants to scale cleantech are proposed. These reforms need to be embedded in a new integrated approach favouring European programmes that promote and implement innovation within ecosystems instead of the current "silo-approach".

By implementing these recommendations, Germany and the EU can bolster energy resilience, support industrial transformation, and accelerate the transition towards climate neutrality ensuring economic competitiveness and societal prosperity in a rapidly changing global landscape.

III.
INTRODUCTION

Germany and the EU face multi-dimensional challenges, while still being leaders in the ambitious transformation towards climate neutrality. Faced by Russia's war of aggression in Ukraine, the subsequent energy crisis, and further fundamental geopolitical shifts, the EU must rethink its industrial and energy security strategies. To this end, energy resilience is ever more central to protect citizens and industries. Energy resilience – as in the ability to shield the energy system from internal and external shocks – must be increasingly understood as a synonym for energy security.

> *"Energy resilience [...] must be increasingly understood as a synonym for energy security."*

Remarkably, the EU imports 60% of its energy (Statista, 2023), a figure that has not changed much in the last few decades. The crises in the energy markets and rising inflation have led to income losses, severely impacting the competitiveness of industry, thereby creating severe challenges to the public budget. The larger global economies are rolling out huge domestic support packages to accelerate the development of clean energy sources in an attempt to make a bid for leadership in the green industrial revolution, e.g. the USA's Inflation Reduction Act (IRA) and the Chinese heavy subsidisation schemes for clean industries.

The geopoliticisation of the transformation already shows clear knock-on effects for the EU's economy, and calls for a new policy approach that goes beyond the European Green Deal.

In order not to lose pace in the transition towards climate neutrality, energy-intense industries need to scale up activities to diversify supply chains of energy resources. All major stakeholders have increasingly focused their innovation and research and development (R&D) programmes on shifting traditional fossil-based value chains into the direction of alternative non-fossil business models (IEA, 2023: 10), which require competitive electricity prices and complementary green lead markets. Now it is high time to get the new technologies applied at the global scale as quickly as possible.

This paper discusses measures to bring down the cost of green energy production and increase energy resilience, through a twofold approach prioritising direct electrification on the one hand, and parallelly boosting the development of innovation. If done correctly, this approach can produce a "dividend" on multiple fronts and adress the multiple challenges facing Europe's economic and security fabric. It can foster industrial competitiveness, speed up climate transformation, and make Europe overall more secure from outside threats. It does so by targeting the challenges faced by industry, addressing the importance of energy resilience, and suggesting a set of principles to base Europe's decarbonisation on. Ultimately, this brief provides a set of five key policy recommendations.

IV.

CHALLENGES FOR OUR INDUSTRY

While the deployment of carbon capture and storage (CCS) opportunities can support greenhouse gas (GHG) reduction, energy efficiency and the substitution of fossil resources have become the guiding vision for the transformation of industrial value chains. This seems to be a relatively small step for industries that already rely on electrified processes, e.g. alumina production or chlorine-based chemicals. In this case, it comes down to a simple comparison of energy costs.

"The EU, and Germany too, need an integrated energy system based on sector coupling [...] and sector integration covering the whole value chain of production, transmission distribution, and consumption."

On the other hand, for industries that depend on internationally traded commodities either as raw materials or as feedstocks for generating heat, e.g. the petrochemical sector (depending on naphtha for the majority of applications), or primary steel production (depending on iron ore and coal), the direct and indirect electrification of processes entail a fundamental change (IRENA, 2022: 14). In the future, they will be predominantly tied to regional power markets, relying heavily on EU and national energy policy frameworks.

Process heat systems in industry have an enormously long service life. An average gas-fuelled steam boiler, for example, runs for 25–30 years, and in some cases even up to 40 years. Germany's goal of achieving climate neutrality by 2045 entails that process heat needs to be decarbonised (i.e. phasing out fossil fuels) in the next 21 years.

In this context, direct electrification is the preferred option to achieve the highest level of efficiency, thus minimising costs from a system perspective. However, there are circumstances where an indirect utilisation of renewable energy is necessary, for instance in the form of renewable hydrogen. Expanding existing gas infrastructure is extremely costly and time-consuming. Direct electrification should be prioritised where capacity expansion is possible from both an economic perspective (e.g. resource allocation, overall cost consideration and time frame) and ecological perspective (i.e. respecting environmental clauses, avoiding conservation areas, and preferring decentralised solutions).

However, the main bottleneck in Europe for the implementation of large-scale direct electrification is the limited availability of renewable energy, and the related uncertainty about how electricity prices will develop in the near to medium-term future. Both availability

PRIORITY 1	PRIORITY 2	PRIORITY 3	TARGETED APPLICATION
Increase energy efficiency and system flexibility	Increase RES and electrification wherever possible	Renewable hydrogen and derivatives	Carbon capture, utilisation and storage

Table 1: energy prioritisation taxonomy to boost energy resilience.

of green electricity as well as the price of electricity (including, but not limited to green electricity) at least in part depend on political processes – e.g. the speed of renewable energy systems (RES) build-out, the overhaul of our energy infrastructure – which are inherently difficult to predict.

Uses of indirect electrification include processes that cannot make use of direct electrification, such as the reduction of iron ore. Examples include industrial processes that currently require high temperature incineration processes, that are designed for constant consumption of energy, or that require energy storage in order to compensate for the intermittent nature of renewables. Storage systems can rely on hydrogen, namely when a shortage of regional energy supply requires energy imports.

The EU, and Germany too, need an integrated energy system based on sector coupling (electricity, heating and cooling, hydrogen and derivatives, natural gas, carbon management), and sector integration, covering the whole value chain of production, transmission distribution, and consumption.

V.

THE VALUE OF RESILIENCE FOR OUR SOCIETY

In Q3 2023, the EU's average power price was 85€/MWh (DG ENER, 2023), whereas in December 2023, in the USA it was as low as 22.67$/MWh (EIA 2023), and China's average 2019-2023 prices amounted to only 8.9$/MWh (Statista, 2024). Besides uncertainty concerning competitive power prices and infrastructure development, there is a lack of clarity with regard to what a "failed transition" would mean to society in terms of costs and resilience. A decreasing level of competitiveness of energy-intense industries, and the eroding of key value chains, can have severe consequences for downstream markets.

"Give way to a more holistic energy resilience framework that reflects the role energy systems play, and the services they provide for our transformation in an increasingly geo-politicised economy."

However, as long as the willingness to pay for green commodities remains limited, there is a consequential limited opportunity to pass on higher costs of production to final customers. Hence, the industry urgently needs a strategy for "green lead markets" on carbon management, the circular economy, storage and flexibility.

When assessing the value of the climate transition for society, the traditional security and supply-demand equation (centred around energy supply and use) needs to give way to a more holistic energy resilience framework that reflects the role energy systems play and the services they provide for our transformation in an increasingly geopoliticised economy. This entails two layers. First, the sufficient and reliable supply of materials, fuels, technologies, and skills needed to maintain the pace and scope of planned energy systems transformation. Second, meeting the projected primary energy demand, and the ability of the system to produce and enable use of (affordable and clean) energy services for industries and households, in a secure, flexible, and efficient manner, at all times.

VI.

INCREASING INSTITUTIONAL CAPACITY

There is currently a lack of institutional capacity (both at the EU and Member State levels) to address new energy security challenges and implement a new understanding of energy resilience with a strong focus on innovation. As energy resilience can best be achieved through EU-level action and integration of energy policy and markets, the establishment of cross-Director Generals and cross-Member State programmes proactively including the private sector, and with the mandate and capacity to implement a new energy resilience agenda as an incremental part of an industrial strategy, is long overdue.

"New EU-wide programmes should focus on developing and implementing the right market framework, regulatory conditions and financial schemes to leverage Europe's innovative capacity and common strengths to enhance energy resilience."

New EU-wide programmes should focus on developing and implementing the right market framework, regulatory conditions and financial schemes to leverage Europe's innovative capacity and common strengths to enhance energy resilience. As part of their mandate, such programmes would be responsible for the operationalisation of this new holistic approach to energy resilience and the balancing of the various objectives thereunder.

A blueprint for closing one governance lacuna can be found in Germany's Federal Agency for Disruptive Innovation (SPRIND) independently financing breakthrough solutions with public finance. It follows a similar model to that of the US-based research agency Defense Advanced Research Projects Agency (DARPA), which achieved widespread success by creating, for example, the Moderna Covid-19 vaccine, weather satellites, and drones (The Economist, 2021). A key aim would be to offer an alternative to current slow and overly bureaucratic processes of EU-funded programmes for upscaling clean energy technologies, including renewable fuels of non-biological origin (RFNBO).

VII.

GUIDING PRINCIPLES FOR GREEN PRODUCTION AND ENERGY RESILIENCE

Enabling a new energy resilience paradigm will require fundamental shifts in political culture, institutional capacity, and public opinion, which will take time. In the shorter term, interventions need to be designed to progress towards achieving this new paradigm, within the boundaries of what is currently possible.

"To structure and advance this debate, a clear compass for operationalisation of and indicators on energy resilience are required."

Energy resilience and the green transition are symbiotic. While resilience is often referred to in the current debate on the agenda of a new industrial policy approach, there is no common understanding of what is meant by this. To structure and advance this debate, a clear compass for operationalisation of and indicators on energy resilience are required. Accordingly, this paper suggests ten principles that should guide energy policymaking, and be proactively pursued through a smarter energy market design and broader regulatory framework, including digitalisation.

- **Assume energy is scarce.** Prioritise the most energy-efficient solutions. Indirect electrification, including through RFNBOs, is generally less energy-efficient than direct electrification, and should thus be targeted towards hard-to-electrify sections of the economy in a timely manner, as well as where they can provide additional services to the energy system.
- **Acknowledge global market mechanisms.** When exploring opportunities for electrification, current market mechanisms need to be better understood. Energy-intense industries serving commodity markets operate in a very competitive and intertwined global environment. Some sectors rely on globally traded feedstocks, while others depend on regional feedstock.
- **Approach a sustainably low and internationally competitive electricity price.** To maintain international competitiveness and preserve Europe and Germany as an attractive industrial hub, the electricity market design should be adapted with the clear target of a highly efficient electricity pricing system.
- **Demand-side action is king.** Achieving reductions in energy use while providing the same services is the most efficient way of reducing costs. How we consume energy will need to adapt to a more intermittent supply of energy. Accordingly, policy instruments should cater for ever-more efficient flexibility options.

- **Integrate digitalisation in the energy market.** A smart use of digitalisation can offer tools to monitor and cut costs across the whole value chain, as well as improving system flexibility, and more effectively managing the grid.

- **Localise and diversify.** Local clean energy sources should be developed wherever possible, and be strategic. Diversification of supply can boost resilience by avoiding overreliance on individual energy sources, suppliers, value chains or technologies.

- **Think European.** Maximising the EU's geographical advantages and diversity of resources, and exploiting Europe's market size can enable the cheapest form of energy transition.

- **Innovation is key.** Continued breakthroughs and innovation are key in pushing the boundaries of what is possible, and accelerating the energy transition. A future-proof energy system should prioritise public support for R&D and investment in new technologies contributing to energy resilience.

- **Infrastructure first.** Our current energy infrastructure is not fit for purpose for the energy transition. Investments need to be ramped up and sped up massively to build out the electricity grids, hydrogen and CO2 infrastructure that are required. The priority should be using existing infrastructure and repurposing it, where economically and technically feasible. Economic logics should point towards extending green grids, while making best use of existing infrastructure with cleaner energy sources, such as synthetic or biogenic methane.

- **Listen more to unusual suspects.** Current policymaking is characterised by inertia, driven by incumbents. Alongside larger companies with a track record, policymakers also need to listen more "to unusual suspects", including actors that have proven that change is possible, and insist on the system change that decarbonisation requires. Small and medium-sized enterprises (SMEs) and cleantech start-ups should receive more public support, as these are where innovation takes place, and where it is most needed. Although the success rate may be lower here, the few successful projects overcompensate for bigger companies to decarbonise and phase out from fossil fuels. Well-established suppliers and offtaker industries should instead be the prime recipients of tax incentives and tax cuts that can boost swift decarbonisation.

VIII.

A NEW INDUSTRIAL POLICY FRAMEWORK FOR INNOVATION

The single market is Europe's key asset to drive down costs for the transformation, but it needs to be strengthened to enable transformation and development of future technologies. This includes a future-proof electricity market design, clear standards, the development of lead markets including through public procurement of green products, more public guarantees, blended finance instruments, the broader application of regulatory "sandboxes", and better aligned internal and external industrial policies. Public funds should be targeted to leverage private capital and increase energy resilience along key value chains with innovations.

"It is important to focus on accelerating innovation efficiently in a competitive environment, rather than micro-managing and overregulating the existing market framework."

With Germany and the EU being at the frontier of international technology, it is important to focus on accelerating innovation efficiently in a competitive environment, rather than micro-managing and overregulating the existing market framework. Elements of the IRA and the USA's DARPA can serve as a model.

1. A FUTURE-PROOF ELECTRICITY MARKET

Electrification requires cheap and affordable clean energy. This is particularly important for Germany as an industrial hub. There has been considerable uncertainty about the future of Germany's energy supply, which has hampered investment decisions. This uncertainty has increased with the energy crisis and a controversial debate on an industrial power price (Weber et al., 2023). A realistic strategy for Germany's future energy supply and resilience is therefore essential if companies are to commit to long-term investments in Germany.

Hence, a reform of the German electricity market design can lower electricity costs and avoid jeopardising any business case for electrification. Whereas the German electricity market reform needs to reflect the current level of feasibility in the context of an accomplished market design reform at the European level, a broader review of the European electricity market design needs to take place in the mid-term. This review should involve the market pricing mechanism as well as tenders and support schemes to ensure an efficient allocation of resources, a re-coupling of supply and demand, and the creation of high innovation and investment incentives for private investors, including those with low return expectations. A well-functioning and efficient power market in the short and medium term with competitive power prices

is necessary to provide efficient investment, dispatch incentives and foster the energy transition. Accordingly, this paper suggests five trajectories.

- **Incentivise flexibility and innovation of industrial power demand.** Flexibilisation of industrial power demand needs to become a core issue, considering the increasing share of intermittent renewable energy. System-friendly demand also translates into savings for offtakers. Where possible, procurement of demand profiles close to renewable energy sources is significantly cheaper than baseload prices. The use of the existing flexibility potential could reduce electricity costs for industrial companies to six cents per kilowatt-hour or less – without the introduction of an industrial electricity price (Aurora 2023).

- **Optimise financing for renewables assets.** Projects with lower financing costs can accelerate buildout of renewable capacity. This is not just a win for developers. Consumers, such as energy-intensive industries, stand to benefit from reduced power prices. Measures that de-risk the buildout of renewables make the energy transition more affordable. Public guarantees for Power Purchase Agreements (PPAs), especially for small and medium-sized enterprises, can substantially decrease financing costs, expand the PPA market, and accelerate the buildout of renewables, contributing to lower long-term power prices.

- **Incentivise system-friendly deployment and operation of renewables.** A system-friendly deployment and operation of renewables, which targets times of scarcity, schedules timely maintenance, and regulates output during surpluses, brings systemic benefits. When creating new instruments to support the buildout of renewables, this needs to be taken into account (e.g. with regard to design parameters for Contracts for Difference (CfD) or other, similar instruments).

- **Establish an innovation-oriented capacity mechanism.** A technology-neutral German capacity mechanism in line with the EU market design reform ensures that investment in flexible technologies takes place, and should be established until 2026. Storage, flexibility and demand side response can play an important role to ensure supply security already in advance. This should start from the immediate and appropriate implementation of the Clean Energy Package, currently only implemented by Luxembourg, and should include the rapid introduction of flexibility support schemes consisting of payments for the available capacity of non-fossil flexibility. Both provide complementary building blocks to procurement of sufficient H2 ready power plants capacity.

- **Speed up infrastructure development.** The ramp-up of urgently required infrastructure in terms of back-up capacities can increase the cost of electrifying industrial processes. Uncertainty over the financing of infrastructure, as well as the slow pace of infrastructure development, need to be addressed.

2. REGULATORY SANDBOXES

To accelerate the decarbonisation of industries, including through RFNBO-solutions, (innovative) technologies, and business models need to be rapidly scaled up. A regulatory environment that is overly strict or administratively burdensome hampers this objective.

- **Innovative tools such as regulatory experimentation or sandboxes** – as intelligently introduced by the Net-Zero Industry Act (NZIA) – should be leveraged by regulators and policymakers to allow the rapid testing and scaling of new technologies and solutions without compromising on core goals such as health and safety.

- **Sandboxes can help test new technologies, market mechanisms, and business models** related to key topics in a controlled environment. By granting certain exemptions or modifications within the sandbox, regulators can assess the effectiveness of different regulatory approaches, and make data publicly available. This can help locate critical issues to identify problem-solvers and best practices that can enhance Europe's development of clean technologies.

- Hence, **sandboxes are a promising vehicle** not only to prevent overly detailed, burdensome regulation from hampering efforts to scale up innovation, but also to enable regulators to gain insights into the potential benefits, challenges, and necessary adjustments for streamlining specific regulations on a larger scale, thereby contributing to a more flexible energy system.

- **In Germany, there have been initiatives based on frameworks somewhat similar to sandboxes.** For example, "Schaufenster intelligente Energie" (SINTEG) has explored new technologies under market conditions with a limited scope of regulation. However, it has stopped short of adapting regulations and the market framework to render it more innovation-friendly.

- **Frameworks to support innovative solutions and business models should be clear, transparent and open to all technologies.** The purpose would be to create adaptable, individual, technology- and business-specific sandboxes with clearly defined transition paths towards the standard regulation for individual actors.

- **The regulatory framework of sandboxes should ensure safety for all forms of life and avoid pollution of the environment.** However, it should disregard selected regulations for first to tenth-of-a-kind projects that establish new technologies with sufficient innovation height. Less regulation and more market is key, particularly in the current framework, where excessive monitoring and reporting are a locational disadvantage for the EU.

3. EFFECTIVE FINANCIAL AND TAX INCENTIVES

A stronger focus on tax incentives as a funding instrument represents an efficient and resource-saving alternative to costly bureaucratic procedures. Whether at the EU or at the German level, every euro that first has to be collected and then distributed is less efficient than a euro that does not have to be collected and distributed, at least in bureaucratic terms.

The IRA and China's support for photovoltaic (PV) and wind power industries represent conspicuous examples of the benefits of tax incentives compared to subsidies. While the latter reduces potential for private investment in R&D, the former boosts technical and operational efficiency (Wei Wu et al., 2023). The dollar-for-dollar reduction under the USA's IRA is additionally appealing due to its flexibility and transferability of tax credits.

- **The EU's funding instruments should hence be better targeted towards potential funding gaps**, taking into account Power Purchase Agreements, (Climate) Contracts for Difference (CCfDs), for investment (CAPEX) as well as for operating cost (OPEX) funding. New financing instruments, such as tax incentives and state guarantees, could be used to support the switch from gas, coal and oil to electricity and renewable hydrogen. Taking such an approach at the EU level is essential, particularly because of the distortion of competition by the huge differences in taxes and charges applied in the Member States, which are not all used for the development of the energy system and for energy consumers.

- **The state's involvement in this funding process must not be limited to the one-sided allocation of subsidies.** It is crucial that the state also keeps the interests of citizens and taxpayers in mind. This not only contributes to the acceptance of such subsidisation measures, but also ensures the sustainable and responsible use of tax revenues. A more balanced strategy is needed to provide positive impetus for the industry without provoking undesirable price increases.

- **One example of strategic state participation is Denmark's plans on CCS.** Here, efficient state participation has been key to set the country en route to reach 110% of CO2 reductions by 2050. Two measures are starting to bear fruit. On the one hand, Denmark provided more than €1 billion in a tender to kick-start CCS projects, and tenders equating to close to €1.5 billion will follow in 2024 and 2025. On the other hand, Denmark put in place a speedy licensing regime, where the state-owned entity Nordsøfonden owns 20% of Danish CO2 storage licences. These are important examples to take steps towards involving the state in the transformation process to a limited, yet effective extent, and at the same time shaping a sustainable energy infrastructure.

4. GUARANTEES FOR INNOVATION AND CLEANTECH

Cleantech companies, especially start-ups, are capital-intensive since they need to build hardware installations. Some of these innovators have tremendous market traction and could receive large amounts of customer pre-payments. This would allow them to scale up much faster, since this is non-dilutive and interest-free capital that could be used to finance working capital, or even investments in production infrastructure. However, typically customers request advance-payment guarantees when placing the deposits.

- **Financial guarantees backed by the state – or an institution – increase investment certainty for the private sector**, most notably by assuring buyers that, in the event of e.g. bankruptcy or simple delays, losses would be covered. The aim is to avoid permanent subsidies and enable targeted, earmarked funding. The EIB has already implemented similar measures in the case of wind manufacturers (EIB, 2023). This blueprint should be rolled out to other technologies that are key for achieving net zero, with ad hoc adaptations.

- **There are various ways of designing and implementing state-backed guarantees.** One option would be focusing on scaling the manufacturers of clean technologies through coverage of up to 80% of the risk, with an initial €5 billion package for all projects. Operationally, such guarantees should be offered with already available funding mechanisms, as a way to make cleantech bankable, by gradually decreasing either the share of risk covered, or the number of projects eligible (Besnainou and Davis, 2023).

- Another option would be to implement a **system to scale up cleantech manufacturing by accompanying start-ups to achieve bankability for the private sector.** EU institutions can leverage existing experience in rolling out guarantees, combined with the simplification, standardisation, and the overall speed increase of application processes. The level of risk of projects would also be based on criteria that can directly serve the purpose of the loan, and not on balance sheets (Lechtenfeld et al., 2023).

- Furthermore, **the scope of guarantees should also include infrastructural purposes.** The aim is to ultimately close the gap between the cost of RFNBOs (especially in the case of renewable hydrogen), and that of fossil fuels for consumers. Guarantees should cover the risk of non-availability of the required pipeline infrastructure in default events. This would help accelerate the system-friendly location of suppliers of RFNBOs with production centres (EPICO, KAS and Guidehouse, 2023).

- **Since start-ups are usually not bankable, banks interested in providing such guarantees typically require a significant deposit.** This renders the advance payments practically useless, because the money remains inaccessible to the companies. On top of this, fees apply for the guarantees. If public guarantees covering advance payments (potentially also incurring manageable fees to cover the risk for

public money) were available, they could be used as a valid source of financing, especially for start-ups with the relevant market traction, which also represents a valuable implicit selection mechanism.

- **For companies with smaller and non-bankable balance sheets, there is a need to finance these through 100% equity**, which is scarce especially at the beginning. Debt financing would accelerate technology roll-out and scale-up considerably. Banks are generally also very interested in financing these innovative projects. However, this is not possible due to the lack of bankability.

5. REGRESSIVE GRANTS TO SCALE CLEANTECH

Public innovation funding in Europe is typically based on excessive proposals, which have low success rates and very long decision times, as in the case of the Important Projects of Common European Interest (IPCEI). By contrast, for the IRA a sole registration is necessary, and the support is then paid as produced.

- **Pay-as-produced is not a conducive funding mechanism for first-of-a-kind installations**, which often do not produce as much as expected. However, these installations are extremely important for validating new technologies. The principle of no waiting and guaranteed funding for technologies is of utmost importance to boost market entry of new technologies. Yet public support available to fund technologies is currently highly inefficient and resource intense.

- **Regressive grants should be a new funding method.** This should require a standardised, short, and simple registration, followed by an assessment of innovation height only. After this assessment has been completed, grants are assigned accordingly. For example, a first batch of projects (batch structure related to aspired production numbers: e.g. one 20 MW electrolyser, or 1,000 solar PV modules) could receive a 70% grant, the second batch 60%, and so on. This mechanism would ensure a limited amount of grant financing, and enforce a defined path towards standalone market viability, while greatly helping the introduction of new and innovative technologies. It would also incentivise customers to buy a first-of-a-kind instead of a tenth-of-a-kind, while leaving sufficient associated risk to ensure a proper, neutral, and market-driven selection of technologies.

- **Regressive grants to companies** (or per plant) **are another method to incentivise cleantech domestic manufacturing and supply.** Their primary focus should clearly fall on the ramp-up of new innovations and first-of-a-kind solutions. Grants may be assigned on a first come, first served basis, as long as geographical criteria are well implemented to avoid counter-productive inequalities between regions. A concrete example would be to tailor grants per new technology, potentially relying on intellectual property.

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ABOUT US

EPICO is an independent climate and energy policy think tank based in Berlin and Brussels. Founded in 2021 by Dr Bernd Weber, EPICO has a social market-oriented approach to promote a socially cohesive and environmentally sustainable transition to climate neutrality. Supported by its broad-based Advisory Council, EPICO provides a platform and network for diverse stakeholders from politics, academia, industry, and civil society to exchange and find majorities for ambitious climate policies.

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