



## DEFINING THE GREEN AGENDA: INTERNATIONAL AND EUROPEAN INSIGHTS INTO GREEN INDUSTRIAL POLICIES

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**Abstract:** *This article explores the green political agenda's evolution, particularly its rise as a driving force behind green industrial policies since the 2000s. These policies have become instrumental for governments aiming to bolster their national businesses' competitive edge and international trade roles. The paper is structured in three main sections. The first section traces the evolution of the Green agenda from the 1970s to the present, highlighting its transformation in policy makers' eyes to an economic and strategic tool in the 2000s. It explores how green industrial policies emerged, influencing international trade dynamics and national economic strategies. The second section delves into the specific aims and instruments of these policies over the past decades. The third section provides an examination of green industrial policy measures enacted by the US, the EU, and China in recent years. The conclusion highlights challenges for European decision-makers in crafting effective green industrial measures and suggests areas for future discussion.*

**Keywords:** *industrial policy, green agenda, subsidies, green industries*

**JEL:** *O24, O25, O38, Q58*

### Introduction

In the context of a weakened global economic governance framework, the historical stability of the European integration project and economic leadership born during the liberal international trade order under GATT and the WTO have shifted. The process of deglobalization is marked by the significant rise of bilateral and regional trade agreements from around 50 in 1990 to about 300 in recent years. The EU, while initially reluctant, has also embraced the trend of bilateral and regional trade agreements. As of 2021, the EU had engaged in around 130 trade agreements. These agreements now govern up to 40% of the EU's external trade. While globalization has brought economic benefits, recent crises such as the COVID-19 pandemic and geopolitical events like Russia's invasion of Ukraine in 2022 have revealed vulnerabilities in supply chains, energy dependency, and environmental sustainability of international trade. Geopolitical dynamics further induced deglobalization and regionalization patterns in economic governance. Currently, national and international economic policies integrate more and more strategic elements tied to geopolitics and industrial policy. Considering these shifts in international economic order, we focus specifically on the underlying green agenda that marks

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most of the development and sustainability debates in the last couple of decades, incl. those discussing the international trade relations and networks.

The rise of the polemics regarding industrial policy and the revival of idea of state interventionism for economic growth has happened considerably in two main areas: digital and green technologies. In the latest years, the push for stricter rules, more security and less trade openness, has been largely reported in those sectors which realize the so called digital and green industrial revolutions. This report specifically focuses on the green political agenda surrounding green transition that since 2000s became the flagship factor for the development and wide application of green industrial policies by many governments in their attempts to create competitive advantages of national businesses and to increase their odds in international trade and value chains. The definition of green industrial policies that is applied within this report follows Rodrik (2014) where it is defined as all the investments, incentives, regulations, and policy support as forms of active government involvement designed to stimulate and facilitate the development of green technologies and the building of competitive positions for national green industries. Green industrialization is defined as maximisation of the application of clean energy, sustainable resources and green-production technologies. The focus industries are the renewable energy sectors; electric vehicles (EVs) production; hydrogen and energy efficiency technologies.

The paper is structured in three main sections. The first section focuses on the evolution of Green agenda since the 70s and the changes in the way it is perceived by policy makers throughout the 2000s when its economic potential and significance for international strategic leadership are revealed. Within the section the emergence of green industrial policy is studied. It is outlined the impact green agenda and environmental goals have on international trade dynamics and national economic policy modifications. The second section discusses the specific aims of, and the main instruments of green industrial policy applied by governments in the last couple of decades. Their evolution and intensity of application is studied. The third section discusses the actual industrial policy measures introduced by the US, the EU, and China in the last decade. Main similarities and differences in terms of approaches and effects are outlined. The concluding section summarizes the main identified challenges in front of the European decision-makers when designing green industrial measures and structuring policy responses to face and withstand the competitive pressure. Some points for future discussion and study are outlined.

## **1. The evolution of Green agenda and its implications for international trade and economic growth**

The history of climate change issues entering the international political discourse goes back to 1949. Then, the UN Scientific Conference addressed resource conservation and utilization, marking the first UN effort on resource depletion. It focused on managing resources for economic and social development rather than conservation. Serious attention to environmental issues within major UN organs emerged in 1968. The Economic and Social Council added



environmental issues to its agenda, leading to the first UN Conference on the Human Environment in 1972. The First Earth Summit, held in Stockholm in 1972, established principles for human environment preservation and an action plan for international environmental action. The summit mentioned climate change for the first time, urging governments to consider their activities' climatic effects. The conference suggested measures, leading to the formation of the United Nations Environment Programme (UNEP) Governing Council, Vienna Convention for the Protection of the Ozone Layer, and Transboundary Air Pollution Convention.

Over the next two decades, concerns for climate gained international attention, leading to the establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988. The UN General Assembly identified climate change as urgent, requesting WMO and UNEP to review and recommend response strategies. In 1989 the Montreal Protocol also came into force.

The 1990 World Climate Conference and the Earth Summit in 1992 further emphasized global climate change concerns. The United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1992 to stabilize greenhouse gases (GHG). The Kyoto Protocol, adopted in 1997, aimed to reduce industrialized countries' emissions. It came into force in 2005 after being negotiated by over 160 nations.

Up to the 90s the state and international efforts on environmental preservation and climate change were dominated by intergovernmental arrangements without clear and definite impact on internal policies and without tangible effect on international cooperation and coordination. Allan, Lewis and Oatley (2021, p. 8) define environmental politics by that time as separated from political economy and a “low-politics” issue – the topic has emerged in the world governance agenda, however, had no effect on global power politics and economic agenda.

For many years, the dominant approach to global environmental policymaking was characterized by what Bernstein (2001) termed the "compromise of liberal environmentalism", emphasizing market-based solutions like pricing pollutants. The Kyoto Protocol exemplified this trend, along with subsequent attempts to establish carbon emission markets at national and regional levels. Concurrently, the political influence of fossil fuels and their subsidies perpetuated state inaction.

The dominant economic mainstream theory did not recognize a possible complementarity between economic growth agenda and environmental protection. They were often perceived as conflicting in political and normative economics. There are plenty of case studies describing the dichotomy between economic growth and green agenda. The 90s focused on market-based policy measures designed to “make” the business comply with the environmental and resource restrictions and to internalize environmental externalities originating from productive activities (the evident example being the carbon emissions market initiatives).

### *1.1. Economization of the green agenda*

The 2000s mark a gradual change in the green paradigm which is well explained by Meckling



and Allan (2020) as an outcome of the plurality of economic theories and the increasing significance of Keynesian and Schumpeterian concepts in economic and political discourse, as opposed to the neoclassical dominance in the 80s and the 90s. This influenced global policy discussions, advocating for state intervention to drive innovation, invest in infrastructure, and establish new industries. New conceptual frameworks launched by the United Nations, such as the "green economy" one, leaned on successful green investment from countries like South Korea and China (in the majority of cases, state-led financial initiatives). This decade marked the emergence of the green growth concepts and the initial design of expected policy reactions.

Despite the initial climate policy shortcomings and inconsiderable successes, the landscape of climate policy underwent substantial changes after 2010. Green industrial policies initiated technological shifts. The decline in solar and wind energy costs between 2010 and 2015 played a significant role, contributing to private sector support and initiatives like Mission Innovation. Announced at the Paris Agreement, Mission Innovation aimed to double clean energy investments and engage the private sector, leveraging recent cost reductions and deployments (Mission Innovation 2015). Schmidt and Sewerin (2017) posit that the Paris Agreement marked a shift from cost-minimization to seizing opportunities, emphasizing the focus on technology over focus on emissions.

### *1.2. Emergence of green industrial policy*

The surge in green industrial policy gained momentum after 2016 due to several cumulative factors. State governance and political agenda saw the rise of populism and more state interventionism, exemplified by the election of President Trump. Protectionist policies and the shaken faith in global liberalized trade and multilateral coordination disrupted the grounds on which international trade and the liberal international order were built in the previous decades. Although international practice did not change significantly, President Trump's critique of free trade opened space for other critiques and for more state creativity when it comes to international trade and national competitiveness.

The decline of free-trade norms and weakening international institutions enabled states to openly promote nationalist economic objectives. This was evident in the pursuit of a European battery industry, framed by the French financial minister as a matter of "sovereignty" (Hall and Milne 2019). Additionally, mounting tensions with China prompted both the US and Europe to use green industrial policy measures in an attempt to reshore value chains and gain more advantageous positions in global rivalry with China.

The sectors which are traditionally identified as "green" – EVs, renewable energy, hydrogen technologies, are now being pointed as strategic ones and their enhancement and subsidization is described as a matter of national security. In a keynote speech by Christine Lagarde, President of the ECB, at the Peterson Institute for International Economics in 2022, it is stated that shifting value systems and alliances are redoing the global map of economic relations in three ways: from dependence to diversification, from efficiency to security, and from globalization to regionalization. Climate politics evolution is entirely subordinated to these



three trends: 1) Diversification of national economies with focus on green technologies, specifically in the energy sector, where the last couple of years clearly demonstrated dependency issue of the developed economies from less reliable from geopolitical point view suppliers; 2) The energy sector, being a major target of green industrial policy, is considered as one of great importance for national security and strategic technologies for greening the energy and transport sector are highlighted as national priority and a matter of “sovereignty”; 3) The geopolitical burden contemporary economic relations have, together with the surge of geo-economic rhetoric, impact the strategic decision-making in the field of climate and green policies (predominantly, industrial ones) to emphasize on regional networks, shorter distribution channels and greater control over and resilience of the supply chains compared to the pre-COVID-19 period.

### *1.3. Difference between “greening” the industrial policy and “industrializing” the green agenda*

The new approach to climate change is putting industrial policy measures at the centre of national response to climate challenges. While in the past environmental policy was considered a sort of an obstacle to development, nowadays the green agenda is at the core of the development and competitiveness strategies. However, environmental policy and industrial policy, despite being intertwined, are not the same thing. They are moved by different motives and, ultimately, different aims.

Environmental and climate policies are originally aimed at addressing sustainability issues and long-term impact of industry and trade on nature and climate. That fundamental definition is opposing the concept of economic progress relying on exploitation of natural resources and driven by higher efficiency and profit. Industrial policy, on the other hand, is generally considered as a toolset of state-driven measures to increase productivity and competitiveness of strategic sectors implemented with the aim to provide economic advantages and benefits in comparison to competitors, specifically, in the international markets. However, the contemporary rhetoric and policy decision-making contributes to their transformation and alignment to each other - environmental policy shifts to green industrial policy as the economic incentives for green technologies take the lead and receive political backup in the face of rising protectionism and the decline of the international liberal order. The geopolitical (and, consecutively, the geo-economic) significance of environment protection and climate policy changes as these measures are being perceived as the rationale for technological restructuring and leadership positions in international markets.

Green industrial policy measures become the one of the pillars of national growth and development strategies. Climate change is being redressed as the next economic challenge pushing the world for a new phase of technological progress. The industries that would contribute to a sustainable attitude to climate change and environment protection become the arena of fierce competition for technological and economic leadership.

The distinctive feature of green industrial policies vis-à-vis other environmental actions is the



intent or the goal of the policies rather than the instrument used (Allan, Lewis, Oatley, 2021, p.3-4). Industrial policy measures aim at securing better positions in global production and trade.

However, it has to be clarified how climate politics and its sectoral implications are transformed into efficiency competition. Economic rationale would suggest that the evolvement of the technologies resulted in cost reduction and larger efficiency which made the potential investment more attractive and the political engagement – more socially acceptable. Indeed, one could contend that the swift cost reductions in wind and solar energy from 2010 to 2015 instigated a political transformation. As the costs lowered, states might have become more inclined to undertake climate actions. However, the existing body of research on technological learning and green industrial policy suggests that these cost declines were, in fact, propelled by national and subnational policies (Hayashi et al. 2018; Schmidt and Sewerin 2017).

In essence, state-driven green industrial policies stimulated processes of policy learning and technology cost reductions. These, in turn, heightened the likelihood of further green industrial policies and brought to the forefront the geopolitical implications of transitioning to cleaner energy sources. This interplay between state initiatives (or lack thereof), domestic technological policies, and geopolitical factors is pivotal for understanding the dynamics of green industrial policy. The efforts to establish green industries have elevated the economic and geopolitical significance of environmental concerns. As governments strive to position their industries within global value chains and reshore strategic sectors, the stakes surrounding these efforts have intensified.

#### *1.4. The Green policy: driver for economic growth and for change in international trade*

A couple of processes contribute to increasing the economic and geopolitical significance of climate and pollution policies:

- 1) Due to the geopolitical and economic paradigms shifts, after 2010 climate politics becomes in line with the traditional understanding of industrial policy giving birth to the green industrial policies with the argument that these would contribute to the achievement of certain climate goals. However, the rhetoric shifts from emission reduction to economic efficiency. That marks the evolution of the green agenda from an issue with low (or none) economic complementarity to a focal instance for economic transformation and restructuring where purposefully designed measures need to be taken to ensure dominant positions in a new international economic order.
- 2) The realization that green agenda and its aims hide economic potential and opportunities for efficiency and trade leadership is the turning point in the way green agenda is perceived by state and business decision-makers.
- 3) The economic potential for industrial transformation is revealed due to a couple of converging factors:
  - a. Geopolitical: rise of the geopolitical tensions between Asia and Western states which

get transferred to the economic arena through trade wars, economic sanctions and protectionist measures; the energy and transport industries being one of the affected ones;

b. International: weakening of the multilateral system of coordinating international trade and decline of globalization and liberalization at the expense of increased regionalization contributing to more dynamic and unpredictable environment in global trade as it creates a world system of regions competing for technological and economic leadership;

c. Economic: considerable enhancement of green technologies development and their efficiency which increases their attractiveness. That process does not happen without state intervention. In the 2000s developed countries push for more measures addressing carbon emissions and require businesses and consumers to comply with certain requirements. By that time climate policy is still in the field of non- (or counter-) economic policies where certain economic or market benefits must be proposed for modifying the behaviour of economic agents. After 2010 the state measures are redirected to a more supply-oriented approach where production capacities to be developed and sustained at internationally competitive levels. For instance, in 2005 the EC communications are aimed at boosting the Lisbon Strategy and its guidelines apply to the protection of intellectual property, the improvement in Community Technical Regulations, the strengthening of SMEs in innovation, the development of cross-national co-operation projects and the support of structural adjustments (Jamet, 2006). The green agenda issues are basically covered in the Community Technical Regulations where industrial companies are submitted to a set of technical rules regarding safety, health, and the protection of the environment. In 2019 the European Commission narrative is considerably different putting specific emphasis on the green technologies and industries pointing out six strategic sectors: 1) Connected, clean and autonomous vehicles, 2) Hydrogen technologies and systems, 3) Smart health, 4) Industrial Internet of Things, 5) Low-CO<sub>2</sub> emission industry, 6) Cybersecurity. The New Industrial Strategy for Europe in 2020 (EC, 2020) envisions a dual transition – green and digital.

Green transition and agenda are nowadays perceived as an economic and technological matter, where governments design measures to help national businesses take the lead in international markets. That process has clear implications for international trade and order. Four are the main consequences:

- 1) Green industrial policy has significant influence on global political economy through its role in enhancing technological advancements. Technological changes subsequently impact the costs and comparative advantages associated with different green industry trajectories, thereby reshaping the distribution of international market positions. Consequently, it makes it indispensable for governments to continue devising different combinations of policy approaches to bolster the growth of green sectors.
- 2) The fact that green technologies predominantly affect the energy sector, which is perceived as strategic and important for national security, further enforces the nationalistic and protectionist rhetoric and action resulting in repositioning in global value chains and pursuit of autonomy and growth in the context of competitive interdependence (Farrell and



Newman 2019; Sbragia 2010).

- 3) Green industrial policy represents a considerable challenge in a globalized context due to the inherent tensions between the political economy of domestic green industries support and the principles of the liberal trade regime. Governments seeking public backing for renewable energy technologies often need to promise job creation and domestic technological advancement. These pledges necessitate direct interventions in international trade flows, potentially conflicting with various provisions of the World Trade Organization (WTO) and domestic trade laws (Allan, Lewis, Oatley 2021). These complexities extend to global supply chains (Helveston and Nahm 2019).
- 4) Trade negotiations and agreements are subjected to additional environmental requirements and prerequisites. In the recent trade deals of the EU with Japan and South Korea some environment and Paris Agreement obligations were integrated. Environment issues were one of the obstacles in the trade agreement with the US (Bongradt and Torres, 2022, p. 18). The EU-Mercosur agreement faced serious problems as the EU put deforestation of the rainforest under Bolsonaro's rule in Brazil as an irreconcilable issue. Regional trade agreements go beyond conventional trade policy, and they tend to include provisions regarding areas which were in the past considered part of the internal policy competence. While the fragmentation of global value chains made areas such as competition, investment, intellectual property protection, part of the international economic and trade negotiations; the strategic transformation of climate policy as an opportunity for increased competitiveness has made it an important aspect in deep trade agreements that currently dominate international trade and its regionalization.

## **2. Specific aims and instruments of the green industrial policy**

Various tools can be employed to facilitate green economic transformation. These include direct capital subsidies, research and development (R&D) grants, export credit assistance, local content mandates for manufacturing, tariffs, customs duties, and procurement policies. Even mechanisms like feed-in tariffs or market-based approaches could be seen as forms of industrial policy if they are tailored to specific sectors. Defining strict boundaries for green industrial policy proves challenging due to this variety of measures.

However, certain instruments are more commonly associated with green industrial policy as opposed to broader emissions reduction or pollution control efforts. For instance, grants, subsidies, RD&D support, and local content requirements (LCRs) tend to target particular industries rather than generating widespread environmental effects.

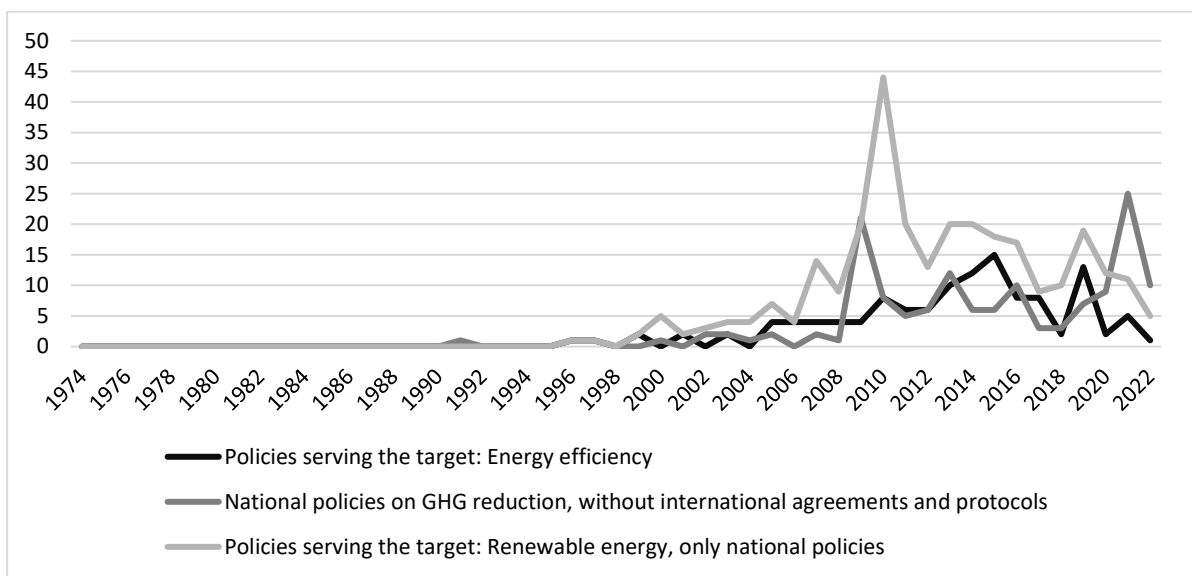
The evolution of the green political agenda described above also suggests change of the focus and scope of the envisioned goals of such policy actions. Figure 1 provides data on the national strategic and policy documents related to climate change. The scope is entirely on national policy tools as our main subject is green industrial policies which by definition are supposed to be targeted at (sub-)national and sectoral level within certain country. We use the Climate



Policy Database, maintained by NewClimate Institute. The national strategic and policy documents are divided into three groups based on the targets they aim to address: 1) National policies for energy efficiency; 2) National policies for GHG reduction; 3) National policies for renewable energy. The database provides exhaustive list of the policy documents in 42 countries (EU considered a country) and non-exhaustive list of the strategic documents in other countries.

The figure presents data for the years 1974 – 2022. The starting year is 1974 since climate change and environment protection appear as issues in international political agenda and decision-making in the 70s. It is evident the number of national policy documents focusing on targets related to climate change significantly increases after 2008.

*Figure 1. National strategic and policy documents on climate change, distribution based on target.*



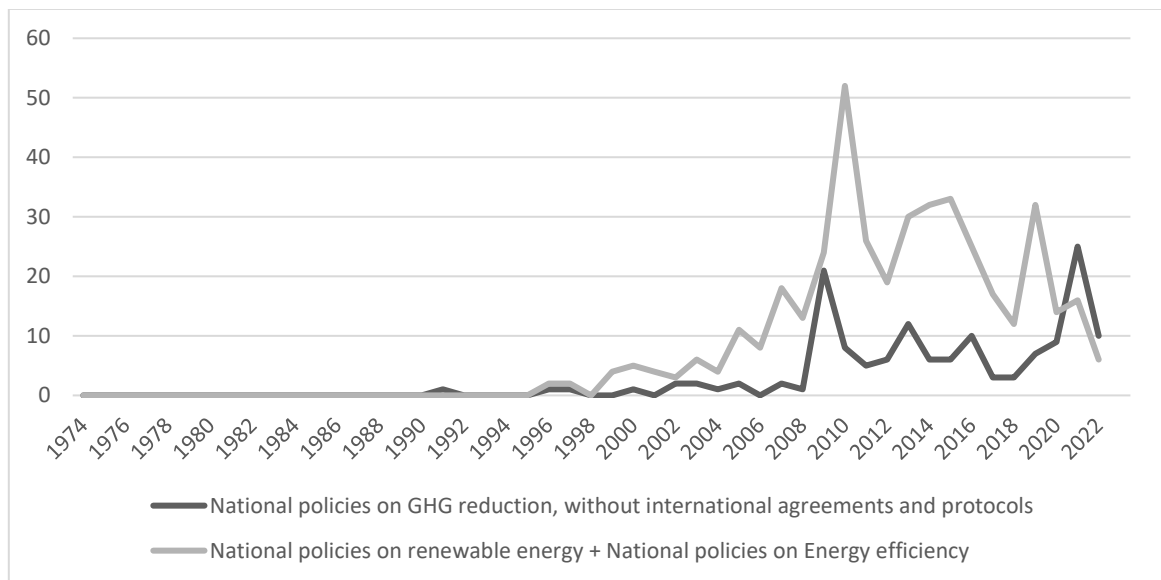
*Source: Climate Policy Database, 2023.*

The most significant increase is reported for national documents focusing on renewable energy as a target. The conventional target related to climate change in the political discourse – the GHG reduction – also marks certain increase in focus, however, national actions in that field are considerably less compared to the ones which we consider are more directly related to the green industrial policy measures at national level – energy efficiency and renewable energy. Here it must be pointed out that all documents related to national contributions and policies part of international UN commitments are excluded from the selection. This would mean that the Montreal Protocol, the Kyoto protocol and Copenhagen Accord, as well as the Paris agreement ratifications and Nationally Determined Contributions (NDCs) are not accounted in the selection. The reason for that is that those engagements are a result of international commitment and do not fall into the scope of the paper – nationally-designed climate and green policies.

It is noteworthy that two out of the three targets have direct economic significance and impact on output levels and structural advantages of production. Renewable energy as a target of green policies has direct effect on energy markets and production. While energy efficiency is entirely

placed in the field of economic reasoning and strategic planning. The target of GHG emissions reduction is the oldest one in terms of climate action and it could be argued that it is the original aim of policies and agreements addressing climate change. However, that target is not economic one. Its achievement is subjected to market-based measures (emissions markets and certificates), however, their nature is related to correction of market operations. This would mean that they are not compliant with the definition of industrial policy. Consequently, the three targets addressing climate change and environment protection could be grouped in the following manner: 1) Non-economic targets achieved through market corrective measures designed to handle economic externalities: the target on GHG reduction; 2) Economic targets achieved through market development measures designed to encourage certain economic activities and sectors: the targets on renewable energy and energy efficiency. Figure 2 is based on this distinction.

*Figure 2. National strategic and policy documents on climate change, economic and non-economic targets*



*Source: Climate Policy Database, 2023.*

After 2000 the economic targets are better presented in national policy and strategic documents which could be considered as a sign that those targets are prioritized compared to the target of GHG emissions reduction. After 2010 the number of documents addressing energy efficiency and renewable energy grows significantly.

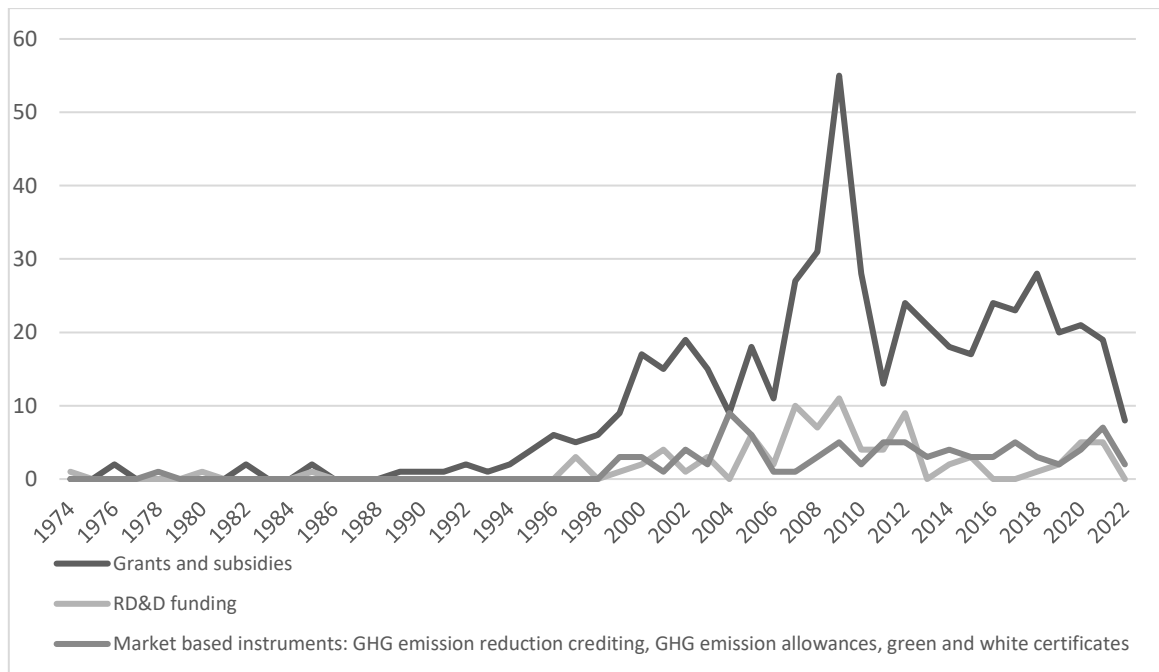
These findings are in line with the data on the number of policy measures introduced by governments to address climate change. Allan, Lewis and Oatley (2021, p. 4) find that some state instruments are more likely to be associated with green industrial policy compared to more general attempts to reduce emissions or control pollutants. For example, grants and subsidies; support for research, development, and deployment (RD&D); and LCRs are all more likely to be used to bolster specific targeted industries rather than produce general effects on the environment. The instruments which are consistent with the definition of green industrial policy



are generally aimed at energy efficiency and renewable energy, while those aimed at the target of GHG emissions reduction (emissions markets and certificates) do not fall into the category of industrial policy measures as they are not directly bolstering national industries and businesses.

Figure 3 presents the number of instances national governments have applied policy measures addressing climate change and environment protection. The policy instruments are grouped as follows: 1) Grants and subsidies (predominantly addressing energy efficiency and renewable energy): industrial policy instrument; 2) Financial support of RD&D (in energy efficiency and renewable energy): industrial policy instrument; 3) Market-based instruments such as GHG emission reduction crediting, GHG emission allowances, green and white certificates: non-industrial measures.

*Figure 3. Policy measures on climate change, number per year*



*Source: Climate Policy Database, 2023.*

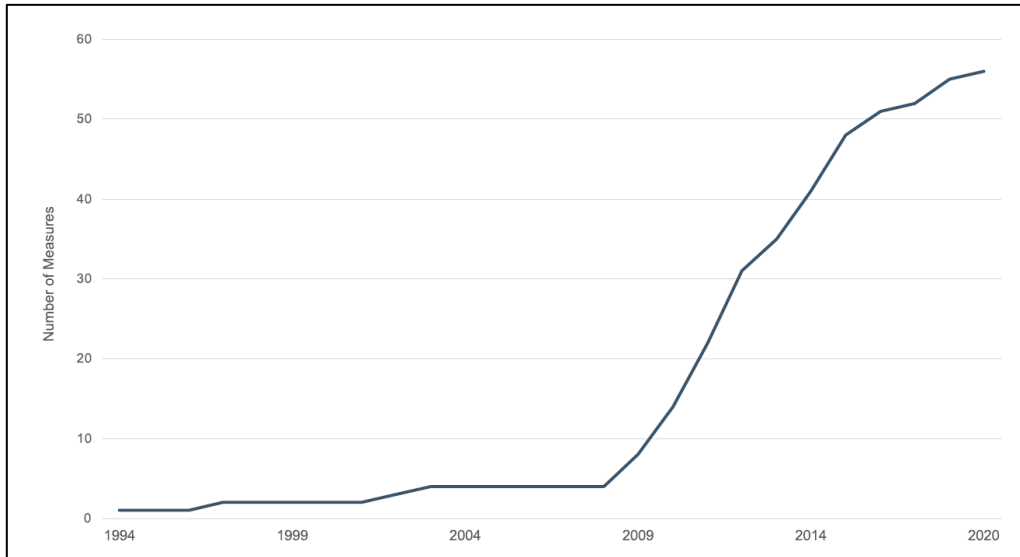
Based on the data, it could be easily concluded that the rise of policy documents addressing economic targets goes together with an uptick of industrial policy measures aimed at achieving the targets. One of the most conventional instruments of industrial policy, grants and subsidies, sees the most significant increase.

The Inflation Reduction Act raised considerable backlash with the newly introduced LCRs (see next section). However, the US is not the pioneer in that matter. Introduction of LCRs in renewable energy increases after 2009 (figure 4). A study estimates that the imposition of LCRs results in an annual reduction of global trade amounting to approximately \$93 billion (Hufbauer et al. 2013). This finding emphasizes the apprehension surrounding green industrial policy,



sparkling fears of reverting trade to a zero-sum world contradicting the foundational principles of the liberal trading system.

*Figure 4. Local contents requirements for renewable energy, number of measures*



*Source: Allan, Lewis, Oatley (2021) referencing Lewis (2021).*

It could be concluded that the intensive application of industrial policy measures in clean energy technological development entails the inevitable emergence of winners and losers, carrying significant geopolitical implications. Studies on the possible outcomes of energy transition have predominantly stated that it will create winners and losers (e.g., Vokalchuk et al. (2020), IRENA (2019), Overland (2019)). Green agenda has turned into geopolitical and geo-economic matter where stronger voice and engagement translate into technological dominance and carry substantial economic significance. For instance, China's investments in alternative energies, EVs, and lithium-ion battery technology in the last 15 years have positioned it as a frontrunner to capture the economic benefits associated with them.

Green agenda is a race to the bottom for technological and trade dominance and the decline of global liberal order makes it possible for competing states to use previously unacceptable instruments and policy measures. Next section will present some of the main tools applied by the key players in global green competition.

### **3. Green industrial policy measures in the US, the EU, and China**

This section will focus on the main policy documents and the green industrial policy instruments introduced by the US, China, and the EU. A comparative analysis will be done between the European measures and the ones introduced by its trade partners and competitors.



### 3.1. The US green industrial policy

The cornerstone of the American green industrial policy lately is the Inflation Reduction Act (IRA) of August 2022. It was hailed as the most ambitious climate policy plan of the US so far, but also it was called “a new paradigm” (Scheinert, 2023) as it envisions ambitious climate goals, but more importantly, it introduces unprecedented and unexpected interventionist and protectionist measures for supporting and developing national industries undermining WTO international trade order.

However, the IRA is not the only act addressing climate issues and green industries, nor it is the first one. Climate issues are a top priority for the Biden administration, leading to a multitude of legislative and policy efforts.

The CHIPS and Science Act, established in August 2022, focuses on bolstering American manufacturing, national security, and research and development in crucial fields like nanotechnology, clean energy, quantum computing, and artificial intelligence.

The American government also employed the Defense Production Act (DPA) in June 2022 to accelerate domestic production of clean energy technologies. The Infrastructure Investment and Jobs Act of November 2021 addresses climate change mitigation through repairing and rebuilding roads and bridges, enhancing transportation options, reducing emissions from the transportation sector, upgrading airports and ports for efficiency and emissions reduction, promoting rail transport, establishing a nationwide network of EVs chargers, and improving infrastructure resilience against climate impacts and cyber threats.

Regarding the IRA's state aid elements, tax credits, tax deductions, grants, loans, and loan guarantees are the primary instruments employed. These measures vary in duration, with some expiring by September 2024, such as grants for domestic heat pump production, while others are permanent, like the tax credit for domestic critical minerals manufacturing.

Three sets of measures are included in the IRA: 1) a tax reform; 2) a healthcare reform; 3) energy and climate legislation, envisioning climate-related expenditure of \$400 billion over 10 years (Kleimann et al., 2023). There are three types of climate and energy subsidies envisioned: 1) Subsidies for EVs purchases, incl. up to \$7500 tax credit; 2) Production and investment subsidies for clean technologies, incl. batteries and components used in renewable energy production; 3) Subsidies for carbon-neutral electricity (hydrogen and clean fuel).

The IRA is defined as the “*continuation of President Trump’s hard-nosed ‘America First’ approach*” (Scheinert, 2023) due to the introduction of LCRs in the green-tech sectors. EVs buyers could get a tax credit of \$3750 for vehicles for which a minimum percentage of critical minerals has been extracted or processed in the US or a country with which the US has a free trade agreement, and an additional \$3750 tax credit for vehicles meeting the requirement that a threshold percentage of battery components are manufactured or assembled in North America. Final assembly in North America is also included as a requirement.

Kleimann et al. (2023) make an estimation on the trade distortive effects the IRA measures could bring. Their provisional estimations point to considerable trade-distortive effects in



consumer electric car tax credit subsidies (\$7.5 billion), clean-tech manufacturing support (\$32 billion of the total \$37 billion), and the bulk of the clean-fuel and emissions-reduction subsidies (\$16 billion). Additionally, the trade-distortive effect of the subsidies for green-energy production and investment might range between 0 and \$21.9 billion, depending on the number of producers meeting the criteria.

### *3.2. The European green industrial policy*

Although there isn't a singular EU flagship green subsidy scheme equivalent to the IRA of the US, a variety of initiatives at both EU and national levels utilize subsidies for similar purposes. Here are some key points:

- **EVs Subsidies:** Many EU member countries provide subsidies to encourage the purchase of EVs. These incentives vary in form and value but collectively amounted to nearly €6 billion in 2022, averaging around €6,000 per vehicle. Unlike the IRA tax credits, these subsidies generally do not discriminate between different vehicle manufacturers.
- **Support for Clean-Tech Manufacturing:** various instruments to support clean-tech manufacturing, including:
  - Important Projects of Common European Interest (IPCEIs): cross-border project-based EU support for initiatives like battery and hydrogen manufacturing.
  - EU Innovation Fund: Established under the EU emissions trading system (ETS), backs the demonstration and deployment of clean technologies in energy-intensive industries.
  - European Innovation Council's EIC Accelerator for breakthrough technologies.
  - European Investment Bank (EIB) Loans: support for clean technology projects.
  - EU Guarantees under InvestEU: Managed by EIB to encourage sustainable investments.
- **Renewable Energy Production Subsidies:** Most EU member states subsidize energy production from renewable sources. In 2020, these subsidies totaled around €80 billion, with Germany leading with €33 billion.
- **EU Recovery and Resilience Facility (RRF):** a temporary financing tool within NextGenerationEU (NGEU), designed to counter the economic impacts of the COVID-19 crisis with a strong focus on green and digital transitions. It involves grants and loans to support these transitions and includes provisions for climate-related initiatives:
  - The EC is funding up to EUR 250 billion (or 30%) of NextGenerationEU by issuing green bonds. This makes the Commission the largest green bonds issuer in the world.
  - Total amount is capped at EUR 750 billion, but inflation adjusted it would be more than EUR 800 billion. The repayment of the EC borrowing will be spread from 2028 to 2058.
- **REPowerEU plan:** launched in May 2022 by the EC as a reaction to the war in Ukraine and the overdependence on Russia's energy supplies. Proposes measures to save energy,



produce clean energy, and energy diversification.

- **Green Deal Industrial Plan:** Introduced on February 1, 2023, the Green Deal Industrial Plan is intended to boost Europe's net-zero industry's competitiveness and climate neutrality. It includes a simplified regulatory environment, improved access to finance, skills development, and open trade for resilient supply chains. The plan proposes acts such as the Net-Zero Industry Act and Critical Raw Materials Act, along with reforms to electricity market design. The EC announced it would be proposing a European Sovereignty Fund.
  - It builds predominantly on relaxing State aid rules, thus allowing more national support, including through tax benefits.

Relaxation of state aid rules is generally one of the tools the EC uses to facilitate state support of businesses. However, this is subjected to certain restrictions by the *acquis Communautaire*. In 2022, the EC introduced specific categories of State aid under The Temporary Crisis Framework, that was created to address various challenges arising from exceptional circumstances (the COVID-19 pandemic). The Temporary Crisis Framework underwent extensions and amendments on October 28, 2022, and eventually evolved into the TCTF on March 9, 2023. Simultaneously, the EC modified the General Block Exemption Regulation (GBER) to facilitate the green and digital transition. This entailed increasing Member States' aid limits in line with inflation and introducing larger State aid allowances in less-developed regions of the EU. The revised GBER will remain in effect until the end of 2026. The TCTF also allows governments to discourage companies from offshoring by granting them authorization to match subsidies offered by other countries, but only for a limited period.

### *3.3. The China green industrial policy*

The Chinese government has recognized the strategic importance of green industries and has introduced a great variety of policy measures to encourage green production. It employs both market policy tools such as carbon emission trading mechanism and financial instruments including green loans, green bonds, tax and fiscal instruments, and non-market measures such as improving the renewable energy standard system and constructing a legal system conducive to green and low-carbon development (Xu, 2022). The range and variety of national and regional regulatory and strategic actions is rich and multidirectional. However, the scale and scope of the Chinese green industrial policy in the last couple of decades has restructured the global markets for solar and wind energy, driving down costs and pushing out competitors (Hopkins and Li 2016; Lewis 2013).

Some of the main Chinese policies supporting green industries include:

- **Feed-in Tariffs and On-Grid Electricity Tariffs:** feed-in tariffs for renewable energy sources like wind, solar, and biomass. On-grid electricity tariffs provide financial incentives for connecting renewable energy projects to the power grid.
- **Subsidies for Renewable Energy Projects:** cover a portion of the installation costs for solar, wind, hydropower, and other renewable energy installations. China's finance ministry has



set the 2022 renewable power subsidy at 3.87 billion yuan (\$607.26 million).

- Subsidies for EVs and energy-efficient appliances: aim to reduce the purchase cost of EVs and encourage the expansion of charging infrastructure. For example, China unveiled in June 2023 a 520 billion yuan (\$72.3 billion) package of tax breaks over four years for EVs and other green cars. At some point purchase subsidies were estimated as probably the most generous ones worldwide (Mock and Yang 2014; Altenburg et al. 2016) combining national support and regional cash subsidies. Additionally, subsidies are tied to local production.
- LCRs and restrictions on foreign manufacturers in the EVs and battery production sectors. A development plan issued in 2010 clearly states that for any joint venture manufacturing key components of EVs – such as batteries, motors and controllers—the Chinese partner must hold at least 51 per cent of the capital.
- Public procurement restrictions on foreign companies in targeted productions.
- R&D Grants: The International Energy Agency (IEA) estimates that overall energy R&D spending by the Chinese government in 2021 was \$8.3 billion—26% of world energy R&D spending. The World Intellectual Property Office (WIPO) ranked China third in the number of energy patents in 2019. China intends to increase its R&D expenditure by 7% per year by 2025 which would represent a total expenditure of 490 billion euros in 2025.
- Tax Incentives for Green Technologies: designed for the so called high and new technology enterprises (HNTEs) which must meet certain criteria and to operate in strategic sectors. Environmental Protection Tax is introduced in 2018.
- Green Bonds and Financing Incentives: China’s green finance market has reached \$2.3 trillion.

Some of the key policy documents and initiatives that have introduced measures to stimulate green industries in China are the 13<sup>th</sup>, 14<sup>th</sup> and 15<sup>th</sup> Five-Year Plans; the strategic plan Made in China 2025 (published in 2015); “Energy saving and New Energy Vehicles industry development plan 2012–2020”; Guiding Opinions on Promoting Energy Storage Technology and Industry Development (in 2017); Catalogue for Guiding Industry Restructuring (in 2019).

#### *3.4. Comparison of the US, EU and China’s green industrial policies*

There are several common broad features of the green industrial measures applied. First, the three economies have strategic and regulation documents that set out green technologies as a priority and envision strategic actions to facilitate that transition and to support their businesses and consumers when modifying their behaviour accordingly. In all three cases the major measures follow similar logic and pursue similar market outcomes. They are directed towards change in the demand patterns; change in the supply structure (resulting in greening of national production) and support of technological progress (resulting in change in international positions and mid-term competitiveness).

The three economies introduce and sustain a considerable financial support package for





purchases of green vehicles. The subsidies could range from \$6000 to around \$9000 (in some Chinese regions). Secondly, they all finance and encourage RD&D investments, an indispensable prerequisite for technological leadership. Here, a quantitative comparison might prove difficult as there is a variety of funding schemes – some of them are on central level, some of them are regional (or national, in case of the EU); they follow different structures and time horizons. Thirdly, in each of the three economies there is a certain toolset for supply-side subsidization encouraging clean-tech manufacturing and renewable energy production.

However, although the measures envision the achievement of similar goals, the concrete approaches of intervention diverge considerably, specifically, when it comes to supply measures.

There could be outlined two fundamental differences in the elaboration of green industrial policy measures which originate from the sovereignty identity of the policymakers.

- 1) ***Level of application.*** The structure of the EU and its *acquis Communautaire* follow a strict order of distribution of competences at Community and at national level. For example, the subsidies for EV purchases are adopted at national level and follow different national rules and schemes. Incentive programs differ in coverage and intensity which creates disparities and diverging impact. It is a fact that in the US and China there are also regional (or state) measures, however, they are in line with centralized measures and policy agenda.
- 2) ***Scope and breadth of centralized decision-making.*** The EC has a very limited competence for vertical sectoral measures and no authority over tax policies. Most of the above-described EU policy measures for state aid exemptions became possible only due to the fact that they were elaborated as a response to unprecedented force majeure circumstances (COVID-19 and the war in Ukraine), which marks their temporary character. The EU architecture is built on the principles of market freedom and minimum interventionism mainly through horizontal policies (competition law and common trade regulations). The member states are generally restricted in applying vertical industrial policy measures by the EU treaties; the EC has no authority to adopt and impose centralized measures. American and Chinese national governments have the competence and authority to impose a much more centralized approach in green industrial policy.

These variations in authority and control over decision-making explain the immediate differences in the green industrial policy measures applied by the EU, the US and China:

- 1) In both, the US and China, there are policy measures following the “Made in America” and “Made in China” imperatives. However, there are no “Made in the EU” measures. That marks a more protectionist stance of the US (after IRA) and China. The existence of strong LCRs in the US and China, inconsistent with the WTO rules, illustrates that difference. China has for a long time applied different restrictions on foreign investors, especially in sectors of strategic importance. The EU has lately introduced some screening and control mechanisms on FDI. However, they are still predominantly a subject of national competence (no strong EU common approach) – which makes it possible to circumvent them.



- 2) More bureaucratic procedures for the EU subsidies; many times, project-based approach, while the US apply a simpler approach using the tax system and planning for tax credits or exemptions. Kleimann et al. (2023) also identify that the IRA measures mostly focus on mass deployment of green technologies, while the EU support finances mostly R&D and innovation efforts.
- 3) The EU policy measures are debt-financed, while the IRA ones are tax-based. This marks a difference in philosophy of the support (Scheinert, 2023), but also difference in the macroeconomic effects these would have, specifically when it comes to fighting inflation.
- 4) More measures in the US and China undermining the liberal trade order and WTO rules. The US has introduced subsidies with LCRs, a practice that has not been observed in advanced countries before and could potentially set a precedent for the application of such measures even in other developed countries. This could contribute to more fragmentation and inefficiency in international trade and refusal of more countries to stick to the international trade norms.
- 5) Political engagement in climate policy and green industrial policy is more vulnerable in the US, compared to the EU and China. Green policies in the US would be probably cut off if a potential Republican President and administration take the rule in the years to come. IRA would probably be modified or cut in size. Although, the EU engagement in green agenda is more consistent, the temporal nature of the financial support is also an issue. The EU tries to establish permanent funds using temporary source of income (Scheinert, 2023). Once, the force majeure circumstances are gone, there would be no reasons for these policies continuation.

### **Closing remarks and discussion**

The rapid advancement of green technologies is now driving a competitive race between developed and developing countries. This competition is not only about addressing the climate emergency but has transformed into a green industrial revolution. Countries are competing for leadership in green technologies, industries, and supply chains, which will ultimately shape the global economy's future hierarchy over the next couple of decades. This shift is accompanied by a change in perspective. The belief that market-focused approaches alone can drive the necessary transformation in industries to address climate change is fading. As carbon subsidies persist, policymakers are reviving traditional tools of industrial policy, like grants and EVs subsidies, to drive the transition.

The theoretical and data review confirms that the evolution of the green agenda since the 70s till nowadays faces its most considerable development in the 2000s when the political climate agenda transforms into geo-economic narrative and the goals of handling climate change and environment protection enter the economic strategic agenda becoming the key challenges moving technological progress and, consequently, economic growth. There are at least two consequences of that process:

- 1) Issues such as climate change and environment protection which are generally placed beyond the economic focus area of efficiency and profit-making are given economic significance *for efficiency and profit-making*. Tracking progress on overcoming these global challenges becomes vaguer and predominantly directed towards economic performance, not environmental impact. The analysis of the climate policy targets frequency in political agenda confirms that observation.
- 2) The *economization* of the topic increases the attention of society and decision-makers and contributes to greater efforts and political and economic involvement, to address these issues. Solving climate and environmental challenges today entails some national economic *benefits*. The approach for achieving them, however, is subordinated to the processes of deglobalization, regionalization and protectionism, giving rise of green industrial policies which further enforce those processes. The rise in the number and size of industrial policy tools such as green energy grants, subsidies and LCRs provides clear evidence for that.

The main findings for the European green industrial policy compared to the US and Chinese ones may be summarized in the following way:

- The EU engagement on green policy, incl. financial, is more consistent over time and more resilient to political changes, specifically when it comes to comparison with the US. However, financing of green initiatives and strategic measures is troublesome in the EU as the currently applied schemes are based on ad-hoc structures and are debt-based.
- The range and scope of the applied measures for supporting green industries is restricted by the institutional architecture of the EU. Most of the funding support is currently described as an action in crisis situations. The path forward for European green industrial policy is not clear.
- The EU green industrial supporting tools are the least protectionist in this selection. So far, the EU still abides to the international trade order when designing its industrial policy. The EU treaties grounded on the principles of free markets also represent a limiting factor. That is not the case with the Chinese and the American policy measures. The retaliatory reaction of the EU might go in two directions: 1) Joining the protectionist race (which might prove to be more harmful than beneficial for the Community (Jansen and Redeker, 2023; Scheinert, 2023; Kleimann et al, 2023)); 2) Remaining loyal to the international rules-based trade order and file complaints. However, either option would not solve the issue with the mid-term prospects for the European green industrial policy.
- One of the main critiques of the European green policy is that the EU managed to create a market, but failed to build an industry (Paris Tech Review, 2012; Altenburg and Assmann, 2017).

The American and Chinese green policy actions have intensified the conflict between Single Market proponents and supporters of a stronger state role in the form of an EU industrial policy. The EU's response will be influenced by its stance on free markets versus interventionist economic approaches (Scheinert, 2023). However, without additional public funds in key green industries, the EU could turn into the loser in that international race and might fail to address the concerns of supplies security which became a major issue as result of geopolitical shifts and



rivalries.

4 issues should be further discussed, analysed and solved in the near future:

- 1) Should the EU economies support financially the European green industries? Here, the predominant opinion is positive, as the economic and geopolitical realities demand a more interventionist approach.
- 2) Which industries to be supported? A lack of focus in the industrial support measures will reduce their impact. A deep analysis of the realistic international positions and potential of the EU green industry is necessary. Jansen and Redeker (2023) provide some initial conclusions in that regard.
- 3) Who to support them? Financial support from the national governments will increase the EU divergence and will result in efficiency losses. Centralized EU financing and industrial planning would require change in the institutional setup of the Community.
- 4) How to support them? Except from the actual industrial policy measures to be applied – their size, format, time horizon, eligibility; there are certain EU labour market issues that need to be addressed if reshoring of production is envisioned. The issue of supplies of raw materials and components concentrated in China may be addressed by intensification of the trade relations and arrangements with Latin America and other regions.

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