Industrial policy For well below 2 degrees Celsius

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Nilsson, Lars J; Åhman, Max; Vogl, Valentin; Lechtenböhmer, Stefan

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LUND UNIVERSITY

PO Box 117
221 00 Lund
+46 46-222 00 00

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Authors:

Lars J. Nilsson, Max Åhman and Valentin Vogl
Lund University, Sweden

Stefan Lechtenböhmer
Wuppertal Institute, Germany & Lund University, Sweden

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Lars J. Nilsson – Lund University - lars_j.nilsson@miljo.lth.se
Max Åhman – Lund University - max.ahman@miljo.lth.se
Valentin Vogl – Lund University - valentin.vogl@miljo.lth.se

Stefan Lechtenböhmer – Wuppertal Institut & Lund University
stefan.lechtenboehmer@wupperinst.org

For well below 2 degrees Celsius: The role of basic materials producing industries.

The well below 2 degree Celsius target sets a clear limit to future greenhouse gas emissions and thus strict boundaries for the development of future industrial processes and sourcing of feedstock. This includes the primary production of steel, cement, plastics and other basic materials that currently account for more than 20 % of global carbon dioxide emissions. It requires decarbonised energy systems and more resource efficient and circular economies in material as well as molecular terms. For example, carbon used in plastics and chemicals can no longer be derived from fossil feedstock but should be sourced from biomass, carbonaceous waste streams, or the atmosphere.

A new industrial policy is needed, one that respects *the necessity of zero emissions* and integrates this with the traditional goals of competitiveness, jobs, economic growth and industrial development. We argue that the recent turn in industrial policy towards green growth and resource efficiency does not fully recognise this necessity nor the policy implications of zero emissions in the basic materials industry. An industrial policy for well below 2 degrees Celsius requires an additional turn – a turn towards long-term target-oriented strategies with a focus on zero emissions in basic materials production.

In recent history, industrial policy has shifted from protecting incumbent industries. e.g., steel and shipyards in the structural crises of the 1970´s, to a greater focus in the 1990´s on promoting high-tech growth sectors and small and medium enterprises (SMEs) for job creation and economic development. Although most countries in principle embrace competition, free trade and globalisation they still take precautions to support and protect their own industries in various ways. Examples of this abound and the basic materials industry is no exception. Motivated by concerns over reduced competitiveness and carbon leakage it is typically sheltered from the potentially adverse effects of energy and climate policy, e.g., through free allocation of emission permits or energy tax exemptions (Wesseling et al., 2017).

The turn in industrial policy towards green growth has been championed by countries like South Korea and the European Union. Re-industrialisation is a core strategy for economic development in the EU since 2011, as part of a broad agenda that also includes a low-carbon and circular economy, digitalisation, and innovation (EC, 2017). The need for industrial policy and the turn towards green growth has also been advocated by scholars such as Rodrik (2014), Aiginger (2014) and Warwick (2013). They argue a strong case for systemic industrial policies that instead of being mainly growth oriented also support broader social and environmental goals. Similar lines of thought in order to tackle societal problems that are systemic in nature are found in OECD reports on green growth (OECD, 2011) and system innovation (OECD, 2015). However, these approaches to industrial policy and innovation do not include, as of yet, explicit attention to the necessity of zero emissions and the profound changes in production, use and recycling of basic materials that this entails.

The EU supports energy efficiency, renewable energy, resource efficiency and cleaner technologies through an array of policies and directives. However, the only policy so far that clearly targets greenhouse gas emissions from basic materials production is the EU Emissions Trading System (ETS). The ETS has not yet produced the carbon prices or long-term certainty that would motivate fundamental process and feedstock changes and investments for deep decarbonisation in basic materials production.

What is Industrial Policy? – Definitions and aims

Industrial policy can be any policy that aims at changing the industrial structure in the economy in a certain direction, or even at preserving it. Industrial policy is thus not one particular policy intervention but rather the combined effects of many policy instruments that are coordinated towards an industrial goal.

Industrial policies can be classified as being either vertical or horizontal depending on whether singular sectors or technologies are targeted (e.g. a national steel policy) or the whole economy (e.g., general R&D or tax policies). Vertical industrial policies typically include more *direct* state interventions via state ownership of industries, public procurement, targeted subsidies and trade tariffs on specific products, demonstration projects, and infrastructure. Horizontal industrial policy relies more on *indirect* state intervention via exchange rates, emissions trading, general tax policies or R&D spending.

The technical options for zero emission basic materials include materials and energy efficiency, carbon capture and storage or use (CCS and CCU) as well as carbon neutral electricity and biomass for process energy and feedstock (Wyns and Axelson, 2016, Lechtenböhmer et al., 2016). Fossil-free basic materials production will often lead to higher material costs but the share of material costs in final product prices is typically small and it can be reduced through materials efficiency (see e.g., Rootzen, 2016). The highest cost increases are likely to occur in plastics and organic chemicals production from hydrogen and carbon dioxide when compared to fossil feedstock (Palm et al., 2016). For example, the price of a 35 gram polyethylene bottle used for ketchup or shampoo may in this case increase from 10 cents to 20 cents. This is hard to implement in cost-cutting value chains but it may be a necessary price to pay for zero emissions and closing the loop on anthropogenic carbon.

The transition to zero emission basic materials requires technology development, fossil-free energy and feedstock (or CCS), dematerialisation, markets for green and recycled materials, and large investments in production plants and infrastructure. The transition requires government engagement, facilitation, interventions and support in all these areas. Also, it should be governed so that it leads to a fair distribution of risks, costs and benefits. In short, it requires an industrial policy for well below 2 degrees Celsius.

Consider, for example, the Swedish steel maker SSAB who recently teamed up with the mining company LKAB and energy company Vattenfall. They will develop a process for fossil-free hydrogen reduction of iron ore through the joint venture company HYBRIT Development AB. The process for research, development, piloting, demonstrations and scaling up is expected to last up to 20 years. At commercial scale, it involves several billion EUR investments in hundreds of MWs installed electrolyser capacity and new hydrogen reduction shafts to replace today's blast furnaces. Government will be important in all steps of such a development and commercial scale-up, and not least in making it possible to get a return on such investments through a level playing field for fossil-free steel.

Innovation policy has traditionally focused on technology push, i.e., spending mainly on technology RD&D and less on creating market demand pull. This is a sensible strategy in the earlier stages of technology development and demonstration but for full-scale demonstrations and commercial deployment, investors need certainty about the economic viability of projects. Experience from the EU NER300-programme, designed for innovative low-carbon energy demonstration projects, illustrates this point. Projects that will be implemented are typically those that demonstrate new renewable electricity technologies whereas projects in CCS and biofuels production have been put on hold or cancelled. High certainty about future demand for renewable electricity facilitates investments. High uncertainty about future carbon prices, CCS regulations, and the demand for liquid biofuels deters investments (Åhman et al., 2017).

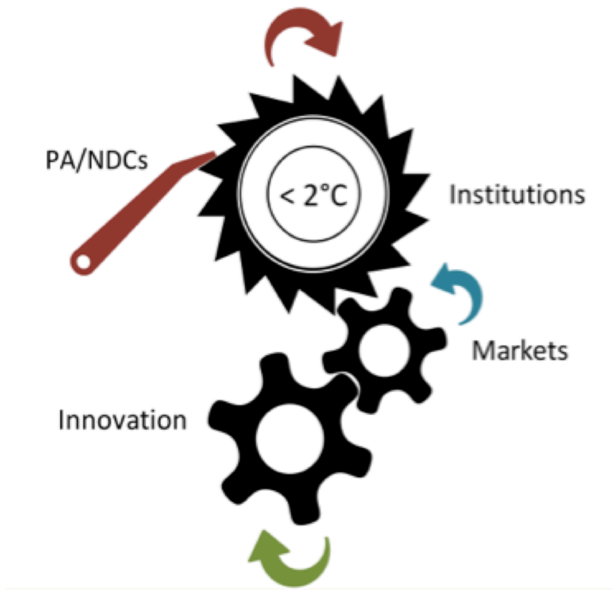

Figure. Industrial policy for well below 2 degrees Celsius needs a ratchet mechanism so that industrial development can proceed under the necessity of zero emissions.

It is instructive to reflect on the experience from successful renewable energy policy for thinking about an industrial policy for well below 2 degrees Celsius. For renewables, technology push policies were complemented early on with strong demand-pull policies. Feed-in-tariffs, quota obligations and auctions for renewable electricity have played an important role in creating investor certainty and bankable projects. Another example is how, in Sweden, the highest carbon tax in the world (about 120 EUR per ton CO_2) effectively locks out fossil fuels from the district heating markets and created demand for fossil-free heating. This illustrates that carbon pricing can be very effective in a sector such as space heating where production cannot relocate geographically and there is no carbon leakage.

Governing decarbonisation of basic materials is a much more complex task than decarbonising energy systems. This is due not least to international competition and trade, and the great diversity of materials, qualities and products.

Furthermore, the energy sector is a sector with decades of institutional development and established governance structures. In contrast, for example, the "plastics system" is not thought of as a sector and nor is it governed as one. It is shaped by a mix of chemicals, waste, recycling, plastic bag regulations, energy and other policies. It is only very recently that a first attempt has been made to build a coherent approach through developing a European Plastics Strategy where the key challenges of fossil feedstock, low recycling rates, and littering and pollution are integrated.

An industrial policy is needed which respects *the necessity of zero emissions* and in particular can deal with the technical and institutional challenges of deep decarbonisation of the basic materials producing industries. This is a fundamental boundary condition within which to handle other demands on industrial policy, e.g., growth, jobs, globalisation, and digitalisation. The need for zero emissions is now increasingly recognised and accepted across these industries but there are still great uncertainties around technology options and potentially viable transition pathways.

A new industrial policy may evolve from the development of shared ideas and visions for zero emission materials. It would require systems for monitoring and verification so that green materials can be properly traced and their environmental attributes linked to the products. Initial voluntary approaches (e.g., niche markets and public procurement) may be followed by more binding policies if needed (e.g., feed-in-tariffs or quotas for green materials). It is important to find ways of sharing risks, responsibilities and benefits, as well as to create level playing fields for industry, companies and regions during the innovation and transition process. Institutional capacity at the member state and EU level is important to handle state-aid rules and many other challenges. The transition of industry to zero emissions must not degenerate to, or be wrongly perceived as, climate protectionism but it should develop in a transparent way within the context of the UNFCCC and NDCs. Under the principle of common but differentiated responsibilities (CBDR) the EU can make the necessary investments in new technologies for basic materials that can later benefit other countries. This is similar to how some countries have invested in and spearheaded the development of solar and wind power technologies.

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