Expert statement on the impact of the German Renewable Energies Act (EEG) on innovation and climate protection

In response to the annual report of the "Expert Commission Research and Innovation" to the German Chancellor

1. Context and significance of the EEG

„The EEG has definitely generated innovation effects and supported the transformation of the energy system."

Renewable energies play a decisive role in the transformation of the energy system. A successful transformation will essentially depend on innovations being triggered and diffused. Besides protecting the climate, natural resources and the environment, it is therefore a declared goal of the German Renewable Energies Act (EEG) to promote the further development of technologies used to generate electricity from renewable energy sources. The actual innovation effect of this instrument is questioned from time to time. The latest report by the **Commission of Experts for Research and Innovation (EFI)** concludes that **"the EEG is neither a cost efficient instrument for climate protection, nor does it seem to have a measurable impact on innovation". The EFI therefore does not see any justification for continuing the EEG.**

Prompted by the current discussion, the authors of this statement decided to pool their findings **from many years of research into the EEG's environmental and innovation impacts,** documented in numerous publications, in order to contribute to the discussion about the impact of the EEG in a condensed but fact-based and differentiated form. **The undersigned conclude that the EEG has definitely generated innovation effects and supported the transformation of the energy system.**

2. What is innovation and how can it be measured?

„The assessment of innovation impacts should be based on a multitude of indicators."

First of all, it should be noted that innovations can be defined as genuinely novel as well as significantly improved products, services and processes already on the market, which are not necessarily based on patented know-how. This definition implies that **innovation should be measured by a variety of indicators**. Alongside patents, conventional indicators include, e.g., the number of new products launched onto the market or products whose quality has improved; improved price/ performance; but also innovative start-ups and investments in research and development. Hence, the comprehensive analysis and assessment of a policy instrument's impact on innovation should be based on a multitude of indicators and therefore on different data collection methods, because single indicators can

only capture partial aspects of innovation – and some of these only very indirectly.

When analyzing the innovation impact of a policy instrument such as the German Renewable Energies Act, it is also important to bear in mind that innovations always depend on the interaction of different factors: Public funding of research and development but also increasing external pressure to act – which innovations should alleviate – play a role as do scientific progress, demand potentials, changes in consumer preferences and policy measures promoting demand, such as the EEG. **Accordingly, the innovation impacts of individual instruments have to be embedded in this overall context and assessed from a systemic point of view.**

3. The innovation impact of the EEG

„For renewable energy technologies one can observe a marked, disproportionate increase in patent applications."

Patent figures are frequently used to illustrate innovation dynamics and potential of future technical performance and market dynamics. **There has been a marked, disproportionate increase in patent applications for renewable energy technologies over the last few years.** Different studies reveal a clear positive correlation between patent development and the demand for renewable energies. **The EEG has without doubt made a major contribution to increasing this demand in Germany** – as have similar instruments in other countries – **and thus to the accelerated diffusion of renewable energy technologies.** For instance, almost 100% of photovoltaic and 85% of wind energy capacities in the EU are based on feed-in tariffs.

Technological innovations

„Also with regard to costs and efficiency of technologies, one can draw a very positive picture of the innovation dynamics."

Similarly, if innovation is indicated by the price and/or performance of a technology, a very positive picture results with regard to innovation dynamics. In the wind power sector, **the average effect of wind turbines more than doubled** from 1100 kW to 2600 kW between 2000 and 2013 according to data from German wind power associations. This increase was driven by technical innovations and enables a much larger amount of electricity to be generated per turbine. In photovoltaics, **solar systems now cost one third of what they did 7 years ago**, and there has been a simultaneous huge increase in their conversion efficiency as well. **Our results show that economies of scale and learning effects made possible due to increased demand have made a major contribution to these changes.** Our case study results indicate that even market newcomers profit from the specific conditions of fixed feed-in payments due to increased investor interest. Furthermore, the market dynamics triggered by the EEG has enabled companies to invest in **process**

„The EEG has also triggered extensive innovative activities in complementary technologies."

innovations and innovative manufacturing equipment, which has a positive impact on technologies' costs and efficiency. Beyond innovations in the technologies it directly promotes, the EEG has also **triggered extensive innovative activities in complementary technologies such as energy storage systems, inverters, forecast software and grid technology**. In particular, there is considerable pressure for innovations in various grid system components. This pressure is being exerted by the requirements of a power sector increasingly based on renewable energies; a situation which has come about due to expansion of renewable electricity generation induced by the EEG.

Organizational and institutional innovations

„Due to the EEG, new actors could be attracted that provide considerable capital."

The innovation impacts are not just of a technical nature, but also relate to organizational and institutional innovations in other fields, e.g. the financial sector. In the public debate, increasing importance is given to the challenge of **financing the energy transition,** which requires innovative solutions. **Due to the EEG and comparable feed-in systems in other European countries, new actors – e.g. small cooperatives, private homeowners, farmers, insurance companies and pension funds – could be attracted which has provide considerable amounts of capital.** The costs of the energy transformation can be significantly reduced thanks to EEG's stable and long-term investment horizon and these actors requiring only low rates of return. The interaction of direct and indirect, technical and organizational innovations is what constitutes a system innovation which enables the transformation of the energy generation system into one based on renewable energies.

International innovation impact

Another aspect to be considered when analyzing the EEG's innovation impact is that innovations are increasingly taking place in international networks and changing global value chains. The EEG and comparable policy instruments have also **triggered internationally relevant innovations**. There have been a lot of reports in the media about rivals from Asia, who also benefit from the EEG and who have recently developed into competitors of Germany's solar cell manufacturers. The development of the relevant capacities in Asia has been made possible by equipment being imported from Europe, into which European know-how and experiences had been integrated. Over time, this has not only **contributed to declining costs and prices of the technologies in Europe**, but has simultaneously **sparked innovations, e.g. in manufacturing equipment**. Even more significant globally is that the enormously reduced costs of renewable energy technologies have facilitated their **application in developing and newly industrializing countries**

„The EEG has also triggered internationally relevant innovations."

and that these countries are now pursuing entirely new strategies in the expansion of their electricity systems. It is now foreseeable that there will be a shift in the market dynamics in these countries. For instance, between 2010 and 2012, about three quarters of new wind power capacity were installed outside the EU and about half in Asia, which means **additional export markets and, thus, that innovation incentives will follow**. The EEG has played a role in triggering these self-reinforcing feedback processes. It could be criticized that other countries benefit from this innovation to a considerable extent, while the costs of the EEG are incurred in Germany. This criticism does not address the EEG's innovation impact, however, but rather the international distribution of its costs – Germany could claim that it is taking on a global responsibility by bearing the investment costs which trigger these innovations.

4. The contribution of the EEG to climate protection

„The conclusion that the EEG has no effect as a climate policy cannot be upheld."

Overall, our scientific findings show that the policy has had a positive impact on innovation on a broad scale. In addition to this, however, there is the question whether the EEG also benefits climate protection or whether it does not bring about any additional CO_2 reductions due to the EU's emission trading scheme's cap on EU-wide CO_2 emissions. **The argument that the EEG does not result in any additional CO_2 reduction ignores the fact that the targets set for emissions trading and renewable energies were coordinated with each other within the EU's 2020 integrated climate and energy package.** The different policy targets of emissions trading and supporting renewable energies were deliberately weighed up by the policy makers. While the main target of the emissions trading scheme is to minimize the short-term costs of avoiding CO_2 emissions, the policy measures supporting renewable energies aim at, and, as shown above, achieve the cost reduction and development of technologies which are not "near market" to start with. The EEG has no effect on climate protection within the EU only if renewable energies exceed their targets and, at the same time, the saved emissions are not "banked" for future trading periods and if future emission targets are not influenced by the success of previous emission reductions and technology developments or banking behavior. According to the most recent evaluations of the EU Commission, however, the expansion of renewable energies is currently proceeding almost exactly in line with the set targets and the current debate about the EU's 2030 targets shows the significance of the previous success from applying new technologies when discussing the targets. In addition, the EEG-induced cost reductions – as described above – also contribute to the **increased diffusion of renewable energy technologies outside Europe and, thus, to global climate**

protection. The conclusion that the EEG has no effect as a climate policy therefore cannot be upheld.

5. Implications for the revision of the EEG

„The positive conclusion does not imply that we believe there is no need to change the EEG. Yet, the positive experiences should be taken into account."

„We regard the amendment of the EEG as only one important component in the transformation of the energy sector."

Based on our findings, it can be stated that the EEG does have a positive impact on innovation. It is important to note that there are direct but also indirect effects, some of which emerge at global level and which cannot be captured by studies based on individual technologies, but which our findings indicate play a key role when evaluating innovation effects. **However, this positive conclusion does not imply that we believe there is no need to change the EEG. The positive experiences made should be taken into account during the forthcoming amendment of this policy tool and when aiming to increase the incentives for innovations.** We regard the amendment of the EEG as only one important component in the transformation of the energy sector: Scientists agree that the innovations which are essential to transform the energy system are most effectively promoted by **combining demand- and supply-side measures in a balanced policy mix**. As clearly shown by our empirical results, these include the **formulation of credible medium- and long-term targets for renewable energies in terms of a mission-oriented innovation policy**. Putting these ambitious targets for renewable energy technologies into practice by using different policy instruments to promote supply and demand and embedding them in the specific given context is what makes an innovation-oriented policy successful – hardly a surprising result from the perspective of systemic innovation research.

Researchers supporting this statement

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