ENERGYWATCHGROUP

Management Summary

Roadmap CO_2-neutral Germany

In 2024, global warming reached 1,6° C. That has already caused drastic climate events across the globe. This calls for increased and immediate action. On the other hand, the pathway to a CO_2-neutral Germany is often perceived as complex and unclear. There are concerns, that it will not be affordable for private citizens, businesses or the government. The debate in society – as reflected in mainstream and other media – is full of contradictory statements that are not well founded in facts. These obstacles considerably slow Germany down on its path to CO_2-neutrality and lead to suboptimal decisions and ineffective solutions. Instead, what is needed is a stable and strong consensus in German society for this "once in a generation" task.

The Roadmap intends to contribute to that by:

- providing facts and figures necessary to find common ground in **emotional and ideological debates.**
- designing a pathway to CO_2-neutrality that is
  - **affordable** for private citizens, businesses and government.
  - **reliably available** since it is based on already commercially available technology.
- focusing on **few but very effective key solutions** that – taken together – will make Germany CO_2-neutral in power supply, building heat, traffic and manufacturing[1].
- **simplifying language, content and calculations** to the degree that they are both sufficiently accurate and understandable for a broader audience.

Another novel feature of the Roadmap is its **„360-degree" picture of the financial effect** on investments and ongoing costs and revenues for each social group. For implementation by parliament and government, the Roadmap contains exemplary measures, that make the transition:

- largely profitable for the individual private citizen and business as well as for government. That facilitates mobilizing private capital and gaining support for the transition in society and parliament.
- mandatory so as to assure CO_2-neutrality where these economic incentives alone do not bring all actors to choose CO_2-neutral solutions.

[1]These sectors cause 90% of the CO_2-equivalent emissions in Germany. The other 10% are caused by waste incineration, agriculture and forestry.

The results show: **if Germany implements this roadmap, it will reach CO_2-neutrality profitably, socially fair and with a net positive effect on public finances.**

The Roadmap is based on these exemplary solutions per sector:

- **Electricity** – The low-cost but variable wind and PV generation of electricity is combined with renewable peak load generation to form an electricity supply that reliably meets demand. This peak load generation utilizes a cost-optimized mix of biogas, green hydrogen, power storage and interconnectors. Where time variable tariffs and interconnection do not sufficiently balance generation and demand, the residual generation and storage needs are sourced competitively for a payment per kWh generated (i.e. feed-in tariff) within the specified operating hours that is stable for 20 years[2]. That type of sourcing is also continued and accelerated for wind, PV and other renewables. The resulting competitive prices are passed on in full to electricity customer. **Green hydrogen** is produced domestically at a price that is competitive with imports.
- **Building** heat is generated with a mix of heat pumps from various heat sources, direct geothermal heating, and wood heating to the extent it is currently being used. In densely populated districts, this heat is provided via an expanded district heating.
- **In transportation**, cars and trucks with internal combustion engines (ICE) are replaced by battery electric vehicles (BEV). The BEV's total cost of ownership is significantly lower than the CO_2-neutral alternatives (efuels, biofuels, fuel cells) and they also have recently become commercially available for most types of trucks. The biofuel, that is currently added to diesel and gasoline, is instead used to fuel the flights originating in Germany. The current amounts are sufficient for that and costs are significantly lower than for synthetic green kerosine. This makes flying CO_2-neutral.
- **Industry** generates process heat with the amount of biofuels currently used and with electricity. Primary steel and ammonium are generated with green hydrogen instead of with coal and natural gas.
- **„Bridging technologies"**[3] are not part of the Roadmap, since they are expensive detours: most will need to be replaced or refurbished before the end of their life cycle to achieve CO_2-neutrality by 2045, the goal Germany has committed to. That requires more investment and of the limited planning, permitting and building capacities than transitioning directly to CO_2-neutral solutions.

[2]This done within the framework of the German Renewable Energy law ("EEG").
[3]An example is building „H2-ready" power plants that are operated on natural gas some time before changing to green hydrogen as a fuel.

Achieving CO_2-neutrality in Germany with these solutions is more economic than perpetuating the status quo:

- **An added investment of 1.900 bn. €** is required to reach CO_2-neutrality. Spread out until 2045 this is a "doable" 5% increase of current total annual investment in Germany.
- The added investment is **paid for by the resulting energy savings** (net effect: 4 bn. € per year).
- In addition, this redirection of expenses from fossil imports to domestic capital investment **increases GNP by 2,5% or 110 bn. € per year**, due to the "multiplier effect".

These macroeconomic benefits create enough value to make transitioning to CO_2-neutrality financially attractive for citizens, business and government. The financial effects per social group are (value without multiplier effect in parenthesis):

- **Added income for private citizens of 35 (1) bn. € per year.** For an average 4-person household, that translates into an added income of 1,700 € every year. For building owners, the added investment for a CO_2-neutral heating system more than pays for itself because of the **increase in building value by about 20%.** Therefore, this investment should not be paid for additionally by raising the rent. However, long-term and low interest **KfW loans** enable building owners to invest without impacting their cash flow. In the few remaining cases of real financial hardship, investment and income subsidies protect home owners and tenants. On average, this reduces tenants' costs slightly by 0.19 € per square meter and month: there is no net increase in housing costs. Overall, the percentage of disposable income reduction is higher for low income households: the measures slightly reduce income disparity in society.
- **Net value generated in non-manufacturing businesses increases by 38 (0) Mrd. € per year.** The savings on electricity, heating and transportation pay for the added investment.
- **Net value generated in manufacturing increases by 13 (2) Mrd. € per year.** The significant increase in energy costs due to substituting fossil fuels with electricity and green hydrogen is compensated
  - for processes where energy costs are a key factor in keeping production in Germany, with energy price subsidies that keep the real, remaining energy price on the current level of fossil fuel prices for 20 years.
  - generally through the multiplier effect, which benefits the industry as a whole.
- **Profits in the energy industry without municipal utilities increase by 13 (12) bn. € per year.** The energy industry makes limited but sufficient profits with the added investment in generating and distributing electricity, heat and green hydrogen via grids or pipelines. On the other hand, the business with and profits from oil and natural gas end.

- **Government net revenue increases by 8 (-10) bn. € per year.** With CO_2-neutrality, revenues from the current energy tax and emissions trading end and a significant subsidy for electricity and green hydrogen in select manufacturing processes is added. This is compensated with elimination of the current EEG subsidies, introduction of a relevant and reliable municipal revenue per kWh of renewable energy generated there, and an increase in vehicle and other taxes.

Beyond energy cost savings and the multiplier effect, further value - not quantified in the above effects by social group Roadmap - is generated by:

- strengthening Germany's international **competitiveness in the large and growing global Clean Tech market.**
- **reducing health costs** by some due to air quality improvements that come with ending fossil fuel combustion.

Key contributions of parliament and government at the federal, state and local level to these results are:

- **Consistent communication** of the pathway and its impacts, **reliable implementation** of the measures, and **speedy permitting** of the resulting investments.
- Making **long term and low interest loans available** through the government owned bank KfW in sectors where that is critical for the financially viability of investments. That includes KfW loans for the upcoming, substantial investments of **municipal utilities** in district heating and electric grids and allowing these utilities to not file for bankruptcy, as long as the repayment via user fees is to be expected.

CO_2-neutrality until 2035 is profitable as well and avoids some 600 bn. € climate damage costs throughout the world.

The Roadmap can be implemented by 2035, if that gains sufficient political support:

- Just maintaining the rate of **wind und PV expansion** achieved in 2023 will create enough generating capacity by 2038 **for CO_2-neutrality** in Germany. With slight acceleration, that capacity level is **reached by 2034.**
- Compressing the investment in BEV, heat pumps, wind and PV into 10 instead of 20 years increases the unit costs and thereby the added investment. On the other hand, energy cost savings start earlier and the German Clean Tech industry gains a stronger position in global markets. The **net financial effects of reaching CO_2-neutrality by 2035 and 2045** are therefore expected to be **comparable**.
- Globally, accelerating German CO_2-neutrality from 2045 to 2035 avoids climate damages in the order of 600 bn. €.

Other pathways to German CO_2-neutrality are conceivable.

Depending on the political priorities chosen, available insights and future technology and market developments, other pathways to German CO_2-neutrality are conceivable. However, before alternative measures are chosen, they should be fully evaluated through to CO_2-neutrality and be shown to be at least as reliable, economic and fair as the corresponding measures in the Roadmap. Germany cannot afford to go down paths, that are not evidently sustainable all the way through to CO_2-neutrality.