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ON SCIENCE AND TECHNOLOGY FOR DEVELOPMENT (CSTD)**

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Contribution of Germany

to the CSTD 2017-18 priority theme on ‘The role of science, technology and innovation to
increase substantially the share of renewable energy by 2030’

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- I. What are the policies (renewable energy strategies, regulations, standards, fiscal measures, financial incentives, etc.) in place in your country/region that encourage renewable energy projects or aim at increasing the share of renewable energy in your country's energy mix? Who are the main actors in the renewable energy sector and what are the linkages between them? Do you have any documentation, references, web addresses or reports on the cited policy measures? If yes, please share it with us.**

1. Policies in place that encourage RE projects or aim at increasing the share of RE in Germany's energy mix

To begin with, in Germany we have agreed the policy of the Energiewende, i.e. an energy transition. The Energiewende is a fundamental transition process embracing all sectors of the economy – no project lasting only one legislative term. It will take us decades to complete, review, revise and adjust this huge project. The Energiewende is our overarching goal, and our pathway into a future that is secure, environmentally-friendly, and economically successful. The main pillars of the energy transition are:

- Reduce energy consumption: energy efficiency first!
- Ongoing expansion of renewable energy, with more modular technologies that create new business structures,
- Digitization of energy services, with new business models,
- Phasing out nuclear power by 2022 at the latest.

Our energy transition targets by 2050 are:

- 80-95% of reduction of CO2 emissions
- At least 80% renewables in the electricity sector, 60% in total final energy consumption
- 50% reduction of primary energy consumption

Essential is a long-term basis for planning and investment for stakeholders, a close integration and optimization of the various fields of action and the sectors as well as cost-efficient instruments, without losing the high acceptance of the German public. To meet the challenges ahead of us, the German government has developed a “10 points energy agenda” at the beginning of this legislative term – lining out the key projects for the last four years.

In order to increase the share of RE in Germany we first have the overarching goal of increasing energy efficiency. Our guiding principle is “Efficiency first!” because

energy that we do not need and use does not have to be generated in the first place. We think that it really does “pay” to be energy-efficient, in every sense of the word. Further, decoupling of energy consumption and economic growth is our strategy. Energy efficiency not only saves energy and contributes to lowering greenhouse gas emissions, it also contributes to innovation and thereby economic growth. In 2014, we adopted the National Action Plan on Energy Efficiency (NAPE) that set out a broad package of new measures (immediate action and further work processes) to boost energy efficiency and support our ambitious energy efficiency targets. NAPE measures concentrate on:

- Boosting funding for investment (CO2 building renovation programme, Market Incentive Programme; STEP up! as innovative, technology-neutral competitive model for funding energy efficiency)
- Package advisory and information services (Information campaign)
- Encourage greater individual responsibility for energy consumers

In 2015 we adopted our Energy Efficiency Strategy for Buildings, and we are elaborating a Green Paper on Energy Efficiency, setting out actions for a medium to long-term efficiency strategy.

Second, we plan the further expansion of renewable energy. In the last 17 years, the share of renewable energy in our electricity consumption grew steadily and very fast. In Germany, we use mostly wind and solar power. Most important for the expansion of the use of renewables was our Renewable Energy Sources Act (EEG), that ensured a fixed technology-specific tariff for every hour of renewably produced electricity and guaranteed priority access to the grid. This strategy not only boosted the deployment of renewable energy in Germany, it also brought down costs (in particular PV prices) globally. Today, around 35 % of our electricity is generated by renewables. We continuously revised our EEG and adopted it to falling technology costs. With the reform of the EEG in 2014 we brought renewables closer to the market, as now all larger plant operators have to market their electricity directly. Moreover we defined reliable deployment corridors – this step ensured that we did not overshoot our own targets. The latest and also most comprehensive reform was the one on the EEG 2017 – financial support for renewables installed as of 2017 is determined via a market-based auction scheme. Germany introduced pilot auction schemes in 2015, and formalized them with the

2017 reform of the Renewable Energy Sources Act. Results of the latest auctions for PV [5,66 EUR Ct/kWh], wind onshore [4,28 EURO Ct/kWh] as well as wind offshore [0,44 EURO Ct/kWh] show that renewables are ready for the market.

Third, we plan to make the market ready for renewables. At some days, sunny and windy summer days for examples, a high percentage of our electricity (approx. 87%) is produced by renewable energy. The percentage could be much lower a few hours later, nevertheless security of the energy system has to be ensured. These large shares of variable renewable energy pose huge challenges on our electricity system und electricity market. Therefore, we had to make the market ready for renewables: We have formulated a new Electricity Market Act that further developed the electricity market 2.0. The measures adopted include to

- strengthen the existing market mechanisms,
- incentivize greater flexibility in the electricity system, and
- integrate the electricity market more strongly into the European internal market – cooperation with neighboring countries to achieve energy security at a better value on a European basis.

The new electricity market design guarantees that we can continue to rely on a secure supply of low-cost electricity even with very high shares of renewables.

Fourth, we aim at improving the grid infrastructure. Not only the electricity market, also the grid infrastructure is challenged by renewable energy in the system. Large shares of our renewable plants (wind) are located in the north of Germany; most intensive consumption centers (major industrial consumers) are located in the south west of Germany. New high voltage transmission lines need to be build; moreover increased level of distribution grids are needed for feeding in renewable energy electricity. Therefore our 10 year Grid Development Plan is revised every two years; here new grid needs are identified. The challenge is to ensure the citizens' acceptance of new transmission lines; we have put in place comprehensive participation and consultation opportunities to define routes. Moreover, we have agreed to use underground cables for the electricity superhighways from north to south. This decision has improved public acceptance for the urgently needed expansion of the power grid.

Renewable energies can be employed in a decentralized fashion, too. This means that more and more electricity consumers are also producers (so called prosumers). This poses also new challenges to the grid: As the share of renewable energy in the power sector will rise, and, as there are more and more prosumers there is a need to intelligently link grids, generation and consumption. Digitization will govern the energy future. Here, smart meters play an important role. They will be the communication platforms for the smart grid of the future which links producers and consumers, and can reconcile electricity supply and demand, integrate renewables into the grid as well as help to reduce energy consumption.

To conclude, one of our major goals of our energy transition is to decarbonize the energy system, i.e. to reduce emissions and thereby contribute to combatting climate change. With higher shares of renewables, we increase our CO₂-free energy production. However, we still have a significant number of lignite power plants, generating high shares of CO₂ emissions. To achieve our climate protection targets, we have started to gradually phase out 2,7 GW of lignite capacity from the electricity market (security stand by). Nevertheless, large amounts of CO₂ are emitted in the transport, buildings and industry sectors. Efficiency measures can and should reduce our energy consumption in these sectors. Our first option is the direct use of renewables also in these sectors, i.e. to use biofuels for transport or heat the necessary hot water using solar thermal energy. Still, this will not be sufficient. Hence, we have to look into the use of renewable power also in these sectors. We think that electrification will contribute to decarbonizing these sectors, because we can produce electricity with no or very little emissions when we use renewable energy sources. If we electrify transport, and many processes in the buildings and industry sectors, this will increase electricity demand enormously. We have to make sure that only renewably produced electricity is used to drive cars, generate heat and produce goods in factories. In 2050, electricity can cover roughly half of all our energy needs – compared with around one quarter today. In the future, electricity will become the most important source of energy in the energy market. Consequently, the electricity sector is “coupled” ever more closely with the building, transport and industry sectors (so called sector coupling). In Germany, we now enter into the third phase of the Energiewende. We have achieved a great deal in the past, but there are many challenges to come:

- Establish an “Energy Efficiency First” strategy that significantly reduces our energy consumption
- Advance the direct use of renewable energy as often and as much as possible.
- Sector coupling: Electrify the other energy sectors, in particular the transport sector, to reduce emissions in emission-intensive sectors.

2. *Main actors in the RE sector and their linkages*

Federal Government, the 16 State Governments, Municipalities, project developers, financing sector, producers of renewable energies, grid operators, consumers, industry.

The Federal Government sets the policies, the State Governments and municipalities set the framework for the expansion for renewables by providing or marking the land that might be used for producing renewables. The project developers decide dependent on the decisions of the financing sector where and how many projects can be developed. The producers are not only large-scale power plant owners but also small scale roof-top owners. The grid operators are relied upon for access to the grid for renewables, transport and distribution to the final consumers. Private consumers and industry decide in a liberalized market (like in Germany) what kind of energy they demand. There is a trend to subscribe to electricity produced by renewables, for example there is a global corporate sourcing campaign of enterprises that would like to use 100% renewably generated electricity.

3. *Further reading*

<http://www.bmwi.de/Redaktion/EN/Dossier/energy-transition.html> (includes further links to all documents mentioned above).

- II. Can you share success stories of renewable energy projects in your country or region? How do you ensure the sustainability of the project, and scale or replicate it? In your answer please include information on the following: location, time period of implementation/starting date, main actors, beneficiaries, funding, technology and innovation used, issues addressed, stage of implementation, sustainability, etc. Do you have any documentation, references, web addresses or reports on the specific examples cited? If yes, please share it with us.**

1. *Success stories of RE projects*

Due to the vast amount of projects we cannot go into details.

2. *How to ensure sustainability of the projects*

As a legal requirement, large-scale projects usually have to undergo an environmental impact assessment to ensure the sustainability of the project.

3. *Further reading*

See above.