The energy transition in Europe: a vision of progress

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The Energy Transition in Europe

A Vision of Progress

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1. The Energy Transition as an Inter-Generational Contract[1]

Europe needs a new vision of progress integrated into a general social-ecological reform concept. A Europeanisation of the energy system transformation is fundamental for this. It is a necessary, if not sufficient, step towards more comprehensive reforms. And it implies a story about a positive social-ecological reform vision, which can be majority capable and give the "European idea" a future-oriented content.

1 This chapter is based on the book Hennicke et al. , Die Energiewende in Europa, published by Oekom-Verlag. A vision of progress, Munich (2019). The authors thank Jochen Luhmann, Stefan Thomas and Michael Müller for important information. Lisa Kolde and Lea Krings gave us great support in the editing.

The energy transition resembles an *inter-generational contract* in which the current generation pre-finances a gradual replacement of the entire fossil and nuclear energy system in the 21st century with energy efficiency, energy saving and renewable energies, and organises the implementation processes in order to protect children, grandchildren, future generations and developing countries and its peoples from the risks of a non-renewable energy system. Moreover, this is a way to avoid the major risks of resource wars over oil or catastrophic nuclear accidents in the long run. This progress project is visionary but sufficiently concrete to be perceived as a feasible and globally generalisable progress for the quality of life of people in Europe and elsewhere.

A "genuine energy transition" means the transformation to a completely decarbonised, risk-minimised, and above all, nuclear energy-free energy system that's socially and economically compatible.

This vision for the energy system is a prerequisite, a driver for enough climate and resource protection, and a socio-ecological modernisation project. It implies an extremely ambitious and historically unique process that will last for decades—at least until the middle of the 21st century. Such a far-reaching transformation process requires a radical change of direction in modes of production and consumption as well as a political leap in quality towards more democratisation of energy policy and economy. The basic question is whether and how the principle of private capital utilisation and capitalist world market competition can be reconciled with social objectives. If the project fails, then the future reform capability of the economy and politics in and beyond global capitalism is generally questioned.

It is not certain that a transformation of the European energy system will succeed in this sense, but essential steps in the right direction have been taken. That's why it seems promising to fight for it in words and deeds. A real progress project can only succeed if the national and international connections between the social and ecological crisis are understood and *integrated solution strategies are* developed and implemented. At the World Climate Conference in Katowice (COP 24 in December 2018), UN Secretary-General António Guterres described the worldwide hesitant climate protection policy not only as "immoral" but also as "suicidal" for humanity. According to the latest scientific findings (Steffen et al. 2018), this is no rhetorical exaggeration. The word of the year 2018 is also "hot age" which in popular scientific form brings the weather extremes of the year 2018 into the context of a conceivable catastrophic climate change. These dimensions of climate change, which pose a threat to humanity, throw a spotlight on all other areas of society. In this respect, they also determine the contexts for solutions to the social crisis.

2. Politics Must Shape the Long Term

So far, economic and fiscal policies have had a time horizon of political and economic "business cycles" of a few years; the interaction with long-term eco-social trends is not systematically included.

The short-term and segmented analyses of traditional policy areas correspond to an often reactive, structurally conservative and short term market-oriented policy that is no longer compatible with the developing *policy style* in the fields of climate, resource and environmental policy, which is oriented towards *key objectives and the long term.* From an economic point of view, an ambitious climate and resource protection policy that is oriented towards key objectives means an announced, state-accelerated economic structural change, the opportunities and challenges of which, however, are not sufficiently analysed and therefore, inadequately designed to be precautionary, socially and economically compatible.

If one defines *sustainability as "not producing and consuming at the expense of environment, social justice and future generations",* then this formulates a high scientific and political claim. But time is our scarcest factor. In this respect, pragmatic and goal-oriented implementation takes precedence over contemplative reasoning. The urgency of climate and resource protection does not allow a delay in action any more than does the need for rapid intervention against the worsening distribution and democracy crisis. Effective, socially acceptable and long-term goal-congruent reforms are indispensable.

The Hubbard Glacier in Alaska

Bush fire in California

3. Lessons from the German Energy Transition

The German energy transition policy offers illustrative material on the opportunities and deficits of an energy transition. As the economically strongest EU Member State, Germany is currently slowing down a more ambitious European framework (e.g. in the mobility sector).

On the other hand, the expansion of renewable power generation, the ambitious goals of the energy transition concept, and Germany's phasing out of nuclear power are still exemplary. A successful European energy transition requires a joint initiative and alliance of several countries, ideally fuelled by the two economically strongest and neighbourly countries: France and Germany.

Today's official German energy transition policy has had a long socio-political lead since the mid-1980s. Its momentum has long been based on the **anti-nuclear movement,** which later associated itself with a **pro-renewable,** and more recently, with a **pro-energy-efficiency movement** and was supported by a growing number of scientific studies.

The nuclear catastrophes in Chernobyl and Fukushima intensified the energy transition, which —after the unification of the two German states—became probably the most important future German project of the 21st century. The term "Energiewende" became the declared trademark of German energy policy. It was initially admired worldwide but is now increasingly viewed with scepticism because the "revolutionary goals" (Angela Merkel) of the German Energy Concept 2010/2011 are not being implemented decisively enough.

The Reactor No. 4 of the Chernobyl Nuclear Power Plant after the accident in 1986

	2016	2020	2030	2040	2050
Greenhouse gas emissions					
Greenhouse gas emissions (compared to 1990)	–27.3 %*	minimum –40 %	minimum –55 %	minimum –70 %	largely greenhouse gas neutral –80 to –95 %
Renewable Energies					
Share of gross final energy consumption	14.8 %	18 %	30 %	45 %	60 %
Share of gross electricity consumption	31.6 %	minimum 35 %**	minimum 50 % EEG 2017: 40–45 % til 2025**	minimum 65 % EEG 2017: 55–60 % til 2035	minimum 80 %
Share of heat consumption	13.2 %	14 %			
Efficiency and consumption					
Primary energy consumption (compared to 2008)	–6.5 %	–20 %	→		–50 %
Energy productivity (2008–2050)	1.1 % per year (2008–2016)	2.1 % per year (2008–2050)			
Gross electricity consumption (compared to 2008)	–3.6 %	–10 %	→		–25 %
Primary energy demand buildings (compared to 2008)	–18.3 %		→		–80 %
Heat demand buildings (compared to 2008)	–6.3 %	–20 %			
Power consumption transport (compared 2005)	4.2 %	–10 %	→		–40 %

* Provisional value for 2016

** A more goal-orientated, efficient, and market-based expansion of renewable energies was specified in coalition agreement between CDU, CSU, and SPD. Under these conditions a share of 65% of renewable energies is strived. Corresponding changes are made. Special tender in the field of wind and solar energy should contribute the 2020 climate goal. The synchronisation of renewable energies and network capacity is challenging.

Figure 1: Quantitative targets for energy transition and status 2016 (BMWi 2018).

3.1 "Revolutionary targets" (Angela Merkel)

In September 2010, the German government adopted an energy concept for the energy transition and supplemented it after the catastrophe at Fukushima in 2011. With far-reaching quantified targets, a drastic reduction in greenhouse gas emissions, a massive expansion of renewable energies, and an absolute reduction in total energy consumption by 50% by 2050—including sectoral targets for existing buildings and the transport sector—previously considered impossible were laid down.

Figure 1 compiles the objectives and the reductions achieved so far according to the sixth monitoring report of the Federal Government (BMWi 2018).

In the spring of 2011, the disaster with Fukushima Daiichi's nuclear reactor tragically demonstrated the technological hubris of the nuclear industry. It became clear to many that there could be other conceivable causes for a prolonged power outage anywhere in the world, transforming the technical masterpiece—a nuclear power plant—into a disaster machine.

In June 2011, the Federal Government, under pressure from public opinion, reacted with the Energy Transition decisions. The extension of the running times was revoked and a timetable for the final nuclear phase-out until 2022 and the short-term decommissioning of eight nuclear power plants were defined.

3.2 The role of research for consensus building

Around 2010-2011, the quantified key objectives of the German government's energy concept were based on a broad consensus, but still unthinkable 10 years earlier, among the relevant research institutes in Germany. This fulfilled a decisive prerequisite with regard to the knowledge base and scientific policy foundation, which is not yet available in a comparable form in other countries.

Figure 2 compares the energy mix today and by the year 2050 in representative long-term scenarios for Germany which, in addition to the forced conversion to renewable energies, all assign a central role to energy efficiency. The quintessence of the current state of knowledge can be summarised as follows:

- *Firstly,* absolute decoupling—moderately rising GDP and roughly halved primary energy consumption—is considered technically possible by 2050;
- *Secondly,* the share of renewable energies in energy consumption can be increased all the faster the more successfully the remaining energy consumption can be reduced through a massive savings strategy;
- *Thirdly,* an ambitious climate protection strategy by 2050 requires that the gradual phase-out of nuclear power by 2022 be accompanied by an equally strategically planned phase-out of coal in the 2030s; and
- *Lastly,* an 80% CO_2 reduction target by 2050 is considered achievable for the state of the art, but full decarbonisation of industry (e.g. the steel industry) and parts of the transport system (air, freight, rail and public transport) requires considerable innovation.

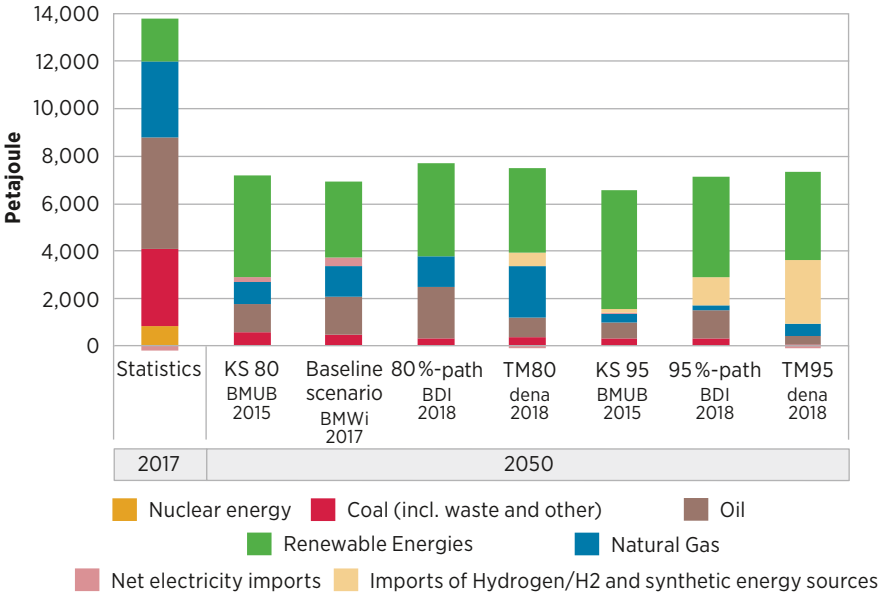

Figure 2: Comparison of primary energy consumption in 2017 with representative energy turnaround scenarios for 2050 by energy source (in PJ/a) (Samadi, S., unpublished manuscript, Wuppertal 2018)

Particularly relevant for the implementation of the energy transition and climate protection are the so-called sector targets for 2030 (see Figure 3), which the Federal Government adopted in the Climate Action Plan 2050 (BMU 2016).

These sector targets (for the five sectors: energy industry, industry, buildings, transport, and agriculture) are to form the core of a Federal Climate Action Act, which the Federal Government intends to initiate in 2019.

Field of action	1990	2014	2030	2030 (reduction in % compared to 1990)
	(Mio. t CO_2-equivalent)			
Energy industry	466	358	175–183	62–61 %
Buildings	209	119	70–72	67–66 %
Transport	163	160	95–98	42–40 %
Industry	283	181	140–143	51–49 %
Agriculture	88	72	58–61	34–31 %
Subtotal	**1.209**	**890**	**538–557**	**56–54 %**
Others	39	12	5	87 %
Total	**1.248**	**902**	**543–562**	**56–55 %**

Figure 3: Sector targets in the German Federal Government's Climate Protection Plan 2050 (BMU 2016).

3.3 Mixed results of the German Energy Transition ("Energiewende")

"Revolutionary goals" (Angela Merkel) can inspire if they are implemented! By the "half-way point" (2018) of the energy revolution, however, this will only be the case to a limited extent. The balance of the energy transition to date is mixed and is summarised briefly: It is a successful current reversal paired with a loss-making traffic and heat reversal. The implementation of the "Energy Efficiency First" principle has been delayed, as has the CO_2 reduction due to the late withdrawal of coal. By increasing the share of renewable electricity from less than 5% in the 1990s to over 40% at the end of 2018, the feasibility of an "electricity transition" within 20 years could at least be demonstrated. Like no other industrialised country, Germany has decided to phase out nuclear energy by 2022 and—in parallel—starting the process of phasing out coal by 2038 at the latest. But the announcement has not yet been completed. If the example were to set a precedent in Europe, implementation would be accelerated. The identification of socio-economic opportunities is central to this.

3.4 Promising benefits of the energy transition

In recent years, there has been a fundamental paradigm shift in science in estimating the expected costs and benefits of climate protection and energy transition. Whereas in the past, the assessment of climate protection measures was dominated by burden sharing. Modern analyses usually calculate considerable positive net effects based on innovations, learning effects and cost reductions. Studies for the Federation of German Industries (BDI 2019) also highlight the predominant benefit of 80% CO_2 reduction for German industry by 2050.

A recent study concisely summarises the analytical paradigm shift in German scientific policy advice (Öko-Institut et al. 2018). In the study, six institutes with different orientations examined the consequences of the implementation of the sector targets up to the year 2030 (see above) of the German Climate Action Plan 2050.

In brief, the following results were obtained (Öko-Institut et al. 2018 p. 7ff.):

1. Achieving the sectoral objectives will require significant additional investment in all sectors. The implementation of the energy transition and ambitious climate protection represents a *future investment programme* with a new "green" quality, as it is suitable to raise the weak German investment rate and increase the resulting macroeconomic multiplier effects. New business fields like in the area of energy and resource efficiency, sustainable mobility and renewable energies, can trigger a new *ecological quality of* "green growth impulses".

2. In most sectors, a strategy focused primarily on energy efficiency is associated with economic advantages, that is, the necessary investments and costs are offset by high and in some cases higher savings. In this respect, the study confirms the economic rationality of the "Energy Efficiency First" principle.

3. The analysis of electricity prices and energy costs also shows that an energy transition is usually advantageous for the economy in comparison to the reference development, or it only leads to minor burdens.

4. Even today in northern Germany, a proportion of variable electricity feed-in of about 50% (mainly from wind) is safely controlled. The study shows how supply security can be guaranteed by "flexibility options" which are integrated into the energy system parallel to the increasing variable electricity input from wind and sun. The study, therefore, states soberly for the period up to the year 2030: "A threat to the security of supply in the area of electricity generation is not discernible or can be avoided by comparatively moderate measures" (Öko-Institut et al. 2018 p. 7).

5. The study by Öko-Institut et al. 2018 also calculates the expected (net) employment effects from the implementation of the above-mentioned sector targets by 2030. In total, significantly higher net employment effects (427,000 additional employees) are calculated for target path A (maximum efficiency) for the year 2030. For target path B (maximum renewable energies) 307,000 additional employees were identified.

In a word: The energy revolution could become a "Green New Deal made in Germany". Climate protection and ecological modernisation, as well as competitiveness and social compatibility go hand in hand.

2 The study distinguishes two target paths: Target path A (focus on energy efficiency) largely exploits existing efficiency potentials and takes renewable energies into account in the heating market only to a very limited extent. Target path B (focus on renewable energies), on the other hand, largely exploits the available heat potential of renewable energy combined with a minimum of energy efficiency.

4. Modernising Energy – Transforming the Society

The energy transition was conceived in the 1980s as a socio-political project. The fact that this should be accompanied by greater decentralisation ("re-municipalisation") and democratisation of the energy industry was at the core of a meaningful socio-political reform vision.

The residential area „Solarsiedlung" in Freiburg, Germany

In the period that followed, however, the technical discussion focused more and more on highly differentiated technical and economic analyses, especially regarding the transition of the electricity sector. This created the danger that the energy transition would be perceived as a technocratic project, that "those up there" would carry out more badly than right. What is the purpose of the project? What good does it bring? What do we, as citizens, benefit from it? These are clear questions, but the answers are still not very satisfactory. It is crucial for the social acceptance of a "project of the century" (1980-2050) that the socio-political dimension of the desired transformation is communicated transparently and supported by a broad citizen movement. The socio-political impetus provided by the German Ethics Commission (2011) and the emerging brilliant decentralisation process are, therefore, fundamental, conceptual and practical impulses for the energy transition.

4.1 Decentralisation as a secular trend

On 30th May 2011, the "Ethics Commission" appointed by Chancellor Merkel presented its final report (Ethics Commission 2011). The energy transition is understood as a socio-political task and against this background, the idea of a *joint work* "Energy Future Germany" is put into the foreground. Above all, the enormous importance of the local level is emphasised.

There are already numerous proofs of this today and future contours are discernible: traditional *energy supply* companies will disappear; millions of new players on the demand and supply sides of the energy system will interact with each other; the electricity, heat and transport sectors will grow together through digitalisation and electrification; networks will be intelligently controlled; and virtual power plants, the interconnection of decentralised generation facilities, storage, and load management options will play a major role. The progress potential of this new

energy world can perhaps be subsumed under the term "re-socialisation".[3] The remaining interaction between centralised and decentralised systems on a renewable basis is still largely open. Technically possible decentralization does not mean democratisation per se, but it can pave the way for a future democratised energy world—social control and governance as well as comprehensive citizen participation—and financing provided.

"Re-socialisation" also does not simply mean ownership decentralisation (e.g. for homeowners) based on the described secular technological decentralisation trends. Fair and secure access for all households (especially tenants) to affordable renewable energy (electricity, heat) and sustainable mobility must rather be combined with this. A new balance must also be found with remaining and new central systems on a renewable basis, such as offshore wind farms, geothermal and solar thermal power generation, electricity and hydrogen imports, Power-to-X plants, large battery storage facilities, national and international grid expansion, etc.

4.1.1 Prosumer: Homeowners benefit - tenants still have a hard time

The most decentralised level of the new energy world is that of the "prosumer", i.e., many new players who mostly **produce** electricity using PV, but also **consume** electricity from the grid at the same time (hence, **prosumer**).

In 2017, there were 1.64 million PV systems in Germany (see BSW-Solar 2018). The majority of this uses electricity for their own consumption and at the same time feeds solar power into the grid. It is estimated that by 2035, about 20.3 TWh of electricity can be replaced from the grid in detached and semi-detached houses in conjunction with decentralised storage facilities (batteries) (cf. PVP4Grid 2018). If tenant electricity models were to support this decentralisation trend in the future[4] , this potential could be even higher, and above all, enable tenants and low-income households to benefit from low-cost solar power.

4.1.2 Citizens' energy cooperatives: driving force for energy transition

Citizens' energy cooperatives are an important driver of energy transition and decentralised energy generation in Germany, both from a regional economic point of view and in terms of acceptance. Their number has risen unexpectedly within 10 years from 8 in 2006 to 850 in 2018. Owners are 95% private individuals, usually from the region. The focus is on electricity generation (83%). For this reason, citizens' energy cooperatives that are anchored locally must continue to receive privileged support in tendering procedures.

3 The term "re-socialisation" is used here to refer to the "return of social rights to dispose of energy"—based on state-of-the-art technologies for energy efficiency, renewable energies, energy-saving behaviour and digitisation. mbined with a minimum of energy efficiency.

4 See the article in the Handelsblatt (Witsch 2018) for criticism of the existing Tenant Flow Act of 2017.

4.1.3 “100ee Regions”/”Bio-Energiedörfer”: Development opportunities for rural areas

The use of renewable energies is becoming increasingly important in rural regions. As of July 2017, 153 “100% renewable” (“100%ee-regions”) municipalities and regions have the goal of completely shifting their energy supply to renewable energies. The 153 regions comprise about 25 million inhabitants and cover a total area of about 127,000 km². Bioenergy villages are a very interesting special form of sustainable village development. They can be part of the 100ee movement. Bioenergy villages are characterised by the fact that a significant part of the electricity and heat demand in the village is mostly produced in CHP (combined heat and power) plants, which are often owned by local heat consumers and farmers and whose biomass used does not come from maize monocultures or GMO crops.

4.1.4 Re-municipalisation

According to estimates by experts (cf. Wagner et al. 2018), about 8,000 of the 14,000 or so concessions in the electricity sector expired in Germany between 2010 and 2016. With the expiry of the concession contracts, many municipalities discussed whether the new award of the concession was a first step towards the (re-)municipalisation of the energy supply. This developed into a veritable wave of municipal utility start-ups. If only companies that are active at least in the electricity business and were newly founded are counted, then the result will be 152 new municipal energy supply companies, all of which were founded between 2005 and 2016.

4.1.5 Solid municipal substructure

Germany has a solid municipal base for decentralised transformation processes where 1,458 member companies were organised in the Association of Municipal Enterprises (VKU) in 2018. Of these, 733 are active in electricity, 646 in gas, and 574 in heat (VKU 2018). In 2018, around € 3.9 billion was invested in these divisions: 91,671 employees were employed and sales of € 81.186 billion were achieved. The CDEC, the European association of local and regional energy companies, is made up of around 1,500 energy companies from 10 European countries—Belgium, Bulgaria, Germany, France, Italy, the Netherlands, Norway, Austria, Sweden and Switzerland. Denmark has carried out a particularly impressive process of decentralisation today.

All these local energy transition activities have an enormous regional economic significance in addition to their driving role for the national energy transition. It is estimated that between 2012 and 2030, municipal value added from renewable energies will increase from €11.1 billion to €16.3 billion. Municipal added value is created through municipal tax revenues, corporate profits, rental income, avoidance of regional outflow of purchasing power through energy cost savings and employment effects (cf. Hirschl et al. 2010).

It is also very remarkable that up to 2012 (more recent figures are not available), about 46% of the investments in renewable energies in Germany were made by private households and farmers and only initially about 5% by the four large electricity companies. Although this proportion has now shifted more in favour of the electricity companies, like investments in offshore wind farms, it is nevertheless clear that the ownership structure of the electricity supply through renewable energies has developed strongly in the direction of citizen financing.

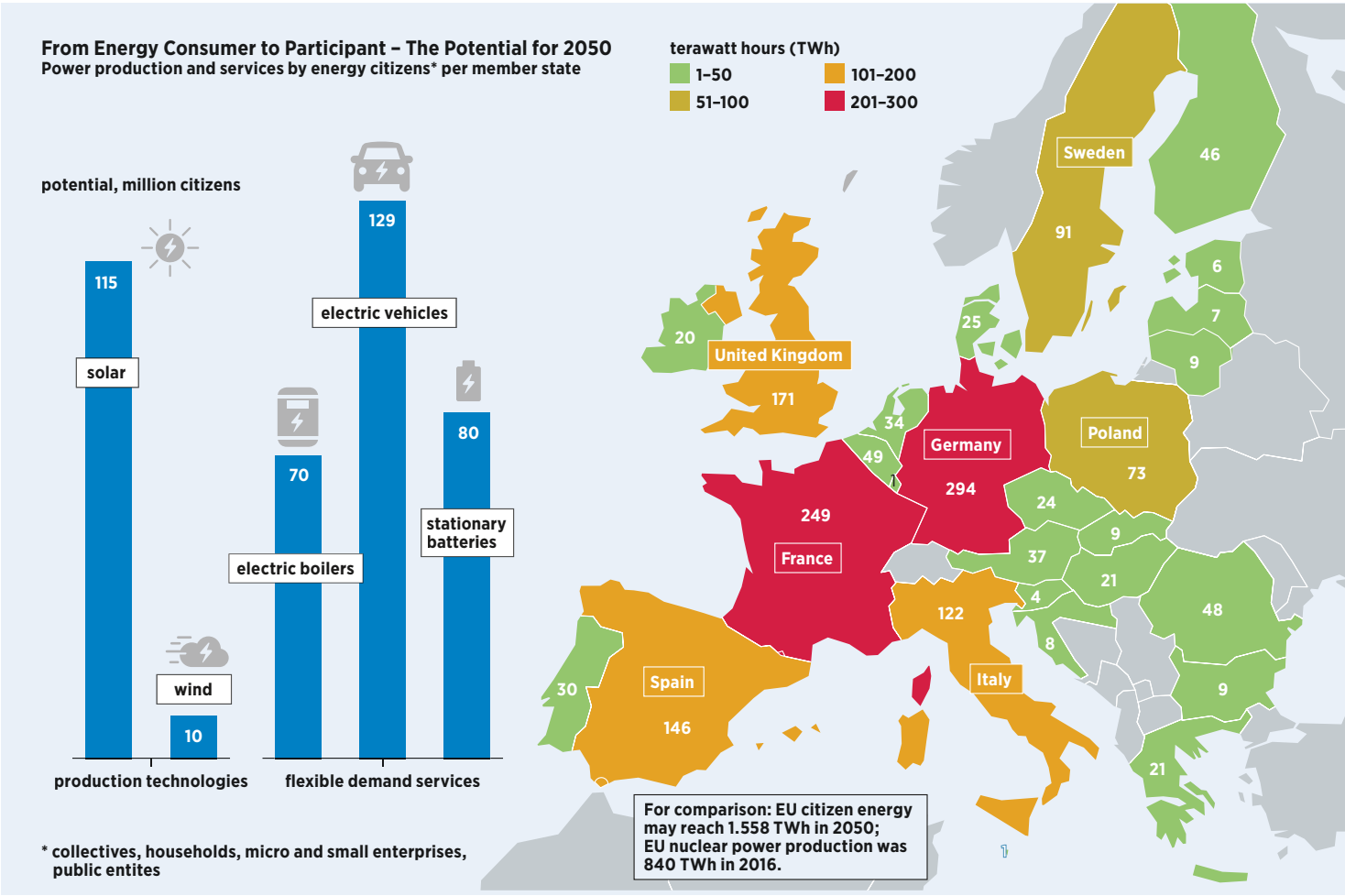

Figure 4: From Energy Consumer to Participant - The Potential for 2050
(Heinrich Böll Foundation and others 2018)

4.1.6 Perspectives for European energy citizens

What is interesting is the overall potential for the EU28, which could be tapped in the long term through modern decentralisation options based on renewable energies and operated by "citizens". This decentralisation potential for "energy citizens" has been identified in a study by the University of Delft for the year 2050 (Kampman et al. 2016). All individuals or households, public enterprises, and small and medium-sized enterprises (SMEs)—that individually or jointly generate decentralised renewable electricity or can participate in local flexibilisation and demand-side management activities through the controllable use of batteries, e-mobility or electric boilers/heat pumps—were grouped together as "energy citizens". The figures are striking and point to a conceivable revolutionary process of technical decentralisation, and thus, of re-socialisation in Europe. Total EU28 decentralised electricity generation from wind power is estimated at more than 900 TWh by 2050 and from PV at more than 600 TWh. The main producing countries of these energy citizens are Germany and France, followed by the UK, Spain, Italy, Sweden and Poland. This electricity generation by "energy citizens" would take place in more than 150 million solar plants and over 10,000 wind power plants.

Of course, today's reality in the EU28 is still far from this scenario projection for the year 2050. At the same time, the scenario analysis illustrates the technically possible potential for deconcentrating and decentralisation on the European electricity markets if the economic and social conditions were also created for this.

Lignite mining

4.2 The "Coal Commission": Lessons for Europe

In view of these perspectives, it is understandable that more and more people are raving about "Small is beautiful". Even a global corporation like Siemens propagates in its marketing activities: "The future of energy supply is local and decentralised" (cf. ZfK 8/2018). And undoubtedly, the trend towards decentralisation is a technological megatrend driven by brilliant cost reductions, not only in the energy transition in Germany and Europe but also worldwide (cf. Nationalgrid 2016).

However, this trend is embedded in and driven or slowed down by existing structures, processes and the vision of a socio-ecological transformation. It is one of the greatest challenges for transformation to free oneself from the status quo and past fossil-nuclear path dependencies and to pursue a completely new vision. This can be easily calculated in scenarios and well hidden in the harmless-sounding term "structural change". However, the hardest test is whether an energy transition can be successfully implemented. For Germany and other European coal countries, for example, a socially responsible coal phase-out—in addition to the nuclear phase-out—is at the heart of the transition of the electricity sector. In terms of mandate, format, composition and outcome, the German "Coal Commission" is not only evidence of the need for a new type of governance but has also compiled numerous indications and recommendations for its regional implementation.

On 26 January 2019, the Commission "Growth, Structural Change and Em-

ployment" (in short: "Coal Commission") appointed by the German Federal Government presented its eagerly awaited final report. Understandably, public attention focused initially on the question of whether the pluralistically composed commission (a total of 31 members) could reach a consensus on a date for the complete phase-out of lignite and hard coal-based electricity generation. After nine meetings within half a year, the Commission finally recommended "the end of 2038" as the closing date for coal-fired power generation. This is earlier than planned by the corporations and if optimistic assumptions are made, it will be compatible with the achievement of the government's official CO_2 reduction target in the energy industry (reduction of CO_2 emissions by about 60% by 2030 compared with 1990, i.e. to 175 to 193 million tonnes), but the German level of ambition is clearly too low for sufficient global climate protection.

Despite this relativisation of the date of exit, it remains to be seen that if the Commission's recommendation is incorporated into binding legislation (a treaty that extends beyond legislative periods) and implemented, then Germany could be the first large industrialised country in the world to implement an orderly phase-out of both nuclear energy and coal-fired power generation. Around 50% of the secured power plant capacity available today will then be taken off the grid in just under 20 years. Indirectly, this ambitious double exit strategy means doing everything possible to ensure that the official expansion target of 65% renewable electricity generation by 2030 is achieved, and then be ambitiously continued up to 100%.

New concepts, institutional innovations, exemplary measures and projects for the implementation of a socio-ecological transformation can be derived from the present recommendations of the Commission, which could have a signal effect not just in Europe, but also globally. The share of coal-fired power generation (2017) in electricity consumption is 40% in Germany, 45% in Romania, 46% in Greece, 54% in the Czech Republic, and 81% in Poland. Moreover, it is even higher in some cases. If Europe is to be decarbonised in the long term, further "coal commissions" are needed in some member states that can provide an impetus for the national transformation process that is currently underway. Europe-wide industrial policy learning effects of the German "Coal Commission" are an example:

1. The Commission has compiled around 200 pages of project proposals for structural development for the Saarland and four other regions concerned (Lusatian, Helmstedter, Central German and Rhine districts); and 157 measures and projects for the Rhineland alone, including 123 "emergency measures" (from 2021). Such an extensive stocktaking and *collection of ideas for (regional) structural change* has not yet taken place.

2. The concrete involvement of 60,000 employees (20,000 of whom are directly employed in lignite mining) and 45,000 people, who have already been resettled or may have been resettled by thousands more on the other, is recognised by all members of the *commission as a clear commitment to socially acceptable transformation.* In addition, there are 5,700 employees in hard coal-fired power plants throughout Germany.

3. This also recognises the structural change accelerated by climate protection and energy transition, and explicitly calls for the resulting *responsibility of society as a whole:* "Terminating coal-fired power generation [...] is a task for society as a whole, since the foundations for this decision are based on ecological and economic considerations for society as a whole" (Commission on Growth, Structural Change and Employment, 2019, p. 111).

4. Summarising a large number of Commission proposals, the contours of a new (regionalised) socio-ecological industrial and service policy can be seen. *New governance of socio-ecological transformation is emerging* both in the necessary cooperation of all political levels (federal government, states, regions, municipalities), through the participation of stakeholders (politics, business, trade unions, NGOs) and through institutional innovations for steering and coordinating processes.

5. Stocktaking of European energy and climate policy

5.1 Status quo of the EU energy system

Power generation
In 2016, the EU produced 46% of its own energy needs, while 54% had to be imported from countries outside the EU (see here and below European Commission 2018; Eurostat 2018). It is a fact today and will remain under "business as usual" policies in the future that, firstly, the EU is *enormously dependent on imports of* oil and natural gas.

The Member States' own energy production is as varied as the energy mix: with 29% of EU energy production (nuclear energy is the main energy source), followed by 28% of renewable energies, 17% of solid fuels, 14% of gas (14%), and 10% of crude oil.

The second fact is that almost a third of Europe's own energy production is still based on nuclear energy. Imagine a situation in which import problems for oil and natural gas coincide with an accidental (partial) failure of nuclear power production in Europe. Obviously, this would be a continental nuclear catastrophe of unimaginable proportions, so that even for *reasons of security of supply,* the acceleration of the European energy system cannot be postponed.

Structure of energy consumption
33% of the European Union's final energy is consumed by the transport sector, followed by households (26%), industry (25%), services (14%) and agriculture and forestry (2%). The efficiency of an internal combustion engine is around 20%, that of an electric motor

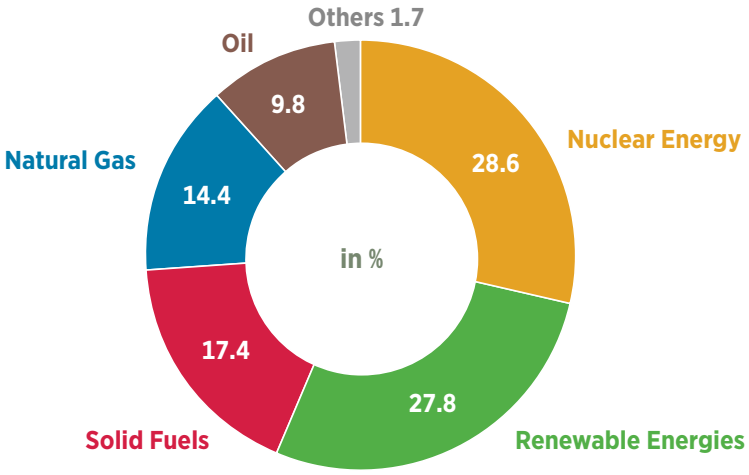

Figure 5: Share of EU energy production by energy source (2016)
(Eurostat 2018)

over 90% - and the recovery of braking energy can also be considered. This makes it clear that the final energy share of transport can be reduced considerably—simply by switching to e-mobility.

In 2016, around 22% of the final energy consisted of electricity from various sources, 44% of the electricity was generated from fossil fuels, 30% from renewable energies, and 26% from nuclear energy. Decarbonisation scenarios in most countries assume that the share of electricity from renewable energies will have to increase drastically in order to decarbonise the transport sector (e.g. through e-mobility) and the building sector (e.g. through electric heat pumps).

CO_2 emissions

In 2015, CO_2 emissions were 22% lower than in the base year 1990 and the EU is likely not only to meet but even to exceed its 2020 target (20% GHG reduction). The absolute decoupling process between rising EU GDP and falling CO_2 emissions is also encouraging but is not yet enough to achieve the 40% CO_2 reduction target for 2030.

Energy efficiency

Energy efficiency is measured by the value of energy intensity, which indicates how much energy is needed to produce a unit of gross domestic product. There are enormous differences between the EU Member States. The EU Member States with the highest energy intensity are Bulgaria and Estonia, while Denmark and Ireland have the lowest energy intensity. The classification of these data shall consider the national economic structure of each Member State. Service-oriented economies have a lower energy intensity than economies with a high industrial share. The consideration of the structural change to less energy-intensive industries together with the specific increase of the energy efficiency of appliances, processes, vehicles and buildings together result in the energy intensity effects.

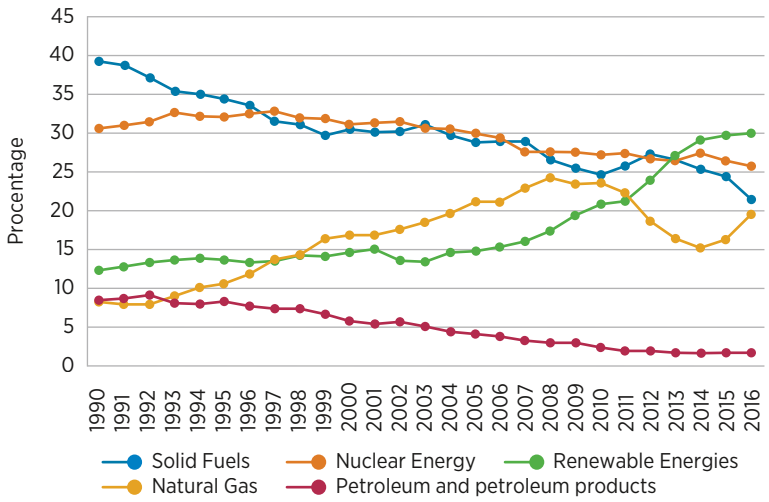

Figure 6: Development of gross electricity generation 1990-2016 in the EU-28 by energy source (in %) (European Commission 2018a)

Renewables

The share of renewable energies in primary energy consumption in the Union rose continuously between 2004 and 2016 (from 8.5% to 17%) and is thus approaching the EU's common target for 2020 of covering 20% of its energy consumption with renewable energies (cf. Eurostat 2018).

The highest share of renewable energies is used in Sweden (53.8%). It was followed by Finland (38.7%) and Latvia (37.2%). At the other end of the scale are Luxembourg (5.4%), Belgium (8.7%), Malta (6%) and the Netherlands (6%). Moreover, 18 member states have not yet achieved the expansion targets by 2020.

The graph below shows the share of renewable electricity, which on average in the EU - based on wind and sun - has outstripped the share of green electricity generation in all other energy sources.

5.2 Trends in power generation: Renewables and coal phasing out

If one compares the development to date and the status of renewable electricity generation (2018) with the EU Commission's expansion targets up to 2030, it becomes clear that a 57% share of renewable electricity in the EU is quite realistic, even if the trend continues (see Figure 7).

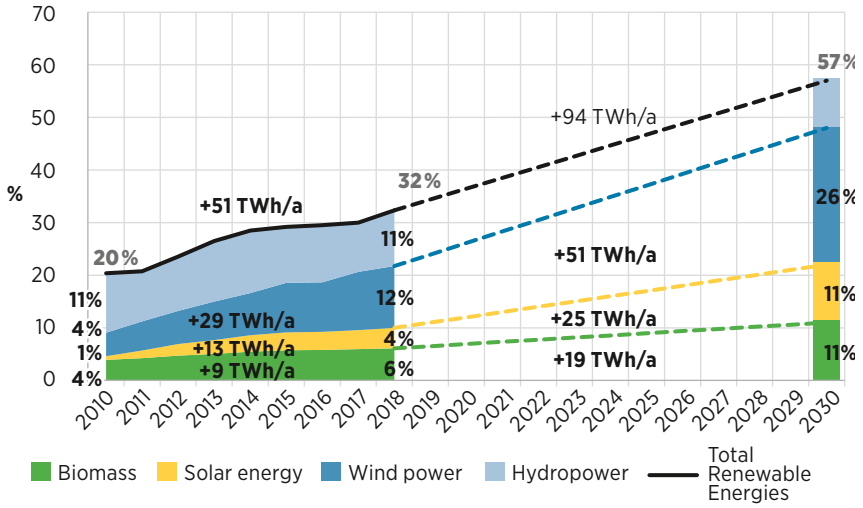

Figure 7: Share of renewable electricity generation up to 2030 according to the long-term strategy of the EU Commission (Agora/Sandberg 2019)

There are plans to phase out the capacities of European hard coal-fired power plants at ¾ by 2030, with the exception of Germany (2038), and above all, Poland. According to current plans (as of the end of 2018), the share of coal-fired power generation in Poland is to be reduced from the current 77% to only 60% by 2030. It is obvious that European support is needed for a faster exit. This also applies to other European countries (Czech Republic, Bulgaria, Romania, Greece and Slovenia), which have "excellent potential for wind and solar energy" (ibid., p. 24). In 2018, the EU Commission presented its platform for "Coal Regions in Transition" in two workshops: "Currently, 41 regions in 12 EU Member States depend significantly on revenues from coal mines and coal-fired power generation, which provide direct jobs for about 185,000 employees" (translation by the authors, (ibid., p. 25). In a concerted action between Germany and these countries, the recommendations of the German "Coal Commission" (see above) and the experience available in these countries can be evaluated for a "Just Transition" strategy and translated into national coal phase-out plans.

5.3 Is the market accelerating the exit from coal?

The increase in operating costs for coal and gas-fired power plants in 2017-2018 is of economic relevance: "Between 2017 and 2018 the price of coal rose by 15%, for gas by 30% and for CO_2 certificates by 170%" (translation by the authors, ibid., p. 31). If this increase continues, there will be a greater incentive to phase out fossil-based electricity supply earlier than previously planned. "Apart from the specific situation in Poland, the political headline of the EU climate and energy legislation for 2030 is to accelerate the withdrawal from coal in Europe" (translation of the authors, ibid., p. 39). It is also consistent with this that the short-term forecast presented by the IEA (see IEA, Renewables. Analysis and Forecast to 2023, Paris 2018) in 2018 and revised upwards, that the total renewable electricity generation capacity will increase from 566.9 GW (2017) to 754.4 GW by 2023, is submitted in 2018. The largest increase was in Germany with around 47 GW, followed by France with 28 GW and the UK with 13 GW.

In addition to the brilliant cost reduction of PV and wind, the profitability of coal-fired power is determined by the stricter regulation of air pollution and the pricing of carbon. According to Carbon Tracker (2018), 42% of current coal-fired power plants are already unprofitable today (2018) and 72% in 2040. For Europe as a whole, it is calculated that by 2018 long-term operating costs for 20% of coal-fired power plants under construction or in operation will be higher than the electricity costs from renewable energies; in 2030 this would apply 100% to all European power plants. This means that for economic reasons, the entire European coal-fired power plant park would have to be shut down by 2030.

The relevance of this analysis for the phase-out of coal in Europe is obvious. Although the figures are based on many assumptions and require further differentiation, a trend seems to be emerging: All European countries and all companies with a high share of coal-fired electricity generation should prepare a much more strategic exit from coal and explore new business opportunities before the cost ratios on the electricity markets enforce this.

6. Legal framework for European energy and climate policy

The EU institutions are empowered to act in those areas where the EU treaties explicitly allow it. The current legal framework is based on the Treaty of Lisbon (w.e.f. 01.12.2009). Article 194 of the Treaty on the Functioning of the European Union, the legal basis for the common energy policy, states that the EU is responsible for the functioning of energy markets, security of supply, promotion of energy efficiency, renewable energies and development of energy networks.

The rights of Member States regarding the exploitation of their energy resources, the choice between different energy sources, and the general structure of the energy supply (energy mix) must not be affected. However, the objective in Art. 194 "Promotion of energy efficiency and energy savings" has an indirect influence on the overall energy supply and its composition, and the objective "Development of renewable energy sources" has a direct influence on it. Therefore, the EU has two considerable levers to influence the energy mix of the Member States, provided there is a political majority.

The main goal is to convince the public of the socio-ecological benefits of the energy transition to analyse what *needs to be done* for ecological reasons, what is already *feasible* today and what may require *further development of the legal framework*.

6.1 New programme - more challenging goals

In 2015, Commission President Jean-Claude Juncker presented the idea of an Energy Union as one of ten priorities on his political agenda. The Energy Union comprises five interlinked political fields of action: Security, solidarity and trust; integration of the internal energy market; energy efficiency; climate protection (decarbonisation); and research, innovation and competitiveness.

Above all, the "Clean Energy for All Europeans" package published in 2016 aims to advance climate protection and to implement more ambitious 2030 targets (see below). The increase in the importance of the energy efficiency target should also be emphasised.

6.2 Efficiency first

The current energy efficiency framework consists of several directives which are constantly being revised. In addition to the Energy Efficiency Directive (EED), the Eco-design Directive (2009/125/EEC), the Energy Labelling Directive (2010/30/EU) and the Energy Performance of Buildings Directive (2010/31/EU) exist.

In 2014, however, it was already foreseeable that the EU would not be able to achieve its efficiency target (20%) by 2020 with the measures taken at that time. It is estimated that the actual savings in primary energy by 2020 will be only 17.6%. With its "Clean Energy for all Europeans" package, the EU Commission therefore formulated "Efficiency first" as the central principle for the first time.

However, the discussion continues on what "first" should mean in practice. Is the current strong prioritisation of the expansion of renewable energies in the EU or especially in Germany to be changed? Hardly in practice. In theory, this is more likely, based on the annual World Energy Scenarios of the Interna-

tional Energy Agency (IEA) in Paris. For the IEA, too, is increasingly advocating the "Energy Efficiency First" principle—a veritable paradigm shift for an institution that for decades served as the most important key witness for the *expansion of* fossil and nuclear power generation.

The more decisively the cost-effective efficiency potential is realised, the faster the share of renewable energies in (residual) energy consumption increases, the more energy (import) costs can be saved, the more positive (net) employment effects are possible and the fewer acceptance and environmental problems arise as a result of the necessary expansion of the renewable energy supply and networks (cf. Hennicke and Welfens 2012).

6.3 No more Nuclear First!

The *Euratom Treaty of* 25 March 1957 still represents a powerful anachronism of EU energy policy. It states as a valid EU objective to this day: "The task of the Atomic Energy Community is to contribute to raising the standard of living in the Member States and to develop relations with other countries by creating the conditions necessary for the rapid formation and development of nuclear industries" (cf. EU 2016). None of these tasks is still accepted today by a majority of European countries because reality has long since refuted the aforementioned requirement of "rapid [...] development of nuclear industries". And even in countries with nuclear energy doubts are growing as to whether nuclear industries actually "contribute to raising the standard of living" in comparison to risk-minimised alternatives. The parliamentary group of Bündnis 90/DIE GRÜNEN has, therefore, called on the Federal Government (Bundestag 2018) to finally take the coalition agreement seriously and to support *Euratom reform*.

Therefore, this should mean, among other things:

- To abolish the special status of nuclear power established by the Treaty;
- No extension of the term beyond 40 years may be granted; and
- To enforce an increase and standardisation of liability requirements.

That would be a first important step. But until the *"Nuclear First"* principle hoped for by the lobby 60 years ago can be changed into a contractually agreed *"exit" principle, there is* still a long way to go. The nuclear industry is by no means beaten and is still considered indispensable by the EU Commission. Both know that new nuclear power plants are no longer competitive with renewables and energy efficiency. Therefore, the nuclear industry is now openly demanding state subsidies. It refers to its alleged contribution to climate protection and refers to "representing nearly 800 European companies" and "supporting about 800,000 jobs" in Europe (cf. FORATOM, Sustainable Finance: Encouraging investment in low-carbon technologies, Position Paper, February 2019).

With this position paper, FORATOM complains to the EU Commission that nuclear power as a "low carbon" technology receives too little support compared to renewables. In concrete terms, one of their demands is: "Encourage the market introduction of flexible and controllable 'low-carbon' technology, like nuclear energy, as a back-up system for variable renewables [...]" (ibid., translation of the authors). In plain language: The nuclear industry demands subsidies for a field of application for which it is the least suitable technology - for flexibilisation and for uninterrupted power generation in unstable power grids!

But it gets even more dubious. A central strategy paper of the EU Commission (cf. European Commission, 2018a) formulates for the year 2050 *with clear reference to more than 80% share of renewable power generation:* "Together with a nuclear power share of approximately 15%, this will be the backbone of a carbon-free European power system" (ibid. p. 9). The position paper of FORATOM uses this unnecessary kowtow (approx. 15% nuclear power in 2050) of the EU Commission in front of the nuclear lobby to falsify the position, which almost claims the opposite: "In its 'Clean Planet for all' communication, the European Commission confirmed that *nuclear power will form the backbone* […] of a carbon-free European power system, together with renewables" (ibid. p. 1). Suddenly atomic energy becomes "the backbone" and renewables change into a secondary role! But PR tricks make nuclear energy neither more risk-free nor more economical: Compared to renewable power generation (including back-up systems), new nuclear power plants, in addition to their unacceptable risks, have no economic chance. A nuclear share of 15% in 2050 is inconceivable without new construction. However, there is a lack of acceptance and willingness to finance on the part of banks as well as a lack of investment interest on the part of economically thinking companies. It is time for the Commission to draw these facts to the attention of the nuclear lobby and concentrate all its efforts on promoting risk-minimising alternatives, efficiency and renewable energies. The termination of the Euratom Treaty is a necessary first step in this direction.

6.4 Energy Union and "Winter Package"

The Winter Package presented by the European Commission in November 2016 set the course for European energy policy in the coming decade. The 'Winter Package' can pave the way for a Europeanisation of the energy transition even if the Commission has not yet used the term 'energy transition' and the quantified objectives of the winter package are formulated in a much more cautious and nuclear-friendly way than in the German Energy Concept 2010/2011 (BMWi and BMU 2010).

The winter package comprises eight legal acts which were at different stages of the legislative process at the end of 2018. These will be briefly presented below:

- **Amendment of the Directive on the Energy Performance of Buildings (2018/844):** Following the winter package amendment, Member States must now develop long-term renovation strategies with a view to 2050.
- **Amendment of the Renewable Energies Directive (2018/2001):** The amended Directive now includes the binding EU target of a share of renewable energies of at least 32% of final energy consumption in 2030. However, this EU target, unlike the 2020 targets, has not been broken down to binding national targets.
- **Amendment of the Energy Efficiency Directive (2018/2002):** The amendment was adopted by the European Parliament and the Council at the end of 2018. It sets an indicative energy efficiency target for the year 2030 at 32.5%, with this target being reviewed in 2023 and revised upwards if necessary. The mandatory savings rate of 0.8% of annual final energy consumption for all Member States has been retained.
- **Governance Regulation (2018/1999):** The Regulation was adopted by the European Parliament and the Council at the end of 2018. It requires all Member States to develop and submit to the European Commission integrated energy and climate change plans (INEK plans) and long-term strategies. It also introduces reporting obligations and a differentiated monitoring process. The Governance Regulation is an essential step towards more effective and transparent coordination and governance of a multi-level policy system such as that of the EU.
- **Amendment of the Electricity Market Ordinance:** This has not yet been adopted by Parliament and the Council (as of January 2019). The amendment addresses the issue of capacity mechanisms or markets and sets requirements for the allocation of limited transmission capacity between the electricity grids of two or more Member States.
- **Amendment of the Electricity Market Directive:** The Directive is intended to strengthen the rights of energy consumers. This is to be achieved through greater use of smart meters, variable tariffs and price comparison

portals. Member States should also create the regulatory conditions for the establishment of Energy Communities. Consumers can join forces in these as prosumers and jointly generate energy for their own consumption or for feeding into a grid.
- **Risk Preparedness Directive:** This directive is intended to oblige Member States to take appropriate measures to increase the resilience of the electricity supply system.
- **Amendment of the ACER Directive:** This amendment is intended to give the *Agency for the Cooperation of Energy Regulators* (ACER) additional and stronger powers.

During COP 24 in November 2018, Miguel Arias Cañete, the EU Commissioner for Climate Change and Energy, presented a long-term strategy for a climate-neutral economy by 2050. The roadmap presented includes the following points:

- By 2050, the EU should reduce its greenhouse gas emissions by 80% compared to 1990 levels; through domestic emission reductions alone
- The milestones are a 40% reduction by 2030 and a 60% reduction by 2040.
- All sectors must contribute to their technological and economic potential (European Commission 2018b)

Despite the non-binding nature of this long-term proposal, it is nevertheless remarkable that the EU Commission - in direct contradiction to the US climate policy under Trump - is introducing such a long-term strategy for all member states into the debate, thus returning to its earlier intentions of assuming a global pioneering role.

The Commission formulates the long-term strategy as a strategy for a "prosperous, modern, competitive and climate-neutral economy" (European Commission 2018c). The reasons are given in the summarised result from eight scenarios. Macroeconomic cornerstones are included:

- Halving total EU energy consumption by 2050;
- Increasing the current energy-relevant investment rate (in terms of GNP) from the current 2% to 2.8%; this means additional investment per year between € 175 to 290 billion by 2050;
- Reduction of the current energy import calculation of € 266 billion by 70% by 2050. Cumulated over the entire period up to 2050, a sum of 2-3 trillion euros from energy cost savings could, therefore, be invested in ecological modernisation;
- Reduction of the current half a million premature deaths from fossil air pollution by 40% and from disease damage costs by around €200 billion per year; and
- In addition, the Commission expects to create 900,000 additional jobs.

6.5 All member countries can benefit

These pan-European advantages of an "energy transition" must be broken down to the individual Member States. Approaches to this are available, for example with regard to quantifying possible workplace effects: A 100% Renewable Scenario for the EU28, like Germany, calculates 1.56 million additional jobs, followed by Italy (907,000), France (682,000), UK (372,000) and Belgium (367,000) (Heinrich Böll Foundation et al. 2018). The following picture gives an overview:

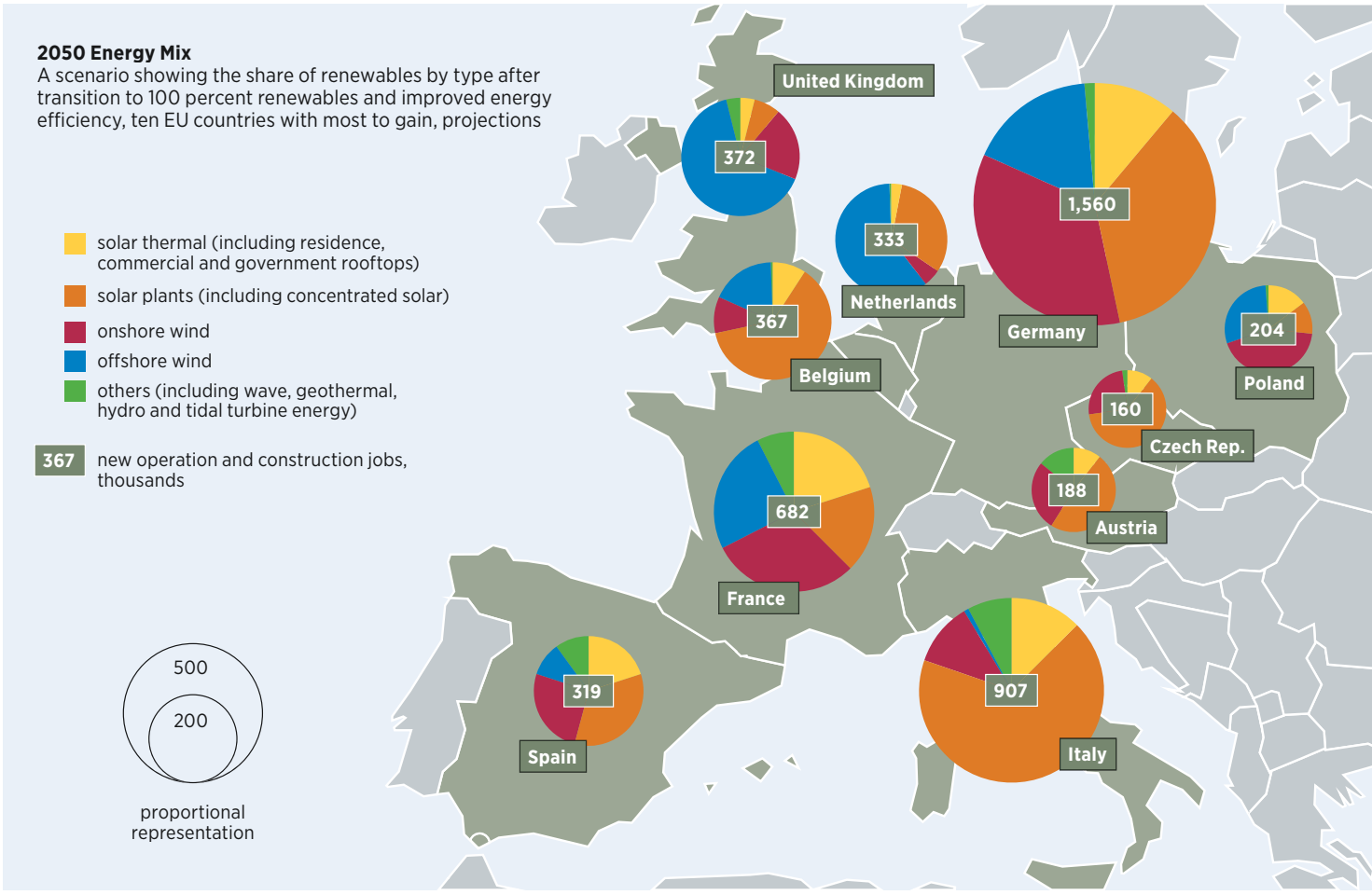

Figure 8: Energy mix 2050 (Heinrich Böll Foundation et al. 2018)

The COMBI project (Thema et al. 2018), which for the first time examines the multiple benefits of increasing energy efficiency for all European Member States in a differentiated way, was an important step in the direction of an even more comprehensive "quantification of country-specific benefits and co-benefits" through ambitious energy efficiency policy. It was assumed that in comparison to a reference path with a reduction in energy consumption of 27% by 2030, a more ambitious reduction in energy consumption of 33% would be achieved. The effects were quantified and, as far as possible, also monetarised:

- reduced emissions to health Ecosystems and Crops;
- the saving of biotic/abiotic resources such as metals and non-metals;
- on social welfare such as disposable income and health;
- macroeconomics (labour market, public budgets, GNP); and
- the energy system (networks, energy supply, security of supply)

For the EU28, about 2.3 million additional years of employment were calculated.

At the latest since the establishment of the "Coal Commission" (see above), attention has also increased for possible negative consequences of structural change. The mass protests in France ("Yellow West") triggered by the gasoline price increases have so far been the clearest signal that an energy transition and climate protection can only succeed in the sense of a "Just Transition".

The instruments of energy transition and climate protection policy must not deepen the already existing social divide in society any further. This requires much more than the consideration of a "social component": What is needed is a more balanced management and selection of instruments for the energy transition than it has been customary so far in terms of social policy.

6.6 Fighting energy poverty

Energy poverty, the inadequate supply of heat, cooling and electricity, is a growing problem in the EU. This is also documented more precisely by the EU Commission (European Commission 2018c). The Commission estimates that more than 50 million households in Europe are affected by energy poverty (see European Commission 2018d). The winter package of the EU Commission, therefore, also places a stronger focus on consumers and social aspects of energy transition. Member States are to be supported in reducing the energy costs of consumers by investing in energy efficiency. Integrated energy and climate plans should also explicitly include Member States' measures against energy poverty.

In Germany, for example, energy poverty is growing and will, unless countermeasures are taken, aggravate the already difficult social situation of poor households. It is completely unacceptable that in 2017, according to the Federal Network Agency, approximately 330,000 electricity and 40,000 gas blocks were imposed because households were unable to pay their bills. "Depending on the definition and calculation method, between 8% and 25% of consumers in Germany fall into the category of energy poverty" (ibid. p. 4). In this respect, the EU must increase the pressure on all Member States not only to collect data but above all, to implement targeted programmes and measures to reduce energy poverty.

7. Transformation strategies for a European energy transition

The implementation of a European energy transition is a complex and protracted process which must be carried out in the Member States within the framework of the EU targets and directives through a national mix of instruments with the active participation of stakeholders at regional and local level. In this respect, it is a matter of establishing a new "polycentric governance", which also means a new understanding of the principle of subsidiarity in energy policy. The following is a concise overview of core strategies and instruments, in particular for implementing the "Energy Efficiency First" principle, which is central to energy transition.

7.1 Core elements of an energy (efficiency) policy ("Policy Mix")

The litmus test for successful energy (efficiency) policy is still pending. In *no other country in the world has it been proven to date that what is necessary for climate protection reasons and what can be achieved in terms of technical and economic savings can also be achieved in reality.* With the directives mentioned above, European energy efficiency policy, more than Germany, has initiated ground-breaking decisions, but there are still considerable gaps between the calculated scenario targets and reality.

Energy efficiency policy needs to be upgraded significantly both institutionally and in terms of human resources and natural resources. Effectiveness must be increased by a *stronger focus on standards and bids for the production side.* The Eco-Design Directive points in the right direction here (cf. also the fundamentally positive assessment by the VDMA (VDMA 2015). This is because reliable and ambitious standard-setting announced in the long term has a widespread effect, is comparatively price-worthy, stimulates innovation and does not impair the competitiveness of forward-looking companies if it applies equally to all competitors, at least in the large EU internal market.

7.2 A quantitative plea for a "New Energy Efficiency Policy".

Everybody's talking about Energy Efficiency First. but nobody knows what it really is! You could put it that way. Here, the thesis is put forward the extremely challenging dimension of what an energy efficiency strategy means since climate and resource protection has not been translated into adequate governance of energy efficiency policy, neither in quantitative terms nor in quantitative terms. Halving the energy market, one of the most important submarkets of highly industrialised countries, in Germany and throughout Europe by 2050, *is an even greater challenge than replacing fossil and nuclear power generation with electricity from renewable sources!* The usual economic policy credo is "markets grow", but socially and economically acceptable *shrinking back* as an energy policy imperative is an absolutely new territory, also with regard to control and coordination. To date, there has been neither historical experience nor an adequate policy mix to achieve this goal. It is, therefore, urgent to conduct a broad social dialogue on this issue. Even convinced market propagandists can hardly claim that the "free" energy market could halve itself by 2050 without a clear and new political framework.

Zero waste store

The quantitative dimension of the "Energy Efficiency First" principle for the development of European energy consumption and for successful climate policy has been impressively illustrated by a recent study (cf. Fraunhofer ISI 2019). An official projection of the currently probable future energy consumption in 2050 ("reference case") of the EU Commission (cf. European Commission 2016) was compared with three alternative development paths:

a. Removal of Market Barriers ("Dismantling")

b. New Trends (Efficient) ("Trends +")

c. New Trends (Inefficient) ("Trends -")

The striking result of this comparison is compared strikingly in the following figure 9: The scenario "reduction" shows that - similar to Germany - also in the EU compared to a reference development by tapping currently known energy saving potentials, a total of about 50% final energy can be saved by 2050. In this methodically usual overall efficiency analysis, the researchers consider in detail the already known technical-economic energy saving potentials through efficiency techniques in all sectors (e.g. for energy-efficient buildings, vehicles, processes, devices, etc.).

Furthermore, the attempt to quantify the energy efficiency of new social trends under different socio-economic conditions and political interventions is interesting and innovative.

The study distinguishes four clusters of new social trends:

a. digitalisation (for products and processes);

b. new social and economic models (e.g. sharing economy, social disparities/energy poverty, more financing of green options);

c. industrial transformation (e.g. reindustrialisation, circular economy, industrial decarbonisation); and

d. quality of life (e.g. health effects, regionalisation, urbanisation).

These new social trends can have very different effects on energy consumption and climate protection, depending on how politics, business and civil society deal with them! In summary, this means unchecked growth, lifestyle and rebound effects that can destroy a large part of the technically achievable energy saving potential ("new trends/inefficient"). But the opposite may also be the case. With favourable framework conditions (e.g. enabling and incentives for a behavioural change), new social trends can contribute to an almost revolutionary additional energy consumption reduction of 67% ("new trends/efficient"). Rarely has the need for *forward-looking energy efficiency and sufficiency policy been* so impressively demonstrated as by this quantitative assessment. You can put it more pointedly: The real design and target-oriented implementation of the "Energy Efficiency First" principle is decisive for whether an energy transition and adequate climate protection can be achieved in Europe and elsewhere.

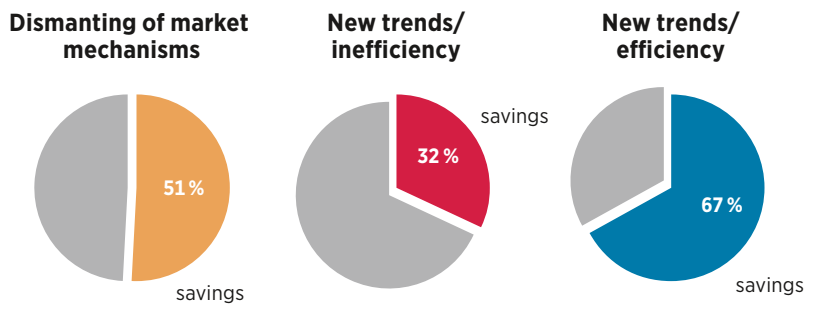

Figure 9: Saving of EU final energy in 2050 with different energy saving strategies in comparison to the reference case of the EU Commission (cf. Fraunhofer ISI 2019)

7.3 Core strategies for an energy saving policy

From a large number of studies, programmes, measures and instruments for the implementation of an energy transition policy, the following chapter selects the section relating to energy saving policy. The focus is on core strategies that have so far received too little attention but should become an indispensable component of a new energy policy mix and the governance of energy saving policy.

Bids for the production side to establish eco-routines

Large social behavioural shifts have many causes and drivers. Encouraging them through price incentives, information, communication strategies and exemplary *individual behavioural changes* ("pioneers") among consumers is not sufficient to change structures (cf. Kopatz 2018). This applies overall to the electricity, building and transport sectors, whose supply-driven infrastructures cannot be changed in a targeted manner, even by the most exemplary consumer behaviour. What is necessary, are more effective and often also more cost-effective requirements (bans and orders, minimum standards, limit values, regulation) on the production side—even if they are initially heavily attacked by the industries concerned. The new EU requirements for CO_2 limits for passenger cars are an example of how the entire European car industry, with a long announcement and conversion periods, is prompted by fleet consumption standards to produce a more climate-friendly car fleet. Intelligently set and long-term announced standards are an incentive for innovation and create reliable investment corridors.

Binding inclusion of energy suppliers in savings policy

As long as the energy suppliers hinder energy saving directly (e.g. through advertising, tariff incentives), and do not actively promote it themselves, the necessary implementation intensity and speed for achieving the energy saving targets is questionable. Article 7 of the EU's Energy Efficiency Directive (EED) explicitly allows the Member States to include distributors and suppliers of energy with binding energy saving targets in their energy saving policy (so-called "Energy Efficiency Obligation Schemes"; cf. European Commission 2017). In Europe (in contrast to 24 states in the USA), this is only used in 14 countries and mostly to a modest extent, but it has been quite successful, like in Denmark, France and Italy. Germany has some catching up to do. As intelligent and necessary as binding incentives for energy-saving programmes may be, in Germany, the lobby immediately swings the ideological club of dirigisme and—due to German history—of central administration. This ignores the fact that a cost recovery mechanism and incentive regulation (guaranteed yield for the programme costs of successful energy saving programmes of energy supply companies) can ensure that energy suppliers can also benefit from the implementation of such programmes by their customers.

Strengthening polycentric governance in efficiency policies

The framework set by EU-wide and respective national policies must be supported by regional/local energy agencies, business networks, consumer advice, forms of citizen participation and citizen financing (e.g. local sustainability funds in conjunction with savings banks). *Regional economic and social councils* could play an important role in this. The energetic refurbishment of existing buildings in the cities and municipalities of all EU Member States requires, in addition to a national funding programme (see below), *responsible regional/municipal centres* ("building agencies") that control the process and mobilise public participation.

The EU should also encourage and support nation states to set up *national energy efficiency agencies* to which parliaments delegate process responsible for the design, governance, coordination, promotion and evaluation of energy efficiency policies. These agencies need adequate staffing and, as far as possible, their own resources for incentives and programmes (cf. Wuppertal Institute 2013).

National Future Programs Energy Efficient Building Modernization

It is undisputed that the implementation of an almost CO_2-free building stock by 2050 and the necessary increase in the annual energy-related building refurbishment rate (at least a doubling) requires not only considerable additional private investment but also an extensive and reliable public funding programme over the long term. Although the German KfW programme (cf. KfW 2018) is regarded as exemplary worldwide, the amount of funding—currently EUR 2 billion per year—is not sufficient. At this point, it must be pointed out that the evaluation of the KfW programmes identified an enormous leverage effect and a high self-financing rate (almost budget neutral). This means that the budget funds to finance the programmes have triggered private investments with a leverage effect of more than 10 times, which through multiplier effects (e.g. more orders, more profits, more wages) have also led to higher tax revenues and considerable employment effects (cf. Prognos 2013).

Massive start-up financing must be combined with clearly defined objectives and conditions, because the energy-efficient refurbishment of existing buildings in rented housing, which is necessary for terms of climate policy, is not used as a pretext for inappropriate rent increases, luxury refurbishment, the expulsion of old tenants, and gentrification of neighbourhoods. The ideal way would be to promote only "warm-rent neutral" renovations (i.e., the increase in the cold rent through the allocation of energy-relevant renovation investments must not exceed the resulting reduction in energy cost). However, it is controversial under which conditions and to what extent warm rent neutrality can generally be achieved.

CO_2 tax

A cross-sectoral core element of climate protection policy is that the exorbitant damage caused by CO_2 emissions is taken into account as far as possible, through a CO_2 tax or an emissions trading system, in the operational cost accounting of the polluters. The Federal Environment Agency (UBA 2019) estimates the externalised environmental costs from the combustion of fossil fuels in the transport, electricity and heating sectors to be around €130 billion per year between 2006 and 2014. Electricity from lignite would, therefore, have to cost an additional 10.75 cents/kWh, and electricity from hard coal an additional 8.94 cents/kWh if the external environmental costs caused by this were considered.

According to the World Bank report, there were 47 CO_2 pricing initiatives worldwide in 2017, including 24 emissions trading systems and 23 national CO_2 taxes (The World Bank et al. 2017). In Europe alone, there are 15 countries (including Switzerland) that have introduced a CO_2 tax in addition to the European Emissions Trading Scheme (EU-ETS). Many efforts to achieve appropriate CO_2 pricing within the framework of the EU ETS and in the non-ETS area have so far failed due to resistance from German governments and various interest groups. This is a position that can no longer be sustained for long.

The various attempts to reform the ETS and to introduce a general CO_2 tax cannot be presented here. It seems important that, in general, CO_2 prices in Europe should be as uniform as possible for all fossil energies in all sectors (including non-ETS) and that socially undesirable negative effects, such as in Switzerland, should be compensated for by revenue.

The *cornerstones of a CO_2* price reform presented by two representatives of institutes with different research orientations (Potsdam Institute for Climate Impact Research (PIK) and the Rheinisch Westfälisches Institut für Wirtschaftsforschung (RWI)) (Edenhofer and Schmidt 2018b) may also have a majority in the Federal Government. The authors demand a minimum price in the EU ETS of initially 20€/t CO_2 which should rise to 35€/t CO_2 by 2030. The aim is a European country alliance (a "coalition of the willing"; see also the Macron proposal below), which is also prepared to offset any difference from the agreed minimum price through an additional flexible national CO_2 tax. In addition, a corresponding "CO_2 signal" is to be introduced in the non-ETS sectors (transport, heat) by Germany, France and other EU states reforming their energy taxes in the direction of a uniform CO_2 price. This could then reduce the electricity tax to a minimum, which in any case creates the wrong incentives by taxing electricity from renewable energies, as well as electricity from coal or gas. With a uniform CO_2 price of 20€/t CO_2, for example, there would be a surcharge on the previous tax of 4.6 cents/l petrol for petrol and 5.2 cents/l diesel for diesel. The proposal is also interesting because, for the first time, the distributional effects are also to be taken into account in "shaping structural change". However, the proposal remains vague here, in that "a lump sum per capita transfer to redistribute the additional tax revenue to the population is (should be) considered" (ibid. p. 6). In addition, "it should be explored how regional structural change can be cushioned and new prospects for economic prosperity opened up without repeating the mistakes of the past" (ibid. p. 6).

7.4 Making the most of the EU's energy and climate policy framework

In addition to these elements of a policy mix, which can mostly be implemented at national level, it is also important to make extensive use of the existing EU legal framework. The focus is on four strategies (cf. also National Academy of Sciences Leopoldina et al. 2018):

Effectively implement governance regulation

Member States are encouraged to effectively *implement* the Integrated National Energy and Climate Plans (iNEK plans). In order to do this effectively, the contents of the iNEK plans should be incorporated into national legislation. In order to consolidate the Commission's vague requirement for public participation in the preparation of the iNEK plans, the Member States should make participation possibilities binding. Within the framework of the Federal Climate Protection Act, guidelines should, therefore, be laid down for the participation of citizens. To mobilise active stakeholder participation at a state level, for example, *scenario-based stakeholder dialogues* with scientific support, such as the preparation of the climate protection plan/law in NRW, have proven their worth (cf. Schepelmann 2018).

Sanction non-compliance with the Governance Regulation

Although sanctioning measures are not foreseen in the Governance Regulation, non-compliance could lead to possible sanctions through a link with the Structural Funds. This would allow the European Union to apply sanctions that go beyond the government regulation and make them more binding. To this end, financial support from the Structural Funds would have to be linked to the achievement of the climate protection targets or compliance with the Commission's recommendations if the Member States fail to achieve them. In addition, it would be possible, for example, to grant environmental associations the right to take legal action under the Aarhus Convention.

Accompanying the governance regulation with pioneering alliances
The Governance Regulation should be flanked by pioneering alliances between the EU Member States willing to cooperate ("Alliance of the willing") and third countries, where appropriate. Alliances for CO_2 pricing and a coal phase-out are conceivable, for example. In the case of a CO_2 price alliance, a minimum CO_2 price for all sectors within the alliance states would be agreed which would be higher than the ETS price. Coordination with the European Emissions Trading System (EU ETS) is necessary to prevent a waterbed effect—emissions that are saved at one point are additionally added at another. This could be done by deleting certificates.

Extended mandate for existing EU funds
The *Social-Ecological Transformation Fund of the Energy Transition* should become a key element for the promotion of social-ecological transformation and for the start-up financing of new fields of business and innovation. One possibility would be to combine the objectives of climate protection and structural policy and thus also use funds from the European Structural and Investment Fund (ESI). The new version of the European Regional Development Fund (ERDF) also provides support for regions affected by structural change. The ESI Fund can also be used to promote cross-regional funding. By linking these funds, joint energy and climate protection projects could be supported (Deutscher Naturschutzring (DNR) 2019), as called for by the Committee on Regional Development of the European Parliament.

Cooperation with national funds
What is needed is close cooperation with national transformation funds such as those proposed by the German Advisory Council on Global Change (WBGU 2018). WBGU calls for the establishment of "Sovereign Wealth Funds for *Timely* Structural Change on Climate Compatibility": "The Transformation Funds should accelerate the implementation of climate and sustainability goals through investments and participation in key industries and use the profits achieved for the early and anticipatory shaping of time-consistent processes of structural change" (ibid. p. 4). WBGU's financing proposal is also innovative: "The volume of the transaction fund should be built up by GHG pricing, supplemented by income from a reformed inheritance or estate tax" (ibid. p. 4). The WBGU continues to advocate "the establishment of a transaction fund as jointly as possible at EU level, possibly initially only in a small group of EU countries" (ibid. p. 36). As early as 2017, the European Parliament had also pleaded for the establishment of a just-transition fund from the auctioning proceeds of emission certificates "with the aim of cushioning the effects of decarbonisation on the labour market" (cf. ibid. p. 36; European Parliament 2017). In the summary of the parliamentary proposal of 2017, it says: "A modernisation fund will help to upgrade energy systems in the lower-income Member States, and an innovation fund will provide financial support for renewable energy, carbon capture, and storage and low-carbon innovation projects. MEPs also propose a "just transition fund", pooling auction revenues to promote skill formation and reallocation of labour affected by the transition of jobs in a decarbonising economy" (ibid.).

8. Franco-German alliance as a driver of a European energy transition?

The neighbouring countries Germany and France are the European countries with the largest primary energy consumption, followed by Italy when Great Britain leaves (EEA 2018). In 2016, the combined Franco-German energy share was just over a third of the EU's total. Is this share and the portfolio of energy policy commonalities sufficient as a "critical mass" to establish a Franco-German Energy Transition Alliance? Sure, it's not, but it's worth a try[5].

In his speech "Initiative for Europe" at the Sorbonne in September 2017, President Macron also mentions *"Europe as a pioneer of effective and balanced environmental change"* (Macron 2017)[6] and calls for the introduction of a fair minimum CO_2 price within Europe—sufficiently high to cover the costs of change (Macron 2017 p. 7) and e.g. to provide aid to regions affected by structural change. For such a change, a European energy market is necessary, as is the will and the promotion of a connection of the electricity transmission grids in order to let renewable energies benefit the whole of Europe and also French nuclear energy. A medium-term solution to the *nuclear energy question* is, therefore, the litmus test for the feasibility of a Franco-German Energy Transition Alliance.

8.1 The nuclear energy question: a resolvable point of contention

In 2015, France adopted an energy transition law which contained a CO_2 reduction target for 2050 of 75% (based on 1990), a reduction of the share of nuclear power to 50% by 2025, a share of renewable energy of 32% by 2030, and a reduction in final energy consumption of 50% by 2050. In November 2018, President Macron corrected an essential aspect of this programme: the share of nuclear power is to fall to 50% in 2035, and not in 2025. The Fessenheim nuclear power plant is to be decommissioned in 2022 and another 14 of the oldest nuclear power plants by 2035. However, there is no talk of a nuclear phase-out. EDF is even to present plans for a possible new building by 2021. This has a long tradition: French governments have maneuvered the country into a *fatal path dependency on nuclear energy with their* forced expansion of nuclear energy, which was also militarily motivated.

There are also alternatives. Analyses show how France, despite this dilemma of strong nuclear path dependence through forced energy saving, behavioural change (sufficiency) and massive expansion of renewable energies, can combine forced climate protection by 2050 with complete decarbonisation and the phase-out of nuclear energy by 2035. The "négaWatt scenario" (cf. Association négaWatt 2017) calculates for a sustainable energy future for France by 2050 the results of halving final energy consumption, increasing the expansion of onshore and offshore wind energy to 67 GW and also increasing PV capacity to 140 GW. France's CO_2 emissions would then be almost zero, the rest being absorbed by biogenic carbon sinks. Despite the almost doubling of the necessary investments for the energy transition compared to a "Business-as-usual" path, the négaWatt scenario is also economically more advantageous due to the savings in energy costs and would create about 500,000 additional jobs by 2050 through employment-intensive branches of the energy transition. It is interesting to note that not only the effects of a sufficiency policy are analysed and quantified, but also in the sense of a "circular economy", the decoupling of resource consumption: "The growth of repairing, recycling and reusing activities can halve raw material needs, even if the development of renewables that will need some resources is taken into account" (Association négaWatt 2017 p. 3). A coordinated French and German energy transition could, with a global signal effect, prove that the joint nuclear and coal phase-out is socially and economically feasible.

5 The background of the Gilets Jaunes ("Yellow West") movement and its demands cannot be discussed here; cf. on the concrete development of energy and climate policy under Macron also Hennicke et al. (2019).y.

6 It refers to studies which can only prove the control efficiency of a CO_2 price from a price between 25 and 30 € per ton of CO_2.

8.2 Aachen Treaty on Franco-German Cooperation

With the Treaty of Aachen signed in January 2019 (cf. Federal Government of Germany 2019), the governments of Germany and France intend to raise relations between the two states to a new level.

In two articles, the Treaty of Aachen makes statements on energy and climate policy, but it avoids controversial issues and remains comparatively general. In Article 18, the Parties undertake to take climate protection into account in all policy areas and to conduct regular government consultations on the subject. Article 19 contains the Memorandum of Understanding to "strengthen the institutional framework for financing, preparing and implementing joint projects, in particular in the fields of infrastructure, renewable energy and energy efficiency". Whether it is possible to find a common position on the minimum CO_2 price demanded by Macron or on the role of nuclear power in the future European energy mix depends on the political will, but also on the pressure of civil society in both countries. There is hope that both countries can build on a long tradition of cooperation.

9. European outlook

So, can a Franco-German alliance become the driving force behind the Europeanisation of energy transition? In order to be able to answer the question with "yes", France would have to go further in the direction of risk minimisation (gradual phasing out of nuclear energy), and Germany in the direction of decarbonisation (gradual phasing out of coal). Why not engage in a result-oriented "energy transition" dialogue in both countries within the framework of long-term Franco-German cooperation on "Just Transition"?

To be successful, such a dialogue has many prerequisites: Continuity and scientific foundation is needed (like the study programmes of German commissions of inquiry), scientific policy advice should be independent, but policy-oriented, and mutual, respectful learning from one another, instead of a teaching certificate, is a basic prerequisite. Since 2016, the German-Japanese Energy Transition Council has had good experience in this area (see GJETC 2018).

It is important to build up the cooperation activities also envisaged within the framework of the Aachen Treaty on the basis of transparent stakeholder dialogues and public hearings. At least representatives of industry, trade unions and environmental organisations must be involved.

As shown above, the Federation of German Industries (BDI) also sees the economic opportunities of climate protection and energy transition as positive for Germany today. The BDI now also recognises that these opportunities could be better exploited not *against* Europe, but within the framework of a more integrated Europe without the dominance of German economic interests, and for the benefit of all Member States (forsa et al. 2019).

A Franco-German innovation alliance involving "green" industries and accelerating climate protection and energy transition in both countries would contribute to making the concrete utopia of Europeanizing energy transition a reality.

10. Epilogue: Transatlantic Dream

The European energy transition must also be seen in a global context; it can be slowed down and spurred on by developments in other metropolitan areas. A final glance at the USA may help one to grasp. This view is often clouded today because a political will-o'-the-wisp, like President Donald J. Trump, attracts a lot of media attention and gives the wrong impression that the U.S. is a nation full of ignoramuses and of climate change deniers. Far from it!

The "other America" has always existed and has moved in many states (e.g. California), in thousands of cities, in numerous corporate alliances and in civil society *against and because of Trump* in a more ambitious direction of climate and resource protection.

In the U.S., for example, a movement is establishing under the keyword "Green New Deal". It has received great media attention through a "resolution" tabled by Alexandria Ocasio-Cortez, the new representative in the House of Representatives, at the beginning of February 2019. Democratic Senator Ed Markey and other leading Democrats support the resolution. "81% of Americans are taken with the idea" (Frankfurter Rundschau, 12.2.2019). The resolution is not yet based on a sophisticated and calculated programme and is more of a "manifesto".

With its call for ambitious climate protection, the manifesto refers to the IPCC Special Report on the 1.5 centigrade target of October 2018 (IPCC 2018). At the same time, it claims for the proposed Green New Deal that it "represents a new national, social, industrial and economic mobilisation on a scale not seen since World War II and the New Deal era. This offers a "historic opportunity" to create millions of well-paid jobs, bring unprecedented prosperity and economic security, and counter systemic injustices (cf. ibid., p.4).

With "systemic", the resolution refers to the disproportionate impact of climate change, air pollution and environmental degradation on "...native people, black neighbourhoods, migrant communities, deindustrialised regions, depopulated rural communities, the poor, the low-income workers, women, the elderly, the homeless, the disabled and the youth" (ibid., p. 4).

The resolution, thus, combines the social and ecological issues in a rigorousness that has not been seen in any official government paper at EU level or in any Member State in Europe to date. President Donald J. Trump tried to nip this frontal attack on his politics in the bud with mockery and derision. And the unrealistic demand of the resolution for a CO_2-free American electricity generation within 10 years (!) uses political and media demagogues in the USA to disavow the seriousness and political power of the "manifesto". But the enormous public response to the resolution shows that the MEP has hit a political nerve in a torn and post-democratised country. No one expects that such a program will find fast majorities in the United States. But *the content and the movement* triggered by the resolution is also an important signal for Europe: not only "green" European and American industries, but a broad-based socio-ecological movement could accelerate the future project "Energy Transition" and, thus, also give a new, truly sustainable content to a European-Atlantic partnership. Dreams are possible – aren't they?

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