



POSITION // MAI 2018

Coal-fired power generation and climate protection until 2030

Discussion contribution of the German Environment Agency for achieving the climate targets in Germany

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12 propositions and recommendations for action in brief

1. More ambitious climate protection targets, especially reducing greenhouse gas emissions by 95 percent compared with their 1990 level by 2050 should be made binding, and a continuous process of transformation guaranteed.
2. The climate protection measures agreed in Germany to date are insufficient for the achievement of the targets set by the German Federal Government. In this respect, additional measures are necessary which should be secured with the enactment of a Climate Act.
3. The energy sector must reduce its greenhouse gas emissions faster and more strongly than other sectors. To this end, additional climate policy instruments are necessary.
4. In the energy sector, a limit to the power generated by old coal-fired power plants can enable relevant reductions in greenhouse gas emissions already by 2020.
5. The gradual closure of the oldest coal-fired power plants will ensure a manageable structural change and relevant reductions in greenhouse gas emissions.
6. By combining limitations to full-load hours with the closures, between 2020 and 2030, the reductions in emissions required by the energy sector will be achieved on a cost-effective and secure basis.
7. The targeted reduction in coal-fired power generation will be compensated for by a reduction in the supply of emissions allowances in the European Emissions Trading System.
8. Investments in new coal-fired power plants and the development or expansion of opencast mines is not considered acceptable from the perspectives of climate policy or the economy.
9. A well-regulated phase out of coal power will limit the challenges faced by the regional economy in the lignite mining regions.
10. The German Federal Government and the federal states should strengthen the regional economy in the lignite mining regions and provide them with structural support.
11. The managed phase out of coal power must be accompanied by a strengthened increase in the use of renewable sources of energy.
12. The managed phase out of coal power avoids environmental costs to the value of several billion Euros.

To achieve a disproportionately high reduction in greenhouse gas emissions by the energy sector as a contribution to achieving the climate protection targets by 2020, the UBA recommends the following mix of climate policy instruments:

Limit to coal-fired power generation

Limiting coal-fired power generation to 4,000 full-load hours per year for hard coal and lignite power plants that are at least 20 years old.

The legislated closure of lignite power plants

The additional closure of at least 5 GW of the oldest/most inefficient lignite power plants in addition to the currently planned closures.

The legislated ensuring of the planned closures

Legislated support to ensure that the planned closures actually take place.

To ensure that the energy sector comfortably achieves its targeted reduction in greenhouse gas emissions by 2030, the UBA recommends the following mix of climate policy instruments:

The legislated closure of hard coal and lignite power plants

The additional closure of the oldest/most inefficient lignite and hard coal power plants following the Nuclear Power Phase-Out in 2022 – reduction to a maximum remaining output of 19 GW.

Limit to coal-fired power generation

Limiting coal-fired power generation to 4,000 full-load hours per year for hard coal and lignite power plants that are at least 20 years old.

Why this position paper?

The climate protection measures agreed and implemented in Germany to date are both insufficient for the achievement of the national climate protection targets and fail to fulfil international obligations. Climate protection must now prepare the way for a society that is greenhouse-gas-neutral in the future. This should be achieved in Germany by 2050.

An important starting place for effective climate protection is a strong reduction in the use of fossil fuels, especially coal, which poses a particular threat to the climate. With this position paper, the UBA proposes strategic measures and targeted climate policy instruments for achieving a reduction in coal-fired power generation for the period up until 2030. These are to be understood as a contribution to the further discussion on achieving the targets for 2020 and 2030. The key focus of the propositions is on the measures and instruments for the energy sector.

In the form of an overall economic objective, the German Federal Government has decided to reduce greenhouse gas emissions by 55% compared with their 1990 level by 2030, which is underpinned by targets for individual sectors (see Climate Action Plan 2050). For the energy sector, the sector target of 61-62% is a disproportionately high reduction. That means that there are felt to be bigger possibilities for reduction here than in other sectors. In 2018, the Climate Action Plan 2050 envisages assessing both the sector targets and agreeing to a plan of measures which aims to ensure that the targets for reducing greenhouse gas emissions are achieved by 2030.

To ensure the energy sector achieves its climate protection targets, a strong reduction in coal-fired power generation will be necessary. In this respect, the “phase out of coal power” describes the path to ensuring long-term energy supplies without coal. Just as the SRU1, we assume that coal-fired power generation needs to be reduced considerably more strongly than previously agreed. This will not be achieved without a structural change in the affected regions and branches of industry. The planned commission for “growth, structural change and regional development” should, as regards lignite “...develop a mix of instruments targeting economic development, structural change, social compatibility and climate action.” (BMUB 2016). Our propositions also provide a contribution to the question of how the German federal government, the federal states and the regions can actively shape such a structural change.

In addition to climate protection, conserving natural resources is a further key area of action in the area of environmental policy. In this respect, the German resource efficiency programme “ProgRes” was agreed in 2012 and updated in 2016. (BMUB 2012) This specifies a strategy for both resource efficiency along the entire value added chain as well as an absolute reduction in the use of raw materials. In the year 2010, almost 30% of the use of raw materials per capita was caused by the use of fossil fuels. The reduced use of fossil fuels also means the objectives surrounding the conservation of resources are achieved and that sustainable developments are enabled. In the foreseeable future, avoiding fossil fuels will be imperative from the perspective of both climate protection as well as the use of resources. In the current study project “A resource efficient pathway towards a greenhouse gas neutral Germany” (UBA 2017a), the UBA sets out a scenario with a collaborative and systemic overview of the protection of the climate and resources.

¹ On 02.10.2017, the German Advisory Council on the Environment (SRU) published a report calling for a complete phase out of coal power within 20 years. (SRU 2017)¹

1 More ambitious climate protection targets, especially reducing greenhouse gas emissions by 95 percent compared with their 1990 level by 2050 should be made binding, and a continuous process of transformation should be guaranteed.

The resolutions of the Paris Climate Conference at the end of 2015 sent a clear signal to society and the global economy: the future has to be low carbon and climate-resilient. That means that the upper limit of 2 degrees must be comfortably met, and if at all possible, 1.5°C should be achieved.

The UBA believes it is necessary for the German Federal Government to determine a more ambitious target – to reduce greenhouse gas emissions by 95 percent compared with their 1990 level by 2050 – so as to provide all of the social and economic stakeholders with long term planning and decision-making confidence for this ground breaking transition to a climate-neutral national economy. (UBA 2016a) A stipulation of this kind would also constitute an important signal towards European and international partners of the willingness of a wealthy industrial country like Germany to now take the necessary and ambitious steps forward in the spirit of the new Climate Change Agreement, and to thereby decisively counteract nascent efforts to ditch the resolutions reached in Paris on the part of individual nations. On this basis, a binding framework would also be created for all of the plans, programmes and measures that are to be determined and implemented over the coming years in every area.

To strengthen the confidence in German climate policy and to make it independent from everyday political business, from the perspective of the UBA, this binding and therefore predictable macroeconomic framework of orientation is necessary for the time frame of today until 2050. The overall target of reducing greenhouse gas emissions by 95% compared with their 1990 level by 2050 should therefore be anchored in the form of a suitable legal form. In addition to this, the phase out of coal power and the reduction contributions of the energy sector should also be legally specified. On this basis, the German federal government can establish and continue its long-term climate action plans. (refer to proposition 2 and 3)

The intermediate targets of a 55% reduction by 2030 and a 70% reduction by 2040 outlined in the energy concept of the German Federal Government **are minimum targets** which should not be fallen short of under any circumstances and should also be verified in terms of the 95% target. The intermediate targets should also ensure that the 95% reduction is achievable by 2050. A 95% reduction by 2050 requires ambitious interim targets for 2030 and 2040. They serve as guidelines for the economic development and should take path dependencies during the transformation of the energy system into account.

As aligned with the Climate Action Plan and – from our perspective – the minimum requirements regarding the reduction in greenhouse gas emissions, over the short term, major challenges will arise in and beyond every area of application, particularly the energy sector, which must make a disproportionately high contribution to the reduction efforts by 2030. The new UBA study project

“A resource efficient pathway towards a greenhouse gas neutral Germany” (UBA 2017a) highlights how ambitious long term climate protection targets can be both achieved and shaped in order to save resources.²

² The savings in greenhouse gases and raw materials due to the phase out of fossil fuels are accompanied by the increased use of raw materials required for the development of the renewable energy system. In the “GreenEe” scenario presented, greenhouse gases are successfully reduced by 95% compared with their 1990 level by 2050 and the use of primary raw materials is reduced by 60% compared with their 2010 value by the year 2050.

2 The climate protection measures agreed in Germany to date are insufficient for the achievement of the targets set by the German Federal Government. In this respect, additional measures are necessary which should be secured with a Climate Act.

Every two years, the German federal government publishes a Projection Report which presents the scenarios for the future development of greenhouse gas emissions in Germany by 2035. In the current Projection Report dating from 2017, a “with further measures scenario” (WFMS) was examined. While the WMS (“with measures scenario”) contains all of the measures that have been implemented by 31st July 2016, the WFMS also takes measures into account which have already been decided but have not yet been implemented. As a general rule, that means the measures of The German Government’s Climate Action Programme 2020 and – as a component of this – the National Action Plan on Energy Efficiency. (BReg 2017)

The scenarios clearly demonstrate that German Federal Government will fail to reach its climate protection targets, even with the measures that have now been decided. By the year 2020, a maximum reduction of 35.5% rather than 40% compared with 1990 is expected to be attained, and by 2030, a reduction of just 45.4% rather than 55%. It is therefore necessary for additional measures to be decided, implemented and become effective if the climate protection targets are to be achieved.

In the last three years, greenhouse gas emissions have not fallen in Germany. In 2015, they amounted to 902 million tonnes of CO₂ equivalents, in 2014 they totalled 904 million tonnes of CO₂ equivalents. According to the current estimates, it is assumed that in 2016, the greenhouse gas emissions will not fall, but increase slightly to 906 million tonnes of CO₂ equivalents. (UBA 2017b) To achieve a reduction of 40% by 2020, it would be necessary to reduce greenhouse gas emissions to 750 million tonnes of CO₂ equivalents within three years. This is more than has been achieved in the last 15 years. The question of whether the target can be realised also depends strongly on the framework conditions, such as population growth, the development of the economy and the prices of CO₂. Both the development of the economy and the population figures are currently above the values in the Projection Report, which is likely to result in higher greenhouse gas emissions. (Agora 2017a) Accordingly, achieving the climate target for 2020 represents a major challenge and can only be achieved with very ambitious additional measures.

It therefore follows that the 2030 target of the Climate Action Plan should be underpinned by appropriate measures and that the targets must be achieved with the appropriate climate policy instruments. As is already the case for the achievement of the 2020 target, the annual Climate Action Report should be extended to include the measures up to 2030, and deliver an in-depth monitoring of the effectiveness. In this way, adjustments can be made in good time as required. Past experience has shown that it is only possible to make very rough forecasts surrounding the reduction. It is therefore necessary to continuously monitor and adjust the development of the framework parameters in particular and to allow for an appropriate buffer.

In this respect, we are of the view that a binding framework should be set for the alignment of the long-term climate protection. The UBA is therefore in favour of the enactment of a Climate Act. This should include binding guidelines for climate protection to

reduce greenhouse gas emissions in Germany by 95% compared with their 1990 level by 2050, offer planning security and orientation to every stakeholder, and set out the responsibilities. The heterogeneous German climate protection legislation could also be unified and harmonised instead of being dispersed across several individual laws. (UBA 2016a) This would also simplify the further development, as well as the discovery, application and completion of the measures. If it were clear that targets could not be achieved, effective countermeasures could then be taken.

3 The energy sector must reduce its greenhouse gas emissions faster and more strongly than other sectors. To this end, additional climate policy instruments are necessary.

Some 90% of greenhouse gas emissions in the energy sector are due to public power generation by fossil and non-fossil power plants. At the same time, the energy sector is the sector with the greatest technical and economic potential for reduction. (UBA 2016b) A Climate Act (see proposition 2) should therefore determine that from 2020 onwards, the overall path of economic development is to be achieved on the basis of disproportionately high reduction contributions by the energy sector and power generation in particular, as shown in the UBA study project on “A resource efficient pathway towards a greenhouse gas neutral Germany”. (UBA 2017a)

For the achievement of the 2020 targets, the biggest and most cost-effective potentials are also to be found in the energy sector. On a short-term basis, these can be achieved in power plants that use fossil fuels. In view of the year 2020, the UBA recommends that **the energy sector - and power generation with fossil fuels - makes a disproportionately high contribution to the climate protection target by 2020**, i.e., by that time, reduces its greenhouse gas emissions by more than 40% compared with 1990. So far, the reality has diverged strongly from the necessary path towards reduction. By the year 2015, the energy sector had reduced its greenhouse gas emissions by less than 26% compared with 1990. At the moment, with some 346 million tonnes of CO₂ equivalents, the energy sector accounts for the biggest share of overall emissions in Germany. (UBA 2017c) **In the area of power generation, over 80% of all greenhouse gases come from coal-fired power plants.**³ (BReg 2017)

According to the current calculations in the 2017 Projection Report, greenhouse gas emissions in the energy sector will fall by 38.6% compared with their 1990 level by 2020, and by 48.4% by 2030. In this respect, the measures from The German Government’s Climate Action Programme 2020 and the National Action Plan on Energy Efficiency have already been taken into account, even if some of them remain to be implemented (WFMS). **The measures and climate policy instruments that are currently decided are not sufficiently effective.** With the currently decided climate policy instruments, there is no way that a proportionate reduction by the energy sector by 2020, and a disproportionately high reduction by 2030 in particular, will be achievable. **On this basis, it will not be possible to achieve the climate protection targets by either 2020 or 2030.**

Therefore, additional climate policy instruments need to be introduced in the energy sector, or the existing instruments must be further developed effectively. These instruments must reduce coal-fired power generation significantly by 2020. To achieve the climate protection target of the German Federal Government in 2030, greenhouse gas emissions from coal-fired power plants must be reduced by at least 60%. (Öko-Institut 2017a) To achieve a reduction beyond the climate protection targets set by the German Federal Government (see proposition 1), which we consider the bare minimum, greenhouse gas emissions from coal-fired power plants must fall even more strongly.

³ The energy sector, as defined in The German Government’s Climate Action Programme 2020 and the Climate Action Plan 2050, encompasses overall emissions from public power generation and heat generation as well as fugitive emissions and emissions from natural gas compressors. Industrial power generation is assigned to the industry sector.

4 A limit to the power generated by old coal-fired power plants can enable relevant reductions in greenhouse gas emissions already by 2020.

By limiting power generation to an electricity budget of 4,000 full-load hours⁴ per year for hard coal and lignite power plants that are more than 20 years old, the greenhouse gas emissions from the energy sector can be reduced on a proportionate basis, i.e. by 40% compared with their 1990 value, by 2020⁵. With such an age limit, it is possible to address old and particularly inefficient power plants.

Lignite power plants currently operate in the range of 7,000 h/year, while hard coal power plants operate in the range of 4,000 h/year. The FLH limit therefore means that the emissions-intensive power generation using lignite is reduced in particular. By limiting both types of plant to 4,000 h/year, there is almost no impact on hard coal-fired power generation with, which means the climate policy instrument only has a very limited effect on the economic efficiency of hard coal power plants. However, it is possible to prevent some of the reductions in emissions to have been achieved in Germany from being lost due to increased power generation by hard coal power plants.

In addition to electricity, heat can also be generated in hard coal and lignite power plants through combined heat and power generation (CHP). The FLH limit means power generation by hard coal power plants is not limited or only limited to a low degree. For lignite, two thirds of the generation of heat takes place in small scale facilities which can be operated for less than 4,000 full-load hours per year as per power generation. In the case of large scale lignite power plants, heat generation only accounts for a minor share of the overall energy output from the appropriate plant (Öko-Institut 2017b); the current rates of heat generation can therefore be maintained with the lower full-load hours.

Germany currently runs a surplus in electrical power exports of more than 53 TWh. This means that although power generation from renewable energy sources almost doubled between 2010 and 2015, the greenhouse gas emissions by the energy sector only fell by 6% in the same period. (AGEB 2017, UBA 2017c) In times of high volume feed-ins of renewable energy it has become clear that lignite and hard coal power plants respond relatively inflexibly. (Fraunhofer ISE 2013) An FLH limit would be particularly effective at reducing power generation with lignite in the case of low electricity prices, i.e. if a high volume of renewable electricity is generated. Lignite power plants are thereby forced into a flexibility contribution so as to adapt to the fluctuations in the sources of renewable energy and electricity prices. This is technically feasible because old coal fired power plants can also be operated more flexibly without changes or only with minor adaptations. (Agora 2017b) Businesses are therefore able to continue generating contribution margins with lignite power plants. This means that large scale closures should not be expected. It also means a chain of closures or a “domino effect” should not be expected. (Öko-Institut 2017b)

⁴ The amount of electricity (e.g. in MWh) which a power plant generates per year in proportion to the installed electrical output (e.g. in MW) is known as its full-load hours (FLH).

⁵A disproportionately high reduction can be achieved if the FLH limit is extended to include more recent power plants which limit their FLH more considerably or if the oldest power plants are closed down. (see propositions 5 and 6)

5 The gradual closure of the oldest coal-fired power plants will ensure a manageable structural change and for relevant reductions in greenhouse gas emissions.

An effective and widely discussed climate policy instrument is the regulatory secured closure of coal-fired power plants (e.g. Agora 2016, Öko-Institut 2017a, Öko-Institut 2017c). The advantage of such instruments is that reductions in emissions due to closures occur regardless of market developments because a coal-fired power plant that has been closed down can no longer be reinitialised. The legislated closure of coal-fired power plants also creates planning security for every stakeholder. The oldest and most inefficient power plants can be decommissioned on a targeted and structured basis. This provides the basis for being able to shape the pending structural change in the German coal industry on a socially compatible and sustainable basis.

The greenhouse gas emission reductions that result from limiting full-load hours in old coal-fired power plants are not sufficient for achieving the climate targets for 2020, however. **In the scope of the existing excess capacities on the electricity market, the additional closure of at least 5 GW of the oldest/most inefficient lignite power plants must therefore take place by 2020 in addition to the closures that are already planned to take place.⁶ With this measure, the greenhouse gas emissions of the energy sector will be reduced by an additional 16-20 million tonnes by 2020. Following the Nuclear Power Phase-Out, the oldest coal-fired power plants should continue to be gradually closed down, so that by 2030, all of the power plants which were built before 1990 have been closed.** That would still mean some 19 GW of installed coal-fired power plants would remain in operation by 2030 (Öko-Institut 2017a). This is equivalent to a closure speed of approximately 2 GW per year for lignite- and hard coal power plants.

On this basis, the legislated closures by 2030 only affect coal-fired power plant units which are considerably more than 30 years old. The investment costs for these power plants, which were originally high, have already been paid off and they have generally made a measurable profit. The operators of coal-fired power plants also benefit from a sufficient planning period. Under constitutional law, the closure of these coal-fired power plants would also be possible without the need for compensation payments.

The gradual closure of the oldest coal-fired power plants means that hard coal contributes strongly to the emission reductions. The oldest coal-fired power plants are generally the least effective, i.e. they are the most inefficient with the conversion of energy. Yet the emission levels from modern lignite power plants are similar to those from old hard coal power plants. (Öko-Institut 2017a) This is due to the lower energy content of lignite. Closing the power plants with the highest emissions first would therefore mean closing the lignite power plants first. Under these circumstances, to achieve the 2030 target for the energy sector from the Climate Action Plan 2050, lignite power plant units which have been operating for less than 30 years would also be affected. (Öko-Institut 2017a) For this reason, a sharing of the burden should be achieved through the simultaneous closure of old hard coal power plants.

⁶ In addition to the 2.4 GW capacity of lignite to be carried over into the security standby, by the start of 2017, the planned closure of hard coal power plants with a total output of more than 6 GW has been announced (or already implemented).

Achieving an ambitious climate protection target of over 55% in 2030 requires a stronger reduction in coal-fired power generation. In the GreenEe scenario⁷ in the UBA study project “A resource efficient pathway towards a greenhouse gas neutral Germany” (UBA 2017a), in the year 2030 the proportion of coal-fired power generation is just 7%. The scenario achieves an overall reduction in emissions of 60% compared with 1990 by 2030. It was assumed that due to the legislated measures, all hard coal power plants that are over 40 years old and all lignite power plants with over 30 operational years have been decommissioned. In addition to the closures, the considerable reduction in greenhouse gas emissions required from the energy sector also result in a relatively low number of full-load hours of approx. 2,000-3,000 h/year in lignite- and hard coal power plants. Against this background, rendering coal-fired power plants far more flexible compared with today, or a further reduction in the capacity of coal-fired power plants would be necessary.

⁷ From the UBA-Study “A resource efficient pathway towards a greenhouse gas neutral Germany” (UBA 2017a).

6 By combining limitations to full-load hours with the closures, between 2020 and 2030, the reductions in emissions required by the energy sector will be achieved on a cost-effective and secure basis.

By combining a full-load hours limitation with the legislated closure of older coal-fired power plants, by 2020 in particular, the achievable reductions in greenhouse gas emissions can be increased. Advantages also result for the pending structural change in the coal industry.

To achieve a disproportionately high reduction in greenhouse gas emissions by the energy sector by 2020, the UBA recommends the following mix of climate policy instruments:

- ▶ **Limit to coal-fired power generation:** limiting coal-fired power generation to 4,000 full-load hours per year for hard coal and lignite power plants that are at least 20 years old.
- ▶ **The legislated closure of lignite power plants:** in addition to the currently planned closures, at least 5 GW of the oldest and/or most inefficient lignite power plants should also be closed.
- ▶ **The legislated ensuring of the planned closures:** legislated support to ensure that the planned closures actually take place.

To ensure that the energy sector comfortably achieves its targeted reduction in greenhouse gas emissions by 2030, the UBA recommends the following mix of climate policy instruments:

- ▶ **The legislated closure of lignite power plants:** following the Nuclear Power Phase-Out in 2022, a gradual closure of older and/or inefficient hard coal and lignite power plants should take place, thereby reducing the remaining total output to a maximum of 19 GW.
- ▶ **Limit to coal-fired power generation:** limiting coal-fired power generation to 4,000 full-load hours per year for hard coal and lignite power plants that are at least 20 years old.⁸

The combination of climate policy instruments supports a targeted transfer of coal-fired power generation from old and inefficient coal-fired power plants to new plants with a high degree of effectiveness, and leads to the required fall in greenhouse gas emissions particularly efficiently.

⁸ By limiting the full-load hours to power plants that are more than 20 years old (i.e. with no additional closures by 2030 beyond those that are already planned), it would not, to all intents and purposes, be possible to achieve the climate protection target for 2030. Climate protection models for the power sector in 2030 (Öko-Institut 2017a) have shown that a FLH limitation for all coal-fired power plants (i.e. including those that are less than 20 years old) leads to full-load hours of 3,200 for lignite and 4,200 for hard coal. For a limit to power plants that are more than 20 years old, considerably lower full-load hours are required in order to achieve the same reductions. For an even more ambitious limit beyond the current climate protection target, even greater contributions would be needed.

The FLH limit should remain in place beyond 2020, since with the legislated closure of coal-fired power plants, it ensures that the climate protection target of the energy sector will be achieved by 2030. Otherwise, the closure of more coal-fired power plants will also be necessary. If the oldest coal-fired power plants are closed by 2030, in 2030 the FLH limit will only apply to a small number of power plants. The impact of the climate policy instruments on the wholesale price on the electricity exchange is limited because sufficient power plant capacity is currently available in Europe (Öko-Institut 2017a).

In view of the limited increase in the wholesale price, no risks to the international competitiveness of energy-intensive industry can be expected. In this respect, it is also necessary to recall that a few years ago, the trading price of electricity was significantly higher. (BNetzA 2017) The instruments also enable the national reductions to be implemented across Europe, as they work on the basis of a reduction in particularly high emission coal-fired power generation. This results in an increased utilisation of lower-emission natural gas power plants outside Germany in particular, which ultimately leads to reductions in European emissions with all instruments. (Öko-Institut 2017a)

The combination of climate policy instruments is also strong in terms of varying energy price developments and changed framework data, such as population growth, the development of the economy and the prices of CO₂.⁹ This is because the installed output of the coal-fired power plants is limited by the legislated closure and utilisation of older coal-fired power plants due to the FLH limit. This allows for strong estimates of the reduction in greenhouse gas emissions from coal-fired power plants. This is only ensured by combining the legislated closure of coal-fired power plants with the limits to the full-load hours of such power plants.

On the one hand, due to the legislated closure of coal-fired power plants, the utilisation of the remaining plants and their greenhouse gas emissions would in particular be dependent on the change in the framework data, the development of the demand for electricity, the increased use of renewable sources of energy at home and abroad, and the development of conventional power plants abroad.

On the other hand, in the case of FLH limits alone, and without the closure of coal-fired power plants, it is possible that in 2030, the output of coal-fired power plants in Germany – as a result of the improved efficiency of the plants, for instance – would also be considerably higher than was assumed when the FLH limit was determined, which means that the greenhouse gas emissions would ultimately be higher. When shaping the FLH limit, it is therefore necessary to ensure that the closures assumed in the reference development are supported by legislative measures. The legislated closures by 2030 mean that the ability to predict the development of the maximum installed output of the existing coal-fired power plants is very strong.

⁹ This means that the combination of instruments does not contradict reformed emissions trading systems and higher CO₂ prices.

7 The targeted reduction in coal-fired power generation will be compensated for by a reduction in the supply of emissions allowances in the European Emissions Trading System.

The European Emissions Trading System (EU-ETS) is the key European instrument for climate protection, and covers around 45 percent of all the greenhouse gases of the EU. At present, however, the EU-ETS is faced with major challenges. Market surpluses have been exerting downwards pressure on the price of emissions allowances for a long time, and are weakening its incentive effect. **The EU-wide upper limit for allowances (the so-called “cap”) is structurally too high and insufficiently coordinated with the other interacting energy and climate policy instruments. (UBA 2016d) An ambitious reform of the EU-ETS is therefore necessary.**

In view of the weak price signal from the EU-ETS, certain member states of the European Union are currently planning to introduce additional national climate and energy policy instruments, or have already done so, to achieve their national climate protection targets or to push ahead with the de-carbonisation of their electrical power generation. These additional emissions reduction measures can, however, lead to a shift of emissions within the EU-ETS and further weaken its price signal if the supply of emissions allowances is not reduced accordingly. On this basis, a targeted phase out of coal power by Germany would further reduce the demand for CO₂ certificates. This would result in further market surpluses which could then be used by other plants in other member states, by industry, or in the future. From 2019, the introduction of a market stability reserve (MSR) will start to gradually reduce the market surpluses. However, UBA believes the MSR to be insufficient for adequately addressing the problem of the “waterbed effect”.

For the fourth trading period, in this respect, some important improvements are evident, however. The European Council and European Parliament on amending the EU emissions trading directive, have agreed that the withdrawal rate of the MSR will be increased from 12 to 24 percent of the surplus, and a significant part of the allowances contained in the MSR will also be deleted. In addition to this, the member states will also be able to compensate for falls in demand in the EU ETS caused by the closure of fossil fuel power plants by omitting the auctioning of allowances on a voluntary basis. Under such conditions, the phase out of coal power in Germany could be designed in a way that is compatible with the EU-ETS.

In the medium to long term, however, the lower CO₂ emissions in Germany must also result in a sustainable reduction in the overall quantity of European CO₂ certificates permitted in the European Emissions Trading System. To achieve this, the CO₂ emissions cap must be reduced. The German federal government must therefore call for the cap to be reviewed in terms of its compatibility with the agreed climate and energy policy measures in the next trading period, and for the linear reduction factor (LRF) to be increased to at least 2.6 percent for the fourth trading period so as to bring the EU-ETS in line with an ambitious medium and long term reduction path and to make further increases in the LRF subsequent to 2030. In review process of the MSR, that has been scheduled to occur by 2021, the German federal government should also commit to the permanent cancellation of allowances from the MSR. (UBA 2016d)

8 Investments in new coal-fired power plants and the development or expansion of opencast mines is not considered acceptable from the perspectives of climate policy or the economy.

The construction of a new large-scale lignite power plant is currently being planned in the Rhenish mining region, the BoAPlus, with a capacity of 1,100 MW. (RWE 2017) The Datteln IV hard coal power plant with a capacity of 1,100 MW is due to be completed and to enter operations soon (Uniper 2017). Another hard coal power plant in Stade-Bützfleht, with 920 MW, is in the planning stage. (UBA 2017d)

The construction of new coal-fired power plants is associated with high investment costs. This is particularly true if opencast mines are expanded so as to support them. In the three mining regions for lignite in Germany, Rhineland, Lausitz and Central Germany, the expansion and further development of opencast mines are included in the lignite plans and have already been approved. The full utilisation of the entire volume of lignite to be approved in the lignite plans (as of 2015) would entail the mining of 4.2 billion tonnes of lignite. (Öko-Institut 2017b)

This would also make the relocation of several communities with hundreds of residents necessary. If coal-fired power plants are closed before the end of their amortisation period or opencast mines are closed shortly after their expansion, capital spending is sacrificed which could otherwise have been put to better use. The high investment costs therefore cause path dependencies including a “lock in” with a fossil fuel system which are not compatible with the climate protection targets. (UBA 2016b)

In the lignite regions it is foreseeable that the structural changes, that initially began several decades ago, will continue to take place. Attempting to stop or delay these changes involves the risk of failed investments and economic problems in such regions. This applies to the construction of new coal-fired power plants and the development of new opencast mines, as well as the continued use of the existing approaches to training and education. It also applies to the unsustainable climate protection measure of carbon capture and storage.¹⁰ (UBA 2009, UBA 2013a)

On the contrary, the direction of the structural change is clear: To achieve a stable regional economic development and a high level of employment in the affected regions it is necessary to create economic growth and employment opportunities beyond the lignite industry. Rather than delaying matters, it is better to make use of the economic opportunities of the energy transition and to strengthen emerging sectors.

Investments in new lignite power plants are only economically viable if the CO₂ prices continue to remain low, which, in view of German and European climate policy, is very unlikely to occur. From an overall economic perspective, such plants are not viable due to their high environmental costs (see proposition 10). The expansion and development of new opencast mines does not make sense from an economic perspective either.

¹⁰ Capture and storage of CO₂ from fossil fuel power plants.

On the one hand, the approved mining volumes for lignite are already sufficient for supplying the existing lignite power plants until the end of their lifetime. On the other hand, added power generation with lignite is not compatible with the long-term climate protection targets. All in all, a further expansion in opencast mining would therefore unnecessarily increase the costs of providing electrical energy, with high social costs also arising due to resettlements as well as damage to the environment and human health. (also refer to proposition 10) (UBA 2015)

In the interests of climate protection, environmental protection and human health, and on economic grounds, it is therefore expedient to prevent both the construction of new coal-fired power plants and the development of new opencast mines, as well as measures for extending the technical lifetime¹¹ of coal-fired power plants and the expansion of existing opencast mines through the imposition of the appropriate framework conditions, and to begin implementing the necessary regional structural changes in the energy sector as soon as possible.

¹¹ Regardless of this, the power plants must satisfy all of the technical requirements, particularly those regarding the ambitious emissions-reducing targets.

9 A well-regulated phase out of coal power will limit the challenges faced by the regional economy in the lignite mining regions.

The number of workers employed in the coal industry has been in decline for several decades. In the course of the general structural changes, the number of employees first began falling in the hard coal industry, and from the early 1990s onwards, also in the lignite industry. In mid-2017, some 19,600 employees were still working in the lignite industry, while in hard coal mining (not including hard coal power plants), there were just 6,600. (Statistics of the German coal industry, 2017)

The current forecasts for the energy sector predict a continued decline in the numbers of those employed in the lignite mining industry. Regional economic analyses come to the same conclusion. The consulting firm Prognos predicts that the numbers of those employed in the lignite mining industry in Brandenburg will continue to decline. According to the basic scenario, without further climate policy instruments, by 2030, the number of (directly employed) workers in the lignite mining industry will fall by 40% in comparison with the position in 2015. In the case of especially ambitious climate protection policy, this value could be as high as 80%, however. (Prognos 2017) At the same time, new jobs will be created through the increased use of renewable energy sources. In Brandenburg, some 10,500 people are currently employed directly and indirectly in the area of renewable energy, with approximately 13,000 projected for 2030, a 24% increase. (Prognos 2017)

At the hard coal and lignite power plants, a full-load hours limit would not have a significant impact on the number of employees. (UBA 2015) The climate policy based limits are not therefore expected to lead to job losses among employees at the lignite power plants because even the old power plants are able to generate sufficient contribution margins due to the full-load hours permitted. Modern power plants that are less than 20 years old are not affected by the FLH limit.

The proposed closures of power plants will lead to a fall in the number of workers employed at the power plants. For the period subsequent to 2020, however, the job losses can be cushioned to a large extent by age-related employee retirement. If job losses are necessary prior to this, social hardship should be prevented as far as possible – on the basis of redundancy plans, training measures or other instruments (see proposition 10).

In the event of a reduction in power generation by lignite power plants, it is inevitable that the mining activities will decline in the lignite mines. **Analyses of the age structure of those employed in the lignite mining industry show that the foreseeable structural changes among the employees can largely take place alongside the natural age developments, i.e. without making anyone jobless, since by the year 2030, almost two thirds of those currently employed in the lignite mining industry will enter retirement.** For a large share of employees, the natural development of the age structure will enable a gentle exit from lignite mining industry. Social hardship should once again be prevented as far as possible – on the basis of redundancy plans, training measures or other instruments (see proposition 10).

The proposed combination of instruments allows for a managed decline in coal-fired power generation and coal mining. The regional economy and employees in the lignite mining industry can adapt to a well-regulated phase out of coal power, and the adjustment frictions will be reduced to the minimum.

10 The German Federal Government and the federal states should strengthen the regional economy in the lignite mining regions and provide them with structural support.

In view of the challenges and opportunities, it is necessary to actively configure the foreseeable structural changes in the lignite mining regions. This can take place in a variety of different ways, including adjustment assistance, training measures for the employees, or with the help of regional support programmes which promote the development of new value added in emerging sectors. In addition to increasing the use of renewable energy sources and other measures for the energy transition, it is also necessary to develop promising economic sectors in other areas of the economy. In this respect, strengthening the university system and training system is also important so as to offer young people good prospects in the lignite mining regions and to help deal with demographic change. Improving the (rail) infrastructure can also contribute to regional economic development. The aforementioned elements should be brought together in the form of an effective overall package. Among others, this should contain the following measures and instruments¹²:

- ▶ **Development of redundancy plans:** the employees affected require a secure planning basis and the knowledge that they will not be abandoned. For this reason, the key points of the redundancy plans for the affected companies should be developed. In addition to the collective bargaining parties, the federal and state governments should also be involved. The framework conditions for cases of early retirement, changing jobs in the group, income compensation, retraining etc. need to be determined.
- ▶ **Careers advice and supporting younger employees:** younger employees – who would not benefit from a redundancy plan – who have already completed sector-specific apprenticeship with which they will only be able to find a job in a different sector with difficulty will be given the opportunity to complete a funded vocational qualification in a different discipline which offers them superior prospects. They will also receive support from a careers advice service established for this purpose.
- ▶ **Using and developing structural support programmes:** in addition to establishing new financial policy instruments for the region by the federal states and possibly the federal government, the existing structural support programmes should be aligned more strongly to supporting the structural change in the lignite mining regions. Resources from the European Fund for Regional Development (EFRD) or the European Fund for Strategic Investments (EFRS) could also create new prospects and provide the appropriate support to existing expertise which can be linked with emerging markets or new areas of business¹³.

¹² The recommendations are based on research work in the scope of the current UFOPLAN project “Climate protection and the phase-out of coal: political strategies and measures until 2030 and beyond.”

¹³ The same applies to the “Central innovation programme for small and medium sized businesses” (ZIM), the “Innovative regional centre of growth”, the joint task for “Improving the regional economic structure” as well as company loans from the KfW investment bank for reconstruction.

- ▶ **Strengthening local initiatives:** on the basis of the local initiatives such as the currently existing *Innovationsregion Rheinisches Revier GmbH*, the *Metropolregion Mitteldeutschland Management GmbH* and the *Innovationsregion Lausitz GmbH* the existing and future activities and stakeholders should be regionally consolidated. The appointment of appropriate experts from a pool of external consultants with professional and sector expertise for process-accompanying coaching will support the realignment of the affected companies. Public assistance will also be put to decisive use in terms of the energy transition and the active management of the structural changes.
- ▶ **Making the most of the opportunities of the energy transition:** in addition to developing renewable sources of energy in the region, the energy transition also offers further economic opportunities. In the two coal mining regions in eastern Germany, for instance, the activity levels in the area of buildings refurbishment are rather limited. To improve the quality of the housing stock and attract well educated people to the region on the one hand, and to create new jobs on the other, funding programmes are providing incentives for refurbishment work.

11 The managed phase out of coal power must be accompanied by a strengthened increase in the use of renewable sources of energy.

A considerable acceleration in the expansion of renewable energy sources is necessary so as to achieve the pursued climate protection targets in all areas of application and to compensate for the decline in coal-fired power generation with climate-friendly power generation. **For this purpose, the expansion paths specified in the Renewable Energy Act (EEG) of 2017 should be considerably raised.**

Over the medium and long term, the required reduction in greenhouse gas emissions in the application areas of industry, transport, private households as well as trade, retail and services can only be guaranteed on the basis of the strengthened use of sector-linking techniques, such as electric mobility and power to heat (e.g. heat pumps), in combination with a strengthened increase in the use of renewable energy sources. For this purpose, the restructuring of the power supply towards renewable energy sources must advance so as to be able to achieve the required substitution effect (reduction of greenhouse gas emissions) in the transformation path through power to X-techniques across all areas of application. (UBA 2016c) In specific terms, that means the additional consumption of electrical power due to the linking of sectors must largely be covered by additional renewable energy plants.

The expansion targets for the power generation from renewable energy sources should therefore be increased. The share of renewable power generation in terms of gross electricity consumption should be raised

- ▶ to at least 50% in 2025 (previously 40% to 45%),
- ▶ to at least 70% in 2035 (previously 55% to 60%),
- ▶ to 100% in 2050 (previously at least 80%).

The current technology-specific expansion targets should therefore be clearly raised. This applies to onshore wind energy and photovoltaics in particular¹⁴. Due to their low costs and considerable potential they are the key technologies for achieving the climate protection targets. Target-oriented expansion targets should ensure the comprehensive restructuring of the energy supply and energy applications, as well as the continued increase in the developmental level of renewable energy plants, and thereby take the decommissioning of the existing plants into account. For this purpose, **the expansion paths for onshore wind energy and photovoltaics must be increased in the short term to at least 4 GW/a (gross)**. Only in this way can the

¹⁴ The 2017 EEG, however, only envisages an annual gross increase in construction in onshore wind energy installations of 2.8 GW (or 2.9 GW from 2020). Gross increase in construction means that decommissioned wind turbines are not deducted from the specified increased construction, while in the case of an equally high target value as the net increase in construction, the decommissioned installations would be factored in. In the coming years however, many of the existing onshore wind turbines will reach the end of their lifetime and be decommissioned, also because the financial support to many old systems is expiring. From 2022, the decommissioned output could therefore mean that the actual (net) increase in construction and the installed output of onshore wind energy would stagnate. Therefore, there is a great need for action here.

stakeholders be provided with planning security and sustainable prospects, as from the middle of the next decade, further increases will be necessary.

The raised medium-term targets for the proportion of renewable power generation in terms of the gross electricity consumption are necessary in order to comfortably achieve the 2030 climate protection target for the energy sector. The UBA takes the view that these are only minimum targets, however, which should not be fallen short of under any circumstances. To robustly achieve the goal of a 95% reduction by 2050 in the scope of a sustainable and resource-conserving development, firstly, ambitious targets for the energy sector should be achieved for 2030, and secondly, the share of renewable energies should be increased clearly once again which is illustrated in the UBA study project "A resource efficient pathway towards a greenhouse gas neutral Germany". (UBA 2017a)

12 The managed phase out of coal power avoids environmental costs to the value of several billion Euros.

The coal-fired power generation isn't only damaging to the climate, but is also severely damaging the environment due to emissions of airborne pollutants. This causes high social and environmental costs due to damage to human health and property, for example. At an average cost of 19.19 Euro Cents/kWh, electrical power generation with lignite causes the highest environmental costs, followed by hard coal with an average of 16.13 Euro Cents/kWh. Power generation with natural gas, by contrast, only results in environmental costs of 8.75 Euro Cents/kWh. Power generation from renewable energy sources is the most environmentally friendly solution. The environmental costs of wind energy are just 0.38 Euro Cents/kWh, and those of photovoltaics are just 1.82 Euro Cents/kWh, far below those of electricity generated with fossil fuels.¹⁵

In total, in 2016, the environmental costs of coal-fired power generation due to greenhouse gas emissions and airborne pollutants amounted to € 46 bn. By 2030, coal-fired power generation must be reduced by half to achieve the target in the Climate Action Plan 2050. This means that by 2030 alone, it will be possible to omit environmental costs of more than € 23 bn. compared with 2016. Without additional climate policy instruments for reducing emissions in the power plant estate, the reduction in environmental costs would turn out to be considerably lower.

The aforementioned environmental costs do not, however, take the environmental damage caused by opencast mining into account, such as the pollution of waterways, the suspension of fine particulate matter in the air, and the use of land, all of which have high social costs. Lignite mining has a direct impact on the status of waterways. Ground depressions have a negative effect on the ground water level, and the quality of the ground water is impaired due to sulphate and chloride in particular. Waste water from lignite mining which contains iron also leads to a build-up of ochre in surface waters, which has a serious impact on aquatic life. (UBA 2017e) The development and expansion of opencast mines destroys environmental and cultural assets that are lost forever. Villages are demolished and relocated and valuable ecosystems are destroyed. Entire rural environments are changed for good.

In the aforementioned environmental costs, the costs to human health are only partially taken into account. When burning coal, power plants release pollutants which are harmful to the air, the water and the soil. (UBA 2017e) In this respect, toxic substances occur which find their way into the environment, such as mercury emissions.¹⁶ These substances can be ingested in food or polluted drinking water and can cause serious damage to health.

¹⁵ Values on the basis of the Methodological Convention 2.0 (UBA 2013b), extrapolated to the year 2016 and adjusted for inflation (€₂₀₁₆). More recent research results justify an increase in the cost rates for greenhouse gas emissions. To take this trend into account, the upper value from the Methodological Convention 2.0 (120€₂₀₁₀) was taken as the basis for the calculations. In the scope of Methodological Convention 3.0, new data are to be published by June 2018.

¹⁶ <https://www.umweltbundesamt.de/themen/gesundheit/umwelteinfluesse-auf-den-menschen/chemische-stoffe/haeufige-fragen-zu-quecksilber#textpart-1>

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