



**Assessment of environmental and social impacts of the  
KfW loan programme “Renewable Energies – Standard”  
for the years 2019 and 2020**

**Summary Results**

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## Abbreviations and explanations

a	Year
CH <sub>4</sub>	Methane
CO <sub>2</sub>	Carbon dioxide
CO <sub>2</sub> -equivalent	Unit used for measuring the global warming potential (i.e. the potential contribution to the warming of near-surface layers of the atmosphere) of a greenhouse gas in relation to the effect of CO <sub>2</sub> . It states the quantity of CO <sub>2</sub> that would have the same greenhouse effect as the gas in question over a period of 100 years. For instance, one kg of methane (CH <sub>4</sub> ) has the same effect as 25 kg of CO <sub>2</sub> .
GW	Gigawatt(s); 1 GW = 1 million kW
GWh	Gigawatt hour(s); 1 GWh = 1 million kWh
KfW	KfW Group
kW	Kilowatt(s)
kW <sub>el</sub> / MW <sub>el</sub>	Kilowatt(s)/megawatt(s) electrical power
kWh	Kilowatt hour(s)
kW <sub>th</sub> / MW <sub>th</sub>	Kilowatt(s)/megawatt(s) thermal power
mill.	Million
MW	Megawatt(s); 1 MW = 1,000 kW
N <sub>2</sub> O	Nitrous oxide; “laughing gas”
NM VOC	Non-methane volatile organic compounds
NO <sub>x</sub>	Generic term for the nitrogen oxides that are most relevant for air pollution, namely nitric oxide (NO) and nitrogen dioxide (NO <sub>2</sub> )
n.q.	Not quantified
RE	Renewable energy
RES	Renewable energy sources
RE Standard	KfW loan programme “Renewable Energies – Standard”
SO <sub>2</sub>	Sulphur dioxide
SO <sub>2</sub> -equivalent	Unit used for measuring the acidification potential of an air pollutant in relation to the acidification potential of SO <sub>2</sub> .
TWh	Terawatt hour(s); 1 TWh = 1,000 million kWh
UBA	German Federal Environment Agency (Umweltbundesamt)
VAT	Value added tax

## Abstract for Political Decision Makers

The renewable energy promotional activities of KfW Group (KfW) represent an important element for reaching the targets for renewable energy (RE) use set in the German long-term strategy for future energy supply. These activities comprise low-interest loans, partly in combination with repayment bonuses financed by the federal government. In order to review their effectiveness and significance within the years 2019 and 2020, the resulting reductions in emissions of greenhouse gases and air pollutants, external costs, fossil fuel consumption and associated fossil fuel imports, as well as employment effects, were assessed for supported installations built in Germany. In addition, plants commissioned outside Germany with support of the KfW RE programmes were considered, covering investment volume, capacity installed and greenhouse gas emissions avoided.

This report summarises the impacts of the KfW loan programme “Renewable Energies – Standard” (RE Standard). The most important results at a glance:

In the years 2019 and 2020, the volume of loan commitments in the KfW programme RE Standard totalled approximately € 2.7 billion and € 3.6 billion respectively, of which almost € 1.1 billion and € 1.4 billion are attributable to supported renewable energy plants outside Germany. The loans triggered investments of € 3.9 billion and € 5.3 billion respectively (of which € 1.8 billion and € 2.6 billion in plants outside Germany). This corresponds to an average share of KfW-financing of 70 % and 67 % respectively. The impacts presented in the following refer to the total investment in installations for using renewable energy supported by KfW funding.

- The investment supported in Germany by RE Standard represents shares of 23.2 % and 24.0 % respectively of the total investment in plants for power and heat production from renewable energy sources in Germany in 2019 and 2020 (not including offshore wind energy plants).
- In the field of electricity production, the renewable energy installations co-financed through the RE Standard programme reached shares of 32.8 % and 33.4 % of total RE electrical power installed in Germany in the years 2019 and 2020 (excluding offshore wind energy plants). With 92 % and 97 % respectively the highest shares could be found for onshore wind turbines.
- Plants supported in the years 2019 and 2020 reduce German energy imports by approximately € 140 million per annum (total for both years). This cumulates to € 2.8 billion over the plants' lifetime of 20 years.
- The installations built in Germany and co-financed by KfW RE Standard in the years 2019 and 2020 lead to a reduction of approximately 4.8 million tonnes of CO<sub>2</sub>-equivalent in total per annum (of which 4.6 million tonnes CO<sub>2</sub>). The plants built outside

Germany with KfW support reduce another 1.0 million tonnes of CO<sub>2</sub>-equivalent annually.

- Avoiding greenhouse gas and air pollutant emissions in Germany reduces external costs by approximately €1.1 billion a year (for both years considered), 89 % of which refer to climate change effects.
- Manufacturing and construction of the installations built in 2019 and 2020 correspond to approximately 41,200 jobs created or preserved in Germany for one year (total for both years). A further 1,114 jobs per annum result from the operation and maintenance of the plants for the assumed 20 years of operation.
- Small and medium-sized enterprises with less than 500 employees account for approximately 54 % of the jobs generated by the construction and operation of plants built in the years 2019 and 2020.



# 1 Background

In the years 2019 and 2020, renewable energy sources (RES) continued to increase their share in Germany's energy provision<sup>1</sup>: In 2019 the share of RES in electricity consumption saw a rise from 37.5 % (2018) to 41.8 %. In 2020, this share further increased to 45.3 %. Thus, almost half of the electricity consumed in Germany originates from renewable sources.

Recently the targets of the German long-term strategy for future energy supply were updated by the amendment to the Federal Climate Protection Act adopted on 24 June 2021. It implements requirements of the Federal Constitutional Court and the increased EU climate target of -55 % for 2030. According to this, German emissions of greenhouse gases are to be reduced by 65 % by 2030 compared to 1990 (instead of 55 % previously) and climate neutrality is to be achieved as early as 2045 (instead of 2050 previously). Against this background, the new German government has stipulated in the coalition agreement to raise the expansion target for the share of renewable energy in gross electricity consumption from 65 % to 80 % for the year 2030.

The renewable energy promotional activities of KfW Group represent an important element for reaching the targets for renewable energy (RE) use described above. These activities comprise low-interest loans, partly in combination with repayment bonuses financed by the federal government.

In order to review the effectiveness and significance of these programmes within the years 2019 and 2020, the resulting reductions in emissions of greenhouse gases and air pollutants, external costs, fossil fuel consumption and associated fossil fuel imports, as well as employment effects, were assessed for installations built in Germany. In addition, plants built outside Germany with support of the KfW RE programmes were considered, covering investment volume, capacity installed and greenhouse gas emissions avoided.

The impacts of the KfW loan programme "Renewable Energies – Standard" (RE Standard) are summarised on the following pages. A detailed description (in German) of the underlying calculation approaches and results of other renewable energy promotional activities of KfW Group can be found in the evaluation report<sup>2</sup>.

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<sup>1</sup> See Bundesministerium für Wirtschaft und Energie (BMWi) – Hrsg.: Erneuerbare Energien in Zahlen – Nationale und internationale Entwicklung im Jahr 2020. Berlin 2021. [www.erneuerbare-energien.de/EE/Redaktion/DE/Downloads/Berichte/erneuerbare-energien-in-zahlen-2020.html](http://www.erneuerbare-energien.de/EE/Redaktion/DE/Downloads/Berichte/erneuerbare-energien-in-zahlen-2020.html)

<sup>2</sup> Bickel, P., Kelm, T., Edler, D.: Evaluierung der inländischen KfW-Programme zur Förderung Erneuerbarer Energien in den Jahren 2019 und 2020. Gutachten im Auftrag der KfW Bankengruppe, Stuttgart, Oktober 2021. [www.kfw.de/%C3%9Cber-die-KfW/KfW-Research/Publikationen-thematisch/Energie-und-Umwelt/](http://www.kfw.de/%C3%9Cber-die-KfW/KfW-Research/Publikationen-thematisch/Energie-und-Umwelt/) (available in German only)

## 2 Loan volume and resulting investment

The KfW promotional programme RE Standard was introduced on 1 January 2009 and supports the construction, extension or purchase of plants using renewable energy for producing electricity and/or heat by granting low-interest loans. The maximum loan per project amounts to €50 million.

In the years 2019 and 2020, the volume of loan commitments totalled approximately €2.7 billion and €3.6 billion respectively, of which almost €1.1 billion and €1.4 billion are attributable to supported renewable energy plants outside Germany (see Table 1). The loans triggered investments of €3.9 billion and €5.3 billion respectively, €1.8 billion and €2.6 billion of which in plants outside Germany. This corresponds to an average share of KfW-financing of 70 % and 67 % respectively.

The average loan volume per commitment amounted to about €0.7 million in both years; the average investment per commitment amounted to €1.0 million in 2019 and €1.1 million in 2020.

**Table 1: Number and volume of loans, as well as supported investment volume in the programme RE Standard for the years 2019 and 2020.**

	2019	2020
<b>Number of loan commitments</b>	3,872	4,992
<b>Volume of loan commitments (€million)</b>	2,685.4	3,567.8
<b>of which plants outside Germany (€million)</b>	1,057.6	1,447.4
<b>Investments financed (€million)<sup>1)</sup></b>	3,860.2	5,332.2
<b>of which plants outside Germany (€million)<sup>1)</sup></b>	1,803.6	2,569.8
<b>Average loan volume per commitment (€)</b>	693,550	714,700
<b>Average investment financed per commitment (€)<sup>1)</sup></b>	996,960	1,068,150
<b>Average share of financing</b>	69.6 %	66.9 %

Totals may differ due to rounding.

<sup>1)</sup> excl. VAT.

Table 2 presents the supported investment volume in RE Standard split by plant type. In the year 2019 (2020), wind energy onshore dominates the supported investment in Germany with 62 % (72 %) followed by photovoltaic energy 35 % (27 %). Other plant types play only a minor role. Outside Germany the shares are similar to those in Germany: Wind energy onshore has shares of 82 % 2019 and 63 % 2020, followed by photovoltaics with shares of 18 % and 36 % and hydropower being practically negligible.

**Table 2: Volume of investment supported in the years 2019 and 2020 by plant type.**

		2019		2020	
		€ million (excl. VAT)	%	€ million (excl. VAT)	%
<b>Germany</b>	<b>Biogas<sup>1)</sup></b>	1.5	0.07	3.5	0.1
	<b>Solid biomass</b>	30.2	1.5	1.4	0.05
	<b>Photovoltaic energy</b>	724.8	35.2	753.2	27.3
	<b>Large heat pump</b>	0.07	0.003	-	-
	<b>Solar thermal energy</b>	0.03	0.001	0.2	0.006
	<b>Heat storage</b>	0.6	0.03	0.2	0.008
	<b>Hydropower</b>	16.1	0.8	10.8	0.4
	<b>Wind energy onshore</b>	1,283.0	62.4	1,990.1	72.0
	<b>Electricity storage</b>	0.4	0.02	3.1	0.1
	<b>Total Germany</b>	<b>2,056.6</b>	<b>100.0</b>	<b>2,762.4</b>	<b>100.0</b>
<b>Outside Germany</b>	<b>Photovoltaic energy</b>	333.0	18.5	936.4	36.4
	<b>Hydropower</b>	-	-	23.0	0.9
	<b>Wind energy onshore</b>	1,470.7	81.5	1,610.4	62.7
	<b>Total outside Germany</b>	<b>1,803.6</b>	<b>100.0</b>	<b>2,569.8</b>	<b>100.0</b>

Totals may differ due to rounding.

<sup>1)</sup> Electricity generation and biogas transportation.

In 2019 and 2020 shares of 23.2 % and 24.0 % respectively of the total investment in installations for power and heat production from renewable energy sources in Germany<sup>3</sup> were supported by the KfW programme RE Standard.

Table 3 gives a detailed picture of the investment volume supported outside Germany by country and plant type.

<sup>3</sup> amounting to € 8,860 million in 2019 and € 11,510 million in 2020 – not including offshore wind energy plants (evaluation report, reference see footnote 2).

**Table 3: Investment volume supported outside Germany in the years 2019 and 2020 by plant type and country.**

€ million (excl. VAT)	2019			2020			
	PV	Wind	Total	PV	Hydro	Wind	Total
<b>Austria</b>	-	-	-	-	-	134.3	<b>134.3</b>
<b>Denmark</b>	0.1	27.8	<b>27.9</b>	-	-	-	-
<b>Finland</b>	-	88.7	<b>88.7</b>	-	-	-	-
<b>France</b>	3.5	395.2	<b>398.7</b>	132.1	-	579.6	<b>711.7</b>
<b>Ireland</b>	-	81.6	<b>81.6</b>	-	-	-	-
<b>Italy</b>	-	88.0	<b>88.0</b>	0.1	-	73.4	<b>73.5</b>
<b>Japan</b>	86.5	-	<b>86.5</b>	-	-	-	-
<b>Netherlands</b>	224.4	-	<b>224.4</b>	654.8	-	22.7	<b>677.5</b>
<b>Norway</b>	-	-	-	-	-	249.8	<b>249.8</b>
<b>Poland</b>	-	-	-	75.6	-	324.2	<b>399.8</b>
<b>Sweden</b>	-	633.8	<b>633.8</b>	-	-	226.4	<b>226.4</b>
<b>Spain</b>	18.5	155.5	<b>174.0</b>	73.8	-	-	<b>73.8</b>
<b>United Kingdom</b>	-	-	-	-	23.0	-	<b>23.0</b>
<b>Total</b>	<b>333.0</b>	<b>1,470.7</b>	<b>1,803.6</b>	<b>936.4</b>	<b>23.0</b>	<b>1,610.4</b>	<b>2,569.8</b>

Totals may differ due to rounding.

### 3 Power installed

In the year 2019, the RE Standard programme co-financed renewable energy plants with a total electrical power of just under 3.2 GW<sub>el</sub>, of which 52 % belong to plants built in Germany and 48 % to plants outside Germany (see Table 4). In 2020 the total supported electrical power installed increased to 4.2 GW<sub>el</sub> with shares unchanged at 52 % for plants commissioned in Germany and 48 % outside Germany. The share of renewable energy installations supported by the RE Standard programme amounted to 32.8 % and 33.4 % of the total RE electrical power installed in Germany<sup>4</sup> in 2019 and 2020 (excluding offshore wind energy).

**Table 4: Installed electrical power supported in the years 2019 and 2020 by plant type.**

<b>MW<sub>el</sub></b>		<b>2019</b>	<b>2020</b>
<b>Germany</b>	<b>Biogas</b>	1.4	2.0
	<b>Solid biomass</b>	0.2	-
	<b>Photovoltaic energy</b>	848.2	980.4
	<b>Hydropower</b>	2.4	1.2
	<b>Wind energy onshore</b>	791.2	1,192.2
	<b>Total Germany</b>	<b>1,643.5</b>	<b>2,175.8</b>
<b>Outside Germany</b>	<b>Photovoltaic energy</b>	324.4	1,056.8
	<b>Hydropower</b>	-	2.0
	<b>Wind energy onshore</b>	1,189.0	963.9
	<b>Total outside Germany</b>	<b>1,513.4</b>	<b>2,022.8</b>

Totals may differ due to rounding.

Table 5 presents the breakdown of the installed electrical power supported outside Germany by country and plant type.

The estimated electricity production of the installations financed 2019 (2020) built in Germany amounts to 2.6 (3.9) TWh per year over the lifetime of the plants. The plants financed outside Germany produce an estimated annual electric output of 2.6 (3.3) TWh. Over 20 years of plant operation, electricity generation accumulates to an estimated 53 (78) and 52 (66) TWh respectively.

<sup>4</sup> 5,006 MW<sub>el</sub> in 2019 and 6,511 MW<sub>el</sub> in 2020 (evaluation report, reference see footnote 2).

**Table 5: Installed electrical power supported outside Germany in the years 2019 and 2020 by plant type and country.**

MW <sub>el</sub>	2019			2020			
	PV	Wind	Total	PV	Hydro	Wind	Total
<b>Austria</b>	-	-	-	-	-	41.7	<b>41.7</b>
<b>Denmark</b>	0.1	14.4	<b>14.5</b>	-	-	-	-
<b>Finland</b>	-	91.2	<b>91.2</b>	-	-	-	-
<b>France</b>	4.9	235.6	<b>240.5</b>	174.0	-	359.4	<b>533.4</b>
<b>Ireland</b>	-	50.8	<b>50.8</b>	-	-	-	-
<b>Italy</b>	-	67.8	<b>67.8</b>	0.1	-	51.6	<b>51.8</b>
<b>Japan</b>	33.5	-	<b>33.5</b>	-	-	-	-
<b>Netherlands</b>	264.2	-	<b>264.2</b>	691.8	-	12.6	<b>704.4</b>
<b>Norway</b>	-	-	-	-	-	200.0	<b>200.0</b>
<b>Poland</b>	-	-	-	85.9	-	154.3	<b>240.2</b>
<b>Sweden</b>	-	552.5	<b>552.5</b>	-	-	144.3	<b>144.3</b>
<b>Spain</b>	21.8	176.7	<b>198.5</b>	105.0	-	-	<b>105.0</b>
<b>United Kingdom</b>	-	-	-	-	2.0	-	<b>2.0</b>
<b>Total</b>	<b>324.4</b>	<b>1,189.0</b>	<b>1,513.4</b>	<b>1,056.8</b>	<b>2.0</b>	<b>963.9</b>	<b>2,022.8</b>

Totals may differ due to rounding.

In the years 2019 and 2020, the RE Standard programme also supported 1.1 MW<sub>th</sub> and 2.3 MW<sub>th</sub> respectively of thermal power (mainly solid biomass), all of which was in plants located in Germany (see Table 6). The heat production of the financed plants can be estimated at 6.3 and 6.2 GWh per year. Assuming a 20-year operational lifetime of the plants, this adds up to a total production of an estimated 126 GWh and 125 GWh respectively.

**Table 6: Installed thermal power supported in the years 2019 and 2020 by plant type.**

MW <sub>th</sub>	2019	2020	
<b>Germany</b>	<b>Solar thermal energy</b>	0,04	0.2
	<b>Solid biomass</b>	1.0	2.1
	<b>Large heat pump</b>	0.08	- <sup>1)</sup>
	<b>Total Germany</b>	<b>1.1</b>	<b>2.3</b>
<b>Outside Germany</b>	<b>Solar thermal energy</b>	-	-
	<b>Solid biomass</b>	-	-
	<b>Large heat pump</b>	-	-
	<b>Total outside Germany</b>	-	-

Totals may differ due to rounding.

<sup>1)</sup> Values for geothermal plants and large heat pumps not shown for data protection reasons.

## 4 Estimated impacts

### 4.1 Savings in fossil fuel consumption and avoided energy costs for imported fossil fuels in Germany

Electricity and heat generated in the plants co-financed by the RE Standard programme replace energy produced from fossil fuel. The savings in fossil fuel are determined by the type of power plant substituted (e.g. coal, natural gas, etc.). They are calculated starting with the estimated electricity or heat produced by the newly built installations. Specific substitution factors allow quantifying the amount of fossil energy replaced by each type of renewable energy plant. The fossil fuel savings (which were calculated for RE plants built in Germany only) finally result by applying primary energy factors to the quantities of substituted electricity/heat.<sup>5</sup>

Table 7 presents the annual fossil fuel savings of plants co-financed in Germany in the years 2019 and 2020, which amount to 5.8 and 8.7 TWh per year. The breakdown by fuel is the same for both years: hard coal 58 %, lignite 22 % and natural gas 20 %. The share of mineral oil is negligible.

**Table 7: Annual fossil fuel savings (primary energy) in Germany resulting from the use of renewables in plants supported by RE Standard in the years 2019 and 2020.**

GWh/a	2019	2020
Hard coal	3,355	5,062
Natural gas	1,178	1,712
Lignite	1,255	1,892
Mineral oil	0	-2 <sup>1)</sup>
<b>Total</b>	<b>5,787</b>	<b>8,664</b>

Totals may differ due to rounding.

<sup>1)</sup> A negative value indicates an increased consumption.

As Germany has to import most of the fossil energy carriers consumed, the savings in fossil fuel use reduce the country's dependency on energy imports. To measure this effect, the corresponding reductions in energy costs were calculated using import prices<sup>6</sup>. It was assumed that the savings presented in Table 7 fully lead to a reduction in energy imports with one exception: Lignite is the only relevant fossil energy source extracted in Germany and it is assumed that no import and thus no reduction in import takes place. Decreased imports of hard coal, natural gas and mineral oil lead to annual savings in energy costs for imported fuel of € 57 million and € 85 million for 2019 and 2020 (see Table 8).

<sup>5</sup> A brief description of the calculation approach is given in Annex A 1. Details including substitution and primary energy factors can be found in the evaluation report (in German; see footnote 2).

<sup>6</sup> Details on the import price scenario are given in the evaluation report (see footnote 2).

**Table 8: Annual savings in energy costs for imported fossil fuels in Germany resulting from the use of renewables in plants supported by RE Standard in the years 2019 and 2020.**

€ million per year <sup>1)</sup>	2019	2020
Hard coal	30.0	44.8
Natural gas	26.8	40.0
Mineral oil	0.0	-0.1
<b>Total</b>	<b>56.7</b>	<b>84.8</b>

Totals may differ due to rounding.

<sup>1)</sup> Assumption: no lignite imported, therefore no resulting cost savings.

## 4.2 Savings in greenhouse gas emissions

The calculation of reductions in greenhouse gas emissions for plants supported in Germany builds upon the approach for quantifying savings in fossil fuel consumption. It applies emission reduction factors that are based on the substitution factors mentioned in the previous section. These are provided by the German Umweltbundesamt (UBA – Federal Environment Agency) and consider net reduction effects: additional emissions from using renewable energy sources (e.g. methane emissions during biogas production) are subtracted from the reduction in emissions from fossil fuels. For plants built outside Germany a simpler approach had to be applied, as no emission factors of equivalent quality were available.<sup>7</sup>

The plants built in Germany and co-financed by KfW in 2019 lead to a reduction of 1.9 million tonnes of CO<sub>2</sub>-equivalent (of which 1.8 million tonnes CO<sub>2</sub>) per year. The installations with KfW support built outside Germany reduce another 0.3 million tonnes of CO<sub>2</sub>-equivalent annually. Plants supported in 2020 avoid annual emissions in the amount of 2.9 million tonnes of CO<sub>2</sub>-equivalent (of which 2.7 million tonnes CO<sub>2</sub>) in Germany and 0.7 million tonnes of CO<sub>2</sub>-equivalent outside Germany (see Table 9).

**Table 9: Annual savings in greenhouse gas emissions resulting from the use of renewables in plants supported by RE Standard in the years 2019 and 2020 by location of plant.**

Million tonnes per year	2019		2020	
	Germany	Outside Germany	Germany	Outside Germany
CO <sub>2</sub>	1.83	n.q.	2.73	n.q.
CO <sub>2</sub> -equivalent	1.93 <sup>1)</sup>	0.31 <sup>1)</sup>	2.89 <sup>1)</sup>	0.72 <sup>1)</sup>

<sup>1)</sup> Figures based on different sets of emission factors.

In many countries outside Germany in which installations are co-financed, electricity generation already has a low carbon intensity (e.g. in France due to a high share of nuclear energy or in Sweden due to a high share of renewable and nuclear energy). Therefore, the total

<sup>7</sup> A brief description of the calculation approach is given in Annex A 2. Details including emission factors applied can be found in the evaluation report (in German; see footnote 2).



savings in greenhouse gas emissions from supported plants outside Germany are comparatively low.

### 4.3 Savings in external costs through supported plants in Germany

Savings in fossil fuel combustion not only result in reduced CO<sub>2</sub> emissions but also in decreasing emissions of air pollutants such as NO<sub>x</sub>, SO<sub>2</sub> etc. Based on emission factors provided by UBA, annual reductions of airborne emissions were calculated for the RE installations financed in Germany as presented in Table 10.

**Table 10: Annual savings in air pollutant emissions resulting from the use of renewables in plants in Germany supported by RE Standard in the years 2019 and 2020.**

Tonnes per year	2019	2020
SO <sub>2</sub>	716	1,082
NO <sub>x</sub>	1,720	2,585
SO <sub>2</sub> -equivalent	1,899	2,857
NMVOC	99	147
Fine particulate matter	16	29

Air pollutants and greenhouse gases cause damage to human health, as well as the natural and man-made environment which represents costs to society that are not borne by the polluter. These so-called external costs can be quantified by applying (monetary) damage cost factors that link emissions to damages caused by a certain quantity (e.g. one tonne) of pollutant emitted. Accordingly, the reduction of pollutant emissions leads to a decrease in external costs, which was quantified for the plants supported in Germany. The cost categories considered for deriving the savings in external costs include climate change, human health impacts, crop losses, damage to materials and losses in biodiversity.<sup>8</sup>

**Table 11: Annual savings in external costs resulting from the use of renewables in plants in Germany supported by RE Standard in the years 2019 and 2020.**

€million per year	2019	2020
Climate change	376.8	563.2
Health impacts	37.2	56.2
Crop losses	1.5	2.3
Material damage	0.6	0.9
Biodiversity losses	5.6	8.4
<b>Total</b>	<b>421.7</b>	<b>631.0</b>

Totals may differ due to rounding.

<sup>8</sup> A brief description of the calculation approach is given in Annexes A 2 and A 3. Details including damage cost factors applied can be found in the evaluation report (in German; see footnote 2).

Avoiding greenhouse gas and air pollutant emissions through co-financed installations in Germany reduces external costs by €422 million per year for 2019 and €631 million per year for 2020 (see Table 11). The largest part of saved external costs can be attributed to global climate change impacts caused by the emission of greenhouse gases.

#### 4.4 Employment effects in Germany

Construction and operation of renewable energy plants lead to a demand in goods and services which creates or preserves employment. Employment effects in Germany caused by the supported German plants were calculated using an approach based on input-output analysis. This approach allows consideration of both direct employment (e.g. building a wind turbine) and indirect employment (e.g. producing steel for a wind turbine). The sum of direct and indirect employment results in so-called gross employment.<sup>9</sup>

Manufacturing and construction of the plants supported in Germany in 2019 and 2020 correspond to 17,650 jobs and 23,520 jobs respectively created or preserved in Germany for one year. A further 474 (640) jobs per annum result from the operation and maintenance of the plants over the assumed 20 years of operation, adding up to 9,470 (12,800) person years. Over a period of 20 years, building and operating the plants supported by the RE Standard programme in the years 2019 and 2020 creates or preserves employment of 27,130 and 36,330 person years (see Table 12).

**Table 12: Gross employment effects in Germany resulting from the use of renewables in plants in Germany supported by RE Standard in the years 2019 and 2020.**

Person years <sup>1)</sup>	2019	2020
Construction of plants	17,650	23,520 <sup>2)</sup>
Operation of plants (over a 20-year period)	9,470	12,800
<b>Total</b>	<b>27,130</b>	<b>36,330</b>

Totals may differ due to rounding.

<sup>1)</sup> One person year equals one person employed for the duration of one year (or 2 persons employed for half a year etc.)

<sup>2)</sup> Another 30 person years are estimated for small battery storage systems. However, this estimate is less reliable and therefore should not be added.

#### 4.5 Impacts attributable to the KfW financing portion

The impacts presented in the previous sections refer to the total investment in installations for using renewable energy supported by KfW funding. In a further step, the share of those

<sup>9</sup> A brief description of the calculation approach is given in Annex A 4. Details can be found in the evaluation report (in German; see footnote 2).

impacts is calculated that corresponds to the share of financing of the RE Standard programme in the total amount of investment (pro rata calculation).

Table 13 presents the average share of financing (which is calculated as loan volume divided by investment volume) by plant type. It illustrates that the share of financing varies considerably between different plant types and years. For this reason, the calculations are carried out on plant type level and then added up for the respective year. Table 14 shows the resulting shares of KfW financing in impacts for installations in Germany, Table 15 reports the figures for installations outside Germany. Please note that due to differing compositions of impacts by plant type the sum over all plant types generally differs from the RE Standard total average percentage share of financing.

**Table 13: Share of financing of the RE Standard programme in the years 2019 and 2020 by plant type.**

		2019	2020
<b>Germany</b>	<b>Biogas</b>	90.6%	83.8%
	<b>Solid biomass</b>	55.6%	69.1%
	<b>Photovoltaic energy</b>	80.3%	80.0%
	<b>Large heat pump</b>	100.0%	-
	<b>Solar thermal energy</b>	100.0%	80.8%
	<b>Heat storage</b>	89.3%	92.8%
	<b>Hydropower</b>	59.8%	87.0%
	<b>Wind energy onshore</b>	79.3%	75.4%
	<b>Electricity storage</b>	100.0%	97.5%
	<b>Total Germany</b>	<b>79.1%</b>	<b>76.8%</b>
<b>Outside Germany</b>	<b>Photovoltaic energy</b>	63.4%	68.4%
	<b>Hydropower</b>	-	46.0%
	<b>Wind energy onshore</b>	57.6%	49.4%
<b>Total outside Germany</b>	<b>58.6%</b>	<b>56.3%</b>	
<b>RE Standard</b>	<b>Total</b>	<b>69.6%</b>	<b>66.9%</b>

**Table 14: Share of KfW financing in impacts resulting from the use of renewables in plants in Germany supported by RE Standard in the years 2019 and 2020.**

		2019	2020
<b>Supported installed electrical power</b>	MW <sub>el</sub>	1,311.1	1,686.6
<b>Annual electricity production</b>	TWh <sub>el</sub> per year	2.1	3.0
<b>Supported installed thermal power</b>	MW <sub>th</sub>	0.7	1.6
<b>Annual heat production</b>	TWh <sub>th</sub> per year	0.004	0.005
<b>Annual fossil fuel savings (primary energy)</b>	GWh per year	4,598	6,626
<b>Annual savings in energy costs for imported fossil fuels</b>	€ million per year	45.1	65.0
<b>Annual savings in greenhouse gas emissions</b>	Million tonnes of CO <sub>2</sub> per year	1.45	2.09
	Million tonnes of CO <sub>2</sub> -equivalents per year	1.53	2.21
<b>Annual savings in external costs</b>	€ million per year	335.0	482.6
<b>due to climate change</b>	€ million per year	299.4	430.8
<b>due to health impacts</b>	€ million per year	29.5	42.9
<b>due to crop losses</b>	€ million per year	1.2	1.7
<b>due to material damage</b>	€ million per year	0.5	0.7
<b>due to biodiversity losses</b>	€ million per year	4.5	6.4
<b>Gross employment effects in Germany</b>	Person years	21,460	27,810
<b>due to plant construction</b>	Person years	13,980	18,010
<b>due to plant operation (over 20-years)</b>	Person years	7,490	9,800

Totals may differ due to rounding.

**Table 15: Share of KfW financing in impacts resulting from the use of renewables in plants outside Germany supported by RE Standard in the years 2019 and 2020.**

		2019	2020
<b>Supported installed electrical power</b>	MW <sub>el</sub>	890.0	1,200.6
<b>Annual electricity production</b>	TWh <sub>el</sub> per year	1.5	1.9
<b>Annual savings in greenhouse gas emissions</b>	Million tonnes of CO <sub>2</sub> -equivalents per year	0.19	0.42

## 5 Summary of effects

Table 16 and Table 17 summarise the evaluation results of the KfW's RE Standard programme for the years 2019 and 2020.

**Table 16: Overview of evaluation results 2019 for the KfW programme RE Standard.**

	Unit	Germany	Outside Germany	Total
<b>Volume of loan commitments</b>	€ million	1,627.8	1,057.6	2,685.4
<b>Investments financed<sup>1)</sup></b>	€ million	2,056.6	1,803.6	3,860.2
<b>Supported installed electrical power</b>	MW <sub>el</sub>	1,643.5	1,513.4	3,156.9
<b>share of KfW financing</b>	MW <sub>el</sub>	1,311.1	890.0	2,201.1
<b>Annual electricity production</b>	TWh <sub>el</sub> / a	2.6	2.6	5.2
<b>share of KfW financing</b>	TWh <sub>el</sub> / a	2.1	1.5	3.6
<b>Supported installed thermal power</b>	MW <sub>th</sub>	1.1	-	1.1
<b>share of KfW financing</b>	MW <sub>th</sub>	0.7	-	0.7
<b>Annual heat production</b>	TWh <sub>th</sub> / a	0.006	-	0.006
<b>share of KfW financing</b>	TWh <sub>th</sub> / a	0.004	-	0.004
<b>Annual savings in greenhouse gas emissions due to plants supported</b>	million tonnes CO <sub>2</sub> -equiv. / a	1.93	0.31	- <sup>2)</sup>
<b>share of KfW financing</b>	million tonnes CO <sub>2</sub> -equiv. / a	1.53	0.19	- <sup>2)</sup>
<b>Annual savings in energy imports</b>	€ million / a	56.7	n.q.	
<b>share of KfW financing</b>	€ million / a	45.1	n.q.	
<b>Gross employment effects</b>	person years	27.130	n.q.	
<b>share of KfW financing</b>	person years	21,460	n.q.	
<b>Annual savings in external costs</b>	€ million / a	421.7	n.q.	
<b>share of KfW financing</b>	€ million / a	335.0	n.q.	

Totals may differ due to rounding.

<sup>1)</sup> excl. VAT.

<sup>2)</sup> Figures based on different sets of emission factors.

**Table 17: Overview of evaluation results 2020 for the KfW programme RE Standard.**

	Unit	Germany	Outside Germany	Total
<b>Volume of loan commitments</b>	€ million	2,120.4	1,447.4	3,567.8
<b>Investments financed<sup>1)</sup></b>	€ million	2,762.4	2,569.8	5,332.2
<b>Supported installed electrical power</b>	MW <sub>el</sub>	2,175.8	2,022.8	4,198.6
<b>share of KfW financing</b>	MW <sub>el</sub>	1,686.6	1,200.6	2,887.2
<b>Annual electricity production</b>	TWh <sub>el</sub> / a	3.9	3.3	7.2
<b>share of KfW financing</b>	TWh <sub>el</sub> / a	3.0	1.9	4.9
<b>Supported installed thermal power</b>	MW <sub>th</sub>	2.3	-	2.3
<b>share of KfW financing</b>	MW <sub>th</sub>	1.6	-	1.6
<b>Annual heat production</b>	TWh <sub>th</sub> / a	0.006	-	0.006
<b>share of KfW financing</b>	TWh <sub>th</sub> / a	0.005	-	0.005
<b>Annual savings in greenhouse gas emissions due to plants supported</b>	million tonnes CO <sub>2</sub> -equiv. / a	2.89	0.72	- <sup>2)</sup>
<b>share of KfW financing</b>	million tonnes CO <sub>2</sub> -equiv. / a	2.21	0.42	- <sup>2)</sup>
<b>Annual savings in energy imports</b>	€ million / a	84.8	n.q.	
<b>share of KfW financing</b>	€ million / a	65.0	n.q.	
<b>Gross employment effects</b>	person years	36,330	n.q.	
<b>share of KfW financing</b>	person years	27,810	n.q.	
<b>Annual savings in external costs</b>	€ million / a	631.0	n.q.	
<b>share of KfW financing</b>	€ million / a	482.6	n.q.	

Totals may differ due to rounding.

<sup>1)</sup> excl. VAT.

<sup>2)</sup> Figures based on different sets of emission factors.

## **Annex: Overview of the underlying methodology**

The following sections give a brief description of the methodology used for evaluating the effects triggered by the renewable energy plants supported by the KfW's RE Standard programme. Detailed information is available in the evaluation report.

### **A 1 Estimation of savings in fossil fuel consumption and avoided energy costs for imported fossil fuels in Germany**

Electricity and heat from renewable energy sources replace fossil fuels. The savings in fuel use are calculated in two steps. In the first step, substitution factors for electricity and heat production provided by the German Umweltbundesamt (UBA – Federal Environment Agency) are applied. These factors give the shares of electricity from lignite, hard coal, natural gas and mineral oil that are replaced in Germany by electricity from renewables. Each technology (wind energy, hydro power, solid biomass, photovoltaics, biogas and geothermal energy) has its specific substitution pattern, determined mainly by the time structure of energy provision. In the second step, the amounts of electricity replaced are combined with primary energy factors for each energy carrier that give the units of fossil primary energy (including up- and downstream processes) necessary to provide one unit of electricity. The fossil energy use associated to the use of renewable energy (in up- and downstream processes) is subtracted from the calculated fossil energy savings, resulting in net savings in fossil energy due to electricity produced in the renewable energy plants supported.

The amounts of net fossil energy saved due to heat provision from renewable energy are calculated accordingly, based on substitution and primary energy factors for fuel oil, natural gas, hard coal, lignite, district heating and electricity for heat provided by solar thermal systems, heat pumps, biogas, solid biomass and geothermal plants.

Since a large share of Germany's fossil fuels have to be imported, the savings calculated lead to a reduction in German energy imports. Lignite, as the only major German domestic fossil fuel source, is assumed not to be imported. The associated costs due to savings in fossil fuel imports are calculated using price forecasts for the import prices of crude oil, hard coal and natural gas.

## **A 2 Estimation of savings in greenhouse gas emissions and air pollutant emissions**

Savings in greenhouse gas (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O) and air pollutant (SO<sub>2</sub>, NO<sub>x</sub>, NMVOC, fine particles) emissions due to supported RE installations in Germany are calculated based on emission reduction factors provided by the German Umweltbundesamt (UBA – Federal Environment Agency). These factors are based on the substitution factors mentioned in the previous section and reflect the specific fossil fuel mix that the renewable energy source replaces. They describe net emission savings, setting off the volume of emissions caused by the use of renewables (final energy supply) against the volume of gross emissions that are no longer being released thanks to fossil sources having been replaced with renewables. All upstream process chains involved in the production and supply of the various energy sources and in installation construction and operation (but not dismantling) are also taken into account.

When calculating the savings in greenhouse gas emissions due to supported plants in countries other than Germany, emission reduction factors are required for each country. No consistent emission factor set of comparable quality is available, therefore – as a second-best approach – emission reductions are estimated based on greenhouse gas emission factors (given as CO<sub>2</sub>-equivalents per kWh<sub>el</sub>) of the average electricity mix of the countries.

## **A 3 Valuation of external costs avoided**

Air pollutant emissions cause changes in environmental burdens and associated impacts on various receptors, such as human beings (e.g. emissions of air pollutants leading to respiratory diseases), crops (decrease in yields), building materials (mainly degradation and soiling) or ecosystems (mainly due to acidification and eutrophication). This change in impacts leads either directly or indirectly (e.g. through health effects) to a change in the utility of the affected persons. Welfare changes resulting from these impacts can be transferred into monetary values and represent external costs to society as they are not borne by the polluter. The German Umweltbundesamt (UBA – Federal Environment Agency) recommends pollutant-specific damage cost factors that link emissions to damages caused by a certain quantity (e.g. one tonne) of pollutant emitted in Germany. In addition to the damage cost factors for air pollutants (SO<sub>2</sub>, NO<sub>x</sub>, NMVOC, fine particles), cost factors for greenhouse gas emissions (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O) are provided. The cost categories considered for deriving the external costs avoided comprise climate change, human health impacts, crop losses, damage to materials and losses in biodiversity.

The external costs avoided by supporting RE installations in Germany are then calculated by multiplying the savings in pollutant and greenhouse gas emissions (in tonnes) by the specific cost factor per tonne of pollutant or greenhouse gas emitted.



## A 4 Estimation of employment effects

Employment effects arise from the construction and the operation of renewable energy installations. Investments in facilities, operation and maintenance create direct employment for manufacturers, operators and service companies. They in turn demand goods from other economic sectors, thus creating indirect employment for suppliers of intermediate inputs. The sum of direct and indirect employment is the so-called gross employment.

Starting point for the calculation of gross employment effects is the demand for goods in Germany resulting from the investments in renewable energy installations supported by the KfW RE standard programme. Direct and indirect effects resulting from this demand are modelled by means of input-output tables, which map the flow of goods and interdependencies of industries within the German economy and with foreign countries. In the final step, employment effects are calculated using sector-specific labour intensities, which reflect the productivities in the different economic sectors.