

Table S1: Hashrates reported by Cambridge Bitcoin Electricity Consumption Index (CBECI), University of Cambridge (2022), for January 2022. Total electricity consumption estimated at 95.52 TWh (due to values rounding, the sum of hashrates \* 95.53 TWh of each country listed below differs of 0.01 TWh with respect to 95.53 TWh from CBECI [1])

	<b>Jan 2022</b>
United States	37.84%
China	21.11%
Kazakhstan	13.22%
Canada	6.48%
Russia	4.66%
Germany	3.06%
Malaysia	2.51%
Ireland	1.97%
Other	9.14%

Table S2: Estimation of the low carbon electricity share in year 2030 and 2050 according to the three modeled Scenario BAD, IRENA and EMBER

	2021/2022	BAD (best available data)				IRENA (global)				EMBER (global)			
		Low carbon share in 2030	Source	Low carbon share in 2050	Source	Low carbon share in 2030	Source	Low carbon share in 2050	Source	Low carbon share in 2030	Source	Low carbon share in 2050	Source
<b>USA</b>	39.9%	56%	[2]	55%	[2]	40%	[3]	84%	[3]	<b>60%</b>	[4]	84%	[4]
<b>China</b>	33.7%	50%	[5]	93%	[5]	40%		84%		60%		84%	
<b>Kazakhstan</b>	10.9%	15%	[6]	50%	[6]	40%		84%		60%		84%	
<b>Canada</b>	82.5%	90%	[7]	100%	[7]	40%		84%		60%		84%	
<b>Russia</b>	38.8%	56%	[8]	64%	[8]	40%		84%		60%		84%	
<b>Germany</b>	50.7%	80%	[9]	100%	[9]	40%		84%		60%		84%	
<b>Malasya</b>	19.1%	45%	[10]	70%	[10]	40%		84%		60%		84%	
<b>Ireland</b>	40.2%	80%	[11]	100%	[11]	40%		84%		60%		84%	
<b>World</b>	38.4%	42%	[12]	85%	[13]	40%		84%		60%		84%	

Table S3: Electricity generation per country referred to each modelled scenario (i.e., 2021 or 2022; 2030 BAD, 2030 IRENA [14], 2030 EMBER [15], 2050 BAD, 2050 IRENA and EMBER)

<b>USA</b>							
<b>Source</b>	<b>TWh consumed in 2022</b>	<b>% 2022</b>	<b>2030 BAD</b>	<b>2030 IRENA</b>	<b>2030 EMBER</b>	<b>2050 BAD</b>	<b>2050 IRENA &amp; EMBER</b>
Coal	909245	20.3%	17.7%	20.3%	16.0%	10.2%	5.4%
Oil	41458	0.9%	0.0%	0.9%	0.0%	0.0%	0.2%
Natural gas	1742100	38.9%	26.6%	38.8%	24.0%	34.7%	10.4%
Biofuels	50781	1.1%	0.0%	1.1%	0.0%	0.0%	2.4%
Nuclear	803669	17.9%	17.7%	18.0%	19.1%	12.2%	37.7%
Hydro	286305	6.4%	7.7%	6.4%	8.3%	5.4%	13.4%
Geothermal	19602	0.4%	0.9%	0.4%	1.0%	0.9%	0.9%
Solar PV	188644	4.2%	14.5%	4.2%	15.6%	22.9%	8.9%
Wind	439789	9.8%	15.0%	9.8%	16.1%	13.9%	20.7%
<i>High carbon</i>	<i>2692803</i>	<i>60.1%</i>	<i>44.4%</i>	<i>60.0%</i>	<i>40.0%</i>	<i>44.9%</i>	<i>16.0%</i>
<i>Low-carbon</i>	<i>1788790</i>	<i>39.9%</i>	<i>55.9%</i>	<i>40.0%</i>	<i>60.0%</i>	<i>55.3%</i>	<i>84.0%</i>
<b>China</b>							
<b>Source</b>	<b>TWh consumed in 2021</b>	<b>% 2021</b>	<b>2030 BAD</b>	<b>2030 IRENA</b>	<b>2030 EMBER</b>	<b>2050 BAD</b>	<b>2050 IRENA &amp; EMBER</b>
Coal	5417484	63.0%	44.9%	53.4%	35.6%	3.0%	14.3%
Oil	11406	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Natural gas	267970	3.1%	5.5%	6.6%	4.4%	3.6%	1.8%
Biofuels	163700	1.9%	1.6%	1.3%	1.9%	1.2%	2.7%
Waste	6649	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Nuclear	407523	4.7%	4.7%	3.8%	5.7%	4.7%	8.0%
Hydro	1338999	15.6%	13.4%	10.8%	16.2%	10.7%	22.7%
Geothermal	125	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Solar PV	329004	3.8%	16.5%	13.3%	20.0%	38.5%	28.0%
Wind	656102	7.6%	13.4%	10.8%	16.2%	38.5%	22.7%
<i>High carbon</i>	<i>5696860</i>	<i>66.3%</i>	<i>50.4%</i>	<i>60.0%</i>	<i>40.0%</i>	<i>6.5%</i>	<i>16.0%</i>
<i>Low-carbon</i>	<i>2902102</i>	<i>33.7%</i>	<i>49.6%</i>	<i>40.0%</i>	<i>60.0%</i>	<i>93.5%</i>	<i>84.0%</i>
<b>Kazakhstan</b>							
<b>Source</b>	<b>TWh consumed in 2021</b>	<b>% 2021</b>	<b>2030 BAD</b>	<b>2030 IRENA</b>	<b>2030 EMBER</b>	<b>2050 BAD</b>	<b>2050 IRENA &amp; EMBER</b>
Coal	67981	59.1%	56.4%	39.8%	26.5%	33.2%	10.6%
Oil	3748	3.3%	3.1%	2.2%	1.5%	1.8%	0.6%
Natural gas	30760	26.7%	25.5%	18.0%	12.0%	15.0%	4.8%
Biofuels	2	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Hydro	9208	8.0%	11.0%	29.3%	43.9%	36.6%	61.5%
Solar PV	1629	1.4%	1.9%	5.2%	7.8%	6.5%	10.9%
Wind	1747	1.5%	2.1%	5.6%	8.3%	6.9%	11.7%

<i>High carbon</i>	102489	89.1%	85.0%	60.0%	40.0%	50.0%	16.0%
<i>Low-carbon</i>	12586	10.9%	15.0%	40.0%	60.0%	50.0%	84.0%
<b>Canada</b>							
Source	TWh consumed in 2022	% 2022	2030 BAD	2030 IRENA	2030 EMBER	2050 BAD	2050 IRENA & EMBER
Coal	29253	4.5%	2.5%	4.5%	4.5%	0.0%	4.1%
Oil	4242	0.6%	0.4%	0.6%	0.6%	0.0%	0.6%
Natural gas	81494	12.4%	7.1%	12.4%	12.4%	0.0%	11.3%
Biofuels	9872	1.5%	1.6%	1.5%	1.5%	1.8%	1.4%
Waste	297	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%
Nuclear	87248	13.3%	14.5%	13.3%	13.3%	16.1%	12.1%
Hydro	398905	60.8%	66.4%	60.8%	60.8%	73.8%	55.5%
Solar PV	6952	1.1%	1.2%	1.1%	1.1%	1.3%	1.0%
Wind	37542	5.7%	6.2%	5.7%	5.7%	6.9%	5.2%
<i>High carbon</i>	114989	17.5%	10.0%	17.5%	17.5%	0.0%	16.0%
<i>Low-carbon</i>	540816	82.5%	90.0%	82.5%	82.5%	100.0%	84.0%
<b>Russia</b>							
Source	TWh consumed in 2021	% 2021	2030 BAD	2030 IRENA	2030 EMBER	2050 BAD	2050 IRENA & EMBER
Coal	187311	16.2%	10.7%	4.3%	9.8%	8.8%	3.9%
Oil	8527	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%
Natural gas	513880	44.3%	33.0%	13.2%	30.2%	27.2%	12.1%
Biofuels	72	0.0%	15.3%	22.4%	16.3%	17.4%	20.5%
Waste	3894	0.3%	3.4%	5.0%	3.7%	3.9%	4.6%
Nuclear	223372	19.3%	3.8%	5.6%	4.1%	4.3%	5.1%
Hydro	216392	18.7%	23.8%	34.8%	25.3%	27.0%	31.8%
Geothermal	429	0.0%	2.5%	3.7%	2.7%	2.9%	3.4%
Solar PV	2224	0.2%	1.3%	1.9%	1.4%	1.5%	1.7%
Wind	3311	0.3%	6.1%	9.0%	6.5%	7.0%	8.2%
<i>High carbon</i>	709718	61.2%	43.7%	17.5%	40.0%	36.0%	16.0%
<i>Low-carbon</i>	449694	38.8%	56.3%	82.5%	60.0%	64.0%	84.0%
<b>Germany</b>							
Source	TWh consumed in 2022	% 2022	2030 BAD	2030 IRENA	2030 EMBER	2050 BAD	2050 IRENA & EMBER
Coal	193504	32.9%	13.3%	32.9%	32.9%	0.0%	10.7%
Oil	4846	0.8%	0.3%	0.8%	0.8%	0.0%	0.3%
Natural gas	91696	15.6%	6.3%	15.6%	15.6%	0.0%	5.1%
Biofuels	41587	7.1%	11.2%	7.1%	7.1%	13.9%	11.7%
Waste	12085	2.1%	3.2%	2.1%	2.1%	4.1%	3.4%
Nuclear	34709	5.9%	9.3%	5.9%	5.9%	11.6%	9.8%
Hydro	23565	4.0%	6.3%	4.0%	4.0%	7.9%	6.6%

Geothermal	245	0.0%	0.1%	0.0%	0.0%	0.1%	0.1%
Solar PV	60787	10.3%	16.3%	10.3%	10.3%	20.4%	17.1%
Wind	125287	21.3%	33.6%	21.3%	21.3%	42.0%	35.3%
<i>High carbon</i>	<i>290046</i>	<i>49.3%</i>	<i>20.0%</i>	<i>49.3%</i>	<i>49.3%</i>	<i>0.0%</i>	<i>16.0%</i>
<i>Low-carbon</i>	<i>298265</i>	<i>50.7%</i>	<i>80.0%</i>	<i>50.7%</i>	<i>50.7%</i>	<i>100.0%</i>	<i>84.0%</i>
<b>Malaysia</b>							
Source	TWh consumed in 2021	% 2021	2030 BAD	2030 IRENA	2030 EMBER	2050 BAD	2050 IRENA & EMBER
Coal	86180	47.9%	32.5%	35.5%	23.7%	17.8%	9.5%
Oil	1013	0.6%	0.4%	0.4%	0.3%	0.2%	0.1%
Natural gas	58431	32.5%	22.1%	24.1%	16.0%	12.0%	6.4%
Biofuels	1225	0.7%	1.6%	1.4%	2.1%	2.5%	3.0%
Hydro	31101	17.3%	40.7%	36.2%	54.3%	63.4%	76.0%
Solar PV	2027	1.1%	2.7%	2.4%	3.5%	4.1%	5.0%
<i>High carbon</i>	<i>145624</i>	<i>80.9%</i>	<i>55.0%</i>	<i>60.0%</i>	<i>40.0%</i>	<i>30.0%</i>	<i>16.0%</i>
<i>Low-carbon</i>	<i>34353</i>	<i>19.1%</i>	<i>45.0%</i>	<i>40.0%</i>	<i>60.0%</i>	<i>70.0%</i>	<i>84.0%</i>
<b>Ireland</b>							
Source	TWh consumed in 2022	% 2022	2030 BAD	2030 IRENA	2030 EMBER	2050 BAD	2050 IRENA & EMBER
Coal	2611	7.7%	2.6%	7.7%	5.1%	0.0%	2.1%
Oil	1074	3.2%	1.1%	3.2%	2.1%	0.0%	0.8%
Natural gas	16611	49.0%	16.4%	49.1%	32.7%	0.0%	13.1%
Biofuels	665	2.0%	3.9%	2.0%	2.9%	4.9%	4.1%
Waste	669	2.0%	3.9%	2.0%	2.9%	4.9%	4.1%
Hydro	954	2.8%	5.6%	2.8%	4.2%	7.0%	5.9%
Solar PV	115	0.3%	0.7%	0.3%	0.5%	0.8%	0.7%
Wind	11224	33.1%	65.9%	32.9%	49.4%	82.4%	69.2%
<i>High carbon</i>	<i>20296</i>	<i>59.8%</i>	<i>20.0%</i>	<i>60.0%</i>	<i>40.0%</i>	<i>0.0%</i>	<i>16.0%</i>
<i>Low-carbon</i>	<i>13627</i>	<i>40.2%</i>	<i>80.0%</i>	<i>40.0%</i>	<i>60.0%</i>	<i>100.0%</i>	<i>84.0%</i>

Equation (S1):  $BEE_{Scenario}$  estimation assuming to maintain a constant mix independently on the amount of electricity consumed to reach the GWP of the Baseline Scenario in 2022

$$a) BEE_{Cmix,Scenario} = BEE_{LC,Cmix,Scenario} + BEE_{HC,Cmix,Scenario}$$

$$b) BEE_{Cmix,Scenario} = \frac{GWP_{LC,Cmix}}{GWP_{LC,TWh}} + \frac{GWP_{HC,Cmix}}{GWP_{HC,TWh}}$$

$$c) BEE_{CmixScenario} = \frac{GWP_{tot} * C\%_{LC,Scenario}}{GWP_{LC,TWh}} + \frac{GWP_{tot} * C\%_{HC,Scenario}}{GWP_{HC,TWh}}$$

Where:  $BEE_{Cmix,Scenario}$  represent the breakeven electricity estimated per each scenario;  $BEE_{HC,Cmix,Scenario}$  represents the breakeven HCE estimated per each scenario;  $BEE_{LC,Cmix,Scenario}$  represents the breakeven LCE estimated per each scenario;  $GWP_{LC,Cmix}$  represents the GWP associated with the LCE amount consumed by assuming that the electricity mix remains constant independently on the amount of electricity consumed;  $GWP_{HC,Cmix}$  represents the GWP associated to the HCE amount consumed by assuming that the electricity mix remains constant independently on the amount of electricity consumed;  $GWP_{LC,TWh}$  is the GWP factor associated to the low carbon fraction of the mix, per consumed TWh;  $GWP_{HC,TWh}$  is the GWP factor associated to the high carbon fraction of the mix, per consumed TWh;  $GWP_{tot}$  is the GWP estimated for the Baseline scenario in 2022;  $C\%_{LC,Scenario}$  is the percentage contribution of LCE to the  $GWP_{tot}$  in each specific scenario; and  $C\%_{HC,Scenario}$  is the percentage contribution of HCE to the GWP in each specific scenario.

Equation (S2):  $BEE_{Scenario}$  estimation assuming that the excess of electricity need to reach the GWP of the Baseline Scenario in 2022 derives by the high carbon fraction of the mix modeled for each specific scenario.

$$a) BEE_{HCex,Scenario} = BEE_{LC,HCex,Scenario} + BEE_{HC,HCex,Scenario} +$$

$$b) BEE_{HCex,Scenario} = \frac{GWP_{LC,HCex}}{GWP_{LC,TWh}} + \frac{GWP_{HC,HCex}}{GWP_{HC,TWh}}$$

$$c) BEE_{HCex,Scenario} = \frac{GWP_{LC,HCex}}{GWP_{LC,TWh}} + \frac{GWP_{tot} - GWP_{LC,HCex}}{GWP_{HC,TWh}}$$

Where:  $BEE_{HCex,Scenario}$  represent the breakeven electricity estimated per each scenario;  $BEE_{HC,HCex,Scenario}$  represents the breakeven HCE estimated per each scenario;  $BEE_{LC,HCex,Scenario}$  represents the breakeven LCE estimated per each scenario;  $GWP_{LC,HCex}$  represents the GWP associated with the LCE amount consumed in each specific future Scenario when the electricity consumed is fixed at the amount consumed in 2022 (95.5 TWh, [1]);  $GWP_{HC,HCex}$  represents the GWP associated with the HCE consumed to reach the difference between  $GWP_{tot}$  and  $-GWP_{LC,HCex}$ .

Equation (S3):  $BEE_{Scenario}$  estimation assuming to maintain a constant mix independently on the amount of electricity consumed to reach the GWP of the Baseline Scenario in 2022 and including in the model the credit associated with heat recovery.

$$a) BEE_{Cmix,HR,Scenario} = BEE_{LC,Cmix,HR,Scenario} + BEE_{HC,Cmix,HR,Scenario}$$

$$b) GWP_{tot} = BEE_{HC,Cmix,Scenario} * GWP_{HC,TWh} - BEE_{HC,Cmix,Scenario} * GWP_{TWh} + BEE_{LC,Cmix,Scenario} * GWP_{LC,TWh} - BEE_{LC,Cmix,Scenario} * GWP_{TWh}$$

$$c) BEE_{Cmix,HR,Scenario} = BEE_{LC,Cmix,Scenario} + \frac{GWP_{tot} - GWP_{LC,Cmix} * (GWP_{LC,TWh} - GWP_{TWh})}{(GWP_{HC,TWh} - GWP_{TWh})}$$

Where the pedix "HR" means the inclusion of the heat recovery credit in the estimated value and  $GWP_{TWh}$  represents the GWP assigned to 1 TWh of heat consumed.

Equation (S4):  $BEE_{Scenario}$  estimation assuming that the excess of electricity need to reach the GWP of the Baseline Scenario in 2022 derives by the high carbon fraction of the mix modeled for each specific scenario, including in the model the credit associated with heat recovery

$$a) BEE_{HCex,HR,Scenario} = BEE_{LC,HCex,HR,Scenario,HR} + BEE_{HC,HCex,HR,Scenario,HR}$$

$$b) \text{ GWP}_{tot} = BEE_{HC,HCex,Scenario} * \text{GWP}_{HC,TWh} - BEE_{HC,HCex,Scenario} * \text{GWP}_{TWht} + \\ BEE_{LC,HCex,Scenario} * \text{GWP}_{LC,TWh} - BEE_{LC,HCex,Scenario} * \text{GWP}_{TWht}$$

$$c) BEE_{HCex,HR,Scenario} = BEE_{LC,HCex,Scenario} + \frac{\text{GWP}_{tot} - \text{GWP}_{LC,Cmix} * (\text{GWP}_{LC,TWh} - \text{GWP}_{TWht})}{(\text{GWP}_{HC,TWh} - \text{GWP}_{TWht})}$$

Table S4: GWP values, net of grid losses, estimated per each electricity source according to each modelled Scenario, assuming that the total electricity consumed for the mining is 95.52 TWh. Black font is assigned to High Carbon Sources and blue font is assigned to Low Carbon Sources

<b>United States</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {RoW}  heat and power co-generation, hard coal   APOS, U	5.18E+08	4.61E+08	5.39E+08	4.16E+08	2.65E+08	1.44E+08
Electricity, high voltage {RoW}  heat and power co-generation, lignite   APOS, U	4.71E+07	4.20E+07	4.91E+07	3.79E+07	2.41E+07	1.32E+07
Electricity, high voltage {RoW}  treatment of coal gas, in power plant   APOS, U	1.75E+07	1.56E+07	1.82E+07	1.41E+07	8.95E+06	4.88E+06
Electricity, high voltage {US-SERC}  electricity production, hard coal   APOS, U	9.22E+09	8.21E+09	9.60E+09	7.42E+09	4.72E+09	2.57E+09
Electricity, high voltage {US-SERC}  electricity production, hydro, pumped storage   APOS, U	1.08E+07	1.33E+07	1.13E+07	1.43E+07	9.29E+06	2.39E+07
Electricity, high voltage {US-SERC}  electricity production, hydro, reservoir, alpine region   APOS, U	7.45E+06	9.15E+06	7.78E+06	9.85E+06	6.39E+06	1.64E+07
Electricity, high voltage {US-SERC}  electricity production, hydro, run-of-river   APOS, U	2.50E+07	3.07E+07	2.61E+07	3.31E+07	2.15E+07	5.51E+07
Electricity, high voltage {US-SERC}  electricity production, natural gas, combined cycle power plant   APOS, U	6.56E+09	4.57E+09	6.83E+09	4.13E+09	5.96E+09	1.83E+09
Electricity, high voltage {US-SERC}  electricity production, natural gas, conventional power plant   APOS, U	1.22E+09	8.51E+08	1.27E+09	7.69E+08	1.11E+09	3.41E+08
Electricity, high voltage {US-SERC}  electricity production, nuclear, boiling water reactor   APOS, U	3.41E+07	3.44E+07	3.56E+07	3.70E+07	2.37E+07	7.52E+07
Electricity, high voltage {US-SERC}  electricity production, nuclear, pressure water reactor   APOS, U	7.08E+07	7.13E+07	7.39E+07	7.68E+07	4.92E+07	1.56E+08
Electricity, high voltage {US-SERC}  electricity production, oil   APOS, U	3.98E+08	0	0	0	0	0
Electricity, high voltage {US-SERC}  heat and power co-generation, oil   APOS, U	6.48E+06	0	0	0	0	0
Electricity, high voltage {US-SERC}  electricity production, wind, <1MW turbine, onshore   APOS, U	6.20E+06	9.63E+06	6.48E+06	1.04E+07	8.95E+06	1.37E+07
Electricity, high voltage {US-SERC}  electricity production, wind, >3MW turbine, onshore   APOS, U	9.33E+05	1.45E+06	9.74E+05	1.56E+06	1.35E+06	2.06E+06
Electricity, high voltage {US-SERC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	7.69E+07	1.19E+08	8.03E+07	1.29E+08	1.11E+08	1.70E+08
Electricity, high voltage {US-SERC}  heat and power co-generation, biogas, gas engine   APOS, U	1.05E+08	0	0	0	0	0
Electricity, high voltage {US-SERC}  heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014   APOS, U	5.60E+07	0	0	0	0	0
Electricity, low voltage {US-SERC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	1.30E+08	4.55E+08	1.35E+08	4.90E+08	7.17E+08	2.86E+08
Electricity, high voltage {US-SERC}  electricity production, deep geothermal   APOS, U	1.38E+07	2.91E+07	1.44E+07	3.14E+07	2.88E+07	3.04E+07
High Carbon	1.80E+10	1.42E+10	1.83E+10	1.28E+10	1.21E+10	4.91E+09
Low Carbon	5.37E+08	7.73E+08	3.92E+08	8.33E+08	9.77E+08	8.28E+08
<i>Total</i>	1.85E+10	1.49E+10	1.87E+10	1.36E+10	1.31E+10	5.74E+09



<b>China</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {CN-SC}  electricity production, hard coal   APOS, U	1.85E+10	1.32E+10	1.57E+10	1.05E+10	8.68E+08	4.18E+09
Electricity, high voltage {CN-SC}  electricity production, oil   APOS, U	3.57E+07	0	0	0	0	0
Electricity, high voltage {CN-SC}  electricity production, natural gas, combined cycle power plant   APOS, U	4.56E+08	8.07E+08	9.61E+08	6.41E+08	5.20E+08	2.56E+08
Electricity, high voltage {CN-SC}  electricity production, natural gas, conventional power plant   APOS, U	1.19E+08	2.11E+08	2.52E+08	1.68E+08	1.36E+08	6.71E+07
Electricity, high voltage {CN}  ethanol production from sweet sorghum   APOS, U	4.16E+06	3.44E+06	2.77E+06	4.16E+06	2.58E+06	5.82E+06
Electricity, for reuse in municipal waste incineration only {JP}  market for electricity, for reuse in municipal waste incineration only   APOS, U	4.10E+07	3.40E+07	2.74E+07	4.11E+07	2.55E+07	5.75E+07
Electricity, high voltage {CN-SH}  electricity production, nuclear, pressure water reactor   APOS, U	1.67E+07	1.67E+07	1.34E+07	2.02E+07	1.67E+07	2.82E+07
Electricity, high voltage {CN-SC}  electricity production, hydro, run-of-river   APOS, U	4.36E+07	3.75E+07	3.03E+07	4.54E+07	2.99E+07	6.35E+07
Electricity, high voltage {CN-SH}  electricity production, deep geothermal   APOS, U	1.79E+04	1.54E+04	1.24E+04	1.86E+04	1.22E+04	2.60E+04
Electricity, low voltage {CN-SC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	7.54E+07	3.26E+08	2.63E+08	3.94E+08	7.58E+08	5.52E+08
Electricity, high voltage {CN-SC}  electricity production, wind, <1MW turbine, onshore   APOS, U	5.13E+05	9.00E+05	7.26E+05	1.09E+06	2.59E+06	1.52E+06
Electricity, high voltage {CN-SC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	5.47E+07	9.59E+07	7.73E+07	1.16E+08	2.76E+08	1.62E+08
High Carbon	1.91E+10	1.42E+10	1.69E+10	1.13E+10	1.53E+09	4.51E+09
Low Carbon	2.32E+08	5.11E+08	4.12E+08	6.18E+08	1.11E+09	8.65E+08
<i>Total</i>	1.93E+10	1.47E+10	1.73E+10	1.19E+10	2.63E+09	5.38E+09
<b>Kazakhstan</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {RoW}  heat and power co-generation, hard coal   APOS, U	9.88E+09	9.74E+09	6.81E+09	4.51E+09	5.65E+09	1.79E+09
Electricity, high voltage {RoW}  heat and power co-generation, oil   APOS, U	3.59E+08	0	0	0	0	0
Electricity, high voltage {RoW}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	2.53E+09	2.49E+09	1.74E+09	1.15E+09	1.45E+09	4.58E+08
Electricity, high voltage {RoW}  heat and power co-generation, biogas, gas engine   APOS, U	6.60E+04	9.34E+04	2.47E+05	3.67E+05	3.07E+05	5.10E+05
Electricity, high voltage {RoW}  electricity production, hydro, run-of-river   APOS, U	1.40E+07	1.99E+07	5.25E+07	7.82E+07	6.54E+07	1.09E+08
Electricity, high voltage {RoW}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	4.98E+06	7.05E+06	1.86E+07	2.77E+07	2.32E+07	3.85E+07
Electricity, low voltage {RU}  electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted   APOS, U	2.11E+07	2.98E+07	7.88E+07	1.17E+08	9.81E+07	1.63E+08
High Carbon	1.28E+10	1.22E+10	8.55E+09	5.66E+09	7.10E+09	2.24E+09
Low Carbon	4.02E+07	5.69E+07	1.50E+08	2.24E+08	1.87E+08	3.10E+08

<i>Total</i>	1.28E+10	1.23E+10	8.70E+09	5.88E+09	7.29E+09	2.55E+09
<b>Canada</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {CA-QC}  electricity production, hard coal   APOS, U	4.19E+07	2.39E+07	4.19E+07	4.19E+07	0	4.18E+07
Electricity, high voltage {CA-QC}  electricity production, oil   APOS, U	5.43E+06	3.09E+06	5.43E+06	5.43E+06	0	5.41E+06
Electricity, high voltage {CA-ON}  electricity production, natural gas, conventional power plant   APOS, U	7.55E+07	4.30E+07	7.55E+07	7.55E+07	0	7.52E+07
Electricity, high voltage {CA-QC}  heat and power co-generation, biogas, gas engine   APOS, U	2.27E+06	2.48E+06	2.27E+06	2.27E+06	2.76E+06	2.27E+06
Electricity, for reuse in municipal waste incineration only {CA}  treatment of municipal solid waste, municipal incineration   APOS, U	4.27E+05	4.66E+05	4.27E+05	4.27E+05	5.17E+05	4.25E+05
Electricity, high voltage {CA-QC}  electricity production, nuclear, pressure water reactor, heavy water moderated   APOS, U	6.11E+06	6.67E+06	6.11E+06	6.11E+06	7.41E+06	6.09E+06
Electricity, high voltage {CA-QC}  electricity production, hydro, reservoir, non-alpine region   APOS, U	1.78E+07	1.95E+07	1.78E+07	1.78E+07	2.16E+07	1.78E+07
Electricity, high voltage {CA-QC}  electricity production, hydro, run-of-river   APOS, U	9.29E+06	1.01E+07	9.29E+06	9.29E+06	1.13E+07	9.25E+06
Electricity, low voltage {CA-QC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	8.08E+05	8.82E+05	8.82E+05	8.82E+05	1.07E+06	1.07E+06
Electricity, high voltage {CA-QC}  electricity production, wind, <1MW turbine, onshore   APOS, U	1.02E+05	1.11E+05	1.02E+05	1.02E+05	1.23E+05	1.01E+05
Electricity, high voltage {CA-QC}  electricity production, wind, >3MW turbine, onshore   APOS, U	2.17E+06	2.36E+06	2.17E+06	2.17E+06	2.63E+06	2.16E+06
Electricity, high voltage {CA-QC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	7.86E+05	8.58E+05	7.86E+05	7.86E+05	9.53E+05	7.83E+05
High Carbon	1.23E+08	7.01E+07	1.23E+08	1.23E+08	0	1.22E+08
Low Carbon	3.98E+07	4.34E+07	3.99E+07	3.99E+07	4.83E+07	3.99E+07
<i>Total</i>	1.63E+08	1.13E+08	1.63E+08	1.63E+08	4.83E+07	1.62E+08
<b>Russia</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {RU}  heat and power co-generation, hard coal   APOS, U	1.48E+08	9.80E+07	5.06E+07	1.07E+08	9.76E+07	5.06E+07
Electricity, high voltage {RU}  heat and power co-generation, oil   APOS, U	3.63E+06	0	0	0	0	0
Electricity, high voltage {RU}  heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical   APOS, U	6.70E+06	4.99E+06	2.58E+06	5.45E+06	4.97E+06	2.58E+06
Electricity, high voltage {RU}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	1.93E+08	1.44E+08	7.44E+07	1.57E+08	1.43E+08	7.44E+07
Electricity, high voltage {RoW}  ethanol production from sweet sorghum   APOS, U	3.09E+03	7.61E+06	0	0	5.48E+03	0
Electricity, for reuse in municipal waste incineration only {RU}  treatment of municipal solid waste, municipal incineration   APOS, U	3.67E+06	3.76E+07	7.09E+07	4.78E+07	5.17E+07	7.09E+07
Electricity, high voltage {RU}  electricity production, nuclear, boiling water reactor   APOS, U	3.55E+06	7.05E+05	1.33E+06	8.98E+05	9.70E+05	1.33E+06
Electricity, high voltage {RU}  electricity production, nuclear, pressure water reactor   APOS, U	4.63E+06	9.20E+05	1.74E+06	1.17E+06	1.27E+06	1.74E+06

Electricity, high voltage {RU}  electricity production, hydro, pumped storage   APOS, U	8.38E+05	1.07E+06	2.02E+06	1.36E+06	1.47E+06	2.02E+06
Electricity, high voltage {RU}  electricity production, hydro, reservoir, non-alpine region   APOS, U	2.95E+06	3.76E+06	7.09E+06	4.78E+06	5.17E+06	7.09E+06
Electricity, high voltage {RU}  electricity production, hydro, run-of-river   APOS, U	5.68E+06	7.24E+06	1.37E+07	9.22E+06	9.96E+06	1.37E+07
Electricity, high voltage {RU}  electricity production, deep geothermal   APOS, U	2.75E+04	1.88E+06	3.54E+06	2.39E+06	2.58E+06	3.54E+06
Electricity, low voltage {RU}  electricity production, photovoltaic, 3kWp slanted-roof installation, single-Si, panel, mounted   APOS, U	1.59E+05	1.07E+06	2.01E+06	1.36E+06	1.47E+06	2.01E+06
Electricity, high voltage {RU}  electricity production, wind, <1MW turbine, onshore   APOS, U	2.59E+05	5.58E+06	1.05E+07	7.11E+06	7.68E+06	1.05E+07
High Carbon	3.51E+08	2.54E+08	1.28E+08	2.70E+08	2.46E+08	1.28E+08
Low Carbon	2.18E+07	5.98E+07	1.13E+08	7.61E+07	8.23E+07	1.13E+08
<i>Total</i>	3.73E+08	3.14E+08	2.40E+08	3.46E+08	3.28E+08	2.40E+08
<b>Germany</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {DE}  heat and power co-generation, hard coal   APOS, U	2.60E+07	1.05E+07	2.60E+07	2.60E+07	0	8.43E+06
Electricity, high voltage {DE}  electricity production, hard coal   APOS, U	9.56E+07	3.88E+07	9.56E+07	9.56E+07	0	3.10E+07
Electricity, high voltage {DE}  heat and power co-generation, oil   APOS, U	3.30E+05	1.34E+05	3.30E+05	3.30E+05	0	1.07E+05
Electricity, high voltage {DE}  electricity production, oil   APOS, U	2.29E+06	9.27E+05	2.29E+06	2.29E+06	0	7.42E+05
Electricity, high voltage {DE}  electricity production, natural gas, conventional power plant   APOS, U	7.10E+06	2.88E+06	7.10E+06	7.10E+06	0	2.31E+06
Electricity, high voltage {DE}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	1.88E+07	7.64E+06	1.88E+07	1.88E+07	0	6.11E+06
Electricity, high voltage {DE}  heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical   APOS, U	2.45E+05	9.96E+04	2.45E+05	2.45E+05	0	7.97E+04
Electricity, high voltage {DE}  electricity production, natural gas, combined cycle power plant   APOS, U	7.45E+06	3.02E+06	7.45E+06	7.45E+06	0	2.42E+06
Electricity, high voltage {DE}  heat and power co-generation, biogas, gas engine   APOS, U	5.79E+06	9.14E+06	5.79E+06	5.79E+06	1.14E+07	9.60E+06
Electricity, high voltage {DE}  heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014   APOS, U	5.08E+05	8.02E+05	5.08E+05	5.08E+05	1.00E+06	8.42E+05
Electricity, for reuse in municipal waste incineration only {DE}  market for electricity, for reuse in municipal waste incineration only   APOS, U	7.24E+06	1.14E+07	7.24E+06	7.24E+06	1.43E+07	1.20E+07
Electricity, high voltage {DE}  electricity production, nuclear, boiling water reactor   APOS, U	3.47E+05	5.47E+05	3.47E+05	3.47E+05	6.84E+05	5.74E+05
Electricity, high voltage {DE}  electricity production, nuclear, pressure water reactor   APOS, U	1.27E+06	2.01E+06	1.27E+06	1.27E+06	2.51E+06	2.11E+06
Electricity, high voltage {DE}  electricity production, hydro, pumped storage   APOS, U	2.53E+06	3.99E+06	2.53E+06	2.53E+06	4.99E+06	4.19E+06
Electricity, high voltage {DE}  electricity production, hydro, reservoir, non-alpine region   APOS, U	1.96E+05	3.09E+05	1.96E+05	1.96E+05	3.86E+05	3.25E+05
Electricity, high voltage {DE}  electricity production, hydro, run-of-river   APOS, U	6.61E+05	1.04E+06	6.61E+05	6.61E+05	1.30E+06	1.10E+06
Electricity, high voltage {DE}  electricity production, deep geothermal   APOS, U	2.03E+04	3.20E+04	2.03E+04	2.03E+04	4.00E+04	3.36E+04

Electricity, low voltage {DE}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	5.97E+06	9.42E+06	5.97E+06	5.97E+06	1.18E+07	9.89E+06
Electricity, high voltage {DE}  electricity production, wind, <1MW turbine, onshore   APOS, U	9.23E+05	1.46E+06	9.23E+05	9.23E+05	1.82E+06	1.53E+06
Electricity, high voltage {DE}  electricity production, wind, >3MW turbine, onshore   APOS, U	6.36E+05	1.00E+06	6.36E+05	6.36E+05	1.25E+06	1.05E+06
Electricity, high voltage {DE}  electricity production, wind, 1-3MW turbine, offshore   APOS, U	1.87E+05	2.95E+05	1.87E+05	1.87E+05	3.69E+05	3.10E+05
Electricity, high voltage {DE}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	5.13E+06	8.09E+06	5.13E+06	5.13E+06	1.01E+07	8.49E+06
High Carbon	1.58E+08	6.40E+07	1.58E+08	1.58E+08	0	5.12E+07
Low Carbon	3.14E+07	4.96E+07	3.14E+07	3.14E+07	6.20E+07	5.20E+07
<i>Total</i>	1.89E+08	1.14E+08	1.89E+08	1.89E+08	6.20E+07	1.03E+08
<b>Malaysia</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {MY}  electricity production, hard coal   APOS, U	1.61E+08	1.09E+08	1.19E+08	7.94E+07	5.96E+07	5.96E+07
Electricity, high voltage {MY}  electricity production, oil   APOS, U	1.71E+06	1.16E+06	1.27E+06	8.45E+05	6.34E+05	6.34E+05
Electricity, high voltage {MY}  electricity production, natural gas, combined cycle power plant   APOS, U	3.35E+07	2.27E+07	2.48E+07	1.65E+07	1.24E+07	1.24E+07
Electricity, high voltage {MY}  electricity production, natural gas, conventional power plant   APOS, U	2.67E+07	1.82E+07	1.98E+07	1.32E+07	9.91E+06	9.91E+06
Electricity, high voltage {MY}  heat and power co-generation, wood chips, 6667 kW   APOS, U	2.51E+05	5.93E+05	5.27E+05	7.90E+05	9.22E+05	9.22E+05
Electricity, high voltage {MY}  electricity production, hydro, reservoir, tropical region   APOS, U	6.88E+06	1.62E+07	1.44E+07	2.16E+07	2.52E+07	2.52E+07
Electricity, low voltage {MY}  electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted   APOS, U	4.53E+05	1.07E+06	9.50E+05	1.42E+06	1.66E+06	1.66E+06
High Carbon	2.23E+08	1.51E+08	1.65E+08	1.10E+08	8.25E+07	8.25E+07
Low Carbon	7.58E+06	1.79E+07	1.59E+07	2.38E+07	2.78E+07	2.78E+07
<i>Total</i>	2.30E+08	1.69E+08	1.81E+08	1.34E+08	1.10E+08	1.10E+08
<b>Ireland</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {IE}  electricity production, hard coal   APOS, U	1.76E+07	5.89E+06	1.77E+07	1.18E+07	0	4.71E+06
Electricity, high voltage {IE}  electricity production, oil   APOS, U	7.03E+06	2.35E+06	7.05E+06	4.70E+06	0	1.88E+06
Electricity, high voltage {IE}  electricity production, natural gas, combined cycle power plant   APOS, U	3.42E+07	1.14E+07	3.43E+07	2.29E+07	0	9.14E+06
Electricity, high voltage {IE}  electricity production, natural gas, conventional power plant   APOS, U	2.53E+07	8.47E+06	2.54E+07	1.69E+07	0	6.78E+06
Electricity, high voltage {IE}  heat and power co-generation, biogas, gas engine   APOS, U	2.78E+05	5.55E+05	2.77E+05	4.16E+05	6.93E+05	5.82E+05
Electricity, high voltage {IE}  heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014   APOS, U	4.19E+05	8.35E+05	4.18E+05	6.26E+05	1.04E+06	8.77E+05

Electricity, for reuse in municipal waste incineration only {GB}  market for electricity, for reuse in municipal waste incineration only   APOS, U	4.54E+06	9.03E+06	4.52E+06	6.77E+06	1.13E+07	9.48E+06
Electricity, high voltage {IE}  electricity production, hydro, pumped storage   APOS, U	8.26E+05	1.65E+06	8.23E+05	1.23E+06	2.06E+06	1.73E+06
Electricity, high voltage {IE}  electricity production, hydro, run-of-river   APOS, U	3.69E+05	7.35E+05	3.68E+05	5.52E+05	9.19E+05	7.72E+05
Electricity, low voltage {IE}  electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted   APOS, U	1.10E+05	2.20E+05	1.10E+05	1.65E+05	2.74E+05	2.31E+05
Electricity, high voltage {IE}  electricity production, wind, <1MW turbine, onshore   APOS, U	1.17E+06	2.33E+06	1.16E+06	1.75E+06	2.91E+06	2.44E+06
Electricity, high voltage {IE}  electricity production, wind, >3MW turbine, onshore   APOS, U	2.28E+05	4.55E+05	2.27E+05	3.41E+05	5.69E+05	4.78E+05
Electricity, high voltage {IE}  electricity production, wind, 1-3MW turbine, offshore   APOS, U	7.34E+04	1.46E+05	7.31E+04	1.10E+05	1.83E+05	1.54E+05
Electricity, high voltage {IE}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	4.95E+06	9.85E+06	4.92E+06	7.39E+06	1.23E+07	1.03E+07
High Carbon	8.42E+07	2.81E+07	8.44E+07	5.63E+07	0	2.25E+07
Low Carbon	1.30E+07	2.58E+07	1.29E+07	1.94E+07	3.23E+07	2.71E+07
<i>Total</i>	9.71E+07	5.39E+07	9.73E+07	7.56E+07	3.23E+07	4.96E+07

Table S 5: GWP values, net of grid losses, estimated per each electricity source according to each modelled Scenario, assuming that the annual electricity consumed for the mining is 85.97 TWh (-10% with respect to the annual consumption estimated for 2022). Black font is assigned to High Carbon Sources and blue font is assigned to Low Carbon Sources

United States	Baseline (kg CO <sub>2</sub> eq)	2030 BAD (kg CO <sub>2</sub> eq)	2030 IRENA (kg CO <sub>2</sub> eq)	2030 EMEBER (kg CO <sub>2</sub> eq)	2050 BAD (kg CO <sub>2</sub> eq)	2050 IRENA & EMEBER (kg CO <sub>2</sub> eq)
Electricity, high voltage {RoW}  heat and power co-generation, hard coal   APOS, U	4.30E+08	3.57E+08	4.49E+08	3.12E+08	2.06E+08	5.51E+07
Electricity, high voltage {RoW}  heat and power co-generation, lignite   APOS, U	3.91E+07	3.25E+07	4.09E+07	2.84E+07	1.87E+07	5.02E+06
Electricity, high voltage {RoW}  treatment of coal gas, in power plant   APOS, U	1.45E+07	1.20E+07	1.52E+07	1.05E+07	6.95E+06	1.86E+06
Electricity, high voltage {US-SERC}  electricity production, hard coal   APOS, U	7.65E+09	6.35E+09	8.00E+09	5.56E+09	3.66E+09	9.82E+08
Electricity, high voltage {US-SERC}  electricity production, hydro, pumped storage   APOS, U	1.08E+07	1.33E+07	1.13E+07	1.43E+07	9.29E+06	2.39E+07
Electricity, high voltage {US-SERC}  electricity production, hydro, reservoir, alpine region   APOS, U	7.45E+06	9.15E+06	7.78E+06	9.85E+06	6.39E+06	1.64E+07
Electricity, high voltage {US-SERC}  electricity production, hydro, run-of-river   APOS, U	2.50E+07	3.07E+07	2.61E+07	3.31E+07	2.15E+07	5.51E+07
Electricity, high voltage {US-SERC}  electricity production, natural gas, combined cycle power plant   APOS, U	5.45E+09	3.54E+09	5.70E+09	3.10E+09	4.63E+09	6.99E+08
Electricity, high voltage {US-SERC}  electricity production, natural gas, conventional power plant   APOS, U	1.01E+09	6.58E+08	1.06E+09	5.76E+08	8.60E+08	1.30E+08
Electricity, high voltage {US-SERC}  electricity production, nuclear, boiling water reactor   APOS, U	3.41E+07	3.44E+07	3.56E+07	3.70E+07	2.37E+07	7.52E+07
Electricity, high voltage {US-SERC}  electricity production, nuclear, pressure water reactor   APOS, U	7.08E+07	7.13E+07	7.39E+07	7.68E+07	4.92E+07	1.56E+08
Electricity, high voltage {US-SERC}  electricity production, oil   APOS, U	3.30E+08	0	0	0	0	0
Electricity, high voltage {US-SERC}  heat and power co-generation, oil   APOS, U	5.38E+06	0	0	0	0	0

Electricity, high voltage {US-SERC}  electricity production, wind, <1MW turbine, onshore   APOS, U	6.20E+06	9.63E+06	6.48E+06	1.04E+07	8.95E+06	1.37E+07
Electricity, high voltage {US-SERC}  electricity production, wind, >3MW turbine, onshore   APOS, U	9.33E+05	1.45E+06	9.74E+05	1.56E+06	1.35E+06	2.06E+06
Electricity, high voltage {US-SERC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	7.69E+07	1.19E+08	8.03E+07	1.29E+08	1.11E+08	1.70E+08
Electricity, high voltage {US-SERC}  heat and power co-generation, biogas, gas engine   APOS, U	1.05E+08	0	0	0	0	0
Electricity, high voltage {US-SERC}  heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014   APOS, U	5.60E+07	0	0	0	0	0
Electricity, low voltage {US-SERC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	1.30E+08	4.55E+08	1.35E+08	4.90E+08	7.17E+08	2.86E+08
Electricity, high voltage {US-SERC}  electricity production, deep geothermal   APOS, U	1.38E+07	2.91E+07	1.44E+07	3.14E+07	2.88E+07	3.04E+07
High Carbon	1.49E+10	1.10E+10	1.53E+10	9.59E+09	9.38E+09	1.87E+09
Low Carbon	5.37E+08	7.73E+08	3.92E+08	8.33E+08	9.77E+08	8.28E+08
<i>Total</i>	1.55E+10	1.17E+10	1.57E+10	1.04E+10	1.04E+10	2.70E+09
<b>China</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {CN-SC}  electricity production, hard coal   APOS, U	1.58E+10	1.06E+10	1.31E+10	7.94E+09	0	1.92E+09
Electricity, high voltage {CN-SC}  electricity production, oil   APOS, U	3.05E+07	0	0	0	0	0
Electricity, high voltage {CN-SC}  electricity production, natural gas, combined cycle power plant   APOS, U	3.89E+08	6.51E+08	8.03E+08	4.87E+08	0	1.17E+08
Electricity, high voltage {CN-SC}  electricity production, natural gas, conventional power plant   APOS, U	1.02E+08	1.70E+08	2.10E+08	1.27E+08	0	3.08E+07
Electricity, high voltage {CN}  ethanol production from sweet sorghum   APOS, U	3.55E+06	2.77E+06	2.32E+06	3.16E+06	0	2.67E+06
Electricity, for reuse in municipal waste incineration only {JP}  market for electricity, for reuse in municipal waste incineration only   APOS, U	4.10E+07	3.40E+07	2.74E+07	4.11E+07	2.49E+07	5.75E+07
Electricity, high voltage {CN-SH}  electricity production, nuclear, pressure water reactor   APOS, U	1.67E+07	1.67E+07	1.34E+07	2.02E+07	1.63E+07	2.82E+07
Electricity, high voltage {CN-SC}  electricity production, hydro, run-of-river   APOS, U	4.36E+07	3.75E+07	3.03E+07	4.54E+07	2.91E+07	6.35E+07
Electricity, high voltage {CN-SH}  electricity production, deep geothermal   APOS, U	1.79E+04	1.54E+04	1.24E+04	1.86E+04	1.19E+04	2.60E+04
Electricity, low voltage {CN-SC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	7.54E+07	3.26E+08	2.63E+08	3.94E+08	7.38E+08	5.52E+08
Electricity, high voltage {CN-SC}  electricity production, wind, <1MW turbine, onshore   APOS, U	5.13E+05	9.00E+05	7.26E+05	1.09E+06	2.52E+06	1.52E+06
Electricity, high voltage {CN-SC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	5.47E+07	9.59E+07	7.73E+07	1.16E+08	2.69E+08	1.62E+08
High Carbon	1.63E+10	1.14E+10	1.41E+10	8.56E+09	0	2.07E+09
Low Carbon	2.32E+08	5.11E+08	4.12E+08	6.18E+08	1.08E+09	8.65E+08
<i>Total</i>	1.65E+10	1.20E+10	1.45E+10	9.18E+09	1.08E+09	2.93E+09
<b>Kazakhstan</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)

Electricity, high voltage {RoW}  heat and power co-generation, hard coal   APOS, U	2.48E+09	0	0	0	0	0
Electricity, high voltage {RoW}  heat and power co-generation, oil   APOS, U	9.01E+07	0	0	0	0	0
Electricity, high voltage {RoW}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	6.35E+08	0	0	0	0	0
Electricity, high voltage {RoW}  heat and power co-generation, biogas, gas engine   APOS, U	4.08E+05	5.43E+05	5.43E+05	5.43E+05	5.43E+05	5.43E+05
Electricity, high voltage {RoW}  electricity production, hydro, run-of-river   APOS, U	8.69E+07	1.16E+08	1.16E+08	1.16E+08	1.16E+08	1.16E+08
Electricity, high voltage {RoW}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	3.08E+07	4.10E+07	4.10E+07	4.10E+07	4.10E+07	4.10E+07
Electricity, low voltage {RU}  electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted   APOS, U	1.30E+08	1.73E+08	1.73E+08	1.73E+08	1.73E+08	1.73E+08
High Carbon	3.21E+09	0	0	0	0	0
Low Carbon	2.48E+08	3.30E+08	3.30E+08	3.30E+08	3.30E+08	3.30E+08
<i>Total</i>	3.45E+09	3.30E+08	3.30E+08	3.30E+08	3.30E+08	3.30E+08
<b>Canada</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {CA-QC}  electricity production, hard coal   APOS, U	7.34E+07	0	7.32E+07	7.32E+07	0	7.33E+07
Electricity, high voltage {CA-QC}  electricity production, oil   APOS, U	9.50E+06	0	9.48E+06	9.48E+06	0	9.49E+06
Electricity, high voltage {CA-ON}  electricity production, natural gas, conventional power plant   APOS, U	1.32E+08	0	1.32E+08	1.32E+08	0	1.32E+08
Electricity, high voltage {CA-QC}  heat and power co-generation, biogas, gas engine   APOS, U	2.27E+06	2.48E+06	2.27E+06	2.27E+06	3.45E+06	2.27E+06
Electricity, for reuse in municipal waste incineration only {CA}  treatment of municipal solid waste, municipal incineration   APOS, U	4.27E+05	4.66E+05	4.27E+05	4.27E+05	6.47E+05	4.25E+05
Electricity, high voltage {CA-QC}  electricity production, nuclear, pressure water reactor, heavy water moderated   APOS, U	6.11E+06	6.67E+06	6.11E+06	6.11E+06	9.28E+06	6.09E+06
Electricity, high voltage {CA-QC}  electricity production, hydro, reservoir, non-alpine region   APOS, U	1.78E+07	1.95E+07	1.78E+07	1.78E+07	2.70E+07	1.78E+07
Electricity, high voltage {CA-QC}  electricity production, hydro, run-of-river   APOS, U	9.29E+06	1.01E+07	9.29E+06	9.29E+06	1.41E+07	9.25E+06
Electricity, low voltage {CA-QC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	8.08E+05	8.82E+05	8.82E+05	8.82E+05	1.34E+06	1.07E+06
Electricity, high voltage {CA-QC}  electricity production, wind, <1MW turbine, onshore   APOS, U	1.02E+05	1.11E+05	1.02E+05	1.02E+05	1.54E+05	1.01E+05
Electricity, high voltage {CA-QC}  electricity production, wind, >3MW turbine, onshore   APOS, U	2.17E+06	2.36E+06	2.17E+06	2.17E+06	3.29E+06	2.16E+06
Electricity, high voltage {CA-QC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	7.86E+05	8.58E+05	7.86E+05	7.86E+05	1.19E+06	7.83E+05
High Carbon	2.15E+08	0	2.15E+08	2.15E+08	0	2.15E+08
Low Carbon	3.98E+07	4.34E+07	3.99E+07	3.99E+07	6.05E+07	3.99E+07
<i>Total</i>	2.55E+08	4.34E+07	2.54E+08	2.54E+08	6.05E+07	2.55E+08

<b>Russia</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {RU}  heat and power co-generation, hard coal   APOS, U	1.24E+08	8.14E+07	2.82E+07	8.47E+07	7.52E+07	2.82E+07
Electricity, high voltage {RU}  heat and power co-generation, oil   APOS, U	3.03E+06	0	0	0	0	0
Electricity, high voltage {RU}  heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical   APOS, U	5.60E+06	4.14E+06	1.44E+06	4.31E+06	3.83E+06	1.44E+06
Electricity, high voltage {RU}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	1.62E+08	1.20E+08	4.15E+07	1.24E+08	1.10E+08	4.15E+07
Electricity, high voltage {RoW}  ethanol production from sweet sorghum   APOS, U	2.59E+03	6.33E+06	0	0	4.22E+03	0
Electricity, for reuse in municipal waste incineration only {RU}  treatment of municipal solid waste, municipal incineration   APOS, U	3.67E+06	3.76E+07	7.09E+07	4.78E+07	5.17E+07	7.09E+07
Electricity, high voltage {RU}  electricity production, nuclear, boiling water reactor   APOS, U	3.55E+06	7.05E+05	1.33E+06	8.98E+05	9.70E+05	1.33E+06
Electricity, high voltage {RU}  electricity production, nuclear, pressure water reactor   APOS, U	4.63E+06	9.20E+05	1.74E+06	1.17E+06	1.27E+06	1.74E+06
Electricity, high voltage {RU}  electricity production, hydro, pumped storage   APOS, U	8.38E+05	1.07E+06	2.02E+06	1.36E+06	1.47E+06	2.02E+06
Electricity, high voltage {RU}  electricity production, hydro, reservoir, non-alpine region   APOS, U	2.95E+06	3.76E+06	7.09E+06	4.78E+06	5.17E+06	7.09E+06
Electricity, high voltage {RU}  electricity production, hydro, run-of-river   APOS, U	5.68E+06	7.24E+06	1.37E+07	9.22E+06	9.96E+06	1.37E+07
Electricity, high voltage {RU}  electricity production, deep geothermal   APOS, U	2.75E+04	1.88E+06	3.54E+06	2.39E+06	2.58E+06	3.54E+06
Electricity, low voltage {RU}  electricity production, photovoltaic, 3kWp slanted-roof installation, single-Si, panel, mounted   APOS, U	1.59E+05	1.07E+06	2.01E+06	1.36E+06	1.47E+06	2.01E+06
Electricity, high voltage {RU}  electricity production, wind, <1MW turbine, onshore   APOS, U	2.59E+05	5.58E+06	1.05E+07	7.11E+06	7.68E+06	1.05E+07
High Carbon	2.94E+08	2.11E+08	7.11E+07	2.13E+08	1.90E+08	7.11E+07
Low Carbon	2.18E+07	5.98E+07	1.13E+08	7.61E+07	8.23E+07	1.13E+08
<i>Total</i>	3.16E+08	2.71E+08	1.84E+08	2.89E+08	2.72E+08	1.84E+08
<b>Germany</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {DE}  heat and power co-generation, hard coal   APOS, U	2.08E+07	5.36E+06	2.08E+07	2.08E+07	0	3.25E+06
Electricity, high voltage {DE}  electricity production, hard coal   APOS, U	7.66E+07	1.97E+07	7.66E+07	7.66E+07	0	1.20E+07
Electricity, high voltage {DE}  heat and power co-generation, oil   APOS, U	2.64E+05	6.82E+04	2.64E+05	2.64E+05	0	4.14E+04
Electricity, high voltage {DE}  electricity production, oil   APOS, U	1.83E+06	4.72E+05	1.83E+06	1.83E+06	0	2.86E+05
Electricity, high voltage {DE}  electricity production, natural gas, conventional power plant   APOS, U	5.69E+06	1.47E+06	5.69E+06	5.69E+06	0	8.90E+05
Electricity, high voltage {DE}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	1.51E+07	3.89E+06	1.51E+07	1.51E+07	0	2.36E+06





High Carbon	2.62E+08	2.50E+08	6.43E+07	1.93E+08	1.72E+08	6.43E+07
Low Carbon	3.57E+07	3.57E+07	3.57E+07	3.57E+07	3.57E+07	3.57E+07
<i>Total</i>	2.97E+08	2.86E+08	1.00E+08	2.29E+08	2.07E+08	1.00E+08
<b>Ireland</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {IE}  electricity production, hard coal   APOS, U	1.47E+07	2.94E+06	1.47E+07	8.83E+06	0	1.77E+06
Electricity, high voltage {IE}  electricity production, oil   APOS, U	5.85E+06	1.17E+06	5.87E+06	3.52E+06	0	7.05E+05
Electricity, high voltage {IE}  electricity production, natural gas, combined cycle power plant   APOS, U	2.85E+07	5.72E+06	2.86E+07	1.71E+07	0	3.43E+06
Electricity, high voltage {IE}  electricity production, natural gas, conventional power plant   APOS, U	2.11E+07	4.24E+06	2.12E+07	1.27E+07	0	2.54E+06
Electricity, high voltage {IE}  heat and power co-generation, biogas, gas engine   APOS, U	2.78E+05	5.55E+05	2.77E+05	4.16E+05	6.24E+05	5.82E+05
Electricity, high voltage {IE}  heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014   APOS, U	4.19E+05	8.35E+05	4.18E+05	6.26E+05	9.40E+05	8.77E+05
Electricity, for reuse in municipal waste incineration only {GB}  market for electricity, for reuse in municipal waste incineration only   APOS, U	4.54E+06	9.03E+06	4.52E+06	6.77E+06	1.02E+07	9.48E+06
Electricity, high voltage {IE}  electricity production, hydro, pumped storage   APOS, U	8.26E+05	1.65E+06	8.23E+05	1.23E+06	1.85E+06	1.73E+06
Electricity, high voltage {IE}  electricity production, hydro, run-of-river   APOS, U	3.69E+05	7.35E+05	3.68E+05	5.52E+05	8.27E+05	7.72E+05
Electricity, low voltage {IE}  electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted   APOS, U	1.10E+05	2.20E+05	1.10E+05	1.65E+05	2.47E+05	2.31E+05
Electricity, high voltage {IE}  electricity production, wind, <1MW turbine, onshore   APOS, U	1.17E+06	2.33E+06	1.16E+06	1.75E+06	2.62E+06	2.44E+06
Electricity, high voltage {IE}  electricity production, wind, >3MW turbine, onshore   APOS, U	2.28E+05	4.55E+05	2.27E+05	3.41E+05	5.12E+05	4.78E+05
Electricity, high voltage {IE}  electricity production, wind, 1-3MW turbine, offshore   APOS, U	7.34E+04	1.46E+05	7.31E+04	1.10E+05	1.65E+05	1.54E+05
Electricity, high voltage {IE}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	4.95E+06	9.85E+06	4.92E+06	7.39E+06	1.11E+07	1.03E+07
High Carbon	7.01E+07	1.41E+07	7.03E+07	4.22E+07	0	8.44E+06
Low Carbon	1.30E+07	2.58E+07	1.29E+07	1.94E+07	2.90E+07	2.71E+07
<i>Total</i>	8.31E+07	3.99E+07	8.32E+07	6.16E+07	2.90E+07	3.55E+07

Table S6:GWP values, net of grid losses, estimated per each electricity source according to each modelled Scenario, assuming that the annual electricity consumed for the mining is 105.07 TWh (+10% with respect to the annual consumption estimated for 2022). Black font is assigned to High Carbon Sources and blue font is assigned to Low Carbon Sources.

<b>United States</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {RoW}  heat and power co-generation, hard coal   APOS, U	6.05E+08	5.65E+08	6.28E+08	5.20E+08	3.24E+08	2.34E+08
Electricity, high voltage {RoW}  heat and power co-generation, lignite   APOS, U	5.51E+07	5.15E+07	5.72E+07	4.74E+07	2.95E+07	2.13E+07
Electricity, high voltage {RoW}  treatment of coal gas, in power plant   APOS, U	2.05E+07	1.91E+07	2.12E+07	1.76E+07	1.09E+07	7.90E+06
Electricity, high voltage {US-SERC}  electricity production, hard coal   APOS, U	1.08E+10	1.01E+10	1.12E+10	9.27E+09	5.77E+09	4.16E+09
Electricity, high voltage {US-SERC}  electricity production, hydro, pumped storage   APOS, U	1.08E+07	1.33E+07	1.13E+07	1.43E+07	9.29E+06	2.39E+07
Electricity, high voltage {US-SERC}  electricity production, hydro, reservoir, alpine region   APOS, U	7.45E+06	9.15E+06	7.78E+06	9.85E+06	6.39E+06	1.64E+07
Electricity, high voltage {US-SERC}  electricity production, hydro, run-of-river   APOS, U	2.50E+07	3.07E+07	2.61E+07	3.31E+07	2.15E+07	5.51E+07
Electricity, high voltage {US-SERC}  electricity production, natural gas, combined cycle power plant   APOS, U	7.68E+09	5.61E+09	7.96E+09	5.17E+09	7.29E+09	2.96E+09
Electricity, high voltage {US-SERC}  electricity production, natural gas, conventional power plant   APOS, U	1.43E+09	1.04E+09	1.48E+09	9.61E+08	1.36E+09	5.51E+08
Electricity, high voltage {US-SERC}  electricity production, nuclear, boiling water reactor   APOS, U	3.41E+07	3.44E+07	3.56E+07	3.70E+07	2.37E+07	7.52E+07
Electricity, high voltage {US-SERC}  electricity production, nuclear, pressure water reactor   APOS, U	7.08E+07	7.13E+07	7.39E+07	7.68E+07	4.92E+07	1.56E+08
Electricity, high voltage {US-SERC}  electricity production, oil   APOS, U	4.65E+08	0	0	0	0	0
Electricity, high voltage {US-SERC}  heat and power co-generation, oil   APOS, U	7.58E+06	0	0	0	0	0
Electricity, high voltage {US-SERC}  electricity production, wind, <1MW turbine, onshore   APOS, U	6.20E+06	9.63E+06	6.48E+06	1.04E+07	8.95E+06	1.37E+07
Electricity, high voltage {US-SERC}  electricity production, wind, >3MW turbine, onshore   APOS, U	9.33E+05	1.45E+06	9.74E+05	1.56E+06	1.35E+06	2.06E+06
Electricity, high voltage {US-SERC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	7.69E+07	1.19E+08	8.03E+07	1.29E+08	1.11E+08	1.70E+08
Electricity, high voltage {US-SERC}  heat and power co-generation, biogas, gas engine   APOS, U	1.05E+08	0	0	0	0	0
Electricity, high voltage {US-SERC}  heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014   APOS, U	5.60E+07	0	0	0	0	0
Electricity, low voltage {US-SERC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	1.30E+08	4.55E+08	1.35E+08	4.90E+08	7.17E+08	2.86E+08
Electricity, high voltage {US-SERC}  electricity production, deep geothermal   APOS, U	1.38E+07	2.91E+07	1.44E+07	3.14E+07	2.88E+07	3.04E+07
High Carbon	2.10E+10	1.74E+10	2.13E+10	1.60E+10	1.48E+10	7.94E+09
Low Carbon	5.37E+08	7.73E+08	3.92E+08	8.33E+08	9.77E+08	8.28E+08
<i>Total</i>	2.16E+10	1.81E+10	2.17E+10	1.68E+10	1.58E+10	8.77E+09
<b>China</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b>

						(kg CO <sub>2</sub> eq)
Electricity, high voltage {CN-SC}  electricity production, hard coal   APOS, U	2.12E+10	1.57E+10	1.82E+10	1.29E+10	0	6.40E+09
Electricity, high voltage {CN-SC}  electricity production, oil   APOS, U	4.10E+07	0	0	0	0	0
Electricity, high voltage {CN-SC}  electricity production, natural gas, combined cycle power plant   APOS, U	5.23E+08	9.61E+08	1.12E+09	7.92E+08	0	3.92E+08
Electricity, high voltage {CN-SC}  electricity production, natural gas, conventional power plant   APOS, U	1.37E+08	2.52E+08	2.92E+08	2.07E+08	0	1.03E+08
Electricity, high voltage {CN}  ethanol production from sweet sorghum   APOS, U	4.76E+06	4.09E+06	3.22E+06	5.14E+06	0	8.90E+06
Electricity, for reuse in municipal waste incineration only {JP}  market for electricity, for reuse in municipal waste incineration only   APOS, U	4.10E+07	3.40E+07	2.74E+07	4.11E+07	3.04E+07	5.75E+07
Electricity, high voltage {CN-SH}  electricity production, nuclear, pressure water reactor   APOS, U	1.67E+07	1.67E+07	1.34E+07	2.02E+07	1.99E+07	2.82E+07
Electricity, high voltage {CN-SC}  electricity production, hydro, run-of-river   APOS, U	4.36E+07	3.75E+07	3.03E+07	4.54E+07	3.56E+07	6.35E+07
Electricity, high voltage {CN-SH}  electricity production, deep geothermal   APOS, U	1.79E+04	1.54E+04	1.24E+04	1.86E+04	1.46E+04	2.60E+04
Electricity, low voltage {CN-SC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	7.54E+07	3.26E+08	2.63E+08	3.94E+08	9.02E+08	5.52E+08
Electricity, high voltage {CN-SC}  electricity production, wind, <1MW turbine, onshore   APOS, U	5.13E+05	9.00E+05	7.26E+05	1.09E+06	3.08E+06	1.52E+06
Electricity, high voltage {CN-SC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	5.47E+07	9.59E+07	7.73E+07	1.16E+08	3.28E+08	1.62E+08
High Carbon	2.19E+10	1.69E+10	1.96E+10	1.39E+10	0	6.90E+09
Low Carbon	2.32E+08	5.11E+08	4.12E+08	6.18E+08	1.32E+09	8.65E+08
<i>Total</i>	2.21E+10	1.74E+10	2.01E+10	1.46E+10	1.32E+09	7.77E+09
<b>Kazakhstan</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {RoW}  heat and power co-generation, hard coal   APOS, U	1.10E+10	1.09E+10	7.96E+09	5.66E+09	6.80E+09	2.94E+09
Electricity, high voltage {RoW}  heat and power co-generation, oil   APOS, U	4.00E+08	0	0	0	0	0
Electricity, high voltage {RoW}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	2.82E+09	2.79E+09	2.04E+09	1.45E+09	1.74E+09	7.53E+08
Electricity, high voltage {RoW}  heat and power co-generation, biogas, gas engine   APOS, U	6.60E+04	9.34E+04	2.47E+05	3.67E+05	3.07E+05	5.10E+05
Electricity, high voltage {RoW}  electricity production, hydro, run-of-river   APOS, U	1.40E+07	1.99E+07	5.25E+07	7.82E+07	6.54E+07	1.09E+08
Electricity, high voltage {RoW}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	4.98E+06	7.05E+06	1.86E+07	2.77E+07	2.32E+07	3.85E+07
Electricity, low voltage {RU}  electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted   APOS, U	2.11E+07	2.98E+07	7.88E+07	1.17E+08	9.81E+07	1.63E+08
High Carbon	1.42E+10	1.37E+10	1.00E+10	7.11E+09	8.55E+09	3.69E+09
Low Carbon	4.02E+07	5.69E+07	1.50E+08	2.24E+08	1.87E+08	3.10E+08
<i>Total</i>	1.43E+10	1.37E+10	1.01E+10	7.33E+09	8.73E+09	4.00E+09

<b>Canada</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {CA-QC}  electricity production, hard coal   APOS, U	1.21E+08	1.08E+08	1.21E+08	1.21E+08	0	1.21E+08
Electricity, high voltage {CA-QC}  electricity production, oil   APOS, U	1.57E+07	1.40E+07	1.57E+07	1.57E+07	0	1.57E+07
Electricity, high voltage {CA-ON}  electricity production, natural gas, conventional power plant   APOS, U	2.18E+08	1.95E+08	2.18E+08	2.18E+08	0	2.18E+08
Electricity, high voltage {CA-QC}  heat and power co-generation, biogas, gas engine   APOS, U	2.27E+06	2.48E+06	2.27E+06	2.27E+06	4.22E+06	2.27E+06
Electricity, for reuse in municipal waste incineration only {CA}  treatment of municipal solid waste, municipal incineration   APOS, U	4.27E+05	4.66E+05	4.27E+05	4.27E+05	7.91E+05	4.25E+05
Electricity, high voltage {CA-QC}  electricity production, nuclear, pressure water reactor, heavy water moderated   APOS, U	6.11E+06	6.67E+06	6.11E+06	6.11E+06	1.13E+07	6.09E+06
Electricity, high voltage {CA-QC}  electricity production, hydro, reservoir, non-alpine region   APOS, U	1.78E+07	1.95E+07	1.78E+07	1.78E+07	3.31E+07	1.78E+07
Electricity, high voltage {CA-QC}  electricity production, hydro, run-of-river   APOS, U	9.29E+06	1.01E+07	9.29E+06	9.29E+06	1.72E+07	9.25E+06
Electricity, low voltage {CA-QC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	8.08E+05	8.82E+05	8.82E+05	8.82E+05	1.64E+06	1.07E+06
Electricity, high voltage {CA-QC}  electricity production, wind, <1MW turbine, onshore   APOS, U	1.02E+05	1.11E+05	1.02E+05	1.02E+05	1.89E+05	1.01E+05
Electricity, high voltage {CA-QC}  electricity production, wind, >3MW turbine, onshore   APOS, U	2.17E+06	2.36E+06	2.17E+06	2.17E+06	4.02E+06	2.16E+06
Electricity, high voltage {CA-QC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	7.86E+05	8.58E+05	7.86E+05	7.86E+05	1.46E+06	7.83E+05
High Carbon	3.55E+08	3.17E+08	3.55E+08	3.55E+08	0	3.55E+08
Low Carbon	3.98E+07	4.34E+07	3.99E+07	3.99E+07	7.39E+07	3.99E+07
<i>Total</i>	3.95E+08	3.61E+08	3.95E+08	3.95E+08	7.39E+07	3.95E+08
<b>Russia</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {RU}  heat and power co-generation, hard coal   APOS, U	1.72E+08	1.15E+08	7.30E+07	1.30E+08	1.20E+08	7.30E+07
Electricity, high voltage {RU}  heat and power co-generation, oil   APOS, U	4.22E+06	0	0	0	0	0
Electricity, high voltage {RU}  heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical   APOS, U	7.79E+06	5.84E+06	3.72E+06	6.59E+06	6.11E+06	3.72E+06
Electricity, high voltage {RU}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	2.25E+08	1.68E+08	1.07E+08	1.90E+08	1.76E+08	1.07E+08
Electricity, high voltage {RoW}  ethanol production from sweet sorghum   APOS, U	3.60E+03	8.91E+06	0	0	6.74E+03	0
Electricity, for reuse in municipal waste incineration only {RU}  treatment of municipal solid waste, municipal incineration   APOS, U	3.67E+06	3.76E+07	7.09E+07	4.78E+07	5.17E+07	7.09E+07
Electricity, high voltage {RU}  electricity production, nuclear, boiling water reactor   APOS, U	3.55E+06	7.05E+05	1.33E+06	8.98E+05	9.70E+05	1.33E+06
Electricity, high voltage {RU}  electricity production, nuclear, pressure water reactor   APOS, U	4.63E+06	9.20E+05	1.74E+06	1.17E+06	1.27E+06	1.74E+06
Electricity, high voltage {RU}  electricity production, hydro, pumped storage   APOS, U	8.38E+05	1.07E+06	2.02E+06	1.36E+06	1.47E+06	2.02E+06

Electricity, high voltage {RU}  electricity production, hydro, reservoir, non-alpine region   APOS, U	2.95E+06	3.76E+06	7.09E+06	4.78E+06	5.17E+06	7.09E+06
Electricity, high voltage {RU}  electricity production, hydro, run-of-river   APOS, U	5.68E+06	7.24E+06	1.37E+07	9.22E+06	9.96E+06	1.37E+07
Electricity, high voltage {RU}  electricity production, deep geothermal   APOS, U	2.75E+04	1.88E+06	3.54E+06	2.39E+06	2.58E+06	3.54E+06
Electricity, low voltage {RU}  electricity production, photovoltaic, 3kWp slanted-roof installation, single-Si, panel, mounted   APOS, U	1.59E+05	1.07E+06	2.01E+06	1.36E+06	1.47E+06	2.01E+06
Electricity, high voltage {RU}  electricity production, wind, <1MW turbine, onshore   APOS, U	2.59E+05	5.58E+06	1.05E+07	7.11E+06	7.68E+06	1.05E+07
High Carbon	4.09E+08	2.98E+08	1.84E+08	3.26E+08	3.02E+08	1.84E+08
Low Carbon	2.18E+07	5.98E+07	1.13E+08	7.61E+07	8.23E+07	1.13E+08
<i>Total</i>	4.30E+08	3.57E+08	2.97E+08	4.02E+08	3.85E+08	2.97E+08
<b>Germany</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {DE}  heat and power co-generation, hard coal   APOS, U	3.14E+07	1.59E+07	3.14E+07	3.14E+07	0	1.38E+07
Electricity, high voltage {DE}  electricity production, hard coal   APOS, U	1.15E+08	5.86E+07	1.15E+08	1.15E+08	0	5.08E+07
Electricity, high voltage {DE}  heat and power co-generation, oil   APOS, U	3.99E+05	2.02E+05	3.99E+05	3.99E+05	0	1.76E+05
Electricity, high voltage {DE}  electricity production, oil   APOS, U	2.76E+06	1.40E+06	2.76E+06	2.76E+06	0	1.22E+06
Electricity, high voltage {DE}  electricity production, natural gas, conventional power plant   APOS, U	8.57E+06	4.35E+06	8.57E+06	8.57E+06	0	3.78E+06
Electricity, high voltage {DE}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	2.27E+07	1.15E+07	2.27E+07	2.27E+07	0	1.00E+07
Electricity, high voltage {DE}  heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical   APOS, U	2.96E+05	1.50E+05	2.96E+05	2.96E+05	0	1.31E+05
Electricity, high voltage {DE}  electricity production, natural gas, combined cycle power plant   APOS, U	9.00E+06	4.57E+06	9.00E+06	9.00E+06	0	3.96E+06
Electricity, high voltage {DE}  heat and power co-generation, biogas, gas engine   APOS, U	5.79E+06	9.14E+06	5.79E+06	5.79E+06	1.26E+07	9.60E+06
Electricity, high voltage {DE}  heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014   APOS, U	5.08E+05	8.02E+05	5.08E+05	5.08E+05	1.11E+06	8.42E+05
Electricity, for reuse in municipal waste incineration only {DE}  market for electricity, for reuse in municipal waste incineration only   APOS, U	7.24E+06	1.14E+07	7.24E+06	7.24E+06	1.57E+07	1.20E+07
Electricity, high voltage {DE}  electricity production, nuclear, boiling water reactor   APOS, U	3.47E+05	5.47E+05	3.47E+05	3.47E+05	7.54E+05	5.74E+05
Electricity, high voltage {DE}  electricity production, nuclear, pressure water reactor   APOS, U	1.27E+06	2.01E+06	1.27E+06	1.27E+06	2.77E+06	2.11E+06
Electricity, high voltage {DE}  electricity production, hydro, pumped storage   APOS, U	2.53E+06	3.99E+06	2.53E+06	2.53E+06	5.50E+06	4.19E+06
Electricity, high voltage {DE}  electricity production, hydro, reservoir, non-alpine region   APOS, U	1.96E+05	3.09E+05	1.96E+05	1.96E+05	4.26E+05	3.25E+05
Electricity, high voltage {DE}  electricity production, hydro, run-of-river   APOS, U	6.61E+05	1.04E+06	6.61E+05	6.61E+05	1.44E+06	1.10E+06
Electricity, high voltage {DE}  electricity production, deep geothermal   APOS, U	2.03E+04	3.20E+04	2.03E+04	2.03E+04	4.41E+04	3.36E+04
Electricity, low voltage {DE}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	5.97E+06	9.42E+06	5.97E+06	5.97E+06	1.30E+07	9.89E+06

Electricity, high voltage {DE}  electricity production, wind, <1MW turbine, onshore   APOS, U	9.23E+05	1.46E+06	9.23E+05	9.23E+05	2.01E+06	1.53E+06
Electricity, high voltage {DE}  electricity production, wind, >3MW turbine, onshore   APOS, U	6.36E+05	1.00E+06	6.36E+05	6.36E+05	1.38E+06	1.05E+06
Electricity, high voltage {DE}  electricity production, wind, 1-3MW turbine, offshore   APOS, U	1.87E+05	2.95E+05	1.87E+05	1.87E+05	4.07E+05	3.10E+05
Electricity, high voltage {DE}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	5.13E+06	8.09E+06	5.13E+06	5.13E+06	1.11E+07	8.49E+06
High Carbon	1.91E+08	9.67E+07	1.91E+08	1.91E+08	0	8.39E+07
Low Carbon	3.14E+07	4.96E+07	3.14E+07	3.14E+07	6.83E+07	5.20E+07
<i>Total</i>	2.22E+08	1.46E+08	2.22E+08	2.22E+08	6.83E+07	1.36E+08
<b>Malaysia</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {MY}  electricity production, hard coal   APOS, U	2.63E+08	2.54E+08	1.20E+08	2.13E+08	1.98E+08	1.20E+08
Electricity, high voltage {MY}  electricity production, oil   APOS, U	2.79E+06	2.71E+06	1.28E+06	2.27E+06	2.10E+06	1.28E+06
Electricity, high voltage {MY}  electricity production, natural gas, combined cycle power plant   APOS, U	5.47E+07	5.30E+07	2.50E+07	4.44E+07	4.11E+07	2.50E+07
Electricity, high voltage {MY}  electricity production, natural gas, conventional power plant   APOS, U	4.37E+07	4.23E+07	2.00E+07	3.54E+07	3.29E+07	2.00E+07
Electricity, high voltage {MY}  heat and power co-generation, wood chips, 6667 kW   APOS, U	2.51E+05	5.93E+05	5.27E+05	7.90E+05	9.22E+05	9.22E+05
Electricity, high voltage {MY}  electricity production, hydro, reservoir, tropical region   APOS, U	6.88E+06	1.62E+07	1.44E+07	2.16E+07	2.52E+07	2.52E+07
Electricity, low voltage {MY}  electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted   APOS, U	4.53E+05	1.07E+06	9.50E+05	1.42E+06	1.66E+06	1.66E+06
High Carbon	3.64E+08	3.52E+08	1.66E+08	2.95E+08	2.74E+08	1.66E+08
Low Carbon	7.58E+06	1.79E+07	1.59E+07	2.38E+07	2.78E+07	2.78E+07
<i>Total</i>	3.71E+08	3.70E+08	1.82E+08	3.19E+08	3.01E+08	1.94E+08
<b>Ireland</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {IE}  electricity production, hard coal   APOS, U	2.05E+07	8.83E+06	2.06E+07	1.47E+07	0	7.65E+06
Electricity, high voltage {IE}  electricity production, oil   APOS, U	8.20E+06	3.52E+06	8.22E+06	5.87E+06	0	3.05E+06
Electricity, high voltage {IE}  electricity production, natural gas, combined cycle power plant   APOS, U	3.99E+07	1.71E+07	4.00E+07	2.86E+07	0	1.49E+07
Electricity, high voltage {IE}  electricity production, natural gas, conventional power plant   APOS, U	2.96E+07	1.27E+07	2.96E+07	2.12E+07	0	1.10E+07
Electricity, high voltage {IE}  heat and power co-generation, biogas, gas engine   APOS, U	2.78E+05	5.55E+05	2.77E+05	4.16E+05	7.63E+05	5.82E+05
Electricity, high voltage {IE}  heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014   APOS, U	4.19E+05	8.35E+05	4.18E+05	6.26E+05	1.15E+06	8.77E+05
Electricity, for reuse in municipal waste incineration only {GB}  market for electricity, for reuse in municipal waste incineration only   APOS, U	4.54E+06	9.03E+06	4.52E+06	6.77E+06	1.24E+07	9.48E+06

Electricity, high voltage {IE}  electricity production, hydro, pumped storage   APOS, U	8.26E+05	1.65E+06	8.23E+05	1.23E+06	2.26E+06	1.73E+06
Electricity, high voltage {IE}  electricity production, hydro, run-of-river   APOS, U	3.69E+05	7.35E+05	3.68E+05	5.52E+05	1.01E+06	7.72E+05
Electricity, low voltage {IE}  electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted   APOS, U	1.10E+05	2.20E+05	1.10E+05	1.65E+05	3.02E+05	2.31E+05
Electricity, high voltage {IE}  electricity production, wind, <1MW turbine, onshore   APOS, U	1.17E+06	2.33E+06	1.16E+06	1.75E+06	3.20E+06	2.44E+06
Electricity, high voltage {IE}  electricity production, wind, >3MW turbine, onshore   APOS, U	2.28E+05	4.55E+05	2.27E+05	3.41E+05	6.25E+05	4.78E+05
Electricity, high voltage {IE}  electricity production, wind, 1-3MW turbine, offshore   APOS, U	7.34E+04	1.46E+05	7.31E+04	1.10E+05	2.01E+05	1.54E+05
Electricity, high voltage {IE}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	4.95E+06	9.85E+06	4.92E+06	7.39E+06	1.35E+07	1.03E+07
High Carbon	9.82E+07	4.22E+07	9.85E+07	7.03E+07	0	3.66E+07
Low Carbon	1.30E+07	2.58E+07	1.29E+07	1.94E+07	3.55E+07	2.71E+07
<i>Total</i>	1.11E+08	6.80E+07	1.11E+08	8.97E+07	3.55E+07	6.37E+07

Table S7: GWP values, net of grid losses, estimated per each electricity source according to each modelled Scenario, assuming that the annual electricity consumed for the mining is 114.62 TWh (+20% with respect to the annual consumption estimated for 2022). Black font is assigned to High Carbon Sources and blue font is assigned to Low Carbon Sources.

United States	Baseline (kg CO <sub>2</sub> eq)	2030 BAD (kg CO <sub>2</sub> eq)	2030 IRENA (kg CO <sub>2</sub> eq)	2030 EMEBER (kg CO <sub>2</sub> eq)	2050 BAD (kg CO <sub>2</sub> eq)	2050 IRENA & EMEBER (kg CO <sub>2</sub> eq)
Electricity, high voltage {RoW}  heat and power co-generation, hard coal   APOS, U	6.93E+08	6.69E+08	7.17E+08	6.25E+08	3.83E+08	3.23E+08
Electricity, high voltage {RoW}  heat and power co-generation, lignite   APOS, U	6.32E+07	6.09E+07	6.53E+07	5.69E+07	3.49E+07	2.94E+07
Electricity, high voltage {RoW}  treatment of coal gas, in power plant   APOS, U	2.34E+07	2.26E+07	2.42E+07	2.11E+07	1.29E+07	1.09E+07
Electricity, high voltage {US-SERC}  electricity production, hard coal   APOS, U	1.24E+10	1.19E+10	1.28E+10	1.11E+10	6.83E+09	5.76E+09
Electricity, high voltage {US-SERC}  electricity production, hydro, pumped storage   APOS, U	1.08E+07	1.33E+07	1.13E+07	1.43E+07	9.29E+06	2.39E+07
Electricity, high voltage {US-SERC}  electricity production, hydro, reservoir, alpine region   APOS, U	7.45E+06	9.15E+06	7.78E+06	9.85E+06	6.39E+06	1.64E+07
Electricity, high voltage {US-SERC}  electricity production, hydro, run-of-river   APOS, U	2.50E+07	3.07E+07	2.61E+07	3.31E+07	2.15E+07	5.51E+07
Electricity, high voltage {US-SERC}  electricity production, natural gas, combined cycle power plant   APOS, U	8.79E+09	6.64E+09	9.09E+09	6.20E+09	8.62E+09	4.10E+09
Electricity, high voltage {US-SERC}  electricity production, natural gas, conventional power plant   APOS, U	1.64E+09	1.24E+09	1.69E+09	1.15E+09	1.60E+09	7.62E+08
Electricity, high voltage {US-SERC}  electricity production, nuclear, boiling water reactor   APOS, U	3.41E+07	3.44E+07	3.56E+07	3.70E+07	2.37E+07	7.52E+07
Electricity, high voltage {US-SERC}  electricity production, nuclear, pressure water reactor   APOS, U	7.08E+07	7.13E+07	7.39E+07	7.68E+07	4.92E+07	1.56E+08
Electricity, high voltage {US-SERC}  electricity production, oil   APOS, U	5.33E+08	0	0	0	0	0
Electricity, high voltage {US-SERC}  heat and power co-generation, oil   APOS, U	8.69E+06	0	0	0	0	0
Electricity, high voltage {US-SERC}  electricity production, wind, <1MW turbine, onshore   APOS, U	6.20E+06	9.63E+06	6.48E+06	1.04E+07	8.95E+06	1.37E+07



Electricity, high voltage {US-SERC}  electricity production, wind, >3MW turbine, onshore   APOS, U	9.33E+05	1.45E+06	9.74E+05	1.56E+06	1.35E+06	2.06E+06
Electricity, high voltage {US-SERC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	7.69E+07	1.19E+08	8.03E+07	1.29E+08	1.11E+08	1.70E+08
Electricity, high voltage {US-SERC}  heat and power co-generation, biogas, gas engine   APOS, U	1.05E+08	0	0	0	0	0
Electricity, high voltage {US-SERC}  heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014   APOS, U	5.60E+07	0	0	0	0	0
Electricity, low voltage {US-SERC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	1.30E+08	4.55E+08	1.35E+08	4.90E+08	7.17E+08	2.86E+08
Electricity, high voltage {US-SERC}  electricity production, deep geothermal   APOS, U	1.38E+07	2.91E+07	1.44E+07	3.14E+07	2.88E+07	3.04E+07
High Carbon	2.41E+10	2.05E+10	2.44E+10	1.92E+10	1.75E+10	1.10E+10
Low Carbon	5.37E+08	7.73E+08	3.92E+08	8.33E+08	9.77E+08	8.28E+08
<i>Total</i>	2.46E+10	2.13E+10	2.48E+10	2.00E+10	1.85E+10	1.18E+10
<b>China</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {CN-SC}  electricity production, hard coal   APOS, U	2.39E+10	1.82E+10	2.08E+10	1.54E+10	0	8.64E+09
Electricity, high voltage {CN-SC}  electricity production, oil   APOS, U	4.62E+07	0	0	0	0	0
Electricity, high voltage {CN-SC}  electricity production, natural gas, combined cycle power plant   APOS, U	5.90E+08	1.12E+09	1.27E+09	9.45E+08	0	5.29E+08
Electricity, high voltage {CN-SC}  electricity production, natural gas, conventional power plant   APOS, U	1.55E+08	2.92E+08	3.34E+08	2.47E+08	0	1.39E+08
Electricity, high voltage {CN}  ethanol production from sweet sorghum   APOS, U	5.37E+06	4.76E+06	3.67E+06	6.13E+06	0	1.20E+07
Electricity, for reuse in municipal waste incineration only {JP}  market for electricity, for reuse in municipal waste incineration only   APOS, U	4.10E+07	3.40E+07	2.74E+07	4.11E+07	3.32E+07	5.75E+07
Electricity, high voltage {CN-SH}  electricity production, nuclear, pressure water reactor   APOS, U	1.67E+07	1.67E+07	1.34E+07	2.02E+07	2.17E+07	2.82E+07
Electricity, high voltage {CN-SC}  electricity production, hydro, run-of-river   APOS, U	4.36E+07	3.75E+07	3.03E+07	4.54E+07	3.88E+07	6.35E+07
Electricity, high voltage {CN-SH}  electricity production, deep geothermal   APOS, U	1.79E+04	1.54E+04	1.24E+04	1.86E+04	1.59E+04	2.60E+04
Electricity, low voltage {CN-SC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	7.54E+07	3.26E+08	2.63E+08	3.94E+08	9.85E+08	5.52E+08
Electricity, high voltage {CN-SC}  electricity production, wind, <1MW turbine, onshore   APOS, U	5.13E+05	9.00E+05	7.26E+05	1.09E+06	3.36E+06	1.52E+06
Electricity, high voltage {CN-SC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	5.47E+07	9.59E+07	7.73E+07	1.16E+08	3.58E+08	1.62E+08
High Carbon	2.47E+10	1.96E+10	2.24E+10	1.66E+10	0	9.32E+09
Low Carbon	2.32E+08	5.11E+08	4.12E+08	6.18E+08	1.44E+09	8.65E+08
<i>Total</i>	2.49E+10	2.01E+10	2.28E+10	1.72E+10	1.44E+09	1.02E+10
<b>Kazakhstan</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {RoW}  heat and power co-generation, hard coal   APOS, U	1.21E+10	1.20E+10	9.11E+09	6.81E+09	7.96E+09	4.09E+09

Electricity, high voltage {RoW}  heat and power co-generation, oil   APOS, U	4.40E+08	0	0	0	0	0
Electricity, high voltage {RoW}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	3.10E+09	3.08E+09	2.33E+09	1.74E+09	2.04E+09	1.05E+09
Electricity, high voltage {RoW}  heat and power co-generation, biogas, gas engine   APOS, U	6.60E+04	9.34E+04	2.47E+05	3.67E+05	3.07E+05	5.10E+05
Electricity, high voltage {RoW}  electricity production, hydro, run-of-river   APOS, U	1.40E+07	1.99E+07	5.25E+07	7.82E+07	6.54E+07	1.09E+08
Electricity, high voltage {RoW}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	4.98E+06	7.05E+06	1.86E+07	2.77E+07	2.32E+07	3.85E+07
Electricity, low voltage {RU}  electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted   APOS, U	2.11E+07	2.98E+07	7.88E+07	1.17E+08	9.81E+07	1.63E+08
High Carbon	1.56E+10	1.51E+10	1.14E+10	8.55E+09	9.99E+09	5.14E+09
Low Carbon	4.02E+07	5.69E+07	1.50E+08	2.24E+08	1.87E+08	3.10E+08
<i>Total</i>	1.57E+10	1.52E+10	1.16E+10	8.78E+09	1.02E+10	5.45E+09
<b>Canada</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {CA-QC}  electricity production, hard coal   APOS, U	1.45E+08	1.32E+08	1.45E+08	1.45E+08	0	1.45E+08
Electricity, high voltage {CA-QC}  electricity production, oil   APOS, U	1.88E+07	1.71E+07	1.88E+07	1.88E+07	0	1.88E+07
Electricity, high voltage {CA-ON}  electricity production, natural gas, conventional power plant   APOS, U	2.61E+08	2.38E+08	2.61E+08	2.61E+08	0	2.61E+08
Electricity, high voltage {CA-QC}  heat and power co-generation, biogas, gas engine   APOS, U	2.27E+06	2.48E+06	2.27E+06	2.27E+06	4.60E+06	2.27E+06
Electricity, for reuse in municipal waste incineration only {CA}  treatment of municipal solid waste, municipal incineration   APOS, U	4.27E+05	4.66E+05	4.27E+05	4.27E+05	8.63E+05	4.25E+05
Electricity, high voltage {CA-QC}  electricity production, nuclear, pressure water reactor, heavy water moderated   APOS, U	6.11E+06	6.67E+06	6.11E+06	6.11E+06	1.24E+07	6.09E+06
Electricity, high voltage {CA-QC}  electricity production, hydro, reservoir, non-alpine region   APOS, U	1.78E+07	1.95E+07	1.78E+07	1.78E+07	3.61E+07	1.78E+07
Electricity, high voltage {CA-QC}  electricity production, hydro, run-of-river   APOS, U	9.29E+06	1.01E+07	9.29E+06	9.29E+06	1.88E+07	9.25E+06
Electricity, low voltage {CA-QC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	8.08E+05	8.82E+05	8.82E+05	8.82E+05	1.79E+06	1.07E+06
Electricity, high voltage {CA-QC}  electricity production, wind, <1MW turbine, onshore   APOS, U	1.02E+05	1.11E+05	1.02E+05	1.02E+05	2.06E+05	1.01E+05
Electricity, high voltage {CA-QC}  electricity production, wind, >3MW turbine, onshore   APOS, U	2.17E+06	2.36E+06	2.17E+06	2.17E+06	4.38E+06	2.16E+06
Electricity, high voltage {CA-QC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	7.86E+05	8.58E+05	7.86E+05	7.86E+05	1.59E+06	7.83E+05
High Carbon	4.25E+08	3.87E+08	4.25E+08	4.25E+08	0	4.25E+08
Low Carbon	3.98E+07	4.34E+07	3.99E+07	3.99E+07	8.06E+07	3.99E+07
<i>Total</i>	4.65E+08	4.31E+08	4.65E+08	4.65E+08	8.06E+07	4.65E+08
<b>Russia</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)

Electricity, high voltage {RU}  heat and power co-generation, hard coal   APOS, U	1.96E+08	1.31E+08	9.55E+07	1.52E+08	1.42E+08	9.55E+07
Electricity, high voltage {RU}  heat and power co-generation, oil   APOS, U	4.81E+06	0	0	0	0	0
Electricity, high voltage {RU}  heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical   APOS, U	8.89E+06	6.68E+06	4.86E+06	7.74E+06	7.25E+06	4.86E+06
Electricity, high voltage {RU}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	2.56E+08	1.93E+08	1.40E+08	2.23E+08	2.09E+08	1.40E+08
Electricity, high voltage {RoW}  ethanol production from sweet sorghum   APOS, U	4.10E+03	1.02E+07	0	0	8.00E+03	0
Electricity, for reuse in municipal waste incineration only {RU}  treatment of municipal solid waste, municipal incineration   APOS, U	3.67E+06	3.76E+07	7.09E+07	4.78E+07	5.17E+07	7.09E+07
Electricity, high voltage {RU}  electricity production, nuclear, boiling water reactor   APOS, U	3.55E+06	7.05E+05	1.33E+06	8.98E+05	9.70E+05	1.33E+06
Electricity, high voltage {RU}  electricity production, nuclear, pressure water reactor   APOS, U	4.63E+06	9.20E+05	1.74E+06	1.17E+06	1.27E+06	1.74E+06
Electricity, high voltage {RU}  electricity production, hydro, pumped storage   APOS, U	8.38E+05	1.07E+06	2.02E+06	1.36E+06	1.47E+06	2.02E+06
Electricity, high voltage {RU}  electricity production, hydro, reservoir, non-alpine region   APOS, U	2.95E+06	3.76E+06	7.09E+06	4.78E+06	5.17E+06	7.09E+06
Electricity, high voltage {RU}  electricity production, hydro, run-of-river   APOS, U	5.68E+06	7.24E+06	1.37E+07	9.22E+06	9.96E+06	1.37E+07
Electricity, high voltage {RU}  electricity production, deep geothermal   APOS, U	2.75E+04	1.88E+06	3.54E+06	2.39E+06	2.58E+06	3.54E+06
Electricity, low voltage {RU}  electricity production, photovoltaic, 3kWp slanted-roof installation, single-Si, panel, mounted   APOS, U	1.59E+05	1.07E+06	2.01E+06	1.36E+06	1.47E+06	2.01E+06
Electricity, high voltage {RU}  electricity production, wind, <1MW turbine, onshore   APOS, U	2.59E+05	5.58E+06	1.05E+07	7.11E+06	7.68E+06	1.05E+07
High Carbon	4.66E+08	3.41E+08	2.40E+08	3.83E+08	3.59E+08	2.40E+08
Low Carbon	2.18E+07	5.98E+07	1.13E+08	7.61E+07	8.23E+07	1.13E+08
<i>Total</i>	4.88E+08	4.00E+08	3.53E+08	4.59E+08	4.41E+08	3.53E+08
<b>Germany</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {DE}  heat and power co-generation, hard coal   APOS, U	3.66E+07	2.12E+07	3.66E+07	3.66E+07	0	1.91E+07
Electricity, high voltage {DE}  electricity production, hard coal   APOS, U	1.35E+08	7.80E+07	1.35E+08	1.35E+08	0	7.03E+07
Electricity, high voltage {DE}  heat and power co-generation, oil   APOS, U	4.66E+05	2.69E+05	4.66E+05	4.66E+05	0	2.43E+05
Electricity, high voltage {DE}  electricity production, oil   APOS, U	3.22E+06	1.87E+06	3.22E+06	3.22E+06	0	1.68E+06
Electricity, high voltage {DE}  electricity production, natural gas, conventional power plant   APOS, U	1.00E+07	5.80E+06	1.00E+07	1.00E+07	0	5.22E+06
Electricity, high voltage {DE}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	2.66E+07	1.54E+07	2.66E+07	2.66E+07	0	1.38E+07
Electricity, high voltage {DE}  heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical   APOS, U	3.46E+05	2.00E+05	3.46E+05	3.46E+05	0	1.80E+05
Electricity, high voltage {DE}  electricity production, natural gas, combined cycle power plant   APOS, U	1.05E+07	6.08E+06	1.05E+07	1.05E+07	0	5.48E+06
Electricity, high voltage {DE}  heat and power co-generation, biogas, gas engine   APOS, U	5.79E+06	9.14E+06	5.79E+06	5.79E+06	1.37E+07	9.60E+06

Electricity, high voltage {DE}  heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014   APOS, U	5.08E+05	8.02E+05	5.08E+05	5.08E+05	1.21E+06	8.42E+05
Electricity, for reuse in municipal waste incineration only {DE}  market for electricity, for reuse in municipal waste incineration only   APOS, U	7.24E+06	1.14E+07	7.24E+06	7.24E+06	1.72E+07	1.20E+07
Electricity, high voltage {DE}  electricity production, nuclear, boiling water reactor   APOS, U	3.47E+05	5.47E+05	3.47E+05	3.47E+05	8.22E+05	5.74E+05
Electricity, high voltage {DE}  electricity production, nuclear, pressure water reactor   APOS, U	1.27E+06	2.01E+06	1.27E+06	1.27E+06	3.02E+06	2.11E+06
Electricity, high voltage {DE}  electricity production, hydro, pumped storage   APOS, U	2.53E+06	3.99E+06	2.53E+06	2.53E+06	6.00E+06	4.19E+06
Electricity, high voltage {DE}  electricity production, hydro, reservoir, non-alpine region   APOS, U	1.96E+05	3.09E+05	1.96E+05	1.96E+05	4.65E+05	3.25E+05
Electricity, high voltage {DE}  electricity production, hydro, run-of-river   APOS, U	6.61E+05	1.04E+06	6.61E+05	6.61E+05	1.57E+06	1.10E+06
Electricity, high voltage {DE}  electricity production, deep geothermal   APOS, U	2.03E+04	3.20E+04	2.03E+04	2.03E+04	4.81E+04	3.36E+04
Electricity, low voltage {DE}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	5.97E+06	9.42E+06	5.97E+06	5.97E+06	1.42E+07	9.89E+06
Electricity, high voltage {DE}  electricity production, wind, <1MW turbine, onshore   APOS, U	9.23E+05	1.46E+06	9.23E+05	9.23E+05	2.19E+06	1.53E+06
Electricity, high voltage {DE}  electricity production, wind, >3MW turbine, onshore   APOS, U	6.36E+05	1.00E+06	6.36E+05	6.36E+05	1.51E+06	1.05E+06
Electricity, high voltage {DE}  electricity production, wind, 1-3MW turbine, offshore   APOS, U	1.87E+05	2.95E+05	1.87E+05	1.87E+05	4.44E+05	3.10E+05
Electricity, high voltage {DE}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	5.13E+06	8.09E+06	5.13E+06	5.13E+06	1.22E+07	8.49E+06
High Carbon	2.23E+08	1.29E+08	2.23E+08	2.23E+08	0	1.16E+08
Low Carbon	3.14E+07	4.96E+07	3.14E+07	3.14E+07	7.45E+07	5.20E+07
<i>Total</i>	2.54E+08	1.78E+08	2.54E+08	2.54E+08	7.45E+07	1.68E+08
<b>Malaysia</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {MY}  electricity production, hard coal   APOS, U	2.99E+08	2.91E+08	1.57E+08	2.50E+08	2.34E+08	1.57E+08
Electricity, high voltage {MY}  electricity production, oil   APOS, U	3.19E+06	3.10E+06	1.67E+06	2.66E+06	2.49E+06	1.67E+06
Electricity, high voltage {MY}  electricity production, natural gas, combined cycle power plant   APOS, U	6.24E+07	6.07E+07	3.27E+07	5.21E+07	4.88E+07	3.27E+07
Electricity, high voltage {MY}  electricity production, natural gas, conventional power plant   APOS, U	4.98E+07	4.84E+07	2.61E+07	4.16E+07	3.90E+07	2.61E+07
Electricity, high voltage {MY}  heat and power co-generation, wood chips, 6667 kW   APOS, U	2.51E+05	5.93E+05	5.27E+05	7.90E+05	9.22E+05	9.22E+05
Electricity, high voltage {MY}  electricity production, hydro, reservoir, tropical region   APOS, U	6.88E+06	1.62E+07	1.44E+07	2.16E+07	2.52E+07	2.52E+07
Electricity, low voltage {MY}  electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted   APOS, U	4.53E+05	1.07E+06	9.50E+05	1.42E+06	1.66E+06	1.66E+06
High Carbon	4.15E+08	4.03E+08	2.18E+08	3.46E+08	3.25E+08	2.18E+08
Low Carbon	7.58E+06	1.79E+07	1.59E+07	2.38E+07	2.78E+07	2.78E+07
<i>Total</i>	4.22E+08	4.21E+08	2.33E+08	3.70E+08	3.52E+08	2.45E+08

<b>Ireland</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {IE}  electricity production, hard coal   APOS, U	2.35E+07	1.18E+07	2.35E+07	1.77E+07	0	1.06E+07
Electricity, high voltage {IE}  electricity production, oil   APOS, U	9.38E+06	4.70E+06	9.40E+06	7.05E+06	0	4.23E+06
Electricity, high voltage {IE}  electricity production, natural gas, combined cycle power plant   APOS, U	4.56E+07	2.29E+07	4.57E+07	3.43E+07	0	2.06E+07
Electricity, high voltage {IE}  electricity production, natural gas, conventional power plant   APOS, U	3.38E+07	1.69E+07	3.39E+07	2.54E+07	0	1.52E+07
Electricity, high voltage {IE}  heat and power co-generation, biogas, gas engine   APOS, U	2.78E+05	5.55E+05	2.77E+05	4.16E+05	8.32E+05	5.82E+05
Electricity, high voltage {IE}  heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014   APOS, U	4.19E+05	8.35E+05	4.18E+05	6.26E+05	1.25E+06	8.77E+05
Electricity, for reuse in municipal waste incineration only {GB}  market for electricity, for reuse in municipal waste incineration only   APOS, U	4.54E+06	9.03E+06	4.52E+06	6.77E+06	1.35E+07	9.48E+06
Electricity, high voltage {IE}  electricity production, hydro, pumped storage   APOS, U	8.26E+05	1.65E+06	8.23E+05	1.23E+06	2.47E+06	1.73E+06
Electricity, high voltage {IE}  electricity production, hydro, run-of-river   APOS, U	3.69E+05	7.35E+05	3.68E+05	5.52E+05	1.10E+06	7.72E+05
Electricity, low voltage {IE}  electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted   APOS, U	1.10E+05	2.20E+05	1.10E+05	1.65E+05	3.29E+05	2.31E+05
Electricity, high voltage {IE}  electricity production, wind, <1MW turbine, onshore   APOS, U	1.17E+06	2.33E+06	1.16E+06	1.75E+06	3.49E+06	2.44E+06
Electricity, high voltage {IE}  electricity production, wind, >3MW turbine, onshore   APOS, U	2.28E+05	4.55E+05	2.27E+05	3.41E+05	6.82E+05	4.78E+05
Electricity, high voltage {IE}  electricity production, wind, 1-3MW turbine, offshore   APOS, U	7.34E+04	1.46E+05	7.31E+04	1.10E+05	2.19E+05	1.54E+05
Electricity, high voltage {IE}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	4.95E+06	9.85E+06	4.92E+06	7.39E+06	1.48E+07	1.03E+07
High Carbon	1.12E+08	5.63E+07	1.13E+08	8.44E+07	0	5.06E+07
Low Carbon	1.30E+07	2.58E+07	1.29E+07	1.94E+07	3.87E+07	2.71E+07
<i>Total</i>	1.25E+08	8.21E+07	1.25E+08	1.04E+08	3.87E+07	7.77E+07

Table S8: GWP values, net of grid losses, estimated per each electricity source according to each modelled Scenario, assuming that the annual electricity consumed for the mining is 143.28 TWh (+50% with respect to the annual consumption estimated for 2022). Black font is assigned to High Carbon Sources and blue font is assigned to Low Carbon Sources.

<b>United States</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {RoW}  heat and power co-generation, hard coal   APOS, U	9.57E+08	9.82E+08	9.85E+08	9.37E+08	5.61E+08	5.91E+08
Electricity, high voltage {RoW}  heat and power co-generation, lignite   APOS, U	8.72E+07	8.94E+07	8.97E+07	8.54E+07	5.11E+07	5.38E+07
Electricity, high voltage {RoW}  treatment of coal gas, in power plant   APOS, U	3.23E+07	3.32E+07	3.33E+07	3.17E+07	1.89E+07	2.00E+07
Electricity, high voltage {US-SERC}  electricity production, hard coal   APOS, U	1.71E+10	1.75E+10	1.76E+10	1.67E+10	9.99E+09	1.05E+10

Electricity, high voltage {US-SERC}  electricity production, hydro, pumped storage   APOS, U	1.08E+07	1.33E+07	1.13E+07	1.43E+07	9.29E+06	2.39E+07
Electricity, high voltage {US-SERC}  electricity production, hydro, reservoir, alpine region   APOS, U	7.45E+06	9.15E+06	7.78E+06	9.85E+06	6.39E+06	1.64E+07
Electricity, high voltage {US-SERC}  electricity production, hydro, run-of-river   APOS, U	2.50E+07	3.07E+07	2.61E+07	3.31E+07	2.15E+07	5.51E+07
Electricity, high voltage {US-SERC}  electricity production, natural gas, combined cycle power plant   APOS, U	1.21E+10	9.74E+09	1.25E+10	9.30E+09	1.26E+10	7.49E+09
Electricity, high voltage {US-SERC}  electricity production, natural gas, conventional power plant   APOS, U	2.26E+09	1.81E+09	2.32E+09	1.73E+09	2.35E+09	1.39E+09
Electricity, high voltage {US-SERC}  electricity production, nuclear, boiling water reactor   APOS, U	3.41E+07	3.44E+07	3.56E+07	3.70E+07	2.37E+07	7.52E+07
Electricity, high voltage {US-SERC}  electricity production, nuclear, pressure water reactor   APOS, U	7.08E+07	7.13E+07	7.39E+07	7.68E+07	4.92E+07	1.56E+08
Electricity, high voltage {US-SERC}  electricity production, oil   APOS, U	7.35E+08	0	0	0	0	0
Electricity, high voltage {US-SERC}  heat and power co-generation, oil   APOS, U	1.20E+07	0	0	0	0	0
Electricity, high voltage {US-SERC}  electricity production, wind, <1MW turbine, onshore   APOS, U	6.20E+06	9.63E+06	6.48E+06	1.04E+07	8.95E+06	1.37E+07
Electricity, high voltage {US-SERC}  electricity production, wind, >3MW turbine, onshore   APOS, U	9.33E+05	1.45E+06	9.74E+05	1.56E+06	1.35E+06	2.06E+06
Electricity, high voltage {US-SERC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	7.69E+07	1.19E+08	8.03E+07	1.29E+08	1.11E+08	1.70E+08
Electricity, high voltage {US-SERC}  heat and power co-generation, biogas, gas engine   APOS, U	1.05E+08	0	0	0	0	0
Electricity, high voltage {US-SERC}  heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014   APOS, U	5.60E+07	0	0	0	0	0
Electricity, low voltage {US-SERC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	1.30E+08	4.55E+08	1.35E+08	4.90E+08	7.17E+08	2.86E+08
Electricity, high voltage {US-SERC}  electricity production, deep geothermal   APOS, U	1.38E+07	2.91E+07	1.44E+07	3.14E+07	2.88E+07	3.04E+07
High Carbon	3.33E+10	3.01E+10	3.35E+10	2.88E+10	2.56E+10	2.01E+10
Low Carbon	5.37E+08	7.73E+08	3.92E+08	8.33E+08	9.77E+08	8.28E+08
<i>Total</i>	3.38E+10	3.09E+10	3.39E+10	2.96E+10	2.66E+10	2.09E+10
<b>China</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {CN-SC}  electricity production, hard coal   APOS, U	3.21E+10	2.76E+10	3.02E+10	2.49E+10	0	1.86E+10
Electricity, high voltage {CN-SC}  electricity production, oil   APOS, U	6.20E+07	5.34E+07	5.83E+07	4.82E+07	0	3.60E+07
Electricity, high voltage {CN-SC}  electricity production, natural gas, combined cycle power plant   APOS, U	7.91E+08	6.82E+08	7.45E+08	6.15E+08	0	4.59E+08
Electricity, high voltage {CN-SC}  electricity production, natural gas, conventional power plant   APOS, U	2.07E+08	1.79E+08	1.95E+08	1.61E+08	0	1.20E+08
Electricity, high voltage {CN}  ethanol production from sweet sorghum   APOS, U	7.20E+06	6.21E+06	6.78E+06	5.60E+06	0	4.18E+06
Electricity, for reuse in municipal waste incineration only {JP}  market for electricity, for reuse in municipal waste incineration only   APOS, U	4.10E+07	3.40E+07	2.74E+07	4.11E+07	4.14E+07	5.75E+07
Electricity, high voltage {CN-SH}  electricity production, nuclear, pressure water reactor   APOS, U	1.67E+07	1.67E+07	1.34E+07	2.02E+07	2.71E+07	2.82E+07
Electricity, high voltage {CN-SC}  electricity production, hydro, run-of-river   APOS, U	4.36E+07	3.75E+07	3.03E+07	4.54E+07	4.85E+07	6.35E+07

Electricity, high voltage {CN-SH}  electricity production, deep geothermal   APOS, U	1.79E+04	1.54E+04	1.24E+04	1.86E+04	1.99E+04	2.60E+04
Electricity, low voltage {CN-SC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	7.54E+07	3.26E+08	2.63E+08	3.94E+08	1.23E+09	5.52E+08
Electricity, high voltage {CN-SC}  electricity production, wind, <1MW turbine, onshore   APOS, U	5.13E+05	9.00E+05	7.26E+05	1.09E+06	4.20E+06	1.52E+06
Electricity, high voltage {CN-SC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	5.47E+07	9.59E+07	7.73E+07	1.16E+08	4.48E+08	1.62E+08
High Carbon	3.31E+10	2.86E+10	3.12E+10	2.57E+10	0	1.92E+10
Low Carbon	2.32E+08	5.11E+08	4.12E+08	6.18E+08	1.80E+09	8.65E+08
<i>Total</i>	3.34E+10	2.91E+10	3.16E+10	2.64E+10	1.80E+09	2.01E+10
<b>Kazakhstan</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {RoW}  heat and power co-generation, hard coal   APOS, U	1.54E+10	1.55E+10	1.26E+10	1.03E+10	1.14E+10	7.55E+09
Electricity, high voltage {RoW}  heat and power co-generation, oil   APOS, U	5.61E+08	0	0	0	0	0
Electricity, high voltage {RoW}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	3.95E+09	3.97E+09	3.22E+09	2.63E+09	2.92E+09	1.93E+09
Electricity, high voltage {RoW}  heat and power co-generation, biogas, gas engine   APOS, U	6.60E+04	9.34E+04	2.47E+05	3.67E+05	3.07E+05	5.10E+05
Electricity, high voltage {RoW}  electricity production, hydro, run-of-river   APOS, U	1.40E+07	1.99E+07	5.25E+07	7.82E+07	6.54E+07	1.09E+08
Electricity, high voltage {RoW}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	4.98E+06	7.05E+06	1.86E+07	2.77E+07	2.32E+07	3.85E+07
Electricity, low voltage {RU}  electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted   APOS, U	2.11E+07	2.98E+07	7.88E+07	1.17E+08	9.81E+07	1.63E+08
High Carbon	1.99E+10	1.95E+10	1.58E+10	1.29E+10	1.43E+10	9.48E+09
Low Carbon	4.02E+07	5.69E+07	1.50E+08	2.24E+08	1.87E+08	3.10E+08
<i>Total</i>	2.00E+10	1.95E+10	1.59E+10	1.31E+10	1.45E+10	9.79E+09
<b>Canada</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {CA-QC}  electricity production, hard coal   APOS, U	2.17E+08	2.04E+08	2.17E+08	2.17E+08	0	2.17E+08
Electricity, high voltage {CA-QC}  electricity production, oil   APOS, U	2.81E+07	2.64E+07	2.80E+07	2.80E+07	0	2.81E+07
Electricity, high voltage {CA-ON}  electricity production, natural gas, conventional power plant   APOS, U	3.90E+08	3.67E+08	3.90E+08	3.90E+08	0	3.90E+08
Electricity, high voltage {CA-QC}  heat and power co-generation, biogas, gas engine   APOS, U	2.27E+06	2.48E+06	2.27E+06	2.27E+06	5.75E+06	2.27E+06
Electricity, for reuse in municipal waste incineration only {CA}  treatment of municipal solid waste, municipal incineration   APOS, U	4.27E+05	4.66E+05	4.27E+05	4.27E+05	1.08E+06	4.25E+05
Electricity, high voltage {CA-QC}  electricity production, nuclear, pressure water reactor, heavy water moderated   APOS, U	6.11E+06	6.67E+06	6.11E+06	6.11E+06	1.55E+07	6.09E+06
Electricity, high voltage {CA-QC}  electricity production, hydro, reservoir, non-alpine region   APOS, U	1.78E+07	1.95E+07	1.78E+07	1.78E+07	4.51E+07	1.78E+07

Electricity, high voltage {CA-QC}  electricity production, hydro, run-of-river   APOS, U	9.29E+06	1.01E+07	9.29E+06	9.29E+06	2.35E+07	9.25E+06
Electricity, low voltage {CA-QC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	8.08E+05	8.82E+05	8.82E+05	8.82E+05	2.23E+06	1.07E+06
Electricity, high voltage {CA-QC}  electricity production, wind, <1MW turbine, onshore   APOS, U	1.02E+05	1.11E+05	1.02E+05	1.02E+05	2.57E+05	1.01E+05
Electricity, high voltage {CA-QC}  electricity production, wind, >3MW turbine, onshore   APOS, U	2.17E+06	2.36E+06	2.17E+06	2.17E+06	5.48E+06	2.16E+06
Electricity, high voltage {CA-QC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	7.86E+05	8.58E+05	7.86E+05	7.86E+05	1.99E+06	7.83E+05
High Carbon	6.35E+08	5.97E+08	6.35E+08	6.35E+08	0	6.35E+08
Low Carbon	3.98E+07	4.34E+07	3.99E+07	3.99E+07	1.01E+08	3.99E+07
<i>Total</i>	6.75E+08	6.41E+08	6.75E+08	6.75E+08	1.01E+08	6.75E+08
<b>Russia</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {RU}  heat and power co-generation, hard coal   APOS, U	2.68E+08	1.81E+08	1.63E+08	2.19E+08	2.10E+08	1.63E+08
Electricity, high voltage {RU}  heat and power co-generation, oil   APOS, U	6.59E+06	0	0	0	0	0
Electricity, high voltage {RU}  heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical   APOS, U	1.22E+07	9.22E+06	8.28E+06	1.12E+07	1.07E+07	8.28E+06
Electricity, high voltage {RU}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	3.51E+08	2.66E+08	2.39E+08	3.22E+08	3.08E+08	2.39E+08
Electricity, high voltage {RoW}  ethanol production from sweet sorghum   APOS, U	5.62E+03	1.41E+07	0	0	1.18E+04	0
Electricity, for reuse in municipal waste incineration only {RU}  treatment of municipal solid waste, municipal incineration   APOS, U	3.67E+06	3.76E+07	7.09E+07	4.78E+07	5.17E+07	7.09E+07
Electricity, high voltage {RU}  electricity production, nuclear, boiling water reactor   APOS, U	3.55E+06	7.05E+05	1.33E+06	8.98E+05	9.70E+05	1.33E+06
Electricity, high voltage {RU}  electricity production, nuclear, pressure water reactor   APOS, U	4.63E+06	9.20E+05	1.74E+06	1.17E+06	1.27E+06	1.74E+06
Electricity, high voltage {RU}  electricity production, hydro, pumped storage   APOS, U	8.38E+05	1.07E+06	2.02E+06	1.36E+06	1.47E+06	2.02E+06
Electricity, high voltage {RU}  electricity production, hydro, reservoir, non-alpine region   APOS, U	2.95E+06	3.76E+06	7.09E+06	4.78E+06	5.17E+06	7.09E+06
Electricity, high voltage {RU}  electricity production, hydro, run-of-river   APOS, U	5.68E+06	7.24E+06	1.37E+07	9.22E+06	9.96E+06	1.37E+07
Electricity, high voltage {RU}  electricity production, deep geothermal   APOS, U	2.75E+04	1.88E+06	3.54E+06	2.39E+06	2.58E+06	3.54E+06
Electricity, low voltage {RU}  electricity production, photovoltaic, 3kWp slanted-roof installation, single-Si, panel, mounted   APOS, U	1.59E+05	1.07E+06	2.01E+06	1.36E+06	1.47E+06	2.01E+06
Electricity, high voltage {RU}  electricity production, wind, <1MW turbine, onshore   APOS, U	2.59E+05	5.58E+06	1.05E+07	7.11E+06	7.68E+06	1.05E+07
High Carbon	6.38E+08	4.70E+08	4.10E+08	5.52E+08	5.28E+08	4.10E+08
Low Carbon	2.18E+07	5.98E+07	1.13E+08	7.61E+07	8.23E+07	1.13E+08
<i>Total</i>	6.60E+08	5.30E+08	5.23E+08	6.28E+08	6.10E+08	5.23E+08



<b>Germany</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {DE}  heat and power co-generation, hard coal   APOS, U	5.25E+07	3.70E+07	5.25E+07	5.25E+07	0	3.49E+07
Electricity, high voltage {DE}  electricity production, hard coal   APOS, U	1.93E+08	1.36E+08	1.93E+08	1.93E+08	0	1.29E+08
Electricity, high voltage {DE}  heat and power co-generation, oil   APOS, U	6.67E+05	4.71E+05	6.67E+05	6.67E+05	0	4.44E+05
Electricity, high voltage {DE}  electricity production, oil   APOS, U	4.62E+06	3.26E+06	4.62E+06	4.62E+06	0	3.07E+06
Electricity, high voltage {DE}  electricity production, natural gas, conventional power plant   APOS, U	1.43E+07	1.01E+07	1.43E+07	1.43E+07	0	9.55E+06
Electricity, high voltage {DE}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	3.80E+07	2.68E+07	3.80E+07	3.80E+07	0	2.53E+07
Electricity, high voltage {DE}  heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical   APOS, U	4.96E+05	3.50E+05	4.96E+05	4.96E+05	0	3.30E+05
Electricity, high voltage {DE}  electricity production, natural gas, combined cycle power plant   APOS, U	1.51E+07	1.06E+07	1.51E+07	1.51E+07	0	1.00E+07
Electricity, high voltage {DE}  heat and power co-generation, biogas, gas engine   APOS, U	5.79E+06	9.14E+06	5.79E+06	5.79E+06	1.72E+07	9.60E+06
Electricity, high voltage {DE}  heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014   APOS, U	5.08E+05	8.02E+05	5.08E+05	5.08E+05	1.51E+06	8.42E+05
Electricity, for reuse in municipal waste incineration only {DE}  market for electricity, for reuse in municipal waste incineration only   APOS, U	7.24E+06	1.14E+07	7.24E+06	7.24E+06	2.15E+07	1.20E+07
Electricity, high voltage {DE}  electricity production, nuclear, boiling water reactor   APOS, U	3.47E+05	5.47E+05	3.47E+05	3.47E+05	1.03E+06	5.74E+05
Electricity, high voltage {DE}  electricity production, nuclear, pressure water reactor   APOS, U	1.27E+06	2.01E+06	1.27E+06	1.27E+06	3.77E+06	2.11E+06
Electricity, high voltage {DE}  electricity production, hydro, pumped storage   APOS, U	2.53E+06	3.99E+06	2.53E+06	2.53E+06	7.50E+06	4.19E+06
Electricity, high voltage {DE}  electricity production, hydro, reservoir, non-alpine region   APOS, U	1.96E+05	3.09E+05	1.96E+05	1.96E+05	5.81E+05	3.25E+05
Electricity, high voltage {DE}  electricity production, hydro, run-of-river   APOS, U	6.61E+05	1.04E+06	6.61E+05	6.61E+05	1.96E+06	1.10E+06
Electricity, high voltage {DE}  electricity production, deep geothermal   APOS, U	2.03E+04	3.20E+04	2.03E+04	2.03E+04	6.01E+04	3.36E+04
Electricity, low voltage {DE}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	5.97E+06	9.42E+06	5.97E+06	5.97E+06	1.77E+07	9.89E+06
Electricity, high voltage {DE}  electricity production, wind, <1MW turbine, onshore   APOS, U	9.23E+05	1.46E+06	9.23E+05	9.23E+05	2.73E+06	1.53E+06
Electricity, high voltage {DE}  electricity production, wind, >3MW turbine, onshore   APOS, U	6.36E+05	1.00E+06	6.36E+05	6.36E+05	1.89E+06	1.05E+06
Electricity, high voltage {DE}  electricity production, wind, 1-3MW turbine, offshore   APOS, U	1.87E+05	2.95E+05	1.87E+05	1.87E+05	5.55E+05	3.10E+05
Electricity, high voltage {DE}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	5.13E+06	8.09E+06	5.13E+06	5.13E+06	1.52E+07	8.49E+06
High Carbon	3.19E+08	2.25E+08	3.19E+08	3.19E+08	0	2.12E+08
Low Carbon	3.14E+07	4.96E+07	3.14E+07	3.14E+07	9.31E+07	5.20E+07
<i>Total</i>	3.50E+08	2.75E+08	3.50E+08	3.50E+08	9.31E+07	2.64E+08
<b>Malaysia</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b>

						(kg CO <sub>2</sub> eq)
Electricity, high voltage {MY}  electricity production, hard coal   APOS, U	4.10E+08	4.02E+08	2.68E+08	3.60E+08	3.45E+08	2.68E+08
Electricity, high voltage {MY}  electricity production, oil   APOS, U	4.36E+06	4.28E+06	2.85E+06	3.84E+06	3.67E+06	2.85E+06
Electricity, high voltage {MY}  electricity production, natural gas, combined cycle power plant   APOS, U	8.54E+07	8.37E+07	5.57E+07	7.51E+07	7.19E+07	5.57E+07
Electricity, high voltage {MY}  electricity production, natural gas, conventional power plant   APOS, U	6.82E+07	6.68E+07	4.45E+07	6.00E+07	5.74E+07	4.45E+07
Electricity, high voltage {MY}  heat and power co-generation, wood chips, 6667 kW   APOS, U	2.51E+05	5.93E+05	5.27E+05	7.90E+05	9.22E+05	9.22E+05
Electricity, high voltage {MY}  electricity production, hydro, reservoir, tropical region   APOS, U	6.88E+06	1.62E+07	1.44E+07	2.16E+07	2.52E+07	2.52E+07
Electricity, low voltage {MY}  electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted   APOS, U	4.53E+05	1.07E+06	9.50E+05	1.42E+06	1.66E+06	1.66E+06
High Carbon	5.68E+08	5.57E+08	3.71E+08	4.99E+08	4.78E+08	3.71E+08
Low Carbon	7.58E+06	1.79E+07	1.59E+07	2.38E+07	2.78E+07	2.78E+07
<i>Total</i>	5.76E+08	5.75E+08	3.87E+08	5.23E+08	5.06E+08	3.99E+08
<b>Ireland</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {IE}  electricity production, hard coal   APOS, U	3.23E+07	2.06E+07	3.24E+07	2.65E+07	0	1.94E+07
Electricity, high voltage {IE}  electricity production, oil   APOS, U	1.29E+07	8.22E+06	1.29E+07	1.06E+07	0	7.75E+06
Electricity, high voltage {IE}  electricity production, natural gas, combined cycle power plant   APOS, U	6.28E+07	4.00E+07	6.29E+07	5.14E+07	0	3.77E+07
Electricity, high voltage {IE}  electricity production, natural gas, conventional power plant   APOS, U	4.65E+07	2.96E+07	4.66E+07	3.81E+07	0	2.80E+07
Electricity, high voltage {IE}  heat and power co-generation, biogas, gas engine   APOS, U	2.78E+05	5.55E+05	2.77E+05	4.16E+05	1.04E+06	5.82E+05
Electricity, high voltage {IE}  heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014   APOS, U	4.19E+05	8.35E+05	4.18E+05	6.26E+05	1.57E+06	8.77E+05
Electricity, for reuse in municipal waste incineration only {GB}  market for electricity, for reuse in municipal waste incineration only   APOS, U	4.54E+06	9.03E+06	4.52E+06	6.77E+06	1.69E+07	9.48E+06
Electricity, high voltage {IE}  electricity production, hydro, pumped storage   APOS, U	8.26E+05	1.65E+06	8.23E+05	1.23E+06	3.09E+06	1.73E+06
Electricity, high voltage {IE}  electricity production, hydro, run-of-river   APOS, U	3.69E+05	7.35E+05	3.68E+05	5.52E+05	1.38E+06	7.72E+05
Electricity, low voltage {IE}  electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted   APOS, U	1.10E+05	2.20E+05	1.10E+05	1.65E+05	4.12E+05	2.31E+05
Electricity, high voltage {IE}  electricity production, wind, <1MW turbine, onshore   APOS, U	1.17E+06	2.33E+06	1.16E+06	1.75E+06	4.36E+06	2.44E+06
Electricity, high voltage {IE}  electricity production, wind, >3MW turbine, onshore   APOS, U	2.28E+05	4.55E+05	2.27E+05	3.41E+05	8.53E+05	4.78E+05
Electricity, high voltage {IE}  electricity production, wind, 1-3MW turbine, offshore   APOS, U	7.34E+04	1.46E+05	7.31E+04	1.10E+05	2.74E+05	1.54E+05
Electricity, high voltage {IE}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	4.95E+06	9.85E+06	4.92E+06	7.39E+06	1.85E+07	1.03E+07
High Carbon	1.55E+08	9.85E+07	1.55E+08	1.27E+08	0	9.29E+07

Low Carbon	1.30E+07	2.58E+07	1.29E+07	1.94E+07	4.84E+07	2.71E+07
<i>Total</i>	1.67E+08	1.24E+08	1.68E+08	1.46E+08	4.84E+07	1.20E+08

Table S9: GWP values, net of grid losses, estimated per each electricity source according to each modelled Scenario, assuming that the annual electricity consumed for the mining is 191.04 TWh (+100% with respect to the annual consumption estimated for 2022). Black font is assigned to High Carbon Sources and blue font is assigned to Low Carbon Sources.

<b>United States</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {RoW}  heat and power co-generation, hard coal   APOS, U	1.40E+09	1.50E+09	1.43E+09	1.46E+09	8.57E+08	1.04E+09
Electricity, high voltage {RoW}  heat and power co-generation, lignite   APOS, U	1.27E+08	1.37E+08	1.30E+08	1.33E+08	7.80E+07	9.45E+07
Electricity, high voltage {RoW}  treatment of coal gas, in power plant   APOS, U	4.72E+07	5.08E+07	4.84E+07	4.93E+07	2.89E+07	3.51E+07
Electricity, high voltage {US-SERC}  electricity production, hard coal   APOS, U	2.49E+10	2.68E+10	2.55E+10	2.60E+10	1.53E+10	1.85E+10
Electricity, high voltage {US-SERC}  electricity production, hydro, pumped storage   APOS, U	1.08E+07	1.33E+07	1.13E+07	1.43E+07	9.29E+06	2.39E+07
Electricity, high voltage {US-SERC}  electricity production, hydro, reservoir, alpine region   APOS, U	7.45E+06	9.15E+06	7.78E+06	9.85E+06	6.39E+06	1.64E+07
Electricity, high voltage {US-SERC}  electricity production, hydro, run-of-river   APOS, U	2.50E+07	3.07E+07	2.61E+07	3.31E+07	2.15E+07	5.51E+07
Electricity, high voltage {US-SERC}  electricity production, natural gas, combined cycle power plant   APOS, U	1.77E+10	1.49E+10	1.81E+10	1.45E+10	1.93E+10	1.32E+10
Electricity, high voltage {US-SERC}  electricity production, natural gas, conventional power plant   APOS, U	3.29E+09	2.77E+09	3.38E+09	2.69E+09	3.58E+09	2.45E+09
Electricity, high voltage {US-SERC}  electricity production, nuclear, boiling water reactor   APOS, U	3.41E+07	3.44E+07	3.56E+07	3.70E+07	2.37E+07	7.52E+07
Electricity, high voltage {US-SERC}  electricity production, nuclear, pressure water reactor   APOS, U	7.08E+07	7.13E+07	7.39E+07	7.68E+07	4.92E+07	1.56E+08
Electricity, high voltage {US-SERC}  electricity production, oil   APOS, U	1.07E+09	0	0	0	0	0
Electricity, high voltage {US-SERC}  heat and power co-generation, oil   APOS, U	1.75E+07	0	0	0	0	0
Electricity, high voltage {US-SERC}  electricity production, wind, <1MW turbine, onshore   APOS, U	6.20E+06	9.63E+06	6.48E+06	1.04E+07	8.95E+06	1.37E+07
Electricity, high voltage {US-SERC}  electricity production, wind, >3MW turbine, onshore   APOS, U	9.33E+05	1.45E+06	9.74E+05	1.56E+06	1.35E+06	2.06E+06
Electricity, high voltage {US-SERC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	7.69E+07	1.19E+08	8.03E+07	1.29E+08	1.11E+08	1.70E+08
Electricity, high voltage {US-SERC}  heat and power co-generation, biogas, gas engine   APOS, U	1.05E+08	0	0	0	0	0
Electricity, high voltage {US-SERC}  heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014   APOS, U	5.60E+07	0	0	0	0	0
Electricity, low voltage {US-SERC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	1.30E+08	4.55E+08	1.35E+08	4.90E+08	7.17E+08	2.86E+08
Electricity, high voltage {US-SERC}  electricity production, deep geothermal   APOS, U	1.38E+07	2.91E+07	1.44E+07	3.14E+07	2.88E+07	3.04E+07
High Carbon	4.86E+10	4.61E+10	4.86E+10	4.48E+10	3.91E+10	3.52E+10
Low Carbon	5.37E+08	7.73E+08	3.92E+08	8.33E+08	9.77E+08	8.28E+08
<i>Total</i>	4.91E+10	4.69E+10	4.90E+10	4.56E+10	4.01E+10	3.61E+10

<b>China</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {CN-SC}  electricity production, hard coal   APOS, U	4.56E+10	4.12E+10	4.37E+10	3.85E+10	0	3.22E+10
Electricity, high voltage {CN-SC}  electricity production, oil   APOS, U	8.82E+07	7.97E+07	8.46E+07	7.44E+07	0	6.22E+07
Electricity, high voltage {CN-SC}  electricity production, natural gas, combined cycle power plant   APOS, U	1.13E+09	1.02E+09	1.08E+09	9.50E+08	0	7.94E+08
Electricity, high voltage {CN-SC}  electricity production, natural gas, conventional power plant   APOS, U	2.95E+08	2.66E+08	2.83E+08	2.49E+08	0	2.08E+08
Electricity, high voltage {CN}  ethanol production from sweet sorghum   APOS, U	1.03E+07	9.26E+06	9.83E+06	8.65E+06	0	7.23E+06
Electricity, for reuse in municipal waste incineration only {JP}  market for electricity, for reuse in municipal waste incineration only   APOS, U	4.10E+07	3.40E+07	2.74E+07	4.11E+07	5.53E+07	5.75E+07
Electricity, high voltage {CN-SH}  electricity production, nuclear, pressure water reactor   APOS, U	1.67E+07	1.67E+07	1.34E+07	2.02E+07	3.62E+07	2.82E+07
Electricity, high voltage {CN-SC}  electricity production, hydro, run-of-river   APOS, U	4.36E+07	3.75E+07	3.03E+07	4.54E+07	6.47E+07	6.35E+07
Electricity, high voltage {CN-SH}  electricity production, deep geothermal   APOS, U	1.79E+04	1.54E+04	1.24E+04	1.86E+04	2.65E+04	2.60E+04
Electricity, low voltage {CN-SC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	7.54E+07	3.26E+08	2.63E+08	3.94E+08	1.64E+09	5.52E+08
Electricity, high voltage {CN-SC}  electricity production, wind, <1MW turbine, onshore   APOS, U	5.13E+05	9.00E+05	7.26E+05	1.09E+06	5.60E+06	1.52E+06
Electricity, high voltage {CN-SC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	5.47E+07	9.59E+07	7.73E+07	1.16E+08	5.97E+08	1.62E+08
High Carbon	4.71E+10	4.26E+10	4.52E+10	3.98E+10	0	3.32E+10
Low Carbon	2.32E+08	5.11E+08	4.12E+08	6.18E+08	2.40E+09	8.65E+08
<i>Total</i>	4.74E+10	4.31E+10	4.56E+10	4.04E+10	2.40E+09	3.41E+10
<b>Kazakhstan</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030</b> <b>EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>BAD</b> (kg CO <sub>2</sub> eq)	<b>2050</b> <b>IRENA &amp;</b> <b>EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {RoW}  heat and power co-generation, hard coal   APOS, U	2.10E+10	2.13E+10	1.83E+10	1.60E+10	1.72E+10	1.33E+10
Electricity, high voltage {RoW}  heat and power co-generation, oil   APOS, U	7.62E+08	0	0	0	0	0
Electricity, high voltage {RoW}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	5.37E+09	5.44E+09	4.69E+09	4.10E+09	4.40E+09	3.41E+09
Electricity, high voltage {RoW}  heat and power co-generation, biogas, gas engine   APOS, U	6.60E+04	9.34E+04	2.47E+05	3.67E+05	3.07E+05	5.10E+05
Electricity, high voltage {RoW}  electricity production, hydro, run-of-river   APOS, U	1.40E+07	1.99E+07	5.25E+07	7.82E+07	6.54E+07	1.09E+08
Electricity, high voltage {RoW}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	4.98E+06	7.05E+06	1.86E+07	2.77E+07	2.32E+07	3.85E+07
Electricity, low voltage {RU}  electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted   APOS, U	2.11E+07	2.98E+07	7.88E+07	1.17E+08	9.81E+07	1.63E+08
High Carbon	2.71E+10	2.67E+10	2.30E+10	2.01E+10	2.16E+10	1.67E+10
Low Carbon	4.02E+07	5.69E+07	1.50E+08	2.24E+08	1.87E+08	3.10E+08

<i>Total</i>	2.72E+10	2.68E+10	2.32E+10	2.04E+10	2.18E+10	1.70E+10
<b>Canada</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {CA-QC}  electricity production, hard coal   APOS, U	3.36E+08	3.23E+08	3.36E+08	3.36E+08	0	3.36E+08
Electricity, high voltage {CA-QC}  electricity production, oil   APOS, U	4.35E+07	4.19E+07	4.35E+07	4.35E+07	0	4.35E+07
Electricity, high voltage {CA-ON}  electricity production, natural gas, conventional power plant   APOS, U	6.06E+08	5.82E+08	6.05E+08	6.05E+08	0	6.05E+08
Electricity, high voltage {CA-QC}  heat and power co-generation, biogas, gas engine   APOS, U	2.27E+06	2.48E+06	2.27E+06	2.27E+06	7.67E+06	2.27E+06
Electricity, for reuse in municipal waste incineration only {CA}  treatment of municipal solid waste, municipal incineration   APOS, U	4.27E+05	4.66E+05	4.27E+05	4.27E+05	1.44E+06	4.25E+05
Electricity, high voltage {CA-QC}  electricity production, nuclear, pressure water reactor, heavy water moderated   APOS, U	6.11E+06	6.67E+06	6.11E+06	6.11E+06	2.06E+07	6.09E+06
Electricity, high voltage {CA-QC}  electricity production, hydro, reservoir, non-alpine region   APOS, U	1.78E+07	1.95E+07	1.78E+07	1.78E+07	6.01E+07	1.78E+07
Electricity, high voltage {CA-QC}  electricity production, hydro, run-of-river   APOS, U	9.29E+06	1.01E+07	9.29E+06	9.29E+06	3.13E+07	9.25E+06
Electricity, low voltage {CA-QC}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	8.08E+05	8.82E+05	8.82E+05	8.82E+05	2.98E+06	1.07E+06
Electricity, high voltage {CA-QC}  electricity production, wind, <1MW turbine, onshore   APOS, U	1.02E+05	1.11E+05	1.02E+05	1.02E+05	3.43E+05	1.01E+05
Electricity, high voltage {CA-QC}  electricity production, wind, >3MW turbine, onshore   APOS, U	2.17E+06	2.36E+06	2.17E+06	2.17E+06	7.30E+06	2.16E+06
Electricity, high voltage {CA-QC}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	7.86E+05	8.58E+05	7.86E+05	7.86E+05	2.65E+06	7.83E+05
High Carbon	9.86E+08	9.48E+08	9.85E+08	9.85E+08	0	9.85E+08
Low Carbon	3.98E+07	4.34E+07	3.99E+07	3.99E+07	1.34E+08	3.99E+07
<i>Total</i>	1.03E+09	9.91E+08	1.03E+09	1.03E+09	1.34E+08	1.03E+09
<b>Russia</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {RU}  heat and power co-generation, hard coal   APOS, U	3.89E+08	2.64E+08	2.75E+08	3.31E+08	3.22E+08	2.75E+08
Electricity, high voltage {RU}  heat and power co-generation, oil   APOS, U	9.55E+06	0	0	0	0	0
Electricity, high voltage {RU}  heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical   APOS, U	1.76E+07	1.34E+07	1.40E+07	1.69E+07	1.64E+07	1.40E+07
Electricity, high voltage {RU}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	5.09E+08	3.88E+08	4.03E+08	4.86E+08	4.72E+08	4.03E+08
Electricity, high voltage {RoW}  ethanol production from sweet sorghum   APOS, U	8.14E+03	2.05E+07	0	0	1.81E+04	0
Electricity, for reuse in municipal waste incineration only {RU}  treatment of municipal solid waste, municipal incineration   APOS, U	3.67E+06	3.76E+07	7.09E+07	4.78E+07	5.17E+07	7.09E+07
Electricity, high voltage {RU}  electricity production, nuclear, boiling water reactor   APOS, U	3.55E+06	7.05E+05	1.33E+06	8.98E+05	9.70E+05	1.33E+06
Electricity, high voltage {RU}  electricity production, nuclear, pressure water reactor   APOS, U	4.63E+06	9.20E+05	1.74E+06	1.17E+06	1.27E+06	1.74E+06

Electricity, high voltage {RU}  electricity production, hydro, pumped storage   APOS, U	8.38E+05	1.07E+06	2.02E+06	1.36E+06	1.47E+06	2.02E+06
Electricity, high voltage {RU}  electricity production, hydro, reservoir, non-alpine region   APOS, U	2.95E+06	3.76E+06	7.09E+06	4.78E+06	5.17E+06	7.09E+06
Electricity, high voltage {RU}  electricity production, hydro, run-of-river   APOS, U	5.68E+06	7.24E+06	1.37E+07	9.22E+06	9.96E+06	1.37E+07
Electricity, high voltage {RU}  electricity production, deep geothermal   APOS, U	2.75E+04	1.88E+06	3.54E+06	2.39E+06	2.58E+06	3.54E+06
Electricity, low voltage {RU}  electricity production, photovoltaic, 3kWp slanted-roof installation, single-Si, panel, mounted   APOS, U	1.59E+05	1.07E+06	2.01E+06	1.36E+06	1.47E+06	2.01E+06
Electricity, high voltage {RU}  electricity production, wind, <1MW turbine, onshore   APOS, U	2.59E+05	5.58E+06	1.05E+07	7.11E+06	7.68E+06	1.05E+07
High Carbon	9.25E+08	6.86E+08	6.92E+08	8.34E+08	8.10E+08	6.92E+08
Low Carbon	2.18E+07	5.98E+07	1.13E+08	7.61E+07	8.23E+07	1.13E+08
<i>Total</i>	9.47E+08	7.46E+08	8.05E+08	9.10E+08	8.93E+08	8.05E+08
<b>Germany</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {DE}  heat and power co-generation, hard coal   APOS, U	7.89E+07	6.34E+07	7.89E+07	7.89E+07	0	6.13E+07
Electricity, high voltage {DE}  electricity production, hard coal   APOS, U	2.90E+08	2.34E+08	2.90E+08	2.90E+08	0	2.26E+08
Electricity, high voltage {DE}  heat and power co-generation, oil   APOS, U	1.00E+06	8.06E+05	1.00E+06	1.00E+06	0	7.80E+05
Electricity, high voltage {DE}  electricity production, oil   APOS, U	6.94E+06	5.58E+06	6.94E+06	6.94E+06	0	5.40E+06
Electricity, high voltage {DE}  electricity production, natural gas, conventional power plant   APOS, U	2.16E+07	1.73E+07	2.16E+07	2.16E+07	0	1.68E+07
Electricity, high voltage {DE}  heat and power co-generation, natural gas, conventional power plant, 100MW electrical   APOS, U	5.72E+07	4.60E+07	5.72E+07	5.72E+07	0	4.45E+07
Electricity, high voltage {DE}  heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical   APOS, U	7.45E+05	5.99E+05	7.45E+05	7.45E+05	0	5.80E+05
Electricity, high voltage {DE}  electricity production, natural gas, combined cycle power plant   APOS, U	2.26E+07	1.82E+07	2.26E+07	2.26E+07	0	1.76E+07
Electricity, high voltage {DE}  heat and power co-generation, biogas, gas engine   APOS, U	5.79E+06	9.14E+06	5.79E+06	5.79E+06	2.29E+07	9.60E+06
Electricity, high voltage {DE}  heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014   APOS, U	5.08E+05	8.02E+05	5.08E+05	5.08E+05	2.01E+06	8.42E+05
Electricity, for reuse in municipal waste incineration only {DE}  market for electricity, for reuse in municipal waste incineration only   APOS, U	7.24E+06	1.14E+07	7.24E+06	7.24E+06	2.86E+07	1.20E+07
Electricity, high voltage {DE}  electricity production, nuclear, boiling water reactor   APOS, U	3.47E+05	5.47E+05	3.47E+05	3.47E+05	1.37E+06	5.74E+05
Electricity, high voltage {DE}  electricity production, nuclear, pressure water reactor   APOS, U	1.27E+06	2.01E+06	1.27E+06	1.27E+06	5.03E+06	2.11E+06
Electricity, high voltage {DE}  electricity production, hydro, pumped storage   APOS, U	2.53E+06	3.99E+06	2.53E+06	2.53E+06	9.99E+06	4.19E+06
Electricity, high voltage {DE}  electricity production, hydro, reservoir, non-alpine region   APOS, U	1.96E+05	3.09E+05	1.96E+05	1.96E+05	7.74E+05	3.25E+05
Electricity, high voltage {DE}  electricity production, hydro, run-of-river   APOS, U	6.61E+05	1.04E+06	6.61E+05	6.61E+05	2.61E+06	1.10E+06
Electricity, high voltage {DE}  electricity production, deep geothermal   APOS, U	2.03E+04	3.20E+04	2.03E+04	2.03E+04	8.02E+04	3.36E+04

Electricity, low voltage {DE}  electricity production, photovoltaic, 570kWp open ground installation, multi-Si   APOS, U	5.97E+06	9.42E+06	5.97E+06	5.97E+06	2.36E+07	9.89E+06
Electricity, high voltage {DE}  electricity production, wind, <1MW turbine, onshore   APOS, U	9.23E+05	1.46E+06	9.23E+05	9.23E+05	3.65E+06	1.53E+06
Electricity, high voltage {DE}  electricity production, wind, >3MW turbine, onshore   APOS, U	6.36E+05	1.00E+06	6.36E+05	6.36E+05	2.51E+06	1.05E+06
Electricity, high voltage {DE}  electricity production, wind, 1-3MW turbine, offshore   APOS, U	1.87E+05	2.95E+05	1.87E+05	1.87E+05	7.39E+05	3.10E+05
Electricity, high voltage {DE}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	5.13E+06	8.09E+06	5.13E+06	5.13E+06	2.03E+07	8.49E+06
High Carbon	4.79E+08	3.85E+08	4.79E+08	4.79E+08	0	3.73E+08
Low Carbon	3.14E+07	4.96E+07	3.14E+07	3.14E+07	1.24E+08	5.20E+07
<i>Total</i>	5.11E+08	4.35E+08	5.11E+08	5.11E+08	1.24E+08	4.25E+08
<b>Malaysia</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {MY}  electricity production, hard coal   APOS, U	5.94E+08	5.86E+08	4.52E+08	5.45E+08	5.29E+08	4.52E+08
Electricity, high voltage {MY}  electricity production, oil   APOS, U	6.32E+06	6.24E+06	4.81E+06	5.80E+06	5.63E+06	4.81E+06
Electricity, high voltage {MY}  electricity production, natural gas, combined cycle power plant   APOS, U	1.24E+08	1.22E+08	9.41E+07	1.13E+08	1.10E+08	9.41E+07
Electricity, high voltage {MY}  electricity production, natural gas, conventional power plant   APOS, U	9.88E+07	9.75E+07	7.52E+07	9.06E+07	8.80E+07	7.52E+07
Electricity, high voltage {MY}  heat and power co-generation, wood chips, 6667 kW   APOS, U	2.51E+05	5.93E+05	5.27E+05	7.90E+05	9.22E+05	9.22E+05
Electricity, high voltage {MY}  electricity production, hydro, reservoir, tropical region   APOS, U	6.88E+06	1.62E+07	1.44E+07	2.16E+07	2.52E+07	2.52E+07
Electricity, low voltage {MY}  electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted   APOS, U	4.53E+05	1.07E+06	9.50E+05	1.42E+06	1.66E+06	1.66E+06
High Carbon	8.23E+08	8.12E+08	6.26E+08	7.55E+08	7.33E+08	6.26E+08
Low Carbon	7.58E+06	1.79E+07	1.59E+07	2.38E+07	2.78E+07	2.78E+07
<i>Total</i>	8.31E+08	8.30E+08	6.42E+08	7.79E+08	7.61E+08	6.54E+08
<b>Ireland</b>	<b>Baseline</b> (kg CO <sub>2</sub> eq)	<b>2030 BAD</b> (kg CO <sub>2</sub> eq)	<b>2030 IRENA</b> (kg CO <sub>2</sub> eq)	<b>2030 EMEBER</b> (kg CO <sub>2</sub> eq)	<b>2050 BAD</b> (kg CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (kg CO <sub>2</sub> eq)
Electricity, high voltage {IE}  electricity production, hard coal   APOS, U	4.70E+07	3.53E+07	4.71E+07	4.12E+07	0	3.41E+07
Electricity, high voltage {IE}  electricity production, oil   APOS, U	1.88E+07	1.41E+07	1.88E+07	1.64E+07	0	1.36E+07
Electricity, high voltage {IE}  electricity production, natural gas, combined cycle power plant   APOS, U	9.13E+07	6.86E+07	9.14E+07	8.00E+07	0	6.63E+07
Electricity, high voltage {IE}  electricity production, natural gas, conventional power plant   APOS, U	6.77E+07	5.08E+07	6.78E+07	5.93E+07	0	4.91E+07
Electricity, high voltage {IE}  heat and power co-generation, biogas, gas engine   APOS, U	2.78E+05	5.55E+05	2.77E+05	4.16E+05	1.39E+06	5.82E+05
Electricity, high voltage {IE}  heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014   APOS, U	4.19E+05	8.35E+05	4.18E+05	6.26E+05	2.09E+06	8.77E+05

Electricity, for reuse in municipal waste incineration only {GB}  market for electricity, for reuse in municipal waste incineration only   APOS, U	4.54E+06	9.03E+06	4.52E+06	6.77E+06	2.26E+07	9.48E+06
Electricity, high voltage {IE}  electricity production, hydro, pumped storage   APOS, U	8.26E+05	1.65E+06	8.23E+05	1.23E+06	4.11E+06	1.73E+06
Electricity, high voltage {IE}  electricity production, hydro, run-of-river   APOS, U	3.69E+05	7.35E+05	3.68E+05	5.52E+05	1.84E+06	7.72E+05
Electricity, low voltage {IE}  electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted   APOS, U	1.10E+05	2.20E+05	1.10E+05	1.65E+05	5.49E+05	2.31E+05
Electricity, high voltage {IE}  electricity production, wind, <1MW turbine, onshore   APOS, U	1.17E+06	2.33E+06	1.16E+06	1.75E+06	5.82E+06	2.44E+06
Electricity, high voltage {IE}  electricity production, wind, >3MW turbine, onshore   APOS, U	2.28E+05	4.55E+05	2.27E+05	3.41E+05	1.14E+06	4.78E+05
Electricity, high voltage {IE}  electricity production, wind, 1-3MW turbine, offshore   APOS, U	7.34E+04	1.46E+05	7.31E+04	1.10E+05	3.66E+05	1.54E+05
Electricity, high voltage {IE}  electricity production, wind, 1-3MW turbine, onshore   APOS, U	4.95E+06	9.85E+06	4.92E+06	7.39E+06	2.46E+07	1.03E+07
High Carbon	2.25E+08	1.69E+08	2.25E+08	1.97E+08	0	1.63E+08
Low Carbon	1.30E+07	2.58E+07	1.29E+07	1.94E+07	6.45E+07	2.71E+07
<i>Total</i>	2.38E+08	1.95E+08	2.38E+08	2.16E+08	6.45E+07	1.90E+08

Table S10: GWP estimations associated with future electricity mix Scenarios and different electricity consumption rates.

<b>Electricity consumption</b>	<b>Baseline</b> (Mt CO <sub>2</sub> eq)	<b>2030 BAD</b> (Mt CO <sub>2</sub> eq)	<b>2030 IRENA</b> (Mt CO <sub>2</sub> eq)	<b>2030 EMBER</b> (Mt CO <sub>2</sub> eq)	<b>2050 BAD</b> (Mt CO <sub>2</sub> eq)	<b>2050 IRENA &amp; EMBER</b> (Mt CO <sub>2</sub> eq)
95.52 TWh (year 2022)	51.7	42.7	45.6	32.3	23.6	14.3
-10 %	36.6	24.7	31.3	20.9	12.4	6.6
+10 %	59.5	50.6	53.1	40.1	26.7	21.6
+20 %	67.0	58.2	60.6	47.7	31.1	28.7
+50 %	89.6	80.9	83.0	70.4	44.2	50.1
+100 %	127.2	120.0	121.0	109.8	66.2	90.3



Table S11: Estimation of the amount of sorbents hypothetically needed to capture the CO<sub>2</sub> eq emitted by mining (Baseline Scenario).

	Amine & Support	Adsorption Capacity <sup>[a]</sup> (molCO <sub>2</sub> /kgsorbent)	Amount of adsorber (Mt)
Class 3	Diethylenetriamine (DETA) on CB-N-g-PCMS-OH-	0.14	8395.97
	Diethylenetriamine (DETA) on CB-gxPCMSOH-	0.14	8395.97
	Diethylenetriamine (DETA) on PS-CC	0.57	2062.17
	Diethylenetriamine (DETA) on Colloidal crystal	0.36	3265.10
	Diethylenetriamine (DETA) on HIPE	0.5	2350.87
	Diethylenetriamine (DETA) on Pick-20%-silica-2%	0.72	1632.55
	Aziridine on Mesoporous silica SBA-15	1.78	660.36
	Poly(L-lysine) on SBA-15	0.6	1959.06
	3-aminopropyl triethoxysilane (APTMS) on Hybrid silica material	1.68	699.66
Class 2	Triaminesilane (TRI) on MCM-41	0.98	1199.42
	Triaminesilane (TRI) on MCM-41	0.9	1306.04
	Triaminesilane (TRI) on MCM-41	1.19	987.76
	Triaminesilane (TRI) on MCM-41	1.4	839.60
	Diethylenetriamino organosilanes (DT) on PE-MCM-41	0.61	1926.94

	Diethylenetriamino organosilanes (DT) on PE-MCM-41	0.54	2176.73
	Diethylenetriamino organosilanes (DT) on PE-MCM-41	1.16	1013.31
	Diaminosilane (H4N2Si) on Silica gel	0.4	2938.59
	Diaminosilane (H4N2Si) on Silica gel	0.44	2671.44
	3-aminopropylmethyldiethoxysilane (APDES) on Nanofibrillated cellulose (NFC)	1.11	1058.95
	3-aminopropylmethyldiethoxysilane (APDES) on Nanofibrillated cellulose (NFC)	2.13	551.85
	N-(2-aminoethyl)-3-aminopropylmethyldimethoxysilane (AEAPDMS) on Nanofibrillated cellulose (NFC)	1.39	845.64
	3-aminopropyltrimethoxysilane, (APS) low on SBA-15	0.12	9795.30
	3-aminopropyltrimethoxysilane, (APS) medium on SBA-15	0.24	4897.65
	3-aminopropyltrimethoxysilane, (APS) high on SBA-15	0.8	1469.29
	3-aminopropyltrimethoxysilane (APS) on SBA-15	0.14	8395.97
	3-aminopropylsilyl (APS) on Mesocellular foam (MCF)	1	1175.44
	Diethylenediamine (DETA) on Porous polymer networks (PPNs)	1.04	1130.23
	Tris (2-amino ethyl) amine (TREN) on MIL-101(Cr)	0.35	3358.39
	NH3 on SBA-15	0.1	11754.36
	Primary on Polystyrene	0.8	1469.29
	Primary on Polystyrene	0.89	1320.71
	3-aminopropyltriethoxysilane (APS) on Mesoporous alumina	0.45 <sup>[b]</sup>	2612.08
	Ethylenediamine (ED) on Mg2(dobpdc)	2.83	415.35
	Hydrazine (H2N4) on Mg2(dobpdc)	3.89	302.17
	Tris(2-aminoethyl)amine (TAEA) on Cr-MIL-101-SO3H	1.12	1049.50
	Ethylenediamine (ED) on Mg/DOBDC	1.5	783.62
<b>Class 1</b>	Tetraethylenepentamine (TEPA)-38% w/w on Silica (CARIACT® and Davisil®-646) and polymethylmethacrylate® (PMMA, Diaion™ HP-2MG)	2.5	470.17
	Polyethylenimine (PEI) on Commercial silica (CARIACTG10HPV)	2.36	498.07

Polyethylenimine (PEI) + (3-aminopropyl)triethoxysilane (APTMS) on Commercial silica (CARIACTG10HPV)	2.26	520.10
Polyethylenimine (PEI) + tetrapropyl orthotitanate on Commercial silica (CARIACTG10HPV)	2.19	536.73
Poly(allylamine) (PAA) on Mesocellular foam (MFC)	0.63	1865.77
Branched Polyethylenimine (PEI) on Mesocellular foam (MFC)	0.61	1926.94
Linear Polyethylenimine (PEI) on Mesocellular foam (MFC)	0.44	2671.44
Polyethylenimine (PEI) (34.7% w/w) on Zr-SBA-15	0.85	1382.87
Polyethylenimine (PEI) on $\gamma$ alumina	1.74	675.54
Polyethylenimine (PEI) on SBA-15	1.05	1119.46
Polyethylenimine (PEI)-H 33% w/w on Fumed silica	1.18	996.13
Polyethylenimine (PEI)-H 33% w/w on Fumed silica	1.77	664.09
Polyethylenimine (PEI)-H 50% w/w on Fumed silica	1.71	687.39
Polyethylenimine (PEI)-H 50% w/w on Fumed silica	1.41	833.64
Polyethylenimine (PEI) on SBA-15	1.52	773.31
Polyethylenimine (PEI) on SBA-15	0.77	1526.54
Polyethylenimine (PEI)PEI+poly(ethylene glycol) (PEG) on Fumed silica	0.68	1728.58
Polyethylenimine (PEI), 67% w/w on SBA-15	1.92	612.21
Polyethylenimine (PEI), 50% w/w on Mixed metal oxides (MMO)	1.66	708.09
Polyethylenimine (PEI), 67% w/w on Mixed metal oxides (MMO)	2.27	517.81
Polyethylenimine (PEI) + poly(ethylene glycol) (PEG) 200 on SBA-15	0.79	1487.89
Linear Polyethylenimine (PEI) on Fumed silica	2.34	502.32
Branched Polyethylenimine (PEI) on Fumed silica	2.44	481.74
Polyethylenimine (PEI)-M (Mw = 1800) on Fumed silica	1.69	695.52
Polyethylenimine (PEI)-H (Mw = 25,000) on Fumed silica	1.67	703.85
Polyethylenimine (PEI) (Mw = 800) on Hierarchical bimodal meso/microporous silica	3.36	349.83
Polyethylenimine (PEI) (Mw = 800) on Hierarchical bimodal meso/microporous silica	2.6	452.09

Polyethylenimine (PEI) 55% w/w on Mesoporous carbon	2.25	522.42
Polyethylenimine (PEI) 55% w/w on Mesoporous carbon	2.58	455.60
Polyethylenimine (PEI) 55% w/w on Mesoporous carbon	3.34	351.93
Branched Polyethylenimine (PEI) (Mw = 800) on Mesoporous $\gamma$ alumina	1.71	687.39
Branched Polyethylenimine (PEI) (Mw = 800) 43–44% w/w on Alumina monolith	0.75	1567.25
Polyethylenimine (PEI) 50% w/w on Non-polar resin (HP20)	2.26	520.10
Polyethylenimine (PEI) 20% w/w on Microporous polymer	0.2	5877.18
Poly(propylenimine) (PPI) prepared by HClO <sub>4</sub> on SBA-15	0.31	3791.73
Poly(propylenimine) (PPI) prepared by HBr on SBA-15	0.25	4701.74
Poly(propylenimine) (PPI) prepared by HCl on SBA-15	0.15	7836.24
Poly(propylenimine) (PPI) prepared by CH <sub>3</sub> SO <sub>3</sub> H on SBA-15	0.17	6914.33
Tetraethylenepentamine (TEPA) on SBA-15	3.6	326.51
PEI Polyethylenimine (PEI) 44% w/w on Nanofibrillated cellulose (NFC)	0.5	2350.87
Polyethylenimine (PEI) 44% w/w on Nanofibrillated cellulose (NFC)	2.2	534.29
N,N'-Dimethylethylenediamine (mmen) on Mg <sub>2</sub> (dobpdc)	2	587.72
Polyethylenimine (PEI) on Carbon fiber	1.3	904.18
Polyethylenimine (PEI) on MIL-101(Cr)	1.35	870.69

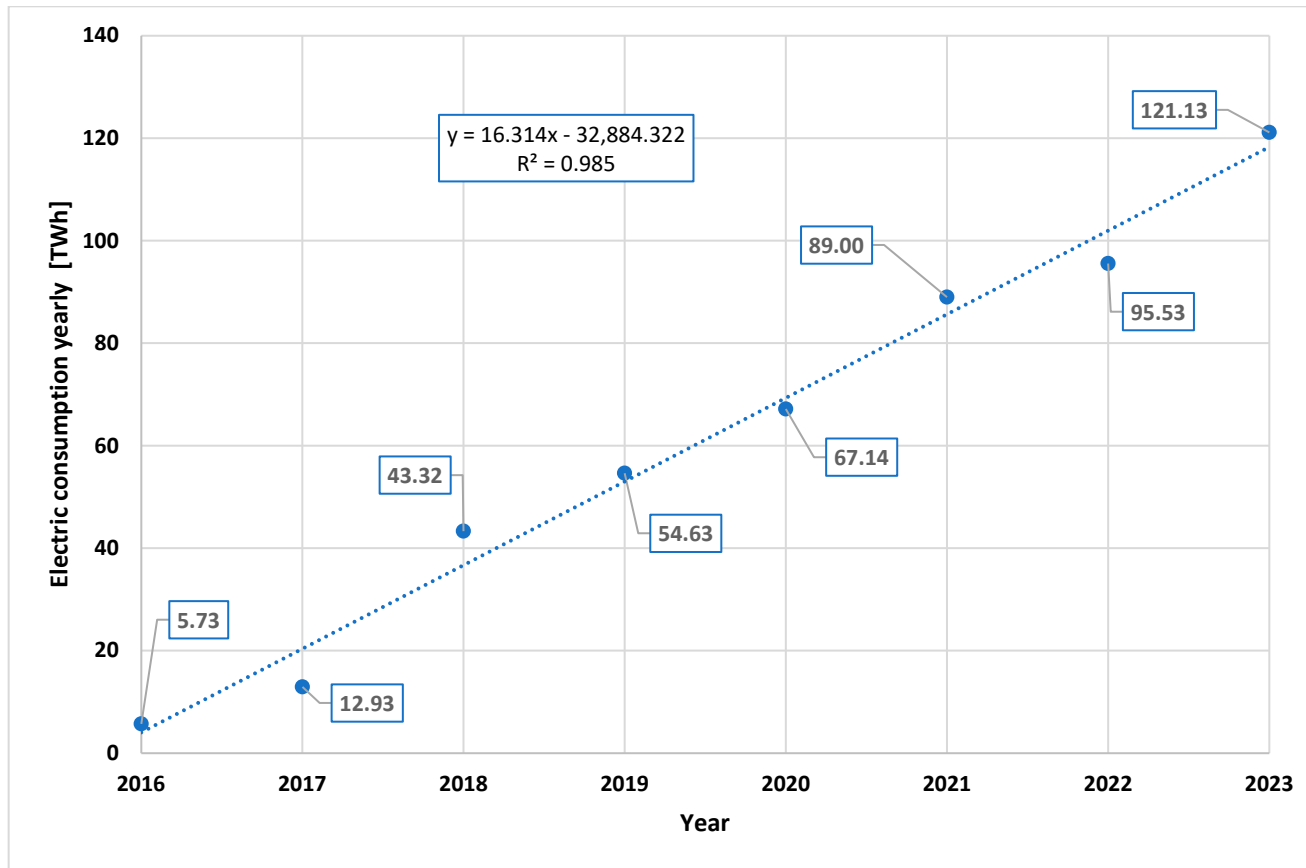
<sup>[a]</sup>Data are taken from ref. [16]; <sup>[b]</sup>The average value from ref. [16] is considered.

Table S12: Data and regression models for extrapolating EfH to 2030

Year	Electric consumption yearly [TWh] <sup>a</sup>
2010	0.00
2011	0.14
2012	0.10
2013	1.06
2014	4.73
2015	3.62
2016	5.73
2017	12.93
2018	43.32
2019	54.63
2020	67.14
2021	89.00
2022	95.53
2023	121.13

<sup>a</sup>Data taken from Cambridge Bitcoin Electricity Consumption Index website. See ref. [1]

a) Linear regression model



b) Quadratic regression model

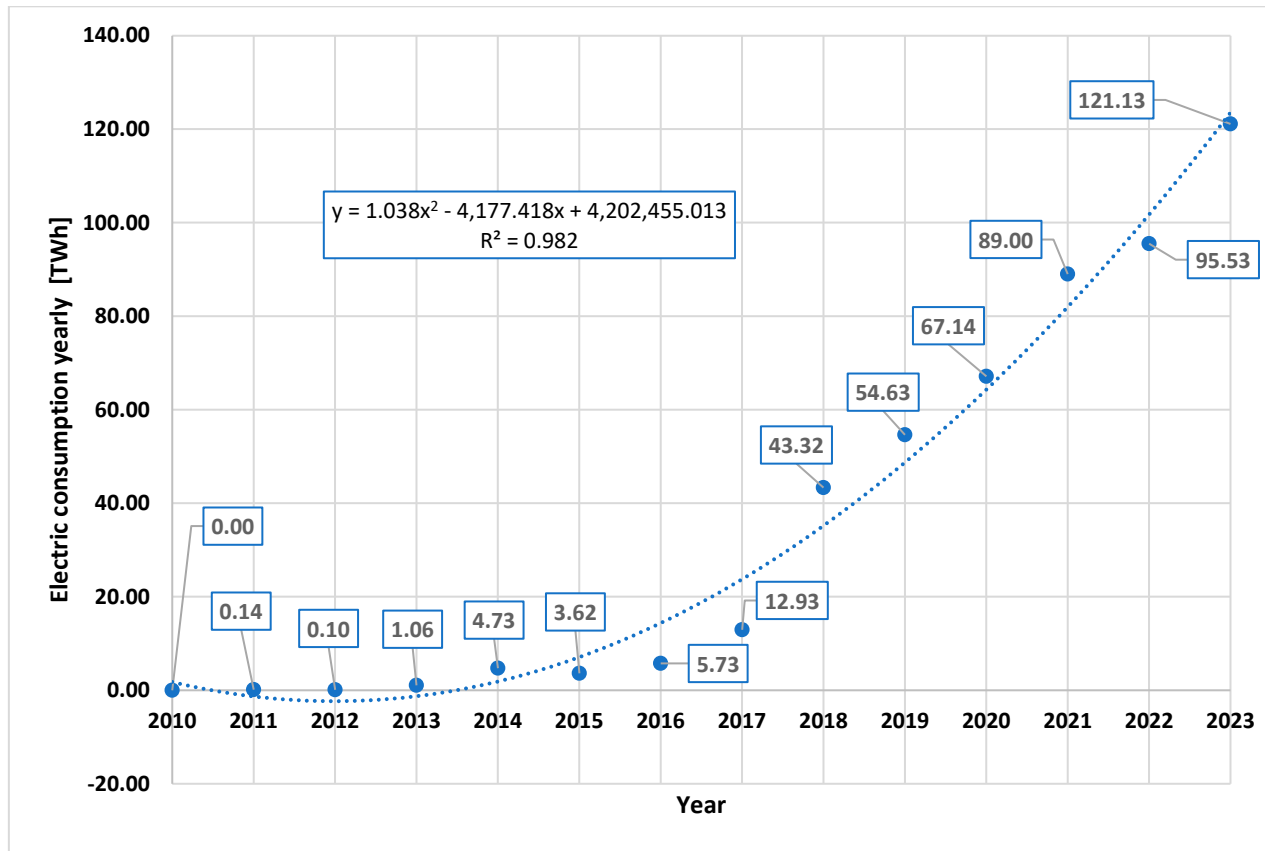
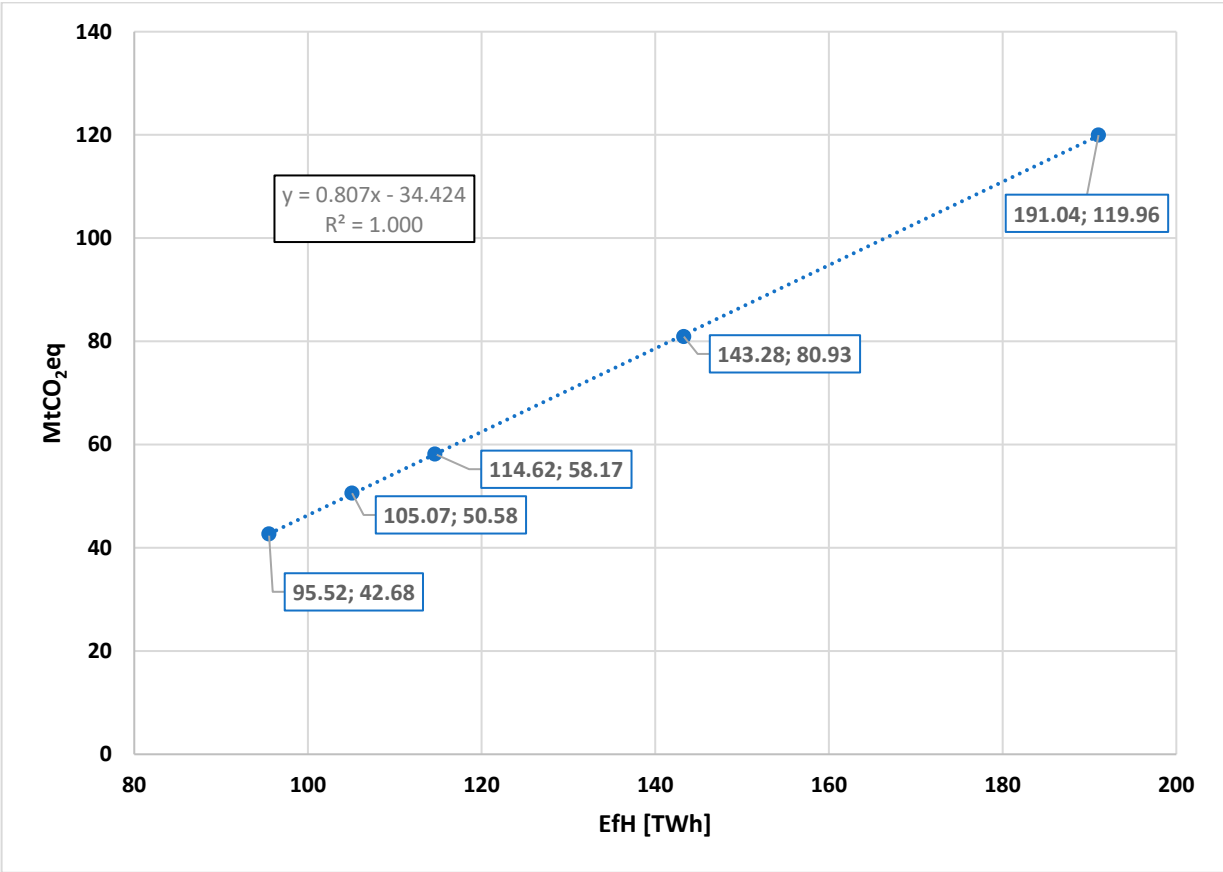


Table S13: Linear regression models for the 2030 BAD, 2030 IRENA and 2030 EMBER scenarios to estimate the carbon emissions of the extrapolated 232.47 TWh and 334.45 TWh.

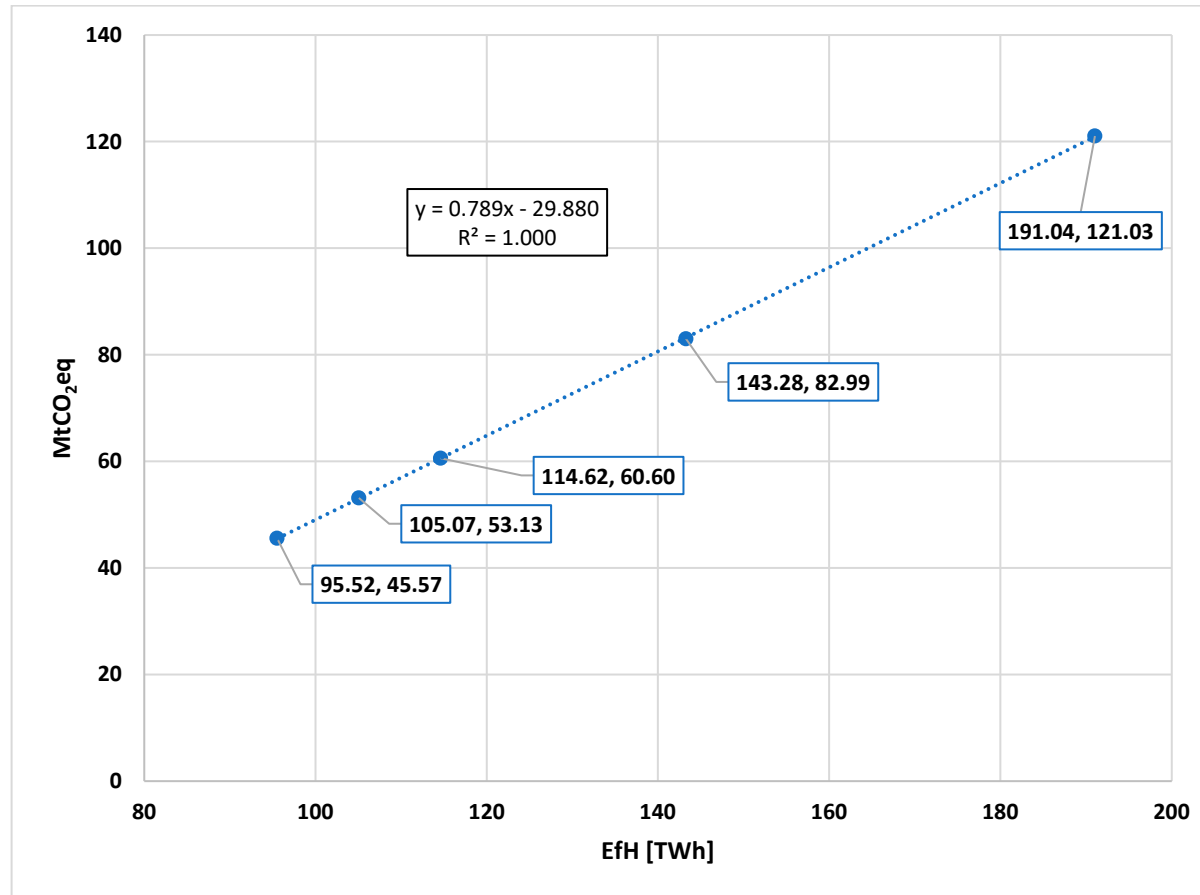
Data hereafter used are listed in table S10 for each scenario (only positive increased from 95.52 TWh are considered). The explicit electricity consumption values are: 0%: 95.52 TWh; +10%: 105.07 TWh; B +20%: 114.62 TWh; B +50%: 143.28 TWh; B +100%: 191.04 TWh.

a) 2030 BAD model

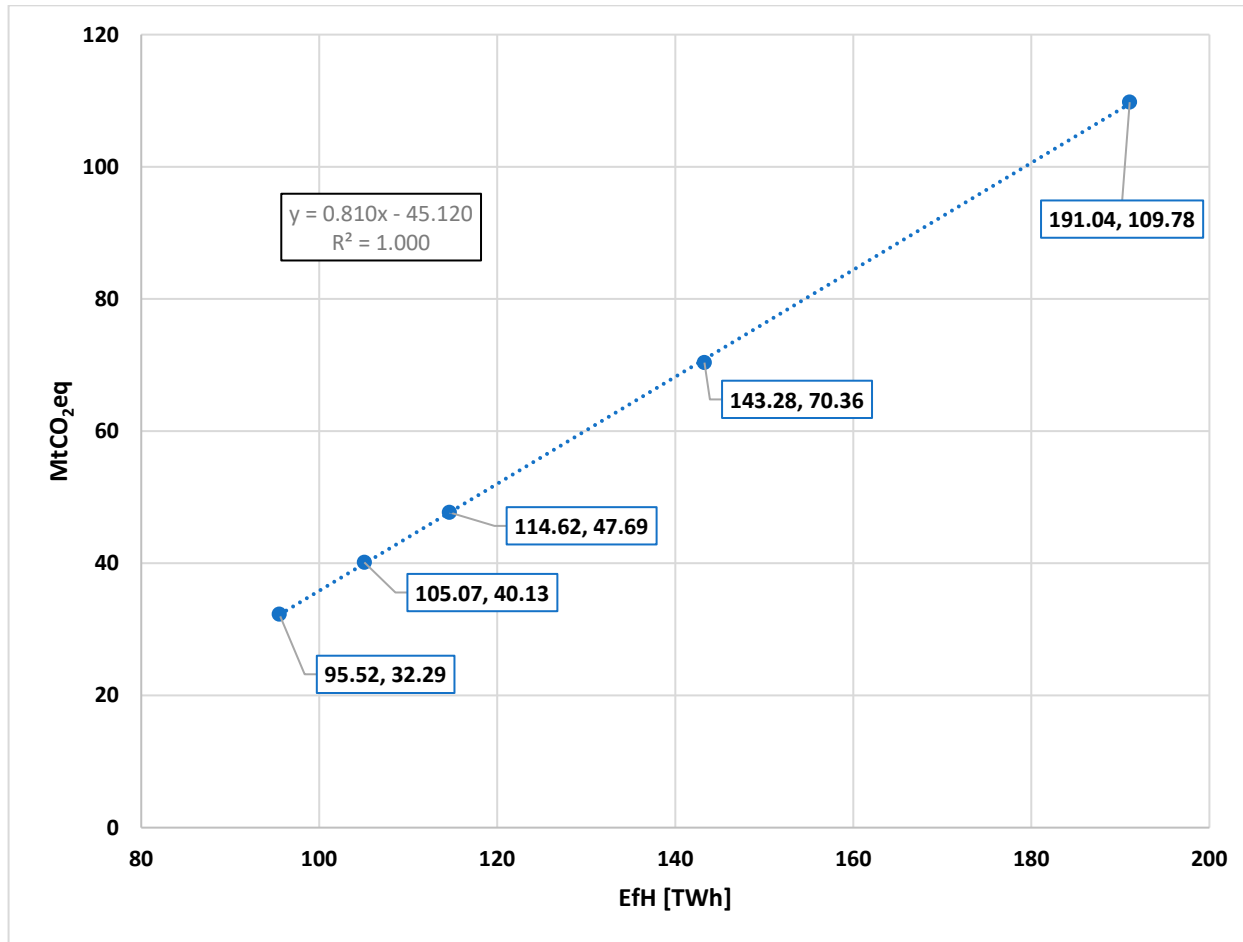




b) 2030 IRENA



c) 2030 EMBER



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