Council of the
European Union

**Brussels, 13 February 2023**
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**6341/23**
**ADD 1**

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**COVER NOTE**

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| From: | Secretary-General of the European Commission, signed by Ms Martine DEPREZ, Director |
| date of receipt: | 13 February 2023 |
| To: | Ms Thérèse BLANCHET, Secretary-General of the Council of the European Union |
| No. Cion doc.: | C(2023) 1086 final - ANNEX |
| Subject: | ANNEX to the COMMISSION DELEGATED REGULATION (EU) …/... supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by establishing a minimum threshold for greenhouse gas emissions savings of recycled carbon fuels and by specifying a methodology for assessing greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and from recycled carbon fuels |

Delegations will find attached document C(2023) 1086 final - ANNEX.

Encl.: C(2023) 1086 final - ANNEX

EUROPEAN
COMMISSION

Brussels, 10.2.2023
C(2023) 1086 final

ANNEX

**ANNEX**

**to the**

**COMMISSION DELEGATED REGULATION (EU) …/...**

**supplementing Directive (EU) 2018/2001 of the European Parliament and of the Council by establishing a minimum threshold for greenhouse gas emissions savings of recycled carbon fuels and by specifying a methodology for assessing greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and from recycled carbon fuels**

**ANNEX**

**Methodology for determining greenhouse gas emissions savings from renewable liquid and gaseous transport fuels of non-biological origin and from recycled carbon fuels**

A. METHODOLOGY

1. Greenhouse gas emissions from the production and use of renewable liquid and gaseous transport fuels of non-biological origin or recycled carbon fuels shall be calculated as follows:

$E = e_i + e_p + e_{td} + e_u - e_{ccs}$

where:

E = total emissions from the use of the fuel ($gCO_2eq$ / MJ fuel)

$e_i$ = e i elastic + e i rigid - e ex-use: emissions from supply of inputs ($gCO_2eq$ / MJ fuel)

e i elastic = emissions from elastic inputs ($gCO_2eq$ / MJ fuel)

e i rigid = emissions from rigid inputs ($gCO_2eq$ / MJ fuel)

e ex-use = emissions from inputs' existing use or fate ($gCO_2eq$ / MJ fuel)

$e_p$ = emissions from processing ($gCO_2eq$ / MJ fuel)

$e_{td}$ = emissions from transport and distribution ($gCO_2eq$ / MJ fuel)

$e_u$ = emissions from combusting the fuel in its end-use ($gCO_2eq$ / MJ fuel)

$e_{ccs}$ = emission savings from carbon capture and geological storage ($gCO_2eq$ / MJ fuel)

Emissions from the manufacture of machinery and equipment shall not be taken into account.

The greenhouse gas emissions intensity of renewable liquid and gaseous transport fuels of non-biological origin or recycled carbon fuels shall be determined by dividing the total emissions of the process covering each element of the formula by the total amount of fuel stemming from the process and shall be expressed in terms of grams of $CO_2$ equivalent per MJ of fuel (g $CO_2$eq/MJ fuel). If a fuel is a mix of renewable liquid and gaseous transport fuels of non-biological origin, recycled carbon fuels and other fuels, all (fuel) types shall be considered to have the same emission intensity.

The exception to this rule is the case of co-processing where renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels are only partially replacing a conventional input in a process.

In such a situation it shall be distinguished in the calculation of the greenhouse gas emissions intensity on a proportional basis of the energetic value of inputs between:

– the part of the process that is based on the conventional input and

– the part of the process that is based on renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels assuming that the process parts are otherwise identical.

An analogous distinction between processes shall be applied where renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels are processed together with biomass.

The greenhouse gas emissions intensity may be calculated as an average for the entire production of fuels occurring during a period of at most one calendar month but may also be calculated for shorter time intervals. Where electricity qualifying as fully renewable according to the methodology set out in Directive 2018/2001 is used as input that enhances the heating value of the fuel or intermediate products, the time interval shall be in line with the requirements applying for temporal correlation. Where relevant, greenhouse gas emissions intensity values calculated for individual time intervals may then be used to calculate an average greenhouse gas emissions intensity for a period of up to one month, provided that the individual values calculated for each time period meet the minimum savings threshold of 70%.

2. Greenhouse gas emission savings from renewable liquid and gaseous transport fuels of non-biological origin or from recycled carbon fuels shall be calculated as follows:

$$\text{Savings} = (E_F - E) / E_F$$

where:

E = total emissions from the use of renewable liquid and gaseous transport fuel of non-biological origin or recycled carbon fuel.

$E_F$ = total emissions from the fossil fuel comparator.

For all renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels, the total emissions from the fossil fuel comparator shall be 94 gCO2eq/MJ.

3. If the output of a process does not fully qualify as renewable liquid and gaseous transport fuels of non-biological origin or recycled carbon fuel, their respective shares in the total output shall be determined as follows:

(a) the fraction of renewable liquid and gaseous transport fuels of non-biological origin shall be determined by dividing the relevant renewable energy input into the process by the total relevant energy inputs into the process.

(b) the fraction of recycled carbon fuel shall be determined by dividing the relevant energy input qualifying as a source for the production of recycled carbon fuels into the process by the total relevant energy inputs into the process.

The relevant energy for material inputs is the lower heating value of the material input that enters into the molecular structure of the fuel[1].

For electricity inputs that are used to enhance the heating value of the fuel or intermediate products the relevant energy is the energy of the electricity.

For industrial off-gases, it is the energy in the off-gas based on their lower heating value. In case of heat that is used to enhance the heating value of the fuel or intermediate product, the relevant energy is the useful energy in the heat that is used

[1] For material inputs containing water, the lower heating value is taken to be the lower heating value of the dry part of the material input (i.e. not taking into account the energy needed to evaporate the water). Renewable liquid and gaseous transport fuels of non-biological origin used as intermediate products for the production of conventional fuels are not considered.

to synthesise the fuel. Useful heat is the total heat energy multiplied by the Carnot efficiency, as defined in Annex V, part C, point (1)(b) of Directive (EU) 2018/2001. Other inputs are only taken into account when determining the emission intensity of the fuel.

4. When determining emissions from supply of inputs, it shall be distinguished between elastic inputs and rigid inputs. Rigid inputs are those whose supply cannot be expanded to meet extra demand. Thus, all inputs qualifying as a carbon source for the production of recycled carbon fuels are rigid, as well as outputs produced in fixed ratio by an incorporated process[2] and which represent less than 10% of the economic value of the output. If it represents 10% or more of the economic value, it shall be treated as elastic. In principle, elastic inputs are those whose supply can be increased to meet extra demand. Petroleum products from refineries fall into this category because refineries can change the ratio of their products.

5. Electricity qualifying as fully renewable according to Article 27(3) of Directive 2018/2001, shall be attributed zero greenhouse gas emissions.

6. One of the three following alternative methods shall be applied during each calendar year to attribute greenhouse gas emissions values to the electricity taken from the grid that does not qualify as fully renewable according to Article 27(3) of Directive (EU) 2018/2001 and is used to produce renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels :

   (a) greenhouse gas emissions values shall be attributed according to part C of this Annex. This is without prejudice to the assessment under State aid rules;

   (b) greenhouse gas emissions values shall be attributed depending on the number of full load hours the installation producing renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels is operating. Where the number of full load hours is equal or lower than the number of hours in which the marginal price of electricity was set by installations producing renewable electricity or nuclear power plants in the preceding calendar year for which reliable data are available, grid electricity used in the production process of renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels shall be attributed a greenhouse gas emissions value of zero g CO2eq/MJ. Where this number of full load hours is exceeded, grid electricity used in the production process of renewable liquid and gaseous transport fuels of non-biological origin and recycled carbon fuels shall be attributed a greenhouse gas emissions value of 183 g CO2eq/MJ; or

   (c) the greenhouse gas emissions value of the marginal unit generating electricity at the time of the production of the renewable liquid and gaseous transport fuels of non-biological origin in the bidding zone may be used if this information is publicly available from the national transmission system operator.

   If the method set in point (b) is used, it shall also be applied to electricity that is used to produce renewable liquid and gaseous transport fuels of non-biological origin and

[2] Incorporated processes include processes that take place in the same industrial complex, or that supply the input via a dedicated supply infrastructure, or that supply more than half of the energy of all inputs to the production of the renewable liquid and gaseous transport fuel of non-biological origin or recycled carbon fuel.

recycled carbon fuels and qualifies as fully renewable according to Article 27(3) of Directive (EU) 2018/2001.

7. GHG emissions of elastic inputs that are obtained from an incorporated process shall be determined based on data from their actual production process. This shall include all emissions arising due to their production over the whole supply chain (including emissions arising from the extraction of the primary energy required to make the input, processing of the input and transportation of the input). Combustion emissions related to the carbon content of fuel inputs shall not be included[3].

   However, GHG emissions from the elastic inputs that are not obtained from an incorporated process shall be determined based on the values included in Part B of this Annex. If the input is not included in the list, information of the emission intensity may be drawn from the latest version of the JEC-WTW report, the ECOINVENT database, official sources such as the IPCC, IEA or government, other reviewed sources such as the E3 and GEMIS database and peer reviewed publications.

8. The supplier of each input, excluding those where the values are taken from part B of this Annex, shall calculate the emissions intensity[4] of the input following the procedures in this document, and report the value to the next production step or final fuel producer. The same rule applies to the suppliers of inputs further back in the supply chain.

9. Emissions from rigid inputs shall include the emissions resulting from the diversion of those inputs from a previous or alternative use. These emissions shall take into account the loss of production of electricity, heat or products that were previously generated using the input as well as any emissions due to additional treatment of the input and transport. The following rules shall apply:

   (a) emissions attributed to the supply of rigid inputs shall be determined by multiplying the lost production of electricity, heat or other products with the relevant emission factor. In case of lost electricity production, the emission factors to consider are for grid electricity generation in the country where the displacement occurred determined according to the appropriate methodology set out under points 5 or 6 . In case of diverted material, the emissions to be attributed to the replacement material are calculated as for material inputs in this methodology. For the first 20 years after the start of production of renewable liquid and gaseous transport fuels of non-biological origin or recycled carbon fuels, the loss of production of electricity, heat and material shall be determined based on the average amount of electricity and heat that was produced from the rigid input over the last three years before the start of production of renewable liquid and gaseous transport fuels of non-biological origin or recycled carbon fuels. After 20 years of production, the loss of production of electricity, heat or other products shall be determined based on the minimum energy performance standards assumed in pertinent best available technology (BAT) conclusions. Where the process is not covered by a

[3] If carbon intensities are taken from the table in part B, combustion emissions shall not be considered. This is because combustion emissions are counted in processing or in the combustion emissions of the final fuel.

[4] Consistent with section 6 the emissions intensity shall not include the emissions embedded in the carbon content of the supplied input.

BAT, the estimation of lost production shall be based on a comparable process applying state of the art technology.

(b) in case of rigid inputs that are intermediate streams in industrial processes, such as coke oven gas, blast furnace gas in a steelworks, or refinery gas in an oil refinery, if the effect of diverting it for fuel production cannot be measured directly, the emissions due to the diversion of inputs shall be determined based on simulations of the plant operation before and after it is modified to produce recycled carbon fuels. If the modification of the plant caused a reduction of output of some products, the emissions attributed to the rigid input shall include the emissions associated with replacing the lost products.

(c) where the process makes use of rigid inputs from new installations such as a new steelworks that uses its blast furnace gas for making recycled carbon fuels, the impact of diverting the input from the most economic alternative use shall be taken into account. Then the emission implications are calculated according to the minimum energy performance standards assumed in the pertinent BAT conclusions. For industrial processes which are not covered by a BAT, the saved emissions shall be calculated on the basis of the comparable process applying state of the art technology.

10. Emissions from existing use or fate include all emissions in the existing use or fate of the input that are avoided when the input is used for fuel production. These emissions shall include the $CO_2$ equivalent of the carbon incorporated in the chemical composition of the fuel that would have otherwise been emitted as CO2 into the atmosphere. This includes $CO_2$ that was captured and incorporated into the fuel provided that at least one of the following conditions is fulfilled:

(a) The $CO_2$ has been captured from an activity listed under Annex I of Directive 2003/87/EC and has been taken into account upstream in an effective carbon pricing system and is incorporated in the chemical composition of the fuel before 2036. This date shall be extended to 2041 in other cases than $CO_2$ stemming from the combustion of fuels for electricity generation; or

(b) The $CO_2$ has been captured from the air; or

(c) The captured $CO_2$ stems from the production or the combustion of biofuels, bioliquids or biomass fuels complying with the sustainability and greenhouse gas saving criteria and the $CO_2$ capture did not receive credits for emission savings from $CO_2$ capture and replacement, set out in Annex V and VI of Directive (EU) 2018/2001; or

(d) The captured CO2 stems from the combustion of renewable liquid and gaseous transport fuels of non-biological origin or recycled carbon fuels complying with the greenhouse gas saving criteria, set out in Article 25(2) and Article 28(5) of Directive (EU) 2018/2001 and this Regulation; or

(e) The captured $CO_2$ stems from a geological source of $CO_2$ and the $CO_2$ was previously released naturally.

Captured CO2 stemming from a fuel that is deliberately combusted for the specific purpose of producing the CO2 and CO2, the capture of which has received an emissions credit under other provisions of the law shall not be included

Emissions associated with the inputs like electricity and heat and consumable materials used in the capture process of CO2 shall be included in the calculation of emissions attributed to inputs.

11. The dates established in point 10(a) will be subject to review considering the implementation in the sectors covered by Directive 2003/87/EC of the Union-wide climate target for 2040 established in accordance with Article 4(3) of Regulation (EU) 2021/1119.

12. Emissions from processing shall include direct atmospheric emissions from the processing itself, from waste treatment and from leakages.

13. Emissions from combustion of the fuel refer to the total combustion emissions of the fuel in use.

14. The greenhouse gases taken into account in emissions calculations, and their carbon dioxide equivalents, shall be the same as specified in paragraph 4 of Annex V, part C, of Directive (EU) 2018/2001.

15. Where a process yields multiple co-products such as fuels or chemicals, as well as energy co-products such as heat, electricity or mechanical energy exported from the plant, greenhouse gas emissions shall be allocated to these co-products applying the following approaches in the following manner:

    (a) the allocation shall be conducted at the end of the process that produces the co-products. The emissions allocated shall include the emissions from the process itself, as well as the emissions attributed to inputs to the process.

    (b) the emissions to be allocated shall be *e i* plus any fractions of *e p*, *e td* and *e ccs* that take place up to and including the process step at which the co-products are produced. If an input into the process is itself a co-product of another process, the allocation at the other process shall be done first to establish the emissions to be attributed to the input.

    (c) if any installation inside the project boundary treats only one of the project's co-products, then the emissions from that installation shall be ascribed entirely to that co-product.

    (d) where the process allows to change the ratio of the co-products produced, the allocation shall be done based on physical causality by determining the effect on the process' emissions of incrementing the output of just one co-product whilst keeping the other outputs constant.

    (e) where the ratio of the products is fixed and the co-products are all fuels, electricity or heat, the allocation shall be done by energy content. If allocation concerns exported heat on the basis of the energy content, only the useful part of the heat may be considered, as defined in paragraph 16 of Directive 2018/2001 Annex V, part C.

    (f) where the ratio of the products is fixed and some co-products are materials with no energy content, the allocation shall be done by the economic value of the co-products. The economic value considered shall be the average factory-gate value of the products over the last three years. If such data is not available,

the value shall be estimated from commodity prices minus the cost of transport and storage[5].

16. Emissions from transport and distribution shall include emissions from the storage and distribution of the finished fuels. Emissions attributed to inputs $e_i$ shall include emissions from their associated transport and storage.

17. Where a process for making renewable liquid and gaseous transport fuels of non-biological origin or recycled carbon fuels produces carbon emissions that are permanently stored in accordance with Directive 2009/31/EC on the geological storage of carbon dioxide, this may be credited to the products of the process as a reduction in emissions under $e_{ccs}$. Emissions arising due to the storage operation (including transport of the carbon dioxide) will also need to be taken into account under $e_{p.}$

[5] Note that it is the relative values of the co-products that matters, so general inflation is not an issue.

B. ”STANDARD VALUES” FOR GREENHOUSE GAS EMISSION INTENSITIES OF ELASTIC INPUTS

The GHG intensities of inputs other than electricity are shown in the table below:

| | **Total emissions gCO2eq/MJ** | **Upstream emissions gCO2eq/MJ** | **Combustion emissions gCO2eq/MJ** |
|---|---|---|---|
| Natural gas | 66.0 | 9.7 | 56.2 |
| Diesel | 95.1 | 21.9 | 73.2 |
| Gasoline | 93.3 | 19.9 | 73.4 |
| Heavy fuel oil | 94.2 | 13.6 | 80.6 |
| Methanol | 97.1 | 28.2 | 68.9 |
| Hard coal | 112.3 | 16.2 | 96.1 |
| Lignite | 116.7 | 1.7 | 115.0 |

| | **$gCO_{2eq}/kg$** |
|---|---|
| Ammonia | 2351.3 |
| Calcium chloride ($CaCl_2$) | 38.8 |
| Cyclohexane | 723.0 |
| Hydrochloric acid (HCl) | 1061.1 |
| Lubricants | 947.0 |
| Magnesium sulphate ($MgSO_4$) | 191.8 |
| Nitrogen | 56.4 |
| Phosphoric acid ($H_3PO_4$) | 3124.7 |
| Potassium hydroxide (KOH) | 419.1 |
| Pure CaO for processes | 1193.2 |
| Sodium carbonate ($Na_2CO_3$) | 1245.1 |
| Sodium chloride (NaCl) | 13.3 |

| | |
|---|---|
| Sodium hydroxide (NaOH) | 529.7 |
| Sodium methoxide ($Na(CH_3O)$) | 2425.5 |
| $SO_2$ | 53.3 |
| Sulphuric acid ($H_2SO_4$) | 217.5 |
| Urea | 1846.6 |

C. GHG EMISSION INTENSITY OF ELECTRICITY

The greenhouse gas emission intensity of electricity shall be determined at the level of countries or at the level of bidding zones. The greenhouse gas emission intensity of electricity may be determined at the level of bidding zones only, if the required data are publically available. The calculation the carbon intensity of electricity, expressed as g $CO_{2\ eq}$ / kWh electricity, shall consider all potential primary energy sources for electricity generation, type of plant, conversion efficiencies and own electricity consumption in the power plant.

The calculation shall consider all carbon equivalent emissions, associated with the combustion and supply of the fuels used for electricity production. This relies on the amount of different fuels used in the electricity production facilities and the emission factors from fuel combustion and the upstream fuel emission factors.

Greenhouse Gases other than $CO_2$ shall be converted to $CO_{2eq}$ by multiplying their Global Warming Potential (GWP) relative to $CO_2$ over the 100-year time horizon as set out in Annex V, part C, point 4 to Directive (EU) 2018/2001. Because of their biogenic origin, $CO_2$ emissions from the combustion of biomass fuels are not accounted for, but emissions of $CH_4$ and $N_2O$ shall be accounted for.

For the calculation of the GHG emissions from fuels combustion, the IPCC default emission factors for stationary combustion in the energy industries shall be used (IPCC 2006). The upstream emissions shall include emissions from all the processes and phases required to make the fuel ready to supply the power production; they result from the extraction, refining and transport of the fuel used for electricity production.

In addition, all the upstream emissions from the cultivation, harvesting, collection, processing and transport of biomass shall be considered. Peat and the components of waste materials that are from fossil origins shall be treated as a fossil fuel.

The fuels used for gross electricity production in electricity only plants are determined based on the electricity production and the efficiency of conversion to electricity. In the case of Combined Heat and Power (CHP), the fuels used for heat produced in CHP shall be counted by considering alternative heat production with average overall efficiencies of 85%, while the rest shall be attributed to electricity generation.

For nuclear power plants, the conversion efficiency from nuclear heat shall be assumed to be 33% or data provided by Eurostat or a similar, accredited source.

No fuels are associated with electricity production from renewables that include hydro, solar, wind and geothermal. The emissions from the construction and decommissioning and waste management of electricity producing facilities are not considered. Thus, the carbon equivalent emissions associated with the renewable electricity (wind, solar, hydro and geothermal) production are considered to be equal to zero.

The $CO_2$ equivalent emissions from gross electricity production shall include upstream emissions from JEC WTW v5 (Prussi et al, 2020) listed in Table 3 and the default emission factors for stationary combustion from IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006) listed in Tables 1 and 2. The upstream emissions for supplying the fuel used shall be calculated applying the JEC WTW v5 upstream emission factors (Prussi et al, 2020).

The calculation of the carbon intensity of electricity shall be done following the formula:

$$e_{gross\_prod} = \sum_{i=1}^{k} \left(c_{i-ups} + c_{i-comb}\right) * B_i$$

where: $e_{gross\_prod}$ – $CO_2$ equivalent emissions $\left[gCO_{2eq}\right]$

$c_{i-ups}$ – upstream $CO_2$ equivalent emission factors $\left[\frac{gCO_{2eq}}{MJ}\right]$

$c_{i-comb}$ – $CO_2$ equivalent emission factors from fuels combustion $\left[\frac{gCO_{2eq}}{MJ}\right]$

$B_i$ – fuel consumption for electricity generation $[MJ]$

$i = 1 \cdots k$ –fuels used for electricity production

The amount of net electricity production is determined by the gross electricity production, own electricity consumption in the power plant and the electricity losses in pump storage.

$$E_{net} = E_{gross} - E_{own} - E_{pump}$$

where: $E_{net}$ – net electricity production $[MJ]$

$E_{gross}$ – gross electricity production $[MJ]$

$E_{own}$ – own internal electricity consumption in power plant $[MJ]$

$E_{pump}$ – electricity for pumping $[MJ]$

The carbon intensity of net produced electricity shall be the total gross GHG emissions for producing or using the net electricity:

$$CI = \frac{e_{gross\_prod}}{E_{net}}$$

Where: $CI$ – $CO_2$ equivalent emissions from electricity production $\left[\frac{gCO_{2eq}}{MJ}\right]$

**Electricity production and fuel consumption data**

Data on electricity production and fuel consumption shall be sourced from IEA Data and statistics that provides data on energy balances and electricity produced using various fuels, e.g. from IEA website, Data and Statistic section ("Energy Statistics Data Browser")[6].

For EU member states, Eurostat data are more detailed and can be used instead. Where the greenhouse gas emission intensity is established at the level of bidding zones, data from official national statistics of the same level of detail as the IEA data shall be used. Fuel consumption data shall include available data at the highest level of detail available from national statistics: solid fossil fuels, manufactured gases, peat and peat products, oil shale and oil sands, oil and petroleum products, natural gas, renewables and biofuels, non-renewable waste and nuclear. Renewables and biofuels include biofuels, renewable municipal waste, hydro, ocean, geothermal, wind, solar and heat pumps.

**Input data from literature sources**

*Table 1 Default emissions factors for stationary combustion [g/MJ fuel on a net calorific value]. Note: values have to be multiplied with GWP factors set out in Annex V, part C, point 4 to Directive (EU) 2018/2001.*

| Fuel | $CO_2$ | $CH_4$ | $N_2O$ |
|---|---|---|---|
| **Solid fossil fuels** | | | |
| Anthracite | 98.3 | 0.001 | 0.0015 |
| Coking coal | 94.6 | 0.001 | 0.0015 |
| Other bituminous coal | 94.6 | 0.001 | 0.0015 |
| Sub-bituminous coal | 96.1 | 0.001 | 0.0015 |
| Lignite | 101 | 0.001 | 0.0015 |
| Patent fuel | 97.5 | 0.001 | 0.0015 |
| Coke oven coke | 107 | 0.001 | 0.0015 |
| Gas coke | 107 | 0.001 | 0.0001 |
| Coal tar | 80.7 | 0.001 | 0.0015 |
| Brown coal briquettes | 97.5 | 0.001 | 0.0015 |
| **Manufactured gases** | | | |
| Gas works gas | 44.4 | 0.001 | 0.0001 |
| Coke oven gas | 44.4 | 0.001 | 0.0001 |
| Blast furnace gas | 260 | 0.001 | 0.0001 |
| Other recovered gases | 182 | 0.001 | 0.0001 |
| **Peat and peat products** | 106 | 0.001 | 0.0015 |
| **Oil shale and oil sands** | 73.3 | 0.003 | 0.0006 |
| **Oil and petroleum products** | | | |
| Crude oil | 73.3 | 0.003 | 0.0006 |
| Natural gas liquids | 64.2 | 0.003 | 0.0006 |
| Refinery feedstocks | 73.3 | 0.003 | 0.0006 |
| Additives and oxygenates | 73.3 | 0.003 | 0.0006 |
| Other hydrocarbons | 73.3 | 0.003 | 0.0006 |

6 Example: https://www.iea.org/data-and-statistics/data-tools/energy-statistics-data-browser?country=GERMANY&energy=Coal&year=202

| | | | |
|---|---|---|---|
| Refinery gas | 57.6 | 0.001 | 0.0001 |
| Ethane | 61.6 | 0.001 | 0.0001 |
| Liquefied petroleum gases | 63.1 | 0.001 | 0.0001 |
| Motor gasoline | 69.3 | 0.003 | 0.0006 |
| Aviation gasoline | 70 | 0.003 | 0.0006 |
| Gasoline-type jet fuel | 70 | 0.003 | 0.0006 |
| Kerosene-type jet fuel | 71.5 | 0.003 | 0.0006 |
| Other kerosene | 71.5 | 0.003 | 0.0006 |
| Naphtha | 73.3 | 0.003 | 0.0006 |
| Gas oil and diesel oil | 74.1 | 0.003 | 0.0006 |
| Fuel oil | 77.4 | 0.003 | 0.0006 |
| White spirit and SBP | 73.3 | 0.003 | 0.0006 |
| Lubricants | 73.3 | 0.003 | 0.0006 |
| Bitumen | 80.7 | 0.003 | 0.0006 |
| Petroleum coke | 97.5 | 0.003 | 0.0006 |
| Paraffin waxes | 73.3 | 0.003 | 0.0006 |
| Other oil products | 73.3 | 0.003 | 0.0006 |
| Natural gas | 56.1 | 0.001 | 0.0001 |
| **Waste** | | | |
| Industrial waste (non-renewable) | 143 | 0.03 | 0.004 |
| Non-renewable municipal waste | 91.7 | 0.03 | 0.004 |

Source: IPCC, 2006

*Table 2 Default emissions factors for stationary combustion of fuels of biomass origin [g/MJ fuel on a net calorific value]*

| Fuel | $CO_2$ | $CH_4$ | $N_2O$ |
|---|---|---|---|
| Primary solid biofuels | 0 | 0.03 | 0.004 |
| Charcoal | 0 | 0.2 | 0.004 |
| Biogases | 0 | 0.001 | 0.0001 |
| Renewable municipal waste | 0 | 0.03 | 0.004 |
| Pure biogasoline | 0 | 0.003 | 0.0006 |
| Blended biogasoline | 0 | 0.003 | 0.0006 |
| Pure biodiesels | 0 | 0.003 | 0.0006 |
| Blended biodiesels | 0 | 0.003 | 0.0006 |
| Pure bio jet kerosene | 0 | 0.003 | 0.0006 |
| Blended bio jet kerosene | 0 | 0.003 | 0.0006 |
| Other liquid biofuels | 0 | 0.003 | 0.0006 |

Source: IPCC, 2006

*Table 3. Fuel upstream emission factors [g $CO_{2eq}$/MJ fuel on a net calorific value]*

| Fuel | Emission factor |
|---|---|
| Hard coal | 15.9 |

| | |
|---|---|
| Brown coal | 1.7 |
| Peat | 0 |
| Coal gases | 0 |
| Petroleum Products | 11.6 |
| Natural gas | 12.7 |
| Solid biofuels | 0.7 |
| Liquid biofuels | 46.8 |
| Industrial Waste | 0 |
| Municipal waste | 0 |
| Biogases | 13.7 |
| Nuclear | 1.2 |

Source: JEC WTW v5

Table A includes the values for the GHG emission intensity of electricity at country level in the European Union. If the greenhouse gas emission intensity of electricity is determined at country level, these values shall be used for electricity sourced in the European Union until more recent data becomes available to determine the emission intensity of electricity[7].

**Table A: Emission intensity of electricity in the European Union 2020**

| Country | Emission intensity of generated electricity (g CO2eq/MJ) |
|---|---|
| Austria | 39.7 |
| Belgium | 56.7 |
| Bulgaria | 119.2 |
| Cyprus | 206.6 |
| Czechia | 132.5 |
| Germany | 99.3 |
| Denmark | 27.1 |
| Estonia | 139.8 |
| Greece | 125.2 |
| Spain | 54.1 |

[7] Updated data will be made available by the European Commission on a regular basis.

| | |
|---|---|
| Finland | 22.9 |
| France | 19.6 |
| Croatia | 55.4 |
| Hungary | 72.9 |
| Ireland | 89.4 |
| Italy | 92.3 |
| Latvia | 39.4 |
| Lithuania | 57.7 |
| Luxembourg | 52.0 |
| Malta | 133.9 |
| Netherlands | 99.9 |
| Poland | 196.5 |
| Portugal | 61.6 |
| Romania | 86.1 |
| Slovakia | 45.6 |
| Slovenia | 70.1 |
| Sweden | 4.1 |

Source: JRC, 2022