

OPINION No 22/2019
OF THE EUROPEAN UNION AGENCY
FOR THE COOPERATION OF ENERGY REGULATORS

of 17 December 2019

on the calculation of the values of CO₂ emission limits referred to in the first subparagraph of Article 22(4) of Regulation (EU) 2019/943 of 5 June 2019 on the internal market for electricity (recast)

THE EUROPEAN UNION AGENCY FOR THE COOPERATION OF ENERGY REGULATORS,

Having regard to Regulation (EU) 2019/943 of 5 June 2019 on the internal market for electricity¹, and, in particular, Article 22(4) thereof,

Whereas:

- (1) According to Article 22(1)(g) of Regulation (EU) 2019/943, Member States shall set out the technical conditions for the participation of capacity providers in a capacity mechanism in advance of the selection process.
- (2) According to the first subparagraph of Article 22(4) of Regulation (EU) 2019/943, capacity mechanisms shall incorporate limits regarding CO₂ emission in the requirements for participation.
- (3) According to the third subparagraph of Article 22(4) of Regulation (EU) 2019/943, the Agency shall publish an opinion providing technical guidance related to the calculation of the values defined in points (a) and (b) of the same Article.
- (4) In this context, Regulation (EU) 2018/2066 on the monitoring and reporting of greenhouse gas emissions already provides an extensive set of rules and it is therefore taken as a reference when addressing specific issues,

HAS ADOPTED THIS OPINION:

¹ [OJ L158](#), 14.6.2019, p. 54.

1. INTRODUCTION

In the context of the EU Clean Energy Package, Regulation (EU) 2019/943 sets rules to enable a transition of the European electricity system towards a system in which security, affordability and environmental sustainability are fully integrated.

The introduction of emission limits for the participation of generation capacity in capacity mechanisms is a key element to enable this transition. Common methodological principles at the European level are needed in order to ensure that the emission limits referred to in the first subparagraph of Article 22(4) of Regulation (EU) 2019/943² will be applied in a homogenous way among Member States. According to points (a) and (b) of Article 22(4) of Regulation (EU) 2019/943, these limits are set for the emissions of CO₂ of fossil fuel origin per kWh of electricity and for the emissions of CO₂ of fossil fuel origin on average per year, per installed kWe.

The Agency understands that the introduction of the CO₂ emission limits is intended to avoid financial support for generation capacity that, as a result of its overall activity, including the trade of electricity in wholesale markets in all time-frames or through over-the-counter (OTC) trades, redispatching, network and strategic reserves, does not meet the environmental goals.

It is against this background that, according to the third subparagraph of Article 22(4) of Regulation (EU) 2019/943, the Agency shall publish an opinion providing technical guidance related to the calculation of the values of CO₂ emission limits defined in points (a) and (b) of the same Article.

1.1. Structure of the Opinion

In Section 2 of this Opinion, the relevant procedural steps taken during the preparation of this Opinion are outlined, while Section 3 provides the legal framework. In order to set the common ground, Section 4 clarifies some relevant terms which are used throughout the Opinion. It starts by providing a definition for terms that are also found in other legislative acts and continues by providing a definition for other terms that, in order to fit the scope of this Opinion, need a higher degree of interpretation. Section 5 then clarifies the scope of application of the emission limits, giving the Agency's recommendation on which 'generation capacity' should be subject to the emission limits. Section 6 sets out the formulae for calculating the values referred to in points (a) and (b) of the first subparagraph of Article 22(4) of Regulation (EU) 2019/943 and Section 7 examines key issues related to the values to be used in the calculation. Sections 8 and 9 conclude this Opinion with considerations on documentation and *ex-post* validation, in order to guide competent national bodies in these activities.

² [OJ L158](#), 14.6.2019, p.87.

2. PROCEDURE

The Agency launched a public consultation on a preliminary draft of the Opinion on 24 September 2019. Contributions were received from 51 respondents from 12 Member States, representing capacity providers, industry associations of power plants producers, national regulatory authorities, researchers/academia and transmission system operators.

On 11 October 2019, the Agency held a technical workshop on this topic. The workshop was open to stakeholders and streamed via web. Moreover, the Agency closely cooperated with all the regulatory authorities during the drafting process. In particular, the following procedural steps were taken:

- 4 September 2019: discussion with all regulatory authorities in the framework of the Agency's Electricity Working Group ('AEWG');
- 10 September 2019: the Agency's preliminary analyses were distributed to all regulatory authorities. As comments were received, these were also discussed and considered in the drafting of the document for public consultation;
- 17 November 2019: an updated draft of the Agency's Opinion was distributed to all regulatory authorities;
- 19 November 2019: discussion with all regulatory authorities, on the final draft of the Opinion, in the framework of the AEWG.
- 11 December 2019: discussion with all regulatory authorities, on the final draft of the Opinion, in the framework of the Agency's Board of Regulators ('BoR').

3. LEGAL FRAMEWORK

Article 22(4) of Regulation (EU) 2019/943 constitutes the legal framework:

“Capacity mechanisms shall incorporate the following requirements regarding CO₂ emission limits:

- (a) from 4 July 2019 at the latest, generation capacity that started commercial production on or after that date and that emits more than 550 g of CO₂ of fossil fuel origin per kWh of electricity shall not be committed or to receive payments or commitments for future payments under a capacity mechanism;*
- (b) from 1 July 2025 at the latest, generation capacity that started commercial production before 4 July 2019 and that emits more than 550 g of CO₂ of fossil fuel origin per kWh of electricity and more than 350 kg CO₂ of fossil fuel origin on average per year per installed kWe shall not be committed or receive payments or commitments for future payments under a capacity mechanism.*

The emission limit of 550 g CO₂ of fossil fuel origin per kWh of electricity and the limit of 350 kg CO₂ of fossil fuel origin on average per year per installed kW_e referred to in points (a) and (b) of the first subparagraph shall be calculated on the basis of the design efficiency of the generation unit meaning the net efficiency at nominal capacity under the relevant standards provided for by the International Organization for Standardization.

By 5 January 2020, ACER shall publish an opinion providing technical guidance related to the calculation of the values referred in the first subparagraph.”

4. DEFINITIONS

First, for the purpose of this Opinion, the Agency considers the following definitions:

- (a) ‘biogas’ means ‘biogas’ as defined in Article 2(28) of Directive (EU) 2018/2001: gaseous fuels produced from biomass;
- (b) ‘bioliquids’ means ‘bioliquids’ as defined in Article 2(32) of Directive (EU) 2018/2001: liquid fuel for energy purposes other than for transport, including electricity and heating and cooling, produced from biomass;
- (c) ‘biomass’ means ‘biomass’ as defined in Article 2(24) of Directive (EU) 2018/2001: the biodegradable fraction of products, waste and residues from biological origin from agriculture, including vegetal and animal substances, from forestry and related industries, including fisheries and aquaculture, as well as the biodegradable fraction of waste, including industrial and municipal waste of biological origin;
- (d) ‘biomass fraction’ means ‘biomass fraction’ as defined in Article 3(38) of Regulation (EU) 2018/2066: the ratio of carbon stemming from biomass to the total carbon content of a fuel or material, expressed as a fraction;
- (e) ‘biomass fuels’ means ‘biomass fuels’ as defined in Article 2(27) of Directive (EU) 2018/2001: gaseous and solid fuels produced from biomass;
- (f) ‘commercial standard fuel’ means ‘commercial standard fuel’ as defined in Article 3(34) of Regulation (EU) 2018/2066: the internationally standardised commercial fuels that exhibit a 95 % confidence interval of not more than 1 % for their specified calorific value, including gas oil, light fuel oil, gasoline, lamp oil, kerosene, ethane, propane, butane, jet kerosene (jet A1 or jet A), jet gasoline (jet B) and aviation gasoline (AvGas);
- (g) ‘demand response’ means ‘demand response’ as defined in Article 2(20) of Directive (EU) 2019/944: the change of electricity load by final customers from their normal or current consumption patterns in response to market signals, including in response to time-variable electricity prices or incentive payments, or in response to the acceptance of the final customer's bid to sell demand reduction or increase at a price in an organised market as defined in point (4) of Article 2 of Commission Implementing Regulation (EU) 1348/2014, whether alone or through aggregation;

- (h) ‘energy storage’ means ‘electricity storage’ as defined in Article 2(59) of Directive (EU) 2019/944: in the electricity system, deferring the final use of electricity to a moment later than when it was generated, or the conversion of electrical energy into a form of energy which can be stored, the storing of such energy, and the subsequent reconversion of such energy into electrical energy or use as another energy carrier;
- (i) ‘fossil fraction’ means ‘fossil fraction’ as defined in Article 3(37) of Regulation (EU) 2018/2066: the ratio of fossil carbon to the total carbon content of a fuel or material, expressed as a fraction;
- (j) ‘generation unit’ means ‘generation unit’ as defined in Article 2(71) of Regulation (EU) 2019/943: a single electricity generator belonging to a production unit;
- (k) ‘mixed fuel’ means ‘mixed fuel’ as defined in Article 3(34) of Regulation (EU) 2018/2066: a fuel which contains both biomass and fossil carbon;
- (l) ‘net calorific value’ (NCV) means ‘net calorific value’ as defined in Article 3(30) of Regulation (EU) 2018/2066: the specific amount of energy released as heat when a fuel or material undergoes complete combustion with oxygen under standard conditions, less the heat of vaporisation of any water formed;
- (m) ‘production unit’ means ‘production unit’ as defined in Article 2(24) of Regulation (EU) 543/2013: a facility for generation of electricity made up of a single generation unit or of an aggregation of generation units;
- (n) ‘waste’ means ‘waste’ as defined in point (1) of Article 3 of Directive 2008/98/EC, excluding substances that have been intentionally modified or contaminated in order to meet this definition.

Second, for the purpose of this Opinion, the following definitions should apply:

- (o) ‘*Annual Emissions* of the generation capacity’ (hereafter *Annual Emissions*): the ratio between the quantity of CO₂ emitted during one calendar year and the installed capacity, calculated on the basis of design efficiency, expressed in kg/kWe;
- (p) ‘competent national body’: the body in the Member State responsible for verifying the compliance of generation capacity with the CO₂ emission limits, in order for the generation capacity to participate in capacity mechanisms;
- (q) ‘design efficiency’: the ratio between the net electricity output and the fuel energy input (on the basis of its net calorific value) of a generation unit operating at nominal capacity, calculated under the relevant standards;
- (r) ‘net electricity output’: the electricity which a generation unit can produce, less any demand associated solely with facilitating the operation of that generation unit and not fed into the network (e.g. the demand of auxiliary systems as fuel preparation, flue-gas treatment, waste water treatment, cooling system, fans and pumps, etc.);

- (s) ‘nominal capacity’: the maximum continuous net active power which a generation unit can produce and feed into the network, as specified in the connection agreement or as agreed between the relevant system operator and the generation unit operator;
- (t) ‘Specific Emissions of the generation capacity’ (hereafter *Specific Emissions*): the ratio between the quantity of CO₂ emitted and the net electricity produced, calculated on the basis of design efficiency, expressed in g/kWh.

5. SCOPE OF APPLICATION OF THE EMISSION LIMITS

The emission limits introduced in points (a) and (b) of the first subparagraph of Article 22(4) of Regulation (EU) 2019/943 refer to the ‘generation capacity’ and should be calculated on the basis of the design efficiency of the ‘generation unit’. For the scope of this technical guidance the following issues require particular clarification:

- (a) The concept of ‘generation capacity’ needs further specifications. Generation capacity is understood as the maximum (nominal) electricity output that an electricity generator can produce, without exceeding its thermal limits. When considering a group of production units (e.g. the production units connected to a specific transmission system), generation capacity refers to the maximum electricity output that can be injected in the system by the group of production units.

However, Article 22(4) of Regulation (EU) 2019/943 does not specify which generation capacity should be subject to the emission limits and what should be the relation between ‘generation unit’, ‘production unit’ and the generation capacity that is subject to the limits.

To ensure an equal application of the emission limits in all Member States, emission limits should be applied, individually, to the generation capacity of each generation unit that either participates in full or in part in a capacity mechanism or that it is part of the generation capacity participating in a capacity mechanism. In principle, generation units belonging to the same production unit have to be considered separately, unless it is technically not possible to operate and control them independently.

Where generation units work in tandem, using the same source of thermal energy, such as for example in a combined-cycle gas turbine (CCGT), their generation capacity or net electricity production should be considered as combined and calculated taking into account the primary energy input of the generation units that participates in the capacity mechanism. Extra thermal inputs should also be considered, together with their related emissions, if linked to the generation unit that participates in the capacity mechanism (e.g. post-combustion of exhaust gases or integrated thermal solar).

In more complex production unit configurations, the ‘generation capacity’ to be subject to the emission limits should be addressed on a case-by-case basis, taking into account the interoperability of the various generation units, the different types of fuels used and the environmental principles underlying the introduction of the emission limits in the Regulation.

- (b) Article 22 of Regulation (EU) 2019/943 refers to emissions of “*fossil fuel origin*”, which implies that, in this context, the emission factor of bioliquids and/or biomass fuels, as well as the emission factor of the biomass fraction of waste and mixed fuels, shall be equal to zero. It is to note, however, that Article 29 of Directive (EU) 2018/2001 establishes criteria that generation units consuming bioliquids and/or biomass fuels have to fulfil in order to be eligible for financial support, such as capacity mechanisms. Therefore, with regards to the participation in a capacity mechanism, operators of generation units using bioliquids and/or biomass fuels should demonstrate compliance with the above-mentioned sustainability and greenhouse gas emission saving criteria.
- (c) On-site back-up generation units linked to demand response and used temporarily to meet electricity requirements, thus providing a reduction of network electricity demand, should be subject to the emission limits introduced in Article 22(4) of Regulation (EU) 2019/943 and the calculation methodology defined in this Opinion should apply.
- (d) In principle, the emission limits should not apply to electricity from energy storage units which are supplied by the grid. However, in the case of energy storage units directly connected (either physically or through OTC contracts) to a generation unit, the operator should provide evidence of this unit’s compliance with the emission limits introduced in Article 22(4) of Regulation (EU) 2019/943.

The Agency’s Opinion does not prevent Member States from being more ambitious in fostering the achievement of EU decarbonisation targets. In this respect, some Member States already apply lower emission limits than those introduced in Regulation (EU) 2019/943³, coal phase-out policies or they might include upstream emissions related to the life cycle of the fuel (e.g. production, transportation, distribution, combustion) in the calculation of the emission limits.

6. CALCULATION OF SPECIFIC EMISSIONS AND ANNUAL EMISSIONS

Together with the results of the calculations performed using the relevant formulae that are introduced in Section 6.1 and Section 6.2, competent national bodies should consider the following principles when determining the eligibility of generation capacity, to participate in capacity mechanisms:

- (a) On an exceptional basis, and until 1 July 2025, operators of generation capacity which does not comply with the emission limits at the pre-qualification stage (i.e. prior to the auction for capacity), could submit a compliance action plan, to the competent national body, describing the measures that will be taken in order for the generation capacity to comply with the emission limits at the start of the delivery period, at the latest. Generation capacity that, according to the submitted action plan, can firmly commit to ensure compliance with the limit of *Specific Emissions* could be allowed to participate

³ An emission limit of 200 g of CO₂ equivalent of fossil fuel origin per kWh of electricity produced has been set in the call for tenders for new capacity in the period 2023-2029, in the French capacity mechanism.

in the capacity mechanism. The competent national body should assess compliance action plans and their effective and timely implementation;

- (b) Subject to the approval of the competent national body, generation capacity, which does not comply with the emission limits at the pre-qualification stage, could be allowed to participate in a strategic reserves mechanism that meets the requirements laid down in Article 22(2) of Regulation (EU) 2019/943 if, based on i) the expected hours of activation, ii) its technical constraints (e.g. start-up time, ramp rate), iii) the duration of the period of delivery and iv) its *Specific Emissions*, the operator of the generation unit can firmly commit to ensure compliance with the limit of *Annual Emissions* during each calendar year that falls into the delivery period of the capacity mechanism. In this case, the expected hours of activation should be provided by the competent national body, based on the relevant resource adequacy assessment. Compliance should be evaluated on the basis of the maximum full load hours the generation unit is allowed to operate, per calendar year, without exceeding the limit on the *Annual Emissions*:

$$FLH_{\max} = \frac{350 \cdot 10^3}{\text{specific emissions}} \quad (1)$$

Table 1. Terms of the formula for the calculation of the “maximum allowed equivalent full load hours”:

| Value | Specification |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FLH _{max} | Maximum allowed equivalent full load hours that the generation unit can operate per calendar year without exceeding the limit of 350 kg CO ₂ /kW _e . |
| specific emissions | The <i>Specific Emissions</i> of the generation unit calculated according to Section 6.1 expressed in [g CO ₂ /kWh _e]. |
| Expected hours of activation | The maximum number of hours that strategic reserves are expected to be activated according to the most relevant resource adequacy assessment. |

Formulae for the calculation of *Specific Emissions* and *Annual Emissions* are described in what follows.

6.1. Specific Emissions of the generation capacity

The *Specific Emissions* of the generation capacity should be calculated, with the following formula, derived from the EU-ETS standard methodology⁴:

$$\text{Specific Emissions} = \frac{0,0036 \cdot (1 - t_{\text{CO}_2}) \sum_f s_f \cdot EF_{f,\text{CO}_2}}{\eta_{\text{des}}} = \frac{[\text{g CO}_2]}{[\text{kWh}_e]} \quad (2)$$

⁴ [OJ L181](#), 12.7.2012, p.41.

Table 2. Terms of the formula for the calculation of the value of “Specific Emission”:

| Value | Specification |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| f | Index of fuel |
| S_f | Share [%] of fuel f over the total fuel input, as further described in Section 7.1. |
| t_{CO_2} | Transferred CO ₂ factor [%], expressed as the share of CO ₂ captured and transferred over the total CO ₂ emitted, as further described in Section 7.4. |
| 0,0036 | Conversion factor (1 kWh equal to 0.0036 GJ). |
| η_{des} | Design efficiency as defined in Section 4 and further described in Section 7.3. |
| EF_{f,CO_2} | Emission factor for CO ₂ expressed in [kg CO ₂ /TJ] determined as described in Section 7.2. |

6.2. Annual Emissions of the generation capacity

In the case of generation units that started commercial production before 4 July 2019 and do not comply with the emission limit of 550 g CO₂ per kWh of electricity produced, the value of *Annual Emissions* has to be calculated, in order to ensure compliance with point (b) of Article 22(4) of Regulation 2019/943.

The same article specifies that, for those generation units, the value of *Annual Emissions* shall be referred to the CO₂ emitted ‘on average per year’. The Agency understands the provisions introduced in Article 22(4) of Regulation 2019/943 as a measure to avoid financial support for generation capacity that, as a result of its overall activity, including the trade of electricity in wholesale markets in all time-frames or through OTC trades, redispatching, network and strategic reserves, does not fulfil the emission limits.

In the Agency’s view, the historical operation of those generation units, excluding testing periods, should be taken into account when calculating the value of *Annual Emissions* of the generation capacity. To the extent possible, the Agency recommends to consider the average *Annual Emissions* of the generation unit over the last three full calendar years⁵ before the pre-qualification. In the Agency’s view, basing the calculation of *Annual Emissions* on the reference period of time of the last three years has two main advantages:

- It gives a very good picture of the CO₂ performance of the generation unit willing to participate in a capacity mechanism;
- It simplifies and streamlines the overall monitoring process (e.g. less need for ex-post monitoring and less risk of errors leading to potential market distortions).

⁵ For the generation units with less than one year of commercial production at the pre-qualification stage, the Agency suggests competent national bodies to undertake ex-post validation (see Section 9).

For generation units that have undertaken a major refurbishment that significantly alters their performance in terms of CO₂ emissions, only the period after the refurbishment should be considered as a reference period.

The Agency recommends to calculate the *Annual Emissions* of the generation capacity with the following formula:

$$\text{Annual Emissions} = \frac{1}{N} \cdot \sum_{y=Y-1}^{Y-1} \frac{\text{Specific Emissions}_y \cdot \text{electricity production}_y}{\text{installed capacity}_y} = \frac{[\text{kg CO}_2]}{[\text{kWe}]} \quad (3)$$

Table 3. Terms of the formula for the calculation of the value of “Annual Emissions”:

| Value | Specification |
|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| Y | Year of pre-qualification of the generation capacity. |
| N | Number of full calendar years considered for the calculation. The latest three full calendar years should be considered when possible. |
| Specific Emissions _y | <i>Specific Emissions</i> of the generation capacity [g CO ₂ /kWh], as defined in Section 6.1, calculated in reference to year y. |
| electricity production _y | Annual electricity production: total electricity injected into the grid by the generation unit in year y, expressed in GWh. |
| installed capacity _y | Nominal capacity of the generation unit, in year y, expressed in MW _e . |

7. SPECIFICATIONS REGARDING THE FORMULAE

This section provides further details on the application of the formulae defined in Section 6, in reference to the ‘generation units’ technology, layout and fuel. A detailed summary of this section is provided with a flow-chart in Annex III. In any case, the values used in the calculation of the emission limits, should be approved by the competent national bodies.

7.1. Fuel Share (S_F)

The share of each fuel should be calculated as the energy input of that fuel over the energy input of all fuels used by the generation unit to produce electricity. The energy input of each fuel should be calculated by using the total quantity (e.g. in t or Nm³) and the Net Calorific Value of the fuel (e.g. in TJ/t or TJ/Nm³ respectively). The fuel shares should be calculated over the period of a calendar year according to the following formula:

$$S_F = \frac{\text{quantity}_F \cdot \text{NCV}_F}{\sum_f \text{quantity}_f \cdot \text{NCV}_f} = [\%] \quad (4)$$

Table 4. Terms of the formula for the calculation of the value of “fuel share” or S_f :

| Value | Specification |
|--------------|-----------------------------------------------------------------------------------------------------------|
| F | The fuel for which the share is calculated. |
| f | Index of fuels used by the generation unit ⁶ . |
| NCV_f | Net Calorific Value of fuel f expressed in [TJ/t] or [TJ/Nm ³] or other units. |
| $quantity_f$ | Quantity of fuel f , used in a calendar year and expressed in [t] or [Nm ³] or other units. |

7.2. Emission factor for CO₂ (EF_{f,CO_2})

The emission factor for CO₂ of each fuel used by the generation unit for the production of electricity is expressed in [kg CO₂/TJ]. In order to streamline the calculation process, the Agency underlines the following recommendations.

7.2.1. Generation units under the EU ETS

Generation units under the EU ETS, applying the standard methodology, should use the CO₂ emission factors⁷ per type of fuel as in the most recent annual emission report. Generation units under the EU ETS, applying the measurement-based methodology or the mass-balance methodology, should determine their emission factor according to the following formula⁸:

$$EF_{F,CO_2} = \frac{CO_2 \text{ emissions}_{ETS}}{\text{fuel consumption}_{ETS}} = \frac{[kg CO_2]}{[TJ]} \quad (5)$$

Table 5. Terms of the formula for the calculation of the emission factor, for units in the EU ETS, applying measurement-based or mass-balance methodology.

| Value | Specification |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| F | The fuel for which the emission factor is calculated. If a distinction between different fuels is not possible, a generic emission factor should be calculated. |
| $CO_2 \text{ emissions}_{ETS}$ | Annual Emissions of CO ₂ reported, expressed in [kg CO ₂] |
| $\text{fuel consumption}_{ETS}$ | Annual fuel consumption reported, expressed in [TJ] |

⁶ It shall be noted that mixed fuels and waste shall each be considered as a single fuel.

⁷ Attention should be given in using the emission factor and not the preliminary emission factor.

⁸ In the case of co-firing, emission factors should be determined on the basis of an alternative method, approved by the competent national body.

7.2.2. Generation units outside the EU ETS

Generation units, which are not under the EU ETS, should apply the following recommendations.

7.2.2.1. *Generation units using mixed fuels*

As the emission limits apply to the emissions ‘*of fossil fuel origin*’, the emission factor of mixed fuels should be determined as a function of their biomass fraction, which is considered as carbon neutral subject to the criteria of Article 29 of Directive (EU) 2018/2001. In this regard, the Agency recommends that:

- (a) Biomass fraction of mixed fuels is determined according to the approach laid down in Article 39 of Regulation (EU) 2018/2066^{9,10};
- (b) Where the biomass fraction of mixed fuels is equal or higher than 97%, the emission factor of biomass could be applied;
- (c) Once the biomass fraction is known, the emission factor should be calculated by applying the principles of point (1) of paragraph 4.3.1 of the Monitoring and Reporting Regulation General Guidance for Installations¹¹, i.e. using either a preliminary emission factor defined through analyses, in accordance with the relevant provisions of Articles 32 to 35 of Regulation (EU) 2018/2066, or default values as country-specific emission factors determined in accordance with points (b) and (c) of Article 31(1) of Regulation (EU) 2018/2066¹² or emission factors determined in accordance with point (d) of the same Article.

7.2.2.2. *Waste-to-energy generation units*

Due to the high variability of the composition of waste, as a general principle, the Agency recommends the use of emission factors determined on a case-by-case basis. The emission factor of waste should be determined as a function of its biomass fraction, which is considered as carbon neutral. In this regard, the Agency recommends that:

- (a) Biomass fraction of waste is determined according to the approach laid down in Article 39 of Regulation (EU) 2018/2066;
- (b) Once the biomass fraction is known, the emission factor should be determined according to the principles referred to in point (c) of the Section 7.2.2.1.

⁹ [OJL334](#), 31.12.2018, p. 22.

¹⁰ In this context the Agency notes that in the case of updates to Regulation (EU) 2018/2066 (MRR), the newest version should be considered, for the purpose of this Opinion.

¹¹ The Monitoring and Reporting Regulation - [General guidance for installations](#). 27.11.2017.

¹² [OJL334](#), 31.12.2018, p.19.

Upon approval of the competent national bodies, waste-to-energy units outside the EU ETS scope could use emission factors derived by an approved methodology other than the one in this subsection or the standard emission factors for industrial waste and municipal waste (non-biomass fraction) listed in Annex I.

7.2.2.3. Generation units using synthetic fuels

Emissions from synthetic fuels, such as synthetic methanol or synthetic methane that are derived (fully or partially) from fossil fuels (including waste) have to be taken into account in the calculations. This should apply also to the so-called carbon capture and utilisation (CCU) fuels, where the carbon is stored only temporarily.

Since, at the time of writing, standard emission factors for synthetic fuels are not defined, a case-by-case approach should be applied to determine them. As a general principle, the Agency recommends that, for all the generation units using synthetic fuels, emission factors should be determined on a case-by-case basis in accordance with the relevant provisions of Articles 32 to 35 of Regulation (EU) 2018/2066.

If applicable, competent national bodies could rely on country-specific emission factors determined in accordance with points (b) and (c) or emission factors determined in accordance with point (d) of Article 31(1) of Regulation (EU) 2018/2066.

As according to Article 28(5) of Directive (EU) 2018/2001, the European Commission shall adopt a delegated act by 31 December 2021 on the estimation of greenhouse emissions for synthetic fuels, and this work is currently ongoing, the Agency recommends competent national bodies to consider this as a future reference for values and methodologies to estimate emission factors for synthetic fuels.

7.2.2.4. Generation units using hydrogen

Hydrogen can be used for electricity production either through combustion or through electrochemical conversion in stationary fuel cells. Hydrogen has no carbon content and therefore there are no direct emissions related to hydrogen utilisation in electricity production.

However, unless the electricity for the production of the hydrogen comes directly from a carbon free source (renewables, nuclear or CCS), an appropriate emission factor should be determined on a case-by-case basis.

7.2.2.5. Other units

Generation units, which do not fall into any of the categories described in this section, should use the emission factors listed in Table 9 in Annex I. Alternatively, emission factors may be determined based on a methodology submitted by the operator of the generation capacity and approved by the competent national body.

7.3. Design efficiency (η_{des})

According to Article 22(4) of Regulation (EU) 2019/943, the emission limits introduced in points (a) and (b) of the first subparagraph of the same article “*shall be calculated on the basis of the design efficiency of the generation unit meaning the net efficiency at nominal capacity under the relevant standards*”.

As indicated in Section 4, the Agency, in the framework of the above-mentioned article, considers ‘design efficiency’ as the net electrical efficiency at design conditions. This value should refer to the latest performance test of the generation unit and the application of relevant ISO standards¹³. If this is not possible, the competent national body may accept calculations based on values from other sources such as power plant commissioning contract or information from other technical documents.

In the case of cogeneration units and in order to ensure a level playing field, the Agency considers that, in the framework of Article 22(4) of Regulation (EU) 2019/943, the calculation of CO₂ emissions should also be based on the net electrical efficiency, since the above-mentioned article sets CO₂ emission limits per kWh ‘of electricity’. The net electrical efficiency of cogeneration units should refer to the generation unit producing only¹⁴ electricity at full load, in line with the General Considerations of the Commission Implementing Decision (EU) 2017/1442¹⁵.

7.4. Transferred CO₂ factor (t_{CO_2})

When calculating *Specific Emissions* and *Annual Emissions* of the generation capacity, CO₂ emissions of fossil fuel origin that are captured and transferred to any of the installations described in points (a) and (b) of the first subparagraph of Article 49 of Regulation (EU) 2018/2066 should be subtracted from the emissions of the generation capacity.

This should be done by applying a transferred CO₂ factor, or t_{CO_2} , different from zero, according to the formula defined in Section 6.1. This value should be equal to the quantity of CO₂ captured and transferred over the total quantity of CO₂ emitted by the generation unit, in one calendar year.

The Agency recommends that the competent national bodies ask for the submission of documented measurements, compliant with the measurement-based methodology of the EU ETS framework¹⁶. In this regard, Article 49 and paragraph 21(b) of Annex IV of Regulation

¹³ A non-exhaustive list of relevant technical standards is provided in Annex II. Where ISO standards are not available, EN standards should be considered.

¹⁴ Where due to the generation unit’s configuration production of electricity alone is not possible (e.g. back-pressure steam turbines) the heat produced under electricity full load operation mode should not be taken into account.

¹⁵ [OJ L212](#), 17.08.2017, p. 11.

¹⁶ [OJ L334](#), 31.12.2018, p. 26.

(EU) 2018/2066 should be applied. As specified in Section 9, the transferred CO₂ factor, or t_{CO_2} , should be confirmed with an ex-post validation.

7.5. Annual electricity production

The value of ‘annual electricity production’ is the total net electricity injected into the grid by the generation unit in year y , expressed in GWh. Available metering systems or TSO/DSO metering should be used as a reference.

Generation units in the EU ETS should use the value of net electricity injected into the grid reported in their most recent annual emission report, if indicated in such a report.

7.6. Installed capacity

The second emission limit introduced in point (b) of Article 22(4) of Regulation (EU) 2019/943 refers to the *Annual Emissions* per ‘installed kW_e’ and the second subparagraph of the same article refers to the ‘nominal capacity’ of the generation unit, as a reference for defining the design efficiency.

With the definition provided in Section 4, the Agency has clarified that ‘nominal capacity’ is understood as the ‘maximum continuous net active power which a generation unit can produce and feed into the network’, i.e. the installed capacity. The most recent performance test should be used as a reference for this value.

Generation units in the EU ETS should use the value of the installed capacity reported in their most recent annual emission report, if indicated in such a report.

8. DOCUMENTATION

Pursuant to Article 22(4) of Regulation (EU) 2019/943, Member States should ensure that the emission limits, defined in the same Article, are included in the applied capacity market rules. Moreover, according to Article 22(5) of the same Regulation, capacity mechanisms that are already in place should be adapted in order to comply with the provisions of Chapter 4 of Regulation (EU) 2019/943, without prejudice to commitments or contracts concluded by 31 December 2019.

In order fully to implement Article 22(4) of Regulation (EU) 2019/943, competent national bodies should have access to all necessary data and should be given the competence effectively to monitor the compliance of the requirements introduced in points (a) and (b) of the first subparagraph of Article 22(4) of Regulation (EU) 2019/943.

As part of the pre-qualification process of the capacity mechanism, capacity providers should submit to the competent national bodies an ex-ante calculation of the *Specific Emission* supported by a document containing, at least, the following data:

Table 6. Data and examples of data sources for reporting Specific Emissions:

| Data | Examples of data source |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Name of company | EU ETS annual emission reporting, connection agreement. |
| Contact person | - |
| Generation unit operator | Connection agreement. |
| Name of generation unit | Connection agreement. |
| Connection agreement ID | Connection agreement. |
| Nominal capacity | Connection agreement, power plant commissioning contract, historic power plant testing, information from other technical sources. |
| Design efficiency | Power plant commissioning contract, historic power plant testing, information from other technical sources. |
| Type of fuel(s) | Connection agreement, power plant commissioning contract, historic power plant testing, information from other technical sources. |
| Emission factor(s) | Annex I (IPCC 2006 GL), EU ETS annual emission reporting, purchase receipts, contract purchase or firm purchase record, national or industry reports, test reports. |
| Assumptions made in the calculations | All applicable sources. |
| Applied ISO standard | Power plant commissioning contract, historic power plant testing. |

Table 7. Data and example of data sources for reporting transferred CO₂ and electricity from energy storage:

| Data | Examples of data source |
|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Transferred CO ₂ Installation name | Installations registry, contract (including unique ID of installation). |
| Transferred CO ₂ Operator name | Installations registry, contract (including unique ID of installation). |
| Transferred CO ₂ CO ₂ captured and transferred | Relevant measuring data, historical unit's measures. |
| Energy storage Origin of energy stored | Certificate of origin, purchase receipts, contract purchase or firm purchase record. |

Finally, in the case of generation units that started commercial production before 4 July 2019 and do not comply with the emission limit of 550 g CO₂ per kWh of electricity produced, capacity providers should also submit to the competent national bodies an ex-ante calculation of the *Annual Emissions* supported by a document containing the following additional data:

Table 8. Data and examples of data sources for reporting Annual Emissions:

| Data | Examples of data source |
|-------------------------------|---------------------------------------------|
| Specific Emissions | Calculation of <i>Specific Emissions</i> . |
| Annual electricity production | Verified metering system, TSO/DSO metering. |

In order to ensure a fair application of the emission limits across Europe and to discourage fraudulent behaviour, the calculation of the *Specific Emissions* and of the *Annual Emissions* of the generation capacity together with their modifications should be verified, e.g. be certified by a third-party verifier accredited for scope 1(a) and/or scope 1(b) of Annex I of Regulation (EU) 2018/2067 of 19 December 2018 on the verification of data and on the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council. Contact details of the third-party verifiers should be provided to the competent national bodies.

According to the specific characteristics of their electricity system, competent national bodies could exempt generation units below 5 MW of installed capacity, burning commercial standard fuels, from the submission of a calculation verified by a third-party, requesting only a self-declaration. In this case, the introduction of a control mechanism, e.g. based on a sampling method, is recommended.

9. EX-POST VALIDATION

In order to ensure an effective introduction of the emission limits, as well as data reliability and validity, the Agency recommends competent national bodies to establish an ex-post validation process for the following categories of generation unit whose characteristics might change in time:

- (a) Generation units the emission factor(s) of which might significantly change in time
 - Generation units using mixed fuels;
 - Waste-to-energy generation units;
 - Generation units in which CO₂ is captured and transferred¹⁷;
- (b) Generation units that started commercial production before 4 July 2019 and have less than one year of commercial production at the time of pre-qualification (validation of the *Annual Emissions*);

¹⁷ To any of the installations described in point (a) and (b) of the first subparagraph of Article 49 of [Commission Implementing Regulation 2018/2066](#).

- (c) Generation units that, based on the provisions of point (a) in Section 6 of this Opinion, have participated in a capacity mechanism (validation of the *Specific Emissions*);
- (d) Generation units that, based on the provisions of point (b) in Section 6 of this Opinion, have participated in a strategic reserve mechanism (validation of the *Annual Emissions*).

The ex-post validation should be performed at the end of each calendar year of the delivery period, using the method described herein, and should provide evidence of the compliance with the emission limits. In the case of validation of the *Annual Emissions*, the calculation should refer to each calendar year of the delivery period.

The ex-post validation activity should be performed on the basis of a report, certified by a third-party verifier accredited for scope 1(a) and/or scope 1(b) of Annex I of the Commission Implementing Regulation (EU) 2018/2067, and submitted by the capacity provider to the competent national body. Similarly to the provision introduced in the last paragraph of Section 8, generation units below 5 MW of installed capacity, burning commercial standard fuels, could be exempted from the requirement to provide a third-party verification.

Member States should ensure effectiveness of ex-post validation, by introducing sanctions for generation units which fail to prove their compliance with the emission limits in the ex-post validation process.

Done at Ljubljana on 17 December 2019.

- SIGNED -

For the Agency
Director ad interim
Alberto POTOTSCHNIG

Annexes:

Annex I: Standard emission factors and net calorific values (NCVs) of fuels

Annex II: Relevant ISO and EN standards

Annex III: Flow-chart of calculation values to be used

ANNEX I: STANDARD EMISSION FACTORS AND NET CALORIFIC VALUES (NCVS) OF FUELS

The emission factors below refer to the latest version of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Emission factors for bioliquids and biomass fuels, as well as the emission factor for the biomass fraction of municipal wastes, should be considered equal to zero, according to the provisions of Article 22(4) of Regulation 2019/943. In line with Article 38 of Regulation (EU) 2018/2066¹⁸, peat, xylite and fossil fraction of mixed fuels or waste should not be considered biomass. Operators of generation units using bioliquids and/or biomass fuels should demonstrate compliance with the sustainability and greenhouse gas emission saving criteria introduced in Article 29 of Regulation (EU) 2018/2001.

Table 9. Standard emission factors and NCVs of fuels.

| Fuel | EF _{CO2} (kg CO ₂ /TJ) | NCV (TJ/Gg) | |
|------------------------------------|--------------------------------------------|-------------|------|
| Crude oil | 73.300 | 42,3 | |
| Orimulsion | 77.000 | 27,5 | |
| Natural gas liquids | 64.200 | 44,2 | |
| Motor gasoline | 69.300 | 44,3 | |
| Kerosene (other than jet kerosene) | 71.900 | 43,8 | |
| Shale oil | 73.300 | 38,1 | |
| Gas/diesel oil | 74.100 | 43,0 | |
| Residual fuel oil | 77.400 | 40,4 | |
| Liquefied petroleum gases | 63.100 | 47,3 | |
| Ethane | 61.600 | 46,4 | |
| Naphtha | 73.300 | 44,5 | |
| Bitumen | 80.700 | 40,2 | |
| Lubricants | 73.300 | 40,2 | |
| Petroleum coke | 97.500 | 32,5 | |
| Refinery feedstocks | 73.300 | 43,0 | |
| Other Oil | Refinery gas | 57.600 | 49,5 |
| | Paraffin waxes | 73.300 | 40,2 |
| | White spirit and SBP | 73.300 | 40,2 |
| | Other petroleum products | 73.300 | 40,2 |
| Anthracite | 98.300 | 26,7 | |
| Coking coal | 94.600 | 28,2 | |
| Other bituminous coal | 94.600 | 25,8 | |
| Sub-bituminous coal | 99.610 | 18,9 | |
| Lignite | 101.000 | 11,9 | |
| Oil shale and tar sands | 107.000 | 8,9 | |
| Brown Coal Briquettes | 97.500 | 20,7 | |
| Patent fuel | 97.500 | 20,7 | |
| Coke | Coke oven coke and lignite coke | 107.000 | 28,2 |
| | Gas coke | 107.000 | 28,2 |
| Coal tar | 80.700 | 28,0 | |

¹⁸ [OJ L334](#), 31.12.2018, p. 22.

| | | | |
|-----------------------------------------|-------------------------------------|---------|------|
| Derived Gases | Gas works gas | 44.400 | 38,7 |
| | Coke oven gas | 44.400 | 38,7 |
| | Blast furnace gas | 260.000 | 2,47 |
| | Oxygen steel furnace gas | 182.000 | 7,06 |
| Natural gas | | 56.100 | 48,0 |
| Municipal wastes (non-biomass fraction) | | 91.700 | 10 |
| Industrial wastes | | 143.00 | NA |
| Waste oils | | 73.300 | 40,2 |
| Peat | | 106.000 | 9,76 |
| Solid Biofuels | Wood/wood waste | 0 | 15,6 |
| | Other primary solid biomass | 0 | 11,6 |
| | Charcoal | 0 | 29,5 |
| Liquid Biofuels | Biogasoline | 0 | 27,0 |
| | Biodiesels | 0 | 27,0 |
| | Other liquid biofuels | 0 | 27,4 |
| Gas Biomass | Landfill gas | 0 | 50,4 |
| | Sludge gas | 0 | 50,4 |
| | Other biogas | 0 | 50,4 |
| Other non-fossil fuels | Municipal wastes (biomass fraction) | 0 | 11,6 |

ANNEX II: RELEVANT ISO AND EN STANDARDS

For some technology, the definition of design efficiency is not yet standardised at the international level. Where ISO standards are not available, European EN standards are provided, if available.

- ISO 3977-2:1997 - gas turbines (standard reference conditions and ratings)
- ISO 3077-3:2004 - gas turbines (design requirements)
- ISO 11086:1996 - gas turbines (vocabulary)
- ISO 18888:2017- gas turbine combined cycle power plants (thermal performance test)
- ISO 15550:2016 - internal combustion engines
- EN 12952-15:2004 - steam generators

ANNEX III: FLOW-CHART OF CALCULATION VALUES TO BE USED

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