EUROMOT

The European Association of Internal Combustion Engine Manufacturers

EUROMOT POSITION
EU TAXONOMY FINAL REPORT

05 May 2020

1. General background

The Taxonomy classification material /1, 2/ was prepared by the Technical Expert Group (TEG), almost entirely composed by representatives of financial institutions, whereas the industry sectors to which the Taxonomy would be applied were not represented.

In below text we have highlighted some of the biggest flaws/errors we have detected when reviewing the Taxonomy material. Thus, it is of paramount importance to revise especially many of the set criteria thresholds in the Technical Annex /2/ in order to later on avoid frequent excess usage of the derogation mechanism included in Article 6 (1a) of the Taxonomy Framework /3/ (see text quote in Annex 1), excessive high implementation costs, etc.

The Final Taxonomy is not a technically robust classification system: a fundamental revision is needed in order to get practical (easy and not burdensome to apply), cost-effective criteria thresholds based on available scientific evidence. The overall objective of Taxonomy should be not only to encourage the development of new green activities, but also not to hinder – based on erroneous data & conclusions – the use of already available viable cost-efficient low carbon alternatives for the Green transition of the EU economy.

Therefore, we are of the opinion that the EU Commission, when preparing the Delegated Acts establishing criteria thresholds for the "Taxonomy Framework" in the upcoming months, should carefully assess (together with the "Platform on Sustainable Finance", expected to be operational in Autumn 2020) especially the criteria thresholds (as well as some other aspects listed in below chapters) set by the TEG in the "Taxonomy Report Technical Annex" /2/.

2. Introduction

The Final Taxonomy Report/1/ was published on 09 March 2020, and is supplemented with a Technical Annex /2/ containing most notably:

- technical screening criteria for, or substantial contribution to, climate change mitigation
- “do no significant harm” (DNSH) criteria for climate change mitigation
- etc.

for the various activities considered in the report.

Euromot participated in the commenting process in September 2019 and gave a comprehensive feedback on the Taxonomy Draft Report (dated June 2019) /4/. The Euromot feedback contained many references to the Euromot Position Paper published in the same context /5/.

After reviewing the Final Taxonomy Report and Technical Annex we however noted that the TEG had to a large context overlooked the feedback submitted by Euromot. In the Euromot September 2019 feedback two **main aspects** were highlighted, namely:

- CCS (Carbon Capture and Storage) development status & suitability (not a mature viable technology still today);
- Criteria thresholds should be set on the performance of the whole integrated power sector (“grid average”) rather than on individual plants.

In below chapters we have included supplementary information to our September 2019 feedback, illustrating why these items need a correction in order to make the future EU Taxonomy robust, practical and based on scientific proof. The DNSH requirement on pollution and the global applicability of the Taxonomy are also briefly discussed in below chapters.

3. Criteria threshold setting

3.1. Taxonomy threshold criteria background /2/

Page 205, *“Metrics and Thresholds”* related, quote:

“... The TEG has developed these Taxonomy criteria for the energy sector so they can be used globally.

An overarching technology-agnostic emissions intensity threshold of 100 g CO_{2e}/kWh is proposed for electricity generation, heat production and co-generation of heat and electricity. This threshold will be reduced every five years in line with political targets set out to achieve net-zero emissions by 2050. …

For electricity and heat generation activities,... or a GHG Protocol Product Lifecycle Standard compliant Product Carbon Footprint (PCF) assessment including measurements of fugitive emissions is required. This includes actual physical measurements of methane leakage from the point of extraction/well-head to production of energy (electricity and/or heat)…”

CCS (Carbon Capture and Storage) related quotes /2/:

- Page 207: *“Unabated natural gas fired power generation is not expected to meet the required threshold. Gas-fired power with carbon capture and sequestration may qualify.”*
- Page 205: *“...In the case where CCS is used to meet the emissions intensity threshold, a contractual agreement is required as proof to show that the carbon will be transported and sequestered in economic activities which are themselves eligible under the taxonomy”.*

“Method for selecting the emissions intensity threshold”, some quotes /2/:

- Page 206: **Substantial contribution to climate change mitigation:**

  “*The calculation of the 100 g CO_{2e}/kWh threshold is based on the political targets for future allowed emissions from the power sector divided by the expected evolution of electricity demand”.*

- Page 471: *“… activities that operate above the regional average of 262 g (as per the IEA*) ***would cause significant harm...”.*** This (for climate change mitigation) DNSH “significant harm” threshold is set for most electricity and heat production activities.

- Page 206 – 207: “The threshold was determined as follows /2/:

  - *Historical power sector emissions and electricity demand data for EU 28 are sourced* ***from Eurostat***
  - *Future emissions are in line with EU political commitments for the ETS sector ... then linearly decline to zero by 2050 ...*
  - *Dividing he projected power sector emissions by the projected electricity demand results in policy-consistent projected annual values for emission factors* ***of the EU power sector***
  - *A given power generator is considered aligned with these policy targets if its emissions are below the average of these annual emissions factors over its lifetime*
  - *To determine a single technology-neutral threshold covering all technologies, the methodology considers the average annual emissions factors over a period of 40 years from the time of commissioning”*
  - *…*
  - *This calculation, rounded to the nearest 5g, results in a threshold value of 100g CO_{2e}/kWh for* ***the power sector****.*

Although the 100 gCO_{2e}/kWh threshold is derived from power sector assumptions, it will apply equally to both electricity and heating/cooling generation ...”

3.2. Discussion (related to above chapter content)

3.2.1 Source /5/ (see also Annex 2 of this paper) figure 1 shows that the above discussed (in Taxonomy) set CO_{2e}/kWhe criteria thresholds cannot be fulfilled by any boiler, gas turbine or reciprocating engine plant when operating on natural gas unless CCS is used. In chapter 4 /5/ information is given why **CCS cannot be considered to be an available viable technology of today and for many years to come**. In chapter “CCS” of this document further information of the CCS technology is also provided.

3.2.2 Figure 2 /5/ shows that the hydrogen content of the natural fuel gas blend has to be > 92 vol-% for a prime mover with a 45 % net electrical efficiency to fulfill the criteria threshold value of 100 CO_2 g/kWhe. **These huge amounts of renewable hydrogen are not expected to be available in sufficient and affordable quantities in EU in the coming decades.** To be noted (see below text) is that the set criteria threshold is also to include the *“whole fuel chain”* (fuel extraction at well, transport, treatment, etc. portions) and not only the power plant operation portion which will thus set an even higher minimum H_2 volume content than above estimated as needed of the used fuel gas!

With respect to a future where hydrogen is foreseen as an important energy carrier, Euromot advocates to concentrate the developments and testing efforts on the production and use of hydrogen on dedicated networks and on a dedicated use of hydrogen. It takes already huge investments and years to develop and test equipment dedicated for hydrogen. Diverting the time and funds on solutions for blends of hydrogen and natural gas will slow down the pace towards reaching a renewable society. The portfolio of power generators in the EU has been optimized for natural gas with respect to performance, reliability and emissions. Adding variable amounts of hydrogen to the natural gas will reduce the power plant performance, reliability and increase the emissions. Making funds and time available for the development of equipment dedicated to hydrogen will speed up the process towards a renewable society. As long as the required quantities of hydrogen are not available and the technologies are not ready, the best option is to run the power plants on natural gas (see typical CO_2 emissions in Annex 2) which is not blended with variable amounts of hydrogen. Maintaining a fixed fraction of hydrogen in natural gas streams is close to impossible according to the gas sector.

3.2.3 The Taxonomy criteria threshold is to include the contribution of the *"whole fuel chain"* (well production, fuel treatment, transport and the power plant operation). In chapter 7.3 /5/ we illustrate that the fuel chain's (well + treatment + transport to end consumer) GHG intensity might be up to 30 ... 80 g CO_2/kWhe: it might thus largely vary case by case due to fuel well locations and transport modes. The plant operator has to use the gas the gas pipeline operator is delivering and has thus in most *cases no control* on the origin of the used natural gas. In light of this, Euromot proposed / 5/ that *the PCF (LCE) assessment boundaries for set criteria thresholds should be restricted to (within) boundaries of the actual power plant* at least until fuel suppliers will start to deliver GHG intensity certificates of their delivered gas and reliable data is available.

3.2.4 In chapter 3.1 /5/ is stated " ... *In **EU** the grid average CO_2 intensity today is 296 g CO_2/kWh (year 2016) ..., in some EU countries the grid CO_2 intensity is much above (Poland about 700 g CO_2/kWhe) and in some well below (**France** about 70 CO_2/kWhe ...)"*.

Above information strongly implies that the TEG "historical power sector emissions ..." (see above) source for the set criteria thresholds ("substantial contribution to climate change mitigation" and "significant harm") are based on the grid average CO_2 intensity and not of an individual plant!

3.2.5 Quote /2/ page 290: *"... CCS on dispatchable generation allows all aspects of the electricity supply system to be deeply decarbonised. CCS provides a backstop to the unabated operation of flexible electricity generation plants that are required to guarantee the operation and supply of year-round electricity. This is especially true in more isolated grids with a high penetration of seasonally variable renewables ...".*

Source to back up this statement in /2/ is /6/, which states*: **"We define a low-carbon electricity system** as one with an overall CI of less or equal then 0.1 tCO_2/MWh … Therefore, in the context of this analysis, the cost-optimal solution is first the deployment of … of wind and the subsequent deployment of sufficient CCS to displace the remaining unabated thermal plant. "*

I.e. an overall cost-effective **grid system** with GHG intensity of 100 g CO_2/kWh was the target of report /6/ – **not an individual plant** with max 100 g CO_2/kWh! Lower efficiency impact (and thus higher CO_2 emissions) of the thermal grid back-up plants if operated on part loads were not considered in this study either.

Some generators fulfill a crucial role in maintaining grid stability and reliability and emit more than 100 g CO_2/kWh when running. However, they are used for the balancing and back-up of the volatile renewable electricity sources from wind and solar radiation. Consequently, the grid-stabilising generators will only run part of the time and therefore their contribution to the total greenhouse gas emissions of the power sector will be low. Without the generators mentioned, the amount of solar and wind-based energy has to be limited. This is another argument to apply the limits for greenhouse gas emissions per kWh not on an individual power plant, but on the whole integrated power plant sector (i.e. **grid average CO_2 intensity**).

The reasoning behind this is explained in detail in the books Smart Power Generation (ISBN 978-951-692-846-6) and Power Supply Challenges (ISBN 978-952-93-3634-0).

Conclusion

Based on above (in chapter 3.2) discussion the TEG reasoning (above chapter 3.1) for the set criteria thresholds values is **not robust nor correct**. TEG text quote "*The TEG adopted a technology-neutral approach that can ensure rapid decarbonisation within the electricity sector"* from page 209 /2/ is **thus not correct.**

Application of the set criteria threshold will result in excess usages of the derogation mechanism included in Article 6 (1a) of the Taxonomy Framework /3/. The discussed set criteria thresholds for the electricity generation, heat production and co-generation of heat and electricity sector activities are burdensome to apply and is not correctly taking into account the specificities of this sector.

The decarbonization of the electricity producing sector can be made in a smart cost-effective way: use of already viable cost-efficient low carbon alternatives (see e.g. /19/) should not be hindered - should on the contrary be encouraged! An essential condition for this is to "correct" the criteria thresholds to reflect **the performance of the whole integrated power sector ("grid average"**) (not for individual plants) which seems also to have been the approach in sources TEG referred to. For the heat production sector separate heat bonus approaches, etc. are also to be worked out.

4. CCS (Carbon Capture and Storage)

Page 207 /2/ quote: "*Unabated natural-gas fired power generation is not expected to meet the required threshold. Gas-fired power with carbon capture and sequestration may qualify"* strongly indicates that CCS seems to be a core fundament for the set criteria threshold levels in the Taxonomy report.

In the Euromot document (information submitted to the September 2019 draft Taxonomy consultation) /5/ we discussed the Taxonomy draft report /4/ texts stating the availability and readiness of CCS. In chapter 4 we concluded, after reviewing the open literature, that the TEG used arguments on the CCS are not valid/correct and that "**Still a lot of R&D work, long-term demonstration plant testing of the CCS is needed before it can be deemed to be proven, commercially available and safe enough.**".

Below we have included **further text and arguments** which support our conclusion on CCS in document /5/.

4.1. (Taxonomy) Quote /2/ page 290: *"... CCS on dispatchable generation allows all aspects of the electricity supply system to be deeply decarbonised. CCS provides a backstop to the unabated operation of flexible electricity generation plants that are required to guarantee the operation and supply of year-round electricity. This is especially true in more isolated grids with a high penetration of seasonally variable renewables (e.g. onshore and offshore wind) where the reliable operation of electricity networks requires on-demand electricity generation ...".*

Discussion

Taxonomy report /2/ refers to source /6/ as a reference for the above statement. Source /6/ refers to amongst all "sub" sources /7/, /8/ and /9/. All of these "sub" sources have either the CCGT (Combined Cycle Gas Turbine) or/and a boiler plant as the studied grid balancing plant technology. Source /9/ (see also Annex 3 of his paper) states that a **CCS start up time at "hot start up" conditions is around 1 – 2 h and a CCGT hot-start up time is 45 - 55 minutes.** The start up time for a boiler-based power plant is longer than for a CCGT. Thus, with this kind of prime mover response times are **in article /9/** the dynamics/flexibility of a CCS will match/be flexible enough (for the CCGT or boiler plant types).

Although hot start conditions for CCGTs vary somewhat by manufacturer, maintaining energized electrical systems, purge credit, and steam temperature control enable CCGT start up times of down to about 30 to 35 minutes from initiation of the start sequence. This is about half the time for conventional hot start (see above) that would require purge and gas turbine holds. /15/. Flexibility of the CCGT can further be enhanced by BESS (Battery Energy Storage System) /10/. When comparing to Annex 3 **CCS** should then **not** be flexible enough long start-up time!

Nowadays and more frequently in the future, existing and new power plants must face the challenges of the liberalized electricity market, predictability issues regarding renewable sources and the requirement to cover intermediate and peak load constraints, to be able to respond to the variation of the electricity load demand. The flexibility requirements have further enhanced over the last years due to the increasing share of intermittent renewable electricity generating sources connected to the grid, see below text quote.

"*Increasing penetration of renewable energy sources presents challenges for transmission grid operators to maintain electric reliability despite the intermittency of wind and solar power. This variability is managed with redundant generating capacity that can quickly respond to fluctuations in demand and has predominately been served <u>by coal and gas fired</u> <u>units</u> that are synchronized to the grid <u>but operating at part load</u>. <u>Flexible power</u> <u>generation that can be rapidly brought online reduces the inefficiency of relying on part load</u> operation.* ***System operators, such as PJM, California ISO and ERCOT define such "quick start" or "non-spinning" reserve as generation capacity that can be synchronized to the grid and ramped to capacity within 10 minutes*** ", see chapter 6.1 /5/.

<u>Slow dynamic response plants (such as boilers) are thus to be kept on-line (at part load) all the time in order to be flexible enough and thus at the same time curtailing production of renewable electricity in times with excess "green power" generation.</u> Part load performance (at lower efficiencies, see Annex 2) of the thermal (e.g. boiler) grid stabilization plants thus increase fuel consumption with associated CO_2 emissions and costs. <u>Fast dynamic/flexible reciprocating engine plants</u> can however be shut down in times with enough/excess intermittent renewable electricity generation and thus fuel is saved and associated CO_2 emissions avoided. As a consequence, the share of intermittent renewable electricity penetration into the grid can be increased - average greenhouse gas intensity of the produced grid electricity is thus further reduced.

In modern power purchase markets flexibility is a key factor for the grid balancing plants. In document /5/ chapter 6.1 it is shown that the flexible **reciprocating engine plant's start up time ("hot start" conditions) is typically 2 - 10 minutes** dependent on engine type. Shut down time of the engine (100% - 0% load) is within less than 1 minute. Flexibility of the reciprocating engine plant can be enhanced further by integration with a BESS (hybrid generation) (see slide pages 5 and 8) /20/.

Conclusion:

Quote /2/: "... *CCS provides a backstop to the unabated operation of flexible electricity* ... "**is not valid in today's power markets**! TEG based its statement on old sources not reflecting the change in power markets in recent years and technology development.

4.2. Quote /2/ page 291 quote: *"Through <u>decade long CO_2 injection</u> experiences in North America and the monitoring of storage in Europe, the safe final disposal of CO_2 both on- and offshore has already been established."*

Quote /2/ page 157 (Application of the CCS in the Manufacturing Section): *"... e.g. the use of CO_2 for enhanced oil extraction **would not qualify**)"*.

Discussion

<u>North America</u>

Figure 1: CCS projects in North America /12/.

The most well-known plants in North America (see figure 1) applying CCS are Petra Nova and Boundary Dam coal fired power plant stations (quote: " ...*However, today, 15 years after CCS development work began in earnest, there <u>remains only one</u> operational coal-fired carbon capture project in the U.S: NRG's experimental Petra Nova project south of Houston<u>. A second</u> North American CCS plant, the Boundary Dam Power Station owned by Saskatchewan Power (SaskPower), <u>is in operation</u> in Canada* ") /11/. In these projects the captured CO_2 is used for EOR (Enhanced Oil Recovery).

Further Quote (Executive Summary) /11/;

"*While Petra Nova and Boundary Dam are operational, <u>both are really only demonstration units</u>. <u>Petra Nova captures just over a third of the flue gas</u> <u>from one</u> of four coal-fired units at the massive W.A. Parish Plant, and it has been an expensive experiment, at a cost of more than $1 billion. <u>Boundary Dam</u>, the smallest of the four projects examined here, has been plagued by <u>operational problems and cost overruns that have pushed its price tag to roughly US$1.1 billion</u>. Further, both Petra Nova and Boundary Dam rely economically on selling their captured carbon <u>for enhanced recovery operations (EOR) in oil fields, an option that is not necessarily available to coal plants elsewhere.</u>*

The integrated gasification combined cycle projects at <u>Edwardsport and Kemper</u> have been <u>disasters</u>, as they proven absurdly expensive to build and costly and unreliable to operate.

*<u>Widescale use</u> of CCS would require a <u>huge network of pipelines</u> (and associated infrastructure) to transport captured CO_2 to sequestration sites, an issue given scant attention in CCS development discussions. Such a network would be <u>**enormously** costly</u> and <u>extremely time-consuming to permit and build</u>. Further, Capturing CO_2, piping it to distant sequestration sites and injecting it into the ground would require an exorbitant amount of water. … <u>**The technology remains unproven at full commercial scale, it is wildly expensive, there are serious questions regarding the after-capture transport, injection and storage of the captured CO_2**</u> and—most important—more reliable and far cheaper power-generation options exist* ".

Europe

TEG seemed to make a reference to the Sleipner field in North Sea, where CO_2 has been injected into the sub-sea saline aquifer since year 1996. **Concerns have however been expressed over the safe long-term storage capability of this field**:

- Quotes /13/:

  *"**Utsira and CO2 storage:** The leakages from Tordis, Visund and Ringhorne all occurred in the Utsira formation, the same geological structure where the Sleipner field is located. The CO_2 storage project at Sleipner has been used by the Norwegian government, as well as the EU, IEA and numerous others, as proof that CO_2 can be safely and permanently stored. For years now, the Utsira formation has been heralded in scientific journals, by industry, NGOs and the media as a geological structure that can store 'endless amounts' of CO_2: … However, a **recent study** conducted by the Norwegian Petroleum Directorate to evaluate possible storage sites for CO2 from the planned Mongstad and Kårstø CCS gas-fired pilot plants. It **concluded that " […] it remains uncertain whether Utsira is suitable for large-scale storage of Europe's carbon emissions**". The main reason for this is the depth of the formation, which is too shallow to provide the pressure required to ensure that the CO2 stays in a fluid phase … ".*

The legal framework for the environmentally safe geological storage of CO_2 ("on the geological storage of carbon dioxide" 2009/31/EC) is also questioned:

- *Quotes /14/; "It's far too early to tell whether the EU's regulatory framework for storage will work in practice over the long term. However, several ambiguities, vague language, potentially conflicting objectives in the Directive in combination with a lack of experience and technological limitations will complicate efforts to effectively implement the framework. See Annex 4 for further information on* this."

Conclusion

Quote /2/: "Through decade long CO_2 injection experiences in North America and the monitoring of storage in Europe, the safe final disposal of CO_2 both on- and offshore has already been established." This statement **is not correct** based on above texts, a lot of uncertainties and issues to solve seem still to exist. See also chapter 4 /5/ for more information.

4.3. Others (Capture and Transport of CO_2):

In chapter 4 /5/ contains information on these aspects, such as:

- *"Brussels also said that the EU should have twelve "demonstration plants of sustainable fossil fuel technologies in commercial power generation" operating by 2015 ... But, as of 2017 the EU has **zero** CCS demonstration plants".*
- Etc.

Conclusion

Quote /5/: "*No demonstration plant exists yet in the EU for a power plant, therefore CCS will not be a mature technology in years to come…".* See chapter 4/5/ for more information.

Final conclusion on CCS

Adequate legislation ensuring a proper supervising of CO_2 storage facilities and its connected responsibilities for many centuries to come is not yet available. It appears that the geological effects, both long-term and short-term, have insufficiently been investigated and cannot today predict the long-term performance of the storage. Thus, still a lot of R&D work, long term demonstrating testing of the CCS is needed before it can be deemed to be proven, commercially available and safe enough.

5. Others

Some aspects such as the BAT-AELs to be used and global applicability of the made Taxonomy is briefly discussed below.

5.1. LCP BREF BAT-AEL

In the Final Taxonomy report the DNSH (Do Not Significantly Harm) requirement on Pollution has been changed to " ... *to be in lower end of the BAT-AEL ranges therein, ensuring at the same time that no significant cross media effects occur...*" for many activities such as "*4.1 Production of Electricity from Gas*".

In the LCP BREF 2017 /16/ the BAT-AELs are given as a range with upper and lower end limits. The intent of this is to give the plant operator some flexibility in meeting the set operational emission limits when surrounding factors such as fuel composition/quality, etc. are varying within allowed boundaries. E.g. the EU EN 16726:2015 natural gas standard has set some parameter limits (such as for the sulphur content) much higher than current praxis in many EU countries and currently no WI (Wobbe Index) limit is set. An amendment process was started up some years back in order to work out an acceptable WI range for all stakeholders (initial EASEE Gas proposal was too wide for many end users) and a parameter such as change speed of WI was missing. A high S-% content of the fuel gas is detrimental: extensive corrosion risk (especially in efficient CHP installations), for oxidation catalysts needed for abatement of unburned flue gas emissions such as CO and formaldehyde /17/, 18/. A too high WI of the fuel gas will result in a very low Methane Number (MN) which is detrimental for the prime mover efficiency (will decrease) and emissions (will increase) performance. A plug flow (sudden gas composition change) will result in shut down of the gas fired power plant due to safety reasons. It is expected that with the increased natural gas sourcing from abroad EU (due to depleting "domestic" productions) frequent occurring "gas quality" changes will appear in the gas distribution net in the future. If in the used fuel gas composition the parameter property limits are too wide, the issues explained above might/will occur. It should also be remembered that LCP BREF is valid for individual prime mover unit sizes > 15 MWth. Thus, a multi-unit power plant > 50 MWth can consist of prime movers of a very wide range > 15 MWth. The LCP BREF emission BAT-AEL range is also reflecting this and is therefore needed.

Therefore, the LCP BREF (BAT-AEL variation range) inbuilt "flexibility" is needed and should not be restricted as proposed in the Final Taxonomy report – maximum span limit as allowed by IED 2010/75/EU should be maintained. E.g. this in order not to force plants to be shut down when no operational flexibility (emission) limit options window are available anymore in coping with the changing gas composition quality (the plant operator is not in control of what gas composition he is receiving in the gas pipe line) if the final EN gas standard contains too wide parameter limit ranges, etc.

5.2. Global applicability of the Taxonomy

Quote page 205 /2/: *"... The TEG has developed these Taxonomy criteria for the energy sector so they can be used globally".*

The plant surrounding existing infrastructure (available fuel qualities, reagents, etc.) and economic realities are setting frames for the achievable emission limits. The EU LCP BREF BAT-AEL set emission ranges are strict and due to infrastructural reasons, etc. not reachable in many locations around the world. Therefore, we in our feedback (where references were made amongst others in /5/) proposed a GIIP (Good International Industry Practice) approach as applied in IFC (International Finance Corporation)/WB (World Bank) EHS (Environmental, Health and Safety) Guidelines to be used in locations with a restricted infrastructure. This view is absent in the Final Taxonomy documents and we thus again repeat our recommendation in order to make the Taxonomy a real tool which can be used globally.

6. Conclusions

The industry feedback on the draft Taxonomy report submitted in September 2019 was almost totally overlooked/disregarded by the TEG. The Final Taxonomy is thus not a technically robust classification system, a fundamental revision is needed in order to get practical (easy and not burdensome to apply), cost-effective criteria thresholds based on available scientific evidence and engineering expertise.

In above texts we have highlighted some main items which need a thorough assessment/change in order to make the Taxonomy a tool enabling - and not hindering based on erroneous data & conclusions – the use of already available viable cost-efficient low carbon alternatives for the Green Transition of the EU economy.

Therefore Euromot urges the EU Commission, when preparing the Delegated Acts establishing criteria thresholds, etc. for the “Taxonomy Framework” in the upcoming months, to carefully assess (together with the “Platform on Sustainable Finance”, expected to be operational in autumn 2020).

the above made counter proposals. By a smart approach, the year 2050 climate goal can be achieved in a cost-effective way when giving – not restricting - sufficient flexibility to society and industry to transform towards the target.

7. Sources

/1/ Final Report on Taxonomy at web: https://ec.europa.eu/info/files/200309-sustainable-finance-teg-final-report-taxonomy_en

/2/ Taxonomy Report; Technical Annex at web: https://ec.europa.eu/info/files/200309-sustainable-finance-teg-final-report-taxonomy-annexes_en

/3/ Provisional Agreement on Taxonomy Framework, 16.01 2020, at web: https://www.europarl.europa.eu/RegData/commissions/econ/inag/2020/01-16/CJ36_AG(2020)646809_EN.pdf

/4/ Taxonomy Technical Report, draft June 2019, at web: https://ec.europa.eu/info/sites/info/files/business_economy_euro/banking_and_finance/documents/190618-sustainable-finance-teg-report-taxonomy_en.pdf

/5/ Euromot Position "Taxonomy – Technical Expert Group on Sustainable Finance Report of June 2019, Implications for stationary/large combustion engines", 3 September 2019 at web: https://www.euromot.eu/wp-content/uploads/2019/09/Taxonomy-Report-June-2019_EUROMOT-Position_Stationary-engines_FINAL_2019-09-03.pdf

/6/ "Quantifying the value of CCS for the future electricity system", 2016, Clara Heuberger, et.al, at web https://pubs.rsc.org/en/content/articlelanding/2016/ee/c6ee01120a#!divAbstract

/7/ "Flexibility of Low-CO_2 Gas Power Plants: Integration of the CO_2 Capture Unit with CCGT Operation ", Nicola Ceccarelli, et.al. 2014, at web: https://www.sciencedirect.com/science/article/pii/S1876610214019948?via%3Dihub

/8/ "Dynamic modelling and analysis of a coal-fired power plant integrated with a novel split-flow configuration post-combustion CO_2 capture process ", N. Mac Dowell, et.al, 2014 at web: https://www.sciencedirect.com/science/article/abs/pii/S1750583614001303?via%3Dihub

/9/ "Operating Flexibility of Power Plants with Carbon Capture and Storage (CCS)", 2013, Rosa Domenichini, et.al, at web: https://www.sciencedirect.com/science/article/pii/S1876610213004001

/10/ "Energiewende shuts down most efficient gas turbine", 2015, at web: https://energytransition.org/2015/04/energiewende-shuts-down-most-efficient-gas-turbine/

/11/ IIEFA Full Report: "Holy Grail' of carbon capture continues to elude coal industry; 'cautionary tale' applies to domestic and foreign projects alike ", 2018, at web: https://ieefa.org/wp-content/uploads/2018/11/Holy-Grail-of-Carbon-Capture-Continues-to-Elude-Coal-Industry_November-2018.pdf

/12/ IIEFA Summary Report: "Holy Grail' of carbon capture continues to elude coal industry; 'cautionary tale' applies to domestic and foreign projects alike ", 2018, at web: https://ieefa.org/ieefa-report-holy-grail-of-carbon-capture-continues-to-elude-coal-industry-cautionary-tale-applies-to-domestic-and-foreign-projects-alike/

/13/ "Leakages in the Utsira formation and their consequences for CCS policy" at web: http://static.greenpeace.org/int/pdf/081201BRUtsira.pdf

/14/ "Acid News", June 2019, at web: https://airclim.org/sites/default/files/acidnews_pdf/an2-19_0.pdf

/15/ "Combustion Engine vs Gas Turbine Startup Time" at link https://www.wartsila.com/energy/learn-more/technical-comparisons/combustion-engine-vs-gas-turbine-startup-time

/16/ LCP BREF 2017 at link: http://eippcb.jrc.ec.europa.eu/sites/default/files/2019-11/JRC_107769_LCPBref_2017.pdf

/17/ Euromot: “Sulphur in Gas Quality”, 2012 at link
https://www.euromot.eu/wp-content/uploads/2017/03/GAS_QUALITY_sulphur_2012-08-30.pdf

/18/ Euromot: “Total Sulphur Levels in Natural Gas with Special Considerations of CI engines”, 2012 at link
https://www.euromot.eu/wpcontent/uploads/2017/03/GAS_QUALITY_sulphur_levels_in_natural_gas_2012-04-04.pdf

/19/ “Euromot Preliminary Comments on IED ”decarbonization study”, February 2020, at link:
https://www.euromot.eu/wp-content/uploads/2020/04/EUROMOT-preliminary-comments-on-IED-decarbonization-study_27-Feb-2020.pdf

/20/ “Integration of Hybrid systems”, B. Grummel, K. Moradi, 2019, at link:
https://arpa-e.energy.gov/sites/default/files/13_Grummel_2019-09-18%20ARPA-E%20Wartsila%20Hybrid.pdf

8. Annexes

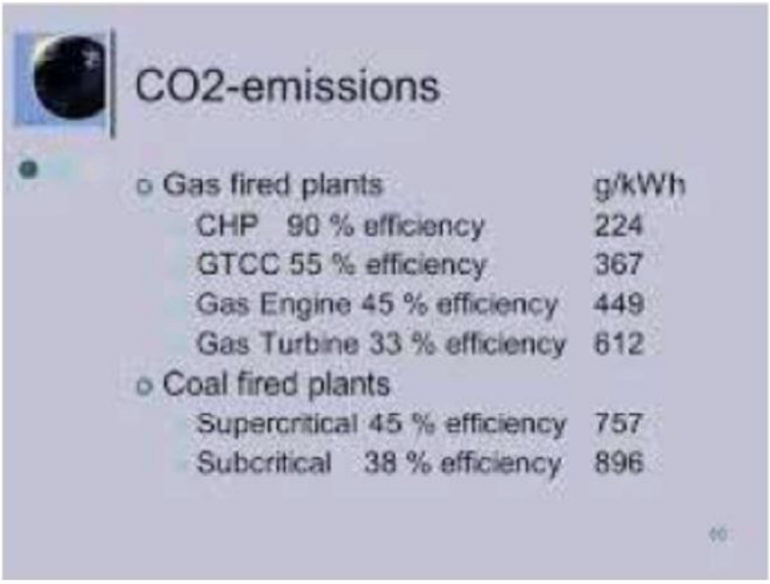
Annex 1 /3/ article 6

"*1a. For the purposes of paragraph 1, an economic activity for which there is no technologically and economically feasible low carbon alternative, shall be considered to contribute substantially to climate change mitigation as it supports the transition to a climate neutral economy consistent with a pathway to limit the temperature increase to 1.5 degrees Celsius above pre-industrial levels including by phasing out greenhouse gas emissions, in particular from solid fossil fuels, where that activity:*

(i) has greenhouse gas emission levels that correspond to the best performance in the sector or industry;
(ii) does not hamper the development and deployment of low-carbon alternatives; and
(iii) does not lead to a lock-in in carbon-intensive assets considering the economic lifetime of those assets.

For the purpose of this paragraph and the establishment of technical screening criteria in accordance of Article 14, the Commission shall assess the potential contribution and feasibility of all relevant existing technologies. "

Annex 2: /5/



Annex 3: Flexibility of CCGT, boiler plants with/without CCS /9/

Table 1. Flexibility features of power plants with and without CCS

	Turndown	Cycling capability Start-up to full load	Ramp rates	Part load efficiency
NGCC	Low load operation: 15-25% CC load (10-20% GT load) Min. environmental Load: 40-50% CC NPO (30-40% GT load)	Hot start-up: 45-55 min Warm start-up: 120 min Cold start-up: 180 min	35 - 50 MW/minute max Hot start-up load change rate: - 0-40% GT load: 3-5%/min - HRSG press.: 1-2%/min - 40-85% GT load: 4-6%/min - 85-100% GT load: 2-3%/min	Approx. constant efficiency down to 85% GT load 2-3 percentage points less @ 60% CC load
with CCS	Post-combustion unit min. load: 30% CO_2 compressor min. efficient load: 70%	Regenerator preheating: - hot start-up: 1-2 h - warm start-up: 3-4 h	Same as plant w/o CCS	Same as plant w/o CCS
IGCC	Min. env. GT Load: 60% PO. Process unit /air separation unit (ASU) cold box min. load: 50% ASU compr. min. load: 70%	Cold start-up: 80-90 h Gasification hot start-up: 6-8 h ASU hot start-up: 6 h	Gasification ramp rate: 3-5%/min ASU ramp rate: 3%/min	Gross electrical efficiency: 2 percentage points less @ 70% CC load
with CCS	CO_2 compressor min. efficient load: 70%	Same as plant w/o CCS	Same as plant w/o CCS	Same as plant w/o CCS
USC PC	Min. boiler load: 25-30%	Very hot start-up: < 1h Hot start-up: 1.5-2.5 h Warm start-up: 3-5 h Cold start-up: 6-7 h	30-50% load: 2-3%/min 50-90% load: 4-8%/min 90-100% load: 3-5%/min	Subcritical boiler: -4 perc. point @ 75% load Supercritical boiler:- 2 perc. point @ 75% load
with CCS	Post-combustion unit min. load: 30% CO_2 compressor min. efficient load: 70%	Regenerator preheating: - hot start-up: 1-2 h - warm start-up: 3-4 h	Same as plant w/o CCS	Same as plant w/o CCS
Oxy fuel				
Air-firing mode	Min. boiler load: 25-30%	Very hot start-up: < 1h Hot start-up: 1.5-2.5 h Warm start-up: 3-5 h Cold start-up: 6-7 h	30-50% load: 2-3%/min 50-90% load: 4-8%/min 90-100% load: 3-5%/min	Subcritical boiler: -4 perc. point @ 75% load Supercritical boiler: -2 perc. point @ 75% load
Oxy-firing mode	Cold box min. load: 40-50%. ASU compressor min. efficient load: 70% CO_2 compressor min. efficient load: 70%	Start-up in air-firing mode, ASU start-up completed in approx. 36 h	ASU ramp rate: 3%/min	Same as plant in air-firing mode

For NGCC and USC-PC with post-combustion capture, Table 1 shows that the introduction of the capture unit may impose additional constraints on the turndown, start-up and fast load changing of the plant. For oxy-combustion plants, the main constraint on flexibility is the ASU, which has a minimum operating load of the cold box of around 50% and a maximum ramp rate of 3% per minute (a boiler can typically ramp at 4-5%).

Annex 4 /14/

The European Union (EU) established "a legal framework for the environmentally safe geological storage" of CO2 (2009/31/EC)

web: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0031&from=EN in 2009.

Article 1 defines "environmentally safe" as "permanent containment of CO_2 in such a way as to prevent and, where this is not possible, eliminate as far as possible negative effects and any risk to the environment and human health".

In short, the EU's CCS Directive *creates a risk-based approach for CO_2 storage to prevent and eliminate environmental and public health risks as much* as possible**. <u>This is a laudable goal but will be difficult to achieve in practice</u> /14/.**

Quotes /14/:

"It's far too early to ***tell whether the EU's regulatory framework for storage will work in practice over the long term. However, several ambiguities, vague language, potentially conflicting objectives in the Directive in combination with a lack of experience and technological limitations will complicate efforts to effectively implement the framework"***.

For example

1. Leakage

A consistent and appropriate definition for leakage is essential because it relates directly to other measures in the Directive, such as corrective measures, potential liabilities (including surrendering ETS allowances) and transferring storage site ownership. The Directive falls short on this front.

Leakage is defined as "any release of CO2 from the storage complex". The term "storage complex" refers to "the storage site and surrounding geological domain which can have an effect on overall storage integrity and security". These ambiguous definitions create several uncertainties, making it difficult to determine what actually constitutes leakage.

2. Quantifying the risk of leakage

Applying quantitative approaches to assess the risk of leakage is difficult due to wide ranges in key parameters, multiple methodological approaches, significant technical uncertainties, and the long timescales involved. Limited case studies and published literature exist to guide regulators and project operators in this exercise and assist with permitting decisions.

3. Significant

"Significant" appears in several important aspects of the Directive. For example, in Article 4, a storage site should only be permitted if "there is no significant risk of leakage, and if no significant environmental or health risks exist". This language seems to be in conflict with the objective in Article 1 of preventing and eliminating any risk to the environment and human health. What's more, "significant" is tied to one of the triggers for corrective measures and could be under protective depending on how that language is applied to individual projects.

4. Corrective measures

The need for corrective measures requires the detection of "significant irregularities" or leakages through monitoring approaches capable of detecting issues wherever they may occur. Previous experience with Sleipner and non-CO2 storage projects in the North Sea demonstrate that modelling and monitoring regimes can fail to accurately predict CO2 movement, prevent over pressurisation, detect fractures, and identify leakages. What's more, corrective measures, such as relief wells, can take several months to deploy in the event of a catastrophic leakage.

5. Financial security and funding mechanism

Articles 19 and 20 rightly include provisions to ensure storage operations provide funding to maintain storage sites through their operation and post closure phases. How much funding will be needed, however, is unknown.

EUROMOT – 2020-05-06

For more information please contact:

EUROMOT aisbl
European Association of Internal Combustion Engine Manufacturers
Domenico Mininni – Technical and Regulatory Affairs Manager
Phone: +32 (0) 28 93 21 40, domenico.mininni@euromot.eu
EU Transparency Register ID number: 6284937371-73
www.euromot.eu

EUROMOT is the European Association of Internal Combustion Engine Manufacturers. It is committed to promoting the central role of the IC engine in modern society, reflects the importance of advanced technologies to sustain economic growth without endangering the global environment and communicates the assets of IC engine power to regulators worldwide. For more than 25 years we have been supporting our members - the leading manufacturers of internal combustion engines in Europe, USA and Japan - by providing expertise and up-to-date information and by campaigning on their behalf for internationally aligned legislation. Taken together, the EUROMOT member companies employ about 200,000 highly skilled and motivated workers. The European market turnover for the business represented exceeds 25 bn euros.

Our **EU Transparency Register** identification number is **6284937371-73.**

www.euromot.eu – your bookmark for IC engine power worldwide