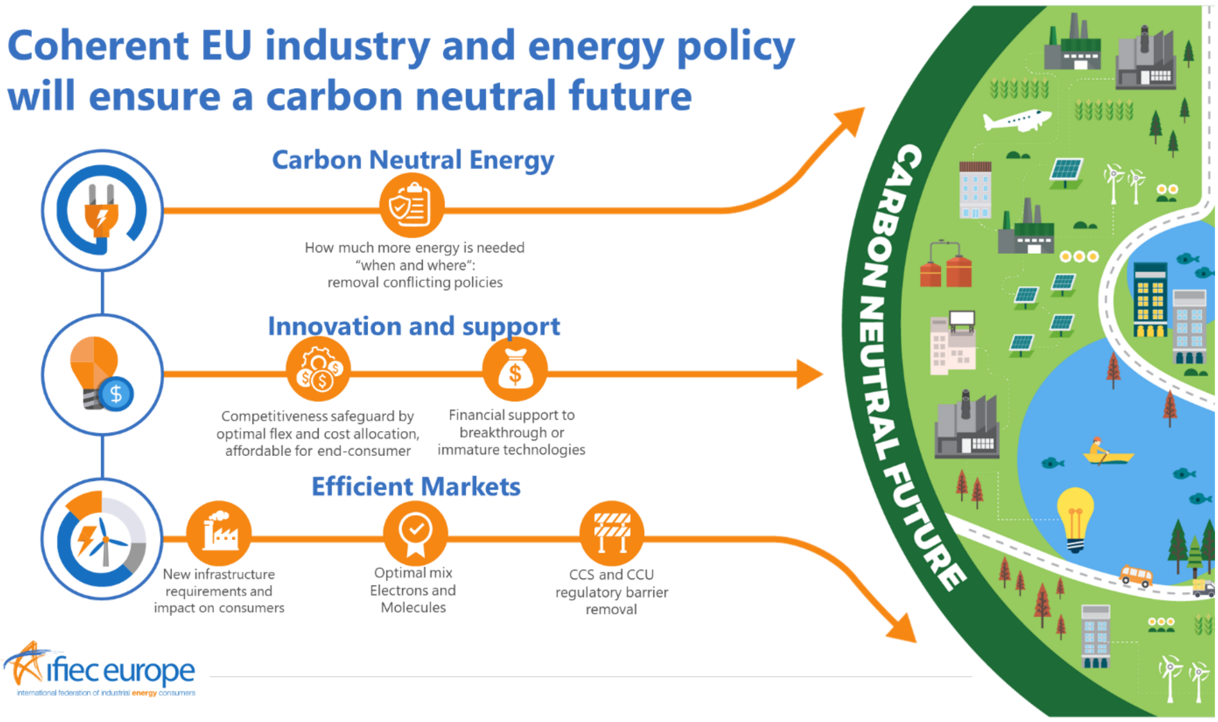
Coherent EU industry and energy policy will ensure a carbon neutral future

A paradigm shift requiring a new balance between energy supply and demand

Abstract:

Following the Paris Agreement, the European Union set ambitious goals for a carbon neutral energy supply. The European industry faces major challenges to reduce its emissions related to energy consumption and feedstock usage and will play a pivotal role in the transition towards a carbon neutral society. The development of innovative sustainable technologies and products within the industrial sector will be crucial.

EU Industry needs a resilient energy and industry policy with a consistent and robust regulatory framework. IFIEC Europe proposes six key recommendations for policy changes and further study:



A close and structured dialogue and cooperation between the European Commission, the industry and energy sector must be established to investigate a regulatory and commercial framework to deliver an increasing demand for carbon neutral, secure and globally competitive energy. This is necessary because energy supply and demand will change dramatically over the next decades as a result of declining fossil fuel usage and the growing share of intermittent renewable electricity generation. Energy production is changing (locations, scale, conversion, etc.), as well are system users (prosumers, aggregators). IFIEC Europe insists to thoroughly analyse possible transition routes and solutions, each from an economic perspective as well as from a system adequacy perspective.
Industry must be able to be competitive in a secure and efficient climate neutral energy market and able and encouraged to deliver flexibility to energy markets. Flexibility is a partial answer to variable energy supply with cost implications. Competitiveness must be safeguarded by realistic plans, fitting in a globalized economy and cost allocation must fit into a European industry plan.

IFIEC Europe sees 3 themes for possible routes and solutions to a **Carbon Neutral Future** that need to be addressed in parallel:

1. **Carbon Neutral Energy**
   - further deployment of renewable energy sources, with existing as well as new sources of flexibility, providing the necessary back-up capacity for coping with intermittency;
   - investments in nuclear technology, geothermic energy, conversion technology (electrons and molecules) and CCUS;
2. **Efficient Markets**
   - investments in new infrastructure, facilitating system flexibility and CCS;
   - continuation of the energy (commodity and flexibility) - and carbon markets as a corner stone for an efficient energy supply system, with an appropriate balance between incentivising consumers to participate in demand response and incentivising all system parties to use it;
3. **Innovation and Support**
   - creation and support for new initiatives, value chains and cooperation, embedded on local and regional levels, including across borders;
   - research and development into innovative solutions and technologies, with carbon and hydrogen as important building blocks for fuels and products.

IFIEC Europe's **Key Recommendations** for policy changes and further study:

Carbon Neutral Energy

A. *Assess how much more energy is needed "when and where" and remove conflicting regulatory policies*: The assessment should look into how much energy is needed, where it is coming from, how to displace it over time, at what cost and how this interacts with an EED energy usage cap;

Innovation and Support

B. *Competitiveness safeguarded by optimal flex selection and cost allocation, affordable for end-consumers*: a clear and predictable strategy to safeguard industries competitiveness using several measures, including a transparent assessment of the total indicated system cost for end-consumers deriving from the energy transition, cost allocation and a cost comparison between flexibility options. State Aid Guidelines have to take into account EU's global competitiveness rather than be limited to a level playing field within the EU;

C. *Financial support to breakthrough or immature technologies* must not be limited to technology innovation support, but also cover scale ups and the market entry of new products and applications to bridge the so-called 'valley of death';

Efficient markets

D. *Impact of new infrastructure on industrial consumers: assessment of the consequences and requirements from an integrated system approach and the consequences for industrial consumers (increasing capacity, congestion, decentralization adaption, costs);*

E. *Optimal mix of electrons and molecules* in creating a demand-driven energy and raw materials policy. Assessment of the optimal mix of low carbon electrons and molecules;

F. *CCS and CCU regulatory barrier removal*: removal of innovation hurdles regarding CCU and CCS in the Monitoring and Reporting Regulation, ETS and CCS Directive.

In fulfilling these requirements, next steps can be made to implement a coherent, secure and affordable carbon neutral energy supply system, giving the European industry an outlook and licence to operate in a prosperous and carbon neutral European society.

1 Carbon neutrality is challenging for industry and energy sectors

In order to meet the targets of the Paris Agreement, the European Union set ambitious goals for a carbon neutral energy supply. Global GHG emission reduction is vital to battle global warming. Usage of fossil fuels needs to be reduced and/or combined with Carbon Capture & Storage (CCS) and Usage (CCU) to prevent adding additional carbon to the atmosphere. The industry faces major challenges to reduce its CO_2-emissions related to both energy consumption and feedstock usage. It is evident that more and more energy will and must be produced from carbon-neutral sources. In the next decades, a major shift has been taking place to carbon-neutral forms of power generation, low carbon gases and hydrogen. European citizens and companies are facing an energy transition that entails multiple challenges in terms of affordable energy prices, security of supply and innovation. For industrial end users, the EU needs to ensure a necessary level of global competitiveness, given that global action on climate change remains fragmented, whilst maintaining security of supply at the same time.

Industry will play a pivotal role in the transition towards a carbon neutral society, both in its energy and feedstock consumption, and in the development of innovative sustainable technologies and products. The energy and industry transition are going hand in hand. Where intermittent energy sources are more frequently used for power generation, the electricity system needs to deal with an increasing volatility of electricity production. As far as gas is concerned, end users will have to face more volatile composition of gas because of decreasing natural gas production, increasing LNG imports and production of intermittent renewable gasses such as biomethane, biogas and hydrogen. Cross-sectoral cooperation, not only between the gas and electricity supply, but also between the industry- and energy sector, as well as process innovation (e.g. high temperature electrified heat and CO_2-chemistry) and product innovation (electrolysers, e.g.) are major parts of the solution.

The energy supply and demand will be imbalanced in an increasing number of hours a year, as a result of the growing share of renewable electricity generation and the changing energy production locations in Europe. From a system perspective, demand side could contribute to balancing those intermittencies when the electricity system needs system support. Promising candidates to provide such services are Power-to-X technologies and demand side flexibilities from end users. Industry is one of the market players determining the energy demand, including which energy carrier will play which role at any moment in time. Interlinking energy markets between the energy and industrial sectors (producers, consumers and *prosumers,* aggregators) can offer solutions to balance the system. However, there is not one way forward. There are several routes available for reducing and/or compensating for GHG emissions in the energy system, each with strongly diverging impacts on system adequacy, system balance and system cost, and each with a strongly diverging potential in different areas of the EU.

IFIEC Europe therefore insists to thoroughly analyse these different routes, each from an economic perspective (impact on system cost) as well as from a system adequacy perspective (capacities needed, back-up needs, grid needs, etc.). Before the full potential of the industrial sector can be realised, it should be identified what is lacking in the energy supply system and industrial installations to empower market players like the European industry to fulfil its key role in the transition. This discussion paper aims at addressing the requirements to make the industry and energy transition possible, and the related various issues that should be further examined.

2 Industry is a key driver in the energy transition

2.1 Raw materials and processes need to change

Industry stands at the core of the energy system transformation and is embedded on a regional level and creates new initiatives, value chains and cooperation. Europe has an open, market driven economy, where companies can grow and new entrants that deliver contributions to modernisation of the industrial production are welcomed. The transition of the European industrial production system therefore needs an adequate, dynamic supportive structure. Even more to prevent carbon leakage by the relocation of activities to other continents.

The transition process implies radical system changes, not only related to energy, but also to raw materials, such as carbon, hydrogen, ammonia, etc. This dual use of energy and materials is integrated in the industrial sector. This unprecedented system transformation requires cross-sectoral cooperation between private and public parties, and will overarch industrial sectors.
Moreover, new infrastructures for gas- electricity- heat, CCS and CCU require cross-border cooperation between member states to find the most effective and efficient solutions.

Industry puts a lot of effort to increase the energy efficiency of its processes, leading to a decrease of the specific energy demand. In many industrial sectors, European industry already has set the benchmark in installations' efficiency levels. Next to that, electrification of industrial production processes and appliances will contribute to decarbonisation, assuming that the electricity sector will be carbon neutral eventually.

2.2 Energy carriers need to change

In the current energy supply system, electricity as an energy carrier represents no more than 20 percent of the overall energy demand. The rest is molecules coming from oil, coal and natural gas. Industrial electricity use will certainly grow in industrial applications, as different studies have concluded. However, 60 percent of the energy use will be molecules by 2050. Industry strives to use biomass based, recycled carbon and hydrogen.

Carbon is – and will be - a major building block in many consumer goods. These elements are also intermediate products of circular and bio-based industries. Large volumes of climate-neutral energy will be needed in order to move to alternative feedstock sources. On the long term, CO_2 should no longer be qualified as waste, but as a valuable raw material (CCU). Carbon may be harvested via CO_2 in the atmosphere or sourced from production processes and ambient air.

Next to carbon, hydrogen is an important building block for fuels and products. Low carbon hydrogen may well be produced via large scale on-site electrochemical conversion (e.g. electrolysis), fuelled by low carbon electricity. However, these technologies, are not yet competitive in comparison to conventional hydrogen production. Using and/or producing biogas and biomethane or nuclear are other options for the industry to decarbonise its energy.

2.3 Industry delivers flexibility and Demand Side Response

To date, a high degree of flexibility has been provided by power generators and natural gas suppliers. Ample dis-patchable conventional installations are able to guarantee that supply will always follow demand. Consumers can provide flexibility in demand to a certain extent. From a business case perspective, industrial processes are baseload and require a stable and non-fluctuating competitively priced energy production since this delivers the highest rate of energy efficiency.

The need to reduce GHG emissions results in an increasing share from stable producers to intermitting electricity producers (sources from sun/wind). In the currently changing system, consumption needs to deal with an increasing intermittent production and price volatility at the detriment of energy efficiency. All electricity consumers must prepare for more volatile prices and respond to price signals in order to contribute to system balance. The flexibility of the electricity market is limited. We cannot store electricity (apart from batteries which are small scale and pumped storage with significant loss of energy) and the quality/ frequency of the electricity grid should be managed permanently safeguarding a stable 50Hz frequency. Also the gas sector has to decarbonize. More low carbon gasses like biogas and biomethane will be produced and injected into the grid. The production of hydrogen will increase and could become a major enabler for the cross sector coupling of gas and electricity. The flexibility of gas as an energy carrier is much more significant than electricity. Via production, storages and line-pack, TSOs are able to balance the gas grid. Because we will face more and more periods of over- and undersupply of electricity, solutions are necessary for storage and backup. A huge challenge lays ahead to displace large volumes of energy in time (winter – summer, intraday) in energy storages. The availability of enough flexibility via storages at competitive cost is a key success factor for carbon neutral transition and a precondition for a successful interlinkage between the energy and industry sectors.

Flexibility could be key to solve the challenge of intermittent renewables. Next to solutions for storage and backup, industrial end users can contribute to a more stable energy supply system. However, demand-response is not straightforward, especially when looking at some of the energy intensive industry's core processes. The deteriorating energy efficiency levels must be accepted and legislation should be adapted to overcome this challenge. Some hurdles include: safety risk (some companies have to manage high risk processes/products and will never adopt demand-response, whatever the benefit), costs related to the manufacturing process and production losses (especially if production is continuous), risk that a sudden and unforeseeable shutdown of an equipment can create in relation to production processes (e.g. restarting production) on product quality and equipment and trade-offs between energy efficiency and demand response.

IFIEC Europe continues to believe in commodity and flexibility markets in delivering efficient outcomes. To enable a flexibility market, the roles and responsibilities must be clear, especially when recognizing that a specific company can fulfil more than one role. There needs to be an appropriate balance between incentivising consumers to participate in demand response and incentivising BRPs, TSOs, DSOs to use it. New local real-time market solutions to balance the system and long-term adequacy requirements for BRPs need to be developed. Proper pricing signals for flexibility and proper adequacy responsibilities will ensure that balancing and backup can be undertaken in the most efficient way and should strive to ensure that the consumer receives the real market value for participation, so that benefits, costs and burdens are properly shared amongst all network users (consumers and producers). Moreover, no binding energy efficiency requirements should hamper participation of industrial consumers to the flexibility market.

3 Energy transition requires a supporting regulatory environment

A successful transition to a carbon neutral future requires a competitive industry in a realistic, balanced and integrated regulatory environment. This also applies for the energy environment, where industry always supported the European Commission's work on further liberalization of energy markets, creating more competitiveness and security of supply. Industry needs support of the European Commission and Member States to cover the so-called 'valley of death' period, going from the existing reality to the future envisaged situation. The main goal is GHG reduction, for which there are different routes available. Derivative regulations or measures should not hamper the motive and goal. Neither should regulatory support lead to market distortions and endanger competitiveness of the energy markets. This chapter aims to summarize the challenges and barriers.[1] Economic growth, a favourable investment climate and a level playing field are prerequisites for R&D and investments in sustainable technologies and products. This also applies for technologies like hydrogen production including temporary storage of CO_2 and developing re-use options for CO_2 in consumer products and fuels (CCU).

A close and structured dialogue and cooperation between EU Commission and the industry- and energy sector must be established to investigate and propose a regulatory and commercial framework that Europe needs to deliver the increasing demand for carbon neutral, secure and globally competitive energy (working groups, common studies, etc.). Moreover, IFIEC Europe looks forward to work together with European sector federations in developing different roadmaps towards decarbonisation. Each sector has the best view on the potential of their respective activities.

There are different pathways to GHG reduction. Either way, industry will play a pivotal role in the transition towards a carbon neutral society, both in its energy and feed stock consumption, and in the development of innovative sustainable technologies and products. From an energy demand perspective, industry must be able to be competitive in a secure and efficient climate neutral energy market (prices in coupled electricity and gas markets) and able and encouraged to deliver flexibility to energy markets. Flexibility is a partial answer to variable energy supply with cost implications.

The energy supply and demand will change dramatically as a result of the growing share of (renewable) electricity and the changing energy production locations in Europe. Consequently, the system costs will rise and supply and demand will be imbalanced in an increasing number of hours a year, leading to flexibility, security of supply and affordability issues that have to be addressed. Innovation and responsibility in the market to honour contracts for delivery for suppliers using intermittent energy are necessary complements and leverages for flexibility are necessary to create a future proof and integrated energy system.

[1] For an extensive list of regulatory barriers, see: Annex I

Key Recommendations

The following key recommendations for policy changes and further study are needed to enable industry to fulfil its key position in the transition to climate neutrality:

Carbon Neutral Energy

A. *Assess how much more energy is needed "when and where" and remove conflicting regulatory policies*: The assessment should look into how much energy is needed, where it is coming from, how to displace it over time, at what cost and how this interacts with an EED energy usage cap;

Innovation and Support

B. *Competitiveness safeguarded by optimal flex selection and cost allocation, affordable for end-consumers*: a clear and predictable strategy to safeguard industries competitiveness using several measures, including a transparent assessment of the total indicated system cost for end-consumers deriving from the energy transition, cost allocation and a cost comparison between flexibility options. State Aid Guidelines have to take into account EU's global competitiveness rather than be limited to a level playing field within the EU;

C. *Financial support to breakthrough or immature technologies* must not be limited to technology innovation support, but also cover scale ups and the market entry of new products and applications to bridge the so-called 'valley of death';

Efficient markets

D. *Impact of new infrastructure on industrial consumers: assessment of the consequences and requirements from an integrated system approach and the consequences for industrial consumers (increasing capacity, congestion, decentralization adaption, costs);*

E. *Optimal mix of electrons and molecules* in creating a demand-driven energy and raw materials policy. Assessment of the optimal mix of low carbon electrons and molecules;

F. *CCS and CCU regulatory barrier removal*: removal of innovation hurdles regarding CCU and CCS in the Monitoring and Reporting Regulation, ETS and CCS Directive.

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IFIEC Europe
International Federation of Industrial Energy Consumers
Av. Louise 250, box 80 | 1050 Brussels
www.ifieceurope.org | ifieceurope@ifieceurope.org | Phone: +32 888 52 69
a.i.s.b.l. NI 436 343 513 | VAT: BE 0436.343.513 | EU Transparency Register: 1978775156-31

Annex I: Regulatory challenges and barriers for industry

Annex I.1. Carbon Neutral Energy: More energy required for transition

In its Long Term Climate Vision, the EC concludes that the share of electricity in final energy demand will at least double by 2050, whilst the electricity production is expected to increase at least 35 percent more by 2050[2]. This is even an underestimation compared to other studies such as McKinsey[3] or Dechema[4]. Transition challenges are:

- Making hydrogen or other products from (low carbon) electricity requires much more energy at times and location where it is not produced. Issue: EED caps absolute energy usage, transporting when and where it is needed;
- Storing energy, hydrogen, heat due to intermittency (electricity) requires more energy. Issue: EED caps absolute energy usage;
- CCS requires much energy to compress CO_2 and transport it. Issue: EED caps absolute energy usage.

Regulatory adjustment and barrier removal needed:

a. An objective and integral assessment of the total final energy demand (electricity and gas, and possibly other energy carriers e.g. heat and hydrogen). This should include an assessment of transition technologies that lead to further increase of the energy demand.
b. Energy efficiency is vital for a cost-efficient transition and to ensure availability of limited carbon neutral resources, but the regulation must not limit economic growth and lead to carbon leakage by industry moving out of Europe to regions with low or no climate policies.

Annex I.2. Innovation and Support: Safeguard competitiveness for successful GHG reduction

The effective opportunity for European industry is to be a driving player and to enable energy transition while maintaining competitiveness. This depends on many settlement factors. Transition challenges are:

- Higher volatility of energy prices, growing infrastructure costs and non-global CO_2-costs.
- As the European industry needs to develop disruptive innovations, it needs a supporting environment. Only in a symbiotic energy and industrial transition, a low carbon future can be successful.
- Liberal energy markets are not a given fact in all EU Member States, whilst market liberalization is a condition to create and develop competitive technology routes.
- The consequences of the rising share of renewables (electricity) on the energy system and industrial competitiveness are not always placed in a global perspective, as well as cost reflectiveness (supply-demand transformation: energy consumption level triggered by price signals) and its effect on markets and competitiveness.

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[2] The electricity share will be 53% of the final energy demand.
See: European Commission (2018): A Clean Planet for all, A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy.

[3] McKinsey foresees a multiplication of electricity needs for industry (from 2000 TWh for BAU to x4 to 9 times). The EC foresees an increase form 3000 TWh (EU-wide) to 4800 TWh in the electrification scenario. The 1.5-scenarios there only foresee an increase to 4000 TWh.

[4] Dechema (2017): Technology Study: Low carbon energy and feedstock for the European chemical industry.

- EU ETS is more ambitious than similar systems in the world, and therefore must allow adequate provisions to protect most exposed industries to unequal international competition.

Regulatory adjustment and barrier removal needed:

a. There is a need to have harmonized market rules. New technologies require a regulatory framework for innovation, but overall these interventions may not lead to market distortions. Flexibility in response to subsidies for (inflexible) technologies is not a cost-efficient solution.
b. More visibility for market actors on the amount of flexibility available at specific times and its location (via digital infrastructures, i.e. smart grids and smart meters) and protocols for sharing information;
c. Price signals for flexibility should reflect the value of the flexibility in the system (more price variation);
d. Balancing responsibility needs to be assigned clearly;
e. The system for carbon leakage protection under the EU ETS for sectors facing international competition must be improved. There should be no discrimination in free allocation for direct emissions and compensation for CO_2 cost impacts in the power price (indirect cost). The marginal price must set the compensation as these are available in the interconnected market.

Furthermore, IFIEC Europe would like to underline the vital importance of research and development into innovative solutions and technologies leading to energy production with lower or no GHG emissions and/or compensation for or absorption of these emissions.

Annex I.3. Innovation and Support: Support for investments in (immature) GHG reduction technologies

Considerable investments will be required, in order to meet rising energy needs and to match industry's baseload demand in a secure manner. Transition challenges are e.g.:

- Different technologies (e.g. electric boilers) are sensitive for electricity prices and are therefore expensive and risky.

Regulatory support and barrier removal needed:

a. Removing interference in the energy market (phasing out of operational subsidies). An innovation framework is needed to immature technologies to reduce the risk of investors, but costs must not be passed on to trade-exposed industries which cannot pass on extra costs in their product prices.
b. A study to analyse if/how the increasing demand for carbon neutral electricity can be delivered at global competitive terms for industrial consumers.
c. Regulation must adapt to increased flexibility of production within economic potential. Flexibility is not an option for structural backup of intermittent electricity, but it can alleviate the need for storage and hence contribute to cost efficiency. Cost optimisation in a (partial) shift from electricity producing facilities towards capacity in industry to absorb variable production must be taken into account.

Annex I.4. Efficient Markets: Infrastructure required for changing energy system

To support cross-sector integration we need a proper energy infrastructure for the changing energy system, including increased infrastructure capacities (electricity). Transition challenges are:

- Infrastructural adaption is needed for energy conversion (hydrogen) and CCS and because of (de)centralizing of energy generation, resulting in locational challenges.
- Consumers that have to make long term technology innovations to reduce GHG (e.g. Power-to-Heat, hydrogen) need a sound and sufficient infrastructure network to reduce the risk.

Regulatory adjustment and barrier removal needed:

a. Infrastructure costs linked to increased decentralized injection and cost-allocation to all net users, including producers, taxation, administrative burden;
b. Complexity thresholds: access to information, access to de-risk strategies and tools; access regarding (flex)market and supply;
c. Competitive grid tariffs are needed to support innovations that reduce GHG (eg. CHP).
d. Overall, an assessment of State Aid regime is needed to enable energy intensive industry's transition in the low-carbon transition, and must allow full compensation of extra charges, and to be protected for increases in grid tariffs. This should look into what is needed for an appropriate market design that enables cost-efficient use of resources in generation, demand and infrastructure and sufficient investment signals at acceptable risk level.
e. A solution to quick start the production of economic viable hydrogen is by cracking natural gas via Steam Methane Reforming (post combustion) or Auto Thermal Reforming (pre-combustion) and capture and store the CO2 in empty gas fields (blue hydrogen).

Annex I.5. Efficient Markets: Technology neutrality is necessary for an optimal decarbonisation route

Various options should be treated non-discriminatory. This requires a technology neutral approach for a given low carbon investment or a given flexibility service (i.e. for a given timeframe). Transition challenge: We are looking at decarbonisation over a 30-year horizon. It is not clear whether further deployment of renewables will be the most effective or the most efficient way to achieve GHG reduction, especially with intermittent renewables for electricity generation and the necessary back-up to cope with periods of over- and undersupply. IFIEC Europe sees different possible routes to achieve GHG reduction:

- The further deployment of low carbon energy sources, with existing (demand response, flexible generation units, storage) as well as new sources of flexibility (power-to-X, new types of storage: hydrogen, ammonia) for providing the necessary back-up capacity for coping with intermittency;
- Investments in nuclear technology (extensions of existing plants as well as 3rd and 4th generation reactors, Small Modular Reactors, nuclear fusion);
- Investments in geothermic energy;
- Development of CCS and CCU.

Regulatory support and barrier removal needed:

a. Looking at <u>all</u> existing technologies is a must, as well as underlining the importance of stimulating R&D into new technologies;

b. Interference of the energy sector with the heat and transport sectors can also be part of the solution, as electrification might be one of the ways to decarbonise these sectors too.

Annex I.6. Efficient Markets: Removal of innovation hurdles for GHG reduction in ETS

Transitional challenges:

a. Lack of recognition in ETS/MRR of CO_2 emissions avoidance resulting from the utilisation of CO_2 as a carbon source for the production of chemicals.
b. Lack of recognition in the ETS/ MRR of CO_2 emissions avoidance resulting from the use of CCU fuels.
c. Transition from gas to electric boilers should not lead to removal of free ETS allowances.
d. CCS for underground storage do not get ETS credit if not transported by pipeline nor CCS into materials.

Regulatory support and barrier removal needed:

a. There should be an equal treatment for CCS also in case the CO2 is not transported by pipeline or CO_2 is built into materials.
b. Recognition in the ETS/ MRR of emissions avoidance resulting from the use of CCU fuels.
c. Recognition of emissions avoidance resulting from the utilisation of CO_2 as a carbon source for the production of chemicals in ETS/MRR
d. Direct allocation should be given for heat consumption from electric boilers, as is given for other heat sources.