European Copper Institute
Copper Alliance

Leonardo ENERGY

LONG-TERM DECARBONISATION IN EUROPE – A COPPER INDUSTRY PERSPECTIVE

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1. THE COPPER INDUSTRY AND THE PARIS AGREEMENT

In signing the COP21 Paris Agreement (The United Nations Framework Convention on Climate Change) in 2016 **the EU fully recognised the urgency of mitigating climate change**. As a Party to the Agreement it committed to holding "*the increase in the global average temperature to well below 2°C above pre-industrial levels"*.

The EU has adopted the role of trailblazer, stimulating other regions around the world to follow in its path. In its Intended Nationally Determined Contribution (INDC) submitted to the Climate Change Convention in March 2015, it translated the Agreement into a binding target of at least a 40% reduction in greenhouse gas emissions by 2030 and an 80-90% reduction by 2050, compared to 1990 levels. In the meantime a goal of 100% climate neutrality by 2050 has been suggested by various EU stakeholders. A similar goal has already been adopted independently by Denmark and Sweden.

The copper industry acknowledges the far-sighted direction the EU is taking on climate change mitigation and believes it can play a key role in making it happen.

Five important aspects of the Paris Agreement:

- Articles 7.4: Climate change mitigation is preferred in order to minimize the costs of adaptation. Or, put simply: **prevention will be less expensive than dealing with the consequences**. Climate change mitigation is therefore considered to be an economically sound direction in the long term.

- Article 4.1: **The sooner, the better**. It is not only the final target of carbon neutrality that counts, but also the path leading to this goal. Parties to the Agreement aim *"to undertake rapid reductions in accordance with best available science"*.

- Article 10: The main **focus should be on technological development and innovation.** "*Accelerating, encouraging and enabling innovation is critical for an effective, long-term global response to climate change."*

- Article 2.1c: **Finance flows should be made consistent** "*with a pathway towards low greenhouse gas emissions and climate-resilient development*".

- Articles 2.1b and 5.1: Actions should be taken **in a manner that does not threaten food production, nor forest conservation and proliferation**. This means that bio energy can play a role but one that is limited by these restrictions. More concentrated energy sources (with a higher Net Energy Gain) are needed, which typically require large capital investment.

The European Copper Institute (ECI) **will continue to play an active role in carrying out Article 12 of the Paris Agreement** ("*to enhance climate change education, training, public awareness, public participation and public access to information"*). Through its Leonardo Energy and DecarbEurope initiatives it is providing sustainable energy professionals and policy makers with knowledge and tools to manage the energy transition. Leonardo Energy was set up in 2004 as a platform to connect energy technologies, policies and markets. The DecarbEurope platform was created in 2017 to engage decision-makers with concrete and cost-effective decarbonisation solutions.

To take on this key role, however, **the European copper industry must be in a position to maintain its competitiveness in the global market.**

2. COPPER AND THE ENERGY TRANSITION

The energy transition, essential for a profound decarbonisation of the economy, **already benefits from a broad range of cost-effective solutions**, comprising both technological and behavioural actions. Regulators play a key role in removing barriers to accelerate adopting these solutions, which can buy time for applications that involve more radical innovation. **Effective support for developing disruptive technologies and guiding them to market maturity** will be necessary if we are to have a full spectrum of decarbonisation solutions to hand in the medium and long terms.

No matter how the mix of solutions will look in 30 years, it is already becoming clear that there will need to be **a shift from a largely fuel-based energy economy with high running costs to one that relies primarily on capital investment**, for example in renewable energy systems and energy efficient end-use equipment. With this comes a different kind of planning and risk, but also the opportunity to make the European economy more self-sufficient.

A significant share of the capital will be invested in materials, among which copper will be a key element thanks to its excellent electrical and thermal conductivity. For the European copper industry, the energy transition is therefore seen as **a particularly close convergence of business opportunity and public interest**.

With materials complementing green fuels as the new cornerstones of the economy, care should be taken to **avoid any new inessential import dependencies**.

Hence the importance of **the circular economy** is set to increase. Materials already in use should be viewed as constituting an "urban mine" and should be re-used or recycled wherever possible. Aside from its importance for Europe's level of autocracy, this is also one of the major principles of a truly sustainable economy. More on this topic in Chapter 6.

A second important concern is **to maintain the international competitiveness of Europe's material industry**. Keeping this industry on the continent is not just important for its role in the EU economy and labour market, but even more so because we rely on it to build our decarbonised, highly self-sufficient energy future. The copper industry has calculated that the energy transition, as currently projected by the EU, would require an additional 20 to 25 million tonnes of copper in the lead-up to 2050. The challenge will be to produce the major part of this copper in Europe, where the industry asserts high sustainability standards, while also taking targeted steps to decarbonise its production.

The European copper industry is already implementing a range of solutions to reduce its own energy-related carbon emissions. It is, however, a mature and energy-intensive industry with powerful international competition. There is no fundamental barrier to decarbonising copper production, but it requires radical innovation and investment that comes at a cost. If the industry had to bear the full cost of this before any careful consideration of the issues at play, this could compromise its competitiveness on the global market with ultimately an adverse effect on the final goal of decarbonisation.

The copper industry is currently responsible for generating approximately 0.1% of GHG emissions in the EU, but the industry also provides the essential material for solutions aimed at decarbonising the processes responsible for the other 99.9%.

3. AN AMBITIOUS BUT BALANCED PLAN

There is an inherent contradiction in developing a European policy framework for far-reaching decarbonisation. On the one hand, we should press on as quickly as possible, since speed can buy us time (PA Article 4.1). But, on the other hand, it is such a massive undertaking, with so many complex market mechanisms involved, that we should go prudently if we want the transition to succeed at all. And even more so **if we want it to succeed without compromising the welfare of our citizens or the competitiveness of our industry.**

To make the exercise even more complex, other objectives must also be kept in mind to avoid negative intersection with other salient issues. These include various aspects of environmental protection, as well as energy and resource efficiency. Policies need to balance all these objectives. **Regulations and finance flows should be compatible** at least, and preferably work in tandem to achieve their goals (PA Article 2.1c). When diverse regulations affect the same product or process, this can lead to challenging trade-offs. What if an environmental policy leads to higher energy consumption? What if a highly-efficient electric motor requires rare earth metals? Innovations aiming to eliminate such dilemmas could be encouraged.

On climate change mitigation, the trajectory leading up to 2050 is just as important as the 2050 target itself. **Decarbonising faster in the next few years will consume the remaining carbon budget at a slower pace**, which would allow us to take more time for the later, more challenging and most expensive stages of the decarbonisation process. Harvesting the low-hanging fruit of the most cost-effective solutions already available today is an obvious step. However, something that is beneficial for the economy as a whole isn't necessarily beneficial for every stakeholder involved. An imbalance in the distribution of benefits can create barriers in the value chain. Policy and regulation can remove these barriers to create stable regulatory and market conditions that foster long-term investment.

On the **longer term trajectory, aiming to propel Europe towards carbon neutrality**, the changes are so radical, and the market mechanisms so complex, that **we need a plan that is well thought through in every respect**, with appropriate consideration for all the affected sectors. Our biggest challenge will be to co-ordinate energy market design, innovation policies, carbon pricing and carbon taxation to create the right investment and innovation climate in the medium and longer term.

A challenge for policy and regulation is to reach a level of sophistication that reflects the reality and diversity in the field without growing excessively complex. Among other realities, they should **recognise that sectors and regions are at different stages of their decarbonisation journey**, with different qualities and challenges (PA Article 2.2). Sectors that can move faster should not be restrained as they innovate and invest. Policies, incentives and taxation regimes for these sectors need to be increasingly devised with a focus on decarbonisation. Historic actions should also be taken into account; early movers on decarbonisation who currently face diminishing returns should be rewarded, not penalised. Any sector or region lagging behind should be helped to engage in the energy transition.

Energy and climate costs form 20-70% of the cost of doing business in energy-intensive industries. Appropriate mechanisms should be put in place to protect these exposed sectors. The decarbonisation rate in other major economies should be closely monitored, among other actions, and **potential carbon leakage resulting from uneven decarbonisation burdens between regions should be tackled**. Ideally, carbon pricing as well as the entire decarbonisation trajectory could be coordinated across regions, and especially with other OECD regions. A closer link between ETS and non-ETS sectors can buy time for ETS sectors to develop and implement disruptive solutions and improve the cost-effectiveness of the energy transition.

4. SOLUTIONS ARE AVAILABLE TODAY

Most of the energy transition can be achieved through solutions that are on hand today. They are market-ready and can be rapidly and cost-effectively scaled up to provide a substantial contribution to decarbonisation. Together they can decarbonise selected sectors of the EU economy by a factor of between 5 and 10. Any long-term decarbonisation strategy could **pursue all the currently-available cost-effective options** (PA Article 10) and still preserve the international competitiveness of the EU economy.

DecarbEurope engages policy and industry decision-makers with these solutions. It was launched by the European Copper Institute in 2017 and is supported by a growing number of partners. An ecosystem of 20 sectors, the initiative connects technologies, policies, and markets with a cross-sector roadmap to move towards a low-carbon economy (PA Article 12). DecarbEurope partners are committed to five common values:

- **Deep decarbonisation**: only solutions that have the potential to add up are considered.
- **Cost-effectiveness**: only pursuing solutions that compete in the market on merit. The minimum life-cycle costing principle should guide each policy design.
- **Circularity**: in the transition from a fossil fuel-based to a carbon neutral energy system, products and systems should be designed to be durable, easy to repair and highly-recyclable.
- **Sector coupling**: the existing boundaries between economic sectors often hamper the development of innovative solutions. More space should be given to integrated energy systems. This can be achieved through a range of vectors including bioenergy, cogeneration, digitalization, district heating, electrification and hydrogen.
- **Consumer engagement**: just as the boundaries between sectors will blur, so will the boundary between consumers and producers. Consumers should have full access to energy markets, while green power purchase agreements, long-term agreements and peer-to-peer energy transactions should be fostered.

Systems thinking is also built in to the initiative. It is not the contributions of individual components or products that count, but those of entire systems delivering particular services or functionalities.

Further information, including the 20 sectors covered by the initiative, can be found on the DecarbEurope website (www.decarbeurope.org).

5. DEVELOPING THE SOLUTIONS OF TOMORROW

The cost-effective solutions available to us today will take us a long way but, to build an entirely carbon-neutral economy, radical breakthroughs will be needed. This is especially the case if we want to achieve the full promise of the energy transition without the EU economy and citizen well-being paying a high cost. Innovation does not happen overnight. Achieving the necessary breakthroughs in the next 30 years demands **the creation of a favourable innovation climate today** (PA Article 10).

Since the kind of innovation that is required works over the long-term and benefits society at large, it will not be sufficient to rely purely on markets to provide the necessary initiatives. The use of public funds for innovation can be justified to mitigate financial risk, to facilitate economically affordability of later phases of the energy transition and to avoid some of the high costs related to climate change adaptation (PA Article 7.4). In view of this, **expanding financial support for innovation in decarbonisation technologies** can be seen as a sound investment of public resources. This can be achieved through prioritisation and enforcement of existing support mechanisms, such as Horizon Europe and the Innovation Fund. Once breakthrough technologies become market ripe, they will need **dedicated support to stimulate first movers**. This will often require additional *ad hoc* measures and new, tailored mechanisms to be successful.

In addition to technological innovation, **social and market innovation** is equally important to stimulate the adoption of new energy technologies in the energy transition.

Placing an emphasis on **cross-sectoral research** is equally crucial, since the energy economy is inextricably linked with many other sectors. Moreover, the boundaries between the various segments of the energy sector itself will need to be crossed if successful innovation is to be developed. The following are examples of transversal innovation areas that could be developed in support of EU decarbonisation:

1. **Direct electrification**. The processes for industrial heating of materials are still largely based on fossil fuels. Using electricity for process heating means rethinking factories and developing new processes.

2. **Indirect electrification through synthetic gases and fuels**. New processes could be developed, for example based on electricity as the heat source and synthetic hydrogen as a reducing agent. Synthetic gases produced from renewable electricity could also be used in long-haul transport systems or in seasonal storage solutions.

3. **Recycling**. Improved recycling rates bring a double advantage: reducing energy consumption in production processes and reducing the EU's dependence on raw material imports (see also chapter 6).

4. **Energy efficiency improvements**. Energy efficiency remains a moving target. Even if today all major efficiency improvements seem already to be implemented, this situation could look very different tomorrow. Rising energy decarbonisation costs could make previously unprofitable efficiency improvements economically-viable. Technological evolution could also create new opportunities or improve the cost-efficiency of existing solutions.

5. **Social innovation through new business models**. Innovative business models can create new opportunities. They could facilitate a systems approach combining human behaviour factors with automation technology to harvest the maximum from energy efficient products and subsystems. Electricity Demand Response is a good example of such new business models.

6. THE ROLE OF THE EU COPPER INDUSTRY

COPPER AS A STRATEGIC MATERIAL

The copper sector is part of the energy-intensive industry and is therefore greatly impacted by energy and climate regulation. At the same time, copper is a strategic material making the energy transition happen. Because of its excellent electrical conductivity it plays a vital role in most decarbonisation solutions.

Electricity as an energy carrier is expected to grow markedly in importance since it can be generated from a wide variety of carbon-free energy sources. It has the additional advantage that it does not generate local emissions, comes with highly-efficient end-use applications and is easy to control digitally. **The need for copper will grow alongside this progressive electrification.** Copper facilitates the production of renewable electricity as well as the electrification of transport, heating and cooling. It is also a key material in battery production. Moreover, increasing the cross-section of electrical conductors reduces the energy losses, which is the reason why energy efficient electrical connections and appliances are generally more copper intensive.

Consequently, the energy transition will require an estimated 20-25 million tonnes of additional copper by 2050, representing roughly six years of EU copper demand based on current figures, or an additional annual growth of 15%.

Given this strategic role for copper, three important questions arise:

1. Will there be enough copper available to support the energy transition?
2. Can copper production decarbonise and grow at the same time?
3. Can we maintain a competitive copper industry in the EU?

IS THERE ENOUGH COPPER? COPPER IN THE CIRCULAR ECONOMY

One of the major advantages of copper is its excellent recyclability. The pure copper used for most electrical conductors becomes high grade scrap at its end of life, which means that it can be recycled without downgrading, substantially reducing its life-cycle carbon footprint. Even where copper is alloyed, or contains impurities, recycling is still possible and efficient. Unlike with some other metals, these foreign elements can be removed so that the copper can be recuperated in a pure state, ready to be re-used in any kind of application. Thanks to this high degree of recyclability, the stock of copper in use in electrical applications is not lost. An estimated two-thirds of the copper produced since 1900 is still in productive use. This enormous stock of copper, in its diverse range of end uses, is often referred to as the “urban mine”.

The production path from pure copper scrap to a copper end product (secondary copper) requires less energy and results in lower carbon emissions than the path from copper ore to a copper end product (primary copper). However, there are two caveats to this statement.

First, this is only true if the entire production path is considered. The energy used to produce copper concentrate from copper ore at the mining site needs to be added to the calculation. When considering manufacture only, the smelting and refining of copper concentrates (primary copper production) requires less energy than the smelting and refining of copper scrap (secondary copper production). This means that for copper manufacturing companies, higher recycling rates result in higher energy consumption. These companies should not be penalised for this, if the goal is to stimulate recycling.

Second, the above statement is true when starting from pure copper scrap. An increasing number of products, however, contain a complex mix of various metals, including a minor share of copper. Due to the difficulty of separating all these materials, recycling could in such cases increase instead of reduce the life cycle energy use

and associated carbon emissions. Recycling could nevertheless still be worthwhile for resource efficiency and the recovery of valuable materials.

Such complex metal mixes, often seen in electronic devices or batteries, are usually recycled by the copper industry. Secondary copper can therefore be called a carrier metal for many critical and valuable materials needed for the energy transition. The same is true for primary copper: the refining process starting from copper ore also yields a variety of valuable metals as byproducts.

The EU is a world leader in copper recycling. In 2015, 61% of European end-of-life copper was recycled, while copper scrap made up 47% of the source material for the production of new copper. **By stimulating the circular economy, the EU could further drive up copper recycling figures.** This would have the double advantage of reducing the energy consumption of copper production as well as Europe's dependence on copper ore imports. More than half of the copper source material originating from mining currently comes from outside the EU (2015 figure).

Primary and secondary copper production are complementary in assuring sufficient copper supply. Because the energy transition will make copper demand grow, the mining of copper ore has to fill the gap between the availability of recycled material and total demand. Globally **there is enough copper available to do so**. According to the US Geological Survey, since 1950, reports have regularly shown that there have always been, on average, 40 years of copper reserves and over 200 years of resources available worldwide. This is because short term supply limitations resulting in upward price trends have been an incentive to explore new deposits.

CAN COPPER PRODUCTION DECARBONISE?

The copper industry has reduced its GHG emissions substantially in the past 20 years, mainly through energy efficiency improvements. **It is now using the best-available techniques to minimise energy consumption.** The industry is currently reviewing eleven solutions to further reduce its energy-related emissions, such as maximising recycled content, corporate purchasing of carbon-free electricity, and making further incremental improvements to the copper production process.

The only way to further and more drastically decarbonise copper production will be through **changing the energy carrier used in the smelting process**. The fossil fuels used today will have to be replaced by electricity or hydrogen from renewable sources. Without careful thought, however, this could compromise energy efficiency. Developing cost-effective, energy efficient and decarbonised alternatives to this process may only be possible with the help of major technological innovations. In a highly competitive international market, **the cost involved in these kinds of innovations may be too far-reaching to be carried by the industry alone**.

CAN WE MAINTAIN A COMPETITIVE COPPER INDUSTRY IN EUROPE?

A market and policy framework that supports the kind of industrial innovation described above will be required to achieve a deep decarbonisation while at the same time maintaining the industry's competitiveness relative to parts of the world with less-stringent or slower-moving decarbonisation policies. **Maintaining a domestic copper industry** is particularly important since copper is an essential part of many technologies crucial to the energy transition, such as electric vehicles, batteries, wind turbines and PV systems.

To maintain a copper industry in Europe, and ensure payback for long term public-private investments in the energy transition, **action should be considered to combat the import of copper from countries with less stringent GHG emission reduction policies (carbon leakage).** Imports should only be considered from countries with similar energy and climate objectives as the EU, or revised trade rules could be proposed to make appropriate adjustments for significant discrepancies.

7. WHAT WE STAND FOR AND WHAT WE CALL ON THE EU TO CONSIDER

WHAT WE CALL ON THE EU TO CONSIDER

1. **Timely removal of barriers to cost-effective decarbonisation measures already available**. The faster we are able to decarbonise in the next few years, the more time we buy to successfully navigate the later most challenging stages of the energy transition.

2. **An ambitious but balanced decarbonisation plan leading up to 2050**. The intersection with other environmental and economic regulations should be carefully evaluated to develop coherent policies that determine a well-considered balance between all the different objectives, such as climate change mitigation, welfare protection, economic sustainability, environmental protection, and energy and resource efficiency.

3. **Policies appropriate to the complexity of the economic landscape.** These should take account of the economic and technological particularities of each sector and the fact that sectors and regions are at different stages of their decarbonisation journey.

4. **Vital financial support for innovation in decarbonisation technologies**. The emphasis should be on cross-sectoral research, as well as on research to decarbonise the energy-intensive metal industries. Mechanisms to stimulate first movers and market innovation should also receive attention.

5. **Recognizing the strategic role of copper and maintaining the competitiveness of the EU copper industry**. The shift from fossil fuels to a carbon-neutral economy will need investment in materials. Copper will be a key element because of its excellent electrical conductivity. It will take on an importance not very far from that of oil in the old energy economy.

WHAT WE STAND FOR

1. **We fully support the EU in taking the lead in the energy transition**, to reduce GHG emissions further than the world average, and to set up an ambitious decarbonisation trajectory up to 2050.

2. **We will continue our own efforts to decarbonise copper production.** The industry is already using the best-available techniques to minimise energy consumption and has put forward an evolving plan including eleven solutions to further reduce carbon emissions. We are keen to extract the very best value from any public support dedicated to innovating and decarbonising copper smelting.

3. **We are proud to be producing a key material for the energy transition** facilitating GHG emission reductions in numerous other sectors, from renewable energy systems, through energy efficient end-use appliances to electrified transport, heating and cooling systems.

4. **We want to play a key role in developing a circular economy**. The energy systems of the future should be durable, easy to repair and highly-recyclable. Copper has excellent recyclability because, among other reasons, it is mostly used in its pure state. Improving recycling rates brings the double advantage of reduced life-cycle energy consumption and reduced dependency on raw material imports. The

industry also contributes to resource efficiency because copper is a carrier metal for many critical and valuable metals needed in the energy transition.

5. Through the Leonardo Energy and DecarbEurope initiatives **we will continue to fully engage with the recommendation in Article 12 of the Paris Agreement**: "*to enhance climate change education, training, public awareness, public participation and public access to information"*.

About European Copper Institute

The European Copper Institute (ECI)—founded in 1996 and based in Brussels—coordinates a team of professionals based in offices across Europe. It works closely with its copper industry members on regulatory matters and market development programs. The ECI is part of the Copper Alliance™, which brings together the global copper industry to develop and defend markets for copper, and to make a positive contribution to society's sustainable development goals.