Orkestra
BASQUE INSTITUTE OF COMPETITIVENESS
DEUSTO FOUNDATION

EXECUTIVE SUMMARY
CUADERNOS ORKESTRA
02/2021
ISSN 2340-7638

ENERGY EFFICIENCY IN THE INDUSTRIAL SECTOR

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2021

Executive Summary. Cuadernos Orkestra 02/2021

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The author would like to thank Joan Manuel Fernández Mendoza and Salvador Acha Izquierdo for their collaboration and their comments and suggestions after reviewing a draft of the document.

EXECUTIVE SUMMARY

Energy efficiency will be a key driver in the coming years of the energy transition and the decarbonization of the industrial sector

The need to achieve ambitious greenhouse gas (GHG) emissions reduction targets worldwide in the medium term increases the **importance of energy efficiency as a key lever for achieving a sustainable energy system in the long run** and, in particular, for fostering the decarbonization of the industrial sector, especially where alternatives such as the electrification of energy consumption are less applicable.

Thus, energy efficiency has gone from being the "hidden fuel" to **the "first fuel" of the energy transition**, and there is some consensus that decarbonization of the industrial sector will require a combination of three types of solutions: (a) a widespread increase in energy efficiency; (b) an increase in renewable energy penetration; and (c) the development of new, clean technologies (e.g., advanced electric batteries, CO_2 capture, storage and utilization solutions, hydrogen technologies, synthetic fuels and bioenergy).

The concept of energy efficiency includes technical and economic efficiency, environmental impact and other non-energy benefits

Traditionally, the concept of energy efficiency has been interpreted from a technical (input-output ratio) or economic point of view (using energy in the most cost-efficient way to produce goods and services). Nowadays, however, the concept is **understood from a more general standpoint, incorporating environmental impact** (reduction of greenhouse gas emissions) or improved security of supply into the analysis.

Energy efficiency is thus seen as another instrument for achieving **competitive advantages (linked to productivity gains)** and, at the same time, as a tool for **advancing in the process of decarbonization** of the industrial sector.

Energy efficiency investments in the industrial sector generate multiple economic and environmental benefits

Energy efficiency improvements in the industry will generate a positive impact on the environment and on the economy (both from a macroeconomic and microeconomic viewpoint), as well as several additional "non-energy" benefits, including positive social impacts related to the reduction of energy poverty and improved access to energy:

- On the **environmental side**, available empirical evidence suggests that potential energy savings and reductions in CO_2 emissions can exceed 10% (and even 20%) in most industrial sectors.
- At the **macroeconomic level**, the available evidence (from academic and international energy institutions) suggests that the impact of investments in energy efficiency in

terms of GDP and employment will be significant in the medium term (horizon 2030). This has led to improvements of energy efficiency in industry being one of the objectives and key pillars of the European Green Deal and of the post-Covid 19 European Union (EU) economic recovery strategy.

- At the **microeconomic level**, there is an impact on the productivity of industrial companies, especially in the most energy-intensive sectors, such as the iron and steel sectors. Improvements in competitiveness are related to technological innovation, the implementation of digital solutions, the use of new materials in production processes and non-technological innovation.
- Finally, **non-energy benefits** include improved comfort and safety conditions in workplaces, (positive) health implications, reputational benefits and reduced legal and commercial risks for companies.

In addition, there exist mature technological solutions that can significantly improve energy efficiency in the industrial sector in the near future

Investments in energy efficiency in the industrial sector can focus on the replacement or adaptation and upgrading of physical equipment, the development of new production and operational processes, new energy sources or better use of materials in production processes. In all these areas, **there are mature and commercially available technologies and technological solutions** that can facilitate the materialization of significant levels of energy efficiency gains.

Among the technologies that can offer the highest return on investment (ratio of efficiency gains to payback time) are integral process control systems and smart meters, which facilitate optimization of energy use, gas flow monitoring systems and high-efficiency burners.

Investments in energy management systems and equipment that optimize combustion processes, heat utilization and gas recovery are also cost-effective. Other investments, such as advanced control systems with automatic speed adjustment (in pumps, fans, motors, etc.) also generate significant efficiency gains in different industrial sectors, although they usually have longer payback periods.

However, despite the technological alternatives and the economic and environmental benefits, the levels of investment in energy efficiency in industry are lower than expected

Despite the existence of mature and commercially available technologies, there is **not a sufficient level of investment in energy efficiency by the most energy-intensive and GHG-emitting industrial companies**, even though in many cases the investments may be financially feasible and sound. The difference between the actual level of energy efficiency investment and the estimated theoretical optimal level is called the “energy efficiency gap”.

The **causes of the energy efficiency gap and a lower rate of adoption of more efficient technologies are varied**. Among them can be mentioned: (1) market failures (e.g., asymmetric information, externalities, prices based on average costs, liquidity constraints or failures in innovation markets linked to information diffusion, etc.); (2) factors related to the behavior of agents (lack of attention, myopia, bounded rationality, heuristic decision methods, systematic biases in views on markets and technologies, etc.); (3) modeling and measurement errors (e.g., incorrect assumptions about costs, usage profiles, product attributes or consumer characteristics, use of incorrect discount rates, irreversibility, the value of the option to wait, etc.).

In order to overcome the so-called "energy efficiency gap", four technological, financial and regulatory challenges will have to be resolved in the coming years

Challenge 1. Boosting R&D activities related to new fuels and new clean and efficient technologies

The decarbonization of the industrial sector will require technological developments and innovation (technological and non-technological) to facilitate the required transformations in production processes. In order to understand where to focus the innovation efforts, it should be considered that:

- Most **emissions in the industrial sector are concentrated in a few energy-intensive sectors** (iron and steel, non-ferrous metals -e.g., aluminum-, chemicals and petrochemicals, and non-metallic minerals, such as cement).
- The **most cost-effective solutions have already been implemented** in many sectors (e.g., process control systems, energy management systems, optimization of low- and medium-temperature heat processes).
- **Energy efficiency solutions in the industrial sector are very sector-specific**, due to the heterogeneity in production processes.
- Fossil **fuel substitution, CO_2 capture, storage and use, and the use of high-temperature waste heat are the most promising ways to reduce emissions** in the most energy-intensive sectors.
- Other promising solutions are the **development of new materials** (e.g., in the cement sector), the use of **renewable hydrogen** (in the chemical and petrochemical sectors and in the heavy industry), **new electrical equipment** (e.g., electric arc furnaces) or the use of **biofuels** (in all sectors).
- Combustion **processes that give rise to process heat, specific industrial processes or other activities** during the life cycle of industrial products (e.g., fugitive emissions of solvents, lubricants, incineration of plastics, etc.) **are also areas of emission reductions**.

Challenge 2: Development of new financing schemes and products for energy efficiency investments

Overcoming the energy efficiency gap requires **ensuring that industrial companies can access financial resources and instruments** to carry out investments in more energy-efficient projects and activities. Creating a **favorable financing context** for these investments can be achieved in several ways:

- An adequate framework for **assessing the impact of energy efficiency projects** will help mobilize public and private resources, as the implications of investment projects can be better identified and evaluated.
- **Mitigating or reducing the credit risk of companies** will help to boost investments, through new guarantee schemes (e.g., guarantees offered by public administrations or specialized institutions, such as Elkargi in the Basque Country), new insurance schemes guaranteeing certain levels of energy efficiency gains or new risk-hedging instruments.
- **Innovative financing solutions based on aggregation schemes** can facilitate the matching between demand and supply of funds to finance energy efficiency projects. This can take place through project aggregators or entities that centralize information on supply and demand at different levels (regional, national markets…).
- **Innovation in financing instruments** (new financial products and services) in the area of sustainable or green investments is growing very rapidly in recent years and will also be a driver for investments in energy efficiency.

Challenge 3: Updating policy and regulatory frameworks

Traditional policy and regulatory measures (e.g., related to energy audits, smart meters, energy management systems, economic and fiscal incentives, white certificates, eco-labeling, etc.) **will not be sufficient to decarbonize the industrial sector** at the required speed.

New investment promotion programs should **build on the elements that work in current schemes and innovate in the area of incentive schemes** by: (1) significantly scaling up existing programs to maximize impact in the short term; (2) incentivizing the adoption of commercially mature and easily implementable technologies and solutions (e. g., plug-and-play equipment); (3) standardizing contracts and technology solutions, (4) reducing administrative barriers; or (5) boosting circular economy solutions (waste reduction, reuse of materials, etc.).

In addition, it will be optimal to **use a set of varied instruments** that take into account the heterogeneity of processes and technologies in the industrial sector, such as tax incentives, auctions, equipment renewal programs, efficiency standards, etc., and to **align R&D strategies with energy and environmental objectives, taking into account local realities**.

On the other hand, the effectiveness of the programs and efficiency in terms of costs must be ensured. Thus, the **prioritization and allocation of available public and private resources must take into account the expected profitability** (economic and environmental) of the investments.

Finally, **there are synergies with other new technologies, especially ICTs**, both at the technological level (automation solutions, AI, etc.) and at the normative-regulatory level (e.g., the use of blockchain can increase the efficiency of white certificate schemes and reduce implementation costs).

Challenge 4: Non-technological innovation, new processes and new business models

Investments in energy efficiency (clean technologies and renewable energies, digital solutions to optimize processes and efficient use of materials and energy) open the door to the **adaptation of value propositions and business models in multiple dimensions**, including: (1) the development of more circular industrial processes and new forms of internal firm organization; (2) the reordering of value chains and new B2B and B2C cooperation schemes; (3) the servitization of assets (e.g., rental of industrial machines operated and maintained by third parties); (4) innovation in products and services related to the massive use of data and analytical tools and to greater sustainability (or smaller environmental footprint); or (5) the generation of new knowledge and new capabilities linked to the development of so-called "industry 4.0" (automation, artificial intelligence, etc.).

All these areas of innovation pave the way for the **development of competitive advantages for industrial companies** related to more efficient forms of operation and more sustainable products and services, in line with the European industrial strategy approved within the framework of the European Green Deal.

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