

When we started the task of coordinating this special issue a year and a half ago, the environmental challenge had already been placed at the center of the economic debate in the European Union (EU). The European Green Deal, published in December 2019, proposed a strategy for economic growth and competitiveness for the UE, focused on environmental sustainability (European Commission, 2019).

The coronavirus crisis raised fears that the focus on environmental sustainability would lose weight, given the sanitary emergency and the severity of the subsequent economic crisis. Despite this, the European Commission maintained the European Green Deal as one of the pillars of the economic recovery plan, with areas such as clean energy, efficient and low-emissions industry and sustainable mobility being drivers of GDP growth, employment and competitiveness in the European Union in the coming years.

In this context, we present this special issue of *Ekonomiaz-Revista Vasca de Economía*, which aims to explore some relevant issues within the wide-ranging process known as «energy transition» and to analyze potential implications for the Basque Country.

The energy transition

The main objective of the process of transformation of the energy system into a sustainable energy system in the long term, known as energy transition (Grubler, 2012), is to drastically reduce greenhouse gas (GHG) emissions associated with this sector --about 73% of global emissions (Ritchie, 2020). While in the past there was a tendency to identify the energy transition with the shift of the energy production and distribution system into a «clean» one, nowadays the concept of energy transition implies the transformation of the entire economy into a sustainable, net-zero emissions economy, including changes on the energy demand side as well.

In the long run, this transformation will have a very significant impact on the organization and functioning of all economic sectors and activities (production, distribution and consumption of raw materials, including energy, and of all goods and services), on economic growth (Fankhauser and Jotzo, 2018), on the competitiveness of firms (Zhang, 2019) and on the well-being of the population (TNO, n.d).

Energy transition processes in Europe are entering a new phase, after a stage (which can be dated between the approval of the «20-20-20 targets» in 2007 and 2020) in which substantial progress has been made in transforming the electricity

generation mix towards a cleaner system and the technological and commercial maturity of certain renewable sources (wind and photovoltaic, mainly) has increased.

The current phase of the energy transition process necessarily involves not only continuing to significantly increase the penetration of renewable energies in the energy matrix, but also moving rapidly towards greater electrification and decarbonization of final energy consumption and substantially improving energy efficiency throughout the economy. The new stage of the energy transition will be characterized by the irruption, deployment and interaction of multiple innovative technologies (hydrogen, carbon capture, use and storage, renewable gases, efficient synthetic fuels, etc.), the decline of conventional generation technologies (e.g., coal), tensions between different actors involved in the transformation and the reconfiguration of many sectors and value chains in the economy (Markard, 2018). Uncertainties also arise, for example, regarding the future of nuclear power or the role of natural gas as the «bridge fuel» of the energy transition.

The broad scope of the energy transition process

The need to achieve a zero-net-emissions energy sector and economy means that energy and climate policy are now inseparable. In this sense, the whole set of energy policies of the Basque Country (and Spain) are closely related to the energy and climate strategy of the EU. This, in turn, responds to the commitments made through the Paris Agreement of December 2015, which obliges the signatory countries to implement the necessary transformations to limit the increase in the global temperature of the planet to 2 °C (and, if possible, to 1.5 °C).

The energy policy objectives of the EU are based on principles that have been embraced for more than two decades, when the first electricity and natural gas directives were adopted: to achieve clean energy for all Europeans while maintaining the security of supply and the competitiveness of the economy. These principles were embodied in the «20-20-20 targets» regarding GHG emission reductions, renewable energy penetration and energy efficiency, and have been maintained in the Clean Energy Package (or «winter package»), the main pieces of legislation of which were adopted in 2018. For 2030, the EU has set ambitious quantitative targets for these three variables (emissions, renewables and energy efficiency). Meeting these goals will entail radical changes in energy systems across Europe.

The target for the year 2050 is even more ambitious: the EU aims to achieve a net-zero emissions economy by that date and has included this milestone in the so-called European Climate Law.

The implementation of this energy-climate strategy will lead to very significant changes on the energy demand side. Over the next three decades, the emphasis of the fight against climate change will focus on transforming the way energy is consumed in sectors of the economy such as transport, industry, buildings or agriculture, for example, where the process of large-scale decarbonization has not yet begun in earnest.

In addition, consumers will take on a more active role in the energy system and energy markets than they have thus far, being able to act as producers with the capacity to manage energy through storage (either stationary or mobile, using for instance, the batteries of electric vehicles).

Success factors and tools

The success of this energy transition process will depend on the evolution and interaction of multiple variables. There is no single solution or standard set of tools to solve the challenge of achieving a zero net emissions economy (Grillitsch and Hansen, 2019; Mattes *et al.*, 2015).

For example, the relative passivity of many economic agents (who will have to be active protagonists of the transformation) towards the changes in the making, will have to be countered with information and awareness campaigns (Niamir and Filatova, 2016).

The graduality of the measures, based on a clear roadmap that has its first implications in the immediate future, will facilitate the transformation of activities, companies and production chains without jeopardizing the sources of value and wealth creation in the economy.

On the other hand, the development of innovative financing mechanisms for the necessary investments in clean and efficient technologies and new support schemes for the creation of companies and new business models will become very important in the coming years. New forms of financing based on public-private partnership schemes, on «green and sustainable financing» by banks and other investors, on green bonds or on project finance schemes by green investment funds (Lamperti *et al.*, 2019), will maximize the multiplier potential of public investment incentives and facilitate investments by smaller companies. This issue will be particularly relevant in the short term, in order to maximize the opportunities that will be generated by the diffusion of financing funds within the NextGenerationEU program.

Strong support for start-ups that champion new business models through incubator and acceleration vehicles, the promotion of business angel networks, etc., and new collaboration schemes in R&D will be tools that will help to increase the value of technological and research capabilities through an effective transfer of knowledge to industrial companies.

A reform of energy and environmental taxation should be backed to induce the technological and behavioral changes that are required to make significant progress in decarbonization and achieve long-term economic, social and environmental sustainability. These changes must guarantee at the same time the fiscal balance of the different layers of government in the short, medium and long run.

The need to increase specialized human capital in areas related to the energy transition (e.g., through specialized technical study programs in energy, circular

economy, data analysis and management, new materials, electronics, statistics, etc.) must also be addressed (Orkestra, 2019).

This broad process also raises the need to deal with issues related to the specific territories in which it is to be carried out. Although the goal of the energy transition is global, the main transformations will take place at more local levels (e.g., regions, counties or municipalities). In each territory, the transformation will have to be tailored by protecting and fostering its economic and social strengths, taking advantage of opportunities to develop sustainable competitive advantages, and ensuring an equitable transformation for all economic sectors and segments of the population most affected by this change (Calvert, 2016; Newell and Mulvaney, 2013; Köhler *et al.*, 2019).

The challenge of the Basque Country for 2021-2030

In the case of the Basque Country, for example, the specificities related to its orography, history and economic structure, the typology of the business fabric and the socio-political and institutional environment must all be taken into account when assessing the opportunities and threats posed by the energy transition process.

The ultimate objective is to carry out the transformation of the Basque energy system, ensuring at the same time that, with an energy-intensive industry and relatively scarce natural resources, energy is available at a competitive cost and with reduced environmental impact. In addition, the bases of competitiveness of the Basque economy, closely related to the strengths of the industrial sector, must be protected. Finally, all agents and institutions must be efficiently engaged in the process in order to exploit synergies and common interests in a coordinated manner and achieve the desired results in terms of increased social well-being. The challenge of the energy transition for the Basque Country, therefore, is threefold: (a) energy-environmental; (b) techno-industrial; and (c) of governance.

In order to face this triple challenge, a Basque law on energy transition and climate change is being drafted at the time of writing these lines, which will establish the bases of a legislative framework that should favor the achievement of energy and environmental objectives, the materialization of advances in R&D in energy and sustainability activities and the consolidation of a technological and industrial policy that is coherent with the strengths of the Basque economy and with the strategic objectives pursued by the Basque Country. In this context, a review of the Basque Energy Strategy 2030 (EVE, 2017) is also planned, which will be framed within the new Basque Strategic Plan for Energy Transition and Climate Change.

The new legislative and strategic energy planning framework, together with the Basque Country 2030 Agenda, the 2019 Energy Sustainability Law and other government strategies (e.g., the 2030 Circular Economy Strategy and the various initiatives within each Historical Territory and the Basque municipalities), will make it possible to integrate and align all relevant policies (industrial, educational, energy, environmental, etc.) with the common goal of improving the competitiveness of the

Basque economy and the sustainability of the economic and energy model in the medium and long term.

The environmental challenge

The decarbonization of industry and the transport sector is a major challenge for the Basque Country. Although GHG emissions in the Basque economy have been considerably reduced since 2000, reaching the 2030 emissions targets -a reduction of about 3 Mt of CO₂, in line with the Basque Government's adherence to the 2015 Paris Agreement (Basque Government, 2016)- and energy efficiency goals will require a profound transformation of the Basque energy matrix.

This will require an increase in the penetration of renewable power generation technologies (mainly onshore and offshore wind and solar photovoltaic) and a significant advance in the electrification of the economy. However, the potential additional penetration of renewable energy is limited in the Basque Country, due to orographic factors and the existence of limited meteorological resources (wind and solar radiation) (IDAE, 2011; Sancho *et al.*, 2012).

Natural gas will remain a relevant source of flexibility for the electricity system, providing a back-up for the penetration of renewable energies until storage and demand management capacity increase. All this will require the transformation of energy grids into smart grids, with the capacity to integrate new distributed energy resources and, especially, storage devices and electric vehicles.

On the consumption side, solutions and technologies with low or zero GHG emissions will have to be deployed in sectors such as industry or transport, responsible for 64% of total emissions in the Basque Country in 2017 (Basque Government, 2020). This is a very ambitious challenge for the Basque industry, which is energy intensive (using mainly electricity and natural gas). A commitment must be made to keep on advancing in the electrification of consumption and the use of new energy vectors, such as hydrogen, and more efficient fuels with low emissions (e.g., green gases or e-fuels).

In the industrial sector, technological innovation in low-emissions equipment and energy storage (with a special focus on the use of high- and medium-temperature waste heat) and the development of new solutions for storing and utilizing CO₂, for example, will be key levers to boost decarbonization.

In addition, the process of decarbonizing energy consumption in the residential and buildings sectors must be accelerated. In these cases, the trends observed in the European context point to an increase in the use of electrical energy (e.g., heat pumps) and renewable energy in uses such as air conditioning or the development of innovative communal solutions where possible (district heating).

It will also be key in this process to significantly increase efficiency in the use of material and energy resources in the manufacturing and heavy industry sectors. Im-

improvements in energy efficiency (in all sectors) should be promoted, both technologically (new energy and process management systems, etc.) and through the deployment of new consumption models (self-consumption, energy communities, etc.) and the development of the circular economy should be fostered (especially in the industrial sector, where eco-design, recycling, the use of new efficient materials and the application of new processes for the reutilization of materials, remanufacturing or maintenance can lead to major economic gains).

Given the possibility that the environmental objectives set for the 2030 horizon will not be achieved in the Basque Country, it also seems necessary to explore the feasibility of using alternative compliance tools and options, such as increasing energy interconnections or using carbon sinks and the flexibility provided by the compensation mechanisms in the Paris Agreement (Schneider *et al.*, 2020).

The technological and industrial challenge

In parallel to the environmental challenge, the Basque Country will have to implement a technological and industrial policy that, leveraging the strengths of the Basque economy, will make it possible to exploit economic opportunities, both in terms of the development of new sources of sustainable competitiveness in different areas of the economy and the creation of employment or in terms of increased welfare of citizens.

These strengths have been developed in sectors that are key to the energy transition; e.g., value chains such as electrical grids, power electronics, renewable energy, oil & gas, automotive components and other booming and emerging sectors, such as electrical energy storage, digitalization and industry 4.0 services, circular economy or technologies related to electric mobility (Álvaro & Fernández, 2019). The specialization of many Basque companies in integrating different technologies (digitization, clean technologies, storage, etc.) and in developing and implementing high-value-added energy solutions in different industrial sectors is another source of strength.

Technological and industrial policy in the coming years should be oriented towards fostering the development of new business models based on the digitization of equipment and processes, servitization of assets, promotion of technological and non-technological innovation within firms and a focus on data analysis and management to develop new solutions and services for customers.

In addition, the transformation of traditionally powerful sectors in the Basque Country, such as oil & gas or automotive components, should be supported by providing incentives to reorient them towards the creation of value in products, services and activities more aligned with the energy transition (e.g. hydrogen, biofuels, new efficient and low-emission petroleum products, renewable gases or alternative fuels in transportation, in the case of oil & gas, and technologies for the deployment of electric mobility, electric battery components and associated services, etc., in the case of the automotive sector).

In short, the Basque Country can become a «reference, state-of-the-art lab» in areas of the energy transition such as smart energy networks (electricity and natural gas), energy storage, circular economy, electric mobility and energy vectors such as hydrogen. In this sense, the commitment to developing the hydrogen economy being made by Basque economic agents and institutions (i.e., the so-called Basque Hydrogen Corridor and other initiatives) seems like a way to implement collaborative projects of a strategic nature and with a great impact on different value chains.

To this end, it will be essential to continue supporting the entire spectrum of R&D activities, especially at the highest levels of technological maturity (TRL) and close to the commercialization of solutions that efficiently contribute to reducing CO₂ emissions (IEA, 2020) due to their impact on the productivity and competitiveness of the Basque economy and their potential capacity to generate «first-mover advantages» in different activity niches related to the energy transition and where sustainable competitive advantages can be developed (Karkatsoulis *et al.*, 2016).

The energy and environmental challenges faced by the Basque energy sector also represent an opportunity for other sectors of the Basque economy to grow, through collaboration in technological innovation, cross-company cooperation and the identification of new business opportunities in converging value chains (e.g., oil & gas and hydrogen, electricity grids and distributed energy resources or energy networks, storage and electric mobility).

The challenge of governance

A transformation of the magnitude of the said transition to a zero net emissions economy requires strong social, business and institutional support and an efficient governance scheme.

Achieving the support and guaranteeing the commitment of society and of economic and institutional agents to the energy transition process is essential for it to be successful, since the transformation needed to achieve the objectives set will require a profound change in the behavior of all economic agents and will render asymmetrical impacts between economic sectors (and within the same sectors) and also between segments of the population.

Cases such as Germany, France or the United Kingdom show the importance of maintaining social support for the energy transition process through a high level of awareness, information on the benefits of the transition for society as a whole, transparency in the process and compensation schemes for those segments of the population and economic sectors at risk (e.g., derived from energy poverty or «carbon leakage»).

To minimize the negative effects of potential conflicts between value chains or between companies with substantially different business positioning, objectives and plans should be established to highlight synergies and complementarities between activities. The measures with the greatest impact should be adopted as soon as possible

to favor a gradual transition to the new energy system. This will allow economic agents to carry out the changes necessary to remain competitive at the minimum cost.

A certain degree of coordination and interaction between energy policy, industrial policy and environmental policy must also be achieved, since the transformation that the productive fabric of the Basque Country will undergo in the coming years will define the basis for the competitiveness of the Basque economy over the coming decades. The German example shows how economic, industrial and innovation policies can be reoriented towards the promotion and consolidation of leadership in energy technologies with low or zero emissions, while generating economic growth around sustainable activities.

The new impetus to the energy transition offers an opportunity to advance in the efficiency of the energy-environmental governance model in the Basque Country. This will be achieved through well-identified, defined and measurable objectives, a clear planning/roadmap, a concrete definition of the role of the different institutions and agents in the process of implementation, monitoring, etc., including specific mandates to key government agencies, mechanisms for monitoring and supervision and continuous review of the planning and schemes to ensure compliance with the objectives set.

The vertical or multilevel governance of the process should be based on the identification of the roles of the different governments and entities and on the development of a collaboration framework to facilitate raising capital to promote the necessary investments. This will require the articulation of vertical coordination bodies/fora with the participation of the Basque Government, the Provincial Councils and, especially, the counties and municipalities.

Horizontally, all stakeholders must commit to the objectives of the process and to the different strategies and plans, including the Basque sustainability agenda (Agenda Euskadi 2030). Multi-agent and intersectoral coordination bodies or fora should also be articulated around strategic priorities related to the energy transition, the adaptation to climate change and the transformation of the economy into one with zero net emissions.

About the contents of this special issue

This issue includes eight academic articles, accompanied by two policy letters, which deal with relevant issues of the energy transition and paint a more complete picture of the implications of the energy transition process for the Basque Country.

Besides analyzing the economic impact of the energy transition, general aspects related to levers that boost positive impacts and facilitate the transformation are addressed (specialization strategies, governance, financing), as well as other specific issues, such as sustainability strategies by companies or the development of distributed energy resources.

The breadth, depth and complexity of this transformation make it impossible for this special issue to cover all relevant areas and issues within the energy transition. Among the issues not addressed explicitly in this monograph, even if in some cases mentions are made, are, for example, energy policy and regulation, the geopolitics of energy, new technological developments or the fairness and balance of the transformation processes (the so-called «just transition»).

In the first article, **Luz Dary Beltrán** and **M. Carmen Delgado** assess the positive economic impact of investments made as part of the energy transition strategy in the Basque Country, in terms of production, GDP and employment, using multisectoral models based on the Social Accounting Matrix of the Basque Country.

Mari Jose Aranguren, **James Wilson** and **Edurne Magro** analyze how the Smart Specialization Strategy (RIS3) and the innovation policies of the Basque Country offer a framework to materialize the opportunities of the energy transition, incorporating the element of environmental sustainability in energy and climate strategies and policies.

Thomas Hoppe reflects on what lessons can be learned from the process of developing a new governance of the energy transition at the regional level, based on an analysis of the case of the Netherlands, where a governance model is being structured at an intermediate level between the state and the municipal level.

A group of researchers from **DeustoTech**, **Deusto Business School**, **Tecnalia**, **EVE**, **Clúster de la Energía** and the **Bilbao City Council** reflect, based on the experience of a pilot project for the development of positive energy districts in Bilbao, on how to articulate bottom-up governance schemes that facilitate energy transformation in urban spaces.

Jorge Fernández and **Macarena Larrea** analyze the role of regional governments as drivers of efficient green finance ecosystems that act as a lever to facilitate investments in clean technologies and sustainable projects, pointing out the main implications for the Basque Country.

The need for economic agents to incorporate sustainability as an axis of action is dealt with in two articles. On the one hand, **Salvador Acha**, **Aitor Soler** and **Nilay Shah** identify the best practices for the reduction of CO₂ emissions in organizations with a high carbon footprint and explore the situation in the Basque Country.

On the other hand, **Jaime Menéndez**, **Jorge Fernández** and **Andrés Araujo** present a new framework for analyzing the sustainability strategies of oil & gas companies, applying it to the specific case of Petronor in the Basque Country.

Roberto Álvaro, **Jesús Fraile**, **Julia Merino** and **Sandra Castaño** analyze the impact of different regulation schemes for energy communities to facilitate the integration of renewable energy and electric vehicles and encourage the active participation of consumers.

In the final part of the special issue, **Henry Wang** reflects in a policy letter on how new climate change, renewable energy and carbon neutrality policies can lead to economic growth in an industrial economy such as the Basque one. **Jacques Le Cacheux**, in turn, analyzes the need to introduce a carbon tax adjustment at EU borders to protect the European industry during the process of transformation into a sustainable industry.

In addition to the articles and Policy Letters already mentioned and within the Special Section in this issue, **Mirene Begiristain**, **Enekoitz Etxezarreta**, **Jon Morandeira** and **Ariane Kareaga** propose a system of indicators to help and guide social and cooperative enterprises towards social transformation. The indicators have been developed in collaboration with members of the cooperative network Olatukoop (Red de Fomento de la Economía Social y Transformadora) involved, from a participatory action research perspective, in the development of the Koopfabrika program, which seeks to promote the social economy and cooperative entrepreneurship.

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