

TOWARDS
A CARBON
NEUTRAL
ECONOMY
HOW CAN
PORTUGAL'S
ECONOMY GROW
WHILE CREATING
EMPLOYMENT?

Portugal aspires to be carbon neutral by 2050. Companies need to prepare for this challenge, and therefore it is important to understand how 2030 might look. Achieving climate change commitments, together with economic growth and social equity, is essential.

This study advocates that energy efficiency can increase GDP, and it is possible to identify a set of technologies that can contribute to such an increase in Portuguese productivity. Nevertheless, to become carbon neutral, it will also be necessary to increase renewable energy penetration and improve carbon sequestration via a contribution from natural systems. Finance (from private and public sources) will be needed. Appropriate fiscal policies will be required, as well as new competences and skills. This represents a challenge for Portugal but also an opportunity. Let's think about the future and prepare Portugal for a sustainable and socially inclusive 4th Industrial Revolution.

MEET2030

BUSINESS, CLIMATE CHANGE
AND ECONOMIC GROWTH

COLLABORATING TO PREPARE FOR A CARBON NEUTRAL FUTURE

With a common purpose, several Portuguese companies have come together to create a vision of the future that is greater and far more complete than they would imagine in an isolated exercise.

MEET2030 was an experimental project, involving the direct cooperation of academics and around 30 companies, that established a common vision and several orientations about a future in 2030, targeting a 2050 carbon neutrality society in Portugal, while envisioning economic growth and competitiveness of the several sectors involved.

Today it is clearer than ever that we are in the midst of a technological and sustainable revolution. In this transition we need to secure continuous economic progress and growth while respecting and advancing on human rights, inclusiveness and reduction of global existing disparities. We also need to innovate, bring forward new services and products while addressing the limited resources on the planet and protecting the environment and its biodiversity.

The private sector has been called upon at the international forums to respond to the global challenges and has now an

increasingly open dialogue with the international structures and public entities. The business sector has been showing lead through commitments, projects and initiatives that are being implemented and that are actually shaping the low carbon transition and contributing to countries and international agendas.

However, we cannot yet identify all the challenges and opportunities that this transition entails for the business, but we can predict and estimate a possible future and reflect it in our corporate strategies, where our companies and people will thrive and contribute to address the main global challenges, such as climate change, and we can imagine it better if we do it together.

The project was a tall order and the report reveals the complexity involved, but the added value of having a vision on the future that arises from a unique collaborative exercise between sectors is outstanding.

António Mexia
President of BCSD Portugal

A COMMON VISION IN A COMPLEX CONTEXT

MEET2030 brought together companies of different sizes from different sectors, to imagine the future of Portugal in 2030 as it makes its transition towards a carbon neutral economy by 2050, the commitment made by the Portuguese government at COP 22 in Marrakesh. A shared vision, as set out in this report, was reached by these companies, working together in workshops using economic modelling and scenario planning.

The modelling revealed that increasing energy efficiency is a key driver of economic growth: a 1% increase in energy efficiency leads to a 2% increase in GDP. In addition, it concluded that electrification, automation, digitalization and the circular (bio) economy, the hallmarks of a sustainable fourth industrial revolution, will be the key drivers of economic growth in the drive towards decarbonisation.

However, the combination of the growth in GDP and in energy efficiency leads to an increase in primary energy consumption. The appropriate energy mix required to meet this demand has to be carefully identified and targeted in order to ensure carbon neutrality by 2050.

With that goal in mind, MEET 2030 identified, in particular, the need to encourage renewable sources of energy, thus helping to decarbonise electricity generation, improve air quality and broaden customer choice, and to increase carbon sequestration coupled to multiple environmental benefits, to be achieved by increasing the area of responsibly managed forests, forestry and agriculture products, as well as via technological solutions. Natural

gas will also be a required part of the energy mix in order to guarantee energy security.

To achieve all of this, a strengthened, consistent and transparent carbon price mechanism should be established at the EU and worldwide levels. Government investment should target Research & Development projects to develop low carbon technologies at the pre-commercial phase. Public policies should be neutral in relation to the technologies in question, to encourage competition, innovation and a market for low carbon solutions.

In order to achieve an inclusive, carbon neutral economy by 2050 in Portugal, based on innovation, new business solutions and partnerships, identifying the green and e-skills needed to support this transition will be crucial, and, in particular, understanding how existing skills can be adapted and new skills developed to deal with this new reality and avoid the potential unemployment generated by automation.

EXECUTIVE SUMMARY

THE RELEVANCE

Under the Paris Climate Change Agreement, countries have agreed to achieve a carbon neutral economy as early as possible in the second half of the XXI century. The Portuguese Government has committed to achieving carbon neutrality by 2050 in Portugal. It is therefore important to imagine the changes that such a commitment may bring to the Portuguese economy, so that companies can anticipate these changes and adapt to them during the transition period, and governments can identify and implement the public policies needed.

THE GOALS

The Goals of MEET 2030 were:

- To build scenarios for Portugal in 2030, against the background of a fourth industrial revolution, taking into consideration commitments made at national, European and worldwide levels, in order to achieve carbon neutrality. This was done by identifying one possible primary energy mix for 2030 that, in conjunction with carbon sequestration measures, would be compatible with a trajectory of CO₂ emissions achieving a low carbon economy by 2050, as defined by the Portuguese Environmental Agency (APA,2012).
- To identify potential new sectors of economic activity, innovation in products and processes, and the competitive advantage necessary to enable companies to maintain sustainable growth over the long term.

- To identify solutions with higher added value.
- To contribute to a policy and plan of action that can promote a transition to a carbon neutral economy in Portugal by 2050.

THE ECONOMIC MODEL USED

To understand how economic growth and job creation are possible in a carbon neutral economy, MEET2030 used the **exergy approach¹ to define the economic model that could lead to a trajectory aimed at carbon neutrality. In this model**, GDP is a function of labour, capital and the productivity of energy, i.e., exergy efficiency. This approach is significantly different from the mainstream economic model that is generally used, in which GDP is a function of labour, capital and an exogenous total factor productivity.

THE SCENARIOS DEVELOPMENT PROCESS

Using the exergy approach as a framework for the GDP growth model, MEET2030 was based on a scenario planning process, involving around 30 Portuguese companies, from 13 different sectors, representing approximately 20% of the nation's GDP², in four workshops over a period of 10 months, and involving several interactions with other organisations, such as the Portuguese Ministry of Environment, the APA, the Portuguese Energy Agency and the Secretary of State for

1. Ayres, R.U. and Warr, B. (2005).

2. Calculation: sum of turnover of participating companies divided by Portuguese GDP in 2016 (184,931 million € at current prices).

Industry. These companies, in a cooperatively constructive and bottom-up process, developed two potential scenarios that the economy could face through to 2030: *The Ostrich Scenario* and *the Iberian Lynx Scenario*.

The *Ostrich Scenario* describes a situation in which Portugal lags behind, in a world transformed by new developments in technology, the environment and energy. In this scenario of stagnation, Portugal manages to comply with the existing, less demanding requirements of the National Low-Carbon Roadmap, but with a fall in GDP. Portugal is becoming ever more peripheral in nature, becoming less attractive for investment. The banking system is unable to adequately support economic development, resulting in a fall in the country's stock of capital. There is an inability to align technological development and investments in science, technology and innovation with the great societal challenges that the country faces. Portugal is thus unable to attract and retain talent. At the same time, automation and the fact that there are fewer individuals working or actively searching for jobs contributes to high unemployment and to greater social unrest.

The *Iberian Lynx* is a scenario of high stability, growth and competitiveness, with significant EU economic growth, financial stabilization of the Portuguese economy and higher levels of investment. In this scenario, the recovery is based on strong cooperation between economic agents within the country and between Portugal and other countries. The banking system recovers and helps support economic development. The result is an increase in Portugal's stock of capital each year. There is an effective digitalization policy, with both a vision and goals, supported by a strong political commitment and close cooperation between agents, while coordination between Government policies and the needs of companies exist, in order to address new societal challenges. This leads to an ability to attract and retain talent and in a fall in unemployment rates.

THE MAIN SCENARIO OUTPUTS AND THE LYNX+ SCENARIO

The modelling pointed to GDP growth under *The Iberian Lynx* scenario producing higher GHG emissions than under *The Ostrich*, a situation which would not comply with the CO₂ limits defined under the most stringent scenario established by the APA (2012). This was mainly due to the fact that, under *The Iberian Lynx* scenario, the effect of exergy efficiency on economic growth is so large that the economy ends up with higher carbon emissions than under *The Ostrich* scenario. As a result, other policies, such as higher renewable penetration and higher carbon sequestration, are required.

Therefore, a derivative of the Lynx scenario, named *The Lynx+* Scenario, was created. Under this new scenario, participants in the workshops identified a possible primary energy mix for 2030 that, on the assumption of a strong carbon price and in conjunction with carbon sequestration measures, is compatible with a trajectory of reducing CO₂ emissions according to the most stringent scenario of the National Low Carbon Roadmap (APA, 2012).

As noted previously, this mix should be seen as a “proof of concept”, demonstrating the viability of the projected decarbonisation trajectory. Any other primary energy mix that enables the same objectives to be achieved, with the same or better economic and environmental performance (understood in a broad sense, taking into consideration both GHG emissions and other environmental issues), should also be considered for developing public policy.

MAIN CONCLUSIONS FOR ALL SCENARIOS

- Exergy efficiency is highly effective at promoting economic growth.
- Exergy efficiency alone is not enough to reach a carbon neutral economy, since the resulting economic growth results in increased primary energy consumption and hence potential additional CO₂ emissions.

MAIN CONCLUSIONS FOR THE LYNX+ SCENARIO

- Decarbonisation of the electricity system and of the primary energy mix, with an enhanced share of renewables, are key to achieving a low carbon economy and economic growth.
- Promoting carbon sequestration that provides multiple additional environmental benefits will be required.
- It is important to gradually adapt the competences and skills of the labour force (existing and future) to the needs of a low carbon economy, in the context of the disruption introduced by the automation that will be a feature of the fourth industrial revolution
- Additionally, in the transition to a low-carbon future and assuming a strong carbon price, coal is likely to be substituted. To ensure the energy security of supply, natural gas will offer an immediate and material opportunity to limit global emissions. The share of oil products in final energy decreases, but their absolute quantity remains roughly constant in the CO₂ low carbon compliance scenario.
- It was possible to identify a possible power generation mix for 2030 that, together with carbon sequestration measures, will be compatible with the trajectory of CO₂ achieving a low carbon economy by 2050. According to the assumptions made by participants in the project, the power sector mix in 2030 under the Lynx+ scenario will be primarily made up of renewables and natural gas, to total 98% of the mix.



PUBLIC POLICY GUIDELINES

Effective climate policy should have, as its long-term objective, the reduction of the risk of the serious impact of climate change on society and ecosystems, while recognizing the fact that abundant, reliable and affordable energy is a requirement to enhance economic growth and competitiveness. As such, Portuguese climate policies should:

- Be science-based;
- Support an effective and economy-wide common carbon pricing system, at least at an EU level (but ideally at a global level);
- Allow markets to drive the choice of solutions, adapting the market design, while supporting the development of pre-commercial phase low carbon technologies;
- Implement effective measures to address potential carbon leakage;
- Promote the concept of the life cycle to identify opportunities, maximize energy efficiency and minimize the carbon footprint and environmental impact of activities and products;
- Recognize the long-term nature of addressing the risks of climate change;
- Be transparent with all stakeholders, while minimizing complexity and administrative costs
- Address both mitigation and adaptation measures;
- Encourage global participation and cross sectoral cooperation.

In line with the main conclusions of the project and as a result of the active participation of several stakeholders during the various moments of interaction among participants, including workshops and meetings, the recommendations below were identified as being the most relevant for creating policy guidelines in different sectors.

TO IMPROVE DECARBONISATION

Taking into account the results of the model and its consequences, it is felt that higher levels of investment should be made in:

- Decarbonization of the electricity system (e.g., hydro, wind, solar, biomass and geothermal);
- Electrification and improvement of final-to-useful energy efficiency (e.g., motorway adaptation for automation and robotisation, and electric vehicles; information technology and engineering; demand-side management);
- Carbon sequestration projects;
- Enhancement of bio-economy activities.

For this investment to take place, project participants identified the following measures that could act as catalysts for this:

- Strengthen consistent and transparent carbon price mechanisms worldwide, in particular at an EU level,

which will encourage investment in innovation, employment and a shift towards a low carbon economy;

- Broaden the scope of the EU-ETS across economic sectors, which will lead to a greater effort by businesses to reduce their GHG emissions;
- Increase the level of investment made by Public and Private organisations in energy efficiency and in R&D on environment related technologies, by encouraging the development of research partnerships between European countries with similar challenges.

TO IMPROVE AGGREGATE EXERGY EFFICIENCY

One result from the exergy efficiency model used, is that it is possible to conclude that electrification is a key aspect to reach the level of efficiency in the economy. Furthermore, it also contributes towards decarbonisation, because the share of renewable energy in electricity is higher than in other energy sectors.

We therefore recommend:

- High levels of electrification in multiple sectors;
- Continued automation in industries and in other sectors (e.g., delivery and mailing services, domestic robots, etc.);
- Promoting efficient lighting technology and substitution of existing stock;
- Expanding the electricity capacity of the Portuguese power grid system.

SPECIFIC RECOMMENDATIONS FOR INDUSTRY

Resulting from the exergy efficiency approach model used	Resulting from inputs of the participants involved in the project
<ul style="list-style-type: none"> • Support for technologies that promote lower primary energy consumption (e.g. high efficiency cogeneration in industry). • Since electricity is the carrier with the highest final-to-useful efficiency (85%), one way to move into a significantly more energy efficient society is to substitute other energy carriers with electricity uses. This can be achieved by introducing new industrial sectors into the Portuguese economy as well as new forms of production. • The goal should be to increase the share of stationary mechanical drive uses. This increase could be achieved by introducing new technologies, such as replacing traditional heat uses by electricity (e.g., furnaces) and a big increase in automation and robotisation in industrial processes. The continuous automation of Industry can be done by replacing low temperature processes with more efficient uses and stabilizing high temperature category shares. 	<ul style="list-style-type: none"> • Implement efficient manufacturing practices and a general reduction in the use of materials. • Promote energy management certification. • There should be a strong policy in relation to the circular economy, namely the: <ul style="list-style-type: none"> - Mapping of inputs and outputs from each activity/industry with the aim of encouraging industrial symbiosis. - Development of green certification. - Provision of incentives for re-manufacture and re-use. - Encouragement of the use of waste/specific raw materials, and alternative fuels for energy production.

SPECIFIC RECOMMENDATIONS FOR ROAD TRANSPORT

Resulting from the exergy efficiency approach model used	Resulting from inputs of the participants involved in the project
<ul style="list-style-type: none"> Promote electric & hybrid vehicles. Promote the use of Natural Gas for vehicles, especially for heavy vehicles. Encourage the implementation of alternative business models (e.g., car-sharing). Increase and improve the infrastructure for electrical vehicle charging. 	<ul style="list-style-type: none"> Public and private partnerships to develop technologies and business models that can lead to lower transport carbon emissions, including the use of ICTs (Information and Communications Technologies), IoT (Internet of Things) and AI (Artificial Intelligence). Promote multi-modal transport systems and planning. Sustainable bio-fuels.

SPECIFIC RECOMMENDATIONS FOR RESIDENTIAL AND COMMERCIAL (SERVICES)

Resulting from the exergy efficiency approach model used	Resulting from inputs of the participants involved in the project
<ul style="list-style-type: none"> Increase the use of more efficient electricity-based heat pumps. 	<ul style="list-style-type: none"> Implement the Nearly Zero Energy Buildings directive; Implement a life cycle assessment approach to building construction; Develop incentives to stimulate the use of sustainable retrofitting and construction methods and materials.

TO INCREASE EMPLOYMENT

As a result of inputs from participants involved in the project and from the consultation process with other stakeholders, it became clear that “green” and “e-skills” are needed for a low carbon transition in Portugal. We therefore recommend:

- Regular assessment of the skills required by industry and discussion on how to adapt educational policy to these needs, especially for technical/professional education;
- Having an educational system in place that is more adaptable to the requirements of workers and industry. This includes: partnerships between business, universities and government; the development of business clusters; training and internships for school teachers companies; continuous innovation and flexibility in the educational system;
- Policies which target employment among the older generation and the population in rural areas. These segments tend to reduce competitiveness in the early stages of the shift towards the 4th industrial revolution, since, in the absence of specific policies to counteract the trend, new employment opportunities will target younger generations and urban areas;
- Policies to ensure that higher levels of employment are not achieved at the expense of “lower quality” jobs;
- Development of internal mechanisms by companies to attract and retain talent, in particular through better compensation policies.

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