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SECURITE ET TRANSITION ENERGETIQUE : POUR UNE NOUVELLE POLITIQUE INCLUSIVE ET ANTICIPATRICE

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Titre : **Rôle de l'efficacité énergétique des bâtiments dans la transition énergétique : principaux défis et perspectives**

Cette présentation aborde un sujet crucial qui a émergé dans la littérature politique et économique ces dernières années : le rôle potentiel de l'efficacité énergétique dans le processus actuel de transformation énergétique. Il fournit une analyse directe pour explorer le rôle prépondérant que l'efficacité énergétique des bâtiments peut jouer dans le façonnement de la transition énergétique et de la voie de la durabilité. Les concepts micro-économiques clés de l'efficacité énergétique sont au centre de cette analyse, à savoir le paradoxe de l'efficacité énergétique et les obstacles qui ralentissent l'investissement dans l'efficacité énergétique. D'un point de vue politique, le document souligne l'importance d'accélérer le processus de décarbonisation dans le secteur du bâtiment et suggère des pistes pour envisager une vision holistique des politiques d'efficacité énergétique dans le secteur du bâtiment.

Mots clés: Efficacité énergétique; Bâtiments; Transition énergétique

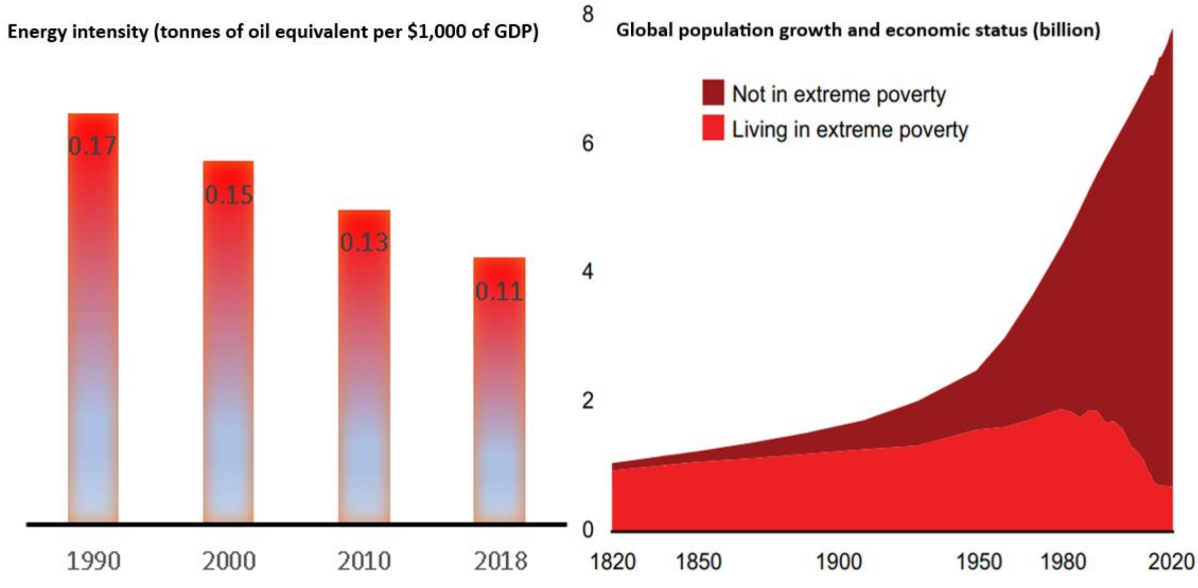
1. Introduction

In this presentation, I will discuss a crucial topic that has lately emerged both in the policymaking arena and scholarly literature: the potential role of energy efficiency in building in the current energy transformation process and climate mitigation agenda. **Specifically, I will discuss the topic from four dimensions: first:** I will discuss why is it important to focus on the energy efficiency of buildings while shaping the energy transition and sustainability path. **Second**, what are the barriers that stand in the way of large-scale deployment of energy efficiency in the sector? **Third**, I will highlight the Energy transition and EE journey in Algeria, and **finally** provide some policy recommendations to speed up the implementation of energy efficiency.

Currently, approximately 100 million barrels of oil are consumed globally per day. The world population grew from 3.8 to 7.7 billion between 1972 and 2019. During this period, annual energy demand per capita also rose from 57 to 75.7 gigajoules (GJ) (BP 2020). This consumption pattern highlights the accelerating pursuit of mass-energy usage and, consequently, energy demand across many developing economies. The contemporary global energy system has fueled this pathway and propagated it on a large scale. Nonetheless, the current global power system, while diverse in type, is still nearly uniform in terms of its carbon source.

Energy demand is increasing regardless of its source. Since the world's population is projected to expand by approximately two billion people over the next two decades, and as standards of living improve, electricity generation is expected to increase by 50% by 2040. The U.S. Energy Information Administration's (EIA's) recently released International Energy Outlook 2019 (EIA 2019) Reference Case expects global energy consumption to increase by nearly 50% from 2018 to 2050. It expects the bulk of this increase to originate from non-OECD countries, and to be driven by regions where strong economic growth is stimulating demand, particularly Asia. During this period, it expects the energy consumed in the buildings sector, encompassing residential and commercial buildings, to increase by 65%, from 91 quadrillion to about 139 quadrillion British thermal units (Btu). It expects this growth will be driven by a combination of rising incomes, urbanization, and increased access to electricity. We note that fossil fuels continue to largely dominate the current global energy mix, with a share of 80%. Even with a sustained high penetration rate of new technologies, the percentage of these alternative energies in primary energy generation will likely be less than 15-20% in the next two decades.

Figure 1. Energy intensity and global population growth



Sources: Authors using IEA (2020); Our World in data (2020) data.

Aware of the role that energy efficiency could play in accelerating the energy transition and meeting global climate and sustainability goals, several countries have adopted energy efficiency plans as an effective strategy to reduce the energy demand in different sectors (e.g., buildings, transportation, industry, etc.). Despite the considerable effort made by various countries, the potential to drive further energy savings is still immense. According to the International Energy Efficiency Market Report of 2014, roughly 70% of world energy consumption is not subject to mandatory efficiency standards targets (IEA, 2014).

Nowadays, energy efficiency investments seem to lag behind public policy objectives set by several countries. In the economic literature, this phenomenon is commonly referred to as the "energy efficiency gap" or "energy efficiency paradox." These terms describe a persistent and significant difference between socially optimal levels of energy efficiency investment - broadly defined as a substantial gap between levels of energy efficiency investment and actual investments made by individuals (Jaffe and Stavins 1994; Gerarden et al. 2015; Bakaloglou and Belaïd 2022). The underlying assumption of this analytical framework is that energy efficiency investments are not as attractive as theoretically expected due to the existence of barriers that prevent their large-scale diffusion. These barriers include market and behavioral failures (Gillingham and Palmer 2014).

Starting from this conjecture, this commentary provides a comprehensive overview of energy efficiency trends, with a significant focus on Algeria. Specifically, it will explore the role of residential energy efficiency in shaping the energy transition and sustainability goals. Further, based on the analysis, the commentary provides an integrated policy framework to accelerate and monitor the energy decarbonization process of the buildings sector. By so doing, this commentary will help facilitate a better understanding of the role of energy efficiency in addressing critical energy and environmental issues facing developing countries, particularly Algeria.

2. Energy efficiency in buildings: Huge untapped potential

The building and construction sectors combined are accountable for more than one-third of the world's final energy consumption and for nearly 40% of total direct and indirect carbon dioxide (CO_2) emissions (IEA 2021). Further, buildings use 25% of the world's water and 40% of the world's resources. This demand continues to grow, due principally to improved energy access in developing countries, increased ownership and use of energy-using devices, and the fast growth in building sizes worldwide (Belaid and Rault 2021).

According to a recent study by the International Energy Agency (IEA), direct and indirect emissions from electricity and commercial heat used in buildings reached 10 gigatonnes of CO_2 ($GtCO_2$) in 2019, the highest level ever recorded (IEA, 2020)). This represents about 28% of total global energy-related CO_2 emissions. If emissions from the building and construction sectors are included, this share reaches 38% of global energy-related greenhouse gas (GHG) emissions.

This increase was driven by multiple factors, including growing energy demand for heating and cooling, increased air conditioner (AC) ownership, and recent extreme climatic events (IEA 2021a). The recent BP Energy Outlook (BP 2020) states that the growth in energy use in buildings is entirely emanating from the developing world, as improvements in wealth and living standards enable people to live and work in greater comfort.

In 2018, the global residential sector solely consumed about 6008 terrawatthours (TWh) of electricity, with consistent growth over the last three decades (IEA 2021b). This growth is driven by different factors, but mainly the increase in the global population and, hence, demand for housing, rising living standards, and, arguably, global warming. From 2010 to 2019, for instance, residential energy consumption increased by more than 5%, adding more upward pressure on emissions, which grew by about 4% during this period. This residential energy consumption growth does not account for the building and construction sectors (UNEP 2020). This remarkable growth in energy consumption was driven mainly by appliances in which energy efficiency plays a critical role in determining their demand, including air conditioning systems, residential appliances, and lighting. The IEA estimates that the number of air conditioning units will increase from 1.93 to 5.58 billion units between 2020 and 2050 (Statista 2020).

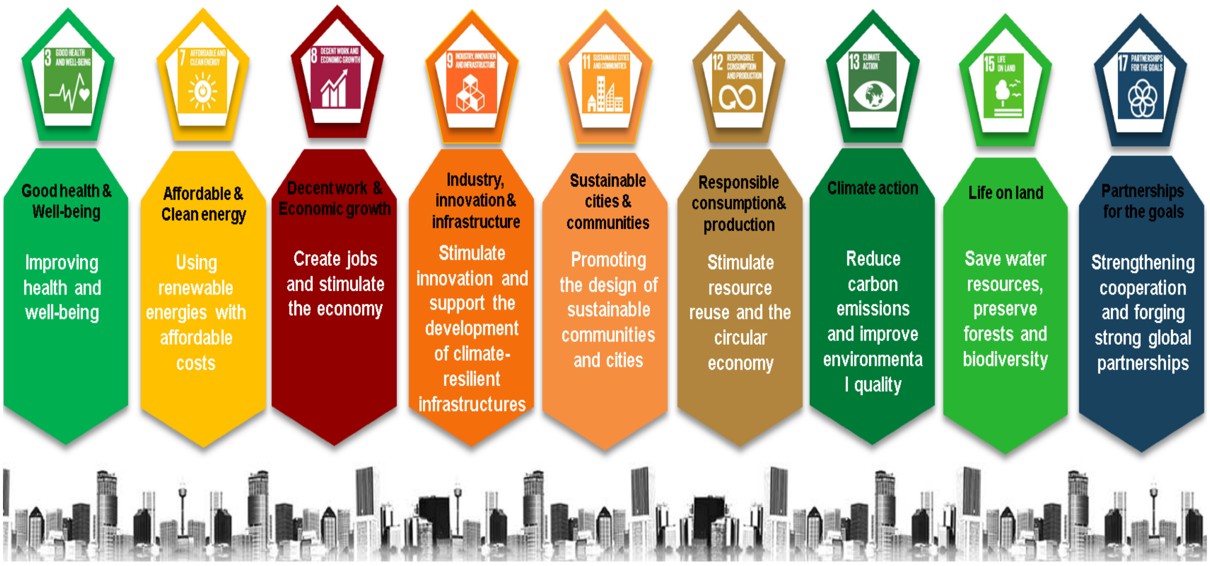
Nevertheless, buildings also have a tremendous potential to deliver cost-effective GHG emission reductions in both developed and developing countries. In addition, buildings' energy consumption can be lowered by 30%-80% using commercially available, mature technologies. It is generally agreed that enhancing energy efficiency in buildings will contribute to achieving the United Nations Sustainable Development Goals (Figure 2) and generate economic, environmental, and social benefits, among other advantages.

Arguably the most obvious potential benefits of energy efficiency investments are environmental, by reducing carbon emissions, improving environmental quality, and mitigating the effects of climate change. But EE can also improve welfare, reduce inequality, and stimulate economic diversification.

The economic benefits of energy efficiency investment are less obvious but prevalent. They include energy cost savings, job creation, and increasing property values. With more emphasis on energy efficiency measures, between 280 billion euros (€) and €410 billion in energy costs could be saved in the EU, equivalent to nearly twice the annual electricity consumption of the United States (European Commission 2015). Energy efficiency investment could create an average of 1.1 million net additional jobs by 2050.

Energy efficiency investment has the potential to 'knock two birds down with one stone' by fostering healthier environments and improving wellbeing. Energy-efficient homes tend to be warmer and less moldy than energy-inefficient homes. They also have better air quality. With healthier home environments, people will pay less for medical expenses, miss fewer days of work, and be more productive when they are at work. This would increase wellbeing while encouraging economic growth.

Figure 2. Contribution of buildings' decarbonization to the U.N. Sustainable Development Goals



Source: Authors, adapted from the World Green Building Council (2021)

Pressing agendas, including climate change mitigation, boosting the energy transition, and strengthening energy security, have put the residential sectors in many countries under the spotlight due to their substantial potential for energy savings (Lévy and Belaïd, 2019). This potential could be realized through investments in energy efficiency (Masson et al. 2015; Belaïd et al. 2019; Belaïd et al. 2020). Nevertheless, energy efficiency investments in the buildings sector appear to be lagging behind the public policy goals set by several countries (Bakaloglou and Belaïd 2022).

Building decarbonization initiatives globally are on a clear upward trajectory. However, they must accelerate in both scale and pace to meet the climate and sustainability goals of the Paris Agreement. These efforts are reflected, for example, in the World Green Building Council's Net Zero Carbon Buildings Commitment. It represents a global action network comprised of around 70 green building councils committed to transforming the building and construction sectors to achieve the goal of net-zero buildings operations by 2050. A second example of a global decarbonization initiative is the science-based target initiative for business, a joint partnership between CDP, the UN Global Compact, the World Resources Institute and the World Wide Fund for Nature. It federates approximately 1,000 companies committed to cutting carbon emissions beyond their own activities by including further indirect carbon emissions in their carbon mitigation plans.

Further, the European Union (EU) has emphasized its aim of becoming a world leader in energy efficiency and pushing pro-environmental agendas. Particularly influential initiatives include the Energy Performance of Buildings Directive (EPBD) and Energy Efficiency Directive (EED) (European Commission 2021). Both initiatives confirm the important role of the buildings sector in achieving the EU's energy efficiency target, as it accounts for about 40% of the EU's final energy consumption. According to the European Commission, the first priority in establishing the Energy Union is the full reinforcement and implementation of existing energy legislation. This Energy Union Strategy (COM/2015/080), published on 25 February 2015, is designed to build an unified energy system that provides EU consumers - both businesses and households - with reliable, sustainable, competitive and affordable energy (EU Commission, 2021). The key complementary goals of the EPBD are: (i) the stimulation of existing building renovation by 2050; and (ii) reinforcing the modernization of the entire existing dwelling stock by implementing smart technologies with a close link to clean mobility.

3. Why are we not obtaining the economically efficient level of energy efficiency?

Despite considerable promises and multiple benefits that building energy efficiency technologies can offer to both developed and developing countries, **there are many barriers that stand in the way of large-scale deployment of energy efficiency in the sector**.

This points to the so-called energy efficiency paradox, sometimes referred to as the "energy efficiency gap."- broadly defined as a significant and persistent difference between the socially optimal levels of investment in energy efficiency. This phenomenon is linked to the fact that individuals seem to under-invest in energy efficiency improvements that have the potential to be more than worthwhile in terms of energy savings.

There are many reasons behind this low level of EE implementation

- Energy efficiency choices require investment decision-making – trading off costs now for future savings.
- The production of EE implies investment decision characterized by:
    - Medium/long term horizon.
    - Higher initial investment
    - Lower future costs

e.g., renovation/construction of new house: choice of **standard** or **new technologies**

From the economic agent perspective, Assessing future costs requires various information, including:

- Future energy prices
- Energy savings with use
- Amount product will be used
- Life duration of the product
- Potential regulatory effect (carbon tax, for example)
- And discount rate

Accordingly, Individual wants to minimize private costs, and society wants to minimize social costs, I mean externalities. Unfortunately, rational decision-making by individuals may not provide the best social outcome. And private decision-making regarding EE may not be economically efficient.

Several explanations can be brought forward to understand the EE paradox, which can be summarized into three different categories: behavioral bias, market failures, and missing or poorly measured costs.

The choice of goods may not minimize present value costs. Principal-agent conflicts-" split incentives"- are among the most frequently cited explanations for the energy efficiency paradox and market failures. The best examples are landlord-tenant and builder-buyer conflicts, in which agents make suboptimal investment choices from the principal's perspective.

A further critical market failure that has received the most attention is that of missing, incomplete, or asymmetric information.

We can distinguish two models of imperfect information. In the first, households and firms may ignore the potential to invest in EE. For example, homeowners are unaware of how poorly their house is insulated and the benefits of insulating the house. The second model is similar to the Akerlof model (the so-called) market of lemons. In this case, buyers know that different products, such as apartments, commercial buildings have different levels of energy efficiency, but these differences are costly to observe. Thus, they are not willing to pay more for goods with better energy efficiency. These individuals are likely to leave the market!

4. Energy efficiency initiatives in Algeria

The buildings sector (residential and commercial dwellings) is one of the largest energy-consuming sectors- 41%. Population has doubled within 35 years - 22 million in 1985 to 44 million2021.

- Global energy consumption in Algeria: 50.4 M TOE-increased by 59% during 2010-2019 (an annual increase of 5%)
- This consumption is mainly driven by buildings which almost doubled during this period
- Per capita consumption has increased from 0.35 to 0.54 TOE/capita

Building energy consumption in Algeria.

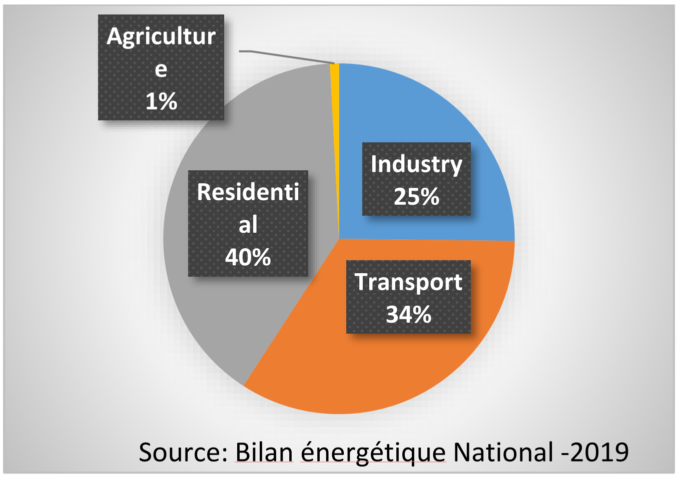


Fig. 3. Final energy consumption by sector in Algeria %

The first energy efficiency program in Algeria was implemented at the legislative level in 2006 and then revised in 2011 and 2015.

- The expected results of the National Energy Efficiency Program are :
- Energy-saving potential of about 63 million toe (i.e., nearly $38 billion in export value)
- Avoided power of more than 1500 MW (nearly $2 billion)
- Reduction of more than 193 million tons of CO_2 (i.e., $1.1 billion)
- Creation of 500,000 new jobs.

Building's efficiency objectives: 15% reduction of buildings energy consumption by 2030 (30 million toe).

Algeria adopted a law on energy management and a thermal regulation in buildings (RTB), revised in 2016.

The National Energy Efficiency Program for the building and construction sector has four objectives: Thermal insulation, thermal rehabilitation, individual solar water heaters, and the distribution of LED lamps for households and public lighting.

- **Results of the first phase of the Algerian EE program (**Source: Ministère De L'énergie et Des Mines**)**
- **Projects :**

- Thermal insulation of 600 new dwellings: 160 dwellings
- Thermal insulation in existing buildings: thermal insulation of 620 m2
- Installation of individual and collective solar water heaters: 407 units
- Substitution of mercury lamps with sodium lamps "Public lighting": 10,000 lamps
- Conversion of VP to LPGc: 9100 converted kits
- Installation of LPGc kits for captive fleet vehicles: 48 kits were installed
- Feasibility studies: 08 studies
- Energy audits: 33 operations
- Investment assistance: 18 operations.

Accompanying actions :

- Energy auditor training in the building industry;
- Realization of an inventory of the construction materials industry;
- Awareness campaigns have been launched to support energy efficiency projects.




5. Discussion and policy recommendations

This commentary presentation the important role that energy efficiency in buildings can play in framing sustainability goals and the so-called 'welfare economic model.' It also discusses the massive unexploited energy savings potential of the buildings sector in the context of the energy efficiency paradox. The analysis supports the idea that the buildings sector has a substantial unrealized energy savings potential. Further, scaling up energy efficiency in the buildings sector (for new and existing buildings) will generate multiple benefits for the environment, economy and society. Compared to other major emitting sectors, buildings offer considerable GHG emissions reduction potential. In parallel, decarbonizing the sector brings many economic benefits, including reducing energy bills, increasing the competitiveness of industries and services, and easing pressures on national budgets. Finally, beyond the environmental and economic advantages, it has been shown that an efficient buildings sector has substantial social impacts, including improved wellbeing and health. The analysis also documents the Algerian efficiency journey and its considerable efforts to improve energy efficiency, mainly in the buildings sector.

Accordingly, as displayed in Figure 4, a successful program should include not only a single measure but a set of integrated instruments to ensure a substantial transformation in energy efficiency. These instruments include (1) regulatory frameworks; (2) fiscal and financial schemes; (3) information and awareness campaigns; and (4) institutional reforms.

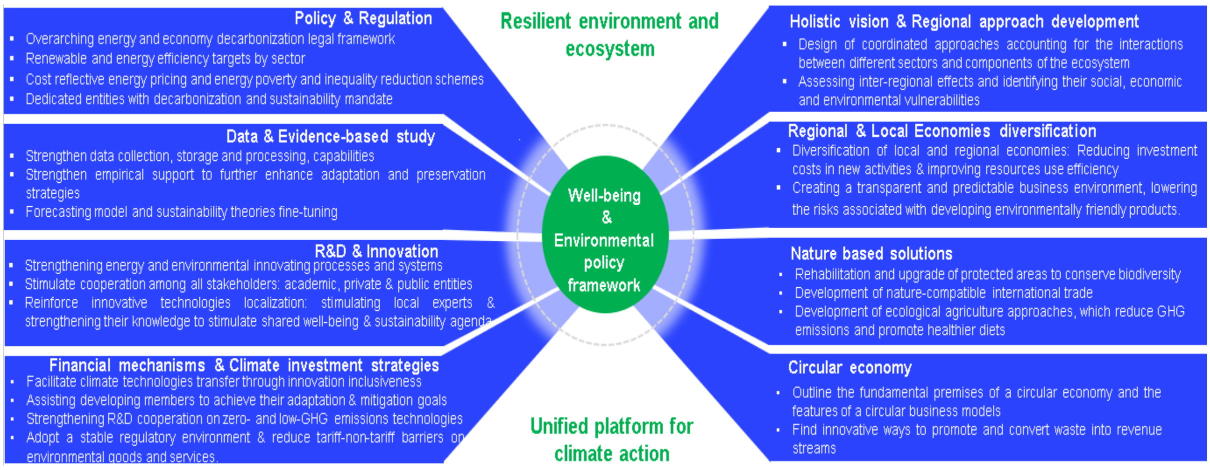


Figure 4. Policy framework to leverage energy efficiency as a pivotal point for promoting economic sustainability and building social and climate resilience.

Here I summarize the most prominent measures to optimize the regional and international learned lessons and leverage them as the backbone of the resilient and well-being economic model. The following key policy recommendations enable countries in the region to take the lead in establishing a unified platform for climate action, channeling investment toward a low-carbon economy, and fostering the underlying co-benefits across its members.

- **First**, Implement measures to increase resilience to the challenges of the global policy-driven energy transition. This includes reforming domestic energy markets within countries in the region through a comprehensive legal framework for the decarbonization of the energy sector and the economy
- **Second**, reinforce data collection & Evidence-based study by promoting:
  - Energy & Envi data collection, storage and processing capabilities
  - Strengthen empirical support to further enhance and inform EE strategies
  - fine-tuning of forecasting models and energy demand theories
- **Third**, stimulate R&D and innovation by:

    - Strengthening energy and environmental innovating processes and systems
    - Stimulate cooperation among all stakeholders: academic, private & public entities
    - Reinforce innovative technologies localization: stimulating local experts & strengthening their knowledge to stimulate shared well-being & sustainability agenda
- **Fourth**, adopt dedicated financial mechanisms by **promoting climate investment instruments**. Facilitate **the transfer of climate technologies** through inclusiveness of innovation within appropriate institutions and networks while assisting developing members to achieve their mitigation and adaptation objectives. Further, a stable regional regulatory environment is needed where tariffs and non-tariff barriers on environmental goods and services are reduced or removed.
- **Fifth**, **Holistic vision & Regional approach adoption through the:**
    - Design of coordinated approaches accounting for the interactions between different sectors and components of the ecosystem
    - Assessment of inter-regional effects and identifying their social, economic and environmental vulnerabilities
- **Sixth, Support sustainable economic diversification** by
    - Aligning climate mitigation and adaptation commitments with economic policies, to enhance a swift transition to sustainable and climate-resilient economic growth.
    - Creating a transparent and predictable business environment, lowering the risks associated with developing environmentally friendly products
- **Seventh, develop nature based solutions by:**
    - Rehabilitation and upgrade of protected areas to conserve biodiversity
    - Development of nature-compatible international trade
    - Support ecological agriculture approaches, which reduce GHG emissions and promote healthier diets
- **Finally, support circular economy through:**
    - The outlining of the essential foundations of a circular economy and the features of a circular business models
    - Innovative approach
    - to promote and convert waste into revenue streams
- And it needs to be complemented by range of policy measures related to technology, for some of which could be good case for international cooperation directed at:
    - RD&D for expensive big-unit high-risk technologies
    - Technology roadmapping and market building (sharing costs of strategic deployment)
    - international technology transfer and diffusion at scale
    - Appropriate ‘division of labour’ according to technological and natural resource base

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