
Shaping a sustainable future: policy recommendations for Algeria's energy landscape - Part1

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Abstract: *Over the course of twenty years, every country grappled with the challenge of balancing energy security with environmental sustainability, Algeria is no exception, as its current energy model faces a pressing need for reform. The dependence on natural gas as unique source of energy is becoming unsustainable, particularly, with recent decrease in production level and the rapid increase in domestic needs, represents a considerable hurdle to the nation's economic stability. This paper analyzes key components at sectoral level through exploration of country's energy potential, consumption patterns, and The complex interplay of greenhouse gas emissions, by exploring recent published data and studies alongside government efforts, the analysis reveals that reforms are needed in several area amongst are subsidy policy, renewable energy implementation, energy efficiency and taxes system. These areas must be addressed urgently by policy makers in order to effectively establish a sustainable and resilient energy model that not only meets economic needs, but also safeguards the environment for future generations*

Keywords: Algeria's energy, environment policy, energy efficiency, fossil fuel, GHG emission, renewable energy, sustainability, energy policy

1. Introduction

Algeria holds significant potential resources both fossil and renewable, establishing it as a key global energy exporter, today Algeria faces critical circumstance in its energy trajectory, its growing domestic needs in parallel with heavy reliance on fossil fuels, particularly, natural gas is becoming unsustainable, this poses dual threat to its energy security and

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environmental well-being, despite its large hydrocarbon reserves. Algeria overdependency on natural gas, alongside, decreasing production level coupled with the ever-increasing domestic energy needs of its growing population, presents a significant challenge to the country's economic stability. In the subsequent sections, we meticulously dissect and explore the untapped potentials within Algeria's energy sector, analyze consumption patterns, and illuminate the nuanced dynamics of greenhouse gas emissions. By weaving together these critical aspects, this paper aims not only to understand the current state of Algeria's energy landscape but also to lay the groundwork for informed discourse and future policy considerations

2. An overview of Algerian energy resources

The diverse combination of conventional and sustainable energy resources positions Algeria uniquely, enabling it to address domestic energy needs, foster sustainability, and explore new opportunities in the global energy market

2.1 Fossil resources potential



Figure 1. Oil and Gas Map of Algeria 2018 edition

The estimation of the proven reserve of crude oil and natural gas reaches 12.2 billion barrels and 4.5 trillion cubic meter respectively [2], the net production for oil and gas reached 1.2 million barrels per day and 100.8 billion cubic meters in 2023 respectively [2], the country has an extensive network of piping for oil and gas transportation attains 21,189 Kilometers

[3] Figure 1, on the other and according to a report by the U.S. Energy Information Administration (EIA)[4], Algeria possesses approximately 707 trillion cubic feet (Tcf) of shale

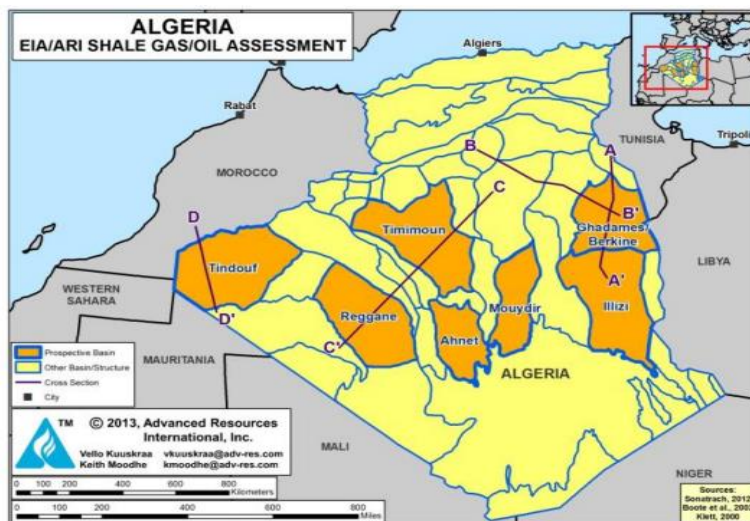


Figure 2. Shale Gas and Shale Oil Basins of Algeria [5]

gas reserves that can be feasibly extracted making it the third in the world Figure 2, however this reserve remain untapped due to public opposition and environmental concerns [6].

2.2 Renewable energies potential

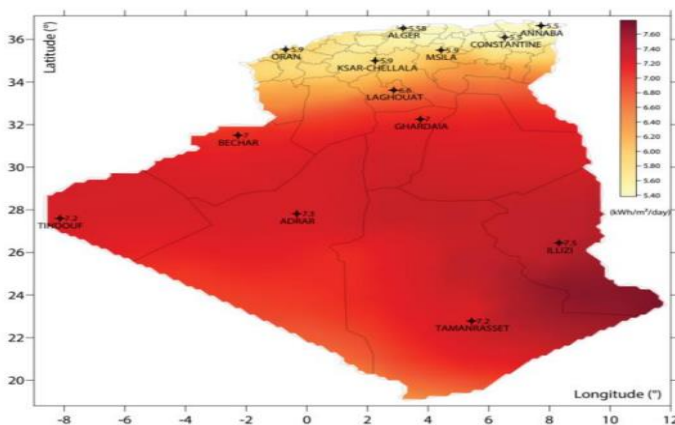


Figure 3. Direct irradiation (beam) map/CDER [7]

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Algeria boasts significant potential for renewable energy generation, particularly in solar and wind energy, there is a growing interest for the renewable energies from the government especially with the increase of domestic demand in electricity, the country aims to satisfy its rising needs of energy, and alleviate its GHG emission through sustainable development.

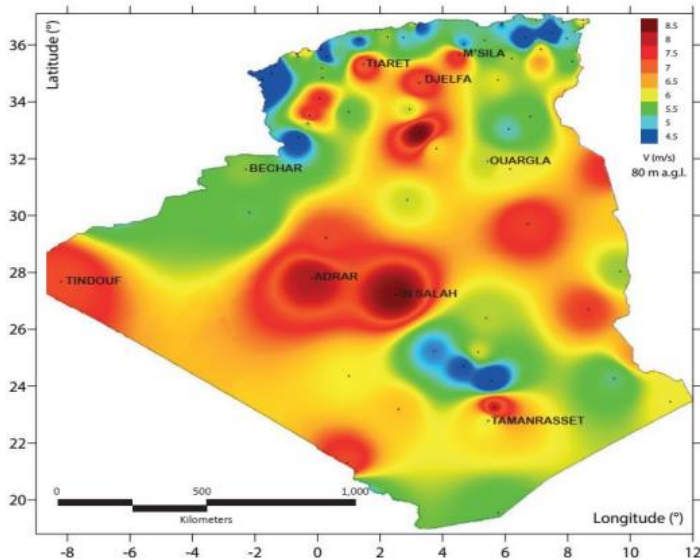


Figure 4. Mean wind speed map/CDER Atlas 2019 [7]

The duration of insolation varies between 2000 hours and 3900 hours annually especially in the high plateaus and the Sahara, the total solar energy received per day on a horizontal surface can vary from 5.1 Kwh in northern region to 6.6 Kw

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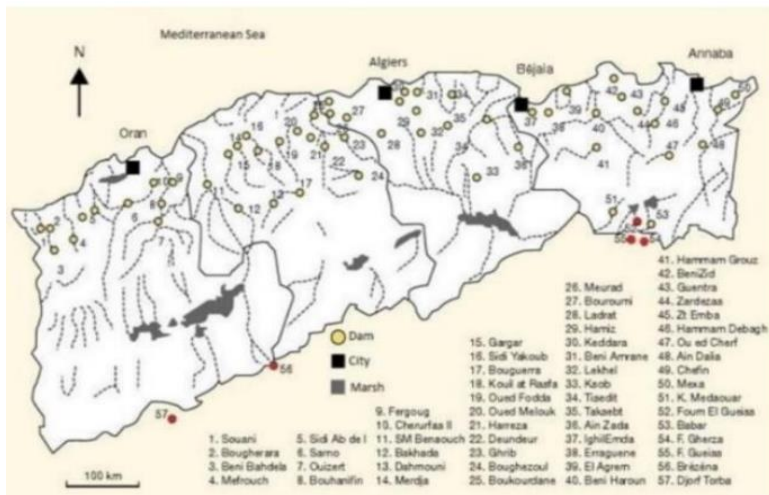


Figure 5. Exploited dam-reservoirs in Northern Algeria [8]

in southern region [9] Figure 3, meanwhile, According to the CDER (Renewable Energy Development Center) [7] with its new updated study, wind speeds can reach 7 to 8 m/s at a height of 80 meters in certain regions of the South, particularly in Tindouf, Adrar Figure 4, however these regions are not suitable for wind power due to unavailability of power grid and extreme environment condition [10], while the center and high plateaus are very convenient region to generate electricity from wind power.

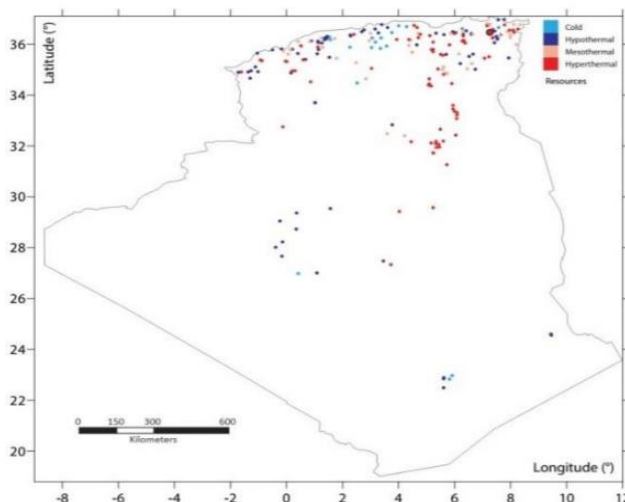


Figure 6. Exploited dam-reservoirs in Northern Algeria [7]

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Algeria possess diverse hydro resources Figure 5, the northern region of Algeria is rich with mountains and valleys with a significant amount of precipitation reaching 65 billion cubic meter [10], however, Hydroelectric power plants experienced a significant decrease (-81%) mainly due to low rainfall observed during the year 2021 [11], conversely, Geothermal energy in Algeria holds promising potential ,the country is rich with geothermal sources Figure 6, however the majority of geothermal resources are with low temperature which is not suitable for electricity generation, although it can be suitable for other application like heating [12], Algeria counts 282 hot springs [12], The overall installed thermal power capacity in the country amounts to 54.64 MWt, with an annual thermal energy consumption of 1699.65 TJ [12]. Furthermore, A wide range of bioenergy resources Table 1 exists in Algeria a comprehensive study conducted in 2017 assessed the renewable bioenergy potential in the country, have a capacity exceeding 500,000 toe [7].

3. energy domestic profile

Algeria Energy Flows

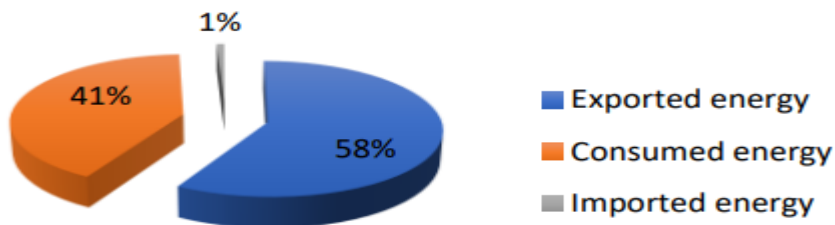


Figure 7. Algeria energy flow 2021 [11]

Energy consumption is an important indicator of country's socio-economic development, the comprehension of domestic energy profile of Algeria is necessary for effective energy planning, resource allocation, and environmental management. National energy consumption reached 67.12 Mtoe (million tonne of oil equivalent) in 2021 [11] this represent 41% of

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total energy of the country which is estimated at 165.9 Mtpe in 2021 [11] Figure 7.

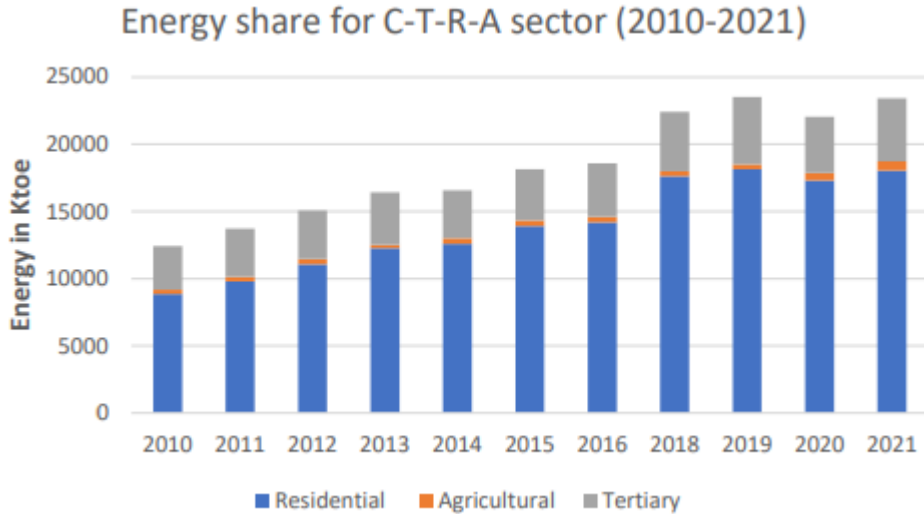


Figure 8. Energy consumption C-T-R-A sector [11],[13]

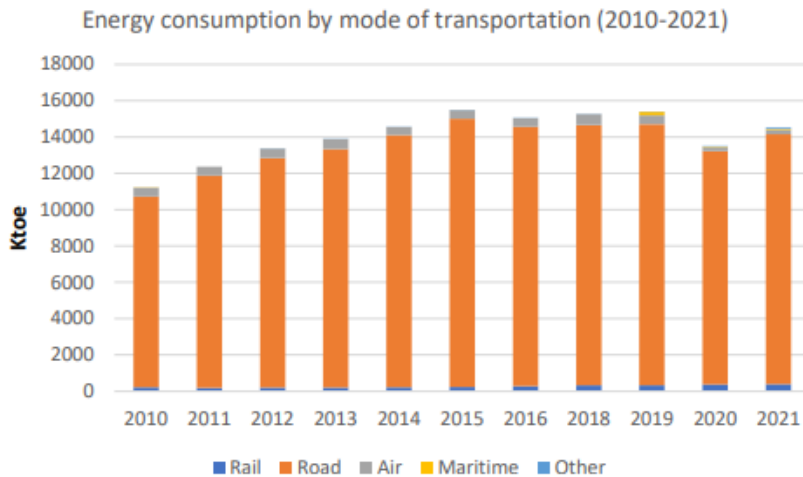


Figure 9. Energy consumption Transport sectors [13],[11]

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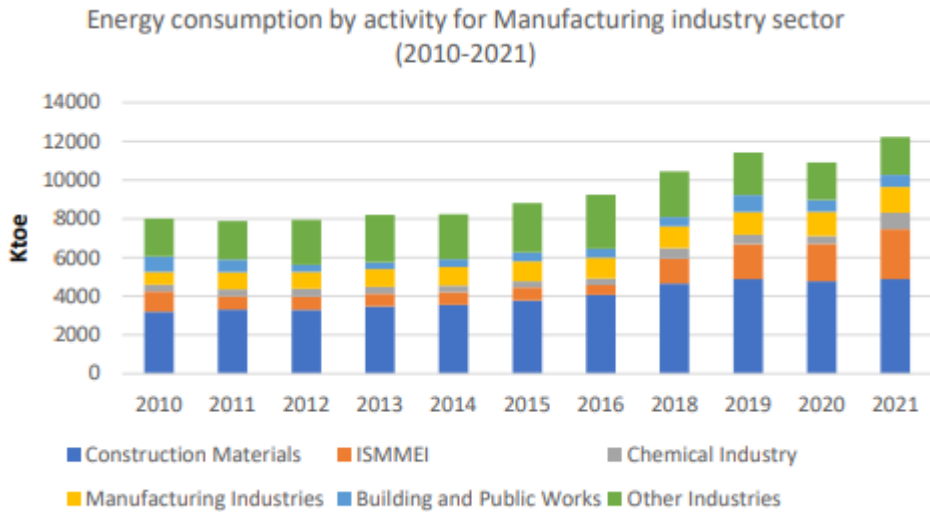


Figure 10. Energy consumption Manufacturing industries [13],[11]

3.1 Sectoral analysis

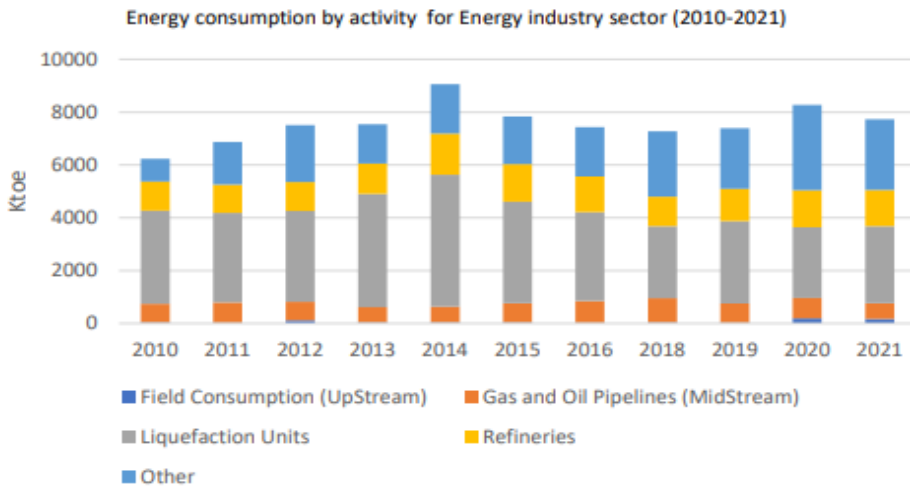


Figure 11. Energy consumption Energy industries [13],[11]

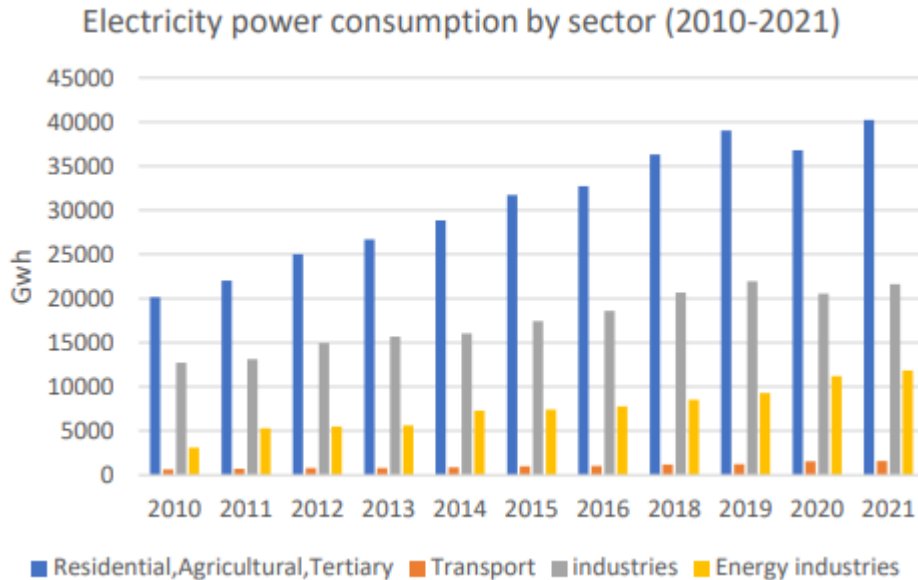


Figure 12. Electricity consumption for all sectors [13],[11] Algeria’s

energy sector is critical to its economy, it encompasses most extractive and transformative industries Figure 11 and is the largest energy consuming sector with 48% of total domestic consumption dominated by electricity power generation Figure 12, the second energy consuming sector is the transport sector with 21% dominated by road transportation mode Figure 9, the CTRA (Commercial, Tertiary, Residential, Agricultural) comes third with 20% of domestic consumption and dominated by the residential consumption Figure 8, finally the industry sector accounts for 10.4% dominated by non-minerals industries (cement) Figure 10.

4. Sectoral analysis of GHG emission in Algeria

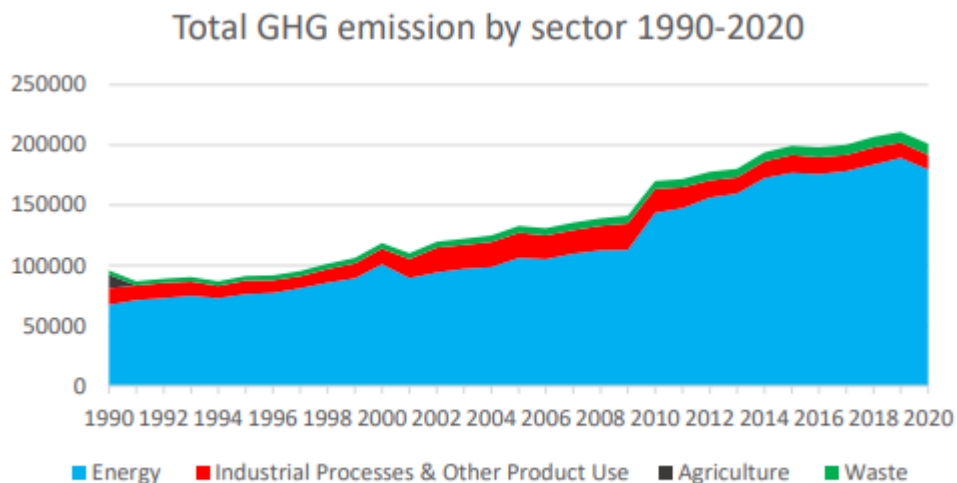


Figure 13. GHG emission for Algeria [14]

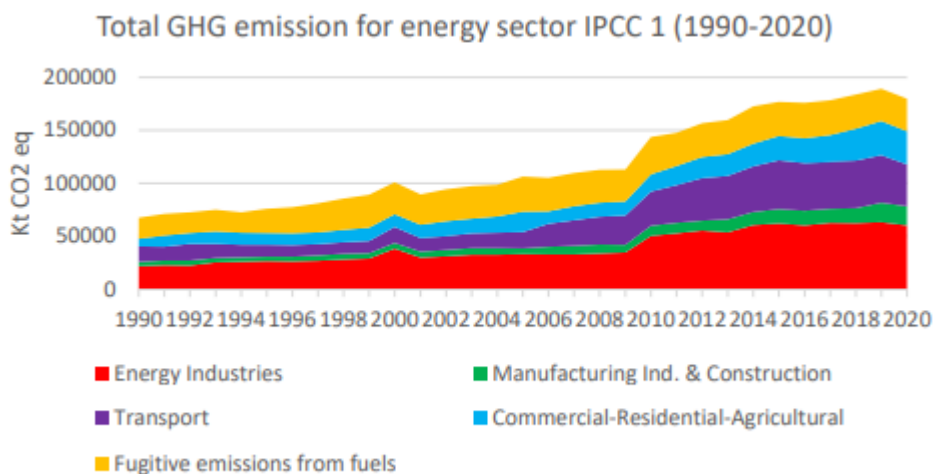


Figure 14. GHG emission for energy sector [14]

Algeria is heavily relied to fossil fuel for its energy demand, consequently it contribute significantly to GHG emission, the country has vowed to reduce

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carbon emissions by at least 7% by 2030, compared to business-as-usual levels. However it is challenging and complex goal to attain, especially when national demand is increasing due to the country policy to forward toward more industrialization and economic modernization [15] [16].

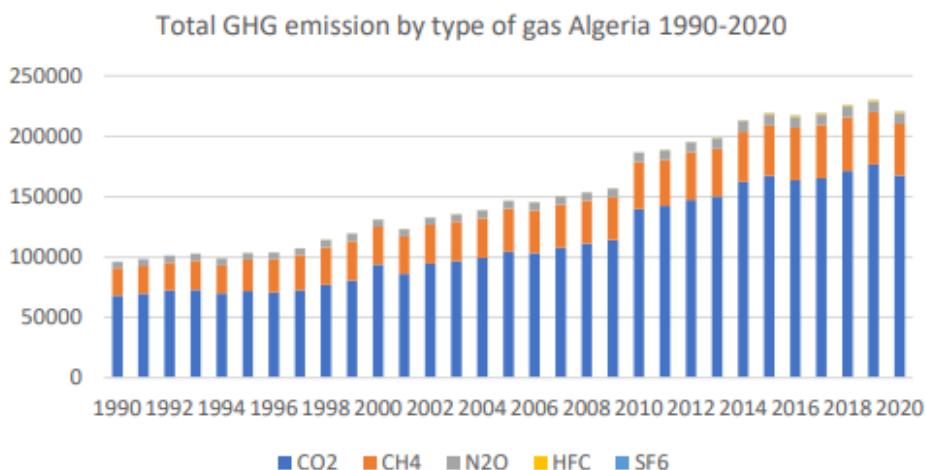


Figure 15. GHG emission by type of gas [14]

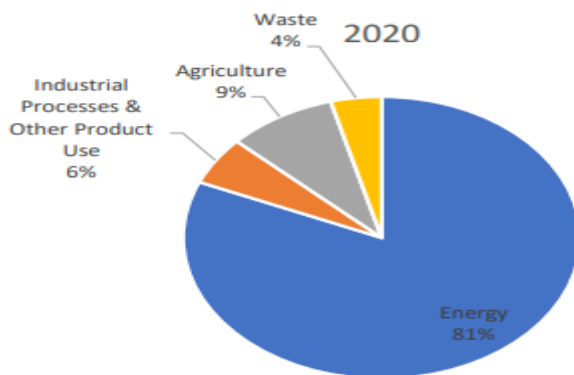


Figure 16. GHG emission share [14]

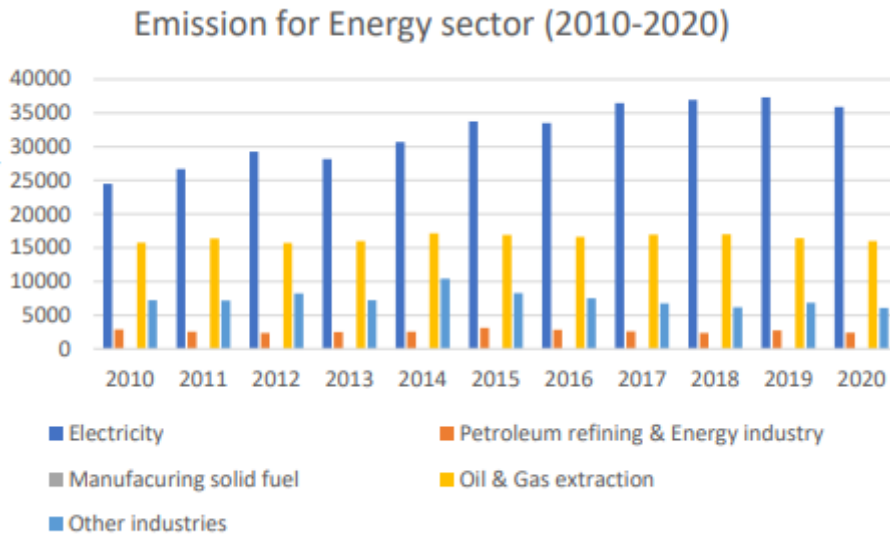


Figure 17. GHG emission Energy sector [14]

6. Recommendations and perspectives

Energy policy-makers in Algeria must recognize expeditiously the need for paradigm shift in country's energy landscape, relying on the current energy model poses a serious threat to both energy security and economic stability, the impending challenges require a careful reassessment and an urgent reaction to ensure a sustainable energy future. Despite, the abundance of fossil and renewable resources options and potentials, alongside significant efforts by the policymakers in terms of legal framework [49] [50], the country has not achieved its targeted goals regarding to establish a resilient sustainable energy model over two decades [43].

Algeria must address deep reforms urgently to its subsidy policy mainly by considering a revision of current energy prices [37] [38] [43] [25]. Subsidy policy imposes a burden on the Algerian economy, in fact Algeria spent 19.9 billions US dollars in 2021 to subsidy all forms of energy [51], for comparison Germany invest about 14.6 billions US dollars in RE plants for the same year [52], the prices of petroleum and gaseous product are among the lowest in world, the Algerian citizen pays 7 time less than European citizen for oil products, and 30 times less than European citizen for natural gas in 2021 [51], this policy of subsidies has been one of the main long

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standing approaches to enhance economic conditions and emphasize the social justice. However, the significant disparities in prices compared to global markets is a principal impeding for any efforts to promote energy efficiency measures and incentivizing to cleaner and sustainable options [25] [37] [31], which is also a consisting urging from government institution and experts, addressing this issue is the most challenging step giving it will be faced by social resistance, so policy makers must have the will to change it.

Funding and providing financial resources for RE projects is crucial, which is a persisting aim for policy-makers in the country, Meanwhile foreign investments play a vital role in bolstering the financial support required for large-scale RE initiatives [44]. Encouraging partnerships with international organizations and investors could bring in the necessary capital to launch ambitious projects [53] [38] [43]. The abandonment of the rule 51/49 in renewable energies is a good sign for investors and encouraging initiative, other reforms must be addressed such as cumbersome bureaucracy, shifting regulations [28], auction system [31] that may slow the progress of implementing renewable energies.

Decision makers in housing and urban planning sector must reevaluate their policies in housing and urban expansion of cities [27] and set standards in building projects, according to ministry of housing and urban planning more than 2.7 million houses were delivered from 2010 to 2019 [22] with the majority of these buildings being energetically inefficient [29], This inefficiency can be addressed by imposing new standards for buildings and gradually phasing out inefficient construction materials from the market [54] [55]. Promoting the use of centralized heating and cooling systems in new buildings could significantly enhance energy efficiency [29]. Moreover introducing renewable energy sources for domestic use, such as solar panels and heaters by incentivizing of environmentally friendly technologies from local authorities [56], alongside the revision of energy prices. Collaboration between urbanist researchers and energy researchers is paramount to developing and implementing effective strategies [25], [55].

The government must prioritize attention to the transport sector, acknowledging it as one of the most polluting and resource-consuming sectors in Algeria [29]. Unfortunately, policymakers, including academics, have shown relatively less dedication to addressing the unique challenges faced by this growing sector. Policymakers should contribute along with

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industry expert, researchers to elaborate and implement effective strategies, promoting eco-friendly fuels such as hydrogen and electric vehicles [57] [58] [25] [59], the implementation of congestion charges or road tolls could help manage traffic, reduce pollution, and fund sustainable transportation projects. Power sector mainly focusing on electricity production in Algeria has been long dominated by single entity which is stat owned company. However, private sector can contribute and invest in production alongside their commitments to feed-in-tariffs agreement, the transmission, distribution and commercialization of electricity is reserved exclusively to stat owned company Sonelgaz [31] [28], such monopolization poses challenges such as lack of innovation, inefficiencies and slow reactivity to market dynamics, a competitive climate can accelerate the responses to market disparities, Sonelgaz must consider the expansion and enhancement of the national electrical grid to support the increasing electrical power expected from renewable energies, electrification of various sectors, and potential export [60] [26] [49]. The current grid's limitations in capacity and efficiency should be addressed to accommodate the growing demand, minimize losses, and ensure a robust infrastructure for sustainable energy development. Furthermore the government can promote auto production from various sectors and particulars to inject their surplus to the electrical grid since it is produced from renewable sources, this can relax the grid during peak period such as hot period in summer in fact government should consider practices such this, unfortunately there is no implementing regulation or text for this [61], moreover Sonelgaz should proceed to decommission to some inefficient plants instead it could proceed by replacing it with renewable plants, Decision-makers should reevaluate their energy plans, paying particular attention to the allocation of shares for each technology. Notably, there appears to be marginalization of Concentrated Solar Power (CSP) technologies in the current strategy [38] [42]. This warrants a closer examination and a potential adjustment in the distribution of resources and support to ensure a more inclusive and diversified energy portfolio. The government should encourage domestic manufacturing of renewable energy equipment through startups and stimulate innovation by involving researchers [53] [43] [62].

Overall Algeria must prioritize the demand side without neglecting the supply side which is crucial for its energy balance, increasing the discovery rates and recovery rate this can be done through a careful assessment of potential reserves and a reevaluation of current policies particularly in

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upstream activities, where alternatives like shale gas could be considered in near future [36] therefore a comprehensive understanding of environmentally impact must be considered alongside country domestic needs [6].

Algeria should reevaluate its tax system and its environmental policy, most of the taxes serve merely budgetary purpose and do not reflect the environmental impact of various activity nor incentivizing to rationalize energy or shift behavior, the government could alleviate existing taxes burdens or phasing out and shift them to a comprehensive tax system addressed to energy and environment and affect them to fund more energy efficient and eco-friendly purposes [62] [63], decision makers should consider enacting carbon taxes law for some polluting sectors without affecting vulnerable categories, more studies are required in this area of research [64]. Finally, through the implementation of renewable energy and the rationalization of energy resources consumption, Algeria can contribute to mitigate its carbon foot print and foster its environmental policy [43] [6] [27] [62] [57] [28], however, a comprehensive revision of taxes system should be conducted alongside an environmentally friendly practices, such as promoting circular economy and rising awareness in terms of waste management and recycling which represent a potential economy opportunity [53], expand environmental auditing to more sectors such as C-T-R-A and transport sectors, monitoring and reporting to ensure transparency and accountability in implementing regulations, promoting more awareness campaigns for sustainable practices and boost the innovations by promoting research and development [62].

7. Conclusions

Algeria urgently needs to reform its current energy policy to effectively address pressing challenges, particularly in confronting the growing demand for energy in its domestic needs, the current energy model centered in natural gas is neither resilient nor sustainable. A comprehensive reform of the current energy policy is urgently needed. This reform must prioritize several key areas. Subsidy policy and energy prices Policy makers must address subsidy policies and energy prices as primary barriers limiting the effectiveness of energy efficiency measures and renewable energy adoption. Comprehensive reforms to these policies are urgently required. Emphasize on renewable energies and energy efficiency Algeria must

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prioritize the expansion of renewable energy sources in its energy portfolio, expediting the adoption of renewable energy technologies by streamlining procedures and diversifying the utilization of other technologies like CSP, alongside efforts in energy efficiency and management to address the rapid rise in domestic demand. Cross-sectoral collaboration Cross-sector collaboration, especially between the electrical power and housing and urban sectors, is essential for managing the future unplanned urban expansion of cities while ensuring power availability. Prioritization of transport sector the government should address the challenges of this sector regarding its energy consumption and pollution by exploring all opportunities to rationalize consumption and mitigate its carbon footprint through comprehensive regulations and measures. Electricity power production Algeria needs to prioritize the expansion and improvement of its electrical grid to accommodate the potential increase in power generation from renewable energy sources, as well as the possibility of exporting surplus energy. Additionally, transitioning old power plants to renewable energy sources or more efficient technologies is essential. Moreover, the country should explore opening up the energy sector to private investments and gradually phase out monopolization. Supply side and upstream activities A thorough reassessment of Algeria's current potential fossil reserves is crucial, alongside efforts to increase discovery and recovery rates by reevaluating policies, especially in upstream activities. Additionally, Algeria should meticulously explore alternative resources in both the short and long term, conducting assessments that consider the implications of climate change, particularly when exploring non-conventional fossil resources like shale gas. Tax system Algeria should reassess its tax system, which currently fails to account for the environmental impact of different activities or incentivize energy rationalization and behavior shift. Instead, it primarily serves budgetary purposes.

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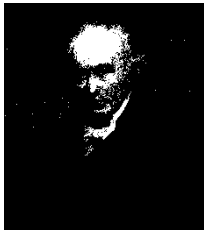
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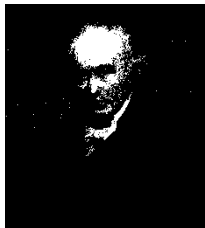


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