International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 7s, 2025
https://www.theaspd.com/ijes.php

# Algeria's Energy Transition: A Critical Assessment For A Sustainable Future

**Kebour Omar[1], Belgroune Nadir[2], Kebour Djamila[3], Kamel Abdeladim[4]**

[1] Structures, Mechanics and Energy Laboratory, University Blida1, Blida, Algeria, kebour.omar@univ-blida.dz
[2] Physical Chemical Laboratory of Inorganics Materials and their Applications, University Blida1, Blida, Algeria. belgroune_nadir@univ-blida.dz
[3] Food Science, Technology and Sustainable Development Laboratory, University Blida1, Blida, Algeria. kebour_djamila@univ-blida.dz,
[4] Energy Renewable development Center , BP 62 Route de l'Observatoire, Bouzaréah 16340, Algiers, Algeria. abdeladim92@hotmail.com

Received:15thApril 2025 , Revised:18th May2025 , Accepted:20th June 2025

**Abstract:** *Algeria faces a critical energy crossroads as its hydrocarbon-dependent economy struggles with rising domestic consumption, declining export capacity and climate commitments. This study analyzes energy trends from 2013-2024, revealing a worrying 42.2% surge in national consumption against only 12% production growth, with energy losses jumping 11.5% in 2023. The exportable surplus has shrunk by 10 Mtoe since 2016, while fossil fuels still dominate 99.5% of the energy mix. The proposed transition strategy addresses these challenges through eight integrated pillars: combating energy waste (targeting 6 Mtoe annual savings), rebalancing consumption toward productive sectors, converting 200 000 vehicles to LPG/CNG, developing electric mobility infrastructure, improving building efficiency, achieving 30% renewable energy by 2030, implementing targeted subsidy reforms, and modernizing agricultural/industrial sectors. Key findings highlight systemic inefficiencies costing $1.8 billion annually in losses, with current consumption trends risking reserve depletion within 20 years. The transition's success depends on overcoming governance challenges, realizing $200 million/year in gas savings through renewable projects, and fostering behavioral change. This research provides policymakers with actionable recommendations to navigate Algeria's energy trilemma-preserving vital export revenues while meeting growing domestic demand and climate obligations through a structured, socially-just transition pathway that leverages the country's significant solar potential and emphasizes energy sobriety as a national priority.*

**Keywords:** *Energy transition, Algeria, hydrocarbon dependence, renewable energy, energy efficiency, subsidy reform, sustainable development.*

## 1. INTRODUCTION:

In a global context marked by energy instability, climate urgency and rising geopolitical risks, Algeria stands at a pivotal juncture. Historically dependent on hydrocarbons, the country faces a dual constraint; such as the gradual depletion of fossil fuel reserves and a domestic energy need, which are growing at 3.5% a year (Ait Mokhtar et al., 2021). This dynamic increasingly reduces the export capacity; still the primary source of foreign currency and threatens the sustainability of its socio-economic model, that are a long supported by energy subsidies and import dependence (Kadri et al., 2023). Structural challenges are expressed by rising water stress linked to climate change, environmental degradation from inefficient energy uses and unbalanced demand across residential, transport and productive sectors. In this setting, energy transition is no longer a climate-driven option but an economic, social and geopolitical necessity (Merzouk et al., 2021). However, a credible transition cannot rely on fragmented technical measures or declarative policies. It requires a systemic, integrated and transparent rethinking of the Algerian model of energy production, consumption, governance and resource distribution (Kebour et al., 2017). This

transformation needs a strategic foresight, inclusive stakeholder dialogue and strong governance mechanisms capable of turning policy into action (Belaid & Zrelli, 2019).

The hydrocarbon emission from the extensive uses of energy in Algeria, arise a domestic and environmental constraints (Kebour et al., 2017). Previous research reported that, a 42.2% increase in consumption since 2013, versus only 12% growth in production, and rising energy losses (+11.5% in 2023) (Ait Mokhtar et al., 2021; Benatia et al., 2022). These imbalances confirm the urgent need for reform. Governance-focused research aims to create an institutional inertia and to split the coordination, which is represent a barriers to transition (Ouki, 2020; Cherfouh & Lucas, 2023). Meanwhile, in Algeria a large renewable potential of energy is occurring, especially in solar energy (Boudghene Stambouli, 2019; Kebour et al., 2021; Kadri et al., 2023). Studies highlight the political sensitivity of subsidy reform, especially with the social dimension increase (Hafsi & Tiberghien, 2022). Hence, the contribution of new insights into targeted mechanisms and compensation frameworks, that reconcile equity with fiscal sustainability are needed.

In order to set up a prior technical assessments (Merzouk et al., 2021), the present work aims to update the consumption patterns and to develop sector-specific transition pathways. since a significant advances knowledge are existing through a data-driven, multi-dimensional approach of the Algerian energy status, trilemma is offering both updated diagnostics and implementable solutions tailored to current realities.

This study offers a strategic and constructive evaluation of Algeria's national energy transition plan, in order to link the gap between intentions and implementation. The aim is to support the oriented results throughout the national dialogue that is an evidence based on social activities for sustainable energy development. The study sets forward practical targets of 30% of renewable energy by 2030 and explores gas-for-renewables swap models as innovative financing options.

## 2. MATERIALS AND METHODS:

### 2.1. Energy Data (2013–2024):

The rigorous methodology provides a precise diagnosis of Algeria's energy challenges and offers concrete solutions for a realistic and sustainable transition. This study adopts an integrated approach to critically assess Algeria's energy transition, combining the following components. All data were obtained from the National Energy Balance reports (NEB, 2023), Sonatrach, Ministry of Energy and Minerals, Algeria, ,considering the Key Parameters of - Growth in consumption (+42.2%) vs. production (+12%), energy losses (+11.5% in 2023) and reduction in exportable surplus (10 Mtoe, since 2016) (NEB, 2023).

**2.2. Policy Framework Evaluation:** Analysis of the 8 proposed transition pillars with respect to the alignment with international commitments (COP28, 2016), technical and financial feasibility and the social acceptability.

**2.3. Forward-Looking Modeling:** Some modeling ways were considered such as Business-as-usual scenario which is Predictable depletion of reserves. Transition scenario, using energy savings of 6 Mtoe/year, 30% renewable energy (by 2030) and the potential economic gains ($1.8 billion/year)

**2.4. Study Limitations:** Limited access to certain sectarian data and Politically other sensitive variables difficult confronted.

The data analysis of the present work carried out following eight integrated policy pillars in order to operate the reform frameworks. The analysis is organized along five key dimensions:

a. Strategic coherence – assessing the plan's vision and internal logic.
b. Relevance of operational priorities – evaluating objectives, feasibility, and impact.
c. Technical and institutional feasibility – testing the capacity to deliver results.
d. Governance challenges – addressing transparency, coordination, and legitimacy.
e. Recommendations for improvement – proposing innovations and additional levers.

## 3. RESULTS:

### 3.1. Energy Consumption Trends (Key Data 2022–2023):

Key trends in the structure of national energy consumption between 2022 and 2023 are presented in table 1. These results development an underscore of the central challenges which is facing Algeria's energy transition; particularly the need to reconcile steadily rising demand with the imperative to optimize energy systems, both reasons aim to reduce technical losses and to enhance overall efficiency. The uneven growth rates across consumption aggregates, suggest a need to reassess a current energy policies, especially in relation to loss mitigation and energy efficiency strategies.

**Table 1.** The national energy consumption across four major aggregates **(2022-2023)**, following the classification standards of the International Energy Agency (IEA, 2023).

| **Unit [ktoe]** | **2022** | **2023** | **Change** | **Change %** |
|---|---|---|---|---|
| Final consumption | 53.106 | 54.204 | +1.098 | +2.1% |
| Non-energy use | 4.493 | 4.605 | +112 | +2.5% |
| Energy industry use | 8.158 | 8.735 | +577 | +7.1% |
| Losses | 4.162 | 4.639 | +477 | +11.5% |
| **Total national consumption** | 69.919 | 72.183 | +2.264 | +3.2% |

**3.2. Structural Trends:**

Direct Energy Demand is expressed by the final consumption is +2.1% with a moderate increase of +1.098 ktoe. This is reflecting a steady economic growth control. This rise can be attributed also to the expansion of industrial and tertiary sectors and the increased of household demand (heating, appliances, mobility). Non-Energy Use (Hydrocarbons as Feedstock) recorded an increase of +2.5%. This slight increase (+112 ktoe), is indicating marginal growth in industries using oil and gas as raw materials (petrochemicals, fertilizers, plastics). The energy industry use (Transformation) showed +7.1% more need. this sharp rise (+577 ktoe), makes it the fastest-growing category. More ever the energy losses is represented by a shift of +11.5%. This alarming sharpest increase (+477 ktoe), is raising a significant concerns due to different possible cause, such as the old infrastructures (electricity transmission, gas leaks) and lack of investment in infrastructure efficiency. these present an impact of losses estimated approximately at 6.4%, of national consumption during the year of 2023, which was around 6.0% in 2022 (NEB, 2024).

Total National Consumption exhibited an increase of +3.2%. Thid rise of energy of +2,264 ktoe, firstly was conducted by the energy industries (+7.1%) and losses (+11.5%) with different ways. This worrying gap, in the energy sector consumption and losses, are growing faster than the final demand and is indicating a decline in the system efficiency. The involved implications are the Systemic inefficiency (Losses exceed OECD averages of 6.4% vs. 5.2%) and the energy paradox (Rising energy sector consumption of+7.1%, contrasts with modest final demand growth of +2.1%) (NEB, 2024).

**3.3. Long-Term Trends (2013–2024):**

The national energy consumption in Algeria has exhibited sustained and increasingly concerning growth over the past decade (Figure 1). The results show a total consumption rise with 42.2%, from 53.3 million tons of oil equivalent (Mtoe) to an estimated 75.81 Mtoe. Following the notable decline in 2014, when consumption dropped to 49.2 Mtoe (a decrease of 7.7%), the need increase quickly from 2015 onward, with an annual average growth of approximately 3.5%. Between 2022 and 2024, energy demand increased from 69.1 Mtoe to an estimated 75 Mtoe, which represents an overall rise of 8.5%. The first semester of

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2024 alone recorded an increase of 5%, compared to the same period in 2023. This trend is particularly important since the domestic energy production has expanded at an annual rate of just 1.1%. The post-2020 period is especially illustrative: although production has gradually recovered from the disruptions caused by the COVID-19 pandemic, domestic consumption is absorbing an increasingly disproportionate share of available resources. Data analysis (Figure 2) reveals a concerning trend in the exportable surplus, an essential indicator of the national energy balance. After peaking at 107.8 Mtoe in 2016 (+6.4% compared to 2013), the surplus has experienced continuous erosion, struggling to stabilize around 97 Mtoe since 2021. The year 2020 marked a historic low of 82 Mtoe (–9.2% in a single year), illustrating the severe impact of the COVID-19 crisis on production capacity. Although the post-pandemic recovery was significant, it was offset by the sustained growth in domestic consumption, which absorbed nearly 40% of production gains between 2020 and 2024. This dynamic underscores a growing structural imbalance between the energy production, marked by volatility (ranging from a low of 144.4 Mtoe in 2020 to a high of 173 Mtoe in 2024), Continuously rising domestic demand, with an average annual growth rate of +3.5%) and Export capacities under pressure (reduction of 10 MTep between 2016 and 2024).

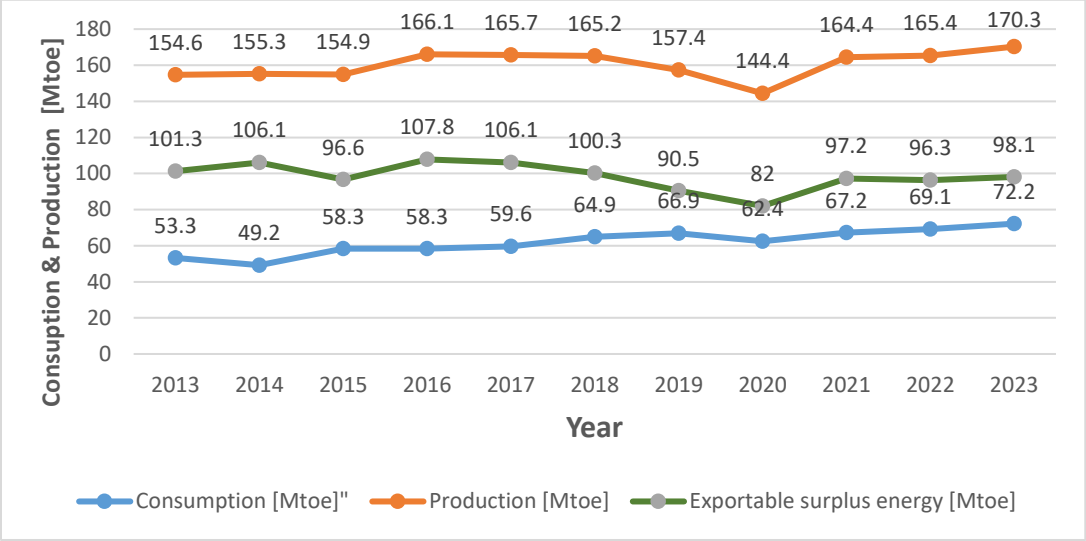


**Figure 1.** Trends in Energy Consumption, Production, and Exportable Surplus in Algeria (2013–2024).

Figure 1 demonstrates that national energy production experienced a moderate overall increase of 12% between 2013 (154.6 Mtoe) and 2024 (173 Mtoe), though the trend was marked by notable fluctuations. After peaking at 166.1 Mtoe in 2016, production declined sharply during the pandemic, reaching a low of 144.4 Mtoe in 2020, a 13.1% drop. However, this was followed by a strong recovery, with production rising by 19.8% between 2020 and 2024, culminating in a record high in 2024. Energy production, now stabilized between 165–170 Mtoe, is failing to keep pace with the sustained growth of domestic demand. This disparity is leading to a gradual decline in export capacity. These were considered by the knowledge of the persistent dependence on fossil fuels, Intensifying pressure from domestic demand (+42.2% between 2013 and 2024), vulnerability to external shocks (e.g., the COVID-19 crisis in 2020) and A vigorous recovery that remains insufficient to meet demand. This situation underscores the limitations of the current energy model in the face of continuously rising national needs and the imperative to preserve exportable resources.

### 3.4. Algeria's Energy Consumption (2013-2024):

The growth of energy industries (+7.1%) overtakes final consumption (+2.1%), suggesting a declining net energy return represented in figure 2. National energy demand has surged by 42.2%, rising from 53.3 Mtoe in 2013 to a projected 75.81 Mtoe in 2024. Following a temporary 7.7% decline in 2014,

consumption has grown at an average annual rate of 3.5%. The recent acceleration is particularly the increase OF 8.5% between 2022 and 2024 (from 69.1 to 75.0 Mtoe) and 5% rise, just during the first half of 2024 (NEB, 2024).

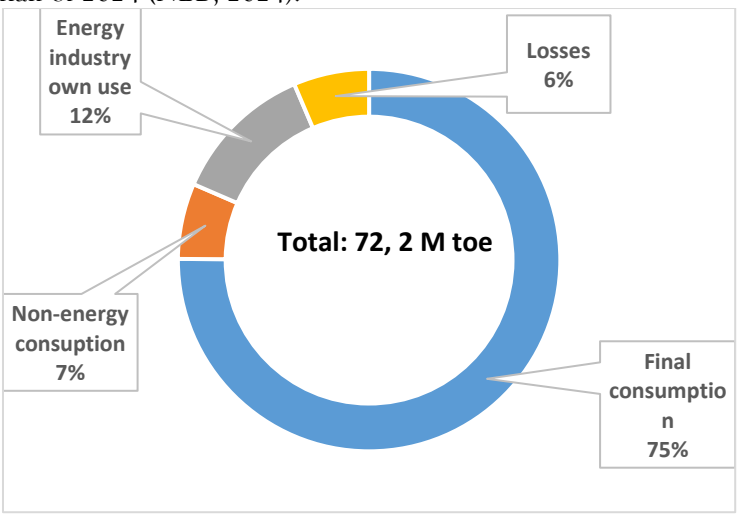


**Figure 2**. Breakdown of Energy Consumption (EROI concept).

The analytical decomposition of national energy consumption, following International Energy Agency methodology, yields several critical were found. Firstly, Mature yet Inefficient Consumption Patterns that represents the final consumption of 75.1% with industrial uses (Smil in 2017). This increase of 6.4% loss rate (+11.5% growth) far exceeds OECD averages (5.2% in 2023). This infrastructure deficiency aligns with Sovacool's (2021) research on aging energy systems. The second critic is the Diverging Sectoral Trends, when the energy sector's records 7.1% growth, compared to 2.1% for a final consumption (York, 2021), where efficiency improvements are negated by increased production. Meanwhile, non-energy uses (+2.5%) mirror global petrochemical trends (IEA, 2023).

### 3.5. Energy Production Analysis (2013–2024):

The energy production is presented in Table 2 show a moderate growth of +3.0% in total energy production between 2022 (165,372 Ktoe) and 2023 (170,252 Ktoe), primarily conducted by natural gas (+4.0%), and to a lesser extent by crude oil (+1.2%) and condensates (+2.0%).

**Table 2:** Commercial Primary Energy Production

| Product | Units | 2022 | 2023 | Gaps | % |
|---|---|---|---|---|---|
| Natural Gas | ktoe | 95.857 | 99.689 | +3.823 | +4.0% |
| | $10^6$ m³ | 101.436 | 105.482 | | |
| Crude Oil | ktoe | 50.437 | 51.035 | +598 | +1.2% |
| | kTons | 45.727 | 46.269 | | |
| Condensates | ktoe | 9.063 | 9.246 | +183 | +2.0% |
| | kTons | 8.006 | 8.168 | | |

| Product | Units | 2022 | 2023 | Gaps | % |
|---|---|---|---|---|---|
| Field LPG | ktoe | 9,833 | 10,111 | +278 | +2.8% |
| | kTons | 8.333 | 8.569 | | |
| Primary Electricity (fossil) | ktoe | 164 | 171 | +7 | +4.2% |
| | GWh | 681 | 723 | | |
| Solid Fuels: Wood | ktoe | 18 | 8 | -10 | -56.2% |
| | $10^3$ $m^3$ | 91 | 40 | | |
| **Total** | **ktoe** | **165.372** | **170.252** | **+4.879** | **+3.0%** |

**3.6. Energy source and production:**

Development and Growth of energy sources remains principally by fossil fuels (gas, oil, condensates, and LPG), which represent 99.5% of the energy mix up to 2023. Unfortunately, the energy transition still limited (Figure 3). These sources are mainly the Fossil Fuels with natural gas 58.6% (2023), steadily growing. Crude Oil represents 30%; with relative stability (Despite climate pressures, oil remains critical for transport and petrochemicals) and geopolitical risks, (Reliance on volatile international markets (price fluctuations, supply chains). Field LPG (5.9%), showed a Flexible uses (Heating, auto fuel, and rural energy supply) Efficiency trade-offs: High calorific value but costly logistics (storage, transport).therefore, fossil-based primary electricity is not significant (0.1%) (Figure3).

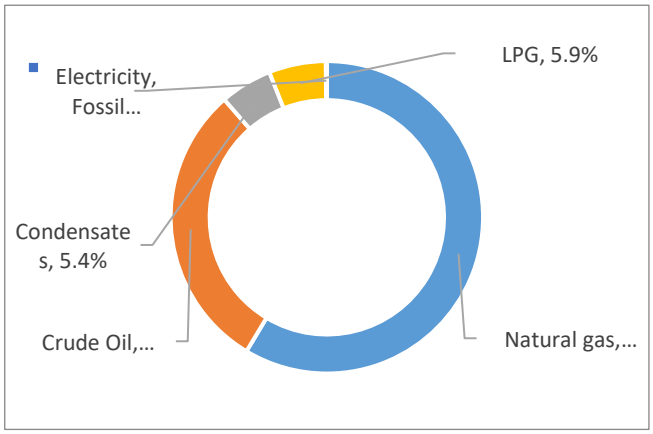


**Figure 3.** Structure of Commercial Primary Energy Production.

Total energy production showed significant growth of +6.8%, rising from 67,179 to 71,774 ktoe. This increase was primarily driven by LNG (+27.4%), followed to a lesser extent by thermal electricity (+2.9%) and LPG (+6.4%) (Table 3).

Petroleum products dominate Algeria's energy mix, accounting for 42% of total consumption (Figure 4). This dependence on hydrocarbons. This model that remains heavily carbon-intensive, despite climate commitments. it represents an economic risk, as it is vulnerable to global oil price fluctuations. Thermal electricity (natural gas) accounts for 31% of total energy consumption. These have a strong dependency on natural gas for electricity generation. Liquefied Natural Gas (LNG) accounts for 24% of the energy

mix, indicating the growing valorization of natural gas for both export and domestic consumption. LPG (2%) remains marginal, despite its potential for the transition (less polluting than gasoline). Other sources (1%, including charcoal) are negligible, but could be developed (biomass, waste) (Figure 4).

**Table 3: Energy Production from different sources (2022-2023).**

| Product | Units | 2022 | 2023 | Change | % Change |
|---|---|---|---|---|---|
| **Oil Products** | ktoe | 29.972 | 30.163 | +191 | +0.6% |
| | kTons | 28.470 | 28.663 | | |
| **Thermal Electricity** | ktoe | 21.852 | 22.494 | +641 | +2.9% |
| | GWh | 90.550 | 94.904 | | |
| **LNG** | ktoe | 13.340 | 16.998 | +3.658 | +27.4% |
| | $10^6$ m³ | 14.117 | 17.988 | | |
| **LPG (Refineries & LNG Plants)** | ktoe | 1.323 | 1.408 | +85 | +6.4% |
| | kTons | 1.122 | 1.194 | | |
| **Other (GHF, Charcoal)**- GHF | ktoe | 691 | 711 | +20 | +2.9% |
| | $10^6$ m³ | 731 | 752 | | |
| - Charcoal | $10^3$ m³ | 0.02 | 0.9 | | |
| **Total** | **ktoe** | **67179** | **71.774** | **+4595** | **+6.8%** |

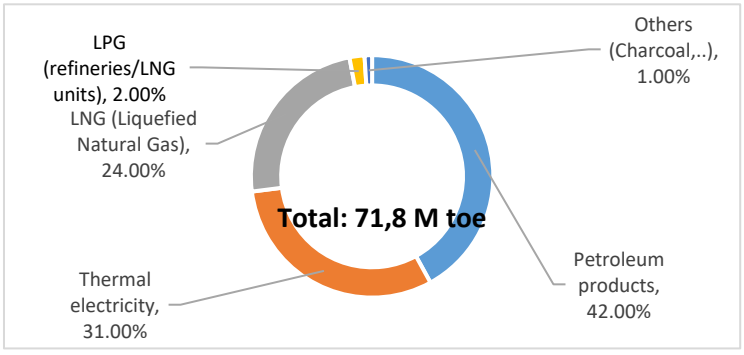


**Figure 4.** Distribution of energy production.

## 4. DISCUSSION:

The current situation calls for urgent action to manage and control domestic energy demand. Without corrective measures, the continuation of these trends could threaten Algeria's exportable energy resources long a cornerstone of the national economy (Ait Mokhtar et al. 2021). The national energy balance (NEB, 2024) confirms a final energy consumption of 54,204 ktoe (+2.1% vs. 2022), with energy losses soaring to 4,639 ktoe (+11.5%) due to aging infrastructure and inefficiencies. The country's energy equation has reached a critical juncture, requiring deep structural reforms and strategic adjustments (Kebour et al., 2021).

The relationship between final energy consumption and GDP growth requires deeper inspection to test decoupling hypotheses (Haberl et al., 2020). Sonelgaz report notes an increase of 6%/year, in electricity demand, since 2012, entirely gas-dependent, further straining the system (Sonelgaz, 2023). The rising loss rates expose inadequate grid investments, highlighting the urgent need for smart grid implementation (Gellings, 2020).

With domestic energy production, increasing at just 1.1% annually, the widening gap between supply and demand poses a serious threat to Algeria's vital energy exports. Since 2020, although production has been recovering, it is increasingly being consumed domestically threatening the nation's economic stability. These impose immediate action, where Three critical measures are required. Firstly, the Implementation of rigorous demand-side management programs. secondary, to Accelerate the deployment of renewable energy infrastructure. Lastly, the comprehensive grid modernization to reduce technical losses. Without these interventions, Algeria risks undermining both its energy security and export revenues in the medium term. The strategy must focus on creating long-term value while promoting a new energy consumption paradigm centered on consuming less, but more efficiently. This requires the adoption of advanced technologies and the encouragement of behavioral change across all sectors of society.

Algeria must urgently break away from a model of energy profligacy and commit resolutely to a path of energy sobriety. The 2030 horizon rapidly approaching represents a critical deadline. Current projections indicate that, without structural reforms, the country will face a major imbalance between its production capacity and its domestic and export energy needs (Sonatrach, 2023).

Algeria is confronted with several overlapping challenges that threaten its long-term stability. The first is the energy challenge, both national and international in scope, requiring resource security alongside a transition to sustainable energy sources. Next is the increasingly urgent water challenge, as growing demand collides with limited availability. Lastly, the environmental challenge worsened by the accelerating impacts of climate change adds another layer of complexity. These challenges demand a unified, long-term strategic vision grounded in rational planning, transparency and scientific rigor (Sonatrach, 2023).

### 4.1. Unsustainable Energy Consumption and the strategic Direction:

National natural gas consumption is growing at an alarming rate, underscoring the urgent need for rationalization. With approximately 2,500 billion cubic meters of gas remaining, reserves could be exhausted within two decades if current trends persist (Belaid & Zrelli, 2019). At this pace, Algeria risks leaving behind a severely energy-depleted legacy. The country stands at a crossroads. The coming decade offers a serious window of opportunity to initiate a structured, sober, and sustainable energy transition. This will require public policies built on rigor, transparency, intergenerational equity, and the full mobilization of renewable energy potential. With oil reserves estimated at around 12 billion barrels (or 1.2 billion tons), Algeria can no longer afford to continue its current trajectory. The decline in hydrocarbon reserves calls for a profound reorganization of the national energy model (Sonatrach, 2023).

In response to these pressing challenges, Algeria has defined a strategic roadmap to move away from an energy model dominated by fossil fuels and toward a more diversified, hybrid approach. This model rests on two pillars, the gradual and responsible use of fossil resources and the accelerated integration of renewable energy sources (RES) into the national energy mix (Boudghene Stambouli, 2019) . In order to implement this vision, Algeria has adopted a multisectoral strategy structured around eight priority pillars. These pillars simultaneously address the country's energy, economic, social and environmental challenges.

They aim to, promote energy sobriety, accelerate the integration of renewable, Optimize the use of natural resources and to rational energy behavior across all segments of society (Shinn, 2022).

**4.2. Combating Waste – The First Lever of the Transition:**

As part of its energy transition strategy, Algeria has identified the reduction of energy waste as a top priority. Many experts now consider energy waste to be the country's largest untapped energy reserve. The data is sobering: between 10% and 15% of nationally consumed energy is lost due to poor control (Ouki, 2020), inefficiencies, outdated infrastructure, or suboptimal equipment. This waste spans all strategic resources—electricity, natural gas, fuels, and even water, which itself requires significant energy for treatment, transport, and distribution. To address this challenge, the national strategy outlines a series of concrete, multisectoral measures aimed at rationalizing energy consumption. These include the conducting comprehensive energy audits across sectors, to develop detailed consumption assessments by sector and region and to Establish the performance indicators monitored, at the district and ministerial levels (Merzouk et al. 2021). The national target is 10% reduction in total energy consumption. Algeria currently consumes approximately 60 million tons of oil equivalent (Mtoe) annually. This translates to a save 6 Mtoe/year, equivalent to around 45 million barrels of oil. In financial terms, this could represent an estimated $1.8 billion in annual savings, significantly easing pressure on the country's fiscal balance. However, realizing this purpose cannot depend only on technical or administrative measures but. It demands the active participation of all stakeholders, beginning with the public (NEB, 2023).

**4.3. Structural Reform of the Algerian Energy Model:**

The current distribution of energy consumption in Algeria reveals a significant structural inequity. The transport sector alone accounts for approximately 30 to 35% of total energy use, while the residential sector consumes between 25 and 30%. In contrast, key value creating sectors such as agriculture and industry, collectively represent barely 2% of energy consumption. This disparity underscores a lack of investment in productive activities and highlights the need for a fundamental shift in approach (NEB, 2023).

**4.4. National Plan for Vehicle Conversion to LPG and CNG:**

The transport sector's energy conversion strategy is built around ambitious, measurable targets. It aims to convert 200 000 vehicles to liquefied petroleum gas (LPG) including 50 000 taxis and to foster the creation of 200 000 startups specializing in vehicle conversion and maintenance. This initiative involves a broad coalition of stakeholders, including the Ministries of Energy, Transport, Interior, and Start-ups, as well as local authorities and public institutions, particularly through the phased conversion of their own vehicle fleets. In order to facilitate the transition, a series of incentives is planned, including partial subsidies for LPG conversion kits, monthly monitoring of converted vehicles, and targeted financial assistance, especially for professional drivers such as taxi operators. The economic impact is expected to be significant: replacing 200 million liters of conventional fuel with 300 million liters of LPG could reduce Algeria's fuel import bill by up to 60%, equivalent to approximately $2 billion, thereby alleviating pressure on the country's trade balance (Sonatrach, 2023).

**4.5. Development of Electric Vehicles and Associated Infrastructure:**

The development of electric mobility is a key component of Algeria's energy transition, with several concrete initiatives already underway. These include the experimental deployment of electric vehicles in Algiers, the installation of charging infrastructure (with four pilot stations currently in progress), and the incorporation of electromobility criteria into vehicle import regulations.

Affordability is improving, with models such as the Dacia Spring available for around €8 000; making electric vehicles increasingly accessible to segments of the population. Additionally, the operating cost of electric vehicles is approximately four times lower than that of conventional fuel-powered vehicles. Public support for this transition appears promising: surveys show that 60% of citizens are in favor. Public

awareness campaigns are scheduled to further promote the economic and environmental benefits of electric mobility (Sonatrach, 2023).

**4.6. Energy Efficiency in Residential and Public Buildings:**

In the residential and public infrastructure sectors, priority actions have been identified to reduce energy use and enhance efficiency. A key measure is the renovation of older buildings, particularly through improved thermal insulation, to minimize energy loss.

An ambitious solar water heater program is also planned, with an initial target of 200 000 units installed in priority facilities such as schools and hospitals. Each unit is estimated to cost approximately 120 000 DZD, supported by a combined financing mechanism involving partial government subsidies and progressive repayment through savings on gas consumption.

Another important initiative involves solar-powered public lighting, with installation costs similar to those of solar water heaters. However, the success of this program depends on the implementation of effective maintenance and security systems to avoid theft and damage. Coordination with the Ministry of Interior is essential to ensure infrastructure sustainability and maximize benefits to local communities (Sonatrach, 2023).

**4.7. Development of Renewable Energy in Southern and Rural Areas:**

The strategy for solar power plant development is based on a rational, phased approach, favoring modular deployment over large-scale announcements. Projects will focus on medium-sized plants (ranging from 50 to 250 MW), tailored to local needs and aligned with agricultural development zones and the trans-Saharan electricity corridor, maximizing cross-sector synergies. To minimize pressure on foreign currency reserves, alternative financing solutions are being explored. One innovative option involves compensating foreign partners with unconsumed natural gas, thereby conserving resources and supporting the energy transition. From a profitability standpoint, a 1,000 MW solar plant could save approximately 500 million cubic meters of gas annually, equivalent to an estimated $200 million in savings (NEB, 2023).

**4.8. Energy Justice and Subsidy Reform:**

Currently, energy subsidies are applied uniformly, despite significant disparities in consumption. For example, both fuel-efficient vehicles (5 l/100 km) and fuel-inefficient ones (20 l/100 km) benefit from the same subsidized fuel prices. In the meantime, non-motorized citizens indirectly bear the burden of these subsidies, exacerbating social inequities. To address this, several reforms are proposed, including the introduction of an annual energy allowance per citizen, e.g., 1 ton of fuel equivalent, sufficient for about 20,000 km of driving. Consumption beyond this quota would be charged at the actual cost of energy. The reform would be implemented gradually, transparently, and with differentiation by social category to protect vulnerable households. For households in “shadow zones”, areas far from the national energy grid. Specific measures are proposed, including the provision of domestic solar kits (300 W to 1 kW) to improve access to electricity. A special social tariff would apply and a compensation fund managed by the Ministry of Agriculture would help support these populations (Sonatrach, 2023).

**4.9. Modernization of the Agricultural and Industrial Sectors**

In the agricultural sector, the transition aims to reduce reliance on fossil fuels through renewable solutions. A central initiative is the deployment of solar-powered irrigation pumps, allowing farms to utilize clean, local energy sources. Furthermore, efforts are underway to replace diesel with more sustainable alternatives, such as blending diesel with 30% LPG and promoting the use of Compressed Natural Gas (CNG) for agricultural vehicles and machinery. These measures will help lower emissions and operating costs. Finally, the deployment of solar kits for agricultural operations offers a decentralized, renewable energy source to support farming activities, reduce long-term energy expenses, and enhance sustainability in rural production (Sonatrach, 2023).

**5. CONCLUSION:**

The success of Algeria's energy transition hinges on the collective mobilization of all stakeholders, not only public administrations, but also businesses and citizens. The proposed energy transition plan distinguishes itself through a structured, pragmatic, and forward-looking vision. It acknowledges the structural limitations of Algeria's fossil fuel-dependent economic model and is anchored in three foundational pillars: long-term vision, cost control, and value creation. The contextual analysis, rigorous and unflinching, clearly outlines the systemic challenges the country faces, while the eight operational pillars address the core levers of change: consumption, transportation, production, subsidies, renewable energy deployment and agricultural modernization. The plan sets out ambitious targets: achieving savings of 6 million tonnes of oil equivalent through energy efficiency measures, converting 200,000 vehicles to LPG, expanding solar street lighting in municipalities, and reaching 16,000 MW of photovoltaic capacity by 2035. Crucially, it integrates a strong social dimension, including the establishment of a compensation fund to support vulnerable populations and a focus on empowering local authorities to adapt policies to territorial realities. The energy transition plan is more than a technical roadmap. It represents a systemic transformation that demands broad-based commitment, institutional innovation and ongoing public engagement. If underpinned by sustained political will and translated into concrete, measurable actions, Algeria can progress toward a more efficient, equitable, and resilient energy future.

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