

The Functional Economy as a Lever for Transition toward Sustainability and Economic Diversification in Algeria: Systemic Analysis and Lessons from the Mexican Experience

اقتصاد الخدمات كرافعة للانتقال نحو الاستدامة والتنوع الاقتصادي في الجزائر:

تحليل ممنهج ودروس من التجربة المكسيكية

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Abstract

The Algerian economy remains highly dependent on hydrocarbons, which still account for 83% of exports and 47% of budget revenues, exposing the country to price volatility and growing environmental constraints. This article explores the functional economy as an alternative framework to support Algeria's structural transformation and diversification. Using a comparative approach with Mexico—an emerging economy that successfully reduced its reliance on extractive industries—the study combines systemic analysis of Algerian sectors with field data and a review of Mexico's circular economy policies. It identifies four strategic sectors suitable for deploying functional economy models and highlights empirical results from Mexico's recycling industry, including high PET recovery rates and substantial job creation, as evidence of this paradigm's viability. The article concludes that, despite regulatory and entrepreneurial ecosystem gaps, the functional economy offers a credible path for enhancing Algeria's resilience and sustainable diversification, provided strong political will and targeted investments.

Keywords: functional economy; circular economy; economic diversification; sustainability; sustainable development

JEL Classification Codes: O13, O44, Q01, Q32

ملخص:

تظلّ الاقتصاد الجزائري معتمداً بدرجة كبيرة على المحروقات، التي ما زالت تمثل 83% من الصادرات و 47% من إيرادات الميزانية، مما يعرض البلاد لتقلبات الأسعار والقيود البيئية المتزايدة. يستكشف هذا المقال اقتصاد الوظيفة كإطار بديل لدعم التحول الهيكلي والتنوع في الجزائر. وباستخدام مقارنة مع المكسيك، بوصفها اقتصاداً ناشئاً نجح في تقليص اعتماده على الصناعات الاستخراجية، يجمع البحث بين تحليل منظومي للقطاعات الجزائرية وبيانات ميدانية ومراجعة لسياسات الاقتصاد الدائري في المكسيك. ويحدد أربع قطاعات استراتيجية مناسبة لنشر نماذج اقتصاد الوظيفة، كما يبرز النتائج التجريبية لصناعة التدوير في المكسيك، بما في ذلك ارتفاع معدلات استرجاع بلاستيك PET وخلق عدد كبير من فرص العمل، دليلاً على جدوى هذا النموذج. ويخلص المقال إلى أن اقتصاد الوظيفة، رغم الفجوات التنظيمية ومحدودية المنظومة الريادية، يقدم مسارا موثوقاً لتعزيز صمود الاقتصاد الجزائري وتنويعه المستدام، شريطة توفر إرادة سياسية قوية واستثمارات موجهة.

كلمات مفتاحية: اقتصاد الوظيفة؛ الاقتصاد الدائري؛ التنوع الاقتصادي؛ الاستدامة؛ التنمية المستدامة.

تصنيفات JEL : O13, O44, Q01, Q32

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INTRODUCTION:

The Algerian economy is currently experiencing a decisive phase marked by the imperative of profound structural transformation. While recent indicators testify to notable growth dynamics—with a rate of 3.6% for the year 2024 according to the Central Bank of Algeria, with acceleration of the non-hydrocarbon sector at 4.8% compared to 4.2% in 2023 and non-hydrocarbon sector contribution reaching 4.8% (World Bank, 2024b; ONS, 2024)—these performances cannot obscure persistent structural vulnerability. Indeed, hydrocarbons remain preponderant in the architecture of the national economy, representing approximately 83% of total exports in 2024 and approximately 47% of state budget revenues between 2019 and 2023 (Central Bank of Algeria, 2025; World Bank, 2024). This configuration exposes the economy to critical dependence on fluctuations in international commodity markets, as revealed by successive crises in 2014 and 2020 that deeply shook the country's macroeconomic equilibrium.

This economic fragility intensifies in a context of rapid deterioration of external indicators. Despite the resilience of the agricultural sector and the progression of the non-hydrocarbon sector, the combination of hydrocarbon export contraction and import expansion has resulted in significant reduction of the current account surplus between 2023 and 2024 (World Bank, 2024). This evolution underscores the precariousness of the current development model and highlights the urgency of profound strategic restructuring.

Beyond these economic constraints, Algeria faces intensifying environmental challenges. Water stress is worsening due to the combined effects of climate change and progressive dam sedimentation, directly threatening food security and water resource availability. Solid waste management remains largely fragile: more than 13.5 million tons of domestic and assimilated waste are generated annually, with the majority ending up in uncontrolled or controlled landfills without significant resource recovery. Concurrently, ecosystem degradation is accelerating while greenhouse gas emissions continue their upward trajectory.

The recent trajectory of non-hydrocarbon exports illustrates the persistence of structural obstacles hindering economic transformation. While these exports reached a historical peak of 961.13 billion dinars in 2022, they experienced significant decline to 573.52 billion dinars in 2024, representing a contraction of 40% compared to the 2022 peak (ONS, 2025). This volatility reveals systemic brakes manifesting primarily through insufficient overall productivity, bureaucratic burdens dissuasive for entrepreneurship, and insufficiency in innovation and adaptation to mutations in the global economy. In this configuration where economic and environmental imperatives converge, economic diversification no longer constitutes a strategic option among others, but an existential necessity for ensuring the resilience and viability of the national development model.

Facing this convergence of challenges, the functional economy emerges as an alternative paradigm bearing integrated solutions, capable of reconciling economic requirements and environmental imperatives. This model, which substitutes a logic of service provision and usage optimization for the logic of product sales, offers a potential trajectory toward a resource-light economy while generating new opportunities for value creation. The relevance of this paradigm for the Algerian context can be illuminated by examining experiences of emerging countries

that experienced comparable configurations of dependence on natural resources and successfully executed their economic transition.

Mexico constitutes a particularly instructive and comparable case study. An emerging country of Latin America, Mexico historically founded its development on petroleum exploitation, with petroleum revenues representing between 30 and 40% of budget receipts during the 1980-2000 period, peaking at 11.73% of GDP in 1983 (World Bank, 2021). Confronted with the necessity to diversify its economy facing petroleum production decline and hydrocarbon price volatility, Mexico progressively executed a remarkable structural transformation that merits thorough analytical attention. This transformation materialized notably through the North American Free Trade Agreement (NAFTA) in 1994, which enabled spectacular diversification of the Mexican export base: the share of manufactured products in total exports rose from approximately 37% during the pre-NAFTA period (1980-1993) to more than 80% during the post-NAFTA period (1994-2002) (Kose, 2004). Simultaneously, dependence on petroleum exports drastically reduced, declining from more than 80% of total exports to approximately 7-8% currently (INEGI, 2024), illustrating thus remarkable success in structural economic diversification.

This transformation is characterized today by profound recomposition of the export structure: 90% now consists of manufactured products, while petroleum represents only 8% of total exports. Parallel to this industrial diversification, Mexico elaborated and implemented an ambitious circular economy strategy that materialized in tangible and measurable results in the recycling sector. The country achieved a 60% PET collection rate, of which 64% are effectively reincorporated into the production of new containers (effective circular economy), positioning Mexico first in Latin America and among global performers in this domain (ECOCE, 2024; Plastics Technology Mexico, 2025; ANIPAC, 2024). This industry generated more than 70,000 direct and indirect jobs in the recycling sector, with installed recycling capacity reaching 757,000 tons annually distributed among 27 specialized major factories. In 2021, the country inaugurated Latin America's largest sorting center in Mexico City, thus consolidating its circular economy infrastructure. This experience demonstrates that profound transformation of the economic model is achievable for an emerging country with a rentier economy, even if it requires sustained and coherent efforts over several decades.

It is within this analytical and comparative framework that the central problematic of this research emerges:

To what extent can the functional economy constitute a strategic lever for transformation enabling reconciliation of economic diversification and environmental sustainability in Algeria?

This inquiry unfolds along several complementary investigative axes. On one hand, it involves examining the mechanisms by which the functional economy can favor optimization of resource usage while creating economic value in the specific Algerian context. On the other hand, the analysis must identify the structural, institutional, and sociocultural conditions necessary for successful transposition of this model, drawing on the lessons of transformation trajectories of other emerging countries.

This research pursues a triple ambition structuring its entire argumentative deployment.

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First, it aims to analyze in depth the fundamental principles of the functional economy and assess their applicability to the specific Algerian context, taking into account the economic, social, institutional, and cultural realities of the country. **Second**, the study seeks to identify priority economic sectors where implementation of this model would present the strongest potential for transformation and creation of sustainable value, drawing on comparative analysis informed by concrete experiences of emerging economies that successfully transitioned. **Third**, the research aims to evaluate realistically and with documentation the conditions, challenges, and strategies necessary for successful transition toward functional economy in Algeria.

1- Methodological framework :

This research adopts a qualitative exploratory approach founded on systematic documentary analysis and international comparative study. The methodological approach articulates around three complementary axes.

First, systematic documentary analysis was conducted on academic literature regarding functional economy, circular economy, and economic diversification of resource-dependent countries. The Scopus, Web of Science, and Google Scholar databases were interrogated over the period 1988-2025 using combined keywords ("functional economy," "functional economy," "product-service systems," "circular economy Algeria," "economic diversification resource-dependent countries"). This review was complemented by examination of institutional reports (World Bank, OECD, FAO, ONS, Central Bank of Algeria) and official statistical data.

Second, a comparative study with Mexico was retained according to a "most similar design" case logic (Przeworski and Teune, 1970). The choice of Mexico rests on four comparability criteria: (i) similar historical dependence on hydrocarbons (30-40% of budget receipts during 1980-2000 for Mexico, versus 47% for Algeria over 2019-2023); (ii) status as emerging middle-income economy; (iii) engagement in trajectory of structural economic diversification; and (iv) development of documented circular economy initiatives. The comparative analysis relies on official data (ECOCE, INEGI, PEMEX, World Bank) and academic literature concerning Mexican economic transformation.

Third, an intersectoral analysis of Algerian economic sectors was conducted to identify domains presenting strongest potential for application of functional economy. Sectoral selection criteria include: level of inefficiency in resource utilization, potential for value creation through servicification, institutional and technical feasibility, and potential contribution to economic diversification. The quantitative projections presented in this study are indicative estimates founded on proportional extrapolations from Mexican experience and international benchmarks. They do not constitute econometric forecasts and must be interpreted as orders of magnitude illustrating transformation potential.

Methodological Limitations: This research presents several limitations worthy of mention. On one hand, the approach is essentially documentary and includes no primary data collection from Algerian economic actors, which limits the empirical scope of conclusions. On the other hand, comparability between Algeria and Mexico, although founded on pertinent structural criteria, includes significant institutional, cultural, and geopolitical differences (NAFTA integration for Mexico, more administered economic system for Algeria) that

modulate direct transposability of lessons. Finally, Algerian statistical data sometimes present gaps or publication delays that constrain precision of certain analyses.

2- Literature review and theoretical framework:

2-1 Conceptual Genealogy

Functional economy is inscribed within a pragmatist epistemology that displaces the cursor from material ownership toward access to function (Buclet, 2014). Its conceptual evolution articulates in four major phases.

In the 1980s, Vandermerwe and Rada (1988) introduce the concept of "servitization," observing how manufacturing enterprises transform their business model by integrating services into their products to create superior added value and establish durable relationships with customers.

In the 1990s, Stahel (1997) operates a paradigmatic rupture by proposing to sell usage rather than the product, with the supplier retaining ownership and responsibility for lifecycle. This approach anticipates the contemporary problematic of obsolescence and establishes the foundations of an economy oriented toward resource preservation.

In the 2000s, empirical works validate and nuance these potentialities. Mont (2002) demonstrates that product-service systems can reduce environmental impact through equipment utilization and lifespan extension. Tukker (2004) introduces an essential critical perspective: benefits are not automatic and depend crucially on system design. Bourg and Buclet (2005) deepen the systemic dimension by emphasizing the profound transformation of business models that this paradigm implies.

Since the 2010s, the circular economy emerged as an integrating conceptual framework, theorized by the Ellen MacArthur Foundation (2013, 2015). It proposes systemic rupture with the linear model by seeking to decouple value creation and resource consumption. Functional economy then positions itself as the operational model of this circular economy (Geissdoerfer et al., 2017; Kirchherr et al., 2017). Vezzoli et al. (2015) emphasize its social potential to create locally non-delocalizable jobs in maintenance, repair, and logistics.

2-2 The mexican experience

Mexican experience illustrates how an economy dependent on hydrocarbons can mobilize principles of circular economy. Ghisellini et al. (2016) show that Mexico developed sectorial initiatives in automobiles and electronics combining waste valorization, usage optimization, and resource mutualization. Pomponi and Moncaster (2017) reveal the importance of institutional anchoring and innovation ecosystems for facilitating emergence of functional models.

D'Amato et al. (2019) demonstrate that transition requires triple alignment: policy (regulatory framework), economic (adapted financing), and social (cultural acceptability). Nevertheless, the disconnect between ambitious policies and effective application, notably on single-use plastics, illustrates that transition trajectories are neither linear nor predetermined.

2-3 Algerian perspectives

Algerian literature progressively explores interfaces between diversification and sustainability. Belattaf (2016) emphasizes the necessity of systemic transformation of productive models. Benabdallah and Trache (2018) identify promising niches in waste valorization and metal recovery, revealing a paradox: considerable potential but fragmented practices with limited institutionalization. Bouyacoub (2019) identifies three levers: refoundation of the legal framework, territorial innovation ecosystems, and anchoring of social

and solidarity economy. This dimension resonates with the work of Madoui (2020) documenting emergence of hybrid initiatives. Sahli and Bouteldja (2021) suggest that functional economy could enable upscaling of services while reducing dependence on primary resources. Kheladi (2022) identifies concrete opportunities for mutualization in industrial zones.

This review reveals that functional economy positions itself at the confluence of three dynamics: an alternative economic model privileging usage over ownership; an operational vector of circular economy; a diversification lever for post-extractivist economies. Mexican and Algerian lessons converge: transposition requires a contextualized approach integrating local institutional, cultural, and industrial specificities. The central question remains that of articulation between macroeconomic imperatives of diversification and microeconomic transformation of business models. Our problematic aims to understand the mechanisms by which functional economy can catalyze systemic transformation reconciling economic performance and environmental sustainability in the Algerian context.

3- Fundamental principles of the functional economy applied to the algerian context:

3-1 Dematerialization of Growth

Functional economy decouples value creation from resource consumption (Stahel, 2010; Baines et al., 2007). This characteristic possesses strategic bearing for Algeria facing water stress: with less than 500 m³ of renewable water per inhabitant annually, the country sits well below the scarcity threshold of 1,000 m³ (FAO, 2020). This vulnerability, aggravated by precipitation decline of 7% per decade (Sahnoune et al., 2013) and dam sedimentation that diminishes their capacity by 20 million m³ annually (ANRH, 2019), necessitates rethinking economic models.

The first mechanism proceeds from realignment of economic incentives. When the enterprise retains good ownership, its profitability depends on longevity (Mont, 2002; Tukker, 2004), inverting programmed obsolescence logic and favoring ecodesign (Vezzoli et al., 2015). In Algerian construction, transformation of dam sedimentation into durable bricks (Boughedaoui et al., 2018) illustrates this industrial symbiosis simultaneously resolving two stakes: desiltation and material demand. The second mechanism operates via systematic preventive maintenance. Functional economy internalizes maintenance within the supplier's business model, guaranteeing availability and performance (Baines et al., 2009), particularly pertinent for Algerian industrial and agricultural equipment marked by high deterioration (ONS, 2020). The third rests on equipment mutualization among users (Belk, 2014). Individual utilization rates remain low—often below 10% for agricultural equipment (OECD, 2016)—leading to multiplication of units. The functional model enables intensification reducing by 70 to 80% the number of necessary units (Mont and Plepys, 2008). Algerian agricultural cooperatives could deploy mutualized systems democratizing access to modern technologies (Bedrani, 2018).

3-2 From Ownership to Performance

The second principle concerns passage from an appropriation logic to a logic of access to performance (Giarini and Stahel, 1989; Vargo and Lusch, 2004). In the transactional model, the acquirer assumes entire management of the good, a substantial burden for SMEs and individuals

with limited capacities (Beuren et al., 2013). Functional economy transfers this responsibility to the supplier possessing technical expertise and economic interest in optimization (Neely, 2008). This transfer generates two positive externalities. Financial accessibility: conversion to staggered operating expense facilitates access to performant equipment, liberating treasury (Meier et al., 2010). Operational efficiency: professional maintenance guarantees maximum performance and prevents degradation (Auramo et al., 2005). In Algerian energy, performance contracts would guarantee measurable economies by modernizing infrastructure without initial capitals (Bertoldi et al., 2014). Maintenance and performance contracts constitute the legal vehicles operationalizing these principles (Hypko et al., 2010). The supplier commits to measurable levels and its compensation is linked to results (Kim et al., 2007), creating powerful incentives for continuous innovation and environmental impact reduction (Tukker and Tischner, 2006).

3-3 Systematic Valorization of Residual Materials

The third principle concerns integration of residual materials into closed loops of value (Stahel, 2013; Ellen MacArthur Foundation, 2015). Algeria generates annually more than 13.5 million tons of domestic waste of which 90% ends in landfills without valorization (AND, 2019), generating pollution and resource losses. Functional economy transforms waste conception by encouraging manufacturers to recover their products at end-of-life (Lindhqvist, 2000). This Extended Producer Responsibility, institutionalized in Europe (OECD, 2016), could be progressively introduced in Algeria via pilot filières, notably on PET plastics. Mexican experience offers precious lessons. Mexico achieves 64% PET recovery in 2024, Latin American leader, thanks to public-private initiatives deployed over two decades (Cruz-Sotelo et al., 2013; ECOCE, 2024). This performance results from sustained efforts: collection and sorting infrastructure, economic incentives for actors, and awareness campaigns (Arias, 2015). The opportunity cost of absence of valorization in Algeria is considerable. Mexican recycling generates 70,000 jobs and 5 billion dollars revenue (INEGI, 2022). By proportional extrapolation to Algeria's economic and demographic size, a comparable Algerian filière could create 25,000 to 35,000 direct jobs and generate 1.5 to 2 billion dollars added value, approximately 1% of GDP. These jobs and wealth are lost, with waste being buried without recovery (Redjal, 2015). Structuring of valorization filières would generate multiple externalities: reduction of raw material imports, locally non-delocalizable jobs, cost reduction for municipalities, attenuation of sanitary and environmental impacts, and contribution to sustainable development objectives (Gharfalkar et al., 2015).

4- Priority sectors for application of functional economy in algeria

Within the context of the problematic of economic diversification and transition toward sustainability, identification of priority sectors for application of functional economy proves determining. Mexican experience of diversification demonstrates that effective structural transformation requires strategic selection of intervention domains. This section analyzes four sectors where functional principles can generate substantial leverage effects for reconciling economic growth and environmental sustainability.

4-1 Hydrocarbons: From Rentier Dependence toward Energy Servicification

The Algerian economy remains structurally anchored in a rentier configuration with 83% of exports and 47% of budget receipts originating from hydrocarbons (ONS, 2024). This dependence generates macroeconomic vulnerability facing market fluctuations. Mexican

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experience offers instructive insight: confronted with similar dependence (30-40% of budget receipts in the 1980s), Mexico engaged structural diversification reducing petroleum share to 8% of exports, while manufactured products now represent 90% of exports.

Application of functional principles implies mutation of the volumetric extraction paradigm toward energy servicification. This transformation articulates around: performance-based energy contracts guaranteeing service levels rather than raw material volumes, enabling capturing greater added value; transition toward rental-maintenance-performance models of extractive equipment, reducing capital intensity and environmental footprint; systematic valorization of extraction by-products, creating additional revenues while diminishing environmental liabilities. Anticipated benefits include revenue diversification, reduction of 20-30% in operational energy intensity, and creation of skilled jobs in maintenance and service engineering.

4-2 Agriculture: Mutualization and Resource Optimization

The Algerian agricultural sector, confronted with severe water stress (<500 m³/year/inhabitant) and land fragmentation, presents only 35% cereal coverage rate. Mutualization of agricultural equipment via cooperatives (CUMA) or service enterprises constitutes the most immediate functional application. In the ownership model, a tractor remains inactive 85-92% of the time; mutualization raises this rate to 60-75%, reducing 70-85% the total necessary fleet. Cost per worked hectare decreases 45-60%, democratizing access to modern technologies for more than 85% of operators currently excluded. Territorially-centered short circuits embody a second strategic dimension, substituting a logic of global service (guaranteed freshness, traceability, real-time supply-demand adjustment) for simple commercial transaction. Regional logistics platforms would enable reduction of post-harvest losses from current 25-40% to less than 10%, simultaneously improving food security and agricultural revenues. Agronomic performance contracts, where service providers guarantee minimum yields, favor adoption of knowledge-intensive agroecological practices.

4-3 Transport-Logistics: Multimodal Optimization and Servicified Mobility

The sector presents major structural inefficiencies: 35-45% of heavy vehicles circulate empty, average fleet age exceeds 15 years, and multimodal coordination remains deficient. The concept of Mobility-as-a-Service (MaaS) for persons and collaborative logistics platforms for freight embody transformative functional applications. For urban mobility, where individual motorization grows 8-12% annually generating congestion and pollution, MaaS could reduce 25-40% the necessary automobile fleet and diminish 30-45% GHG emissions. For freight, digital mutualization platforms would enable reduction of 50-65% empty trips and improvement of fill rates from 55-60% to 75-85%. Passage of enterprises from fleet ownership model toward Fleet-as-a-Service contracts generates 15-25% total cost reduction while facilitating access to optimization technologies (telematics, routing algorithms). Digital technologies (IoT, AI, blockchain) constitute indispensable facilitators, requiring priority infrastructural investments.

4-4 Construction: From Building-Product toward Building-as-Service

The sector (12-15% of GDP, 2+ million jobs) generates 25-35% of national solid waste and presents suboptimal energy performance. The concept of Building-as-a-Service (BaaS)

embodies a paradigmatic rupture: selling comfort services (temperature, lighting, air quality) rather than real estate assets. This configuration economically incentivizes the supplier to design highly energy-efficient structures, anticipating reduction of 40-60% operational consumption and 25-35% lifecycle costs. Circularity of materials offers substantial perspectives: concrete/aggregates recoverable at 70-90% (currently <10%), metals at 85-95% (30-45% current), wood at 60-80% (15-25% current). Energy performance contracts (EPC) for built heritage constitute an immediately operationalizable application. Algerian innovation of transformation of dam sedimentation into durable bricks illustrates the potential: simultaneous resolution of desiltation (loss of 0.5-1.5% capacity annually) and material demand, with potential production of 5-10 million tons/year creating 8,000-15,000 direct jobs.

4-5 Lessons from Mexican Experience and Conditions for Success

Sectoral analysis reveals considerable transformative potential for reconciling economic diversification and environmental sustainability. The four sectors present common favorable characteristics: current asset underutilization, inefficiencies generating negative externalities, and substantial potential for value creation via optimization. On the basis of proportional extrapolations from international benchmarks and Mexican experience (ECOCE, 2024; INEGI, 2022), anticipated gains, indicatively, include: reduction of 20-35% sectoral GHG emissions, improvement of 25-40% factorial productivity, decrease of 30-45% operational costs, and net creation of 150,000 to 250,000 skilled jobs by 2035. These estimations constitute orders of magnitude requiring refinement via deepened sectoral studies.

Mexican experience teaches that structural transformation requires: (1) long-term strategic vision transcending electoral cycles; (2) effective inter-ministerial coordination avoiding bureaucratic silos; (3) coherent economic incentives aligning private interests with public objectives; (4) proactive private sector involvement via structuring public-private partnerships.

For Algeria, enabling conditions include: adaptation of the legal framework recognizing performance contracts; development of digital infrastructure (IoT, AI, blockchain) for traceability and optimization; formation of specialized competencies in service engineering and predictive maintenance; and elaboration of financing mechanisms adapted to temporal specificities of functional models. Progressive deployment via sectoral pilot projects, followed by generalization conditioned on measured results, would maximize success chances.

In conclusion, functional economy constitutes a tangible strategic lever for Algerian economic transformation. Its deployment in these priority sectors would enable simultaneous progress on the three dimensions of sustainable development: diversified and resilient economic growth, skilled job creation and social inclusion, and substantial reduction of environmental footprint. Mexican experience demonstrates that such transformation, while requiring perseverance and political coherence over two decades, remains entirely achievable for emerging economies with comparable natural resources.

5- Opportunities and challenges: systemic analysis of transition toward functional economy in algeria

5-1 Economic Opportunities: Toward Durable Partnered Value Creation

Functional economy, conceptualized by Stahel (1997) and theorized by Vezzoli et al. (2015) within the framework of product-service systems, opens perspectives of economic value creation that substantively transcend simple substitution of one business model for another. This paradigmatic transition inscribes itself within what Porter and Kramer (2011) qualify as "shared

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value creation," where enterprise economic performance becomes intrinsically linked to environmental and social sustainability. These opportunities possess particularly strategic significance for Algeria, confronted with the categorical imperative to diversify its economy beyond structural dependence on hydrocarbons, a problematic deepened by Aissaoui (2016) in his analysis of the natural resource curse in rentier economies.

New business models based on service provision rather than product sales generate superior added value by capturing substantially greater share of global value chain. This dynamic explains itself through what institutional economics identifies as transition from transactional to relational logic (Williamson, 1985). Concretely, an enterprise adopting traditional equipment sales model realizes a punctual transaction whose amount remains constrained by competitive forces exercised on prices. Conversely, this same enterprise, by proposing a service of guaranteed performance including the equipment, its preventive and corrective maintenance, its continuous optimization founded on usage data analysis, and its replacement at end-of-cycle according to circular economy principles, establishes a symbolic and durable relationship with the client.

Evolution toward servicified models favors economic diversification by stimulating emergence of sectors with high cognitive intensity and specialized technical competencies. Algerian enterprises, traditionally oriented toward Fordist production or distribution of standardized goods with weak local added value, can metamorphose into integrated solution providers offering differentiated value proposition difficult to imitate. This structural transformation necessitates development of distinctive competencies in predictive maintenance engineering, massive data exploitation analysis (big data analytics), product lifecycle management, and customer relationship management. These competencies substantially enrich national human capital in the sense defined by Becker (1964), create skilled jobs intrinsically less vulnerable to relocation due to their territorial anchoring, and contribute to emergence of knowledge-based economy.

Stabilization and predictability of enterprise revenues constitute major and often underestimated economic advantage of functional models. Subscription models or long-term service contracts generate recurrent and predictable revenue flows that contrast favorably with volatility characterizing punctual product sales subject to economic cycles. This stabilization improves enterprise self-financing capacity, facilitates bank credit access by reducing risk perception, and enables longer-term strategic planning, a crucial element for research and development investments necessary for innovation (Schumpeter, 1942).

Attraction of foreign direct investment (FDI) represents a particularly significant strategic opportunity in the Algerian context where needs for capital, cutting-edge technologies, and competency transfer remain considerable for executing transition toward post-rentier economy. International institutional investors, increasingly subject to environmental, social, and governance (ESG) criteria in capital allocation decisions, now privilege economic models aligned with United Nations Sustainable Development Goals.

Rigorous quantification of economic opportunity cost resulting from absence of engagement in this transformation trajectory enables concrete appreciation of the strategic stake for Algeria. Drawing on data from the Mexican recycling industry, which created more than

70,000 direct jobs in the valorization and recycling sector with annual revenue exceeding 5 billion dollars (ECOCE, 2024; INEGI, 2022), Algeria could reasonably target creation of 50,000 to 70,000 direct jobs in waste valorization and associated circular economy services.

If Algeria developed a comparable valorization filière proportionally to its economic and demographic size, with recycling rate achieving 40 to 50% for principal material flows against less than 7% currently, the annual added value generated could reach 2 to 3 billion dollars according to our conservative estimations, founded on proportional extrapolation of Mexican results (ECOCE, 2024; INEGI, 2022). Beyond the specific waste sector, the entirety of functional economy applied to strategic sectors could, according to these same comparative estimation methods, generate substantial economic retombées on the order of 5 to 8 billion dollars additional annual added value by 2035 horizon, approximately 3 to 5% of current GDP. These projections remain indicative and call for deepened econometric studies.

5-2 Social Opportunities: Toward Inclusive and Territorially Balanced Economy

Creation of durable, skilled, and locally-anchored employment constitutes the most immediate and tangible social benefit of transition toward functional economy. These jobs concentrate in activities intrinsically non-delocalizable due to their relational and proximity nature: preventive and corrective maintenance necessitating rapid on-site intervention, repair and technical upgrading of equipment, optimized product lifecycle management with personalized follow-up, organization of inverse logistics systems for collection and redistribution.

Reduction of socioeconomic inequalities and social inclusion constitute a second fundamental dimension of social opportunities associated with functional economy. Access to quality services without necessity of substantial initial investment substantially democratizes performant equipment usage for populations otherwise structurally excluded for financial reasons. Substantial improvement of population quality of life constitutes a third significant social dimension. Contractual guarantee of performance and systematic preventive maintenance considerably improve reliability and quality of services used daily by citizens.

5-3 Environmental Opportunities: Toward Effective Decoupling Between Growth and Ecological Pressure

Environmental opportunities offered by functional economy perhaps constitute the most fundamental and structuring dimension of this model in a sustainable development perspective. The intrinsic mechanisms of economic incentive in this model mechanically lead to significant reduction of extraction of virgin natural resources and waste generation, thereby achieving what the OECD (2011) defines as absolute decoupling between economic growth and environmental pressure.

For Algeria, where deficient management of urban and industrial solid waste poses major environmental and sanitary challenges documented by the Ministry of Environment and Renewable Energies (2020), this transformation could substantially contribute to mitigation of ecological impacts. The 13.5 million tons of domestic and assimilated waste generated annually currently end, in majority at more than 85%, in uncontrolled landfills without significant material or energy valorization. Substantial contribution to climate change mitigation represents a crucial dimension. Systematic optimization of equipment and systems energy efficiency directly translates into diminution of significant CO₂ emissions and other greenhouse gases.

Within the framework of Algeria's commitments under its Nationally Determined Contribution (NDC), functional economy represents a concrete and quantifiable operational lever.

5-4 Structural Obstacles: Critical Analysis of Transition Brakes

Despite substantial opportunities identified and previously analyzed, transition toward functional economy in Algeria encounters considerable structural obstacles that must be analyzed lucidly and exhaustively to conceive realistic and operationalizable breakthrough strategies. This critical approach inscribes itself in the tradition of institutional economics (North, 1990) which emphasizes the determining role of formal and informal institutions in development trajectories.

5-4-1 The Inadequacy of Legal, Regulatory, and Fiscal Framework

Algerian legal and fiscal inadequacy is rooted in a conceptual heritage deeply marked by the Fordist paradigm of intensive industrial production. This regulatory framework, largely inherited from previous periods, was conceived according to economic logic systematically privileging ownership over usage, sales over service, and produced quantity over optimization of usage value. This conceptual orientation still permeates today the entirety of legislative texts and constitutes a major structural brake on development of circular economy and social entrepreneurship models, as witnessed by multiple "regulatory, institutional, and economic obstacles" identified by sector actors (El Watan, 2020; Bouadam, 2022; GIZ, 2024). This inadequacy manifests concretely through a fiscal system valorizing detention of physical assets rather than their usage optimization, with depreciation mechanisms exclusively conceived for full ownership, where "only elements of fixed assets" held in property can benefit from tax deductions (DGI, 2024), rendering structurally disadvantageous the rental, sharing or service usage models that characterize circular economy (ACF, 2025; CLS Strategy, 2025).

5-4-2 Technological and Infrastructural Deficits

Technological and infrastructural deficit constitutes a major obstacle to circular economy in Algeria. Despite robust infrastructure, the country struggles to transform its technological maturity into tangible economic growth, obtaining only 30.7/100 on the "Impact" sub-index of the Network Readiness Index and ranking 75th globally (El Watan, 2025). National capacities in cutting-edge technologies remain limited, with growing but deficient scientific production in crucial domains like blockchain, applied artificial intelligence, and automated systems (El Moudjahid, 2025). This situation reflects absence of an integrated ecosystem and persistence of dependence on imported technologies, hindering development of automated sorting systems, traceability, and digital platforms essential to circular economy.

5-4-3 Cultural and Behavioral Constraints

Cultural and behavioral constraints constitute a third ensemble of obstacles that would merit deepened empirical investigation. Works of Addi (1999) on mutations of Algerian society reveal persistent tensions between economic modernization and traditional representations, particularly in a context of post-independence institutional uncertainty. This complexity of social representations necessitates an interdisciplinary approach (Guignard, 2017). Recent CREAD survey on Algerian youth confirms existence of notable "social malaise" and frustrations linked to current lifestyle modes (Hammouda et al., 2018), without however specifically documenting attitudes toward ownership. The hypothesis of persistence of

traditional representations of ownership as marker of social success remains unverified empirically. Validation via targeted surveys proves necessary, drawing inspiration from World Values Survey methodology which analyzes economic and social values in 90 countries (Inglehart et al., 2014). This investigation would inscribe itself in continuity of Addi's (1994) analyses on obstacles to democratization in Algeria, where persistence of populist ideologies in collective imagination hinders emergence of modern political pluralism.

5-4-4 Difficulties in Access to Adapted Financing

Difficulties in access to adapted financing represent a fourth critical obstacle. Algerian banks, predominantly public and characterized by institutionalized risk aversion, privilege traditional economic models they understand and master. This assertion finds validation in several recent empirical studies and field data. The oligopolistic structure of the Algerian banking sector constitutes a first indicator of this situation: public banks hold 85.92% of banking assets with 103.692 billion dollars US, versus only 14.08% for private banks, with domination estimated at 99% by public bank branches (Algerian Investment Promotion Agency [AAPI], 2024). This public hegemony concretely translates into representation of 85.7% of credits and 89.1% of deposits in the banking system (Central Bank of Algeria, 2012).

The institutionalized risk aversion of these public banks manifests itself through massive exclusion of enterprises from bank financing. Assad (2025), economist and director of FINABI Conseil consultancy, reveals in his study that only 13% of enterprises and households have access to bank credit in Algeria, signifying that "six enterprises out of seven are not financed by banks". This extreme selectivity is confirmed by the Union of Maghreb Banks which demonstrates that the Algerian credit granting rate is the region's lowest with an average of 53% (only one request out of two is accepted), versus 68% in Morocco and 96% in Tunisia (Algeria-Watch, 2017). Furthermore, research of Si Lekhal (2012) establishes that Algerian SMEs evolve "in an economic transition environment, characterized by strong information asymmetry" which aggravates credit rationing.

Academic research corroborates this finding in empirical manner. Boumghar and Menna (2014) cite World Bank (2007) survey on "Investment Climate and Enterprise Competitiveness" which reveals that "very small enterprises undergo discrimination based on their size in obtaining credits". A doctoral thesis defended at the University of Versailles Saint-Quentin (Boumediene, 2014) demonstrates that "the reluctance of banks to engage in SME financing is largely explained by structural characteristics proper to the Algerian banking system, whose reform is recent and development still limited". More recently, Kourichi et al. (2020) in their Maghreb comparative study emphasize that "bank support is inadequate to SME financing needs, credit granting procedures are burdensome and not adapted".

This reticence translates into marked preference for traditional and safe economic models. Assad (2025) analysis reveals that Algerian public banks "prefer to concentrate their loans on solvent large enterprises, often supported by public contracts or state guarantees", thereby avoiding innovative projects or new business models they do not master. This behavioral rigidity was documented in the comparative study between BEA (public bank) and Société Générale (private bank) which reveals that "learning traces remain insignificant in BEA bank due principally to cognitive and behavioral rigidity of individuals".

The Functional Economy as a Lever for Transition toward Sustainability and Economic Diversification in Algeria: Systemic Analysis and Lessons from the Mexican Experience

Conclusion

In this complex context where economic diversification imperatives, growing environmental constraints, and social aspirations for more inclusive and sustainable development converge, functional economy emerges as an integrating paradigm offering a coherent trajectory toward systemic transformation. This model, by substituting the acquisitive logic of possession with that of optimized usage and by structurally aligning the interests of producers with sustainability, energy performance, and product longevity, creates the institutional and economic conditions for qualitative growth decoupled from linear and excessive consumption of non-renewable natural resources.

The opportunities identified and quantified in this research empirically demonstrate that this path is not simply an option among others but constitutes a strategic necessity to guarantee the economic, social, and ecological resilience of Algerian development facing twenty-first century challenges:

- **Economic:** 2 to 3 billion dollars annual added value in the waste valorization sector and 5 to 8 billion additional in the entirety of functional economy
- **Social:** 50,000 to 70,000 durable direct jobs in valorization and associated services, plus their indirect multiplier effects
- **Environmental:** substantial reductions in carbon footprint (20-30% in transport) and waste generation (40-60% diversion toward valorization)

Mexican experience, analyzed in detail in this comparative study according to international benchmarking methodology, offers empirical demonstration that profound and structural transformation of economic model is possible for an emerging country historically dependent on hydrocarbons. Mexico succeeded in reducing petroleum exports share from more than 30% in the 1980s to only 7-8% in 2024 (INEGI, 2024) while developing a valorization industry creating more than 70,000 direct jobs.

The identified structural obstacles must not be underestimated. They constitute real, substantial, and systemic challenges that cannot be overcome by simple declarations of political intention. However, these obstacles are not insurmountable and their precise identification enables conception of sequenced strategies to overcome them progressively through a systemic approach coordinating regulatory actions, infrastructural investments, capacity-strengthening programs, and social awareness campaigns.

The opportunity cost of inaction, rigorously quantified in this study, underscores the strategic urgency of resolutely engaging in this path of structural transformation. Each year without major political inflection represents tens of thousands of potential jobs uncreated, hundreds of millions of dollars of added value not generated, and natural resources continuing to be overexploited without consideration for future generations.

This research, although exploratory and requiring completion via deeper empirical investigations, clearly establishes the strategic relevance of functional economy for Algeria. It demonstrates that this model constitutes a coherent, systemic, and empirically validated response to the multidimensional challenges with which the country is structurally confronted. Transition toward functional economy is not decreed but constructed progressively, in an incremental and iterative manner. It requires long-term strategic vision capable of transcending

short political cycles, a systemic approach coordinating actions at multiple levels, close collaboration between public and private sectors, and broad social appropriation where citizens become conscious actors of transformation.

Algeria undeniably possesses the fundamental assets to succeed in this transition: considerable human capital with a young and educated population, substantial financial resources, relative political stability, and promising local innovations demonstrating capacity for adaptation to local constraints. The moment to act has imperatively come. Environmental challenges intensify inexorably, economic opportunities of circular economy materialize in numerous countries that acquire potentially irreversible competitive advantage, social expectations for more sustainable development assert themselves increasingly strongly. Algeria can choose to proactively seize these historic opportunities or continue on the path of rentier dependence at major risk of seeing delays accumulate and seriously compromising prospects for prosperity of future generations.

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