

Regional Value Chains: A Key to Economic Integration Regional Focus: "Solar Energy Sector" — Current Status and Prospects The Case of North Africa: Algeria, Morocco, Tunisia

سلاسل القيمة الإقليمية: مفتاح للاندماج الاقتصادي التركيز الإقليمي: "قطاع الطاقة الشمسية" -
الوضع الحالي وآفاق المستقبل حالة شمال إفريقيا: الجزائر، المغرب، تونس

SOUSSI fatima zohra¹, CHOUAM bouchama²

¹ Fatima Zohra SOUSSI, Assistant Lecturer A, University of Oran 2 Mohamed Benahmed:
soussi.fatima@univ-oran2.dz

² Bouchama CHOUAM, Professor, University of Oran 2 Mohamed Benahmed, Algeria:
chouam_boucha@yahoo.fr

Received: 05/05/2025

Accepted: 25/05/2025

Abstract:

The objective of this study is to analyze the impact of participation in the regional value chain (RVC) on economic integration in the Maghreb, as well as to determine how to stimulate these RVCs to promote such integration. We have chosen to approach the topic from two angles. The first will examine the importance of regional value chains in contemporary trade models. The second will offer a descriptive analysis of the value chain structure of a specific sector, in order to highlight the relationship between RVCs and regional economic integration.

Keywords : regional value chain, regional economic integration, added value, intra-regional trade, solar energy.

Jel Classification Codes : A10, A13.

ملخص:

تهدف هذه الدراسة إلى تحليل تأثير المشاركة في سلسلة القيمة الإقليمية على التكامل الاقتصادي في منطقة المغرب العربي، وكذلك تحديد كيفية تحفيز سلاسل القيمة الإقليمية هذه لتعزيز هذا التكامل. لقد اخترنا تناول الموضوع من زاويتين. الأولى ستدرس أهمية سلاسل القيمة الإقليمية في نماذج التجارة المعاصرة. أما الثانية فستقدم تحليلاً وصفيًا لهيكل سلسلة القيمة لقطاع معين، بهدف تسليط الضوء على العلاقة بين سلاسل القيمة الإقليمية والتكامل الاقتصادي الإقليمي.

كلمات مفتاحية: سلسلة القيمة الإقليمية، التكامل الاقتصادي الإقليمي، القيمة المضافة، التجارة البينية الإقليمية، الطاقة الشمسية.

تصنيف JEL: A10, A13

¹ **Corresponding author :** SOUSSI fatima zohra, **e-mail:** soussi.fatima@univ-oran2.dz

INTRODUCTION

The new global context, marked by the intensification of regional blocs around the world—referred to as a “mosaic of blocs”—is pushing Maghreb countries (Algeria, Morocco, and Tunisia) to work toward regional integration.

It is crucial to develop a key strategy to promote this movement, which is seen as essential for, firstly, confronting other groupings that dominate international trade, and secondly, securing a place on the global stage to claim a fairer share of added value, which is often distributed unequally and unlawfully.

The development of regional value chains (RVCs) serves as a vital lever for fostering regional integration, particularly through the enhancement of economic relations. However, the connection between RVCs and regional economic integration remains a complex challenge. It is indeed difficult to accurately measure RVCs, just as it is challenging to assess their impact on regional economic integration.

Value chains play a crucial role in today’s global economy. African countries actively participate in them, but often at a fragile stage that prevents them from achieving meaningful structural transformation. Africa must strive to strengthen its upstream integration and increase the share of added value within its exports, while also expanding the dynamics of global value chains to other economic sectors.

Trade integration within a region enhances its attractiveness to companies engaged in global value chains. Thus, intra-regional trade in products developed through regional value chains represents a major opportunity for African businesses. Maghreb countries must strengthen their regional integration process to benefit from improved efficiency, productivity, and economies of scale.

This research confirms the existence of a positive relationship between RVCs and regional economic integration.

The commercial incorporation of a region makes it more appealing to firms operating within international value chains. Consequently, African enterprises view intra-regional trade of products processed according to local value chains as the primary opportunity to seize. To increase efficiency, productivity, and economies of scale, Maghreb countries must deepen their regional integration process.

The aim of this study is to illustrate how RVCs support the implementation of regional economic integration in the Maghreb. To do so, we have chosen the solar energy sector due to its underexploited potential in the region. The study is divided into two key parts. In the first, we will examine the sector’s value chain, providing an opportunity to present its mapping. Next, we will explore intra-regional relations within the sector and existing RVCs in order to assess their potential to drive forward regional economic integration.

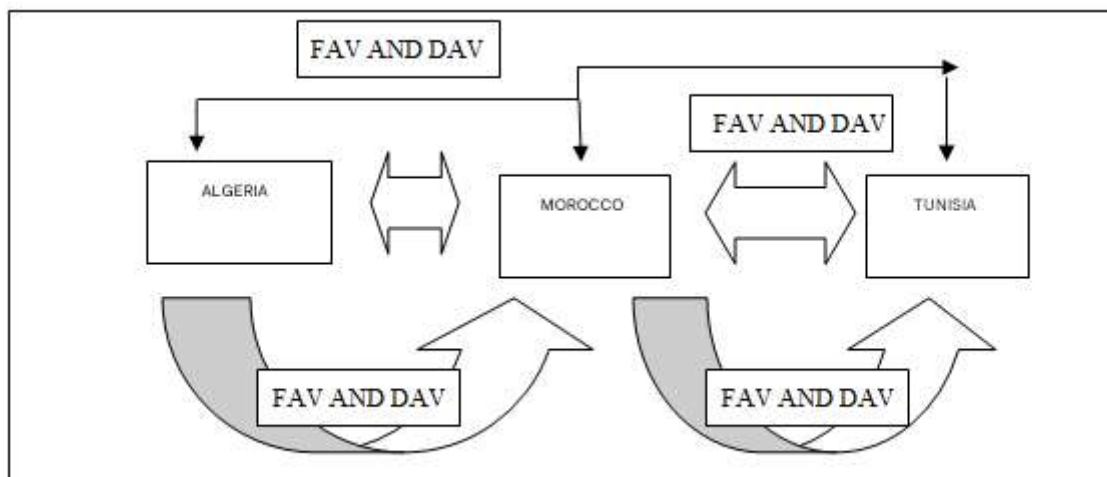


Diagram prepared by the authors to illustrate the exchange of foreign added value (FAV) and domestic added value (DAV) within the bloc.

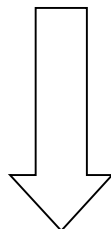
1) Regional Value Chains: An Essential Driver for Economic Recovery in the Maghreb Bloc

Reviving the economy in North Africa—specifically the Maghreb—through a strategy centered on regional value chains (RVCs) will allow us to stimulate two major pillars:

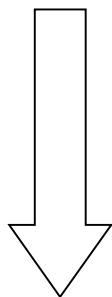
- Accelerate the diversification of the Maghreb economies (Algeria, Morocco, Tunisia) by creating both local and foreign added value within intra-group trade;
- Promote the development of new dynamic comparative advantages by selecting the appropriate sectors to boost the Maghreb bloc.

This new dimension linking regional value chains and Maghreb economic integration enables us to identify the following relationship:

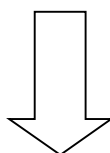
Stimulating RVCs in the Maghreb



Accelerating the diversification and sophistication of economies
(Creation of local and foreign added value within intra-group exchanges)



Fostering the emergence of new dynamic comparative advantages



Achieving regional economic integration

2) Maghreb Countries and Adaptation to Changing Trade Models

1-2 Integration through Regional Value Chains (RVCs):

However, the missing link in regional integration can be attributed to the weakness of regional policies and the underdevelopment of regional value chains (African Development Bank [BAD] 2014; Baldwin 2012; Koopman et al. 2010; OECD 2014).

Regional value chains (RVCs) are now essential for North African countries seeking to establish their position in the new global order. The RVC strategy is inspired by a production model similar to that of global value chains (GVCs), but differs in its regional scope. Its goal is to produce finished goods intended for export by a country within the region.

2-2 Solar Energy RVCs: An Untapped Source of Growth

2.2.1 An Overview of North Africa's Participation in GVCs:

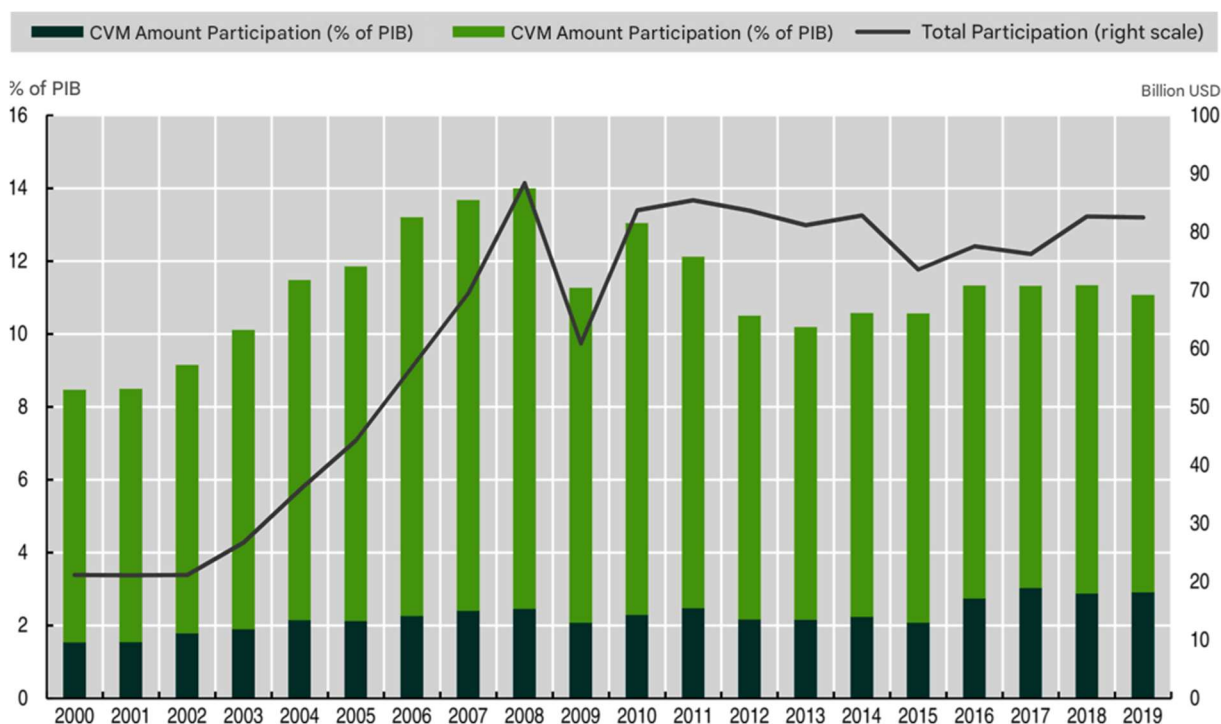
Overall, North Africa's participation in GVCs showed an upward trend (see Graph 1), before experiencing a sharp decline due to the 2008 global financial crisis.

North African countries are primarily integrated into GVCs through less profitable segments. A significant share of the added value generated by these countries comes from exports to third-party markets.

Between 2000 and 2019, upstream contributions represented 20% of total GVC participation, while 80% were downstream. This imbalance is due to the low degree of sophistication and the limited diversity of exports in the region.

To enhance their involvement in GVCs, North African countries must strengthen their regional value chains (RVCs). Establishing processing chains that transform raw materials into finished or semi-finished products is a critical path toward achieving this goal.

Graph 1: North Africa's Participation in Global Value Chains



Source: Dynamics of Development in Africa. Report 2022. p. 187.

2.2.2 North Africa's Participation in RVCs:

2.2.2.1 The Renewable Energy Value Chain (REVC) and the Maghreb Economic Integration Strategy:

Renewable energy (RE), particularly solar energy, represents a viable alternative to fossil fuels. North Africa is positioning itself within the global strategy for clean energy supply to Europe, with the goal of achieving at least 20% renewable energy by 2030 (African Energy Commission [CEA], 2012). The region benefits from exceptional solar potential, with between 2,000 and 3,600 hours of sunshine per year, compared to only 1,500 to 2,000 hours observed in non-Mediterranean Western Europe, Canada, and Russia.

2.2.2.2 The Expansion of RVCs in Solar Energy: What Challenge for the Maghreb Bloc?

I- Key Structure of a Solar Value Chain in the Maghreb:

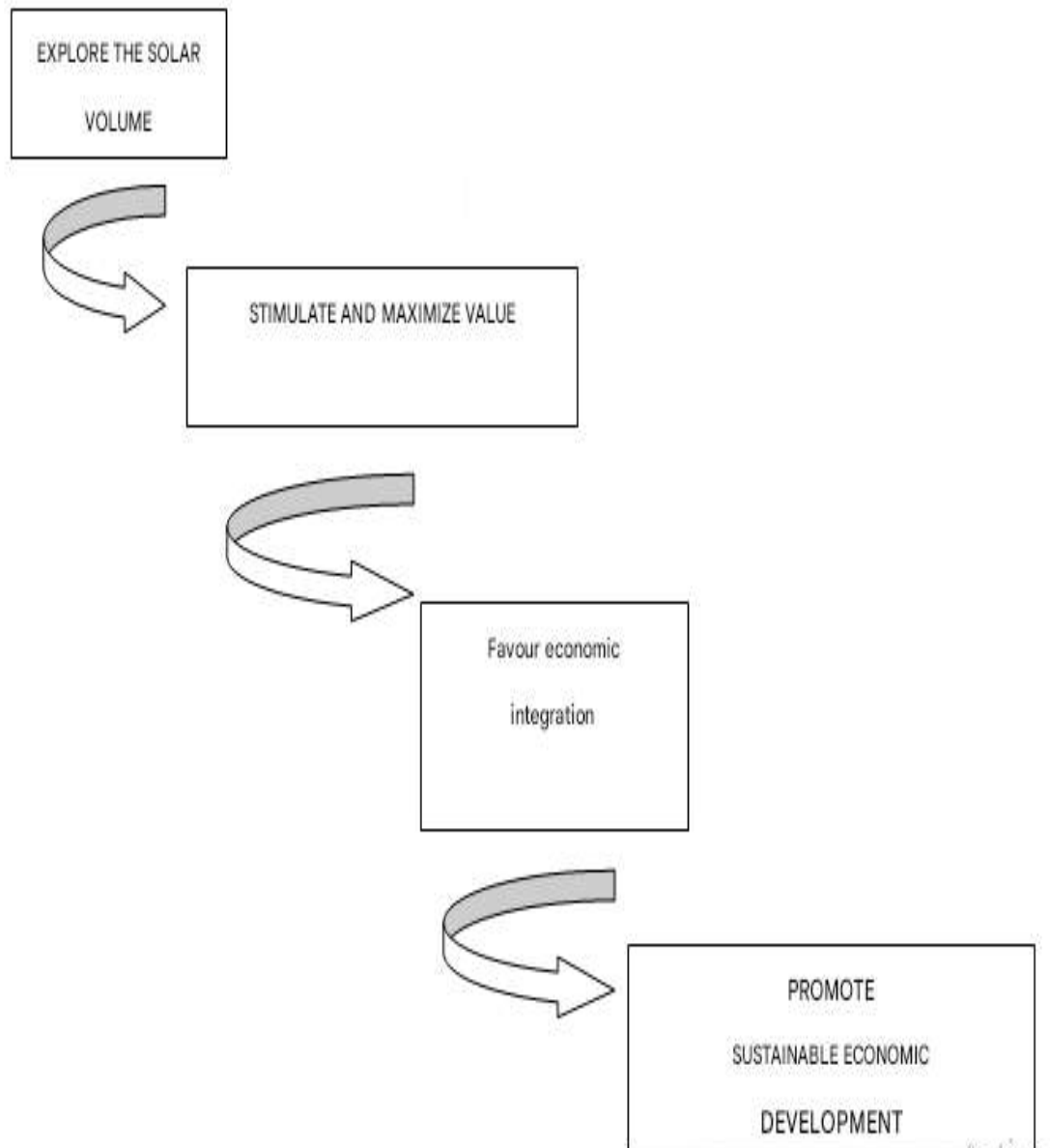


Diagram prepared by the authors

II - How to Stimulate Solar Value Chains in the Maghreb to Strengthen Regional Economic Integration?

To implement this new vision of reasoning, we propose accelerating the diversification and sophistication of Maghreb economies, and to achieve this, it is necessary to exploit the sector of semi-finished products related to solar energy. This approach is translated into three key points:

- Exploit the sector of semi-finished solar energy products within the Maghreb bloc.
- Stimulate the solar RVC.
- Boost regional economic integration within the Maghreb.

1-2 The Semi-Finished Solar Energy Products Sector: A Strategic Key for Maghreb Economic Integration:

Energy challenges represent a crucial concern for the Maghreb nations, a region marked by high sun exposure and increasing dependence on fossil fuels. In this context, expanding the sector of semi-finished products related to solar energy emerges as a strategic opportunity, allowing not only to meet growing energy needs but also to leverage a regional value chain based on solar energy and promote economic integration within the region.

The production of semi-finished goods, such as photovoltaic panels, energy storage system components, and suitable building materials for solar technologies, can catalyze investments in research and development. By fostering the development of local industries, Maghreb nations will have the opportunity to reduce their dependence on imports while enhancing their competitiveness in the international market. This approach is essential to initiate an economic empowerment process that will enable countries in the region to capitalize on their resources and strengths.

The development of local industries in Maghreb countries represents a potentially transformative strategy.

By promoting the growth of these industries, these countries can not only reduce their dependence on imports but also create new opportunities to generate added value both locally and internationally. This process could lead to improved economic autonomy and the establishment of a more sustainable and competitive dynamic.

In conclusion, the semi-finished solar energy products sector represents a strategic opportunity to foster economic integration in the Maghreb region. On one hand, it is essential to establish a regional value chain, and on the other hand, to promote regional cooperation. Such an initiative could profoundly transform the region's energy landscape while contributing to its economic development. Decisions made today will have a significant impact on building a harmonious and integrated energy future for the Maghreb.

2.2 Structure of the Solar Energy Value Chain:

North Africa, blessed with an abundance of solar resources, holds considerable renewable energy potential. With exceptional sunshine, ranging from 2,000 to 3,900 hours annually and high average solar radiation, the region holds a significant energy advantage. Increasingly aware of this strategic benefit, North African countries are gradually integrating solar energy into the heart of their national energy policies.

Table 1. Hours of Sunshine per Year in North African Countries

Country	Algeria	Egypt	Morocco	Tunisia
Sunshine Hours/Year	2000 - 3900	3200 - 3600	2800 - 3400	2800

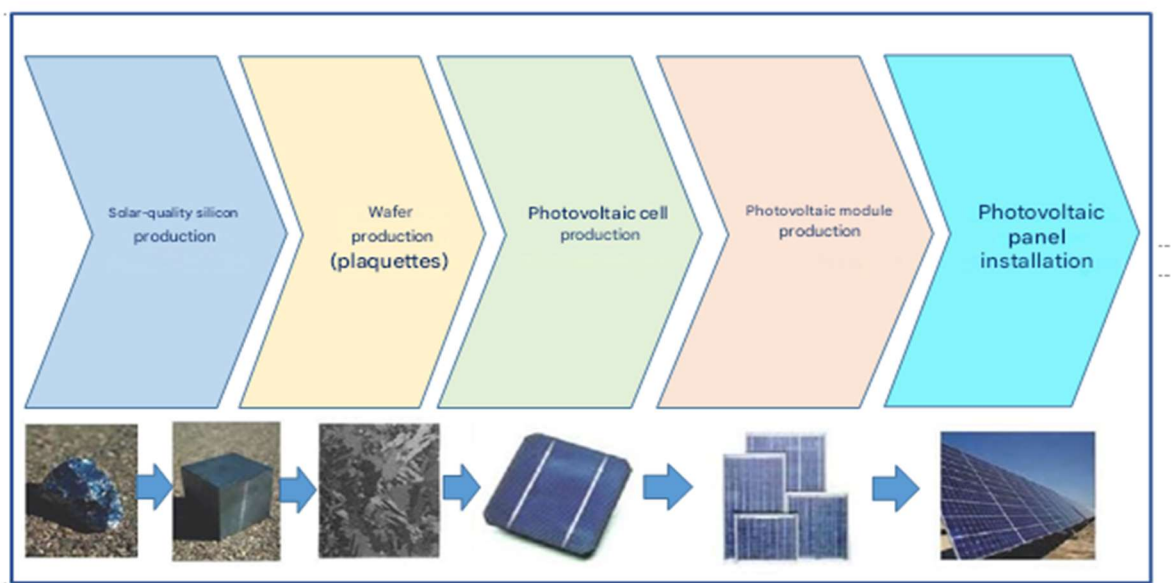
Source: GIZ (2013), p. 54.

Photovoltaic solar energy is generated by directly converting a portion of solar radiation into electricity. This energy transformation takes place within a photovoltaic cell, which operates based on the photovoltaic effect. This specific physical phenomenon results in the production of an electric current when the surface of the cell is exposed to light.

Currently, collaboration initiatives are increasing between North African nations (Algeria, Egypt, Morocco, and Tunisia) and certain European countries (Germany, Italy, Spain, and France). These partnerships aim to stimulate investment in the solar energy sector and facilitate the export of this energy to Europe. These projects represent an opportunity to attract foreign capital and develop both the production and distribution of solar energy, with the ultimate goal of creating a dynamic regional electricity market.

The solar energy sector is distinguished by a complex and fragmented value chain. This chain spans various activities, ranging from the manufacturing of photovoltaic cells to panel installation, through solar condensation, and ultimately the conversion of solar energy into electricity. Although the process is diverse, it relies on fundamental steps. **Graph 1** provides a simplified representation of the basic value chain inherent to the photovoltaic industry, highlighting the essential components that make it up.

Graph 1. The Basic Value Chain of the Photovoltaic Industry



3-2 Opportunities for Creating Regional Value Chains (RVC) in the Photovoltaic Industry and Their Impact on Regional Economic Integration:

The objective of this strategy is to determine how the realization and participation in the regional value chain related to the photovoltaic industry can foster regional economic integration in the Maghreb, leading to diverse value-added opportunities.

Although the lack of precise statistical data prevents a quantitative assessment of its scale, North Africa possesses significant potential for developing regional value chains (RVC) in the solar energy sector at two distinct levels: the photovoltaic industry and solar energy production.

Regarding the photovoltaic industry, it seems unlikely that the countries of the region will be able to control the entire value chain due to the nascent nature of this industry and the advanced technologies required for certain segments, such as wafer production. However, specialization in the production of solar-grade silicon is a feasible option. The development of this RVC could involve the establishment of multinational companies specializing in wafer, cell, and photovoltaic module production, while local companies could focus on silicon production and the final assembly of panels, positioning themselves at the ends of the value chain.

At the same time, the development of an RVC in the photovoltaic industry would facilitate the capture of opportunities related to solar energy production. The countries of North Africa are integrated into a global strategic plan for supplying Europe with clean energy, aiming to achieve 20% renewable energy by 2030. The Mediterranean Solar Plan projects, supported by the Union for the Mediterranean, foresee an export capacity of 22,000 MW to Europe by

2030. This large-scale opportunity requires a collaborative approach, as no country can develop this industry alone.

North Africa is showing increasing interest in renewable energy, driven by ambitious national objectives. Morocco is positioned as a leader, aiming to integrate 10% to 20% of renewable energy into its primary energy consumption by 2030, through large-scale wind and solar projects, including the Ouarzazate complex. Tunisia, on the other hand, aspires to reach 30% of electricity production from renewable sources by 2030, motivated by a decline in oil production and significant wind and solar potential. Algeria, with a policy focused on national integration, aims for a 37% renewable energy mix by 2030, signaling significant investments in this sector.

However, to optimize the solar energy value chain in the region, several measures are crucial. These include implementing cooperation agreements with European countries, encouraging the establishment of subsidiaries of multinational companies specializing in photovoltaic panels, creating a regional electricity market, developing transport and distribution infrastructure, and setting up favorable regulations to encourage local investment in solar installations. The following precise and recent (2023) data on installed capacity, investments, and growth forecasts highlight the region's significant potential.

1. Installed Solar Energy Capacity in the Maghreb:

Here are some figures on the installed solar energy capacity in the Maghreb countries:

Country	Installed Capacity (MW)	System Type	Year of Data
Morocco	2,146 MW	Photovoltaic & Concentrated	2023
Algeria	1,216 MW	Photovoltaic	2023
Tunisia	532 MW	Photovoltaic	2023
Libya	73 MW	Photovoltaic	2023
Mauritania	174 MW	Photovoltaic	2023

Source: Moroccan Agency for Sustainable Energy (MASEN), National Renewable Energy Agency of Algeria, and IRENA (International Renewable Energy Agency) reports.

2. Solar Energy Investments:

Country	Investment (in million USD)	Year of Data
Morocco	9,000	2023
Algeria	5,500	2023
Tunisia	500	2023
Libya	150	2023

Mauritania	200	2023
------------	-----	------

Source: World Bank and IRENA investment reports.

3. Growth Forecasts:

According to IRENA, the installed solar energy capacity in the region could reach:

Country	Installed Capacity (MW) by 2030
Morocco	5,000 MW
Algeria	5,000 MW
Tunisia	2,000 MW
Libya	150 MW

In conclusion, the data presented highlights the considerable potential of solar energy in the Maghreb, while reflecting ongoing initiatives to harness this resource. Regional economic integration in the solar sector is a key challenge. It represents a significant opportunity to stimulate economic development, strengthen environmental sustainability, and encourage cooperation among Maghreb nations. The in-depth study, supported by factual data and databases, emphasizes the intrinsic link between regional solar energy value chains and the strengthening of regional economic integration.

Regional economic integration in the Maghreb is based on an institutional framework that includes the Union of the Arab Maghreb (UMA) and various free trade agreements. These mechanisms aim to stimulate trade and cooperation, particularly with partners such as the European Union. At the same time, the region is experiencing significant growth in the solar energy sector. Morocco, with the Noor Ouarzazate complex (580 MW in phase I and aiming for 2,000 MW), is positioned as a leader. Algeria, through the Tamanrasset project (1,000 MW planned), and Tunisia, with a deployment plan of 1,000 MW by 2030, are also showing increasing commitment to this renewable energy source. The development of these solar capacities represents a potential lever to strengthen regional economic integration, particularly through energy cooperation and resource sharing.

Country	Installed Capacity (MW)	Target by 2030 (MW)	Estimated Investment (in million USD)
Morocco	2,146	5,000	9,000
Algeria	1,216	5,000	5,500
Tunisia	532	2,000	500
Libya	73	150	150

Mauritania	174	500	200
------------	-----	-----	-----

4. Analysis of the Relationship Between Solar Value Chains and Regional Economic Integration:

a. Integration Opportunities:

- **Trade Exchanges:** The development of joint solar projects could facilitate better integration of electricity grids and energy trading between countries. This would enhance regional energy security and contribute to the broader goal of sustainable development.
- **Job Creation:** The solar sector generates employment in research, manufacturing, and installation, thereby also improving technical capabilities within the region. It creates a skilled workforce that can support the growth of other industries as well.

b. Competitive Advantages:

- **Natural Resources:** The availability of abundant sunshine makes it possible to optimize solar energy production, which is a strong asset for exports. This advantage could help countries become major players in the renewable energy export market.
- **Economies of Scale:** Regional projects can lower costs by sharing resources and technologies. This collaborative approach can reduce the financial burden on individual countries and accelerate the deployment of solar energy systems.

c. Challenges to Overcome:

- **Infrastructure:** A lack of electricity transport infrastructure can limit integration capacities. Efficient and interconnected transmission systems are vital to support regional solar energy projects and enable cross-border energy trade.
- **Diverse Regulations:** Variations in national energy policies and regulations can hinder cooperation. Standardizing regulations and policies within the region could facilitate smoother collaboration and make the market more attractive to investors.

d. Future Prospects:

- **Interconnected Projects:** Initiatives like Desertec, which aim to connect solar networks in the Sahara to European markets, could drive integration. This would increase energy exports and contribute to a greener future by reducing reliance on fossil fuels.
- **Carbon Footprint and Sustainability:** The increase in renewable energy capacity would contribute to regional and international climate commitments. The transition to solar energy could help reduce the carbon footprint of the region, aligning with global sustainability goals.

Conclusion:

The development of a new global order focused on regional value chains is essential for enhanced regional integration in North Africa. This approach will not only boost economic growth by increasing and developing new value-added sectors but also improve intra-regional investments, thereby transforming the economic structure of the region.

This new approach to regional value chains can play a crucial role in addressing these challenges by:

- Accelerating the diversification and development of economies.
- Encouraging the emergence of new dynamic comparative advantages.
- Facilitating access to global value chains in higher value-added sectors.

Through the descriptive analysis presented, we can conclude that the regional value chain process fosters the strategic realization of the regional bloc. Initially, this process generates locally added value, which is subsequently exchanged within the region and later transferred to other blocs.

Regional integration in the solar energy sector remains insufficient. However, this dimension is crucial for the regional integration agenda, as it enables countries to develop regional value chains while advancing along the productive value chain. To support this development, it is vital to work on a logical mapping that highlights the sources of this strategy. Appropriate policies could include adopting specific regulations to encourage these business models, as well as fostering collaborative support with the private sector to strengthen technical and vocational education related to these value chains.

In conclusion, it is essential to affirm that accelerating regional value chains is a strategic key to achieving regional economic integration in the Maghreb. It is imperative to intensify efforts to catch up with the progress made by other regions.

Ultimately, the growth of such a scale is not limited to this sector, although we consider it a good starting point. For instance, imagine that Algeria's major company, SONATRACH, instead of merely exporting crude oil, adopts Michael Porter's theory and implements a new value chain strategy to enrich its products for export with a high value-added. The benefits for the Maghreb in general, and for Algeria in particular, could be considerable.

References:

- Alfredo, S. (2011). *Intégration régionale. Évolution d'un concept* (Regional Integration: Evolution of a Concept). Hachette Supérieur.
- Backer, K. D., & Mirondot, S. (2007). Mapping global value chains. *Communication sur la politique commerciale de l'OCDE N° 159* (Communication on the OECD Trade Policy No. 159).
- Banque africaine de développement. (2013). *Rapport annuel 2013* (Annual Report 2013).
- BAD. (2012). *Libérer le potentiel de l'Afrique du Nord grâce à l'intégration régionale. Rapport* (Unlocking the Potential of North Africa Through Regional Integration. Report).
- Célimène, F. (1997). *L'intégration régionale des espaces* (Regional Integration of Spaces). Éditions Économica.
- Elyoussoufi, L., & Bousfoul, H. (2021). Impact des énergies renouvelables sur le développement économique des pays de l'Afrique du Nord : Analyse en régression des panels cointégrés. *African Scientific Journal*, 6(3), 339-364.
- FMI. (2019). *Base de données des Perspectives de l'économie mondiale, octobre 2019* (World Economic Outlook Database, October 2019).
- <https://www.imf.org/fr/Publications/WEO/Issues/2019/10/01/world-economic-outlook-october-2019>
- FMI. (2021). *Regional Economic Outlook: Arising from the Pandemic: Building Forward Better*.
- <https://www.imf.org/en/Publications/REO/MECA/Issues/2021/04/11/regional-economic-outlook-middle-east-central-asi>
- IRENA (International Renewable Energy Agency): *Rapports et statistiques sur les énergies renouvelables* (Reports and Statistics on Renewable Energies).
- Mayer, T., & Mucchielli, J.-L. (2005). *Économie internationale* (International Economics). Dalloz.
- OCDE. (2007). *Progresser le long de la chaîne de valeur : Rester compétitif dans l'économie mondiale. Principales conclusions* (Progressing Along the Value Chain: Staying Competitive in the Global Economy. Main Findings).
- OCDE. (2014). *Chaînes de valeur mondiales : Défis, opportunités et implications politiques* (Global Value Chains: Challenges, Opportunities, and Policy Implications). Rapport à soumettre à la réunion des Ministres du commerce du G20, Sydney, Australie.
- OCDE-CAD. (2021). *Base de données sur les statistiques en ligne sur le développement international (SDI)* (Online Database on International Development Statistics (SDI)). <https://www.oecd.org/fr/developpement/financementpourledeveloppementdurable/statistiques-financement-developpement/sdienligne.htm> (consulté le 14 septembre 2021).
- Richet, X., & Safir, N. (2016). *Le Maghreb à l'épreuve de la mondialisation* (The Maghreb Under the Test of Globalization). L'Harmattan.

- Semedo, G., & Villieu, P. (1998). *Mondialisation, intégration économique et croissance* (Globalization, Economic Integration, and Growth). L'Harmattan.
- Siroen, J.-M. (2004). *La régionalisation de l'économie mondiale* (The Regionalization of the Global Economy). La Découverte.
- **Maghreb Energy Cabinets:** Specific data on national solar projects and their results.
- **World Bank:** Financial resources and investment data.
- **National Energy Agency Reports:** Details on installations and ongoing projects.