DOI: 10.38027/ICCAUA2022EN0225

Energy Efficiency Benchmarking: Review of Key Policies, Agencies, Program Developments in North Africa, Case of Algeria

* Ph.D. **Soumia Rahmani** [1], Dr. **Dalel Kaoula** [2] and Dr. **Mohamed Hamdy** [3]
University of BLIDA1, ETAP Laboratory, Institute of Architecture and Urban Planning, B.P 270, Soumaa Road, Blida, Algeria [1&2]
Norwegian University of Science and Technology (NTNU), Department of Civil and Environmental Engineering, Trondheim, Norway [3]
E-mail [1]: rahmani.soumia@etu.univ-blida.dz , E-mail [2]: d.kaoula@univ-blida.dz, E-mail [3]: mohamed.hamdy@ntnu.no

Abstract
The energy efficiency benchmarking is an approved solution to achieve sustainability. Although the universal common challenges, North African countries still generate policies and frameworks governing energy efficiency in the building sector. This paper examines the key players in the energy efficiency benchmarking by diagnosing the existing energy agencies and institutions which contribute to that. The samples are from Algeria. The key programs in energy development are discussed with gaps in the timeline of the programs compared to the Malaysian key players in energy development. This work indicates the lack of continuity in such fields in R&D agencies, explains the gap in the regularities and the existence of protocols, and the absence of testing authorities for evaluation tasks, which guarantees compliance. This type of research will unveil another portal in building's energy efficiency benchmarking field in Algeria and transpose it to all North African countries.
Keywords: Energy development; Energy efficiency; Energy policy; Energy agency; Building sector; Benchmarking.

1. Introduction

Since the very beginning of the construction industry, the environmental indicators began to take lower ranges to flow in. The proportion of threats recorded in each category for populations in Africa and the Asia Pacific in the WWE- Living Planet Report 2020, considered the threats percentage of changes in land use, as the higher recorded threat (Fig.1). Moreover, the same report presented the statistics of the ecological Footprint of humanity per land use, which considered the activity of housing in second place after the food activity with a percentage of 25%, faced to a 60% of global activities responsible for carbon footprint (Fig.2)(WWF, 2020)

The countries of Africa and Asia tend to be countries undergoing rapid urbanization and industrialization, and due to the series of crises and circumstances, unfortunately, the fast growth of the construction field ignores in most cases the environmental dimension, which effected the environmental indicators. The global built environment energy consumption attended 36% between the Construction industry and buildings sector, where the residential type has the highest final energy consumption of 22% face to 8% for non-residential building type..(Fahmy et al., 2019; IEA, 2019, Amen,2021)

The energy efficiency benchmarking is provided as an approved solution to achieve sustainability, by the collaboration of researchers and engineers' developers in the R&D governmental and private agencies in developed countries. Although the universal common challenges(IRENA, 2020), North African countries are still on the way to generating their energy policies and frameworks governing energy efficiency(IEA, 2019; Kangas & Kivimaa, 2017), to implement sustainability in the building sector, and overthrow part of those challenges(Bencheikh & Bederina, 2020; Kaoula & Bouchair, 2019)

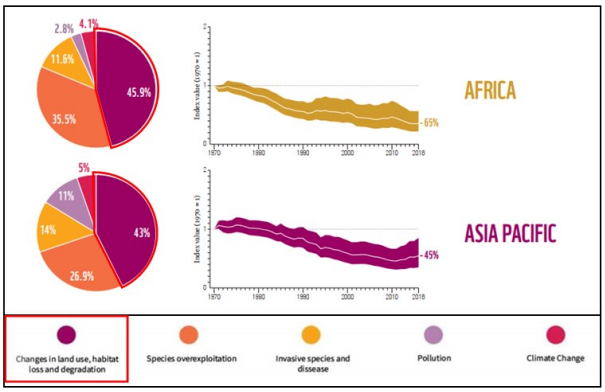

Figure 1: The proportion of threats recorded in each category for populations in each IPBES region: Africa, Asia Pacific

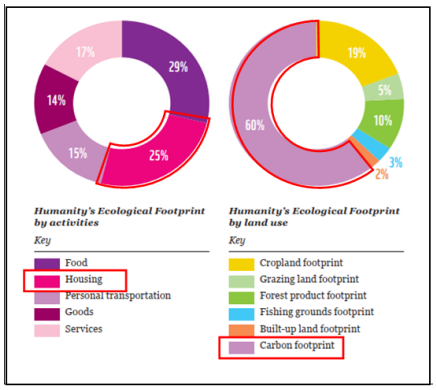

Figure 2: Humanity's Ecological Footprint by land use and by activities

Data Sources: WWF (2020) Living Planet Report 2020 - Bending the curve of biodiversity loss. Almond, R.E.A., Grooten M. and Petersen, T. (Eds). WWF, Gland, Switzerland.

Algeria is the chosen sample for an investigation about the authority role in implementing sustainability in the building sector in public community, and its tools also cores that are related to achieve such international goals whether in research or in the R&D sector, in comparison to the Malaysian institutional system.
At the time of independence of Algeria, the break with the market economy, inherited from the colonial period, in favour of an egalitarian economic policy of a socialist type was the only acceptable option for the leaders of the National Liberation Front [6]. After the financial crises, the unpredictable economic after-shocks come quickly to clarify the situation of the national economy in front of foreign strategies. The energy market was the most remarkable draining sector in Algeria, while the creation of any agency or high impacted institution of sustainability in the private sector is quiet absent comparing to the international field. [7][8]
There was therefore the raison to instigate a strategy of nationalization of the use of energy. Which has pushed the ministerial authorities concerned to develop a regulation and a preliminary framework to control the energy efficiency in buildings.
That's why this research is held to diagnosis the agencies and institutions of energy efficiency and energy benchmarking in Algeria, clarify their missions and charges to the energy sector. The aim of this paper is to pinpoint the authority institutions and agencies that are held to implement the energy efficiency in the national building's field and find the gaps that contribute to the delay of Algerian building's efficiency to the international way to sustainability.

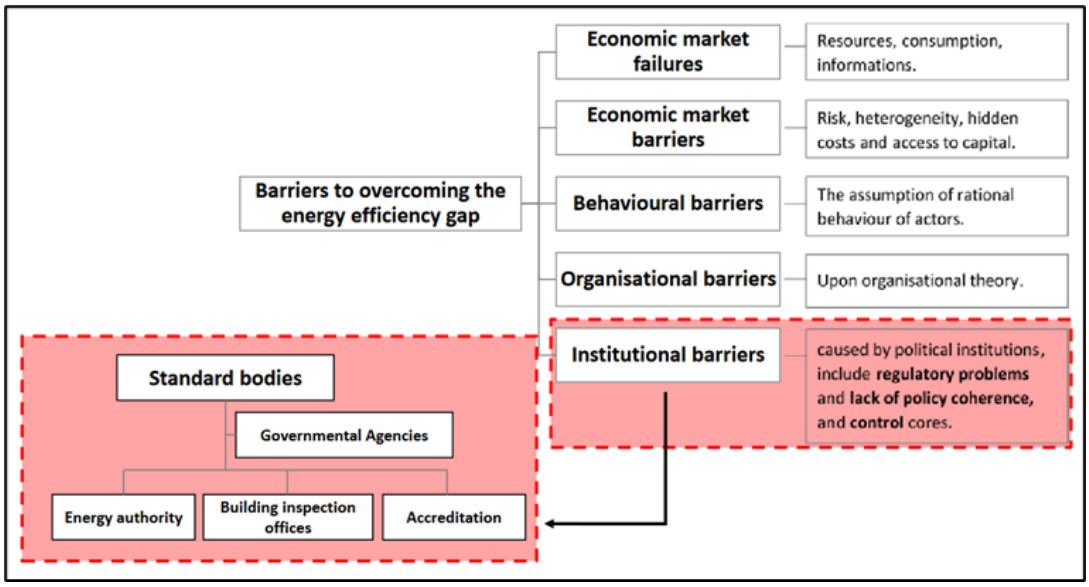

Figure 3. Gaps map demonstration & Barriers to overcoming the energy efficiency gap

The first aim of this study is to diagnose the agencies and institutions of energy efficiency and energy benchmarking in Algeria, then clarify their missions and charges to the energy sector, and at last, define the gaps that contribute to the delay of Algerian building's efficiency. (Figure 4)

2. Material and Methods

In this paper we have chosen to give a brief review on the agencies and programs that held the responsibility of creating and organizing the regulatory part of energy efficiency in Algeria which is quit slow development sector according to the coming diagnosis and comparison. We analyse energy efficiency barriers to overcoming the energy efficiency gap in building sector. The pinpoint of the authority institutions and agencies that are held to implement the energy efficiency in the national building's field and find the gaps that contribute to the delay of Algerian building's efficiency to the international railway to sustainability.

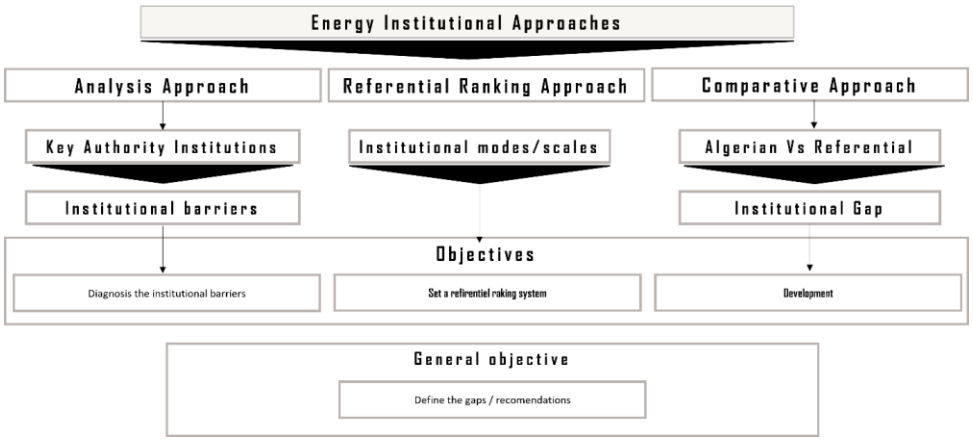

Figure 4. Structure of the Study (Developed by Author)

3. Study case

The chosen sample is from Africa, Algeria as a developing country, we held an analysis approach to another country with similar historical background (politically-colonisation-, economically and same religion), from Asia, which is Malaysia, that reveals the challenges and jumped from a developing to a developed country, according to the world bank report.

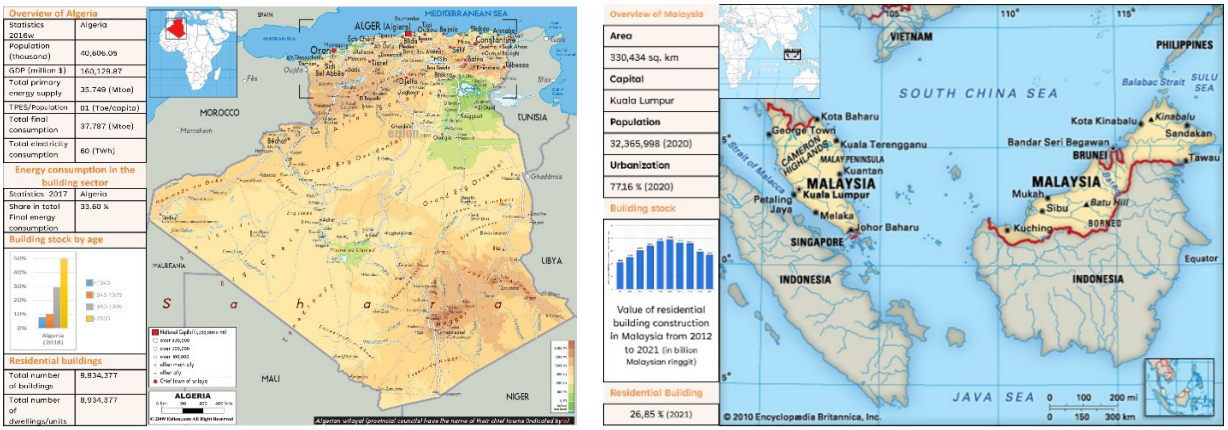

Figure 5. Case study presentation ALGERIA and referential cas (Malaysia)

Table 1. Ecological footprint vs Biocapacity (gha per person) for Algeria & Malaysia.

Ecological footprint vs Biocapacity (gha per person) for Algeria & Malaysia	
Algeria	Malaysia
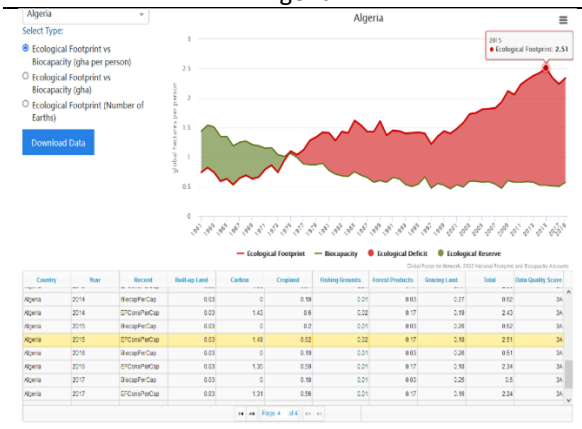	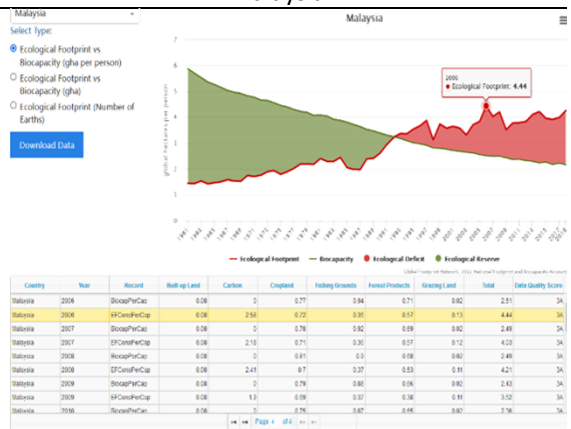
Figure 6. Ecological footprint VS Biocapacity for Algeria	**Figure 7.** Ecological footprint VS Biocapacity for Malaysia

Data Sources: National Footprint and Biocapacity Accounts 2022 edition (Data Year 2018); GDP, World Development Indicators, The World Bank 2020; Population, U.N. Food and Agriculture Organization.

4. Analysis approach

a. Institutional modes and scales: an analytical framework

Due to the economic/political nature of the Algerian government and the lake of the private resources beside the national petroleum fortune, the creation of any agency or high impacted institution of sustainability in the private sector is quiet absent comparing to the international field. Since more than a decade, the financial crisis touched Algeria, there was therefore the raison to instigate a strategy of nationalization of the energy use. Which has pushed the ministerial authorities concerned to develop a regulation aims at ensuring a satisfactory level of comfort, while reducing energy needs: heating, air conditioning.

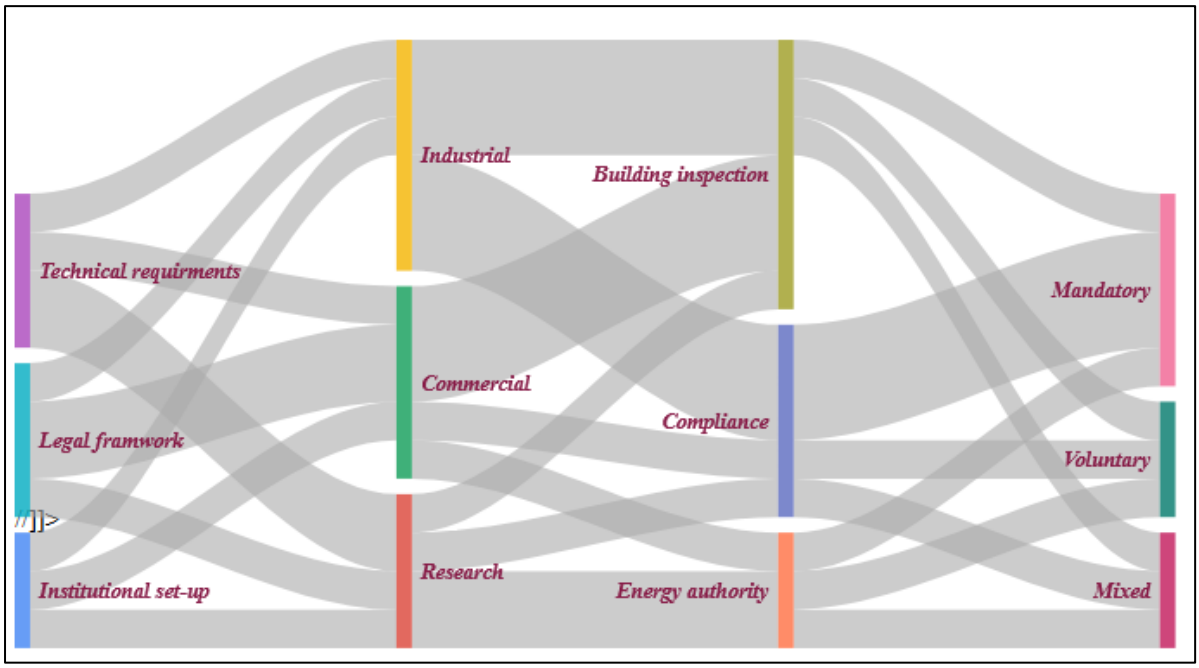

Figure 8: Sankey Diagram, analytical framework of institutions. Source: Author, 2022

a. Algerian approach of setting-up authority institution and agencies to implement energy efficiency in the national field (Diagnosis and missions)

Diagnosis of Authority institutions and agencies the setting-up of the first official institutions in charge of research development and monitoring: The Center for the Development of Renewable Energies (CDER) in 1988 and the National Agency for the Promotion and Rationalization of Energy Use (APRUE) in 1985, to the latest institution: The Commission for Renewable Energies and Energy Efficiency (CEREFE) in 2019.

- CDER : The Center for the Development of Renewable Energies (CDER) is a Research Centre, resulting from the restructuring of the High Commission for Research, created on 22 March 1988. It is a Public Establishment of Scientific and Technological Character (EPST) in charge of elaborating and implementing research and development programs, scientific and technological, of energy systems exploiting solar, wind, geothermal and biomass energy.
- CEREFE : is a public institution with legal status and financial autonomy. It is created under the Prime Minister by Executive Decree No. 19-280 of 21 Safar 1441 corresponding to October 20, 2019. As a cross-sectoral coordinating body, CEREFE's mission is to assist in the design, implementation and evaluation of the national strategy for the development of renewable energy and energy efficiency. It is also a center of expertise and an interface between policy, industry and research in the field of renewable energy and energy efficiency. CEREFE has a board of directors composed of representatives of 15 ministerial departments and 4 public institutions, in addition to an advisory board composed of recognized national expertise in the field, economic operators and representatives of civil society.[9]
- APRUE : The national agency for the promotion and rationalization of energy use is a public institution with an industrial and commercial character created by presidential decree in 1985, supervised by the Ministry of Energy and Mines. Its main mission is the implementation of the national policy of energy mastery through the promotion of energy efficiency.[10]

The Sectoral Committee for Energy Management (CIME). The National Fund for Energy Management and for Renewable Energies and Cogeneration (FNMEERC): which is the specific public instrument to encourage the policy of energy management and renewable energies. In two lines: Renewable energies and cogeneration, and the second is Energy management.

The National Energy Management Program (PNME): It provides the framework for the implementation of energy management at the national level, beside The Energy Efficiency Action Plan (PAMEE).

Table 1. Details about energy agencies of Algeria

N°	Agency		Setting-up	Unit
01	**APRUE**		1985	The National Agency for the Promotion and Rationalization of Energy Use
02	**CDER**	CDER	1988 Bouzareah	The Center for the Development of Renewable Energies
		UDES	1988 Tipaza	Solar Equipment Development Unit
		URAER	2002 Ghardaia	Unit of Applied Research in Renewable Energies
		URERMS	2004 Adrar	Research Unit for Renewable Energies in the Saharan Environment
03	**CEREFE**		2019	The Commission for Renewable Energies and Energy Efficiency

Thus, a first regulatory has been developed at CNERIB for the problem related to the thermal building in winter, and which proposes a simplified method of calculating losses. This method takes into account the losses by transmission and air renewal, as well as the losses at the level of thermal bridges. It also allows to estimate the heating power needs through the calculation of basic losses. In addition, this text allows the use of dynamic tools in a regulatory framework.

b. Algerian institutions dedicated to energy performance

Table 2: Type, character, units & zone of the key energy agencies in Algeria

AGENCY	**APRUE**	**CDER**	**CEREFE**
TYPE	EPST Public Scientific and Technological Institution	EPST Public Scientific and Technological Institution	EPST Public Scientific and Technological Institution
CHARACTER	Industrial/ commercial	Research Centre	Industrial/ commercial
UNITS	01	04	01
ZONE	North	North/South	North
MISSION	- The implementation of the national policy of energy mastery through the promotion of energy efficiency	- In charge of elaborating and implementing research and development programs, scientific and technological, of energy systems exploiting solar, wind, geothermal and biomass energy	- Assist in the design, implementation and evaluation of the national strategy for the development - Center of expertise and an interface between policy, industry and research.

c. Malaysia's energy performance institutions

Policy	**Year of set up**	**Key Emphasis**
National Petroleum Policy	1975	Introduced to ensure optimal use of petroleum resources and regulation of ownership, management and operation, and economic, social, and environmental safeguards in the exploitation of petroleum due to fast growing petroleum industry in Malaysia
National Energy Policy	1979	Formulated with broad guidelines on long-term energy objectives and strategies to ensure efficient, secure and environmentally sustainable supplies of energy.
National Depletion Policy	1980	introduced to safeguard against over exploitation of oil and gas reserves. Thus, it is production control policy

Four Fuel Diversification Policy	1981	Fuel diversification was designed to avoid over-dependence on oil as main energy supply and aimed at placing increased emphasis on gas, hydro and coal in the energy mix
Electricity Supply Act	1990	Regulates the licensing of electricity generation, transmission and distribution Gas
Gas Supply Act	1993	Regulates the licensing of the supply of gas to consumers through pipelines, prices, the control of gas supply pipelines, installations and appliances as well as safety
Fifth Fuel Policy	2000	introduced in recognition of the potential of biomass, biogas, municipal waste, solar and mini hydro as potential renewable energy resources for electricity generation
Energy Commission Act	2001	was established to provide technical and performance regulation for the electricity and piped gas supply industries, as the safety regulator for electricity and piped gas and to advise the government on matters relating to electricity and piped
National Biofuel Policy	2006	Supports the five fuels diversification policy. Aimed at reducing the country's dependence on depleting fossil fuels, promoting the demand for palm oil. Five key thrusts: transport, industry, technologies, export and cleaner environment.

5. RESULTS & DISCUSSION

The samples were typically governmental in both sectors whether research or development as shown in table1 a review of energy efficiency agencies that was held in this paper, clearly indicate the slow grow up, and long intervals that summarize the development gap as in figure 1; compared to the international fast-grow agencies in energy efficiency for the case of Malaysia[11] (as a developing country too) figure 2; which shows that short period between each national program helped in fast development in results. [11]

The Gaps:

- The remarkable gap in timeline
- the slow grow-up of the existing agencies
- the development of control and compliance cores

Supervision cores to apply regularities/developpe

Also, the gap in time evolution that captivate the attention to the lake of continuity in such field whether it is in research agencies or R&D agencies, that explained the gap in the regularities in the earlier stages of this research thematic.

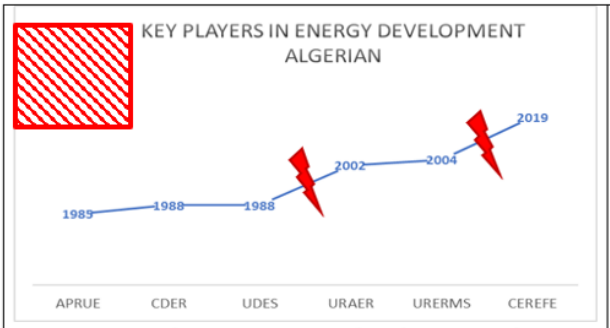

Figure 1: Key players in energy development Algerian

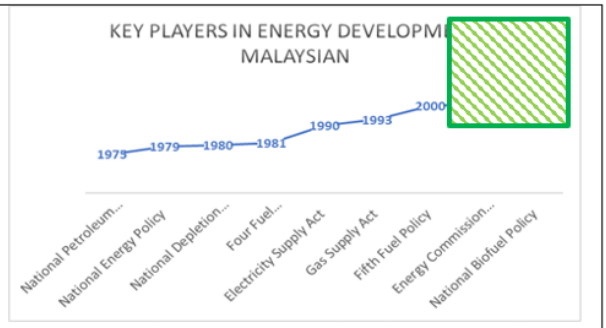

Figure 2: Key players in energy development Malaysian

Figure 4. key players in energy developpment Malaysia

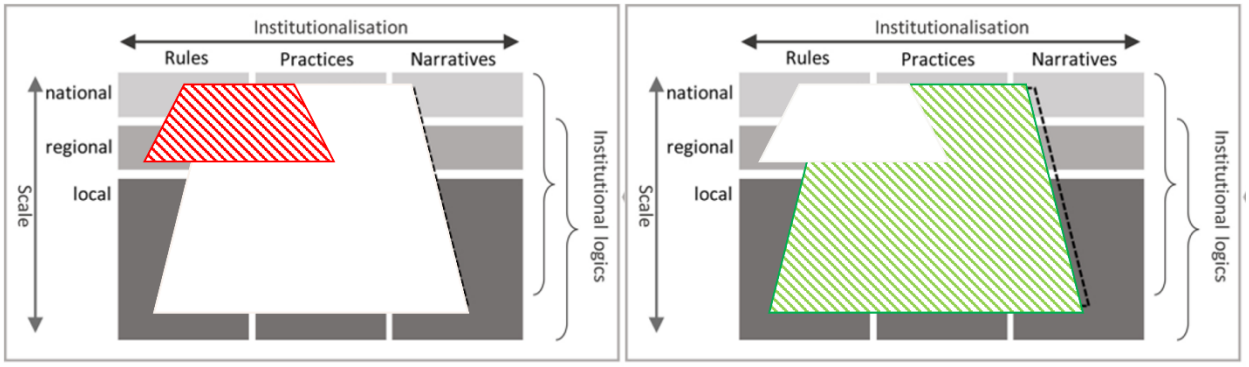

Figure 5. institutionalisation theory application on Algeria & Malaysia

For the institutionalisation, the Algerian constitution are situated in the red spot, and the referential country - Malaysia- is situated in the green one, gathering all scales and modes of institualisation. This confirms the gaps related to the regulatory framework and legislation. Also, serves the aim of this work, which is Diagnosis the agencies and institutions of energy efficiency and energy benchmarking in Algeria, and clarify their missions and charges. Extract the institutional modes and scales through an analytical framework. And finally, define the gaps that contribute to the delay of African countries building's efficiency (Figure 10).

6. Conclusions

To conclude, the brief review on agencies that held the responsibility of organizing the regulatory of energy efficiency in Algeria shown that the development line of this sector is quite slow according to the chronologic diagnosis. The pinpoint of authority institutions and agencies that are held to implement the energy efficiency in the national building's field, clarified that we have in Algeria a poor energy field cores according to foreign experiences in energy efficiency and benchmarking that assure the control and compliance of the regularities. The remarkable gap in time and results that contribute to the delay of Algerian building's efficiency to the international railway to sustainability is resumed in the slow grow-up of the existing agencies and cores also in the development of other cores that contribute in applying such regularities and developpe new once to accomplish the national and international goals to remain sustainability and protect the planet.

It is frequently suggested that the cores of control and compliance should be injected in the energy efficiency regularity sector, so the existed regularities see the light according to the protocols. The normative research in energy efficiency sector rely on the evaluation of the applicable regularities, so it could be developed and walk along to better results.

Acknowledgement

This work has been written in cooperation with the Research Center on Zero Emission Neighbourhoods in Smart Cities (FME ZEN). The authors gratefully acknowledge the support of ZEN partners, Norway and the Research Council of Norway.

References

Ahmed, B., Hasan, R., & Maniruzzaman, K. M. (2014). Urban morphological change analysis of Dhaka city, Bangladesh, using space syntax. *ISPRS International Journal of Geo-Information, 3*(4), 1412-1444. https://doi.org/10.3390/ijgi3041412

Amen, M. A. (2021). The Assessment of Cities Physical Complexity through Urban Energy Consumption. Civil Engineering and Architecture, 9(7), 2517–2527. doi:10.13189/cea.2021.090735

Bencheikh, D., & Bederina, M. (2020). Assessing the duality of thermal performance and energy efficiency of residential buildings in hot arid climate of Laghouat, Algeria. *International Journal of Energy and Environmental Engineering*, *11*(1), 143–162. https://doi.org/10.1007/s40095-019-00318-z

Fahmy, A., Abdou, A., & Ghoneem, M. (2019). Regenerative Architecture as a Paradigm for Enhancing the Urban Environment. *Port-Said Engineering Research Journal*, *23*(2), 11–19. https://doi.org/10.21608/pserj.2019.49554

IEA. (2019). *World Energy Balances 2019 – Analysis - IEA* (p. 23). https://www.iea.org/reports/world-energy-balances-2019

IRENA. (2020). Global Renewables Outlook: Energy transformation 2050. In *International Renewable Energy Agency*. https://www.irena.org/publications/2020/Apr/Global-Renewables-Outlook-2020

Kangas, H.-L., & Kivimaa, P. (2017). Technical Skills, Disinterest and Non-Functional Regulation: Energy Efficiency Barriers Viewed in an Ecosystem of Energy Service Companies. *SSRN Electronic Journal*, *February*. https://doi.org/10.2139/ssrn.2920505

Kaoula, D., & Bouchair, A. (2019). The pinpointing of the most prominent parameters on the energy performance for optimal passive strategies in ecological buildings based on bioclimatic, sensitivity and uncertainty analyses. *International Journal of Ambient Energy*, 1–28. https://doi.org/10.1080/01430750.2019.1665583

WWF. (2020). Living Planet Report 2020 - Bending the curve of biodiversity loss. In *Wwf*.