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ЭКОНОМИКА МЕЖДУНАРОДНЫХ ПЕРЕВОЗОК И ЛОГИСТИКИ:
ИНТЕЛЛЕКТУАЛЬНЫЕ И ЦИФРОВЫЕ РЕШЕНИЯ И ПРАКТИКА

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Analysis of transport and energy components of Africa's logistics infrastructure

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ABSTRACT The study analyses the transport and energy components of Africa's logistics infrastructure. The purpose of the analysis is to create an integrated transport system with all modes of transport operating in a coordinated and concerted manner. The transport system should provide stability of transport, freight and passenger flows on the basis of logistics. The analysis method used in the study analysed data mainly collected from secondary sources and involved methods of statistics. The findings of the analysis have shown that Africa has a low level of infrastructure development, especially in the power engineering and transport sectors. The performance of the currently operational facilities is very poor compared to the world's statistics. The findings also show that the energy infrastructure in Africa is very limited and the majority of its elements do not operate, ultimately resulting in frequent outages which affect the production and social sectors. The authors conclude that the economic development of African countries is in many respects dependent on trade. Without a proper unified and integrated transport network running across Africa, it will be impossible to integrate African economies into a single national economic mechanism. A unified and interconnected transport and energy network will help Africa to create a strong logistics system.

KEYWORDS: unified transport system; unified energy system; unified logistics system; transport component; energy component; railway; maritime transport; air transport; power engineering; infrastructure; logistics

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Научная статья

Анализ транспортной и энергетической составляющих логистической инфраструктуры Африки

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АННОТАЦИЯ Проанализированы транспортная и энергетическая составляющие логистической инфраструктуры Африки. Целью этого анализа является создание интегрированной транспортной системы, в которой все виды транспорта функционируют скоординированно и согласованно. Транспортная система должна обеспечивать стабильность транспортных, грузовых и пассажирских потоков на логистической основе. Был использован метод анализа, при котором данные, в значительной степени собранные из вторичных источников, были проанализированы с использованием статистических методов. Результаты анализа показали, что Африка имеет низкий уровень развития инфраструктуры, особенно в секторе энергетики и транспорта. А те, которые в настоящее время функционируют, функционируют в очень плохом состоянии по сравнению с мировой статистикой. Результаты также показали, что энергетическая инфраструктура в Африке очень ограничена, и большинство её элементов не функционируют, что в конечном итоге создает частые перебои с поставками электроэнергии, которые влияют на производство и социальную сферу. Выводы заключаются в том, что экономическое развитие африканских стран во многом зависит от торговли. Без надлежащей унифицированной и интегрированной транспортной сети, которая проходит через всю Африку, будет невозможно интегрировать экономики африканских стран в единый народо-хозяйственный механизм. Унифицированная и взаимосвязанная транспортная и энергетическая сеть поможет Африке создать мощную логистическую систему.

КЛЮЧЕВЫЕ СЛОВА: единая транспортная система; единая энергетическая система; единая логистическая система; транспортная составляющая; энергетическая составляющая; железная дорога; морской транспорт; воздушный транспорт; энергетика; инфраструктура; логистика

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INTRODUCTION

Meeting the needs for transporting goods and passengers is one of the main functions of logistics. Infrastructure is a key component of the logistics sector and the economy and an integral and supporting part of production, distribution and marketing of goods. The progressive economic development of regions requires that the transport and energy components of the industrial infrastructure be developed. So, for African countries to develop in a progressive and sustainable manner, they need to be provided with a well-developed transport network and supply of energy to power its operation. The increasing demand for transport services requires that the transport system operate sustainably and efficiently to support logistics of freight and passenger transport in all modes of transport.

The transport system includes different modes of transport that have interrelated and interacting elements. Interrelated elements include rolling stock, motorways, railways, waterways, air transport routes, sea and river ports, airports, cargo terminals and other elements of transport infrastructure.

In the logistics infrastructure, the transport component is important both for the creation of product value and for the provision of access to markets of raw materials and goods, stability in transportation of goods and passengers, and related services.

Another essential factor in the logistics infrastructure is the transfer lead time as it demonstrates the efficiency of the transportation and other related processes and depends on the condition of the transport and energy components.

ROAD TRANSPORT INFRASTRUCTURE

Any economy that needs growth requires a well-developed road network that provides reliable connections both domestically between regions and internationally. The road infrastructure is the most cost-intensive, but it is also the most important infrastructure for economic growth in a country [1–6].

Fig. 1 shows a detailed map of Africa's roads, including routes from cities to townships.

Both quantitative and qualitative indicators highlight the urgent need for strategic investment in the road infrastructure in African countries. Hard surface road networks in rural and urban areas are distributed nonuniformly, and the road density in most African countries is low. The condition of the majority of roads in rural areas is very poor and a large percentage of them lack hard surface. These factors make traffic flow and transport of goods and passengers more complicated.

According to the African Transport Policy Programme, high transport costs account for up to 40% of the final price of goods. Addressing the historically high inflation rates requires a fundamental improvement of the road infrastructure and transport links both within and between regions.

So, achieving Africa's economic development requires a well-integrated and coordinated road network that will ensure trade links on the continent. Road infrastructure is less cost-intensive than railway infrastructure and it is an important component of trade and transport logistics, as it can support door-to-door services.

Fig. 1. Detailed map of African roads with routes from cities to towns, road junctions to provinces (https://www.ezilon.com/maps/africa-road-maps.html)

It is the most important mode of transport in Africa as 80% of goods are transported by motorways. Road infrastructure is the most important infrastructure for Africa's economic growth. Roads in Africa are in a poor condition, with disproportionate distribution of paved roads, where most paved roads are located in urban areas, including large cities, while roads in rural areas involved in agricultural activities remain unpaved. This hinders the flow of goods from rural areas which account for 53% of all roads in Africa, thereby strongly affecting logistics.

According to programmes of the African transport policies, high inflation rates in Africa are due to very high transport costs, ultimately leading to a 40% increase in prices of final products. Thus, according to the report, one of the ways to address the inflation is to improve the level of road infrastructure.

Africa has total 16 countries without access to sea, and road transport, along with railway transport, plays an important role in the economy of these countries.

Ports in South Africa, Angola, Dar es Salaam and Mozambique help serve the interests of landlocked countries such as Botswana, Malawi, Zambia and Zimbabwe, owing to the good road infrastructure of the North–South corridor which acts as the main corridor connecting six countries, including South Africa, Zambia, Malawi, the Democratic Republic of the Congo, and Botswana (see *Fig. 1*).

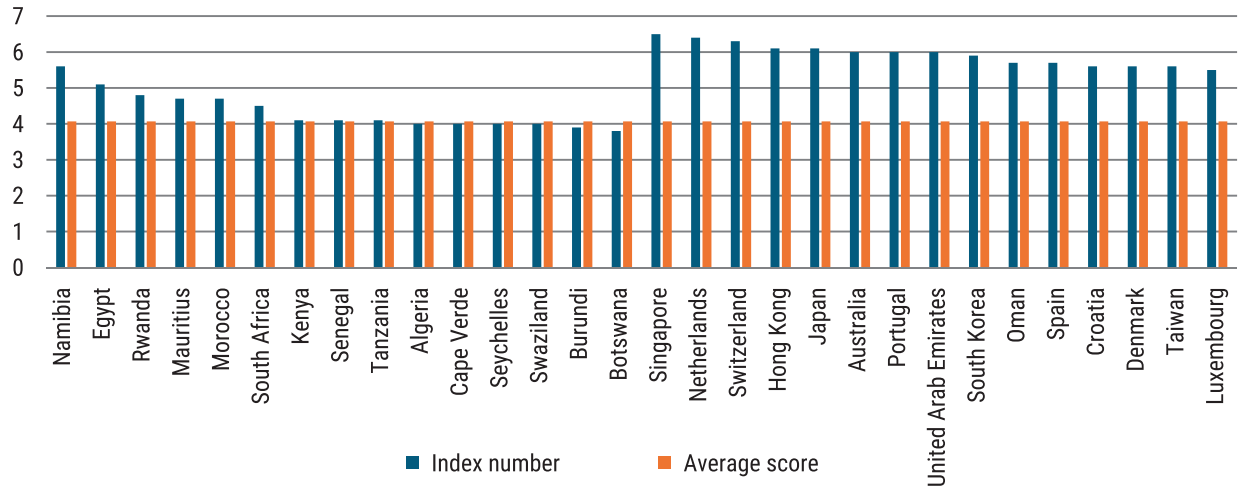

Fig. 2. Road quality (https://search.app/Eu1EDMYeEDfHQZbz9)

Table 1 and *Fig. 2* present an analysis of the quality of motorways in different countries in 2024 on a seven-point scale.

According to heads of enterprises, as of 2024, Namibia has the best road infrastructure in Africa. The country has reached an index rating of 5.57 on a seven-point scale (with 1 the lowest and 7 the highest) in terms of the condition and length of roads. Egypt and Benin rank second with 5.53 and 5 points, respectively. As can be seen from the graph, only nine African countries exceeded the average score of 4.07.

The geography of Africa can also be a factor affecting the condition of roads. The Sahara Desert makes up to 25% of Africa's land area, separating the North African countries from the countries located to the south of the Sahara Desert. The Congo rainforest is a factor that influences the development and coordination of the road transport infrastructure in Africa. It covers 12% of African land, extending for more than 3.6 million square kilometres, from the Republic of Congo, the Central African Republic, Equatorial Guinea, the Democratic Republic of Congo, and Gabon. Heavy rains in these areas accelerate the deterioration of roads, since the wetter the region, the higher maintenance costs are.

Table 1

Analysis of the quality of motorways in different countries

African countries	Index number	Countries of the world	Index number
Namibia	5.6	Singapore	6.5
Egypt	5.1	Netherlands	6.4
Rwanda	4.8	Switzerland	6.3
Mauritius	4.7	Hong Kong	6.1
Morocco	4.7	Japan	6.1
South Africa	4.5	Australia	6
Kenya	4.1	Portugal	6
Senegal	4.1	United Arab Emirates	6
Tanzania	4.1	South Korea	5.9
Algeria	4	Oman	5.7
Cape Verde	4	Spain	5.7
Seychelles	4	Croatia	5.6
Swaziland	4	Denmark	5.6
Burundi	3.9	Taiwan	5.6
Botswana	3.8	Luxembourg	5.5

Proper and strict compliance with traffic rules and the development of railway construction can also be regarded as a solution for maintaining the quality of motorways at an appropriate level. Therefore, instead of using road transport to transport heavy goods, railway transport should be used.

80% of the goods flow in East Africa is provided by road transport. Thanks to the East African Community, which is a trade area comprising eight countries, namely Tanzania, Kenya, Uganda, Rwanda, Burundi, Somalia, South Sudan, and the Democratic Republic of Congo, there are no trade tariffs and the applicable trade laws and regulations are less stringent, facilitating trade between these countries.

In West Africa, transportation of goods from landlocked countries such as Mali, Burkina Faso and Niger, largely depends on gateways from coastal countries, such as Guinea, Togo, Senegal, Ghana, and Benin, where road transport is the main mode of transport. Burkina Faso is a transit country for Mali, with 50% of its imported cargo passing through Togo and 36% going through Ghana.

In Central Africa, countries such as Chad and the Central African Republic heavily rely on the port of Cameroon for their international trade (exports and imports) where, as in West Africa, road transport is the main mode of transport for goods.

RAILWAY INFRASTRUCTURE

Policymakers in Africa should assess the condition of its railways to determine whether the existing railway system is compatible with Africa's social and economic environment, and develop strategies to improve the railway industry getting it out of its decline and making it as efficient and competitive as other modes of transport in order to provide transportation within African countries of large volumes of goods and passengers at reasonable prices.

Below are the areas considered to be the most promising for railway projects in Africa:

1) Main mining areas;
2) Densely populated areas;
3) African metropolitan cities;
4) Transport corridors from ports to internal markets.

Table 2 and *Fig. 3* present an analysis of the quality of railways in different countries in 2024 on a seven-point scale.

Compared to railways in other regions of the world, African railways are underdeveloped and are still trying to transform from being subsidy-dependent into commercially efficient entities. Low technical capabilities and unfavourable economic conditions are the key challenges faced by railway transport in Africa.

Table 2

Analysis of the quality of railways in different countries

African countries	Index number	Countries of the world	Index number
Kenya	4	Japan	6.8
Morocco	3.9	Hong Kong	6.5
Algeria	3.8	Switzerland	6.4
Egypt	3.8	South Korea	5.9
Botswana	3.6	Singapore	5.8
Namibia	3.4	Netherlands	5.7
Tanzania	3.2	Finland	5.5
Tunisia	3.2	Spain	5.4
Ethiopia	3	Taiwan	5.4
South Africa	3	Austria	5.3
Ivory Coast	2.9	United States of America	5.2
Senegal	2.9	Malaysia	5.1
Cameroon	2.7	France	5
Gabon	2.6	Luxembourg	5
Mozambique	2.6	Russia	4.9

MARITIME TRANSPORT INFRASTRUCTURE

Africa is the only large region in the world that does not have its own maritime policy or strategy, despite the recognized importance of this component of any national or regional economy.

A large portion of Africa's maritime transport infrastructure is in a poor condition, including the use of low-quality equipment for cargo handling operations. It also lacks an information system for port management for daily operation of offshore port terminals (The Report (Katasonov, 2019)).

Using a modern infrastructure is still the best way to reduce transportation costs which are largely determined by the accessibility of ports and shipping lines.

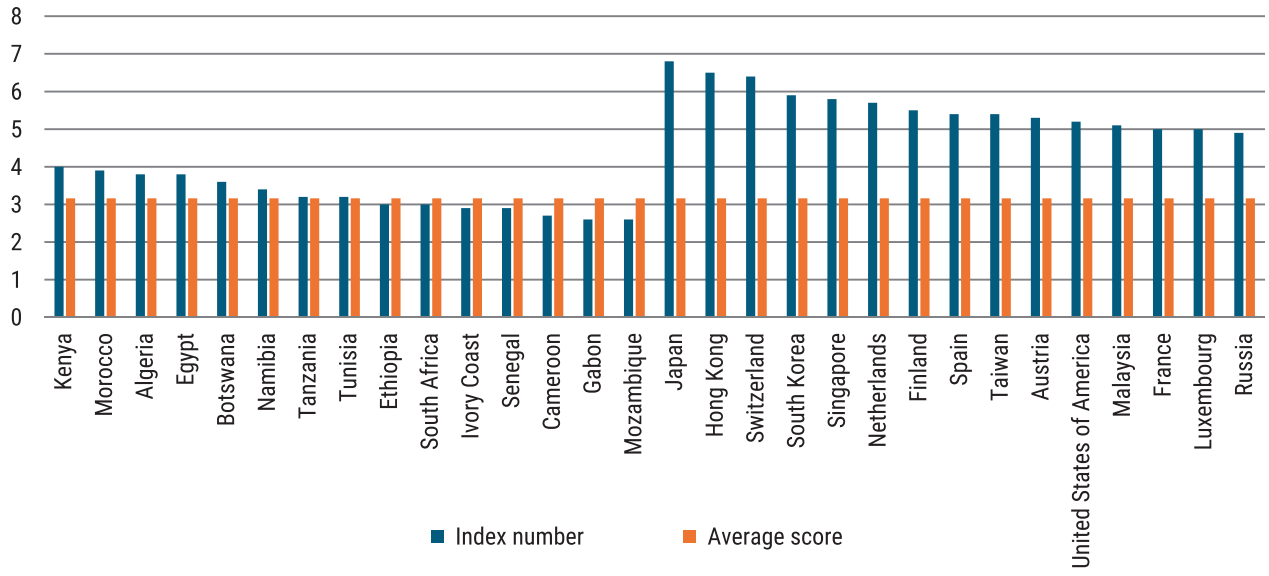

Fig. 3. Quality of railway infrastructure (https://search.app/Eu1EDMYeEDfHQZbz9)

Lower freight rates, communication with rural areas by motorways and railway, and port facilities, taken together, contribute to the competitiveness of a port (Wilmsmeier & Hoffmann, 2008). Vehicle congestion at port area, berth allocation long waiting time contribute to higher maritime trade payment (Abe & Wilson, 2008).

The success of the maritime industry is largely dependent on the success of other modes of transport, mainly railways and motorways, and this is due to the complementarity of port, railway and motorway systems in handling of export, import and domestic freight and passenger traffic in all modes of transport. Therefore, the maritime industry should be developed in parallel with other modes of transport which are not alternative but rather interdependent, each playing an important role in a single transport system (Opportunity and Growth Diagnostic of Maritime Transportation in the Eastern and Southern Africa by Professor Godius Kahyarara).

The development of a proper infrastructure, including ports, inland communication and shipyards, is the key to providing efficient and uninterrupted trade and transport operations, which is crucial for promoting the prospects of maritime transport in Africa. Investment in the transport infrastructure will lead to the expansion of the transport sector, thus resulting in the growth of other sectors of the economy and industry, including the agricultural and maritime sectors.

This will increase employment rates, provide more employment opportunities, which will ultimately accelerate the growth of African economies (Paice, E. (2021). Youthquake: Why African Demography Should Matter to the World. Bloomsbury Publishing).

SEAPORTS

African ports have been considered the most valuable physical intangible assets because of their role for accessing Africa's vital natural resources, both during colonial times and today when just a few terminals and port facilities have been created to handle exported mineral products for processing plants in Europe and other countries of the world (AFC State of Africa's Infrastructure Report).

African ports are also a link for exporting African natural resources, commodities and food, as well as for importing industrial products and equipment, although Africa's trade volume is significantly lower than that of other continents. Seaports are considered an integral part of the dynamics of African trade.

Given that by 2050 the population of Africa is expected to grow from 1.4 billion to 2.4 billion and it can boast some of the world's fastest growing economies, particularly in West and East Africa, African ports remain a lucrative gateway to the African market for foreign countries, and the combined forces of economic and demographic growth are fuelling the increased consumption and promoting foreign trade transportation. As a result, African ports are becoming highly attractive physical assets, and the port segment of the African market of transport services has good prospects of sustainable growth in the foreseeable future.

During colonial times, African ports were designed to facilitate access to raw materials for European countries. Railways were also built during this period to connect ports with the hinterland. Despite the post-colonial establishment of national shipping lines, the dominance of foreign transport, primarily by former colonial powers, continues to this day [7].

Table 3 and *Fig. 4* present an analysis of the quality of the port infrastructure in different countries in 2024 on a seven-point scale.

In 2024, the average score for 101 countries was 4.03. The highest score was recorded for Singapore (6.5 points) and the lowest was for Tajikistan (1.0).

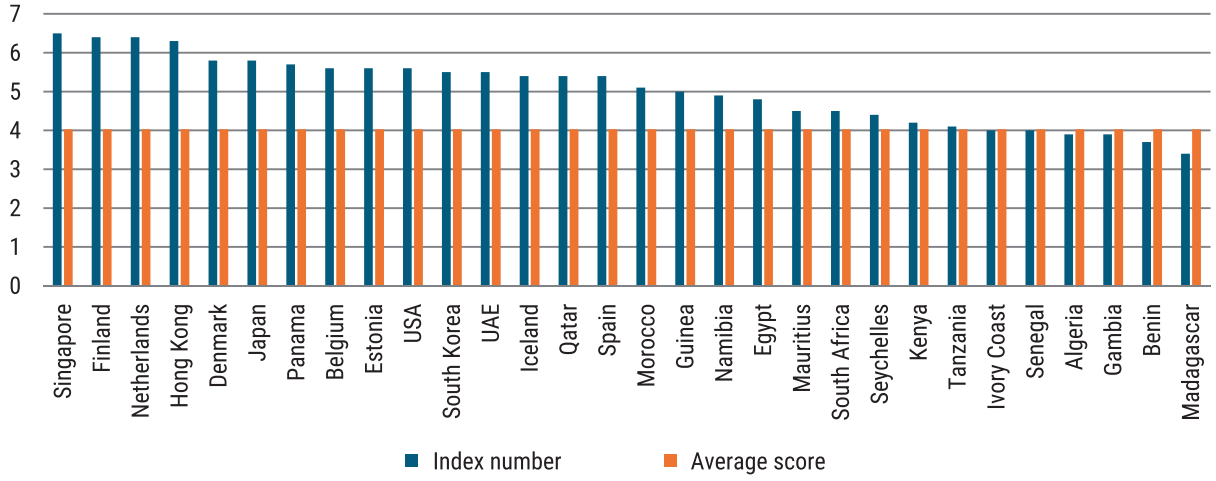

Fig. 4. Quality of port infrastructure (https://search.app/Eu1EDMYeEDfHQZbz9)

Table 3

Analysis of the quality of port infrastructure in different countries

African countries	Index number	Countries of the world	Index number
Morocco	5.1	Singapore	6.5
Guinea	5.0	Finland	6.4
Namibia	4.9	Netherlands	6.4
Egypt	4.8	Hong Kong	6.3
Mauritius	4.5	Denmark	5.8
South Africa	4.5	Japan	5.8
Seychelles	4.4	Panama	5.7
Kenya	4.2	Belgium	5.6
Tanzania	4.1	Estonia	5.6
Ivory Coast	4.0	USA	5.6
Senegal	4.0	South Korea	5.5
Algeria	3.9	UAE	5.5
Gambia	3.9	Iceland	5.4
Benin	3.7	Qatar	5.4
Madagascar	3.4	Spain	5.4

LINKS WITH THE HINTERLAND (RAILWAYS AND MOTORWAYS)

The hinterland connectivity is crucial for the development of Africa. The lack of important components of the transport infrastructure, such as motorways and railways, increases the cost of both imports and exports.

In 1971, the concept of a trans-African highway was presented and 9 potential projects were discussed for highway corridors with a total length of 64,374 km to connect African towns with seaports. Although more than a half of the network has been built, significant sections remain insufficiently modernised, in particular, those between Mombasa and Lagos (Hanson, S. E., & Nicholls, R. J. (2020). Demand for ports to 2050: Climate policy, growing trade and the impacts of sea-level rise. Earth's Future, 8(8), e2020EF001543).

But the progress in the completion of the project was postponed due to problems, such as economic and political turbulences and the local terrain.

Africa should develop and focus both on improving the performance and efficiency of its seaports and on developing other transport infrastructure elements that interact with seaports, such as railway and pipeline networks. This will help reduce its dependence on road transport and thus remove barriers to the development of the shipping sector in the maritime segment of the transport services market [8].

The future development of Africa's economy is based on the reliability of its 16 arterial roads. To resolve financial problems, it is planned to invest on average USD 4.6 billion per year in completing the project for the development of the African road network, and by 2030 this will total USD 78 billion [9].

To improve the transport connectivity between its regions, the continent needs from 60,000 to 100,000 kilometres of additional roads. The African Development Bank has identified an annual infrastructure funding gap of USD 67.6–107.5 billion. In Africa, transport costs are notably, by 50–175%, higher than in other regions due to the unbalanced throughput and carrying capacities, as well as because of the technical condition of the transport infrastructure elements.

Moreover, foreign trade is further complicated by bureaucratic hurdles, a large number of paper documents, and the existing system for document execution, processing and transfer between structural divisions, as transport companies have to process up to 1,600 documents for just one truck crossing international borders [10].

AIR TRANSPORT INFRASTRUCTURE

Air transport infrastructure includes airports, air traffic control centres, and entities involved in coordinating their provision and use.

Regional airports in Africa are often owned and financed by regional governments; otherwise these airports are not commercially attractive to private businesses, since the private sector is mainly concerned with gaining profits and therefore they only invest in projects where they believe the demand is high. However, the private sector is also important for the economic development of the region; therefore, the majority of regional governments that retain ownership of the airport infrastructure usually look for a proper balance between providing incentives to the private sector for making profit as long as they can maximize commercial performance.

The African aviation sector remains relatively small on a global scale, especially when compared with the aviation sector on other continents, in particular in Europe and North America.

In the period between 2001 and 2015, the total air transport capacity in sub-Saharan Africa increased significantly from estimated 47 million to 105 million seats, which suggests a CAGR of nearly 6% (AFC State of Africa's Infrastructure Report).

Africa's air sector is very important for the economic development of the continent, providing access to landlocked countries and the hinterland of the continent, as well as for transportation of perishable goods.

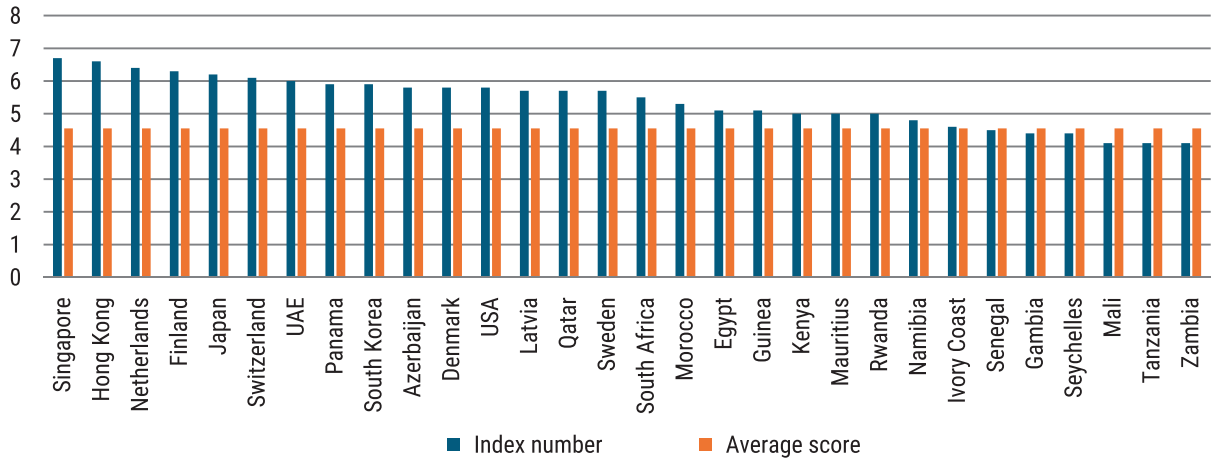

Fig. 5. Quality of air infrastructure (https://search.app/Eu1EDMYeEDfHQZbz9)

The establishment of air freight hubs was limited to certain regions where the economies show higher diversification, such as Egypt, South Africa, and Kenya.

Only 3 out of 54 African countries have air freight hubs, which suggests that further investment in the infrastructure of cargo handling and storage is needed to promote economic diversification efforts and the ongoing transition to a higher value added economy (AFC State of Africa's Infrastructure Report).

17% of the global population lives in Africa, but currently the continent accounts for just 2% of the world's air traffic.

At present, Africa has more than 477 airports and 419 airlines.

Table 4

Analysis of the quality of air transport infrastructure in different countries

African countries	Index number	Countries of the world	Index number
South Africa	5.5	Singapore	6.7
Morocco	5.3	Hong Kong	6.6
Egypt	5.1	Netherlands	6.4
Guinea	5.1	Finland	6.3
Kenya	5	Japan	6.2
Mauritius	5	Switzerland	6.1
Rwanda	5	UA Emirates	6
Namibia	4.8	Panama	5.9
Ivory Coast	4.6	South Korea	5.9
Senegal	4.5	Azerbaijan	5.8
Gambia	4.4	Denmark	5.8
Seychelles	4.4	USA	5.8
Mali	4.1	Latvia	5.7
Tanzania	4.1	Qatar	5.7
Zambia	4.1	Sweden	5.7

Table 4 and *Fig. 5* show an analysis of the quality of the air transport infrastructure in different countries in 2024 on a seven-point scale.

In 2024, the average score for 101 countries was 4.55. The highest score was recorded for Singapore (6.7 points) and the lowest was for Lesotho (1.4).

ENERGY INFRASTRUCTURE

Africa is home to 18% of the global population, yet it accounts for just 6% of the global consumption of power. Africa consumes the least amount of power compared to other continents, both in total and per capita terms. Africa's energy landscape plays a major role in the economic development of the continent. But obtaining and supplying electric power is very expensive and is largely hard to implement, which affects both the transport sector and all the other industries (AFC State of Africa's Infrastructure Report).

Systematic transition from non-renewable to renewable energy is essential for the development of Africa's industrial and transport sectors. Africa is the second largest continent in the world, comprising 54 countries with an estimated population of over 1.2 billion people (World Bank, 2023).

Many African countries have some of the youngest populations in the world. Therefore, the working-age population is expected to grow the fastest of all regions, with a projected net increase of 740 million people by 2050 (World Bank, 2023). With the growth of population, industrialization, and major renovation projects in the transport sector, including 16 highway projects, the demand for electric power on the continent is expected to increase significantly in the next decades.

Africa has sufficient resources to produce energy from a variety of sources: hydropower, solar power, wind power, geothermal power, and bioenergy, which

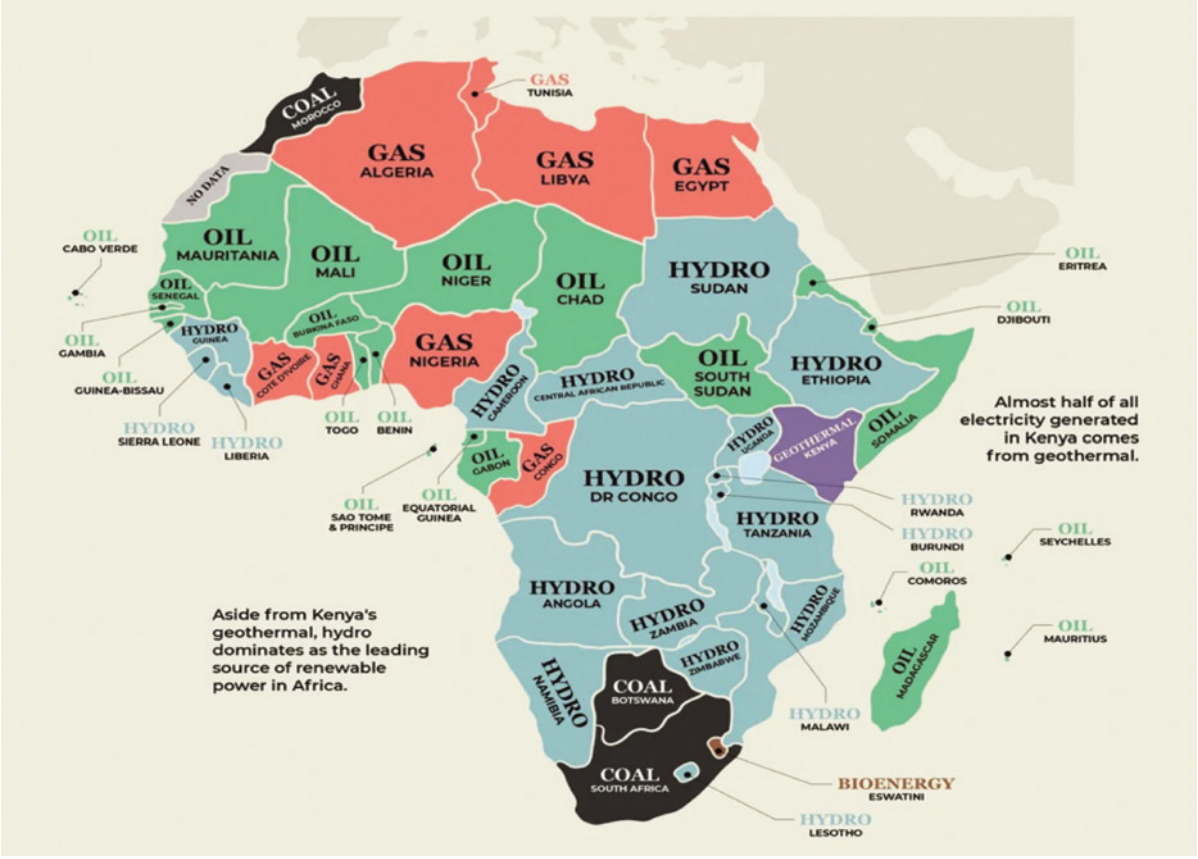

Fig. 6. Main sources of energy in African countries (https://www.tell.ng/africas-power-struggle-how-oil-gas-and-hydropower-shape-the-continents-energy-future/)

is 1,000 times higher than the projected demand for electric power in 2040 (IRENA and AfDB, 2022).

Africa also has mineral resources necessary for the production of renewable power, such as copper, cobalt, platinum, manganese, and chromium (*Fig. 6*).

ENERGY ACCESS CHALLENGES

In 2010–2021, Africa was considered a continent with an absolute deficit of access to electric power, with Nigeria being one of the countries where 86 million people live without any access to electricity, and 26 million people in the Democratic Republic of Congo having no access to electricity (AFC State of Africa's Infrastructure Report).

Frequent power outages have negative effects on businesses due to the increased cost of production because of using other generation methods, including fuel generators. Most of these businesses are involved in agriculture, including small farming businesses. Agriculture is the basis of the African economy (IRENA and AfDB, 2022).

The energy system is inextricably linked to the uninterrupted operation of the economy, people's well-being, and the sustainability of ecosystems.

POWER SUPPLY INFRASTRUCTURE

In Africa, the power supply infrastructure consists of a lot of energy sources that are not integrated at the regional level. There is also a lack of coordination between countries in production and distribution of energy.

As a result, some countries of Africa have excessive electric power, while others experience shortages. Without a proper energy infrastructure countries with excessive electric power are unable to export it to those with permanent shortages. Ghana is a good example of countries with an excess of electricity, while South Sudan and Burundi experience shortages of electric power.

In total, the continent's oil refinery capacity is 3.5 million barrels per day (mbpd), with Northern Africa accounting for 60% of them.

USING ELECTRIC POWER ON RAILWAYS AND MOTORWAYS

The low level of industrialization, lack of trade within Africa, and extreme poverty have resulted in low levels of power consumption in the railway trans-

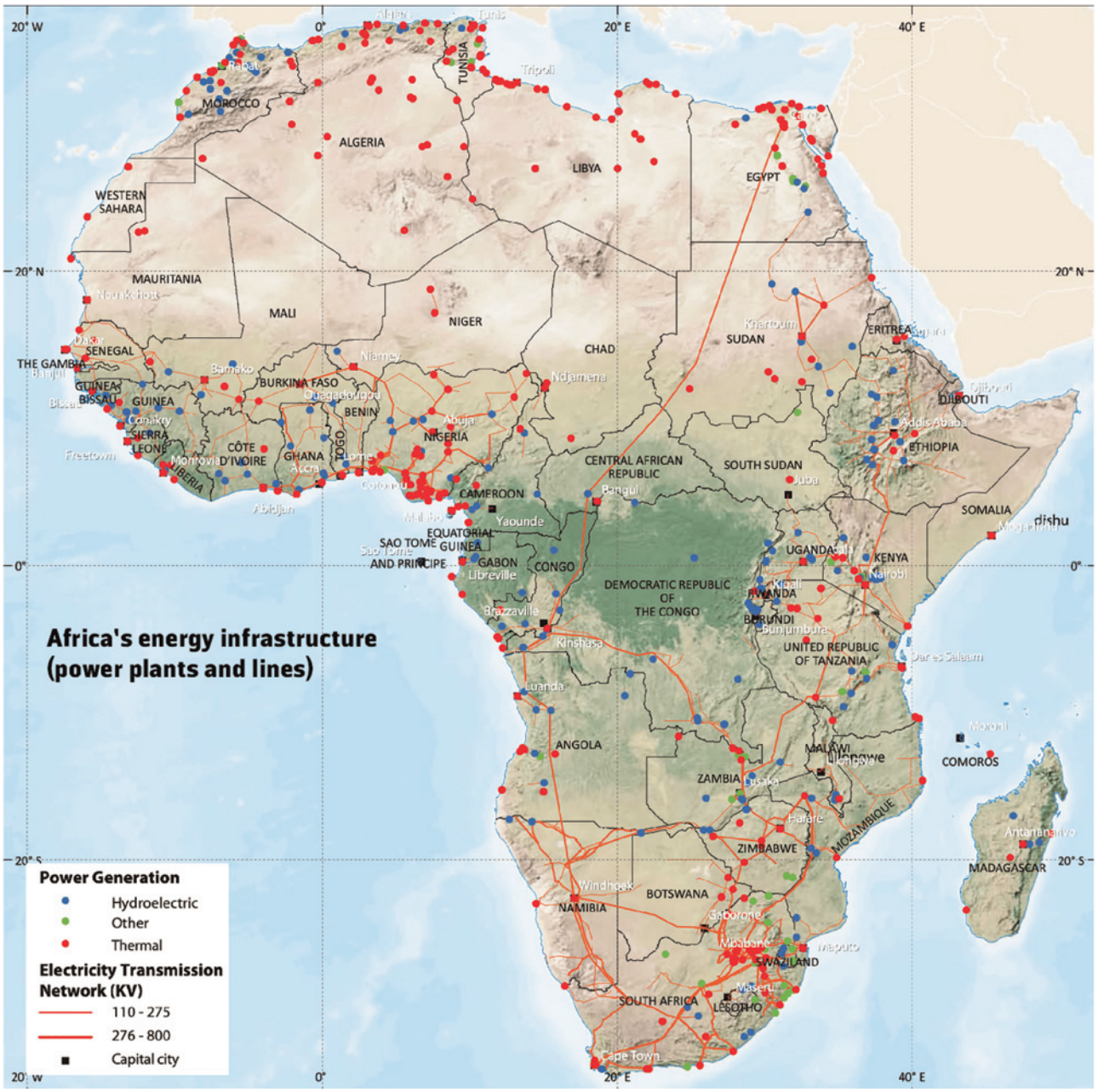

Fig. 7. Energy infrastructure of Africa, power plants and lines (https://geographical.co.uk/climate-change/african-energy)

port sector, which accounts for just 1% of Africa's total power consumption.

With the current railway projects, including the construction of a standard gauge railway to connect five countries in East Africa, including Tanzania, Uganda, Burundi, Rwanda and the Democratic Republic of Congo, and projects for unification of all rail tracks in Africa, the entire railway network in Africa is expected to have the 1,435 metre gauge.

All these projects will lead to an increase in power consumption by railways from 1% to 10% in 2020–2030, while road transport is expected to grow by nearly 40% in the same period (2020–2030).

75% of electricity generated in Africa comes from fossil fuels, while the remaining portion is dependent on oil and imported fuels. Ultimately, this makes the African economy vulnerable to fluctuations in oil prices determined by international markets (*Fig. 7*).

CONCLUSION

The findings of this study which analysed the condition and performance of the transport and energy components of the logistics infrastructure have shown the following.

Africa's infrastructure is underdeveloped, especially in the power engineering and transport sectors, and the currently operating elements are in a very poor condition compared to other countries. This is supported by world statistics which show that the quality of motorways is above average (4.07) only in 9 out of 54 African countries. These are Namibia, Egypt, Rwanda, Mauritius, Morocco, South Africa, Kenya, Senegal, and Tanzania.

The findings also show an unsatisfactory quality of the railway transport infrastructure, where only 4 out of 54 countries have a quality above the world average (3.61). These are Kenya, Morocco, Algeria, and Egypt.

The quality of the port infrastructure is also unsatisfactory. Only 9 out of 54 African countries have scores above the world average (4.03). These are Morocco, Guinea, Namibia, Egypt, Mauritius, South Africa, Seychelles, Kenya, and Tanzania.

The findings also show that the quality of the airport infrastructure in most African countries is below the average level (4.55), and only 9 countries have scores above the world average. These are South Africa, Morocco, Egypt, Guinea, Kenya, Mauritius, Rwanda, Namibia, and Ivory Coast.

The energy infrastructure is very limited and the majority of its elements are non-operational, ultimately resulting in frequent outages which affect both the production sector and people's conditions of existence. Access to energy/electricity is less than 50% in 23 African countries, although Africa has 13% of the world's natural gas reserves and 7% of the world's oil reserves.

The findings also show that the economic geography of Africa can be considered to be one of the constraints for the development of transport infrastructure. Due to the high levels of poverty and low population, African countries have difficulties mobilizing domestic resources to finance and implement transport infrastructure projects, especially in sub-Saharan Africa (5).

The study has shown that transport systems of different African countries are not sufficiently integrated into a single whole. African transport infrastructures are very fragmented. The coherence of operations is low and thus evidences the need for reforming transcontinental highways and railways.

This generally affects landlocked African countries. In total, there are 15 such countries. They are to a great extent dependent on their neighbours in terms of access to global markets.

Due to the fragmented nature of the transport infrastructure network, the cost of infrastructure services is twice as high as elsewhere in the world. This is true both for the transport infrastructure and for the energy infrastructure. 30 out of 54 countries in Africa are facing regular shortages of electric power, and many pay a very high price for it. Therefore, it is extremely important to open up opportunities for attracting new investors, and introduce new mechanisms of financing the development of the transport and energy components of the logistics infrastructure. This is particularly relevant in the current context of the Russian economy and industry when logistics of Russian foreign trade flows and energy flows are being reformatted to serve the eastern and southern directions, as discussed in papers [11–19].

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