# "PIPELINE-BASED ECONOMICS": THE GLOBAL RELIANCE ON OIL AND GAS EXPORTS DOI: 10.52174/2579-2989\_2024.6-73

"He who controls the oil controls the world." Henry Kissinger

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Oil and natural gas rank among the most widely traded commodities globally. However, since production regions often do not align with major consumer markets, transportation — particularly via pipelines across continents and oceans — plays a critical role in shaping the dynamics of the global oil and gas industry.

"Pipeline-based economics" refers to the economic systems and geopolitical strategies shaped by the production, distribution, and consumption of oil and natural gas, heavily reliant on pipeline infrastructure. This concept characterizes economies, markets, and policies influenced by energy resources transported through extensive networks of pipelines. In other words, "Pipeline-Based Economics" explores the critical role of pipelines in the global energy economy, emphasizing how oil and gas exports shape economic strategies and dependencies worldwide.

Although renewable energy sources are playing an increasingly significant role in global energy consumption, the global economy remains largely reliant on oil. As the most widely used energy source, the growing demand for energy continues to drive oil extraction and transportation activities.

Pipelines are widely regarded as the safest and most efficient method for transporting oil and gas products. However, their construction is a complex and often controversial process. In cases where distances are too vast or political and geographical challenges render pipelines impractical, oil tankers and Liquefied natural gas (LNG)





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bttps://orcid.org/0000-0002-5854-2473 vessels serve as alternatives for transportation.

The economic nature of pipelines lies in their status as long-term, capital-intensive projects that influence regional development and international trade. They create economic interdependencies between producing and consuming nations while fostering economic growth in regions they traverse. Geopolitically, pipelines are highly significant, their routes and control over them are frequently subjects of international negotiation, conflict, or cooperation.

Pipelines are among the most efficient and widely used systems for transporting energy resources like oil, gas, and water. They generate significant economic benefits, including job creation, revenue, and economic growth for many nations and regions. However, pipelines also come with notable economic, social, environmental and geopolitical challenges that need to be carefully considered and addressed<sup>1</sup>.

Pipeline-Based *Economics* can be characterized as а framework that emphasizes the economic, geopolitical, and infrastructural significance of oil and gas pipelines in global energy trade and supply chains. It reflects the ways in which countries and regions depend on the transportation of fossil fuels via pipelines to sustain energy needs, drive industrial growth, and manage strategic energy security.

As interstate pipeline capacity is a key factor in determining the amount of natural gas that can be physically traded between markets, the connections between capacities, flows, and spot prices are consistent and quantifiable<sup>2</sup>.

In the context of economic influence, pipelines play a vital economic role by enabling efficient resource transportation and stimulating regional development. They require significant upfront investment but offer substantial returns through revenues, profits, and job creation. During construction, pipelines inject capital into local economies, supporting businesses and creating a multiplier effect. Once operational, thev lower transportation costs. improve energy security, and enhance market access for industries reliant on oil or gas. However, they can also introduce challenges, such as market distortions, monopoly risks, and the potential for stranded assets when demand shifts or resources deplete. Overall, pipelines drive economic growth by ensuring reliable resource access and attracting industrial investments.

According to the research results, conducted by the research consultancy firm for energy technologies THUNDER SAID ENERGY, the following interesting points have been revealed<sup>3</sup>:

- The biggest cost for a pipeline is *capital expenditure* (capex). A rough estimate is *\$1-2 million per kilometer*, but this cost depends on the pipeline's size, location, and terrain.
- It costs \$1 per barrel (bbl) to transport oil or similar liquids 500 kilometers using a pipeline operating at a medium-to-large scale (measured in thousands of barrels per day, or Mbpd).
- The energy needed for this transport is about 2.1 kilowatt-hours (kWh) per barrel, and it produces about 0.8 kilograms of CO<sub>2</sub> emissions per barrel.
- Pipelines become less efficient at smaller volumes: *if the volume is reduced by half, the cost doubles*. This highlights that transporting larger volumes of liquid is more cost-effective due to economies of scale.

Oil and gas are top global commodities, and pipelines are crucial for connecting distant production regions to consumer markets. The primary methods for transporting crude oil, oil products, and natural gas are tanker

<sup>&</sup>lt;sup>3</sup> THUNDER SAID ENERGY, Pipeline costs: moving oil, products or other liquids? https://thundersaidenergy.com/downloads/ pipelines-the-energy-economics/ (Date of access: 10.12.2024).



<sup>&</sup>lt;sup>1</sup> Pipeline economics: The economic aspects and impacts of pipeline development and operation, FasterCapital, 5 June 2024, https://www.fastercapital.com/content/Pipeline-economics--The-economic-aspects-and-impacts-of-pipeline-development-and-operation.html

Oliver, M.E., Mason, C.F. & Finnoff, D. Pipeline congestion and basis differentials. J Regul Econ 46, 261–291 (2014). https://doi. org/10.1007/s11149-014-9256-9



The Longest Operational Oil Pipeline Networks Worldwide in 2024 (in kilometers)⁴

ships and pipelines, with global oil tanker capacity exceeding 650 million tons' deadweight in 2023. That year, oil tankers represented about 29% of global seaborne trade by tonnage<sup>5</sup>.

The regions with the world's longest oil pipeline networks are presented in Figure 1.

The world's longest oil pipeline network is located in North America, which remains

the leading one at over 111,000 kilometers as of May 2024, although the Asian continent has notably expanded its pipeline network in recent years. The United States and Canada, as major producers and refiners, have developed an extensive pipeline network spanning the continent, with the U.S. boasting an oil pipeline system nearly three times larger than that of China. Asia follows



<sup>&</sup>lt;sup>4</sup> Statista, Global oil pipeline length 2024, by region, Sep 13, 2024, https://www.statista.com/statistics/1491014/length-of-oil-pipelines-by-region/

<sup>&</sup>lt;sup>5</sup> Statista, Capacity of oil tankers in seaborne trade 1980-2023, Jun 20, 2024, https://www.statista.com/statistics/267605/capacity-of-oil-tankers-in-the-world-maritime-trade-since-1980/

<sup>&</sup>lt;sup>6</sup> IEA (2024), Year-on-year changes in global oil demand by quarter, 2023-2025, IEA, Paris https://www.iea.org/data-and-statistics/charts/year-on-year-changes-in-global-oil-demand-by-quarter-2023-2025, Licence: CC BY 4.0 (Accessed: 01.12.2024).



North America with operational oil pipeline network of more than 86,700 km long.

The Asian continent includes producing giants such as Saudi Arabia and leading consumer countries like China and India. Among key investors in Asian pipeline infrastructures are countries like Iraq, Iran, and India<sup>8</sup>.

Europe is the third largest region with a long pipeline network, measured in 74,077 km. The distance of pipelines in Latin America and the Caribbean region is 26,755 km, in Africa – 23,854 km. And, Oceania is characterized by the thinnest network of pipelines, with only 2115 km long.

Despite the clean energy transition trends and growing usage of electric cars worldwide, global oil demand increased by 2 million barrels per day (mb/d) in 2023 to 99 mb/d, nearly doubling the pre-2020 average growth rate. This surge was driven by increased petrochemical use in China, which saw a 1.5 mb/d rise, and global transport demand, while advanced economies experienced a 0.3 mb/d decline. In 2024, demand growth is projected to slow significantly, especially in China, with a total increase of less than 1 mb/d expected. Over the past decade more than 45% of global oil demand growth was due to road transport, which has increased oil demand by 4.2 mb/d<sup>9</sup>.

The picture reflected in Figure 2 and Figure 3 shows that the growth in global oil demand in 2023-2024 was largely due to the recording of upward trends in demand growth in China, especially between the second quarter of 2023 and the first quarter of 2024.

According to Figure 3, during 2015-2023. demand for oil in China increased by 4.9 million barrels per day (mb/d), in India - by 1.1 mb/d, in South Asia, Africa and the Middle East, oil demand was relatively modest -0.1-0.4 mb/d. There was no change in demand in North America. During the period under review, oil demand in Europe decreased by -0.7 mb/d, in Japan and Korea - by -0.9 mb/d.

The global market for liquefied natural

<sup>&</sup>lt;sup>7</sup> IIEA (2024), Change in global oil demand in selected regions, 2015-2023, IEA, Paris https://www.iea.org/data-and-statistics/ charts/change-in-global-oil-demand-in-selected-regions-2015-2023, Licence: CC BY 4.0 (Accessed: 01.12.2024).

Statista, Global ofi and gas transportation industry - statistics & facts, Sep 16, 2024, https://www.statista.com/topics/8216/global-oil-and-gas-transportation-industry/#topicOverview

<sup>&</sup>lt;sup>9</sup> IEA (2024), World Energy Outlook 2024, IEA, Paris https://www.iea.org/reports/world-energy-outlook-2024, Licence: CC BY 4.0 (report), p. 37, 70.

gas (LNG) is expected to grow significantly as part of the world's efforts to use cleaner energy. As of December 2024, about 400 million tons of LNG are produced each year, but this is projected to increase to 1,100 million tons per year by 2050. This growth means LNG production will increase at an average rate of around 4% per year<sup>10</sup>. The main reason for such kind of rapid growth is that LNG is much less polluting than coal - burning coal produces twice as much carbon dioxide (CO2) as LNG. So, switching from coal to LNG helps reduce greenhouse gas emissions.

Nevertheless, Global coal demand grew by over 100 Mtce in 2023, reaching around 6,000 Mtce, driven by increased power sector use in China and India. Advanced economies, however, saw a sharp decline of over 120 Mtce (10%), with coal use in U.S. and EU power sectors falling by 20-25%. In 2024, coal demand is expected to slightly

exceed 2023 levels due to rising electricity needs in China and India, outweighing reductions in the EU<sup>11</sup>.

Liquefied natural gas (LNG) is natural gas converted into a liquid form to simplify transportation and storage, making it more cost-effective. efficient and Composed primarily of methane with small amounts of ethane, natural gas is a non-toxic, odorless, and colorless substance. It is liquefied by cooling it to an extremely low temperature of -160°C (-260°F).

By the end of 2023, the global liquefied natural gas (LNG) tanker fleet included 772 vessels, including floating storage units. The fleet has grown steadily since 2011, driven by rising LNG trade volumes, which reached 549 billion cubic meters in 2023, necessitating more tankers to meet increasing consumer demand<sup>12</sup>.

The trade of liquefied natural gas (LNG) is especially crucial for gas-exporting nations



FIGURE 4

# Countries Leading in Operational and Planned Natural Gas Pipelines Worldwide as of 2024 (number)<sup>1</sup>

Statista, Countries with largest number of operational and planned natural gas pipelines worldwide as 2024, Feb 20, 2024, https://www.statista.com/statistics/744480/gas-pipelines-by-country-status-worldwide/

<sup>&</sup>lt;sup>10</sup> THUNDER SAID ENERGY, LNG: top conclusions in the energy transition? https://thundersaidenergy.com/downloads/category/ Ing/ (Accessed: 10.12.2024).

IEA (2024), World Energy Outlook 2024, IEA, Paris https://www.iea.org/reports/world-energy-outlook-2024, Licence: CC BY 4.0 (report), pp. 70-71.

<sup>12</sup> Statista, Global LNG trade volume 1970-2023, Aug 14, 2024, https://www.statista.com/statistics/264000/global-Ing-trade-volume-since-1970/

like Qatar and Australia, which rely almost entirely on maritime shipping to reach distant consumer markets. On the demand side, major LNG-importing countries are primarily located in East Asia, with Europe emerging as a significant market in recent years.

Over the last 30 years, there has been an enduring interest in constructing large-scale natural gas pipelines across the globe<sup>14</sup>. Natural gas, with a volumetric energy density nearly 1,000 times lower than crude oil, is among the most challenging and expensive primary fuels to transport. Internationally traded natural gas is typically transported either in gaseous form via long-distance pipeline systems or in the form of liquefied natural gas (LNG) on specialized ships for international trade (LNG carriers)<sup>15</sup>.

Globally, the total number of operational gas pipelines exceeds 1,500, highlighting the critical role of this infrastructure in energy transportation. For pressurized natural gas, pipelines are typically constructed from carbon steel to ensure safety and durability.

According to the Figure 4, China leads the world in operational gas pipelines, with 442 functional segments as of February 2024. Additionally, 302 more segments are either under construction or planned, further expanding the country's extensive gas network. China is followed by Russia (230 pipelines overall, 70 of which is under construction) and the United States (225 pipelines overall, 30 of which is under construction). Among European countries gas pipeline operational infrastructures are available in Italy, Germany, France, Spain and the Netherlands.

Global natural gas demand rose by 20 billion cubic metres (bcm) in 2023 to

4,190 bcm, driven by higher usage in North America's power sector and the Middle East's buildings and industry sectors. This was offset by a 40 bcm (7%) drop in Europe, where demand fell to its lowest since the early 1990s after a 13% decline in 2022. Preliminary 2024 data shows a 50 bcm increase in the first half, largely due to rising industrial and power sector demand in Asia<sup>16</sup>.

Interestingly, LNG is growing faster than overall natural gas supply. While global natural gas production will also grow doubling from 400 billion cubic feet per day now to 800 billion cubic feet per day by 2050 — it will only grow at about 2.5% per year on average. To support this LNG growth, the world will need to invest heavily in new facilities to liquefy natural gas. These facilities will require around \$20 billion in new investments every year<sup>17</sup>.

In 2023, the United States was the world's leading exporter of liquefied natural gas (LNG), with an export volume of approximately 114 billion cubic meters. Meanwhile, China ranked as the largest LNG importer, purchasing 97.8 billion cubic meters<sup>18</sup>. Japan followed as the second-largest importer in 2022, with 90.3 billion cubic meters<sup>19</sup>. That year, global LNG trade volumes reached 542 billion cubic meters, continuing a steady growth trend since 1970.

Qatar remains a key player in the LNG market, holding the world's third-largest natural gas reserves, totaling 24.7 trillion cubic meters in 2020. Most of its reserves are located in the North Field, a massive offshore area roughly the size of the country itself. Qatar produced 177 billion cubic meters of natural gas in 2021 and ranked as

<sup>&</sup>lt;sup>4</sup> Perrotton, F. & Massol, O. (2018). The technology and cost structure of a natural gas pipeline: Insights for costs and rate-ofreturn regulation. Utilities Policy, 53, pp. 32-37. doi: 10.1016/j.jup.2018.05.004

<sup>&</sup>lt;sup>15</sup> Molnar, G. (2022). Economics of Gas Transportation by Pipeline and LNG. In: Hafner, M., Luciani, G. (eds) The Palgrave Handbook of International Energy Economics. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-86884-0\_2

<sup>&</sup>lt;sup>16</sup> International Energy Agency. (2024). World Energy Outlook 2024. International Energy Agency, Retrieved from https://www. iea.org, p. 71.
<sup>17</sup> TURNED ENDED ENDED SALE DESCRIPTION of the energy transition? https://www.description.com/descrip

<sup>&</sup>lt;sup>17</sup> THUNDER SAID ENERGY, LNG: top conclusions in the energy transition? https://thundersaidenergy.com/downloads/category/ Ing/ (Accessed: 10.12.2024).

<sup>&</sup>lt;sup>18</sup> Statista, Global LNG trade volume 1970-2023, Aug 14, 2024, https://www.statista.com/statistics/264000/global-lng-trade-volume-since-1970/

<sup>&</sup>lt;sup>19</sup> Statista, Global LNG imports 2023, by country, Sep 20, 2024, https://www.statista.com/statistics/274529/major-Ing-importing-countries/



FIGURE 5

the second-largest LNG exporter in 2022, closely following the United States<sup>20</sup>.

The Oil and Gas Pipelines Market was valued at USD 63.8 billion in 2022 and is expected to grow from USD 68.9 billion in 2023 to USD 127.5 billion by 2032, with a compound annual growth rate (CAGR) of 8.00% from 2024 to 2032<sup>21</sup>. This growth is primarily driven by increasing demand for natural gas and oil in both residential and commercial sectors.

Despite the modern world being characterized by a crucial dependence on energy resources, oil and gas pipelines hold significant economic, social, environmental, and geopolitical importance, each playing a key role in global energy markets and shaping various aspects of society.

The influence of pipelines can be analyzed through several key dimensions, reflecting their economic, political, social, and environmental impact. These factors highlight how pipelines shape global energy markets, international relations, and local communities (Figure 5).

The economic influence of pipelines is significant as they facilitate global energy trade. allowing countries to export resources and access new markets. Pipeline infrastructure stimulates economic activity through job creation, investment, and regional development. During construction and operation, pipelines generate significant revenue, foster industrial growth, and enable access to essential energy resources, boosting overall economic productivity.

Geopolitically, pipelines provide strategic leverage, with countries controlling key routes having considerable influence. Pipelines are often used as tools of diplomacy. Countries can negotiate pipeline projects to enhance bilateral or multilateral relationships, while energy trade can be used to foster cooperation. They ensure energy security by providing

<sup>&</sup>lt;sup>20</sup> Statista, Global liquefied natural gas exports by country 2023, Jul 19, 2024, https://www.statista.com/statistics/274528/major-exporting-countries-of-lng/

<sup>&</sup>lt;sup>21</sup> Mandaokar A., Global Öil and Gas Pipelines Market Overview, December 2024, ID: MRFR/E&P/6212-HCR, 128 p., Source: https://www.marketresearchfuture.com/reports/oil-gas-pipeline-market-7681

stable and reliable supplies, reducing dependency on unstable routes.

Socially, pipelines improve energy access and development, boosting living standards and economic growth. By connecting regions, they foster economic cooperation and integration. However, pipeline projects can also spark social movements due to concerns over environmental or community impacts.

Environmentally, pipelines pose risks such as spills and habitat disruption, which can harm ecosystems. While they are energyefficient, they support fossil fuel use, contributing to environmental challenges. However, pipelines may also play a role in transporting low-carbon energy, aiding the transition to renewable sources.

Technological influence refers to the innovations in pipeline design and monitoring

systems improve efficiency and safety, reducing risks.

As for the legal and regulatory aspects, pipelines crossing borders require international agreements and legal frameworks, influencing relations between nations. Governments also enforce regulations on environmental and safety standards, which affect the design, construction, and operation of pipelines.

In summary, pipelines have far-reaching influences across multiple dimensions economic, geopolitical, social, environmental, technological, legal, and cultural. Their role in shaping global energy markets, international relations, and local communities underscores their complex and multifaceted impact on modern society.

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## Աննա ՓԱԽԼՅԱՆ

«Ամբերդ» հետազոտական կենտրոնի ավագ հետազոտող, <ՊՏ<, տնտեսագիտության թեկնածու, դոցենտ

#### ԱՇԽԱՐՀԱՏՆՏԵՍԱԿԱՆ ՔՐՈՆԻԿՈՆ

## «ԽՈՂՈՎԱԿԱՇԱՐԱՅԻՆ ՏՆՏԵՍԱԳԻՏՈՒԹՅՈՒՆ». ՀԱՄԱՇԽԱՐՀԱՅԻՆ ԿԱԽՎԱԾՈՒԹՅՈՒՆԸ ՆԱՎԹԻ ԵՎ ԳԱԶԻ ԱՐՏԱՀԱՆՈՒՄԻՑ

Նավթը և բնական գազը աշխարհում ամենաշատ վաճառվող ապրանքների շարքում են։ Այնուամենայնիվ, քանի որ արդյունահանող տարածաշրջանները հաճախ չեն համընկնում հիմնական սպառողական շուկաների հետ, տրանսպորտը, հատկապես մայրցամաքային և օվկիանոսային խողովակաշարերը, կարևոր դեր եт խաղում նավթի և գազի համաշխարհային արդյունաբերության դինամիկայի ձևավորման գործում։

«Խողովակաշարերի վրա հիմնված տնտեսագիտությունը» վերաբերում է տնտեսական համակարգերին և աշխարհաքաղաքական ռազմավարություններին, որոնք ձևավորվում են նավթի և բնական գազի արտադրության, բաշխման և սպառման արդյունքում, որոնք էլ իրենց հերթին մեծապես կախված են խողովակաշարերի ենթակառուցվածքից։ Այս հայեցակարգը բնութագրում է տնտեսությունները, շուկաները և քաղաքականությունները, որոնք ազդում են խողովակաշարերի լայն ցանցերով փոխադրվող էներգետիկ ռեսուրսների վրա։ Այլ կերպ ասած, «Խողովակաշարերի վրա հիմնված տնտեսագիտությունն» ուսումնասիրում է խողովակաշարերի կարևոր դերը համաշխարհային էներգետիկ տնտեսության մեջ՝ ընդգծելով, թե ինչպես է նավթի և գազի արտահանումը ձևավորում տնտեսական ռազմավարություններն ու կախվածություններն ամբողջ աշխարհում։

<իմնաբառեր.

. խողովակաշար, նավթ, գազ, բնական ռեսուրսներ, ենթակառուցվածքներ, աշխարհաքաղաքական նշանակություն

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## ГЕОЭКОНОМИЧЕСКАЯ ХРОНИКА

## «ТРУБОПРОВОДНАЯ ЭКОНОМИКА»: ГЛОБАЛЬНАЯ ЗАВИСИМОСТЬ ОТ ЭКСПОРТА НЕФТИ И ГАЗА

Нефть и природный газ входят в число наиболее широко продаваемых товаров в мире. Однако, поскольку регионы добычи часто не совпадают с основными потребительскими рынками, транспортировка — особенно по трубопроводам через континенты и океаны — играет решающую роль в формировании динамики мировой нефтегазовой отрасли.

«Трубопроводная экономика» относится к экономическим системам и геополитическим стратегиям, сформированным производством, распределением и потреблением нефти и природного газа, в значительной степени зависящим от трубопроводной инфраструктуры. Эта концепция характеризует экономики, рынки и политику, на которые влияют энергетические ресурсы, транспортируемые по обширным сетям трубопроводов. Другими словами, «трубопроводная экономика» исследует решающую роль трубопроводов в мировой энергетической экономике, подчеркивая, как экспорт нефти и газа формирует экономические стратегии и зависимости во всем мире.

Ключевые слова: трубопровод, нефть, газ, природные ресурсы, инфраструктура, геополитическое значение