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QUANTITATIVE AND QUALITATIVE ANALYSIS OF THE GLOBAL HYDRAULIC MARKET DEVELOPMENT

КІЛЬКІСНИЙ ТА ЯКІСНИЙ АНАЛІЗ РОЗВИТКУ ГЛОБАЛЬНОГО РИНКУ ГІДРАВЛІЧНОГО ОБЛАДНАННЯ

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Abstract. The article provides an integrative quantitative and qualitative assessment of the global hydraulic equipment market, combining data from recent commercial reports, consulting studies and scientific publications. The analysis confirms that, despite methodological differences, all major sources predict sustained market expansion with an average compound annual growth rate of about 4% over the next decade, indicating favourable conditions for entering industrial and mobile hydraulics. Particular attention is paid to regional distribution, sectoral structure and component-level dynamics, showing the leading roles of Asia-Pacific, construction and mobile hydraulics, as well as the rising importance of energy-efficient pumps, smart systems and advanced actuators. The study identifies three key transformation drivers: electrification, digitalisation and smart hydraulics, and the green transition, which jointly shape future R&D priorities.

Keywords: global hydraulics market; SMART hydraulics; electro-hydraulic systems; energy efficiency.

Introduction.

The global hydraulic equipment market is undergoing simultaneous quantitative growth and qualitative transformation under the influence of electrification, digitalisation and the green transition in industry. Multiple analytical reports and scientific publications describe individual technological directions or forecast figures, but they usually focus on specific segments, regions or applications and therefore do not provide an integrated picture of how these trends interact at the system level. This fragmentation makes it difficult for researchers, OEMs and component suppliers to assess the real prospects of industrial, mobile and power hydraulics, to prioritise R&D, and to choose between electro-hydraulic and electromechanical solutions when planning future product portfolios. There is a lack of consolidated analysis that combines numerical market indicators with a structured overview of key technological shifts and sectoral demand changes. Consequently, a generalised quantitative and qualitative assessment of the global hydraulic market, based on an integrative review of the most authoritative market studies and technological reports, is required to support evidence-based decisions on launching new projects in the fluid power domain.

Literature Review.

Numerous industry reports and scientific publications analyse different dimensions of the current hydraulic market and its prospective development trends. The report [1] explains how vehicle electrification is driving a renaissance in mobile hydraulics by forcing OEMs to radically improve hydraulic energy efficiency to protect battery life in off-highway machines. Traditional hydraulic systems remain attractive for their low cost and high-power density, but their poor efficiency makes them problematic in battery-electric architectures, so OEMs are

experimenting with multiple technical pathways rather than a single universal solution. Electric mini excavators are highlighted as an early testbed, representing a multibillion-dollar hydraulics market segment where new architectures can be trialled at a manageable scale. Three main technology directions are discussed: electromechanical actuators, which trade power density for precision, low noise and lower total cost of ownership in low-power applications; digital hydraulics, including digital displacement pumps that can raise fuel efficiency by around 30% while preserving familiar architectures; and electro-hydraulic actuation, where each actuator has its own pump and motor, enabling energy recuperation back to the battery but at significantly higher upfront cost. Overall, electrification is fragmenting the mobile hydraulics landscape, creating challenges but also strong innovation opportunities as suppliers and OEMs balance efficiency, cost, and application-specific requirements.

The report [2] argues that smart hydraulics are set to trigger a major transformation in the fluid power systems by combining significant energy savings with higher uptime and productivity. Industrial pumps already represent a huge market of about 70 billion dollars and are projected to reach 85–90 billion dollars in 2025, while accounting for nearly 15 % of total EU electricity consumption, making them an important target for efficiency gains. Smart pumps support three main value-creation cases: energy-efficiency optimization, predictive maintenance, and system-level optimization of entire fluid circuits, with particularly strong potential in energy-intensive process industries such as steel, oil and gas, and pulp and paper, where CO_2 reduction and lifecycle costs are critical. The study highlights that OEMs, component suppliers, and automation companies must shift from single-component offerings to integrated system solutions, expand digital capabilities, and build new business models around data and services, while end users should prioritize Return on Investment (ROI), total cost of ownership, and regulatory compliance in their investment strategies. Overall, the report positions smart fluid hydraulics as both a competitive necessity and a major growth opportunity, driven by rising energy prices, tightening environmental regulations, and the maturation of digital technologies and cloud-based analytics across pump applications.

The report [3] forecasts that the global hydraulics market will grow from 44.51 billion dollars in 2023 to 64.71 billion dollars by 2034, at a CAGR of 3.5 percent, driven by the rising use of hydraulic systems across construction, agriculture, manufacturing, mining, and other industrial sectors. Asia Pacific currently leads with 39 percent of global revenue and is expected to retain dominance due to strong manufacturing bases, rapid industrialisation, and cost-effective production, while North America is projected to post the fastest growth on the back of infrastructure investment and expanding industrial activity. Cylinders form the largest component segment today, reflecting their central role as the “heart” of hydraulic systems, whereas hydraulic pumps are set for notable growth as energy-efficient designs enable lower consumption and emissions. By application, mobile hydraulics dominate owing to their durability and suitability for harsh environments, but industrial hydraulics are also expected to expand steadily. Construction remains the leading end-use segment, with agriculture emerging as a key growth area as hydraulics support precision, productivity, and safety in modern farm machinery.

The report [4] projects the global hydraulic equipment market to grow from about 42.1 billion dollars in 2025 to 54.3 billion dollars by 2030, reflecting a CAGR of roughly 5.2 percent, driven mainly by infrastructure megaprojects, warehouse automation, and the electrification of off-highway machinery. Pumps remain the largest equipment segment with over 28 percent revenue share, while filters and accumulators post the fastest growth as stricter cleanliness and energy-recovery requirements raise demand for high-performance contamination control and storage components. Construction is the leading end-user industry with more than 30 percent of revenues, but aerospace and defence show the sharpest growth on the back of rising aircraft production and modernization programs. Mobile hydraulics account for nearly 59 percent of market revenue and are expected to see the highest growth as

electro-hydraulic hybrids and high-pressure systems gain adoption in compact, energy-efficient equipment. Geographically, North America currently contributes the largest share, supported by major water and infrastructure funding, while Asia-Pacific offers the strongest growth outlook, with an expected CAGR above 8 percent due to large-scale infrastructure and urbanization programs in China and India.

The article [5] shows that the main ways to save energy in hydraulic drives are to eliminate throttling losses in control valves and to provide energy recovery in hybrid mobile equipment. The focus on hydraulic excavators and wheel loaders has the greatest impact due to their dominant share in the off-road equipment fleet. Accordingly, a structured overview and critical analysis of their energy-efficient system architectures, including the internal combustion engine, is provided. The discussion [5] covers concepts about proportional valves for energy recovery, digital valve technology, motion control systems, electro-hydraulic control, and electro-hydraulic converters. This provides readers with a current synthesis of available solutions and their impact on performance, while indicating that future developments will combine hybridization and closer integration of hydraulics with internal combustion engines to achieve higher efficiency and lower emissions.

The research aims to generalise the key qualitative and quantitative trends in the development of the global hydraulic market, considering both industrial and mobile applications as well as regional differences between major economies. It focuses on identifying dominant product groups, technological shifts such as electrification and digitalisation, and structural changes in demand across sectors, including construction, agriculture, mining, and manufacturing. To achieve this aim, an integrative review approach was applied, combining data from market reports, scientific publications, and industry analyses to synthesise a coherent picture of the current state and prospective evolution of the hydraulic market worldwide.

Research Methodology.

The study applies an integrative review approach, which allows the combination of heterogeneous sources (market reports, scientific papers, industry analyses) into a single analytical framework to identify both numerical trends and structural technological shifts in the hydraulic market. This design was chosen because primary statistical data are dispersed across commercial and open analytical studies that differ in time horizon, regional focus, and segmentation logic, which makes meta-analysis in the strict statistical sense impractical. Partially, for the information sources' generalisation the methods of generative AI were used, particularly Perplexity.ai.

The empirical base includes specialised market research reports on hydraulic equipment, open analytical reviews by consulting companies, and peer-reviewed scientific publications on energy-efficient hydraulics, smart fluid systems and electromechanical alternatives. Sources were selected according to the following criteria: explicit quantitative estimates of market size and compound annual growth rate (CAGR), clear segmentation by region, application or component, and direct relevance to industrial, mobile or power hydraulics. Priority was given to the most recent publications (mainly 2022–2025).

For the quantitative part, the reported market sizes, forecast horizons and CAGR values were extracted from each selected study and tabulated to enable cross-comparison. Where necessary, data were brought to a unified form (billion USD, explicit final forecast year) to calculate the average CAGR and to visually compare the growth trajectories of the hydraulic market across different reports. Qualitative descriptors of regional structure, sectoral demand (construction, agriculture, mining, manufacturing, aerospace, etc.) and component composition (cylinders, pumps, valves, filters, accumulators) were coded and grouped to identify recurring patterns.

A narrative synthesis was then performed to generalise the main technological trends affecting the hydraulic market, with a focus on electrification, digitalisation (smart and

connected hydraulics) and the green transition. Descriptions of electro-hydraulic architectures, digital hydraulics, hybrid systems, and electromechanical actuators from scientific and technical publications were compared with the strategic theses of consulting reports to reveal convergences or contradictions in expert expectations. Special attention was paid to the role of Industry 4.0/IoT integration, energy-efficiency requirements, and CO_2 reduction targets as drivers of new product development in industrial and mobile hydraulics.

The methodology is subject to several limitations arising from the secondary nature of the data and the commercial orientation of many market reports. Differences in scenario assumptions, baselines and segmentation may introduce dispersion into numerical indicators; therefore, the calculated average CAGR and generalised structural conclusions should be interpreted as indicative rather than exact. Nonetheless, the applied integrative review provides a sufficiently robust basis for assessing the prospects of entering the global hydraulic market and for identifying promising R&D directions in fluid power technologies. r achieving the aim integrative review method was used.

Results.

Several research studies on the global hydraulic equipment market are available on the Internet. Although the quantitative forecasts differ, they all agree that the hydraulic equipment market will grow in the next 10 years. Table 1 presents a generalization of the numerical characteristics of the world hydraulic equipment market, according to different research.

Table 1. Generalization of the numerical characteristics of the world hydraulic equipment market

№	Research name	Website`s link	Market size 2024, USD Billion	Market size/Final year of forecast, USD Billion	CAGR, %
1	2	3	4	5	6
1	Hydraulics Market Size, Share, and Trends 2024 to 2034	https://www.precedenceresearch.com/hydraulics-market#:~:text=The%20global%20hydraulics%20market%20size,3.5%25%20from%202024%20to%202034. [3]	44.51	64.71/2034	3.4
2.	Hydraulics Market Global Forecast to 2028	https://www.marketsandmarkets.com/Market-Reports/hydraulics-market-209607944.html [6]	42.5	50.5/2028	3.5
3.	Global Hydraulic Equipment Market Overview	https://www.marketresearchfuture.com/reports/hydraulic-equipment-market-8066 [7]	49	97.09/2032	9.11
4.	Hydraulic Equipment Market Size & Share Analysis - Growth Trends & Forecasts (2024 - 2029)	https://www.mordorintelligence.com/industry-reports/hydraulic-equipment-market [4]	46.94	56.07/2029	3.62
5.	Hydraulics Market Size and Forecast	https://www.verifiedmarketresearch.com/product/hydraulics-market/ [8]	36,67	40.98/2031	1.4
6.	Global Hydraulics Market Size, Share & Trends Analysis Report, 2023-2030	https://www.kbvresearch.com/hydraulics-market/ [9]	43	54.9/2030	3.7

1	2	3	4	5	6
7.	Hydraulic Equipment Market Size, Share & Trends Analysis Report 2024-2032	https://straitsresearch.com/report/hydraulic-equipment-market [10]	47.23	65.82/2032	4.23
8.	Hydraulics Market Size to Surpass USD 60.36 Billion in 2032	https://finance.yahoo.com/news/hydraulics-market-size-surpass-usd-150000627.html?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAAHLpU6iuULvwCa-x3ZXJ9SiFta8_cgR3QZAJeltlVkCHNA5CmJN82W_kVIoapTJnUZw6cz5CaRkFYjSrEpVDk_3zeSjTnQLMnS4L7v7juqyA8riex47XiTBFEwl48dhK9YUfonHgPLrB42dUzuD1J7XTo7KOeZgw1nx29EKOQT4p [11]	45.26	60.36/2032	3.5

To assess whether it is worth entering the industrial, mobile and power hydraulics business in 2024/2025, the most important parameter is the compound annual growth rate (CAGR). CAGR represents the mean annualized growth rate for compounding values over a given time. CAGR smoothest the effect of the volatility of periodic values that can render arithmetic means less meaningful. For the eight studies listed in Table 1, the CAGR average value is 4.07 %. This shows the prospects of the hydraulic equipment market in the foreseeable future.

The growth trajectory of the hydraulic equipment market is illustrated in Fig. 1 [3].

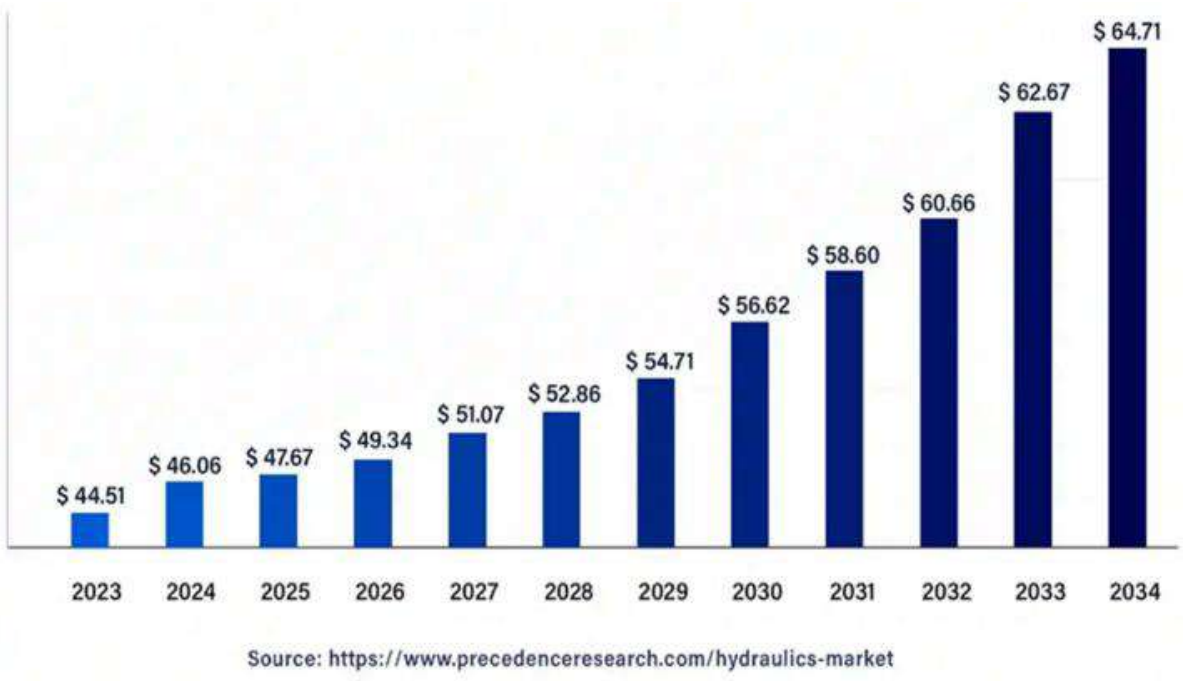


Fig 1. Global Hydraulic Market Size 2023 to 2034 (USD Billion) [3]

All the above analytical reports agree that Europe will occupy the middle position in hydraulic systems and their component consumption. Recent analytics [4] show that the Asia-

Pacific region is expected to remain the leading consumer of hydraulic equipment (Fig. 2) [4]. According to current fluid power market studies, the key driver of market transformation and expansion is the integration of heavy-duty industrial and mobile machinery with Industry 4.0 technologies, particularly the Internet of Things (IoT). This development underpins a second major trend: accelerating demand for smart, automated hydraulic equipment. In Fig. 3 [6], we see that the largest sector of consumption of hydraulic systems is construction. In my opinion, it would also be appropriate to separately add such sectors as agricultural equipment and the aerospace industry to the diagram in Fig. 3 [6].

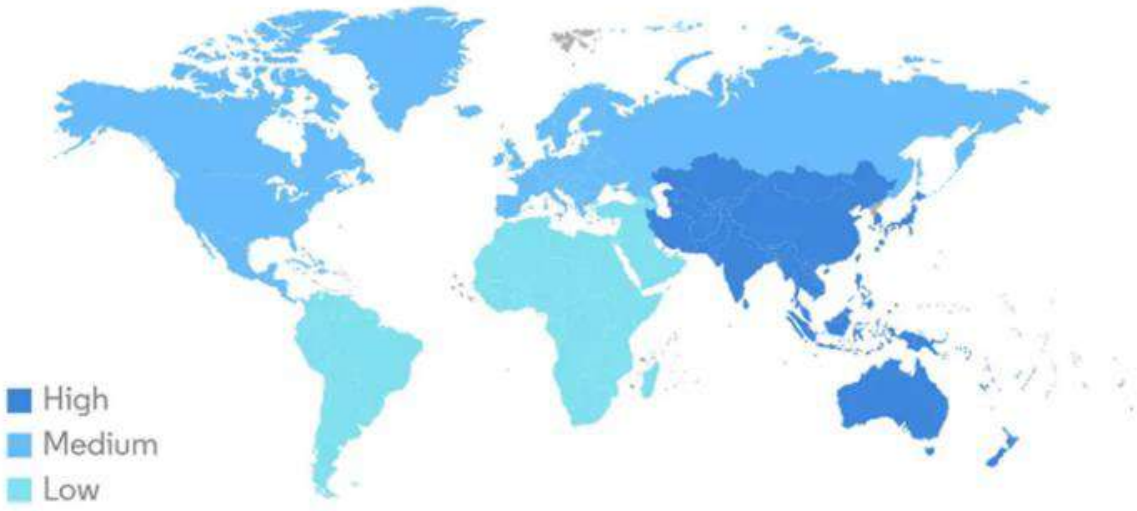


Fig 2. Hydraulic Equipment Market CAGR (%), Growth Rate by Region, 2025-2030 [4]

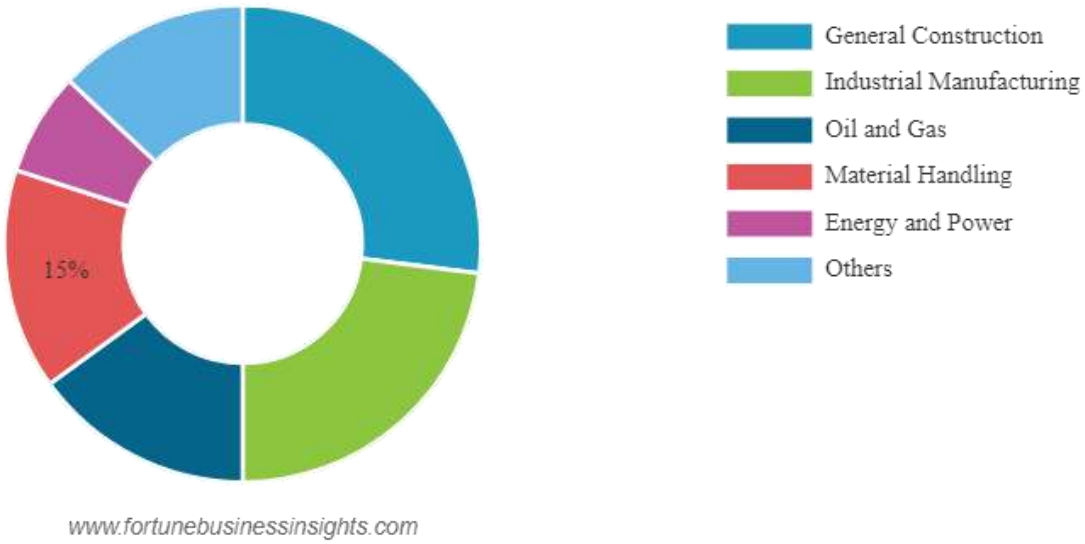


Fig. 3. Global Industrial Hydraulic Equipment Market Share, By Application, 2022 [12]

In Fig. 3 [12] we see that the largest sector of consumption of hydraulic systems is construction. In my opinion, it would also be appropriate to separately add such sectors as agricultural equipment and the aerospace industry to the diagram in Fig. 3 [12]. List [13] of key players in the Hydraulic Equipment Market is the next: Daikin Industries Ltd, Danfoss. Eaton, Emerson Electric Co., Kawasaki Heavy Industries Ltd., Komatsu Ltd., Parker-Hannifin Corp.. Robert Bosch GmbH. Siemens AG. Wipro Limited.

According to [2, 5, 14, 15], companies can make progress in embracing the full potential of smart hydraulics if they quickly adopt these technologies [16].

The third trend involves the green transition of fluid power systems within the industrial equipment and machinery sectors. According to the data presented by the European academic Fluid Power Association, fluid power equipment produces 2.4 times more CO2 than global aviation, making energy-saving solutions for hydraulic systems an important contribution to climate change mitigation.

Some electromechanical technologies, e.g. planetary roller screws, linear actuators and ball screw linear actuators [17-20], can become a serious competitor to electrohydraulic drives in the process of ongoing industrial and mobile equipment electrification.

Conclusions.

The conducted integrative review confirms that the global hydraulic equipment market is set to grow steadily over the next decade, with an average compound annual growth rate of about 4%, which indicates favourable conditions for launching new projects in this field. At the same time, the structure of demand is changing: Asia-Pacific and the construction sector retain leadership, while agriculture, mining, manufacturing and aerospace increase their contribution, and component priorities gradually shift towards energy-efficient pumps, smart systems and advanced actuators. Three interrelated transformation drivers have been identified: electrification of mobile and industrial machinery, digitalisation and emergence of smart hydraulics, and the green transition with strict CO_2 reduction and energy-efficiency requirements, which jointly shape the agenda for further R&D, standardisation and product portfolio renewal in industrial, mobile and power hydraulics.

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КІЛЬКІСНИЙ ТА ЯКІСНИЙ АНАЛІЗ РОЗВИТКУ ГЛОБАЛЬНОГО РИНКУ ГІДРАВЛІЧНОГО ОБЛАДНАННЯ

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Анотація

У статті виконано кількісний та якісний аналіз розвитку глобального ринку гідравлічного обладнання на основі узагальнення даних провідних комерційних досліджень, консалтингових звітів і наукових публікацій за 2022-2025 роки. Показано, що попри відмінності у методиках розрахунку, усі розглянуті джерела демонструють стабільне зростання світового ринку з середньорічним темпом приросту (CAGR) близько 4%, що підтверджує доцільність запуску нових проєктів у сфері промислової та мобільної гідравліки. Проведено узагальнення регіональної структури попиту, галузевих сегментів та компонентної бази ринку, що дозволило виділити провідну роль Азійсько-Тихоокеанського регіону, домінування будівельної техніки та мобільної гідравліки, а також зростаюче значення енергоефективних насосів, «розумних»

гідросистем і високотехнологічних гідроциліндрів та виконавчих органів. Окрему увагу приділено тенденціям цифровізації та впровадженню SMART-гідравліки, інтегрованої з технологіями Індустрії 4.0 та IoT, що забезпечує перехід від постачання окремих компонентів до сервісно-орієнтованих рішень на рівні систем.

Обґрунтовано три ключові драйвери трансформації гідравлічного ринку: електрифікацію мобільних і промислових машин, цифровізацію та формування SMART-гідравліки, а також зелений перехід із посиленням вимог до енергоефективності й скорочення викидів CO_2. Показано, що ці фактори одночасно створюють нові ніші для гідравлічних систем і посилюють конкуренцію з електромеханічними приводами, зокрема на базі гвинтових передач кулькового й роликового типу.

Запропонований інтегральний огляд дозволяє сформувати цілісне уявлення про перспективи розвитку світового ринку гідравлічного обладнання, а також окреслити пріоритетні напрями R&D у галузі енергоефективних гідроприводів, SMART-гідравліки та гібридних електрогідравлічних і електромеханічних систем. Отримані результати можуть бути використані виробниками обладнання, постачальниками компонентів і дослідниками для прийняття обґрунтованих рішень щодо формування продуктового портфелю, вибору технологічних платформ та виходу на перспективні сегменти глобального ринку гідравліки.

Ключові слова: глобальний ринок гідравліки; SMART гідравліка; електрогідравлічні системи; енергоефективність.