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THE ROLE OF DIGITAL NUCLEAR ENERGY IN THE WORLD ECONOMY

Abstract. The article highlights the dominance of the digital economy and the great positive impact on the development of nuclear energy. In the new economy, the digital energy network or Internet energy market is already taking shape. A digital nuclear power plant always has accurate information about the status of all assets and equipment. Most importantly, digital NPPs will have all the hallmarks of a modern dynamic business. The analysis opens up opportunities to change the business model, reduce costs, and find new sources of revenue. Thus, over time, the construction of nuclear power plants will lead to the formation of a new generation of markets for products and services, in contrast to nuclear products.

Keywords: Nuclear power, nuclear power plant, International Energy Agency, 3D, Digital Nuclear Power Plant, "Harbor Research", IT-systems, SAP S / 4HANA Enterprise Management - FLM, SAP Capital, SAP Product Life Management, SAP Visual Enterprise, SAP Enterprise Asset Management, SAP Mobile platform.

Nuclear energy, despite its conservatism, cannot be excluded from universal digitization. Fifteen years ago, not all of us had a cell phone, and some had to go to Internet cafes on a regular basis to get information. We couldn't imagine an electricity meter connected to the internet. Ten years ago, only half of our population used laptops. Only a third of the population had access to the global Internet via mobile phones or personal computers. At that time, only 3% of the population used Smartphone, and even now the majority of the population in Uzbekistan does not know how to use the cloud (drob box).

Today, daily life and work look very different. Electric cars and electric buses are moving along the roads, "smart" electricity meters are being installed in new homes, and energy-saving lighting systems have appeared in offices. In short, despite its conservatism, the energy is changing along with the rest of the world.

Our planet is slowly transitioning to a digital economy; hence, the demand for electricity, natural gas and water will increase. The demand for clean and reliable energy supply will also increase. According to the International Energy Agency, global energy demand will grow by 151% by 2050, and this will be done taking into account the main scenario of economic development and energy saving [1].

These processes lead to the formation of a new energy-saving culture with the provision of appropriate technological support, both among energy producers and consumers. International consulting firm "McKinsey & Company" forecasts that by 2035, energy efficiency could increase by 43% and by rapid technology development by 70%. As a result, the world will give up 100 billion terajoules of excess energy, saving between $ 600 billion and $ 1.2 trillion [2].

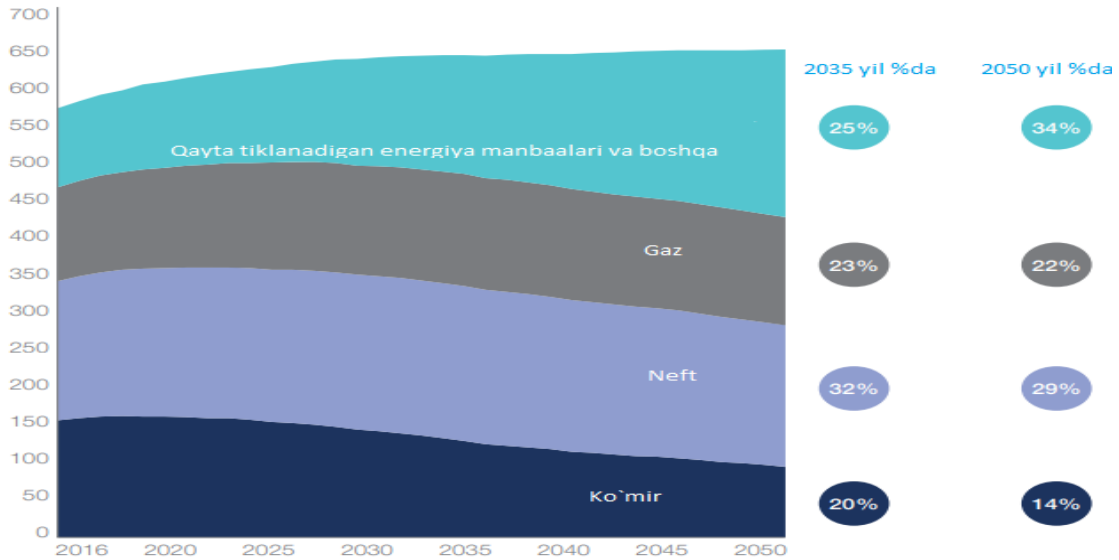

Figure 1. Demand for primary fuel energy (in millions of terajoules) [2]

These processes could create an interesting situation, which could lead to the emergence of new, conservative players in the global energy market, such as Uber or Google, who are not involved in this network. Traditional business models focused on the generation and production of network assets are losing their relevance in the evolving digital economy. The market predicts rapid changes, decentralized growth of supply and demand.

In the new economy, the digital energy network or Internet energy market is already taking shape. All participants in this network: traditional energy companies, consumers and new players - are looking for real-time demand and supply of electricity, smart grid management and innovative collaboration with consumers. There are currently seven major technologies for digital nuclear energy, including:

1. M2M connections that develop the idea of sensors in power generation;
2. Processing big data to help plan, build and forecast trends;
3. Personnel mobility - the process from recruitment to maintenance and training of engineers;
4. Staff training, organization and design of events;
5. Keeping "smart" documents and journals;
6. Print 3D;
7. Management of the life cycle of the NPP, which has a digital copy of each building and equipment, which allows real-time analysis of its condition, early detection of problems and the use of predictive analysis.

Each of these seven technologies has "corrections" regarding the safety of nuclear power plants and their longevity. These technologies will lead to significant changes in the process of working in nuclear power plants, the labor market, production and marketing.

A digital nuclear power plant always has accurate information about the status of all assets and equipment. According to the US company "Harbor Research", by 2020, the power generation chain will use more than 7 billion devices connected to the Internet. Continuous monitoring of the data they record will change many day-to-day work processes, including nuclear power plants.

Accurate calculation - the book allows you to manage labor productivity at a new level. Detailed information about production leads to lower electricity prices, the opportunity to plan workload of employees, and increase the efficiency of investment returns.

The role of the engineer in the digital atom is growing. A French corporation specializing in IT consulting, system integration, business process outsourcing and server manufacturing. "Atos" estimates that over the next 25 years, nuclear power plants will need about 1.75 million new engineers [3].

Naturally, the share of personnel for existing IT systems, such as ERP *(Enterprise Resource Planning)* and modern technologies that are being introduced today, will be high. It will also lead to the formation of a labor market for specialists in the nuclear industry and key infrastructure.

Most importantly, digital NPPs will have all the hallmarks of a modern dynamic business. The analysis opens up opportunities to change the business model, reduce costs, and find new sources of revenue. Thus, over time, the construction of nuclear power plants will lead to the formation of a new generation of markets for products and services, in contrast to nuclear products.

What will happen in 2050 if each nuclear power plant sells "cloud" IT services to businesses based on its own data centers? In the digital economy, geographical boundaries are gradually blurring and it is much easier for technologically advanced participants in the nuclear market to enter the global market. Their activities are developed not only in cooperation with local authorities through the construction of nuclear power plants in foreign countries, but also through the reconstruction and maintenance of power plants.

Each country and each NPP has its own management culture and technology. In terms of automation, some businesses are more developed, while others are less developed. Today, in order not to lag behind other energy sectors, it is necessary to carry out the process of transformation in this sector. For this, the life expectancy of the NPP plays an important role.

During the life of nuclear power plants, i.e during the design, construction, operation, modernization, decommissioning, it is necessary to work with many suppliers and partners. Working with each of them is documented in detail, and gradually a huge database is formed. In the traditional approach (telephone confirmation, email, paper document exchange), this leads to significant delays, multiple iterations, separation from actual work and deadlines, and increased costs. That is why today it is very important for every company to create a reliable information sharing system throughout the entire chain of business processes.

In the context of constant changes in the field of communications, it is necessary to achieve the integrity of engineering and commercial data. All participants in the process should interact in the same way. If the data is updated in one system, then all participants in the process must be aware of it at the same time. If this situation is analyzed, the postal system will lose its efficiency, lead to increased paperwork, and only electronic interconnection can provide the necessary integrity.

The world is on the brink of a fourth industrial revolution. While some companies are limited to data and experience in the field of the Internet, others are making full use of the level of knowledge achieved as a basis for the upcoming digital transformation. The bridge between today and tomorrow's digital day is modern IT solutions. The automated process management system, SARP (Automated System Design) and accounting data set obtained in real time should be immediately processed in analytical systems and, conversely, the recommendations based on the analysis should quickly reflect the work process.

All the changes described above are related to the modern management of the NPP based on the concept of Mechanical Life Management (FLM - Facility Lifecycle Management) - the concept of life expectancy management of the power plant, i.e the interconnected processes at all stages from design to commissioning. prepares the plain for management. In fact, such an approach allows us to create a digital 3D model of NPPs.

This concept is closely integrated with many organizations (designers, government agencies, customers, suppliers) where we need to quickly exchange large amounts of data.

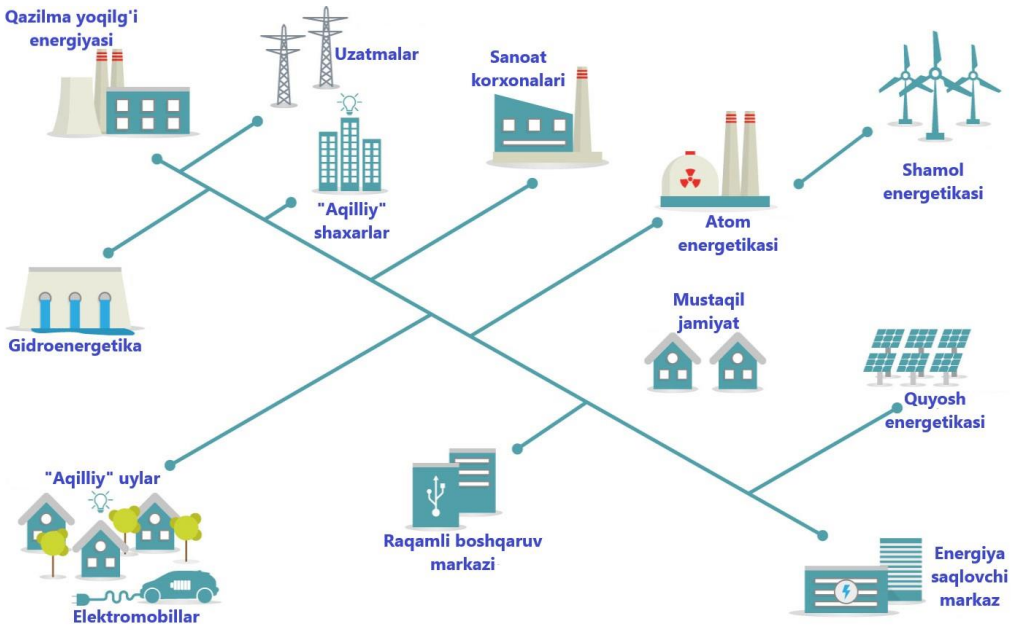

Figure 2. Elements of a digital energy system

Technically, the FLM concept is implemented in planned solutions integrated with 3D visualization, normative reference management, capital construction and operation, design system and many ancillary systems. Examples are the SAP product line: SAP S / 4HANA Enterprise Management - FLM, SAP Capital project management, SAP product life management, SAP Visual Enterprise, SAP Enterprise Asset Management, SAP Mobile platform [4].

Accounting systems in a digital nuclear power plant are integrated with design systems to create digital engineering data. With this, the 3D model of a nuclear power plant combines all data sources, from SAPR and document creation tools to business-level systems. This digital engineering data increases the operational efficiency of assets. It is enriched and modified according to each stage during the life cycle. At the design stage, the 3D model of the NPP will be graphically enriched with project - planning, design and working documents, estimated cost estimates. In the schedule of the construction phase - construction and installation schedules, procurement of equipment and materials, contracts, information on the attraction of own funds, development and financing schedules, as well as execution and operation documents all is reflected. New materials and equipment for the NPP under construction will be purchased in conjunction with a 3D model of each floor and building.

The design of the digital model of the NPP at the operational stage includes its repair and maintenance schedules, technical maps, sensors and data obtained during the technical inspection, use of assets, planning their modernization, real value during operation, as well as the composition of assets filled in with information about changes.

Thus, the digital model integrates the flow of unstructured data in the asset management system during the life cycle of assets, such as documents and drawings, as well as data from 3D projects, business systems, portals, information networks, sensors, technology-level systems. The system collects all the information about the NPP and the user is always able to refer to the primary source. All new technologies are applied in the digital power plant, the main of which is to manage the entire life cycle of the power plant. By 2050, nuclear power plants will develop and operate in a completely different world. By this time, many problems will be solved due to new technologies, for example, 1.3 billion people in the poorest countries of the planet will finally have access to electricity [5].

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