The Impact of Covid-19 on the Industry of Energetics

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Abstract: The problems that have developed in the world in connection with COVID-19 have accelerated the transition to a more flexible and sustainable energy, taking into account the digitalization and intellectualization of the fuel and energy complex industries. The digitalization of the industry has proven the high reliability of work in the power industry in a pandemic, successfully debugging all remote business processes and eliminating risks of reducing efficiency, becoming a significant help for continuing to operate in a remote format.

1 INTRODUCTION

The World Energy Council (WEC), in its publication on the impact of coronavirus infection on the energy sector, notes: “The global energy sector is experiencing unprecedented events, the pandemic is having a fundamental impact on the pace and direction of the industry. Among the most significant changes that could occur as a result of the crisis will be sharp cost cuts and a reallocation of capital in favor of digital solutions and environmental sustainability.” (http://www.acexpert.ru/articles/chto-budet-s-energetikoy-posle-pandemii.html)

The introduction of digital technologies has made it possible to obtain a positive economic effect for further development in the field of remote means of communication, operation and control (Ţălu and Nazarov, 2021). The new technological basis made it possible to adequately respond to the challenges and threats in its sphere in the context of the spread of the pandemic (Ţălu and Nazarov, 2020). The presence of digital data transmission channels, means of their verification, processing and analytics allows you to see an objective picture, as in the electric power industry, which ensures the efficiency and timeliness of decisions (Hosseini, 2020; Kuzemko et al., 2020; Steffen et al., 2020).

Energy decentralization receives an additional impetus during the coronavirus crisis (Chapman and Tsuji, 2020; Fezzi and Fanghella, 2020; Graff and Carley, 2020; Klemeš et al., 2021; Smith, 2020; Soava et al., 2021; Xu et al., 2021). Indeed, hundreds of millions of people around the world have moved to remote work, creating demand for clean and flexible energy solutions for households (Jiang et al., 2021). Digitalization in the new conditions is generally becoming a factor of survival for many businesses (http://www.ngv.ru/magazines/article/vliyanie-covid - 9-na-energeticheskuyu-otrasl).

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2 CURRENT TECHNOLOGIES CHALLENGES

The development of energy infrastructure contributes to the formation of a common electricity market by considering a set of alternative measures:

- transition to renewable energy sources (use of wind energy; energy of water and sun; energy of sea currents, tides and waves; biomass of animal, plant and domestic origin; geothermal energy (heat of the Earth); temperature gradient (temperature difference between air mass and ocean), etc.;
- network technologies in the electric power industry (transition to remote control (operational dispatch));
- technologies of unmanned and "connected" transport (electric vehicles, including cars on hydrogen fuel);
- autonomous power plants with solar panels (energy storage).

When using an uninterrupted supply of electricity from an autonomous power plant, its capacity and technical and operational characteristics are taken into account:

1. Type of construction;
2. Manufacturing material:
   - Lead acid battery
   - Alkaline
   - Gel
   - AGM
   - OPzS and OPzV - the operating period can be up to 25 years.
   - Lithium - LiFePO4 (lithium iron phosphate)
   - Sodium ion batteries
   - Aluminum-based rechargeable batteries - fully charged in 45 minutes with 1500 cycle life
   - Organic fast charging batteries - withstands higher temperatures
   - Solid state batteries - liquid or gel electrolyte. Long service life.
   - Super and ultracapacitors - this is a hybrid of a capacitor and a battery
3. The number of deep discharge cycles;
4. Maximum permissible currents during the discharge-charge cycle (frequency of use);
5. Operating conditions;
6. Service rules;
7. Time taken for charging and full discharging;
8. Discharge rate;
9. Capacitive volume (size and weight), for mobile applications;

Graphene and carbon nanotubes were seen as viable replacements, but new research has highlighted another possibility. Seamless silicon nanowire junction that can be used for photovoltaic applications (https://hackaday.com/2018/06/03/silicon-nanowires-create-flexible-photodetectors/). Hydrogen - to replace fossil fuels - store it in a liquefied form. As such, hydrogen can be used as a fuel for internal combustion engines or other installations at any time. Batteries are the best friend of renewable energy sources - compressed air systems, sodium sulfide and lithium batteries stand out.

The greatest development is received by lithium-ion batteries for backup and autonomous power supply due to:

- increasing the energy density in storage;
- the ability to work at high currents;
- the ability to quickly deliver energy;
- safety and ease of production;
- increase in service life;
- availability and price factor;
- ecological.

Due to the fact that LIBs have greater fault tolerance and better scalability, both batteries for cars and large energy storage systems are being developed from lithium-ion storage cells. They are already being used simultaneously with renewable energy sources - for uniform energy distribution, because the generation at wind and solar stations directly depends on weather conditions. Moreover, energy storage technologies solve the problem of load on the system, smoothing out surges and discharges of electricity. In July, Elon Musk announced that he had received approval from the Australian authorities to build the world's largest lithium-ion battery system there. The electricity storage station was connected to a wind farm in Jamestown, owned by Neoen. The total capacity of the battery system was 100 MW, and the capacity was 129 MWh.

According to IRENA, over 80% of all new power generation capacities put into operation in 2020 are based on renewable energy sources. Among them are dominated by:

- Solar (127 GW) - US engineers have created low-cost, high-performance solar cells by combining layers of silicon with perovskite and using a unique combination of cells. This allowed us to raise the efficiency up to 27% (https://hightech.plus/2020/03/06/perovskitovii-sloi-podnyal-kpd-solnechnih-elementov-na-tret).

A cascade perovskite solar battery has been created that retains 90% of its performance after 400 hours of operation at maximum parameters. The efficiency of a device with a small area (0.049 sq. Cm) was 24.8%, for a larger one (1.05 sq. Cm) - 22.1% (https://techxplore.com/news/2019-10-all-perovskite-tandem-solar-cells-efficiency.html).

Sunpower - solar panels for home solar power plants - will help large households not only meet their electricity needs, but also give part of the generated electricity to the grid (https://mytechtv.com/2019/03/09/sunpower-launches-worlds-most-powerful-residential).

Sun and nanofluids: Specialists of the National Research Nuclear University MEPhI, together with colleagues from the University of Bergen (Norway), have begun an active phase of preparation for launching at NRNU MEPhI a solar installation that has no analogues in the world, which generates electricity by boiling nanofluids (https://www.facebook.com/official.MEPhI).

- Wind (111 GW) - Today the most powerful wind turbine in the world is the Haliade X from General Electric with a capacity of 12 MW. One of the emerging technologies in wind energy is floating foundations for wind power plants. They make it possible to build wind turbines in coastal areas (at depths of up to 800 meters), where the wind speed is higher.

- Hydro power plants - Pumped storage plants - energy for energy. Hydroelectric power generation does not produce greenhouse gases, toxic waste or particulate matter.

3 DEVELOPMENT OF ENERGY CONSUMPTION

Today, the total capacity of various types of energy storage systems in the world is approximately 150 GW. The overwhelming share of storage systems (97%) falls on pumped storage power plants, and $ 7-10 billion is annually invested in the construction of new pumped storage power plants. The leaders in terms of the installed capacity of pumped storage power plants: China (31,999 MW, 34 pumped storage power plants), Japan (28,252 MW, 43 pumped storage power plants) and the USA (22,561 MW, 38 PSPPs).

Around the world, pumped storage power plant (PSPP) is the largest form of energy storage on a large scale. The energy efficiency of PSPP varies, in practice, from 70% to 80% (https://www.economist.com/technology-quarterly/2012/03/03/packing-some-power?frsc=dg%7Ca).

Forecast of the energy balance in the world up to 2100 is given in Figure 1. (The source - German Advisory Council on Global change Report. World in Transition: Towards Sustainable Energy Systems // WBGU. www.wbgu.de).

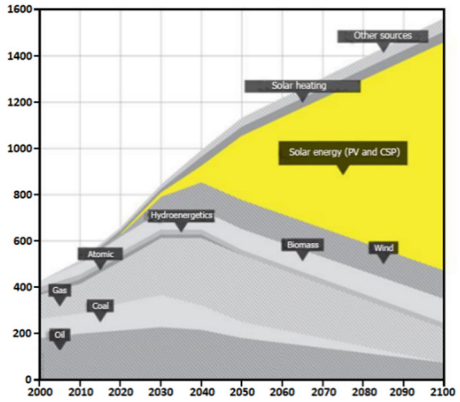

Figure 1: Forecast of the energy balance in the world up to 2100 (www.wbgu.de).

In conditions of self-isolation, modern information technologies help to interact with consumers.

The introduction of digital remote-network control allowed:

- to reduce the duration of non-optimal modes of the power system
- provided stable and reliable power supply to consumers
- to reduce the duration of operational switching of electrical equipment
- to reduce the risks of erroneous actions of the operating and dispatching personnel of the power plant
-increase the stability of the functioning of the UPS.

The use of industrial storage devices as storage facilities for electricity is fundamentally changing the electricity market oriented towards flexibility, not only for low-power devices, but also for large power plants.

The development of Internet technologies also allows the use of remote control. Controlling the operation of devices can be carried out using special applications, SMS notifications about emergency modes of operation of this or that equipment can come. Thus, the user will be able to remotely learn about the problems and resolve the issues that have arisen without leaving the location of the electrical equipment, which greatly simplifies the control process. Remote control is also used to control the equipment of large substations. For example, automated program switches APP are used in the telecontrol of equipment (https://neftegaz.ru/news/view/174280-Tsifrovizatsiya-v-elektroenergetike).

The use of autonomous power units based on renewable energy sources provides electricity to

those places where the installation of the network is technically difficult or economically unprofitable.

The ability to accumulate and store energy obtained from renewable energy sources for a long time made it possible to organize the stable operation of all branches of production during the peak demand for electricity consumption. The demand for electricity is growing rapidly due to the development of smart home technologies.

The pandemic has stimulated an alternative to renewable energy sources as one of the primary areas of innovation, expanding the boundaries of research activities to reduce greenhouse gas emissions into the atmosphere, move away from cumbersome energy systems and fossil fuels.

Renewable energy resources are important in the policy structure for the Czech Republic. There are a number of reasons for this:

- Firstly, it is an interest in self-sufficiency, since the country is heavily dependent on imported energy.
- Secondly, renewable energy sources will help reduce GHG emissions.
- Thirdly, it is important because of the country's accession to the European Union. According to the EU Renewable Energy Directive (Directive 2001/77 / EC), member states are to meet the indicative target for the share of renewable energy in electricity generation by 2010 (www.encharter.org).

The problem of energy storage is now one of the key issues for the entire world energy sector. Share of electricity generation from solar and wind in the world's leading economies in the first half of 2020 is given in Figure 2.

Modern technologies can provide sufficient generation, but the lack of cost-effective storage technologies remains, and it limits the opportunities for transformation of the sector. Scientific and technical groundwork in such areas as pumped storage power plants, supercapacitors, lithium-ion batteries, flywheels, elevators for solid goods. At the same time, it is necessary to consistently increase the level of localization and build up engineering competencies in other components that are presented on the market only in foreign versions (thermal accumulators, pneumatic systems, zinc-air accumulators, etc.) (https://www.forbes.ru/tehnologii /350445-vatty-i-tehnologii-2-barery-i-perspektivy-razvitiya-vie-v-rossii).

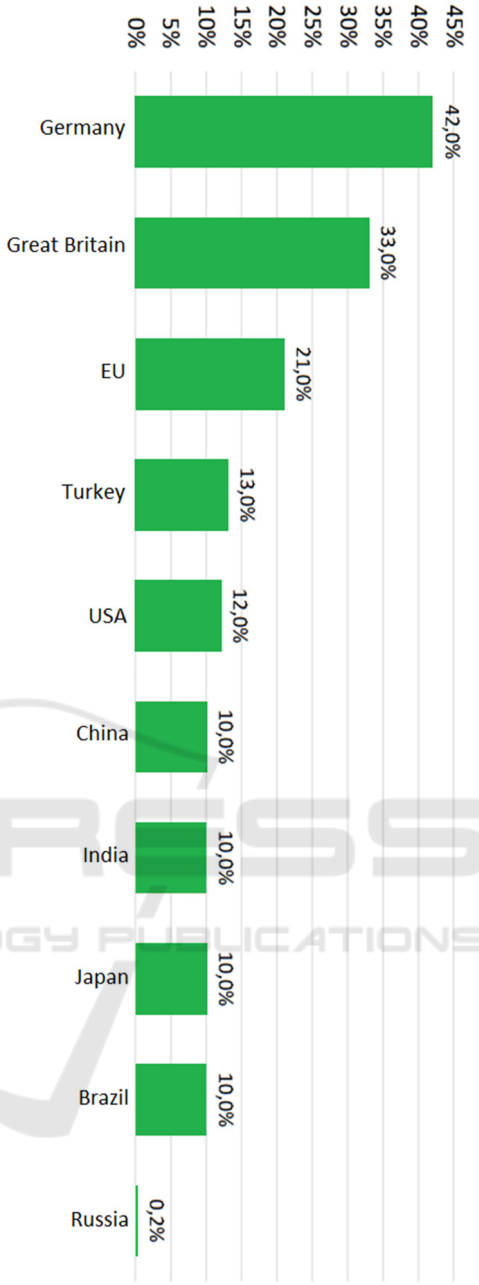

Figure 2: Share of electricity generation from solar and wind in the world's leading economies in the first half of 2020.

4 CONCLUSIONS

In the global energy sector, COVID-19 has caused more significant turmoil. The provision of a sufficient number of reserve sources of electricity supply made it possible to timely avoid interruptions in the power

supply of industrial enterprises and life support facilities.

Removing barriers in the energy storage system and moving to more reliable, cheap storage and more energy-intensive:

• as part of the distribution energy "Internet energy"

• as part of a large centralized energy sector "new general scheme"

• in the hydrogen cycle "hydrogen energy"

At the same time, the IEA report notes that renewables "have demonstrated the greatest [market] resilience during the COVID-19 crisis," and the STEPS baseline scenario assumes upcoming rapid growth in production in this energy segment: from 2020 to 2030, the total the volume should increase by two-thirds. According to IEA analysts, renewables will be able to meet 80% of total global electricity demand over the next decade and by 2025 will overtake coal as the main means of generating electricity. And by 2030, hydropower, wind and solar photovoltaic installations, bioenergy, geothermal energy, etc. will be able to jointly provide nearly 40% of the global electricity supply (https://www.stimul.online/articles/sreda/energetika-pandemii/).

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