Committee: International Energy Agency (IEA)

Issue: Digital business models in the new energy economy

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Position: Secretary General

PERSONAL INTRODUCTION

Dear Delegates,

My name is Erika Kunstmann, I am 17 years old and I am attending the 12th grade of the German School of Athens. This will be my first ATSMUN Conference and my 24th Conference overall, while also being my fourth time in the Secretariat. I want to congratulate you all for being selected as delegates in this amazing Committee and Conference. I can assure you the four days we will spend together will be amazing. We will all grow closer, gain a deeper knowledge of the topics discussed and, most importantly, have fun.

During this session, we will be discussing and debating very important topics, namely the digital business models in the new energy economy and redesigning the power planning systems to support the energy transition process. This document is here as a useful guide and should help you understand the topic better, however it should not be your only piece of research. I encourage you to further research this topic by visiting the links I provided at the Study Guide's end.

Furthermore, if you have any questions about the following guide or the issue in general, feel free to contact me. My email is kunstmann.erika@gmail.com.

I am looking forward to meeting and working with you all and hope for a fruitful debate.

Best Wishes,

Erika Kunstmann

TOPIC INTRODUCTION

Digitalization is gradually shaping a new environment for economic policymaking and especially when it comes to the energy field. Implementing new digital business models in the new energy economy could accelerate the process of the energy transition.

Currently, the energy system includes new technologies such as photovoltaic solar systems, wind farms, electric cars, electric plans and others that require a huge amount of investment. The business models already existing in the energy economy cannot deal with the magnitude and rapid change of these new technologies.

From another perspective, using digital business models could be an innovative solution. These models are software-driven; they have access to more granular data, combined with advanced analytics capability. These tools can also help speed the development of new products and services. Moreover, can ease and accelerate the energy transition by facilitating efficiency and demand-side flexibility.

DEFINITION OF KEY TERMS

Business Model

"The term business model refers to a company's plan for making a profit. It identifies the products or services the business plans to sell, its identified target market, and any anticipated expenses. Business models are important for both new and established businesses. They help new, developing companies attract investment, recruit talent, and motivate management and staff."[1]

Digital Business Model

"A digital business model is a form of creating value based on the development of customer benefits using digital technologies. The aim of the digital solution is to generate a significant advantage for which customers are willing to pay."[2]

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[1] Kopp, Carol M. "What Is a Business Model with Types and Examples." *Investopedia*, Investopedia, 23 Aug. 2022, www.investopedia.com/terms/b/businessmodel.asp.

[2]"Digital Business Model." *Innolytics*, 25 Feb. 2020, innolytics.net/digital-business-model/#:~:text=A%20digital%20business%20model%20is,customers%20are%20willing%20to%20pay.

Energy economics

“Energy economics is the application of economics to energy issues. Central concerns in energy economics include the supply and demand for each of the main fuels in widespread use, competition among those fuels, the role of public policy, and environmental impacts. Given its worldwide importance as a fuel and the upheavals in its markets, oil economics is a particularly critical element of energy economics. Other efforts have treated natural gas, coal, and uranium. Energy transforming and distributing industries, notably electric power, also receive great attention. Energy economics addresses, simultaneously as well as separately, both the underlying market forces and public policies affecting the markets.”[3]

Blockchain

“A blockchain is a distributed database or ledger that is shared among the nodes of a computer network. As a database, a blockchain stores information electronically in digital format. The innovation with a blockchain is that it guarantees the fidelity and security of a record of data and generates trust without the need for a trusted third party.”[4]

Digitalisation

“Digitalization is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business.”[5]

Artificial Intelligence (AI)

“Artificial intelligence (AI), is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of

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[3] “." Macmillan Encyclopedia of Energy. . Encyclopedia.com. 25 Aug. 2022 .” *Encyclopedia.com*, Encyclopedia.com, 10 Sept. 2022, www.encyclopedia.com/environment/encyclopedias-almanacs-transcripts-and-maps/energy-economics.

[4] Hayes, Adam. “Blockchain Facts: What Is It, How It Works, and How It Can Be Used.” *Investopedia*, Investopedia, 7 Sept. 2022, www.investopedia.com/terms/b/blockchain.asp.

[5] Gartner_Inc. “Definition of Digitalization - Gartner Information Technology Glossary.” *Gartner*, www.gartner.com/en/information-technology/glossary/digitalization.

humans, such as the ability to reason, discover meaning, generalize, or learn from past experience.”[6]

BACKGROUND INFORMATION

The difference between traditional and digital business models

A typical business structure has a physical presence and provides goods or services through brick-and-mortar businesses to the local community. This includes businesses like restaurants, agencies, and anything that resembles an office setting. Traditionally, businesses sell their goods and services through retail outlets.

A typical firm provides services to consumers in exchange for money. Both Capital expenditure (CAPEX) and Operating expenses (OPEX) can be used. While most of these firms concentrate on making a profit, a small number—non-profit organizations—work for clients without anticipating rewards.

Anyone sitting anywhere in the world can browse the web and use the company's services and goods in the case of a digital business setup. Modern commerce is conducted primarily online, which represents a considerable departure from the accepted paradigm. This approach uses technology to enhance value and create new opportunities, providing a completely different client experience.

Both traditional companies that utilize contemporary advances and brands that are exclusively available online fall under this general definition. A few well-known examples of digital enterprises are Netflix, Disney+Hotstar, and Uber, a service that lets users book cabs online.

Compared to its digital version, the traditional company model takes more capital. The first requires a location, furnishings, transportation, personnel, and other utilities. Digital firms are efficient from a financial standpoint.

Customers like a business unit that uses a digital strategy because of the flexibility it offers in terms of product diversity and price. Rigidity is a big problem in the conventional configuration. Customers are now more likely to shop online as a result.

[6] “Artificial Intelligence.” *Encyclopædia Britannica*, Encyclopædia Britannica, Inc., www.britannica.com/technology/artificial-intelligence.

When it comes to the real-time client experience, the digital business model is still not flawless. For instance, you cannot test a mobile phone before making an Amazon purchase. You rely on client testimonials and the website's specifications. The conventional business model manages to get around this problem.

Distributed Generation and Digitalisation

Currently, three major trends—electrification, decarbonization, and digitalization—are shaping the future of energy systems. Unquestionably, a portion of the solution to meet the rising demand for electricity while adhering to a low-carbon emission limit is to increase the share of renewable generation. By helping to achieve a better balance between supply and demand at the edge of the grid and by increasing the hosting capacity of distribution networks, digital technologies, specifically Big Data, Artificial Intelligence, Blockchain, and Distributed Ledgers, will have a positive impact on the adoption of renewable distributed energy resources.

However, structural factors (such as low power density of renewable resources, economies of scale in renewable generation and storage), regulatory factors (such as access to the grid, pricing policy), and technological limitations in digital technology continue to pose barriers to decentralized energy production (e.g., a limited number of transaction per second). As a result, a fair blend of centralized and (including digitally enabled) decentralized renewable energy generation interconnected with an active consumer and highly developed and intelligent distribution and transmission networks is the most likely scenario for development.

Net Zero

A net zero energy system requires swift and significant transformation. According to the IEA's net-zero energy scenario (NZE), 100 million buildings would have residential Panels by 2030, adding 630 Gigawatts of solar Panels to the system annually, four times the records set in 2020. (from 25 million in 2020). In order to continually balance electricity supply and demand and preserve grid stability, more than 500 GW of demand response technology must be commercially available by 2030 in the NZE. By the late 2020s, investments must nearly quadruple to an average of 800 billion U.s. dollars, and those in digital assets in the NZE must expand eightfold.[7]

Digital technologies are expected to play a significant part in the globalization, efficiency, sustainability, and reliability of energy systems throughout the ensuing decades. With the correct incentives, distributed energy resources can be turned into valuable grid assets. Digitalization makes it possible to locate Distributed Energy Resources (DER) in the best location, make them visible to system operators, and enable real-time monitoring and control, supporting the security and dependability of the power system as well as the provision of flexibility.

Artificial Intelligence, Machine Learning, Deep Learning and Blockchain

Demand Response (DR) has drawn more attention in recent years due to its potential to increase energy system resilience while also being cost-effectively flexible. However, due to the high level of complexity of DR activities, extensive use of vast amounts of data, and regular demands for quick choices, artificial intelligence (AI) and machine learning (ML), a subset of AI, has just lately emerged as crucial technologies for enabling DR. AI techniques can be used to address a variety of issues, including choosing the best group of consumers to respond to inquiries, learning about their characteristics and preferences, dynamic pricing, scheduling, and device control, as well as figuring out how to fairly and economically reward DR scheme participants.

Although AI methods have been used in a variety of power system applications, demand-side response research has only lately started to show substantial interest. Growing the breadth and scope of DR programs is crucial for many system operators because DR has been highlighted as one of the promising techniques for supplying demand flexibility to the power system. This improved functionality of DR schemes necessitates a framework that is automated, adaptable in a dynamic context, and capable of learning. This framework can be developed with the use of AI approaches; in fact, it is becoming more and more clear that AI

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[7] Iea. "Distributed Renewable Energy and the Digital Transformation of Energy Systems - Challenges and Opportunities for Latin America - Event." *IEA*, 20 Sept. 2022, www.iea.org/events/distributed-renewable-energy-and-the-digital-transformation-of-energy-systems-challenges-and-opportunities-for-latin-america.

may significantly contribute to the future success of DR schemes by automating the process and figuring out end-user preferences.

The fast rise in research interest in this field serves as a good illustration of the expanding demand for AI-based solutions in the DR industry. According to Figure 1, between 2012 and 2018, the number of scientific papers on the topic increased by an order of magnitude (about 15 times). The necessity for a systematic review to summarize the AI algorithms utilized for the many DR application areas has grown as a result of this trend. While making important contributions, the majority of these studies actually tend to concentrate primarily on examining a single AI/ML technique and application domain.

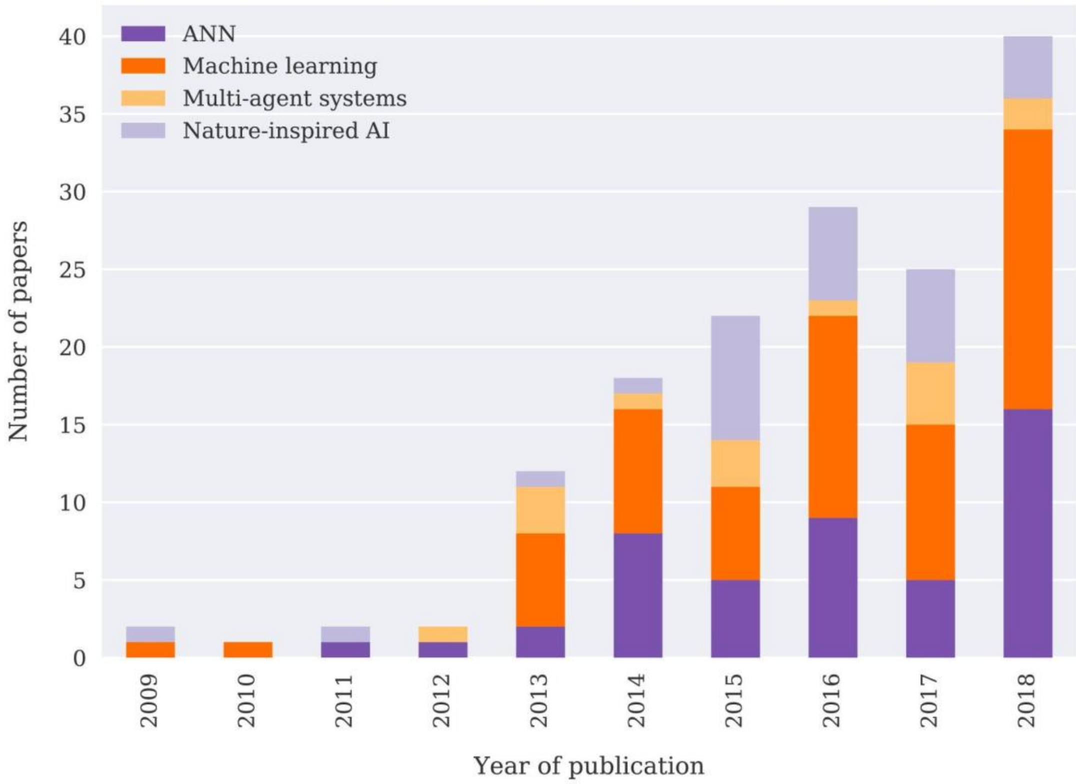

Fig. 1. Evolution of AI methods used for DR research[8]

Demand response operation and market structure

Electricity is fed to end users through a unidirectional power flow in the conventional electric grid paradigm. High voltage generators that are under centralized control provide this flow. Demand side management, and in particular demand response,

[8] *Evolution of AI Methods*. ars.els-cdn.com/content/image/1-s2.0-S136403212030191X-gr1_lrg.jpg.

have become innovative strategies for reliably and effectively managing the electric grid as a result of the growth of markets for grid services and the increasing share of DER in the energy mix. A DR model needs a bidirectional communication system and clever algorithms to process the generated data, in contrast to conventional power grids. As a result, smart metering devices are crucial for DR models and one of the main elements of a smart grid.[9]

In general, it is feasible to think of energy demand response as one of the methods under demand side management and something that is made possible by ongoing smart grid initiatives.[10] In response to a signal from a system operator or service provider, the customers agree to alter their usual consumption patterns by temporarily utilising on-site standby generated energy or reducing/shifting their power usage away from periods with low generation capacity. There are many different DR program types, and the most popular way to categorize them is according to who starts the demand reduction[11]. DR systems can be divided into two types, as seen in Figure 2.

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[9] *A Bayesian Game-Theoretic Demand Response Model for the Smart Grid*. www.ijsgce.com/uploadfile/2015/0811/20150811031931862.pdf.

[10] "Demand Side Management: Demand Response, Intelligent Energy Systems, and Smart Loads." *IEEE Xplore*, ieeexplore.ieee.org/document/5930335.

[11] Siano, Pierluigi. "Demand Response and Smart Grids-A Survey." *Renewable and Sustainable Energy Reviews*, Pergamon, 14 Nov. 2013, www.sciencedirect.com/science/article/abs/pii/S1364032113007211.

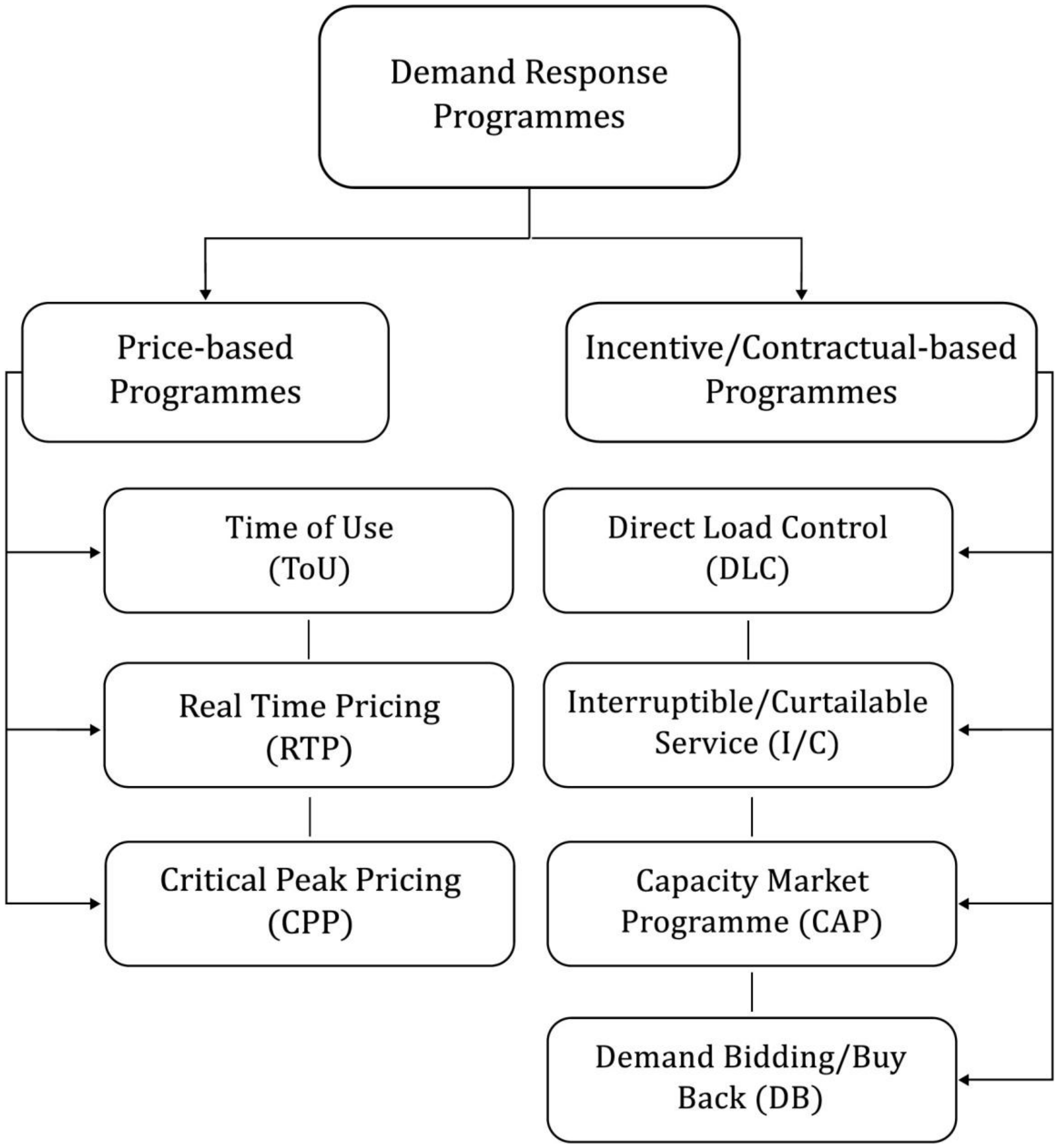

Figure 2. Categories of DR programmes[12]

Prosumers and small-scale renewable generation

In general, prosumers are characterized as energy users that generate a portion of their own electricity from a power plant and use the distribution network to inject excess output and to

[12] *Categories of DR Programmes*. ars.els-cdn.com/content/image/1-s2.0-S136403212030191X-gr3_lrg.jpg.

withdraw electricity when self-generation is insufficient to fulfil needs[13]. Only in Greece and North Macedonia do prosumers have their own regulatory framework. There is no distinct legal process that deals with this issue in any of the other markets we looked at exclusively with prosumers, but issues that concern or are related to prosumers are governed by other laws, such as Georgia's laws governing electricity supply and consumption, the support program for renewable energy source generators, and the authorization process for the construction of new renewable energy source generation capacity.

Small-scale renewable energy systems like solar panel systems, small-scale wind systems, small-scale hydro systems, solar water heaters, and air source heat pumps are all eligible under the Small-scale Renewable Energy Scheme, which offers financial incentives to individuals and small enterprises. It achieves this by producing small-scale technology certificates, which are provided "up front" for the systems' anticipated power generation over a 15-year period, or, starting in 2017, from the installation year until 2030 when the scheme ends, and which Renewable Energy Target liable entities are legally required to buy and surrender to the Clean Energy Regulator on a quarterly basis. This clean energy takes the place of energy produced by fossil fuels. In exchange for a lower purchasing price, most people who buy these systems give an agent the authority to create their certificates. Depending on how much solar energy is available, the extent of this benefit varies across the nation.

Barriers to implementation and digital solutions

Numerous dated business models in the energy services industry may not be capable of meeting the challenge given the size of the investments necessary and the speed at which change must occur. For instance, it is challenging for them to quickly alter their physical infrastructure and equipment to meet changing consumer needs, and their analogue data collection techniques are labour-intensive and produce few insightful results.

Digital business models, in contrast, depend on software. Digitally enabled businesses are better equipped to quantify the advantages that their products bring to clients because they have access to more detailed data and have the capacity to use advanced analytics. Additionally, it may hasten the creation of fresh goods and services. The energy transition can be sped up and made easier with the use of digital technologies and platforms that promote

[13]"Energy Community Homepage." *Energy Community Homepage*, 6 Sept. 2022, www.energy-community.org/.

efficiency and demand-side flexibility. Digitalization simultaneously gives energy service providers new commercial options and sources of income, while also assisting consumers in better understanding their energy use and reducing their bills.

MAJOR COUNTRIES AND ORGANISATIONS INVOLVED

China

China has transformed from a technical backwater to one of the largest digital economies in the world in a relatively short period of time. China's e-commerce sales increased to $1.7 trillion in 2020, accounting for 30% of all retail sales in the country, thanks to a base of about one billion internet users.[14]

However, this is not merely a matter of scale. Above all else, it is a tale of creativity and disruption. The nation is creating numerous "China-first" breakthroughs in omnichannel retail, social media, on-demand services, mobility, finance, health tech, and other fields.

As the industrial internet of things (IIOT) is applied at scale to transform digital manufacturing, digital supply chain development, and blockchain-based inventory management, China's digital development has enormous potential for efficiency improvements. To increase efficiency and sustainability, manufacturing businesses will progressively adopt IIOT-enabled digital manufacturing. 11 "lighthouse" manufacturing hubs for industry 4.0 innovative manufacturing techniques were located in China in 2020.

Greece

Due to its island location, Greece's ecology is anticipated to be severely impacted by climate change and extensive ecological damage. Acting in favour of eco-innovation is crucial for this reason. Greece's environmental strategy is centred on the promotion of energy efficiency and eco-innovation-promoting renewable energy sources. The nation gains from its substantial natural resources in agriculture and the food sector innovation, expansion in green and alternative tourism, and renewable energy sources (solar, wind, and tidal). Despite the

[14] Bu, Lambert, et al. "The Future of Digital Innovation in China: Megatrends Shaping One of the World's Fastest Evolving Digital Ecosystems." *McKinsey & Company*, McKinsey & Company, 12 Apr. 2022, www.mckinsey.com/featured-insights/china/the-future-of-digital-innovation-in-china-megatrends-shaping-one-of-the-worlds-fastest-evolving-digital-ecosystems.

financial crisis, solar installations reached 2,828 MWp by the end of 2019, covering 7.1% of the world's electricity needs. However, the adoption of renewable energy has been stalling lately. With a score of 75, Greece still has the lowest eco-innovation performance among the EU28 nations in 2018. (on an EU average of 100). Greece is only seven positions behind the EU average in terms of eco-innovation performance, but it is moving closer to catching up.

Latin America

Digitalization of the energy system is progressively spreading around the world, while it has only reached a minor level in Latin America. The region's advanced meter infrastructure roll-out is still below 10% despite the widespread deployment of distributed PV resources, and time-of-use tariffs are being implemented at a moderate rate[15]. Accelerating the adoption of digitalized technologies in Latin America can optimize the deployment of distributed resources, expanding systems' flexibility and boosting efficiency, since distributed PV (DPV) is expected to grow in the upcoming years.

The complexity of the energy system's digital transformation creates questions about cybersecurity, technology and innovation, planning, financing, and political economy (who pays and who benefits). Governments have a responsibility to create an environment that will support this transition, realize its advantages, and reduce its hazards.

Moldova

During the reporting period, Moldova's reform initiative nearly came to a standstill. All necessary energy-related regulations have not been updated, and the unbundling of the two now operating transmission system operators has been unsuccessful. The establishment of a functional balancing system, the following step in the process of opening up the wholesale power market, has been delayed. Even more, has been lost in the gas market. A fresh gas interconnector with Romania was nevertheless finished and approved. The approval of new regulations is necessary for further development in the fields of renewable energy auctions and energy conservation.

[15] Iea. "Distributed Renewable Energy and the Digital Transformation of Energy Systems - Challenges and Opportunities for Latin America - Event." *IEA*, 20 Sept. 2022, www.iea.org/events/distributed-renewable-energy-and-the-digital-transformation-of-energy-systems-challenges-and-opportunities-for-latin-america.

The Transnistria thermal power plant is Moldova's sole electrical source, and the country is still not connected to Romania, which is Romania's Western neighbour. The connecting project is progressing slowly. By 2024, asynchronous connectivity (through back-to-back stations) is anticipated to be finished. In the gas industry, since Gazprom controls the market leader, dependence is also significant. The operator of the Romanian system, Transgaz, constructed a pipeline linking Moldova's major consumption centres to the Romanian system, creating an alternate infrastructure. The nation offers a considerable amount of untapped potential for renewable energy initiatives.

International Energy Agency (IEA)

The International Energy Agency, founded in 1974 to guarantee the safety of oil supplies, has changed over time. IEA is at the forefront of the global energy debate today, focusing on a wide range of topics, including investments, climate change and air pollution, energy access and efficiency, and much more. Energy security is still one of the organization's primary missions.

Although maintaining energy security is still the IEA's primary goal, the organization has changed over time to keep up with how the world's energy system has changed. The IEA is now at the centre of the global conversation on energy, offering reliable data and analysis, looking at the full range of energy-related challenges, and advocating for policies that will improve the security, affordability, and sustainability of energy in its 31 member nations and beyond. Three pillars formed the framework for the IEA's modernization: a stronger and broader commitment to energy security beyond oil, to include natural gas and electricity; a deeper level of engagement with significant emerging economies; and a greater emphasis on clean energy technology, including energy efficiency.

The IEA suggests strategies to improve the energy's dependability, affordability, and sustainability using an all-fuels, all-technology approach. It covers a wide range of topics, such as demand-side management, energy efficiency, sustainable energy technology, electricity markets and systems, access to energy, renewable energy, oil, gas, and coal supply and demand, and much more. In order to increase its worldwide effect and strengthen cooperation in the areas of energy security, data and statistics, energy policy analysis, energy efficiency, and the expanding use of renewable energy technology, the IEA has been welcoming important emerging nations since 2015.

TIMELINE OF EVENTS

Date	Description of Event
26th of September 1973	Resolution 73/22 passed
1974	The International Energy Agency was founded
20th of September 1974	Resolution 74/29 passed
1996	The Multidisciplinary Digital Publishing Institute was founded
2014-2018	The number of scientific papers on the topic of Artificial Intelligence increased by 15 times
2015	The IEA has been welcoming important emerging nations
2020	25 million buildings started using panels and introduced the net zero scenario
2020	China's e-commerce sales increased to $1.7 trillion in 2020
27th of June 2022	The Article on Digitalisation in the Renewable Energy Sector was published

UN INVOLVEMENT: RELEVANT RESOLUTIONS, TREATIES AND EVENTS

Resolution 73/22[16]

Resolution 73/22 was adopted by the Committee of Ministers in the Council of Europe on the 26th of September 1973 at the 224th meeting of the Ministers' Deputies. The Resolution focuses on the protection of the privacy of individuals vis-a-vis electronic data banks in the private sector.

[16] *On the Protection of the Privacy of Individuals Vis-a-Vis Electronic ...* rm.coe.int/1680502830.

Resolution 74/29[17]

Resolution 74/29 was adopted by the Committee of Ministers in the Council of Europe on the 20th of September 1974 at the 236th meeting of the Ministers' Deputies. The Resolution focuses on the protection of the privacy of individuals vis-a-vis electronic data banks in the public sector.

PREVIOUS ATTEMPTS TO SOLVE THE ISSUE

Article Digitalization in the Renewable Energy Sector—New Market Players[18]

Published on the 27th of June 2022 by Teresa Pakulska and Małgorzata Poniatowska-Jaksch on the website of the MDPI the Article " Digitalisation in the Renewable Energy Sector-New Market Players" explores the idea of using digitalisation in the energy sector. The authors dive into the history of digitalisation and digital business models and investigate the flaws and strengths of new and disruptive business models and blockchain experiments and regulations.

In the article's conclusion, the development of digital technology in the field of renewable energy results in a more dynamic transformation of the energy sector as well as an increase in the number of organizations using novel business models[19]. Even so, these changes are gradual and are also influenced by several non-technological elements. Other studies reveal that the political and regulatory frameworks are firmly ingrained in the commercial models for renewable energy. These include tariff rules, among other things, in solar energy. The distribution of energy is significantly influenced by the existence of capacity compensation mechanisms put in place by legislators and regulators.[20]

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[17] *Council of Europe Committee of Ministers Resolution (74) 29*. rm.coe.int/16804d1c51.

[18] Pakulska, Teresa, and Małgorzata Poniatowska-Jaksch. "Digitalization in the Renewable Energy Sector-New Market Players." *MDPI*, Multidisciplinary Digital Publishing Institute, 27 June 2022, www.mdpi.com/1996-1073/15/13/4714/htm.

[19] Curry, Edward, et al. "Data Spaces: Design, Deployment, and Future Directions." *SpringerLink*, Springer International Publishing, 1 Jan. 1970, link.springer.com/chapter/10.1007/978-3-030-98636-0_1.

[20]*Distribution of Energy*. www.sciencedirect.com/science/article/abs/pii/S030142151730438X.

Digitalisation of the European Energy System[21]

By 2030, the EU hopes to have cut net greenhouse gas emissions from 1990 levels by at least 55%[22]. To fulfil the European Green Deal, adhere to the Paris Agreement obligations, and become the first carbon-neutral continent by 2050, and take the lead in the fight against climate change, Europe must achieve these reductions in the coming ten years. All of this will be accomplished by using renewable energy sources more frequently and by improving energy efficiency.

As a result, the energy system will need to continue its radical change, which includes building a bridge between energy and the digital economy. The energy system of today is still largely dependent on fossil fuels. With more than 80% of the electricity coming from renewable sources, the share of electricity in total energy demand will increase to 53% by 2050[23]. The traditional customer environment will also shift as a result of the electrical system's expansion of distributed generation and storage.

POSSIBLE SOLUTIONS

Reaching Net zero

According to the IEA's Net Zero Emissions by 2050 Scenario (NZE), 1.6 billion electric vehicles and 240 million rooftop photovoltaic solar systems will be integrated into the world's power grid by the middle of the century, and more than 85% of the world's existing buildings will have undergone retrofitting to meet zero-carbon ready standards. In NZE, the average yearly rate of progress in the entire economy's energy efficiency doubles through 2030 in comparison to the average during the previous 10 years to 2020. To do this, the flexibility of future low-carbon electricity networks must treble to handle variable renewable energy sources (depending on hour-to-hour ramping needs). About half of the increases in NZE flexibility are brought about by batteries and improved demand-side response. Therefore, stepping up efforts in the coming decade is essential for achieving these climate goals.

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[21] "European Digital Rights and Principles." *Shaping Europe's Digital Future*, digital-strategy.ec.europa.eu/en/policies/digital-principles.

[22] "EU Achieves." *European Environment Agency*, 26 Oct. 2021, www.eea.europa.eu/highlights/eu-achieves-20-20-20.

[23] *Energy Systems*. eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52018DC0773.

By 2030, clean energy investments under the NZE will have increased to over USD 4 trillion annually. Consumers and investors, who will be responding to pricing signals and governmental actions, are responsible for about 70% of that. The necessary actions, such as building renovations, the installation of EV charging infrastructure, and other initiatives, all need significant up-front financial commitments. Reaching this degree of financial commitment is extremely difficult, especially in emerging markets and developing nations, though not solely.

Supporting the deployment of innovative technologies and creating new revenue streams

For established energy companies, digitalization is opening up new possibilities. Large technological companies are being drawn to the energy sector as a result. Energy and tech firms are increasingly funding initiatives, alliances, and digital energy firms. For retail power suppliers, digital business models can open up new revenue streams and assist the formation of new organizations. For instance, by matching DER operations with grid needs, electricity producers and aggregators can generate income by offering balancing services to the neighbourhood network through virtual power plants. As in the case of Centrica's USD 23 million virtual power plant project in Cornwall, southwest England, these organizations can also engage in wholesale power market trading and offer retail power delivery.

Digitalization can also hasten the adoption of cutting-edge technologies and encourage innovation among utilities and grid operators by lowering upfront investments and risk and helping to optimize capital expenditures. Utilities can use the software as a service (SaaS) or purchase online licenses or subscriptions rather than paying upfront for the software, to improve grid planning and dynamically monitor their assets in locations where cybersecurity is sufficiently strong. Additionally, SaaS's inherent flexibility makes updates and other system changes possible as technology advances.

Creating regulatory frameworks

Digital firms require a legislative environment that is conducive to innovation in addition to suitable infrastructure. Peer-to-peer and virtual power plant models can only be successful if producers and consumers are permitted to participate in aggregations and if the legislative framework clearly defines the duties of possible players. More than USD 1.2 billion in investment pledges for virtual power plants were made as a result of the issuance of the US Federal Energy Regulatory Commission's Order 2222, which permits groups of DERs in the US to participate in wholesale power markets.

New business models may emerge as a result of ambiguities being removed from the legislation and industry standards. Operators of charging stations for electric vehicles are one example. In Indonesia, there is a comprehensive legal structure that includes licensing rights and procedures. However, operators in India are only required to adhere to a set of technical and safety requirements. Peer-to-peer communities also require a method to handle potential charge imbalances, uniform rules and procedures that regulate their interactions with utilities and retail customers.

Governments supporting digital business models

The increased interest in digital energy entrepreneurs from venture capitalists and major corporations illustrates how high the sector's growth prospects are anticipated. But in order for these businesses to scale up, governments and regulatory authorities urgently need to provide proper frameworks. Consumers also require legislation that may safeguard them from unfair business practices, promote transparency, and guarantee the proper handling and protection of any personal information provided by digital enterprises.

Following the Covid-19 recession, economies are currently recovering. Government recovery plans that include initiatives to promote more user-centred innovation, as well as financial incentives to modernize digital and energy infrastructures, can open up new commercial prospects for the digital sector.

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