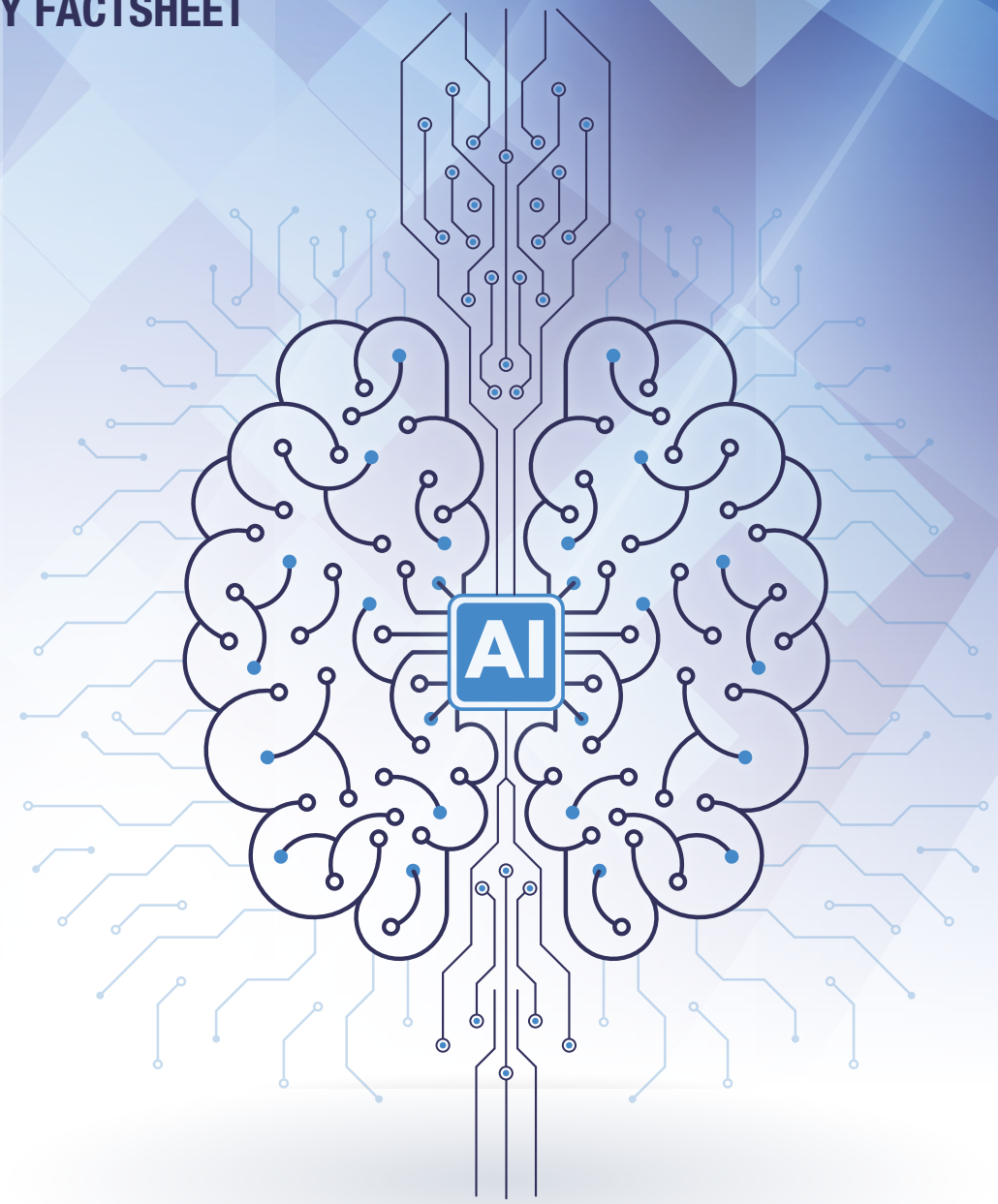
SUMMARY FACTSHEET



ARTIFICIAL INTELLIGENCE & BIG DATA

EMERGING TECHNOLOGIES FOR THE RENEWABLE ENERGY SECTOR

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CONTENT

ARTIFICIAL INTELLIGENCE AND BIG DATA

SUMMERY

1. What is Artificial Intelligence

Artificial intelligence (AI) is a branch of computer science that focuses on creating intelligent machines that function and react similarly to humans. AI refers to systems that modify behavior without being explicitly designed in reaction to data observed, collected, and analyzed (WCO, 2019).

Although AI and machine learning are frequently used interchangeably, they are not synonymous. According to some authors, machine learning is a subset of AI in which machines gather data and learn for themselves. To forecast outcomes, machine learning use algorithms and models (IBM, 2019).

The use of AI and big data will improve decision-making and planning, as well as condition monitoring, inspections, certifications, and supply chain optimization, all of which will improve energy system efficiency.

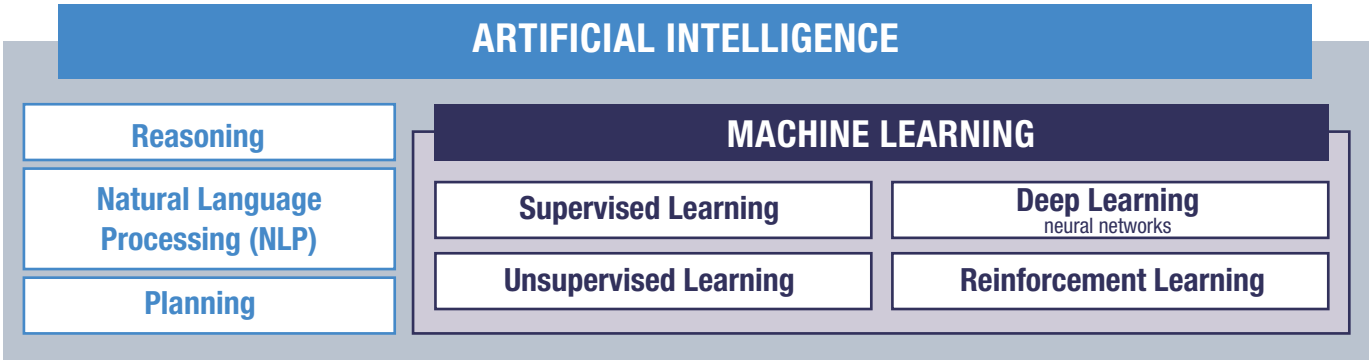


Figure 1: AI intelligent tools

2. What is Big Data?

The term "big data" refers to extremely massive datasets, both structured and unstructured. The requirement for intelligent technologies to efficiently analyze the large amounts of data being generated and translate it into value for the power sector is the link between AI and big data (SAS, 2019).

3. AI and big data role in the power sector

The growing use of renewable energy technology, bidirectional power flow, large flows of data acquired by IoT and other devices, increased use of energy storage, and utilities' and consumers' developing roles. Because of the limited amount of automatically controllable resources, many system operations choices are still made and implemented manually or with a minimum level of automation.

4. Applications of AI and big data in the Energy Sector

1. Improved renewable energy generation forecast

Big data and AI can produce precise power generation estimates, allowing more renewable energy to be integrated into the grid (MIT, 2014).

Accurate VRE forecasting on shorter time frames can assist generators and market players better forecast output and bid in the wholesale and balancing markets while avoiding penalties. Accurate short-term forecasting can help system operators improve unit commitment, increase dispatch efficiency, and reduce reliability difficulties, lowering the number of operating reserves required in the system.

2. Maintain grid stability and reliability

AI can improve the functioning of a system by providing accurate demand and supply forecasts, which is especially useful in the context of decentralised systems with the bidirectional electrical flow, which adds to the complexity of power systems.

As a consequence of weather conditions, AI can boost the capacity of power grids and eliminate the demand for additional connections by making better use of current lines. By autonomously recognizing disruptions, AI can improve the power system's safety, reliability, and efficiency.

3. Improved demand forecast

Demand forecasting combined with renewable generation forecasts can be utilized to improve demand-side management and efficiency as well as optimize economic load dispatch.
Smart meters that could communicate data to utility providers as frequently as every hour. AI can forecast not only network load but also consumption habits based on this information, and can precisely create a consumption pattern for each customer.

4. Efficient demand-side management

AI can optimize a consumer's home energy management, lowering their electricity bill, by using weather forecasts, occupancy, usage, energy prices, and trends detected in consumer behavior.

5. Optimised energy storage operation

Large-scale batteries, aggregated small batteries ("behind the meter"), and plugged-in electric vehicles are all emerging as significant enablers for renewable energy integration. AI can aid in the more efficient operation of these technologies, maximizing renewable energy integration (including the reduction of generation forecast mistakes), lowering rates for power consumed locally, and increasing returns for storage system owners.

This involves decisions on storing extra renewable electricity in a network of batteries and discharging the batteries to fulfill demand at a later time, all while taking into account expected demand, renewable energy, and other factors. Furthermore, by applying predictive logic algorithms to charging and discharging data, AI can assist in estimating and extending the useful life of a storage unit. Other factors include energy generation, costs, and network congestion.

6. Optimised market design and operation

In addition, sophisticated AI-based models are being used to optimize near-real-time market operations. To enable rapid response to market changes, such optimization relies on the analysis of large streams of diverse data.

5. Challenges and Enabling factors

• Technological maturity

Recent advancements in processing power, data collection, and communications are allowing AI applications in the power sector to emerge. To realize its full potential, meanwhile, additional investment and research are required.

• Availability and quality of data

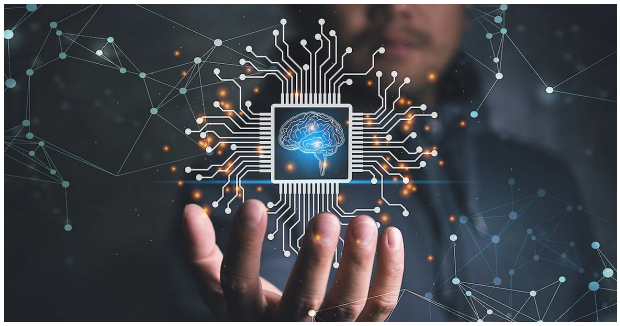
One of the most difficult aspects of AI is the quality of the large datasets (big data) used to build models. Today's data isn't always sufficient or of high enough quality to build systems that can deal with complex scenarios.

• The growing importance of cybersecurity

As ICT and energy networks become more integrated and new digital technologies and modes of communication become more common, cybersecurity will become a bigger challenge. Grid attacks have been more common in recent years, and some have been successful. These attacks threaten the energy system's essential infrastructure, including the electricity grid, as well as the highly integrated and interdependent natural gas, water, communications, and fuel delivery systems (AEE Institute, 2018).

• Training and re-skilling of energy sector professionals

The profound transformation that digitization may usher in necessitates a reform in how human capital is handled and developed. Energy sector actors, as well as businesses in general, must engage in reskilling and training their staff in order to manage and run digitalized power assets and systems.



6. Projects and Services

• BeeBryte

BeeBryte is a private firm based in France and Singapore that uses AI algorithms and automated control of heating-cooling equipment (e.g. HVAC), pumps, electric vehicle charging points, and batteries to reduce utility expenditures. BeeBryte uses advanced weather forecasts, occupancy, consumption, and power price signals to keep operations and temperatures within a customer-defined operating range, saving up to 40%.

• Grid Edge

The United Kingdom bases company Grid Edge offers cloud-based software services that help consumers forecast, optimize, and regulate their energy demand.

• Utilityx, McKinsey

Utilityx uses predictive maintenance to assist asset managers in improving productivity. Advanced analytics are used to turn network data into a condition-based plan that is based on an asset's health and criticality.

• Nnergix

Nnergix is a solar and wind power forecasting company established in Spain and the United States that serves energy markets and system operators.

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