COP29 Baku Azerbaijan

Japan Pavilion, Seminar (Organizer NEDO&AIST, Co-organizer METI)

Challenging toward Carbon Neutrality through Innovative Energy Technologies

(onsite in Baku and online)

AIST
Create the Future, Collaborate Together

Innovative Pathways to Carbon Neutrality: Advancing Smart Grid Technologies
~ How can we use AI technologies ~

Nov. 15, 2024

National Institute of Advanced Industrial Science and Technology (AIST)

Renewable Energy Research Center, Energy Network Team

Team Leader

Dr. Jun Hashimoto

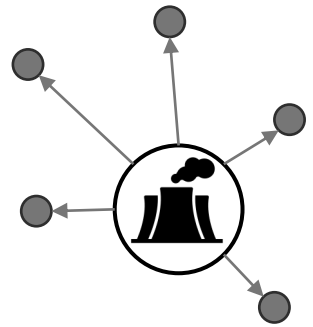
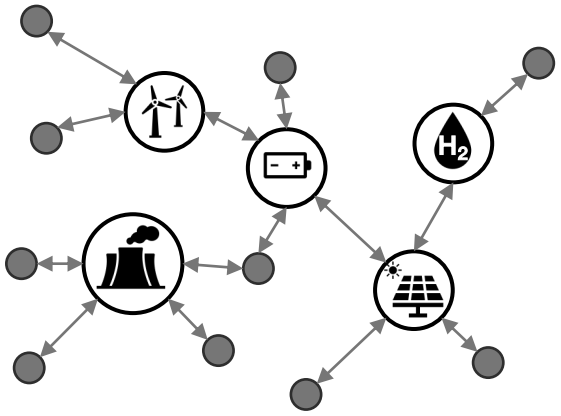
Challenges to Achieving Carbon Neutrality

Expanding renewable energy is essential to achieving carbon neutrality.

- *Challenges:*
  - *Difficulty in maintaining* ***supply-demand balance***
  - *Management* ***complexity due to bi-directional*** *power flow*
  - *Challenges for* ***ensuring redundancy*** *in the power grid*

- *Solution:*
  - *AI Technology Expected to*

Improve "Grid Flexibility" & "Efficiency"

Traditional	Smart Grid
	
Production *Few large power plants* ***System/Market*** *Centralized* ***Power flow*** *One-direction* ***Storage*** *None* ***Customer*** *Passive*	***Production*** *Many small power producer* ***System/Market*** *De-centralized* ***Power flow*** *Bi-direction* ***Storage*** *Diversity* ***Customer*** *Active*

AI Application Areas in Energy Technology

- **Electricity Demand Forecasting**
  Real-time analysis of weather and consumer behavior data for accurate demand-supply balance management.
- **Grid Flexibility Enhancement**
  Automated control of distributed energy resources and demand-supply balance using AI.
- **Fault Prediction & Maintenance**
  AI-based detection of anomalies in electrical equipment and infrastructure to improve preventive maintenance.
- **Optimization & Data-Driven Management**
  Utilization of real-time data to optimize distribution networks and improve operational efficiency.
- **Smart Grid Solutions**
  Advanced microgrid control and energy management systems using AI.

Theme "AI and Smart Grid" by AI

Grid Visualization and Data-Driven Technologies with AI

- *Importance of Grid Visualization*

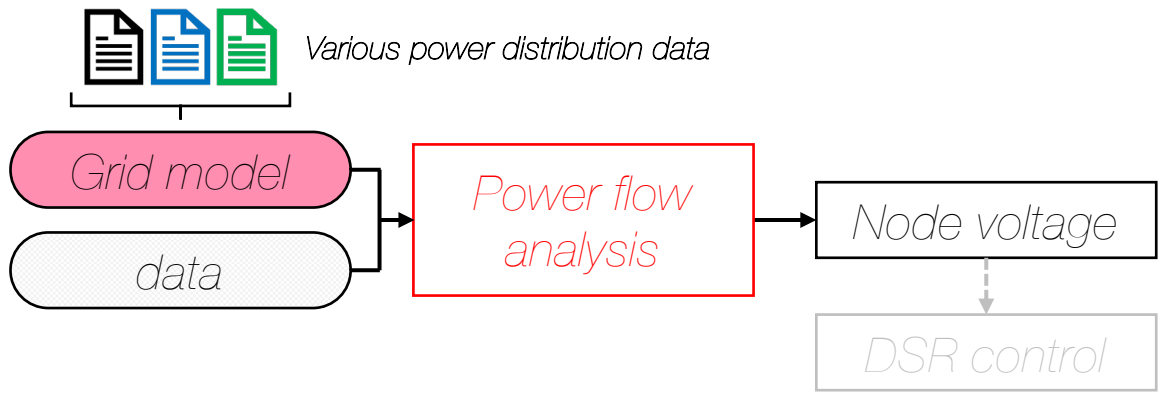
  Technologies that provide real-time power grid monitoring enable immediate identification of power flows and anomalies and help maintain supply-demand balance.

- *Utilization of Data-Driven Technologies*

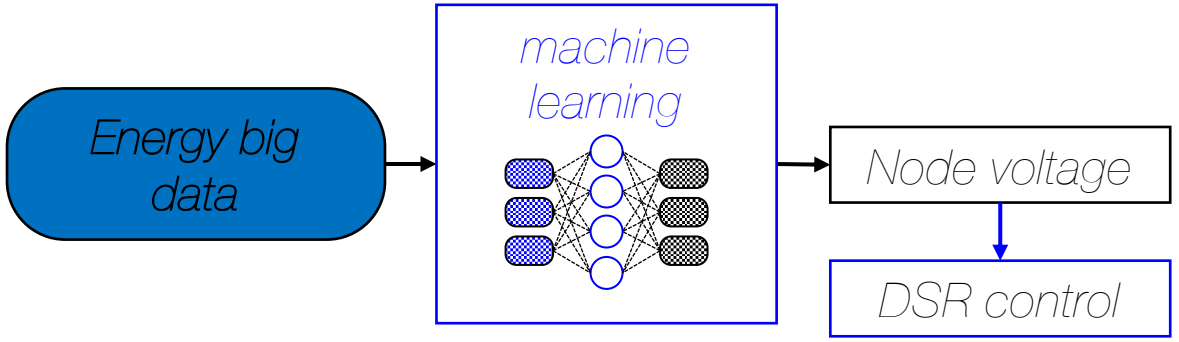
  Model-free analysis techniques that leverage data from advanced metering infrastructure (AMI). These technologies provide faster and more flexible evaluations of grid conditions compared to traditional model-based approaches.

- *Keys to a New VPP Business Model*

  Model-free analysis technology enables non-experts to perform power flow analysis for intelligent flexibility.



Traditional (Model-based)



Data-driven (Model-free)

*Demand Side Resources (DSR)

Key message

"Grid visualization and automation are necessary for the future power grid and required standardization."

Preliminary key questions and answer

Key questions and answer

- *What are the Pros and Cons of AI technologies for the power sector?*
  - *Pros*
    - *Improved efficiency: Optimization of electricity demand and supply, forecasting of renewable energy generation, etc.*
    - *Real-time analysis and control of complex system management: Big data processing & decision making, Advanced management of renewable energy, etc.*
    - *Cost reduction: fault prediction, maintenance automation, etc.*
  - *Cons*
    - *Data quality and quantity: AI performance depends on quality data*
    - *Lack of transparency: accountability and credibility challenges of AI decision making*
    - *Security Risk: Reliability risk, such as vulnerability to cyber attacks*
- *How can we collaborate on R&D for AI technologies at an international level?*
  - *Set common goals: Set common goals for utilizing AI technology and establish a cooperative framework.*
  - *Establishment of an open platform: Cooperation in non-competitive areas, joint use and improvement of data and algorithms*
  - *Promote standardization and collaborative projects: Create a climate in which many technologists can easily cooperate*