Microgrids

Introduction

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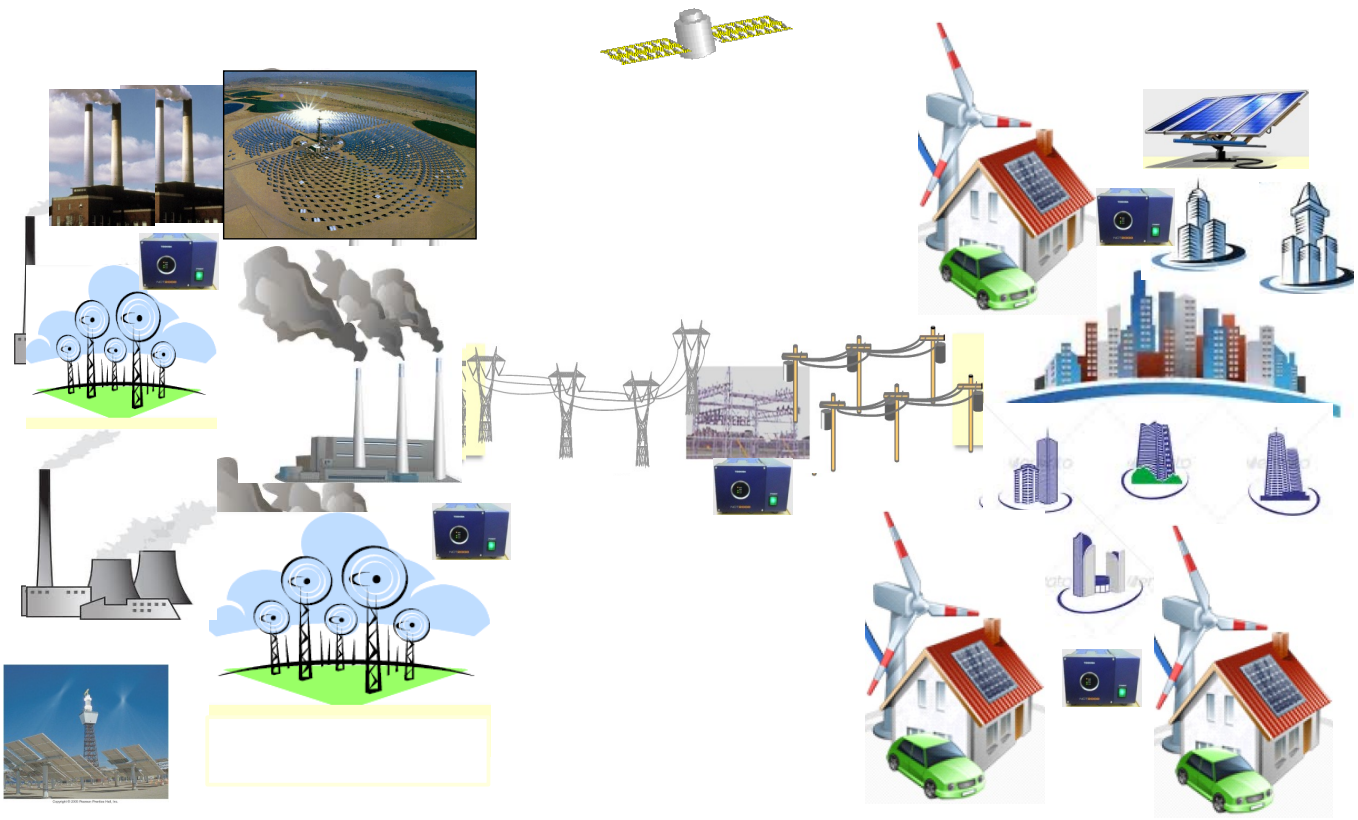
Outline

- Conventional and Modern Power Grids
- Smart Grid Definition
- Smart Grid Challenges
- Microgrids
- Microgrid Capabilities
- Important Topics in Microgrids
- Microgrid Control
- Conclusion

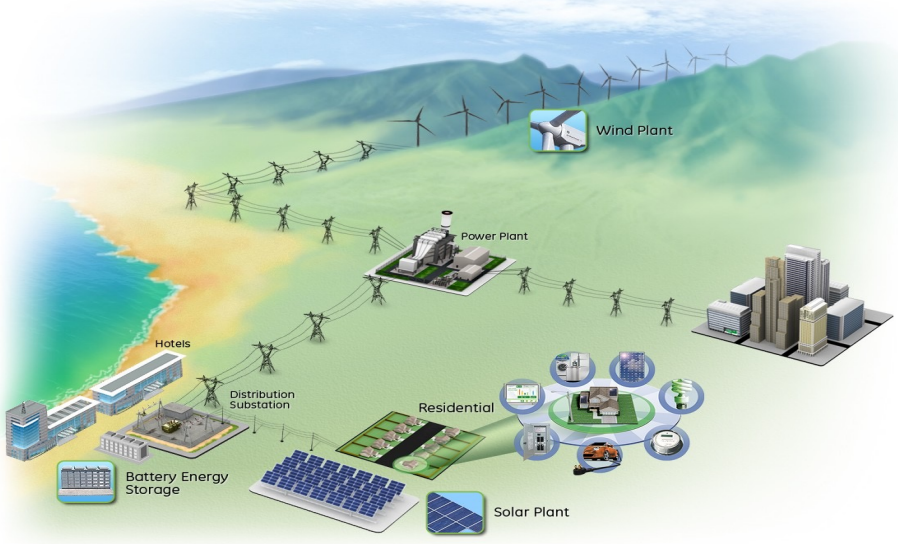
Conventional vs Modern Power Grids



Smart Grid

The Energy Independence and Security Act (EISA):

The term "**Smart Grid**" refers to a modernization of the electricity delivery system (**automated network**) so it **monitors**, **protects** and **automatically optimizes** the operation of its interconnected elements.



A Comparison

Existing Grid	Intelligent Grid
Electromechanical	Digital
One-Way Communication	Two-Way Communication
Centralized Generation	Distributed Generation
Hierarchical	Network
Few Sensors	Sensors Throughout
Blind	Self-Monitoring
Manual Restoration	Self-Healing
Failures and Blackouts	Adaptive and Islanding
Manual Check/Test	Remote Check/Test
Limited Control	Pervasive Control
Few Customer Choices	Many Customer Choices

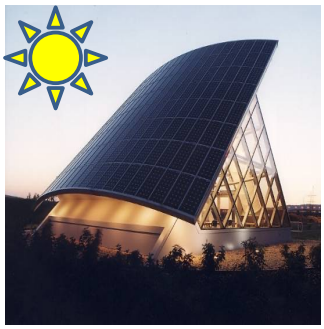
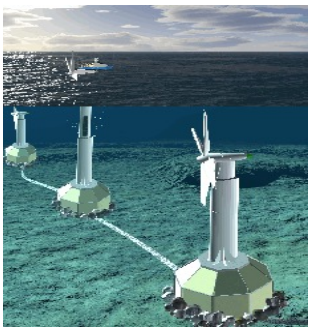
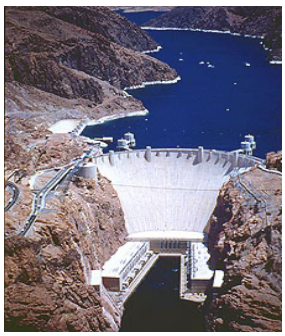
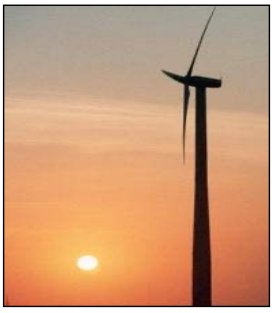
New Characteristics

- Emerging DGs/RESs and new functions
- Increase of size/complexity
- Wide network of monitoring units (IEDs/PMUs)
- Bidirectional communication and power flow
- Fully generation/load control

Some Challenges

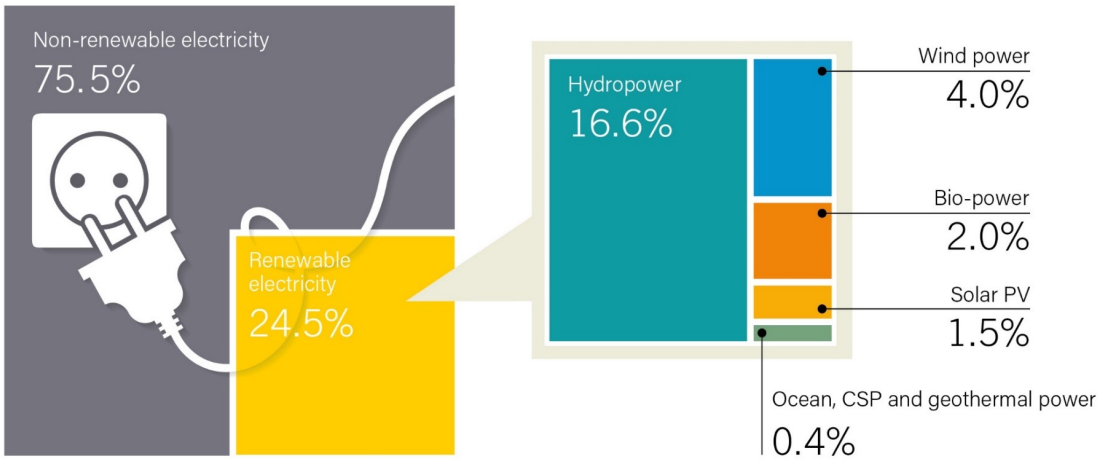
- Huge amount of data
- Require fast data processing/calculation
- Highly decentralized control structure
- Update conventional control synthesis
- High penetration of renewable power
- Intermittent nature of RESs (Solar, Wind)
- Low inertia due to use of electronic interfaces
- Update conv. stability/security assessment
- Revision of control performance standards

High Penetration of RESs/DGs

High Penetration of Renewable Power

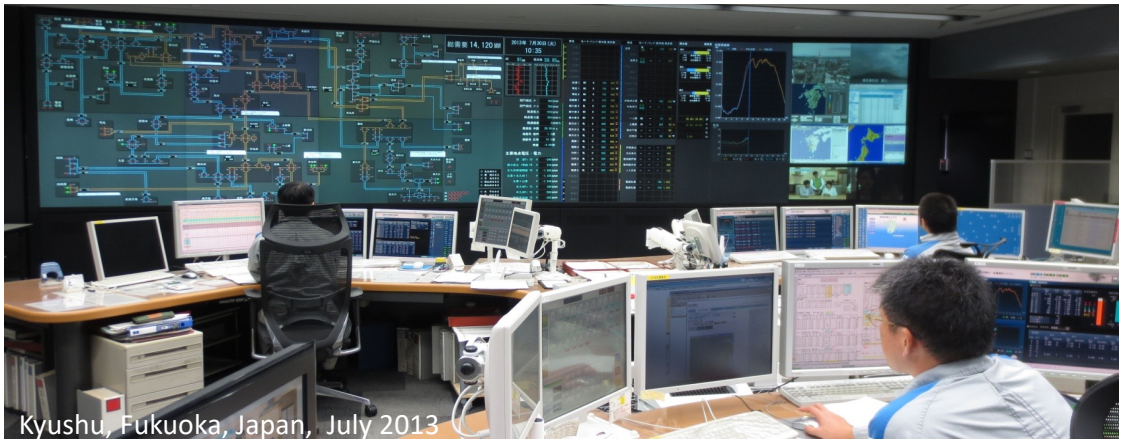
Estimated Renewable Energy Share of Global Electricity Production, End-2016



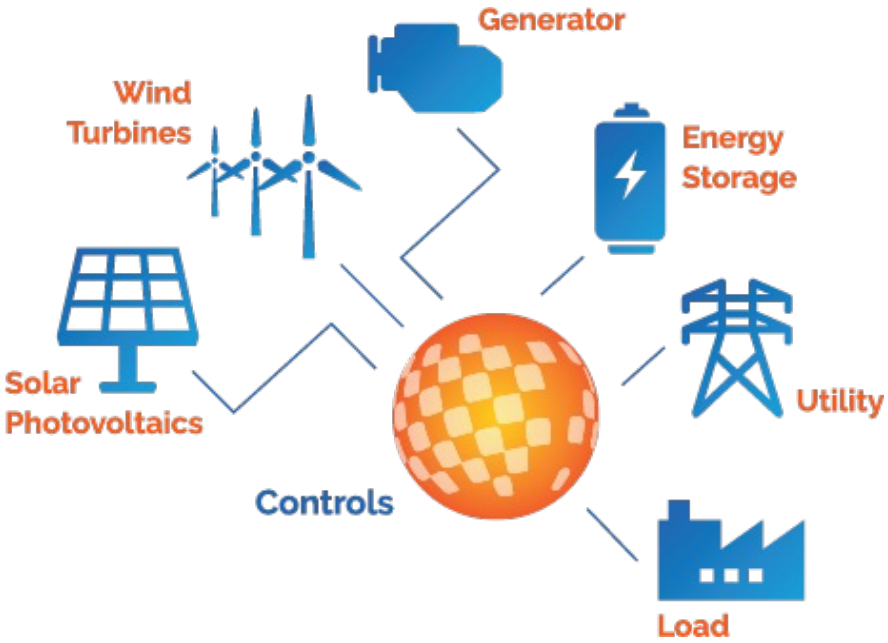
REN21 *Renewables 2017 Global Status Report*

Solutions (1)

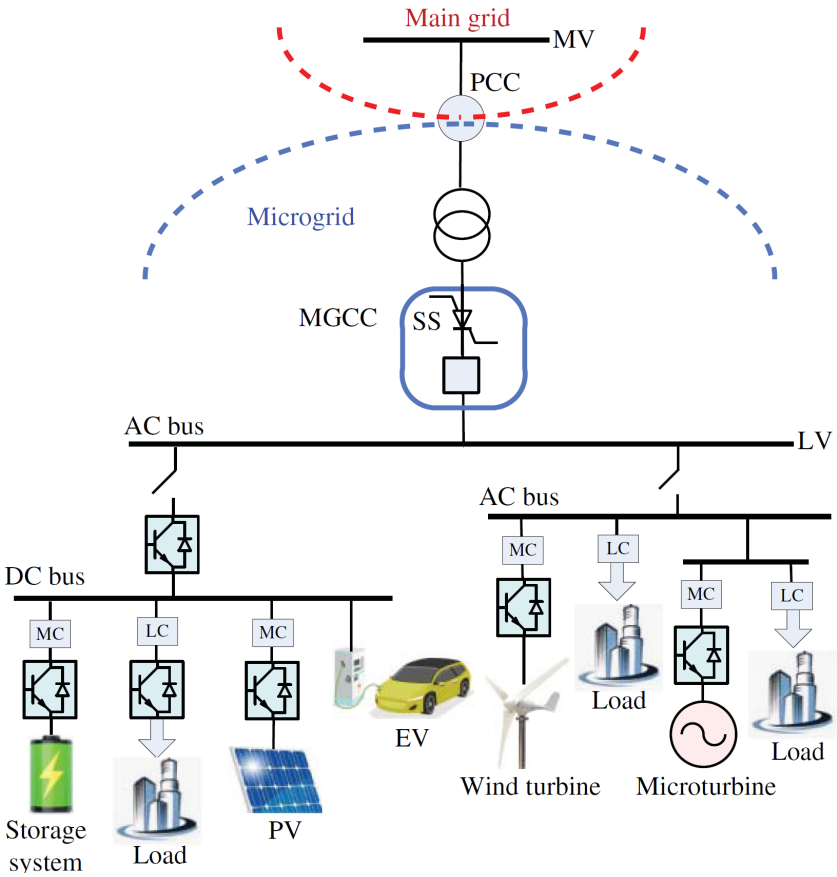
Increasing Smartness and Improving Monitoring/Control Technologies


Kyushu, Fukuoka, Japan, July 2013

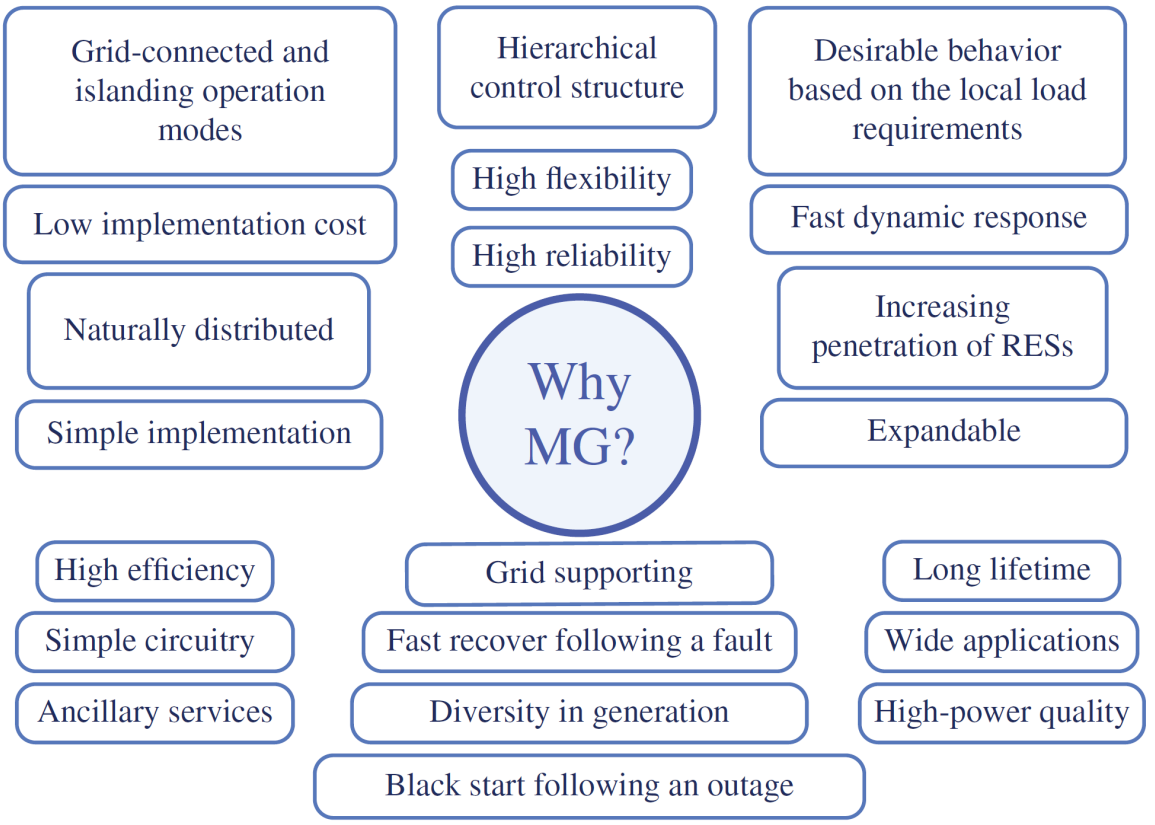
Using Microgrids



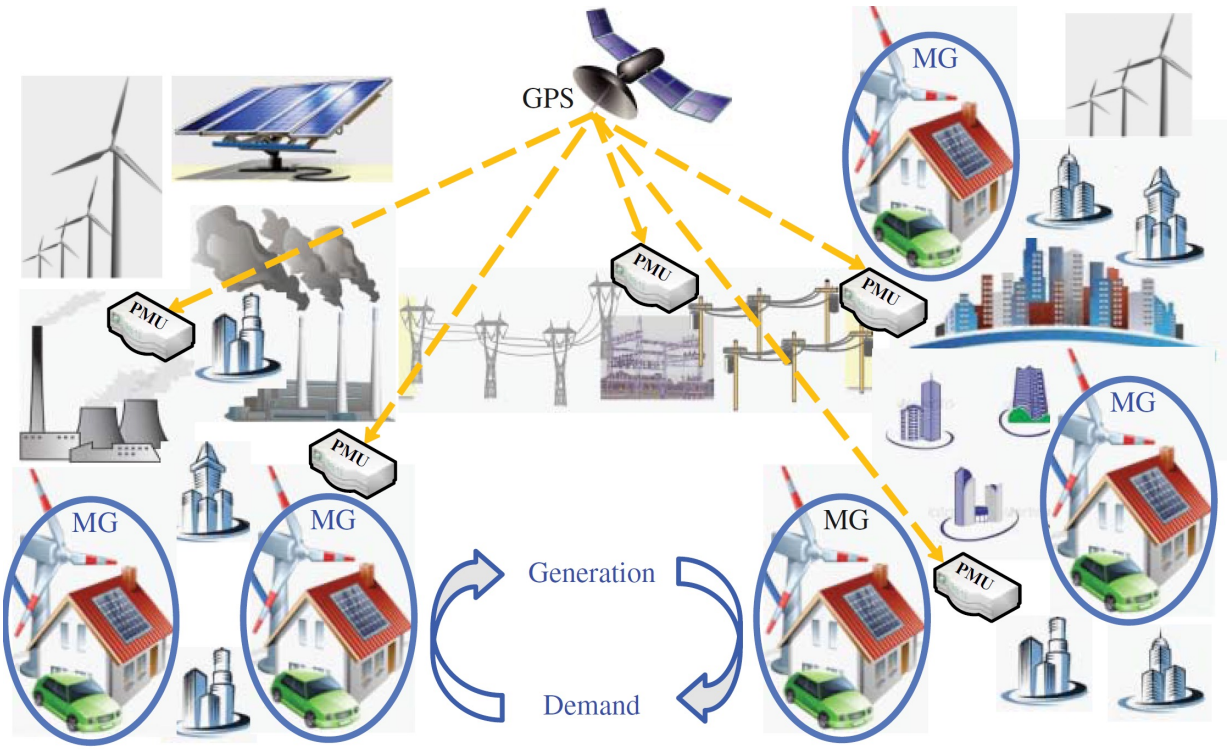
Microgrid



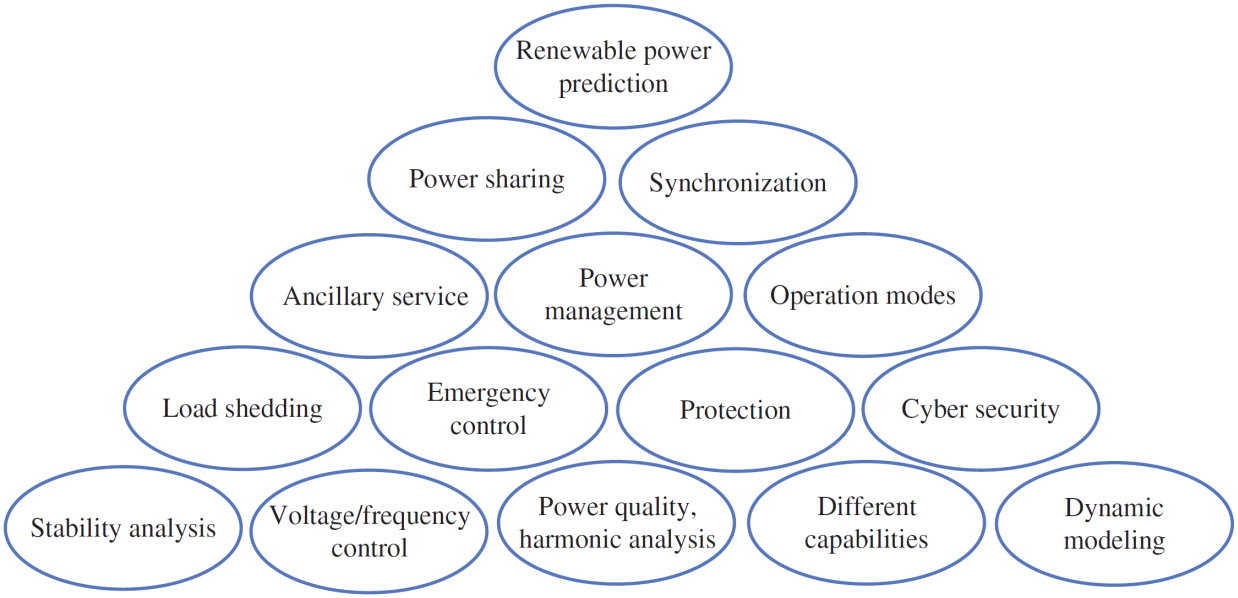
Microgrid Capabilities



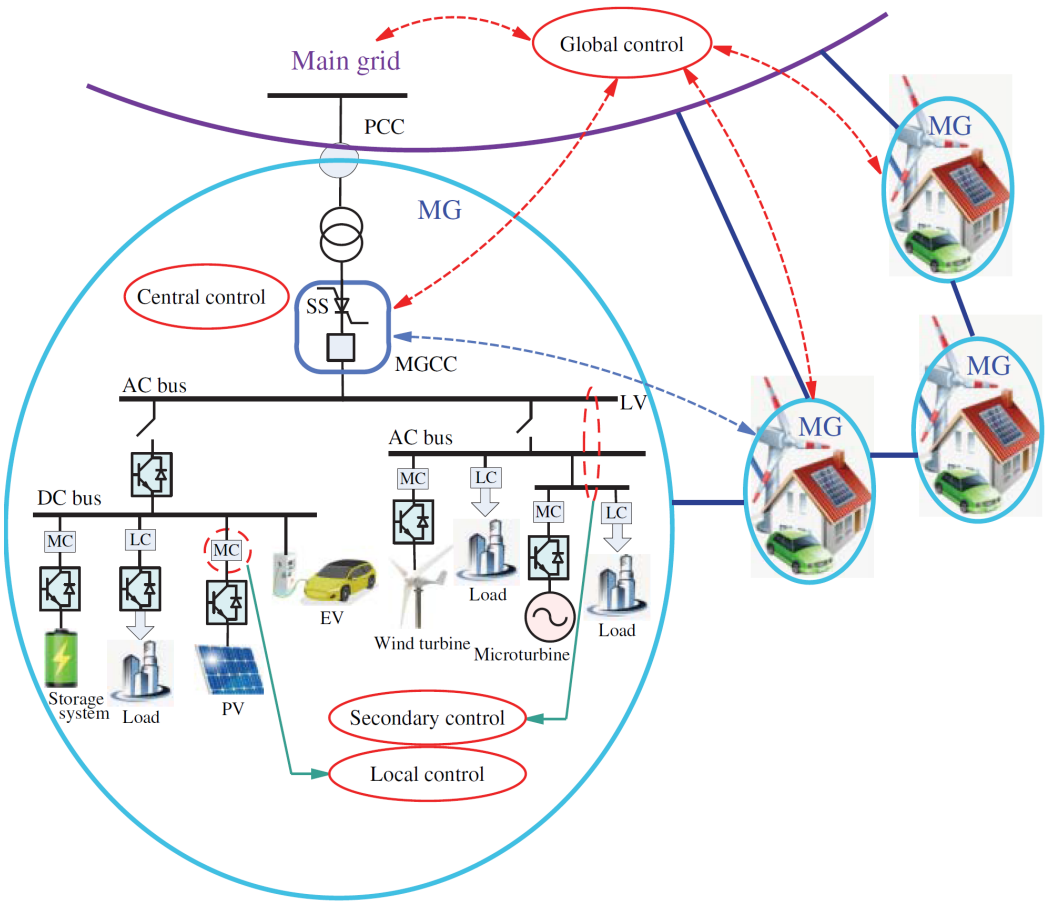
Microgrids in the Future Smart Grids



Most Important Topics in Microgrids



Microgrid Control



Control Challenges

- Low inertia
- Intermittent nature of RESs, high uncertainty
- Highly decentralized property (no central authority)
- Need for a real-time response (fast dynamic)
- Adapting the existing controls for MV and LV level
- Plug and play

Conclusion

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Power Grid

Smart Grid

Micro Grid


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Thank you for your attention!