# Challenges, Approaches and Practical Implementations of Micro-Grids with Energy Conservation Strategies

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# Characteristics of a Micro-Grid

- May be regarded as an aspect of DG
- Based on small power units
- Any kind of generating source and thus can make use of clean, renewable sources of energy
- May be installed in commercial and residential buildings, industries, universities, etc.
- Connected to the local distribution system rather than the transmission network

# Technologies Applied in Micro-Generation

- Small hydro
- Micro-turbines
- Small power wind turbines
- Photo-voltaic cells
- Fuel cells
- Diesel generating units

# Micro-grid Operation

There are two modes of operation:

- Connected to the grid. It provides quality of supply, global efficiency, flexibility of use, reduced cost, etc.
- Isolated from the grid operating autonomously. Mainly for energy supply to remote locations.

# Challenges

- Nature of electricity generation using wind and solar can be intermittent and unpredictable.
- Variation of wind and solar may not match with the time distribution of load demand.
- Using intermittent resources to provide electricity to meet load at all times in a regular way can be a challenge.

# Challenges Contd.)

- Design of a hybrid system becomes complicated through uncertain renewable energy supplies.

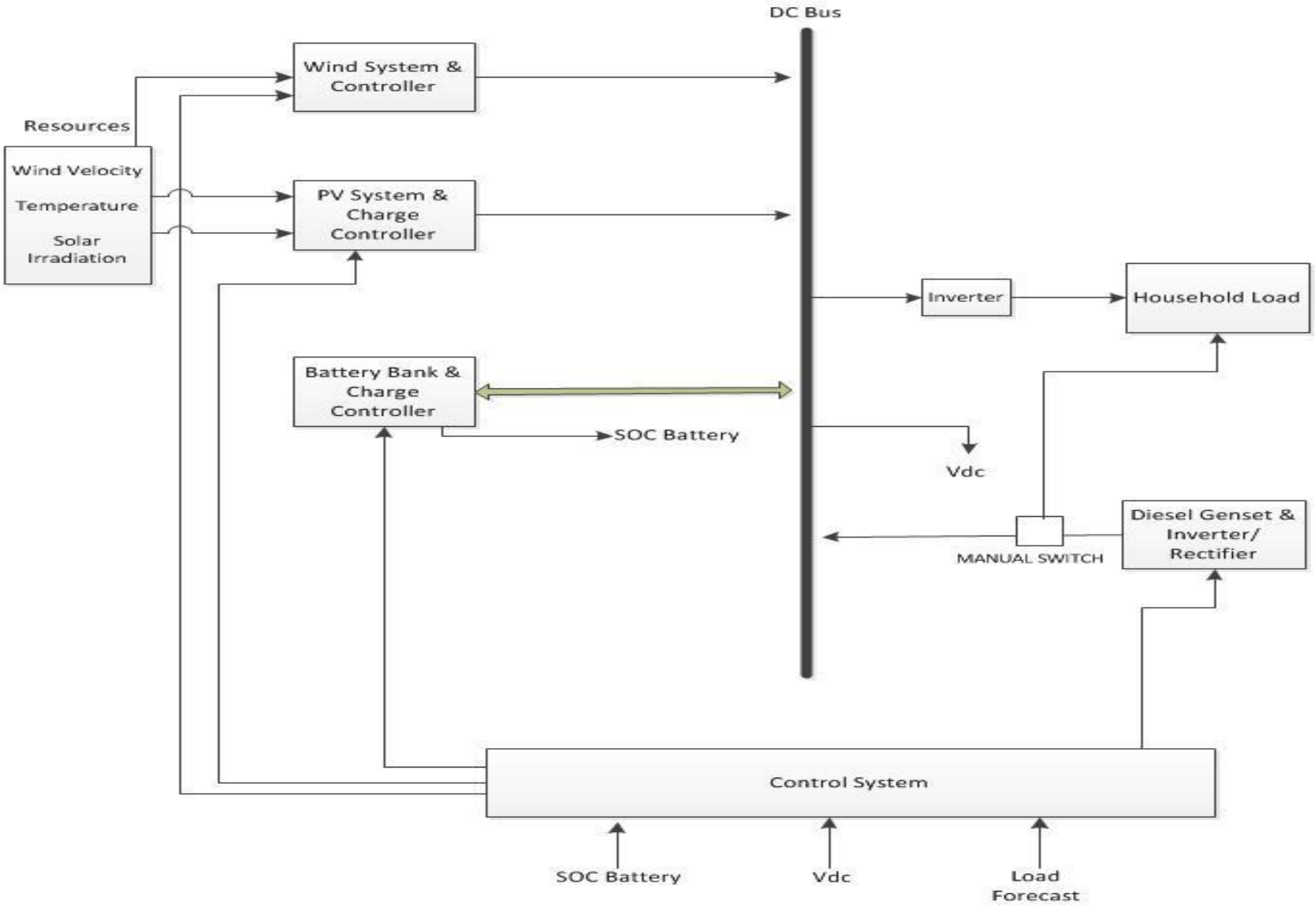
# Handle the Challenges

- Use energy storage devices to balance load demand and generation by intermittent sources of generation.
- Design the system considering relative sizes of various generating sources and storage devices.
- Proper control techniques to manage the operation of all components.

# Energy Storage Technologies

- Small hydro pumped storage
- Batteries
- High speed flywheels
- Super-capacitors
- Compressed air
- Chemical conversion to Hydrogen, fuel cells

# Illustrative Example of a Micro-grid



# Other Technologies

- Fuel cells and photo-voltaic cells require power electronics to convert dc to ac and vice-versa.
- Wind power generation also requires power electronics in certain configurations depending on the mode of operation and type of electric generator used.

# Concluding Remarks

- Opportunities:

(a) Micro-grids can be very useful in making use of renewable resources for electricity generation.

(b) They can provide electricity at reasonable cost to remote, isolated communities.

- Challenges exist, but they can be overcome by judicious design and applying proper control techniques in the operation of the micro-grid.