RSET
RAJAGIRI SCHOOL OF ENGINEERING & TECHNOLOGY

EE403 Distributed Generation & Smart Grids

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Module II

Distributed energy resources: Introduction - Combined heat and power (CHP) systems - Solar photovoltaic (PV) systems – Wind energy conversion systems (WECS) - Small-scale hydroelectric power generation - Storage devices: Batteries: Lead acid, nickel metal hydrate, and lithium ion batteries , ultra-capacitors, flywheels

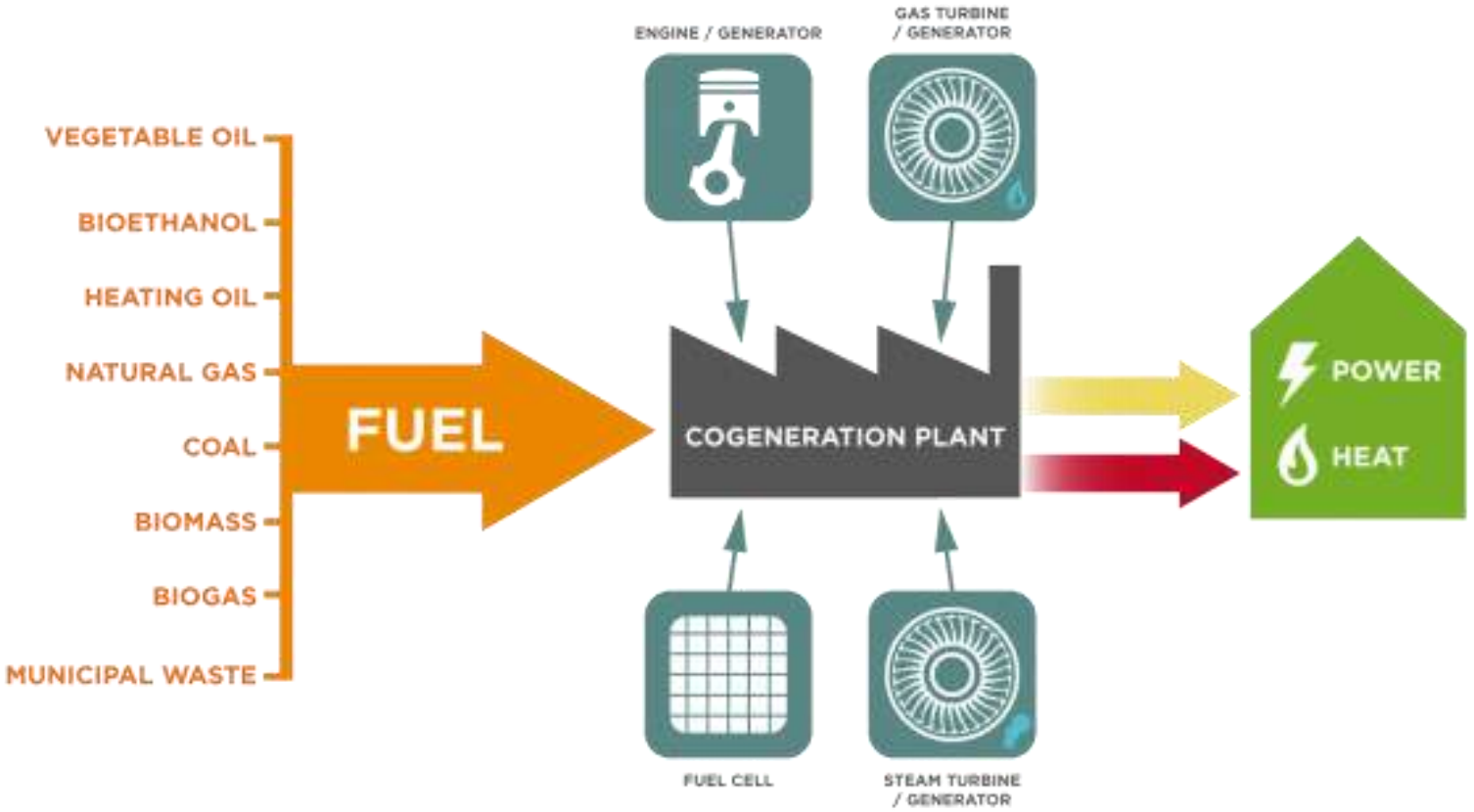
Control of Microgrids: Introduction to Central Controller (CC) and Microsource Controllers (MCs) - Control functions for microsource controller, Active and reactive power control, Voltage control, Storage requirement for fast load tracking, Load sharing through power-frequency control

Distributed energy resources:

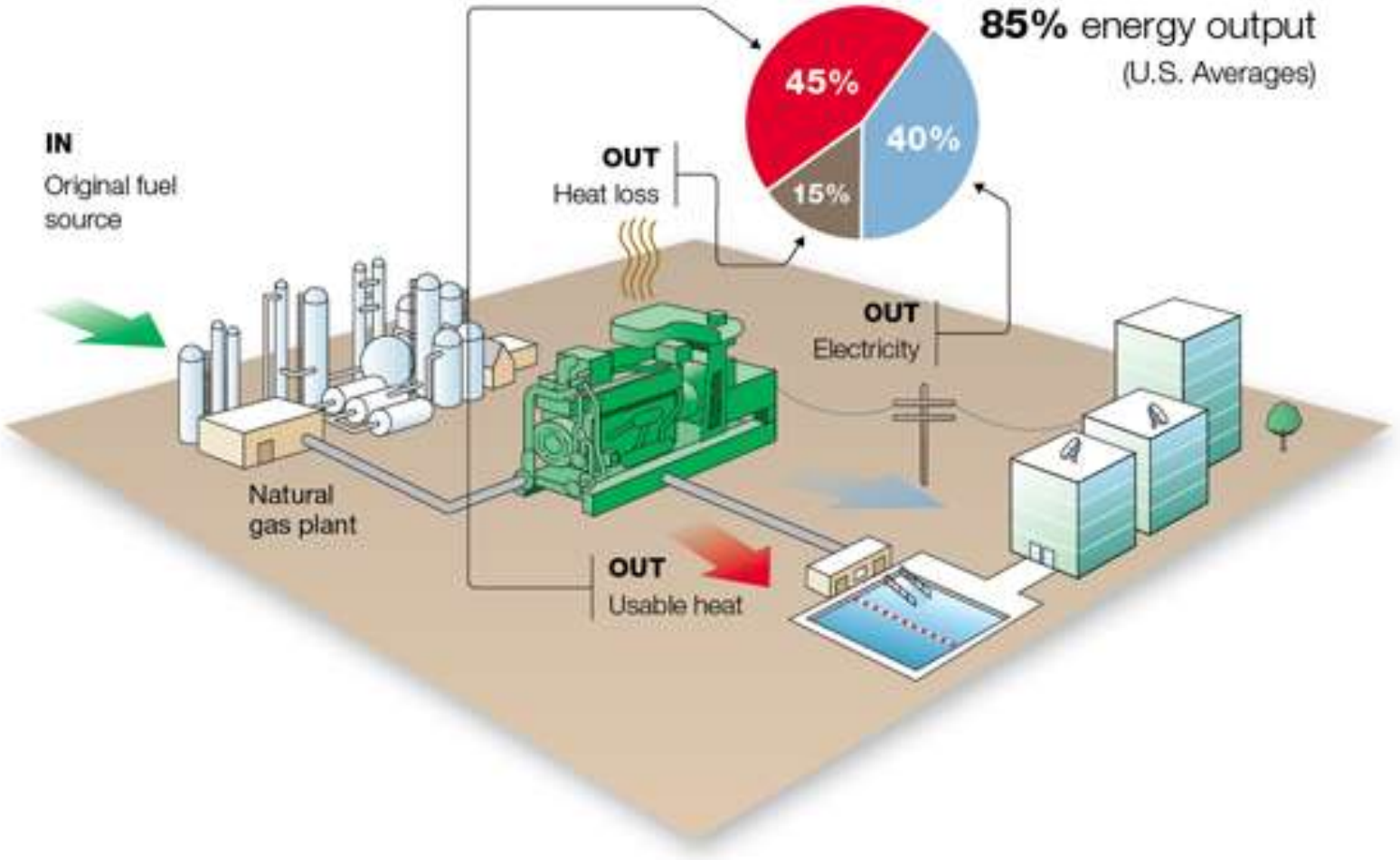
- Combined Heat and Power(CHP) systems or Cogeneration systems
- Wind Energy Conversion Systems (WECS)
- Solar photovoltaic (PV) systems
- Small-scale hydroelectric generation
- Storage Devices (Fuel Cells, Battery etc)
- Electric Vehicles(EV)
- Microturbines
- Other renewable energy sources

Combined Heat and Power Plant (CHP)

The Cogeneration Principle



Co-generation CHP System



Combined Heat and Power

- Combined heat-and-power, also known as “cogeneration,” refers to the use of recovered exhaust heat of any production unit for another process requirement.

- Heat produces at moderate temperatures (100-180 °C) can be used in absorption chillers for cooling.

- This in turn results in improvement in the energy utilization of the unit. By so doing, the overall thermal efficiency of generation may be raised from 40–50% to 70–90%. The upper limit of 90% holds for large installations with a very well-defined and constant heat demand.

Combined Heat and Power…..

- Combined heat-and-power does not have to be a renewable source of energy; in fact, many CHP installations use natural gas as a source.
- The use of biomass as a source is the only renewable form of CHP. The direct combustion of organic matter to produce steam or electricity is the most advanced of the different CHP processes and, when carried out under controlled conditions, is probably the most efficient.
- Micro CHP plants used for space heating and electricity receiving a lot of attention. Possible applications are domestic heating, hotels shopping centers and offices.
- An example is a unit that produces 1 kW electricity together with 7.5– 12 kW heat

Micro-CHP Systems

Micro-CHP systems are installed in smaller premises like homes or buildings

Micro-CHPs are based on the following technologies

1. Internal Combustion (IC) Engines
2. Stirling Engines
3. Microturbines
4. Fuel Cells

Internal Combustion (IC) Engines

- Fuel is burnt in air or in a combustion chamber with or without oxydisers
- Commonly used fuels are diesel, petrol ,gasoline, natural gas or Liquified Petroleum Gas (LPG)
- Liquid and gaseous bio fuels, like ethanol and biodiesel also can be used
- IC Engines are provided with spark ignition or compression ignition systems in their cylinders

Stirling Engines

- An external combustion engine, though heat can also be supplied by non-combustible sources like solar, geothermal, chemical and nuclear energy
- Stirling engine uses an external heat source and an external heat sink.
- Working fluid: Combination of air and hydrogen or helium gas in a sealed chamber
- Processes: Cooling, compression, heating and expansion
- 'Hot' heat exchanger is kept in thermal contact with an external heat source while the 'cold' heat exchanger is kept in thermal contact with an external heat sink like radiator

Stirling Engines …….

- When the gas is heated , it expands in the sealed chamber and acts on the power piston to produce a power stroke.
- When the gas is cooled its pressure drops and then less work has to be done by the piston to compress the gas on the return stroke
- Stirling engines as CHP: The primary heat source enters the engine heater and produces mechanical power (can be used to generate electricity as a secondary product) and the waste heat from the engine's heater can be used for heating applications

Stirling Engines

Advantages:

- High energy conversion efficiency
- Quite, More reliable, low maintenance
- Pollution free

Disadvantages

- Larger size, Higher capital cost

Applications

- Water pumping, Electrical generation

Stirling Engine-Solar Concentrator

Stirling Energy Systems

Thank You!!!