



Power 101

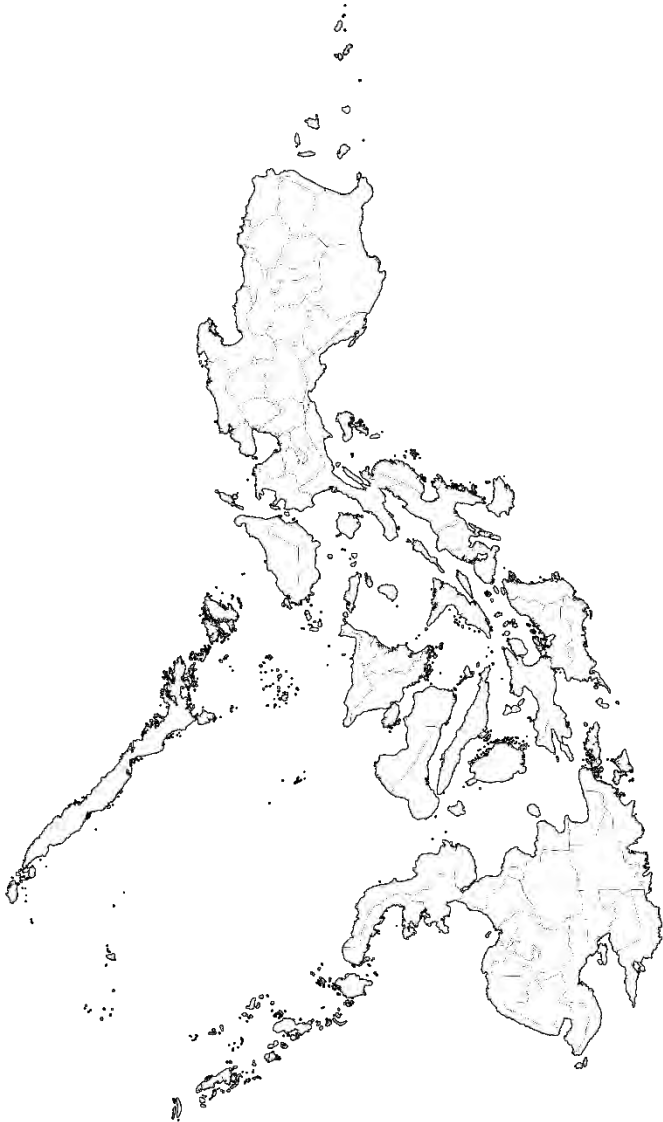
Atty. Felix William B. Fuentesbella
Undersecretary

E-Power Mo Energy 101 for Media
10 October 2018
Grand Xing Imperial Hotel, Iloilo City

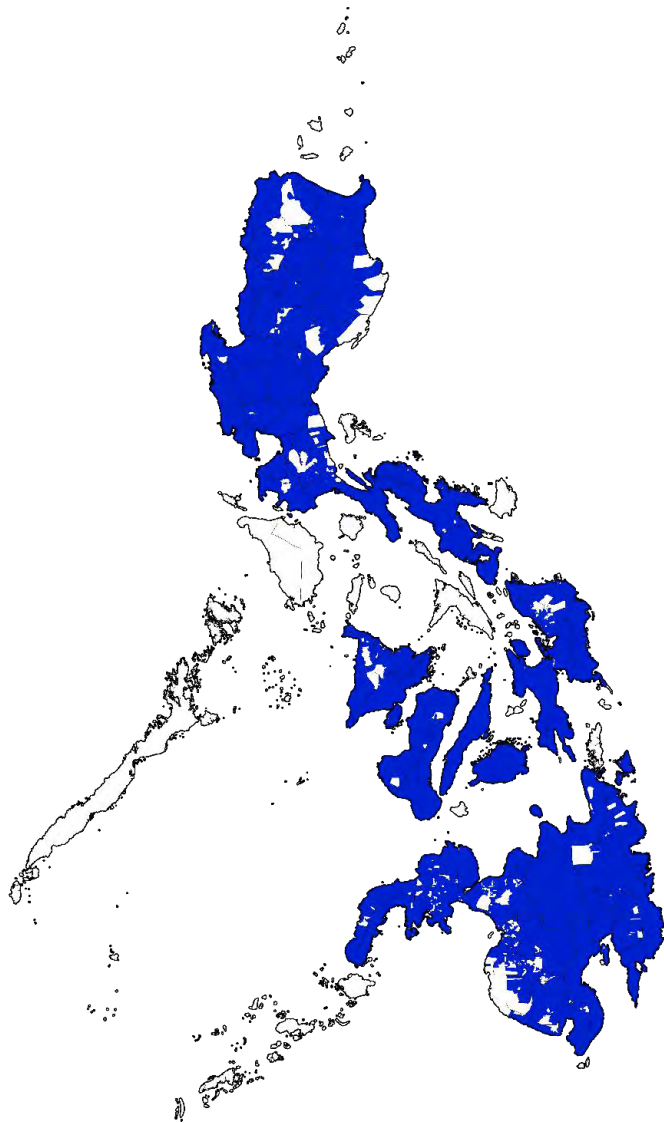


Philippine Power System

Power System



Philippine Power System



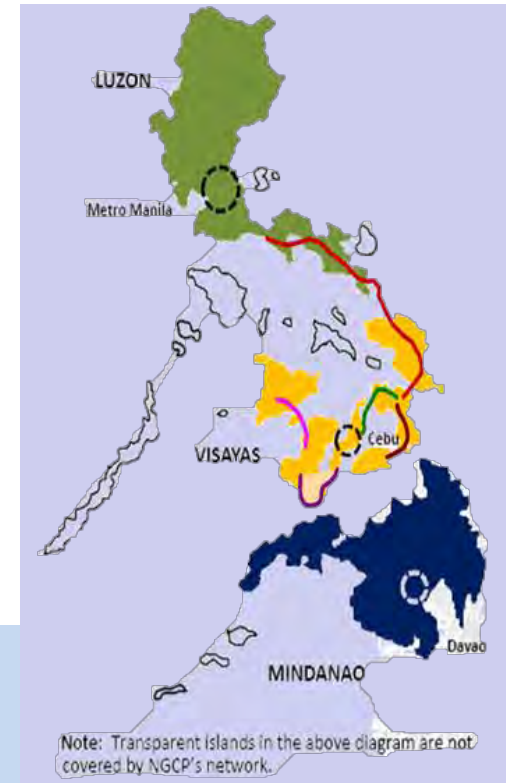
Power System

Grid

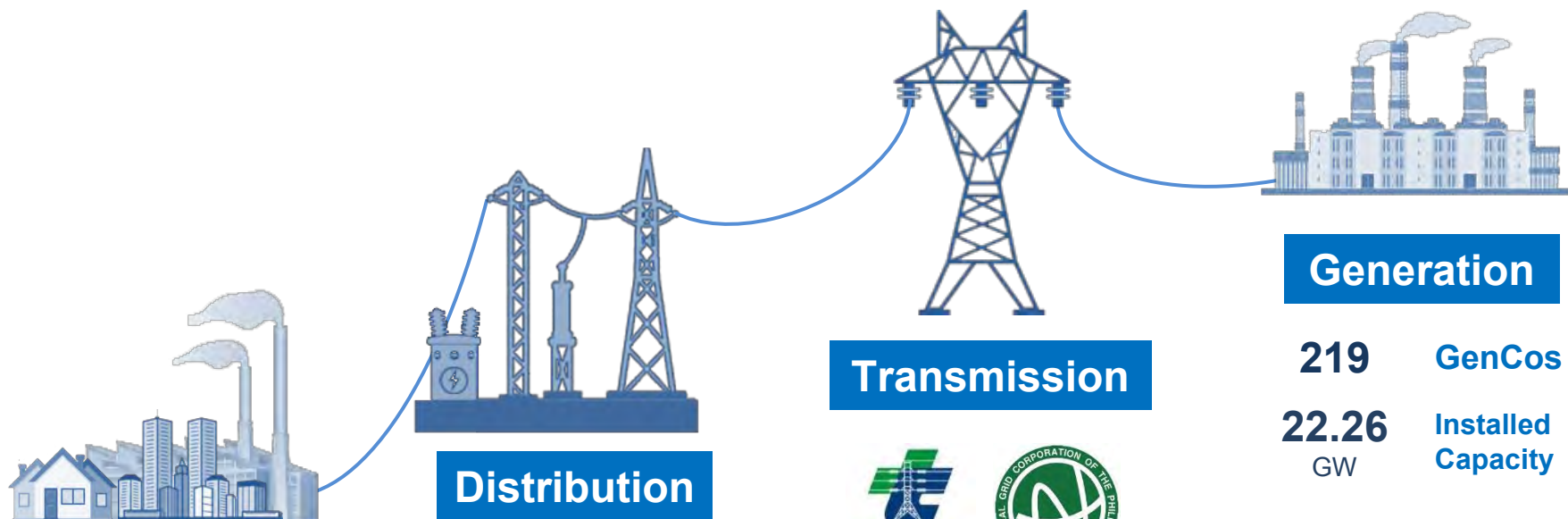
- **Luzon**, **Visayas** and **Mindanao** grids
- Connected to main transmission backbone

Interconnection Line Capacity

- Leyte-Luzon (440 MW)
- Leyte-Cebu (400 MW)
- Cebu-Negros (200 MW)
- Negros – Panay (200 MW)
- Leyte-Bohol (100 MW)

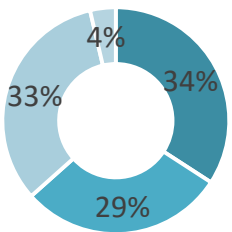


Grid Power System



Load

77,793 GWh



- Residential
- Commercial
- Industrial
- Others

Distribution

23 **PIOU**s
 100 **EC**s
 2 **LGUOU**s

PIOUs - Private-Investor Owned Utilities
ECs - Electric Cooperatives
LGUOUs - LGU-Owned Utilities

Transmission

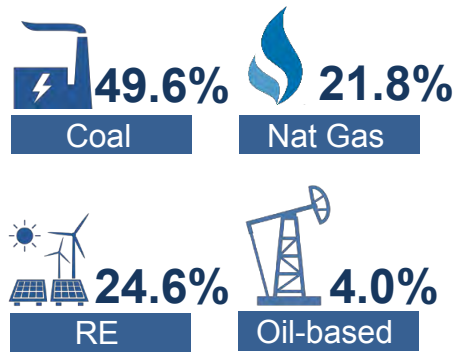


31,501 **MVA**
 20,053 **ckt-km**

Peak Demand: 13.789 GW

Generation

219 **GenCos**
 22.26 **GW** **Installed Capacity**
 94,370 **GWh** **Gross Generation**



Sources of Data: DOE; NGCP

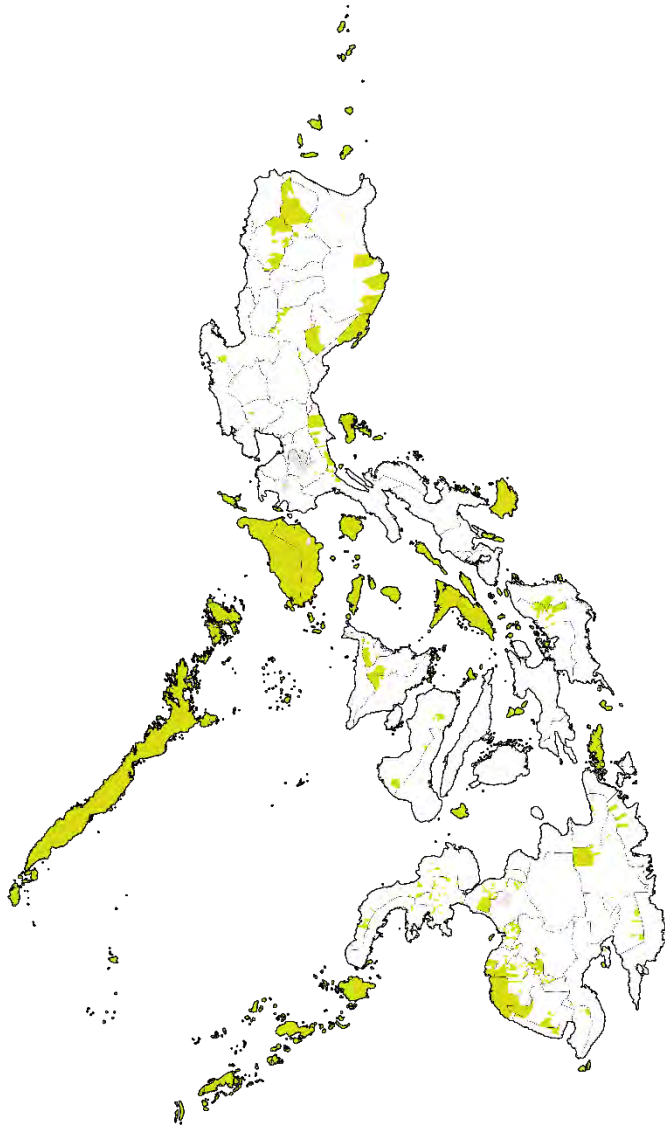
* DU data as of December 2017

** Based on 2014-2015 TDP

***Gross Generation data as of December 2017



Philippine Power System



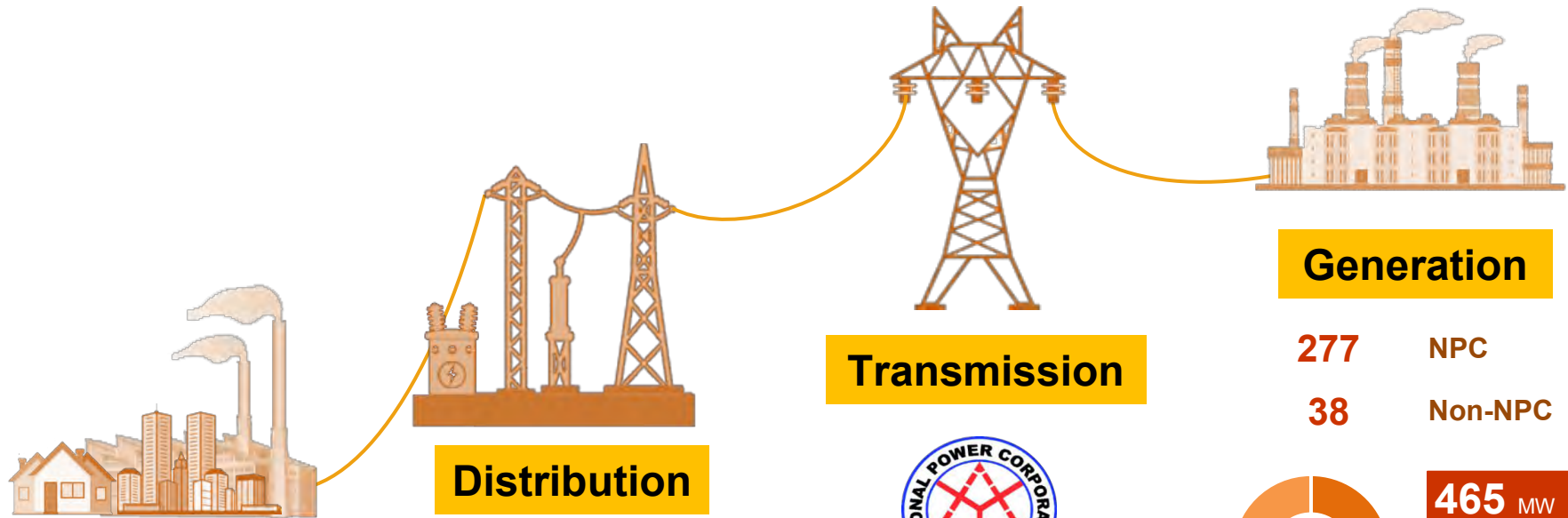
Power System

Off-Grid

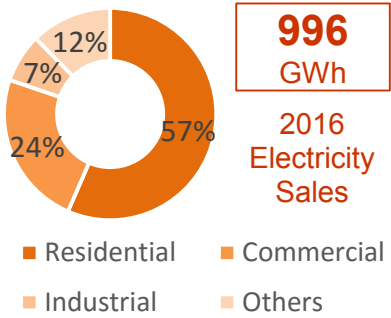
- Missionary areas
- Also known as Small Islands and Isolated Grid (SIIG)
- Power supplied by NPC SPUG and Private Sector (New Private Provider and Qualified Third Party)



Off-Grid (SPUG) Power System



Load



76.6%*
Energized

Distribution

- 21** ECs
- 1** MPCs
- 3** LGUOUS
- 2** QTP

ECs - Electric Cooperatives
 MPCs - Multi-Purpose Cooperatives
 LGUOUS - LGU-Owned Utilities
 QTP - Qualified Third Parties

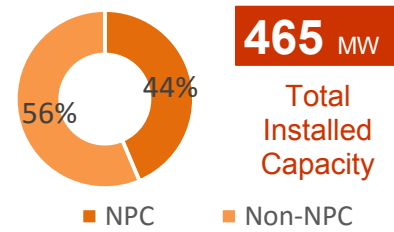
Transmission



185 MVA
776 ckt.-km

Generation

277 NPC
38 Non-NPC



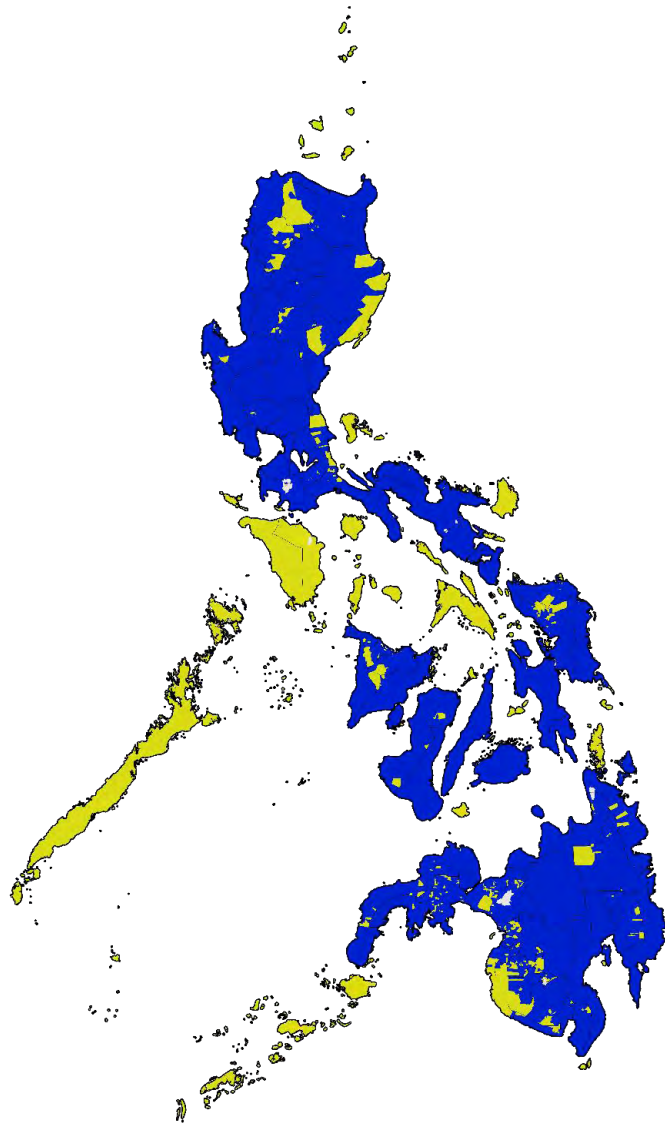
1,315 GWh Gross Generation

97% Diesel
3% Hydro

Source of Data: DOE; NPC; NEA

*As of January 2018; excluding ARMM ECs
 **Gross Generation data as of December 2017
 ***Transmission data as of April 2018

Philippine Power System



Power System

Grid

- Luzon, Visayas and Mindanao grids
- Connected to main transmission backbone

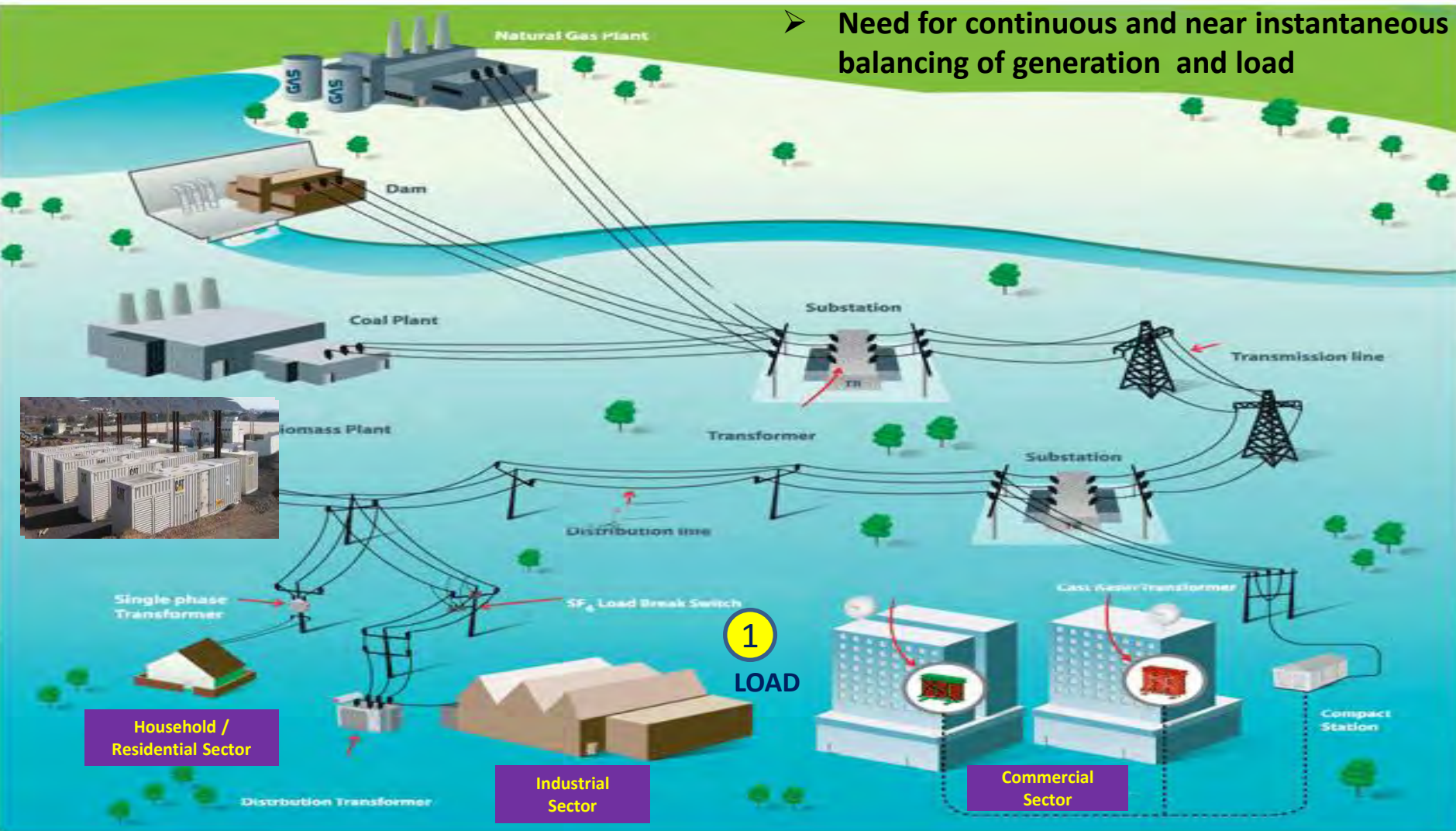
Off-Grid

- Missionary areas
- Also known as Small Islands and Isolated Grid (SIIG)
- Power supplied by NPC SPUG and Private Sector (New Private Provider and Qualified Third Party)



How the Power System Works

- Need for continuous and near instantaneous balancing of generation and load





Load Sector

Load is a power required of or consumed by a circuit.

Customer Types of Load:

- Residential
- Commercial
- Industrial
- Others

2017 Percent Electricity Consumption*, (%)

CUSTOMERS	LUZON	VISAYAS	MINDANAO	PHILIPPINES
Residential	34	36	37	34
Commercial	34	16	16	29
Industrial	31	36	42	33
Others*	2	12	5	3



* Excluding Own-Use and Systems Loss

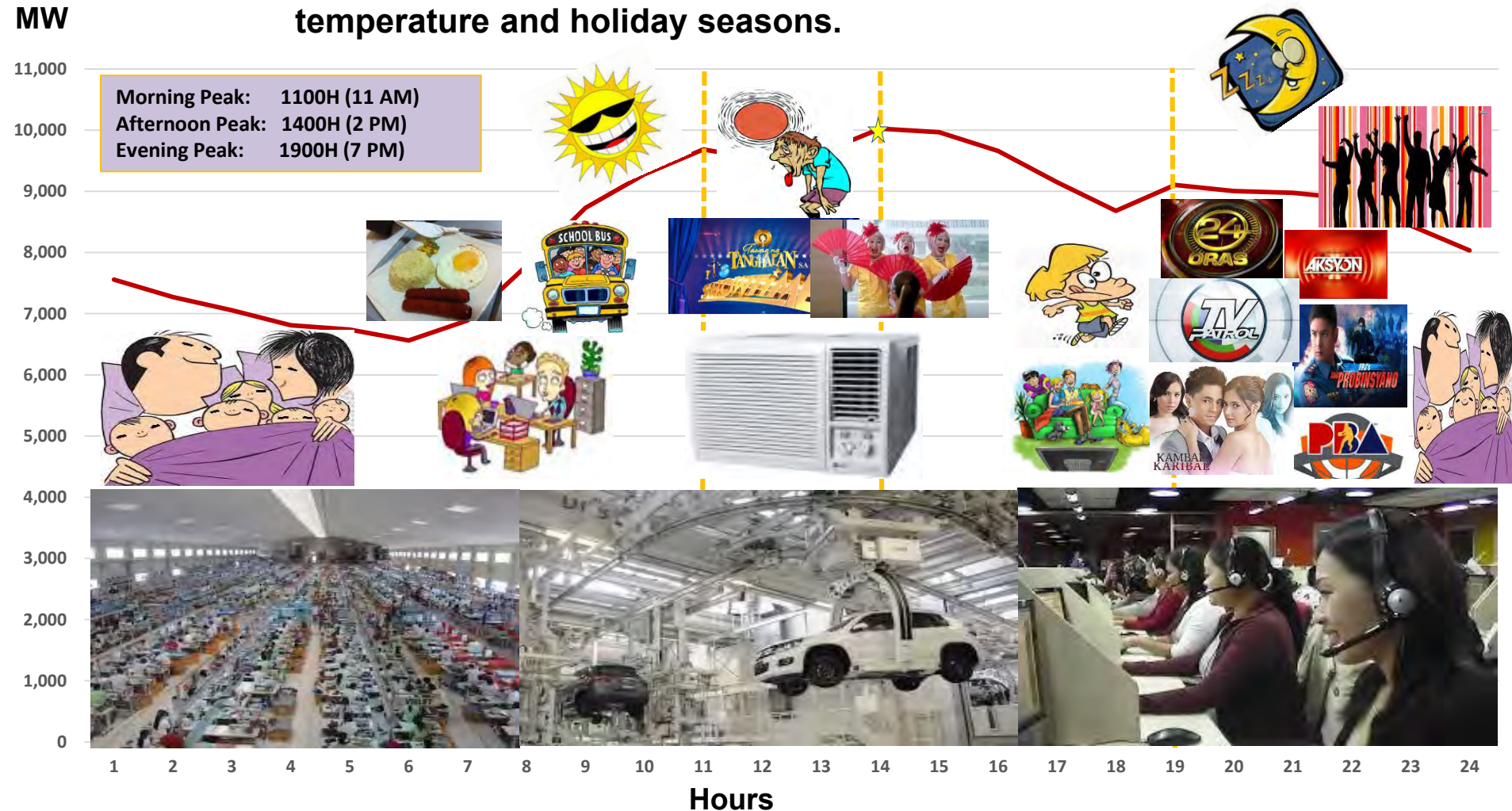
** Others includes public buildings, street lights, irrigation, energy recovered and others not elsewhere classified.





Typical 24-hour Load Profile

24 – HOUR LOAD PROFILE, a load profile is a graph of the variation in the electrical load versus time. A load profile will vary according to customer type (typical examples include residential, commercial and industrial), temperature and holiday seasons.

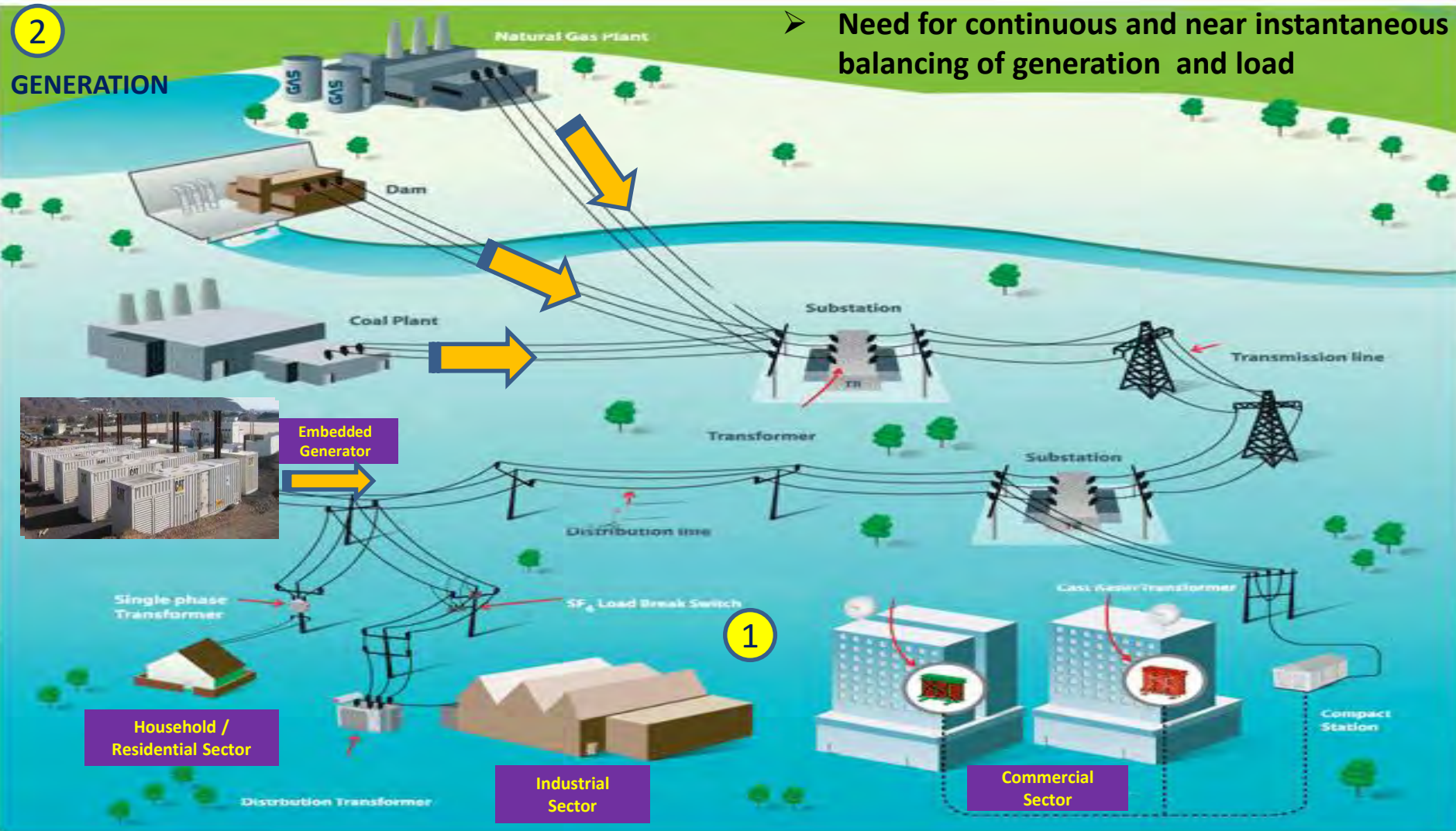


How the Power System Works

2

GENERATION

➤ Need for continuous and near instantaneous balancing of generation and load





Generation Sector



Fossil-based Power Plants

- Coal
- Natural Gas
- Oil-based
- Liquefied Natural Gas (LNG)
- Nuclear



Renewable Energy Power Plants

- Biomass
- Geothermal
- Solar
- Hydro
- Ocean / Tidal
- Wind





Generation Sector



Fossil-based Power Plants

- Coal
- Natural Gas
- Oil-based
- Liquefied Natural Gas (LNG)
- Nuclear

No existing facilities yet within the Philippines

Photo credits:

PEDC Coal-fired Power Plant

Ilijan Combined-Cycle Power Plant

Therma Marine Inc. – Nasipit Oil-fired Power Barge





Generation Sector



Renewable Energy Power Plants

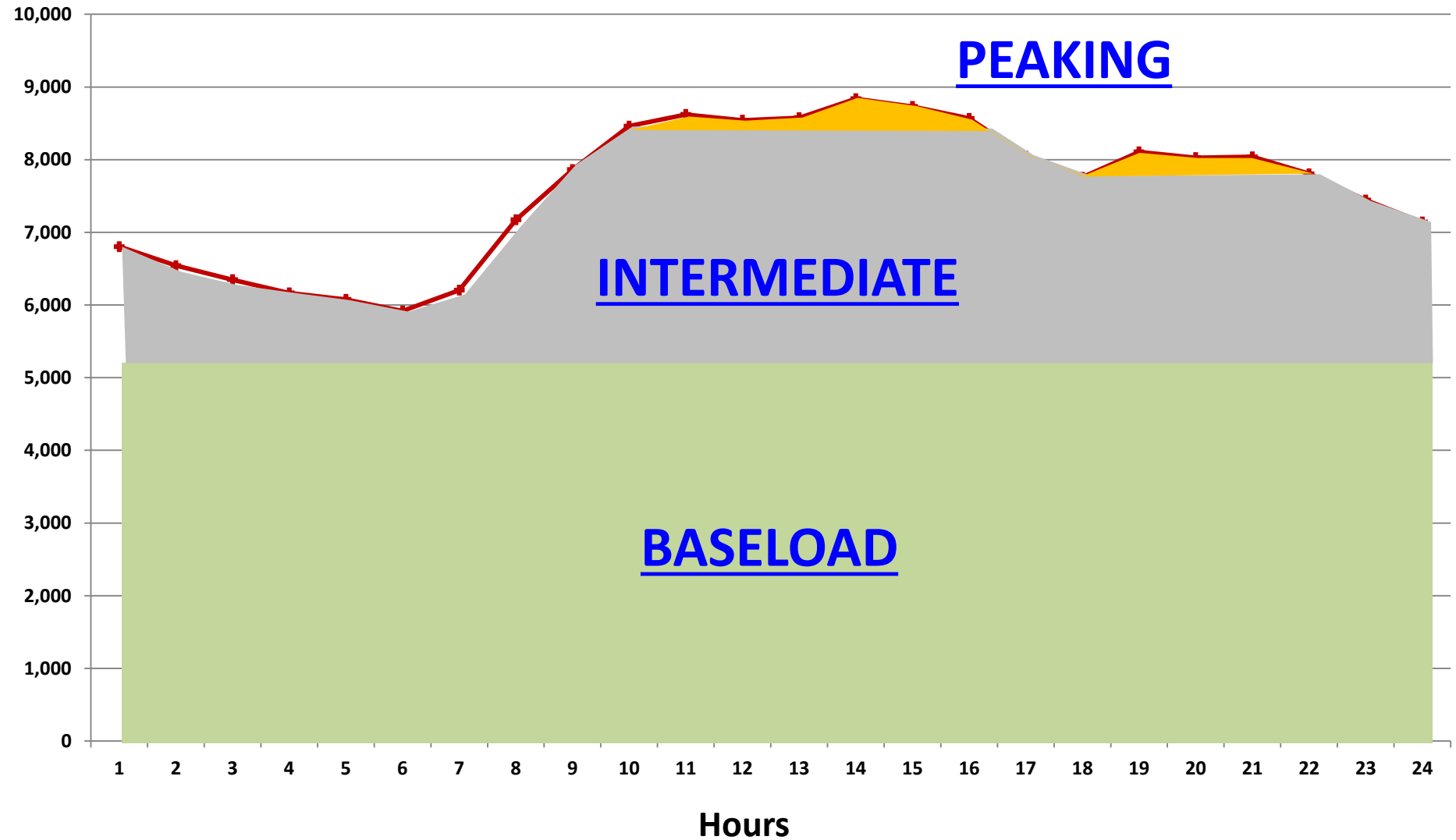
- Biomass
- Geothermal
- Solar
- Hydro
- **Ocean / Tidal**
- Wind

No existing facilities yet within the Philippines

Photo credits:
VMC Bagasse-fired Cogeneration Plant
Leyte Geothermal Production Field
Burgos Wind – EDC
Burgos Solar – EDC
Angat Hydroelectric Power Plant



Plant Operations



Plant Operations

Baseload Power Plants

- Plants which can generate **consistent power** to meet daily demand
- Produce **continuous, reliable and efficient power at low cost**
- **Run at all times** through the year except in the case of repairs or scheduled maintenance
- Capacity Factor at 67% and above
- Typically Coal, Biomass, and Geothermal Power Plants



2 x 315 MW AES Masinloc Coal-Fired Power Plant (Zambales)



20 MW Maibarara Geothermal Power Plant (Batangas)



2 x 647 MW TeaM Energy Sual Coal-Fired Power Plant (Pangasinan)



Plant Operations

Intermediate / Mid-merit load Power Plants

- **Fill the gap** between base load and peaking plants
- Compared to peaking plants, Intermediate/Mid-merit plants are larger so the construction costs are higher but their operational costs are cheaper.
- Also they **run more efficiently**
- Capacity Factor between 23% to 67%
- Natural Gas Power Plants



2 x 600 MW KEILCO Ilijan Natural Gas-fired Power Plant (Batangas)



First Gas Power Corp. 2 x 250 MW San Lorenzo and 4 x 250 MW Sta. Rita Natural Gas-fired Power Plant (Batangas)



Plant Operations

Peaking Power Plants

- Provide power **during peak system demand** periods
- **More responsive to changes** in electrical demand and can be **started up relatively quicker**
- **Expensive to operate** (for oil-based power plants due to usage of diesel/bunker oil as fuel)
- Capacity Factor below 23%
- Dam-type Hydro and Oil-Based Power Plants



242 MW TMI Therma Mobile Power Barges (Navotas)



235 MW 1590ec Bauang Diesel Power Plant (La Union)



4 x 90 MW SNAP Magat Hydroelectric Power Plant (Isabela)



Capacity Terms

Installed Capacity

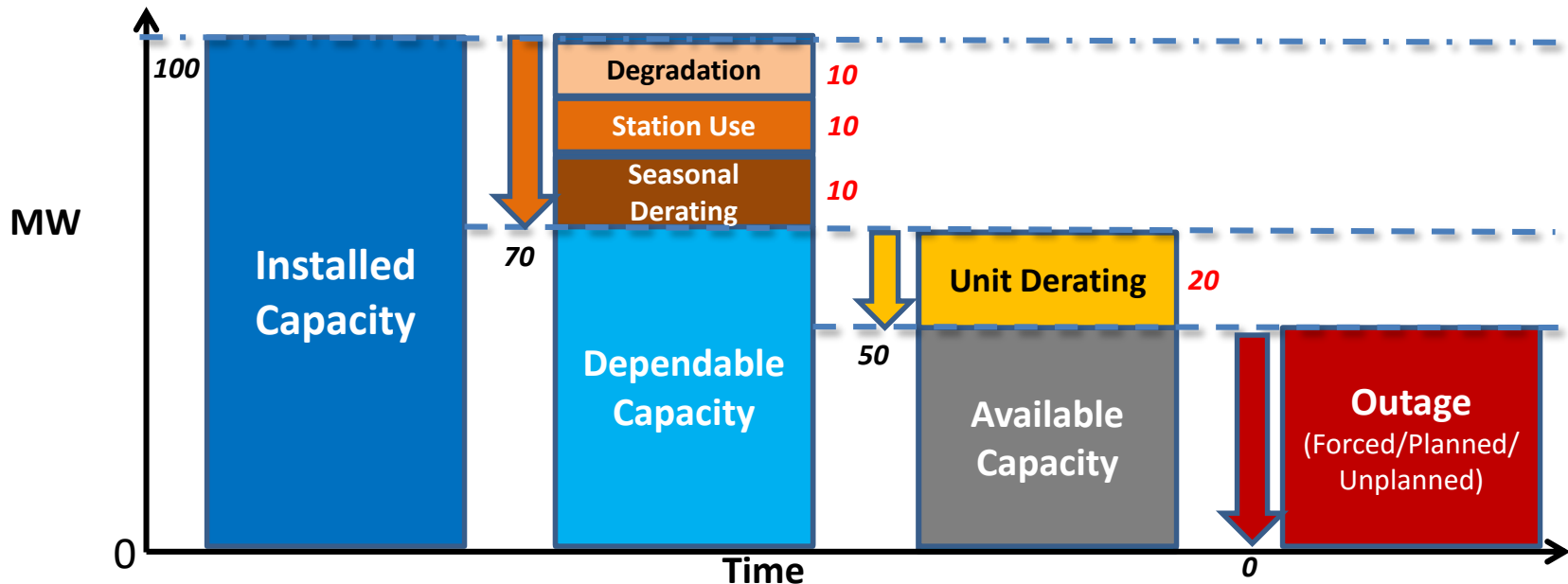
- Maximum amount of electricity that the power plant can produce
- The total manufacturer-rated capacity of equipment (as indicated in the nameplate)

Dependable Capacity

- The load carrying ability of an electric power plant or a generating unit
- The capacity that can be relied upon (monthly or annually)
- For Medium Term (MT) and Long Term (LT) Planning

Available Capacity

- The current available capacity of an electric power plant
- The ability of a power plant or a generating unit to produce electricity in a certain time period (hourly or daily)
- For Short Term (ST) planning



How the Power System Works

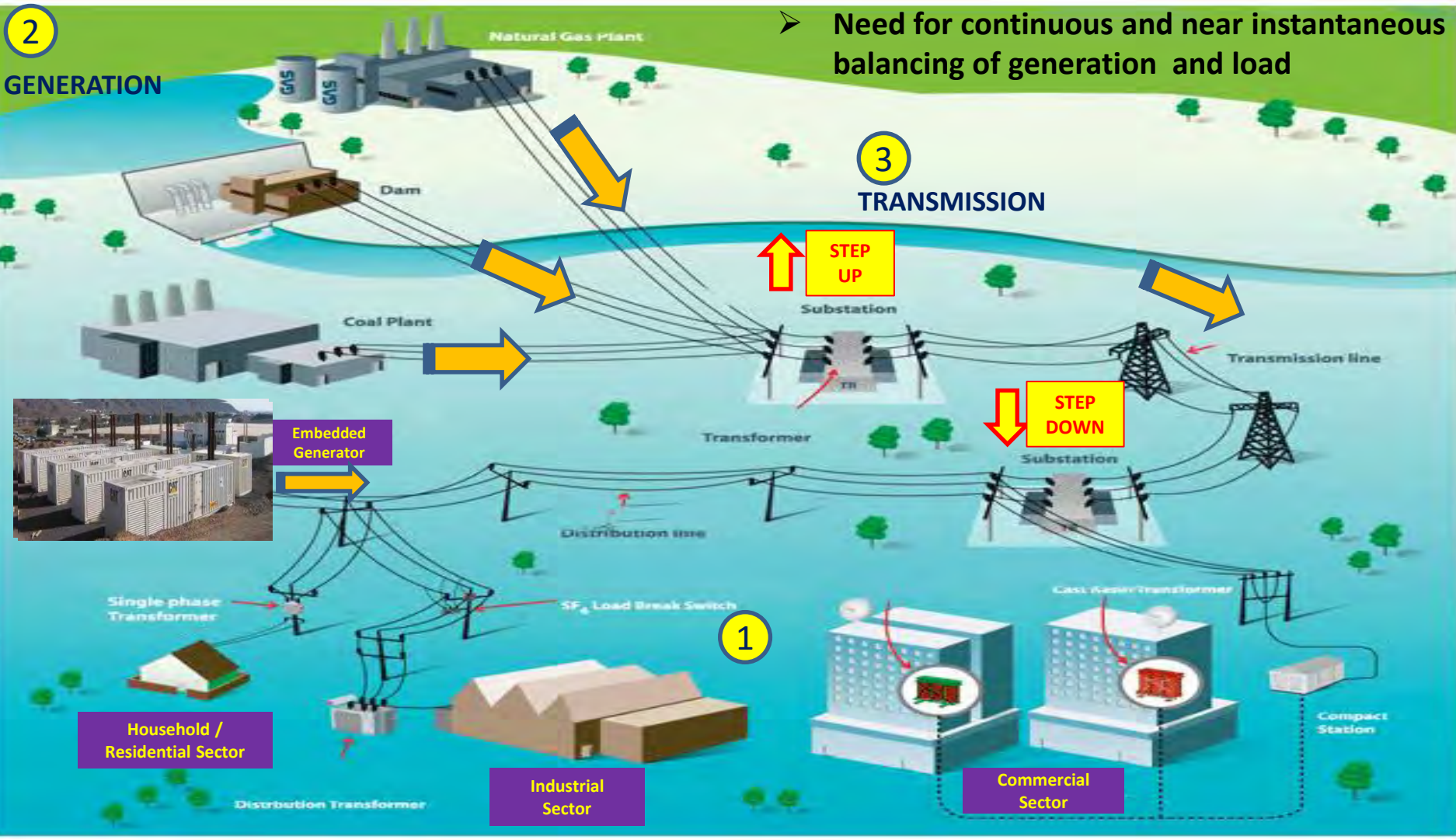
2

GENERATION

➤ Need for continuous and near instantaneous balancing of generation and load

3

TRANSMISSION





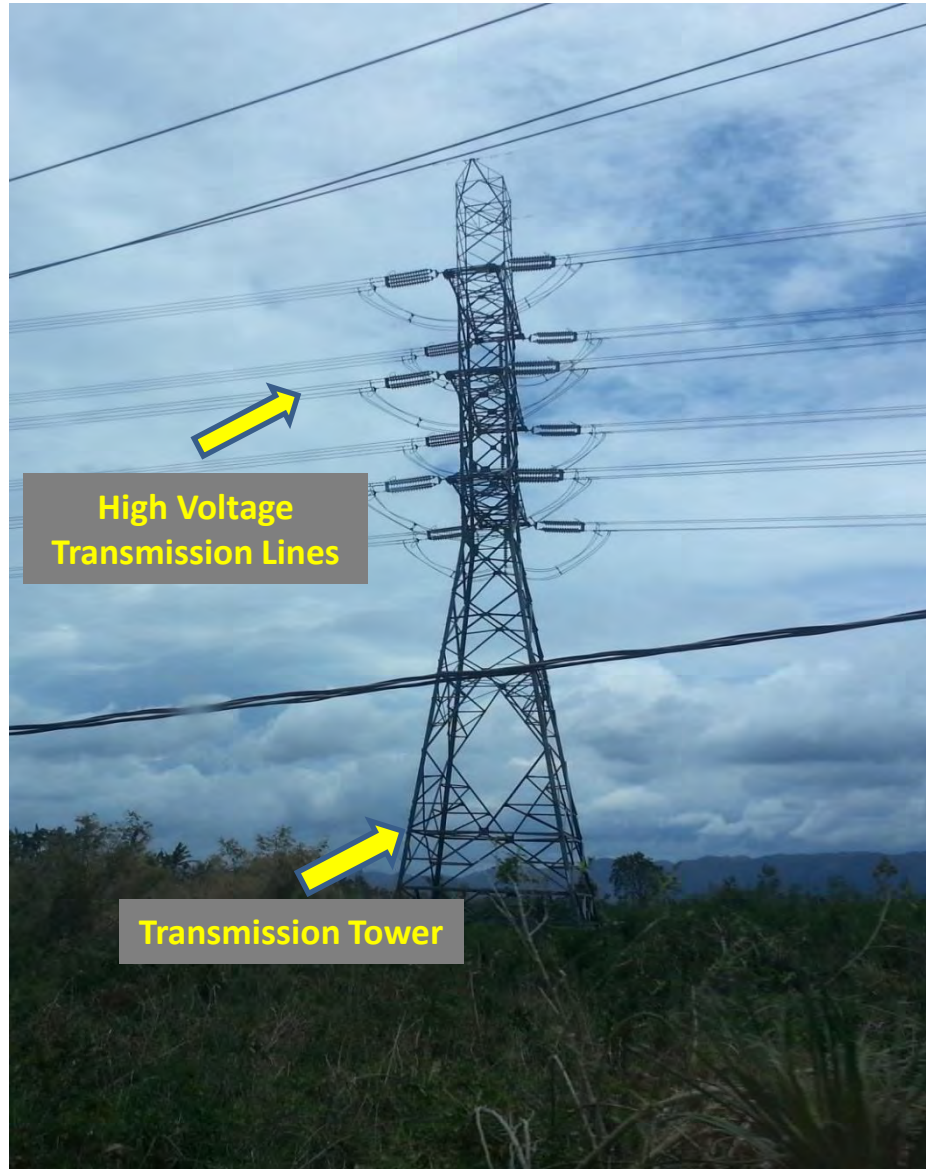
Transmission Sector

Thick wires on tall towers carry high-voltage electricity from power plants to local communities and connect one region to another.

Transmission Voltages

- **Luzon:** 500, 230, 138, 115, & 69 kV
- **Visayas:** 230, 138, & 69 kV
- **Mindanao:** 138 & 69 kV

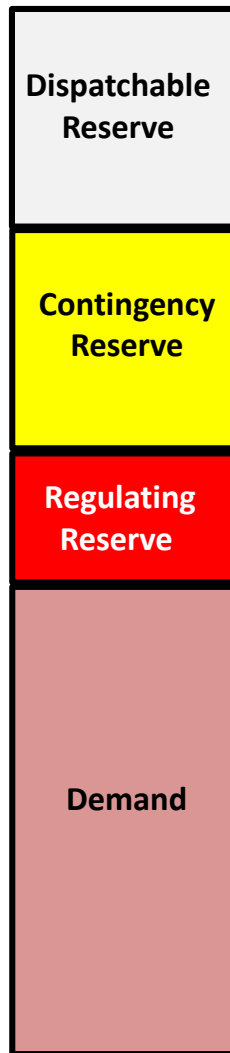
Note: 1 kiloVolt = 1,000 Volts



Reserve / Ancillary Service Requirements

TOTAL REQUIREMENT (DEMAND + RESERVE)

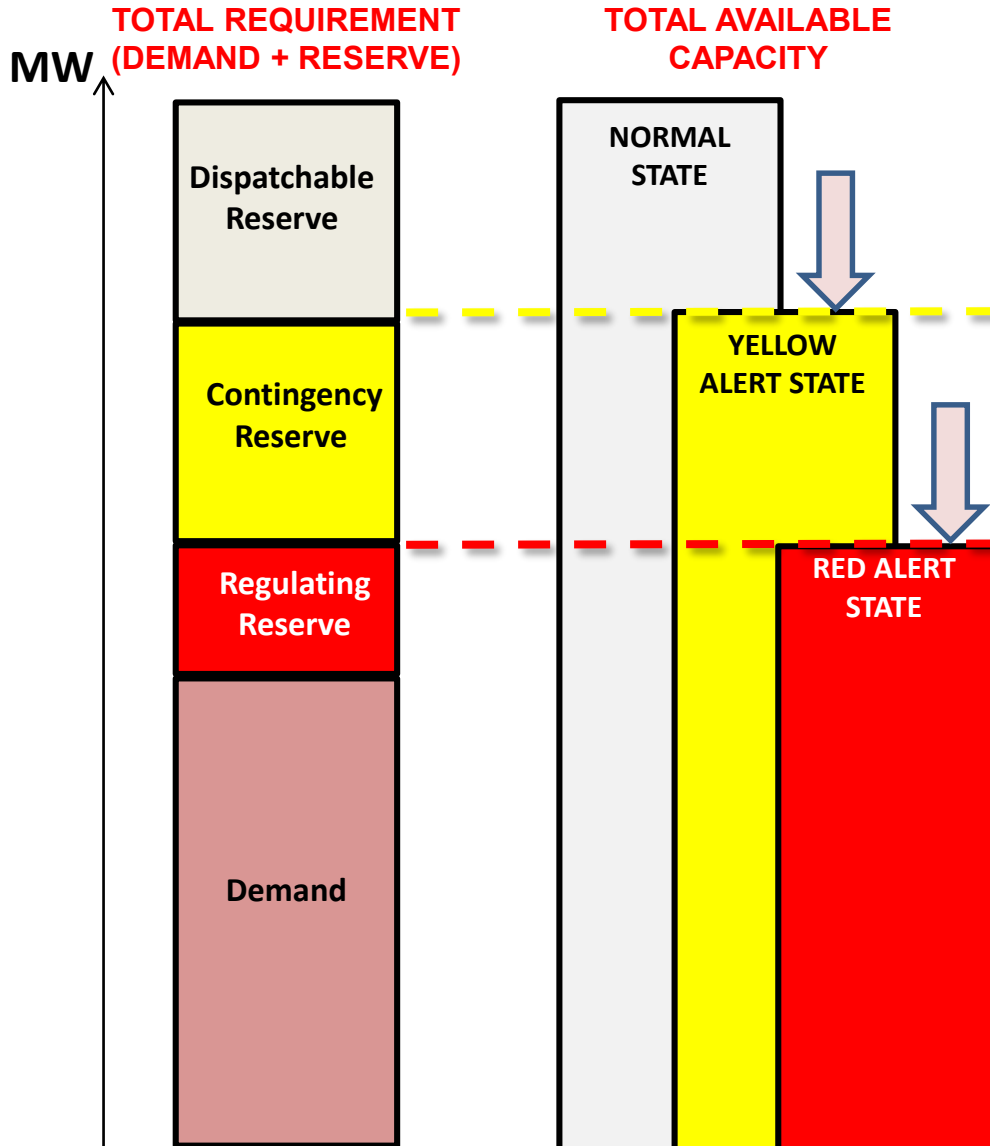
MW



- Generating capacity that is readily available for dispatch in order to replenish the Contingency Reserve Service whenever a generating unit trips or a loss of a single transmission interconnection occurs. (replaces Contingency Reserve)
- Equivalent to the the sum of the load of the second largest generating unit connected to the Grid
- Luzon = 647 MW, Visayas = 150 MW, Mindanao = 150 MW
- Synchronized generation capacity from Qualified Generating Units and Qualified Interruptible Loads allocated to cover the loss or failure of a synchronized generating unit or a transmission line or the power import from a single circuit interconnection, whichever is larger. (addresses forced outage)
- Equivalent to the the sum of the load of the largest generating unit connected to the Grid
- Luzon = 647 MW, Visayas = 135 MW, Mindanao = 150 MW
- Generating capacity that is allocated exclusively to cover inter- and intra-hour variations in demand (load behaviors), variations from generation schedules and hourly forecasts (regulation of frequency and voltage)
- Equivalent to the 4% of System Demand
- Total Demand of the System
- Includes Residential, Commercial, Industrial and Others (Street lights and public offices)
- Also includes non-utility customers (directly connected customers)



Grid Alert Levels / Notices

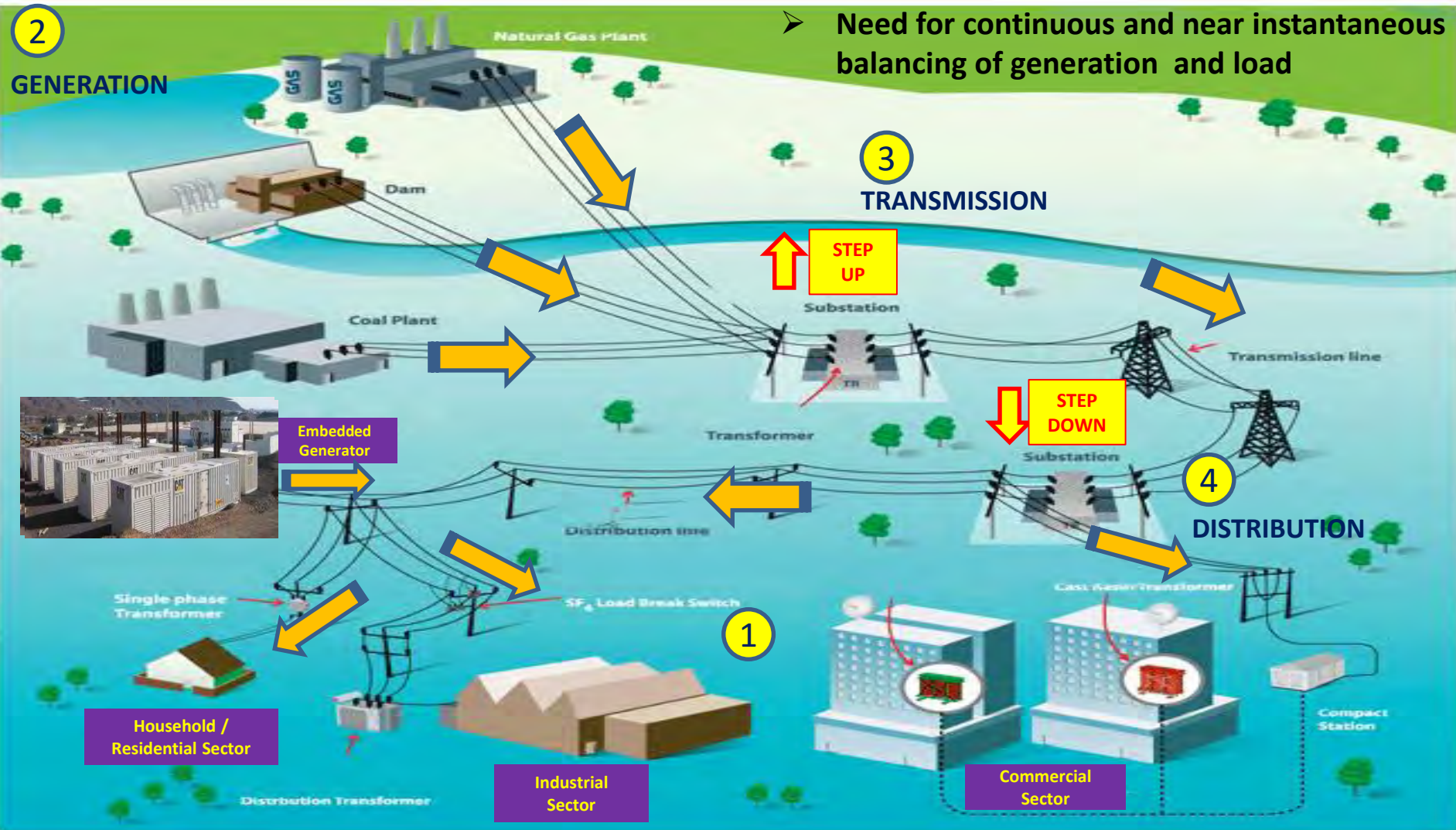


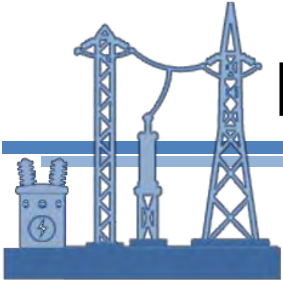
- Working within normal operating limits of System Frequency, Voltage and all transmission line and equipment loading
- Operating Margin is **SUFFICIENT**
- Grid Configuration allows for interruption and isolation of any fault current
- Contingency Reserve is **LESS THAN** the capacity of the Largest Synchronized Generating Unit of the grid
- Contingency Reserve is **ZERO**
- Generation deficiency exists
- There is Critical loading
- Imminent Overloading of transmission lines or equipment
- May lead to **Manual Load Dropping / Rotating brownouts**

Blue Alert
 A notice issued by the System Operator when a tropical disturbance is expected to make a landfall within 24 hours



How the Power System Works





Distribution Sector

Thinner wires on smaller towers or electric poles; carry much lower voltage power to homes, businesses and other load centers.

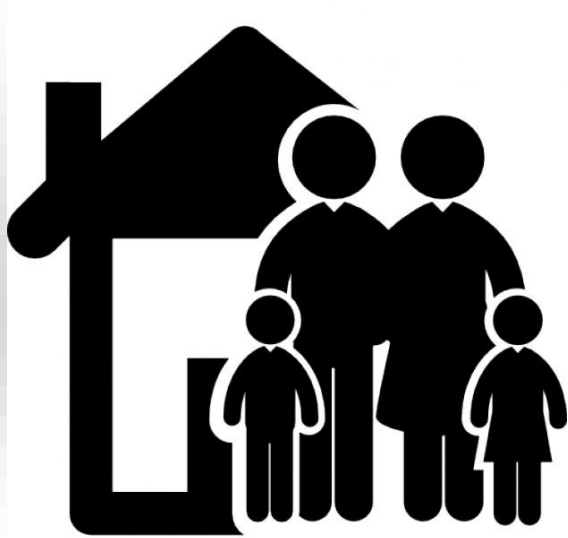
Distribution Voltages

- Primary : 4.16 kV, 13.8 kV, 34.5 kV, 69 kV
- Secondary: 110/115 or 220/230 V

Note: 1 kiloVolt = 1,000 Volts



Terminologies



Brownout: Reduced voltage in certain areas which may result in flickering of lights and/or damage to equipment/appliances.

Power interruption: Loss of electric power in a specific area. May be scheduled for service improvements, or unscheduled due to emergencies.

Blackout: Total or partial system collapse in the power grid.





Thank You!



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