Maximizing Power & Efficiency with the Right Energy Mix: Combined Heat & Power (CHP) and Distributed Power (DP)

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SMX Convention Center
Pasay City, Philippines
20-22 October 2016
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Thank you.
Introduction
Introduction

- **Law of Conservation of Energy**
  Energy cannot be created nor destroyed, but can be changed from one form to another.

- **Forms of Energy**
  - Kinetic
  - Nuclear
  - Chemical
  - Mechanical
  - Thermal (Heat)
  - Solar
  - Sound
  - Magnetic
  - Ionization
  - Gravitational
  - Potential
  - Wind
  - Electrical
  - Radiant
  - Elastic
  - Intrinsic
  - Ionization
  - Hydro

Chapter 1

Thermal, Mechanical & Electrical Losses
Energy Conversion

Energy Balance: Energy In = Energy Out

Chemical [Fuel as Energy In]
- Coal
- Diesel
- Bunker
- Natural Gas
- Biogas
- Landfill Gas
- LPG

Thermal (Combustion)
- Steam Boiler
- Gas Turbine
- Reciprocating Engine

Mechanical (Equipment)
- Steam Turbine
- Gas Turbine / Compressor
- Reciprocating Engine

Electrical (Gross) [Before the Meter]
- Generator

Electrical (Net) [After the Meter]

Electrical [Useful Energy]
- Residential
- Commercial
- Manufacturing Plants

Thermal Losses
- Thermal or Heat (Exhaust Gases)
- Radiation

Mechanical Losses
- Mechanical (Friction and Wear)
- Thermal or Heat (Condenser Cooling System)
- Radiation

Electrical Losses
- Generator Losses
- Parasitic Load
- Radiation

System Energy Losses
- Conductor Resistance (Transmission Lines, Distribution Lines and Substations)
- Core Losses of Transformers
- Uncalibrated Meters
- Pilferage

Sample energy balance of conversion of energy for power plants
Coal-Fired/HFO-Fired Power Plant Process Flow

**Fuel:**
Coal
Heavy Fuel Oil (Bunker Oil)

**Energy Input = 100%**

**Thermal, Mechanical & Electrical Losses = 65%**

**Gross Electrical Energy = 35%* **

*Note: Brand New Power Plants*
Sample Coal-Fired/HFO-Fired Power Plants

Sual Coal Fired Power Plant

Sucat Oil Fired Power Plant
Combined-Cycle Power Plant Process Flow

**Thermal, Mechanical & Electrical Losses = 40%**

**Fuels:**
- Natural Gas
- Diesel
- Kerosene

**Energy Input = 100%**

- *Note: Brand New Combined Cycle Power Plants*

**Gross Electrical Energy = 35%**

**Total Gross Electrical Efficiency = 60%**

**Gross Electrical Energy = 25%**
Sample Combined-Cycle Power Plants

San Lorenzo Combined Cycle Power Plant

Ilijan Combined Cycle Power Plant
Combined Heat & Power (CHP) Process Flow

**Fuels:**
- Natural Gas
- Biogas, LPG

**Applications:**
- Hot Water

**Users:**
- Commercial Establishments
- Manufacturing Plants

**Energy Input = 100%**

**Net Electrical Energy = 40%**

**Net Thermal Energy = 45%**

**Total Net Efficiency = >85%**

**Thermal, Mechanical & Electrical Losses = 15%**
Combined Power & Chilled Water

**Thermal, Mechanical & Electrical Losses = 30%**

**Fuels:**
- Natural Gas
- Biogas, LPG

**Energy Input = 100%**

**Total Net Efficiency = >70%**

**Net Electrical Energy = 40%**

**Net Chilled Water = 30%**

Gas Engine Generator Cogeneration Set

Cooling Tower

Absorption Chiller (Double Effect)
Sample Combined Heat & Power (CHP)

2x 1.4MW Biogas Power Plant with Heat Recovery, Containerized Version, Del Monte, Cagayan de Oro
Chapter 2

System Energy Losses
Energy Conversion

Energy Balance: Energy In = Energy Out

Chemical [Fuel as Energy In]
- Coal
- Diesel
- Bunker
- Natural Gas
- Biogas
- Landfill Gas
- LPG

Thermal (Combustion)
- Steam Boiler
- Gas Turbine
- Reciprocating Engine

Mechanical (Equipment)
- Steam Turbine
- Gas Turbine / Compressor
- Reciprocating Engine

Electrical (Gross) [Before the Meter]
- Generator

Electrical (Net) [After the Meter]

Electrical [Useful Energy]
- Residential
- Commercial
- Manufacturing Plants

Thermal Losses
- Thermal or Heat (Exhaust Gases)
- Radiation

Mechanical Losses
- Mechanical (Friction and Wear)
- Thermal or Heat (Condenser Cooling System)
- Radiation

Electrical Losses
- Generator Losses
- Parasitic Load
- Radiation

System Energy Losses
- Conductor Resistance (Transmission Lines, Distribution Lines and Substations)
- Core Losses of Transformers
- Uncalibrated Meters
- Pilferage

Sample energy balance of conversion of energy for power plants
NGCP System Energy Loss = 2.98%

North Luzon Stakeholders
District 1 and 2 (Generators), Le Monet Hotel
Date: February 22, 2013

1. **Reduction of Line Loss.** One of DECORP’s questions is if there will be reduction on the 2.98% line loss. NGCP clarified that it regularly provides updates to ERC on the recorded monthly Transmission System Loss. Also, it clarified that the 2.98% loss factor is being uniformly applied by NGCP to all its customers in Luzon for billing purposes. This does not affect NGCP’s revenue.

Meralco system loss
Consistent reduction = Savings to customers*

System Loss Cap

11.10 10.21 10.10 9.65 9.28 8.61 7.94 7.35 7.04 6.92 6.49

Meralco Energy
System Loss = 6.49%

*Since 2008, a total of P16.8Bn or equivalent to 7.88¢/kWh

Electric Cooperatives’ System Loss (According to NEA)

The Electric Cooperatives (ECs) being supervised by the National Electrification Administration (NEA) posted an average record low of 11.12% in 2015, a reduction of 0.55% from the 11.07% in 2014 and 1.88% lower than the 13% cap set by the Energy Regulatory Commission (ERC). The reduction in system loss has an equivalent savings of 71,258,654.01 kWh or about Php488 million for ECs’ member-consumers.

NEA Officer-In-Charge Sonia B. San Diego said, “Strategic interventions are being carried out to reduce system loss of the electric cooperatives for them to be operationally efficient and be of better service to their member-consumers. Lower system loss could also mean lower cost of electricity rates.”

The cost savings is the combined application of the national average system loss ratio of 60% technical

Chapter 3

Offer vs Demand Energy Losses
Source: WESM 05 to 11 May 2014 Report, www.wesm.ph
Hourly Load Profile of Electricity Offer & Demand for Luzon

Energy losses are huge as big power plants can’t be shutdown for a short period of time and are still operating early in the morning even with less demand.

Very low demand from 1 to 7 AM
# Daily Summary of Electricity Offer & Demand for Luzon

<table>
<thead>
<tr>
<th>DATE</th>
<th>OFFER, MW</th>
<th>RTD DEMAND, MW</th>
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<tbody>
<tr>
<td></td>
<td>MIN</td>
<td>AVE</td>
</tr>
<tr>
<td>May-05</td>
<td>8,451</td>
<td>9,031</td>
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<tr>
<td>May-06</td>
<td>8,870</td>
<td>9,204</td>
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<td>May-07</td>
<td>8,991</td>
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<td>9,157</td>
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<td>May-10</td>
<td>8,778</td>
<td>9,384</td>
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<tr>
<td>May-11</td>
<td>8,996</td>
<td>9,346</td>
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<tr>
<td></td>
<td>8,451</td>
<td>9,245</td>
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</tbody>
</table>

**Losses = 1,003MW**

**Offer vs Demand Energy Losses = 10.8%**
Chapter 4

Summary of Energy Losses
**NatGas: Energy Distribution of Centralized Power Generation**

1. **Energy Input = 100%**
   - (Natural Gas Fuel)

2. **Electrical Energy Output (Gross) = 55%**
   - (Old Combined Cycle Power Plants in Batangas)

3. **Losses = 45%**
   - (Thermal, Radiation, Friction, Parasitic Load)

4. **NGCP System Loss = 2.5%**
   - (Conservative)

5. **EC System Loss = 9%**
   - (Conservative)

6. **Available & Useful Electrical Energy (Net) [Before Meter] = 38%**
   - 55% Less 10% (Offer vs Demand Losses) of 55% = 49.5%
   - 49.5% minus 11.5% System Losses = 38%

**Total Energy Loss = 62%**
Coal: Energy Distribution of Centralized Power Generation

1. Energy Input = 100% (Coal Fuel)

2. Electrical Energy Output (Gross) = 35% (New Coal Fired Power Plants in Batangas)

3. Losses = 65% (Thermal, Radiation, Friction, Parasitic Load)

Total Energy Loss = 80%

Available & Useful Electrical Energy (Net) [Before Meter] = 20%
- 35% Less 10% (Offer vs Demand Losses) of 35% = 31.5%
- 31.5% minus 11.5% System Losses = 20%

NGCP System Loss = 2.5% (Conservative)
Distributed Power Plants are small power plants at/or near the point of use or consumption. Generating power on-site, rather than centrally, eliminates the cost, complexity, interdependencies, and inefficiencies associated with transmission and distribution. Thus, system losses are eliminated. Other terminologies are ‘embedded’ and ‘decentralized’ power plants.
Three Waves of Power Innovation

Wave 1
Year 1880-1910

The Distributed Power Era
Small distributed power plants provided electricity to local customers through DC power lines.

Wave 2
Year 1910-2000

Centralized Power Period
Economies of scale drive increasingly large power plants, eventually exceeding 1000 MW.

Wave 3
Year 2000+

Return of Distributed Power
Innovative technologies and growing R&D and fuel networks usher in a new distributed power era.

Source: General Electric
If small power plants are imbedded inside the manufacturing plants and commercial establishments, no need to pay the grid & distribution charges, other charges and taxes, thus SAVINGS!
## Comparative Analysis: CO2 Emission of Different Fuel

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>CO2 Emission (lb CO2 / mBtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal (anthracite)</td>
<td>228.6</td>
</tr>
<tr>
<td>Coal (bituminous)</td>
<td>205.7</td>
</tr>
<tr>
<td>Coal (lignite)</td>
<td>215.4</td>
</tr>
<tr>
<td>Coal (subbituminous)</td>
<td>214.3</td>
</tr>
<tr>
<td>Diesel fuel and heating oil</td>
<td>161.3</td>
</tr>
<tr>
<td>Gasoline</td>
<td>157.2</td>
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<tr>
<td>Propane</td>
<td>139.0</td>
</tr>
<tr>
<td>Natural gas</td>
<td>117.0</td>
</tr>
</tbody>
</table>

*Source: https://www.eia.gov/tools/faqs/faq.cfm?id=73&t=11*
Comparative Analysis: ‘Coal’ Versus ‘CHP & DP’

**NatGas CHP & DP**  (85% Efficiency)  
**Coal Fired Power Plant**  (35% Efficiency & Sub-Bituminous Coal)

- **Same Useful Energy Output**
- **Energy Input in MW**: 100, 118
- **Estimated Investment Cost in Million US$**: 100, 200
- **Equivalent Tons of CO2 Emission per Hour**: 21, 167
- **Power Plant Construction Period in Months**: 12, 36

- **Input is 4.25 times for the same Energy Output**
- **Double the Investment Cost (using clean coal technology)**
- **7.78 times CO2 Emission**
- **3 times Construction Period**
Natural Gas Produces Lower CO2 Emission

MANUFACTURING INDUSTRY & COMMERCIAL ESTABLISHMENTS:

More than 87% CO2 reduction thru:
- Distributed Power
- Cogeneration (or CHP)
- Trigeneration
- Quadgeneration

2 units 1.4 MW CHP & DP at Del Monte using Biogas
Chapter 5

Challenges from Fluctuating Renewable Energy from Wind and Solar
Challenge: Fluctuating Renewable Energy from **Wind**

**Location:** Bangui Windmills, Ilocos Norte
**Date:** 29-31 August 2016

**Wind Gusts @ 1:00AM:**
- **33 knots** Maximum
- **15 knots** Minimum

**Difference:** 18 knots or 45% Fluctuation in 2 days

**Source:** [http://www.windguru.cz/](http://www.windguru.cz/)
Challenge: Fluctuating Renewable Energy from Solar

Big power plants will not shut-down even when solar power can provide 100% electricity. Meaning, we still pay the energy production of big power plants.

Small distributed power plants are flexible and can be modulated or be simply shutdown when not needed, thus energy losses are reduced.

Challenge: Fluctuating Renewable Energy from both Wind & Solar

Flexibility Instead of Just Base Load: “The New Role of Bioenergy”

Red: Demand in Germany (2010)
Green: Production of Wind & Solar (80% RE Sources)

- Flexible Systems – fill the valleys of the wind and solar energies
- CHP – with Bioenergy and Natural Gas
- Distributed Power

Chapter 6

Advantages of Distributed Power
Advantages of Distributed Power

- Flexible and Modular Operation (also for Ancillary Power):
  - Can operate as baseload, 24/7 operation
  - Can operate as peaking power plant
  - Can be modulated or be simply shutdown when not needed, thus can reduce losses (by filling the valleys with wind and solar energies)

![Graph: Demand in German (2010) vs Production of Wind & Solar (80% RE Sources)]
Advantages of Distributed Power

- Higher Efficiency thru:
  - Cogeneration or Combined Heat & Power (CHP)
  - Trigeneration
  - Quadgeneration
  - Reduced or even eliminated System Energy Losses

The higher the efficiency, the lower the carbon footprint, thus more environmental-friendly.
Advantages of Distributed Power

- **Other Advantages:**
  - Scalable power that grows with demands
  - Affordable technology
  - Reduces or even eliminates costly electrical transmission networks
  - Shorter unit delivery schedule thus electricity can be produced in less than 1 year upon order
  - Provides clean electricity [*Clean electricity is electrical power that is free from voltage spikes and drops*]
  - Smart Grid Capable
Advantages of Distributed Power

• Other Advantages:
  • Remote Monitoring and Diagnostic Solution
Other Advantages (fuel flexibility):

- Engine automatically adjusts itself in case the source of gas changes from low methane content (biogas) to high methane content (LNG) or vice versa.
- Since small gas engines can handle different percentage content of methane; different fuels, e.g., purified biogas and synthetic or substitute natural gas (SNG), can be injected or blended with the natural gas.
Other Advantages:

- Can operate on ‘Island-Mode’ in case grid is not available, e.g., regular maintenance, natural calamities

Small 1MW natural gas power plant in Bogo, Cebu, which is imbedded within CEBECO 2 Distribution Line.

This power plant has survived the 315 km/h maximum sustained wind of Typhoon Yolanda last November 2013. And this can operate on an ‘Island-Mode’ in case the grid is damaged by natural calamities.
Chapter 7

Supporting Slides
Sample Efficiency Calculation

Efficiency = \frac{\text{Useful Energy}}{\text{Energy Input}} \times 100%  

Where:
Useful Energy = Energy Input Less Losses

Electrical Efficiency = \frac{\text{Electrical Output}}{\text{Energy Input}} \times 100% 

(Generator Sets)

Thermal Efficiency = \frac{\text{Thermal Output}}{\text{Energy Input}} \times 100%  

(Steam or Hot Water Boiler)

Total Efficiency = \frac{\text{Electrical + Thermal Outputs}}{\text{Energy Input}} \times 100%  

[Combined Heat & Power (CHP)  
or Cogeneration ~85%]
Economics & Energy Balance of Heat Recovery

Annual Coal Consumption **without** Heat Recovery Plant = P103+ million

*(based on year 2014 values)*
**Economics & Energy Balance of Heat Recovery**

- **Annual Coal Consumption** with Heat Recovery Plant
  - $= P94+ \text{ million}$

- **Annual Fuel Savings**
  - $= P9+ \text{ million}$
  - $\times 2 \text{ units}$
  - $= P18+ \text{ million}$ (based on year 2014 values)

- **Almost 9% Coal Reduction**

- **Biogas CHP Plant**

- **Heat Recovery System to preheat boiler feedwater**

**Existing Manufacturing Plant in Cagayan de Oro**
Combined Power & Heat (Hot Water)

**Fuels:**
- Natural Gas
- Biogas
- LPG

**Energy Input**
- Gas Engine Generator
- Cogeneration Set

**Exhaust**
- Exhaust Gas
- Heat Exchanger

**Decoupling Heat Exchanger**

**Heat Recovery System**

**Energy Output**
- Hot Water
- Electrical Energy

**Users:**
- Hospitals
- Hotels
- Manufacturing

**Cogeneration:** One Energy Input – Two Energy Outputs
Combined Power & Heat (Steam)

**Fuels:**
- Natural Gas
- Biogas
- LPG

**Energy Input**
- Gas Engine Generator Cogeneration Set
- Decoupling Heat Exchanger
- Heat Recovery System
- Boiler Feed Water

**Output:**
- **Steam**
- **Electrical Energy**

**Users:**
- Hospitals
- Hotels
- Manufacturing

**Cogeneration:** One Energy Input – Two Energy Outputs
Combined Power & Chilled Water

**Fuels:**
- Natural Gas
- Biogas
- LPG

**Energy Input**
- Gas Engine Generator
- Cogeneration Set

**Cogeneration: One Energy Input – Two Energy Outputs**

**Exhaust**

**Cooling Tower**

**Chilled Water**

**Absorption Chiller**

**Users:**
- Hospitals
- Hotels
- Malls
- Office Buildings
- Manufacturing
Combined Power, Heat & Chilled Water

**Fuels:**
- Natural Gas
- Biogas
- LPG

**Energy Input**
- Gas Engine Generator Cogeneration Set
- Decoupling Heat Exchanger

**Energy Outputs**
- Electrical Energy
- Chilled Water
- Hot Water

**Trigeneration:** One Energy Input – Three Energy Outputs
**Combined Power, Heat & CO2 Recovery**

**Fuels:**
- Natural Gas
- Biogas
- LPG

**Energy Input**
- Gas Engine Generator Cogeneration Set

**CO2 Recovery**

**Energy Outputs**
- Electrical Energy
- Hot Water
- Liquid CO2

**Trigeneration**: One Energy Input – Three Energy Outputs
Combined Power, Chilled Water & CO2 Recovery

**Fuels:**
- Natural Gas
- Biogas
- LPG

**Energy Input**

Gas Engine Generator Cogeneration Set

**Decoupling Heat Exchanger**

CO2 Recovery

Liquid CO2

**Cooling Tower**

Absorption Chiller

**Chilled Water**

**Electrical Energy**

**Exhaust**

**Trigeneration:** One Energy Input – Three Energy Outputs
Combined Power, Heat, Chilled Water & CO2 Recovery

**Fuels:**
- Natural Gas
- Biogas
- LPG

**Energy Input**

- Gas Engine Generator
- Cogeneration Set

**Exhaust**

**CO2 Recovery**

**Liquid CO2**

**Cooling Tower**

**Chilled Water**

**Hot Water**

**Electrical Energy**

**Decoupling Heat Exchanger**

**Quadgeneration:** One Energy Input – Four Energy Outputs
Distributed Power Technology Continuum

Source: General Electric, 2012 Global installations (MW)
Biogas Power Plants in Germany

Source: German Renewable Energy Federation
http://www.bee-ev.de/english/
Partial List of Distributed Power Today in the Philippines

- **Green Future Innovation**, Isabela
  3x 1.0 MW JMS320 CHP, Biogas

- **URC RF12**, San Miguel, Bulacan
  2x 0.5 MW JGS312, Biogas

- **Asian Carbon**, Capas, Tarlac
  3x 1.0 MW JGS320, Biogas

- **Bacavalley Energy**, San Pedro, Laguna
  4x 1.0 MW JGC320, Landfill Gas

- **Pig City**, Cavite
  1x 1.0 MW APG1000 CHP, Biogas

- **Aseagas**, Lian, Batangas
  4x 1.4 MW JGS420 and
  3x 1.0 MW JGS320, Biogas

- **DESCO**, Libertad, Bogo, Cebu
  1x 1.0 MW JGC320, Natural Gas

- **Marcella Farm**, Bohol
  1x 0.5 MW L36GLD, Biogas

- **Del Monte**, Cagayan de Oro
  2x 1.4 MW JMC 420 CHP, Biogas
Partial List of Distributed Power Today

Philippines has more than 28MW+ distributed gas-fired power plant and most of them are using biogas fuel.

~37,000 Units Installed Base • 82 GW of Capacity • >170 Countries
Climate Change is Here!

Duterte tells Cabinet in first meeting: Climate change is here

Published June 30, 2016 4:48pm

In his first meeting with his Cabinet on Thursday, President Rodrigo Duterte underscored the effects of climate change in the Philippines.

"Climate change is here. We were warned several years ago," he said.

The Cabinet meeting, held at the Aguinaldo State Dining Room in the Malacañan Palace, tackled the status of disaster risk reduction and management in the country.

Duterte set the tone for the meeting by sharing his experience during Super Typhoon Yolanda in 2013 in Leyte, his birthplace.

He said that during disasters, water is the most important need that should be addressed as soon as possible.
Policies in Reducing the Impact of Climate Change

Office of the President
Climate Change Commission

Source: http://climate.gov.ph/

DENR

Source:
Compliments with other Government Policies

Policies in Reducing the Impact of Climate Change

NEDA

PHL vows to cut emissions by 70% by 2030

Reference:
Compliments with other Government Policies

DOE’s Policies in Reducing the Impact of Climate Change and More Secured Energy

DOE – sets 30% gas share in energy mix

DOE – Promotion on Low Carbon Future & to ensure a more Secured Energy


CHP Incentives in UK & China

Reference: https://www.gov.uk/guidance/combined-heat-and-power-incentives

CHP Incentives in USA

Reference: https://www.epa.gov/chp/dchpp-chp-policies-and-incentives-database

Reference: http://www.bgesmartenergy.com/business/chp
CHP Incentives in USA

Reference: http://energy.gov/eere/femp/energy-incentive-programs-massachusetts

Energy Incentive Programs, Massachusetts

Updated August 2015

Massachusetts budgeted over $680 million in 2014 to promote energy efficiency in the state.

What public-purpose-funded energy efficiency programs are available in my state?

Comprehensive legislation on electricity restructuring includes a non-bypassable systems benefit charge of roughly 2.5 mills/kWh for energy efficiency programs. The public benefit funding was augmented, starting in 2009, by Massachusetts’ portion of proceeds from both the ISO-New England Forward Capacity Market (see below in the load management/demand response section) and the northeastern states’ Regional Greenhouse Gas Initiative (RGGI).

The energy efficiency programs are administered by Mass Save, an entity contracted by Berkshire Gas, Blackstone Gas Company, Cape Light Compact, Columbia Gas of Massachusetts, Liberty Utilities, National Grid, Eversource, and Unitil. Mass Save is intended to serve as a "one stop shop" for electric and gas efficiency programs offered by these utilities. The range of rebates and technical assistance through the initiatives is broad. For information on offerings for your area, visit the Mass Save website, where you can search for programs by location and by equipment type.

Reference: http://www.nyserda.ny.gov/All-Programs/Programs/IPE-Data-Centers
CHP Incentives in Korea & Singapore

Energy is rising on the agenda of the government of the Republic of Korea (ROK) as it tries to reconcile economic growth with increasing energy prices and stricter environmental targets. The government works closely with research institutes and private companies in creating policy, and developing new energy technologies to achieve these aims. Combined heat and power (CHP) is firmly embedded in energy policy, largely through its application in district heating and cooling (DHC). The government already supports CHP through its planning policy and tax incentives, and further measures are under development.

Source: https://www.iea.org/media/topics/cleanenergytechnologies/chp/profiles/Korea.pdf
Conclusion & Recommendation
Global Temperature & CO2 Emission on the Rise

In combination with Renewable energy, the CHP & DP are the low hanging fruits in cutting CO2 emission by 70% by year 2030.

Source: http://www.climate4you.com/GreenhouseGasses.htm
DOE’s Proposed NatGas Pipeline Strategic Infrastructure

- Pipelines
  - 423 kms of Transmission
  - 504 sq. kms. of Distribution
- Gas-fired Power Plants
- 3000 MW of Greenfield
- 600 MW of Conversion

- Gas in Industry
  - 30 Ecozones in Calabarzon
  - Subic and Clark
- Cogeneration Systems

- Gas in Buildings
- Cogeneration Systems
- District Cooling
- Gas in Transport
  - 10,000 units of CNG Vehicles
  - Refilling Stations
  - Mother Stations
  - Conversion Kits
- LNG Terminals

Since DOE is also promoting “Energy Efficiency”, then, CHP or Cogeneration System should be the priority.

Reference: DOE
Since DOE is also promoting “Energy Efficiency”, then, Industrial and Commercial establishments should be the priority customers of natural gas pipeline.
Thank you for your attention!

Questions?

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