Contribution of DKI Jakarta Mitigation Action Plan to the National GHG Emission Reduction Target of Indonesia NDC

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INTRODUCTION

GHG Emission Reduction Target of Indonesia’s NDC and The Potential Area for Contribution of DKI Jakarta Mitigation Action
### Indonesia NDC (Nationally Determine Contribution)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Base Year, 2010 (MTon CO2-e)</th>
<th>GHG Emission 2030 (Mton CO2-e)</th>
<th>% reduction of BaU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BaU</td>
<td>CM1</td>
<td>CM1</td>
</tr>
<tr>
<td>Energy*</td>
<td>453.2</td>
<td>1,669</td>
<td>1,355</td>
</tr>
<tr>
<td>Waste</td>
<td>88</td>
<td>296</td>
<td>285</td>
</tr>
<tr>
<td>IPPU</td>
<td>36</td>
<td>69.6</td>
<td>66.85</td>
</tr>
<tr>
<td>Agriculture</td>
<td>110.5</td>
<td>119.66</td>
<td>110.39</td>
</tr>
<tr>
<td>Forestry**</td>
<td>647</td>
<td>714</td>
<td>217</td>
</tr>
<tr>
<td>Total</td>
<td>1,334</td>
<td>2,869</td>
<td>2,034</td>
</tr>
</tbody>
</table>

*Including fugitive; **Including peat fire; CM1 = unconditional, CM2 = conditional

### Remarks

<table>
<thead>
<tr>
<th></th>
<th>BaU</th>
<th>Development Path not deliberated the mitigation policies</th>
</tr>
</thead>
<tbody>
<tr>
<td>CM1</td>
<td></td>
<td>Mitigation scenario &amp; considers sectoral development target (Unconditionally)</td>
</tr>
<tr>
<td>CM2</td>
<td></td>
<td>Ambitious mitigation scenario + International support available (conditionally)</td>
</tr>
</tbody>
</table>

Source: Indonesia first NDC 2016; Rencana Aksi Nasional Penurunan Emisi Gas Rumah Kaca

Indonesia First NDC and Long Term Mitigation Actions
NDC INDONESIA: REDUCTION TARGET ENERGY SECTOR 2030

- **RE in Power Generation**
- **Energy Eff. in Final Demand**
- **Clean Coal Power Plant**
- **Biofuel in transport**
- **Kerosene to LPG**
- **Reclamation after mining***)

Un-conditional Commitment with Total 314 Million Ton CO2e, 2030), which in 29% below the baseline

GHG Emission reduction, Million Ton CO2e

*) Land base sector

Source: Indonesia First NDC, 2016
### Mitigation Action Plan (Indonesia 1st NDC, 2016)

#### Energy
1. Energy efficiency in final demand
2. Clean coal technology in power
3. Renewable energy in power
4. Biofuel in transportation sector
5. Additional gas distribution lines
6. Additional CNG fuel station
7. Conversion Kerosene to LPG

#### Agriculture
1. The use of low-emission crops
2. Implementation of water efficient concept in water management
3. Manure management for biogas
4. Feed supplement for cattle

#### LULUCF
1. Reduction unplanned deforestation
2. Rehabilitation of land & forest in watershed
3. Development of community forest & village forest
4. Establishment of timber plantation and private forest
5. Restoration of production forest ecosystem
6. Development of partnership forest
7. Fire management & combatting illegal logging
8. Establishment Forest Management Unit
9. Conversion of forested peatland, issued moratorium policies for peatland
10. Development Fire early warning system
11. Strengthening community based fire fighting system
12. Improving of peatland management

#### Waste
1. LFG recovery
2. Composting and 3R
3. RDF Utilization
4. Management of Domestic WWT
5. Management of Industrial WWT

#### IPPU
1. Reduction of Clinker/Cement ratio
2. Feedstock utilization and CO2 recovery in primary reformer in petrochemical industry
3. Other actions in steel industry and aluminum smelter

#### Key Policies and Plans
1. Indonesian NDC
4. National Electric Power Expansion Plan (RUPTL-PLN)
6. Mandatory for Biofuel utilization in various sectors
8. Timber Legality Assurance System (TLAS)
9. Moratorium Issuance of new conversion permits for primary forest & peat-lands
10. Establishing a new agency called the National Agency for Peatland Restoration (Badan Restorasi Gambut),
11. Forest Law Enforcement National Strategy

Source: Indonesia first NDC; various other source
In response to climate change issues, the Governor of DKI Jakarta in 2010 announce “non binding commitment” to reduce GHG emissions 30% below the baseline by 2030, which was estimated about **35,24 million ton CO$_2$e** contribute to NDC,. In energy sector, the mitigation are related to EE in final demand (building, transport, and industry sectors), the use of less emission energy (RE and natural gas)

To achieve the target, the Governor developed mitigation actions plan that was published as Provincial GHG Mitigation Action Plan.

As one of the main sources of GHG emissions, transportation is an important sector in the RAD GRK, particularly GHG emissions from oil fuels combustion.
Potential Area for Contribution of DKI Jakarta to The National Mitigation Actions Under NDC

Energy Sector

1. Energy efficiency in final demand → Industry, Transport, Building
2. Clean coal technology in power
3. Renewable energy in power
4. Biofuel in transportation sector → Transport
5. Additional gas distribution lines → Transport
6. Additional CNG fuel station → Transport
7. Conversion Kerosene to LPG

GHG Emission Reduction Potential in Transportation Sector
- The paper presents result of a modeling study concerning development paths of transport infrastructure in DKI Jakarta in 2030.
- Transportation is one of important issues during discussion of Low Carbon Development for a City, particularly city such as DKI Jakarta, one of megacities in the world.
- DKI Jakarta contributes 10% of national GHG emissions, of which 89% is from energy sector. The main consumers of energy in DKI Jakarta are transportation (34%) and industries (34%).
- Therefore, energy used in transportation is one of important sub-sectors for GHG emission reduction target.
OVERVIEW OF DKI JAKARTA ENERGY SECTOR

The Associated GHG Emission form Energy Sector
Overview of Jakarta Characteristics

The Jakarta city is characterized by:
- high economic activity.
- very dense city’s population (> 10 million population living in 662 km² of land area),
- limited public transport infrastructure and having high motorized vehicle density (mostly cars and motorcycles), and

Legend:
- Land area: 661.62 sq.km
- Total Population: 9,604,900/nighttime
  12,000,000/daytime
- Population density: 14,500/km sq
- Vehicle/Cars: 1,837,608
- Motorcycle: 2,511,257
- Total Jakarta Greater Area: 6.9 million

± 17,000 Islands (56% nameless, 7% inhabited)
- 1.9 million sq km land area
- 7.9 million sq km maritime area
- 54,700 km coast line
- 33 Provinces, 497 Cities/Regencies

National population
244.8 million (2014)
DKI Jakarta is a coastal city with several rivers flowed across the city. Combined with the low topography (40% of land area is below sea level) makes Jakarta prone to flooding from swollen rivers in wet season and high sea tides.

Lack of water level control infrastructure, deforestation in surrounding area of DKI Jakarta, and complex socio-economic problems indirectly contribute to triggering a flood event.

This situation makes the city **vulnerable** to the impact of climate change, especially the rise of sea level and rainfall intensity.
Energy Use and Sources of GHG Emissions in DKI Jakarta

1A4b. Rumah Tangga
1A5. Lain-lain
angunan Komersial
Perikanan
Energy Use and Sources of GHG Emissions in DKI Jakarta

Energy Consumption in Power
2010-2015

1,000 TJ

2010 2011 2012 2013 2014 2015

- HSD/IDO
- MFO
- Natural Gas

Energy Consumption in Manufacture
2010-2015

1,000 TJ

2010 2011 2012 2013 2014 2015

- Kerosene
- Diesel Oil
- Fuel Oil
- LPG
- Gas
Energy Use and Sources of GHG Emissions in DKI Jakarta

Commercial Building
2010-2015

Residential Building
2010-2015

- Diesel Oil
- Gas
- Electricity (indirect)

- LPG
- Gas
- Electricity (indirect)
Energy Use and Sources of GHG Emissions in DKI Jakarta

Transport Sector
2010-2015

- Diesel Oil (Incl. biodiesel)
- Biodiesel on Biosolar
- Premium
- Biopremium
- Pertamax
- Biopertamax
- Pertamax Plus
- Pertamax Dex
- Diesel Oil
- Vigas
- BBG
- Electricity (indirect)
GHG Emission Level of DKI Jakarta

Fossil Fuel Combustion

Transportation

The use of electricity
GHG EMISSION MODEL USING EXSS-GAMS

The Projection of GHG Emissions in Energy Sector
ENERGY AND GHG EMISSION MODEL FOR DKI JAKARTA

Non-linear programming (GAMs based Extended Snap Shot) is used as a tool for developing energy development paths and estimating associated GHGs.

Two projection scenarios are developed:
• BaU envisions development paths of energy sector and the associated GHG emission without considering mitigation efforts
• Mitigation scenario envisions development paths to achieve low carbon city.

Base year for projection scenarios is 2005 and target year is 2030.

Socio-economic variable (input parameters to ExSS Modeling)

<table>
<thead>
<tr>
<th>Socio Economic Parameter</th>
<th>Base year 2005</th>
<th>Target year 2030</th>
<th>Ratio 2030/2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population, Million</td>
<td>8.9</td>
<td>11.4</td>
<td>1.3</td>
</tr>
<tr>
<td>Number of household, Million</td>
<td>2.2</td>
<td>2.85</td>
<td>1.3</td>
</tr>
<tr>
<td>GDP (at constant price 2000), trillion IDR</td>
<td>474</td>
<td>2,347</td>
<td>5</td>
</tr>
<tr>
<td>GDP per capita, million IDR</td>
<td>53</td>
<td>206</td>
<td>3.9</td>
</tr>
<tr>
<td>Gross output, trillion IDR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Primary</td>
<td>5.2</td>
<td>18.8</td>
<td>3.6</td>
</tr>
<tr>
<td>- Secondary</td>
<td>305</td>
<td>1,250</td>
<td>4.1</td>
</tr>
<tr>
<td>- Tertiary (commercial/floor area)</td>
<td>594</td>
<td>3,367</td>
<td>5.3</td>
</tr>
<tr>
<td>Passenger-transport demand, billion psg. km</td>
<td>49</td>
<td>192</td>
<td>3.9</td>
</tr>
<tr>
<td>Freight-transport demand, billion ton km</td>
<td>15.8</td>
<td>61</td>
<td>3.8</td>
</tr>
</tbody>
</table>
1. Driving Force Settings
2. Final Energy Demand
3. Primary Energy Demand
4. CO2 emissions
Economically, the city significantly contributes to national economy. With the city’s GDP level at around 396 trillion rupiah (at constant price 2000) in 2010, DKI Jakarta accounts for 17% of national GDP.

During 2005-2010, the city’s GDP grew around 6.5% per annum, in which contribution of tertiary (commercial) industry is 73% and secondary (manufacturing) industry is 15%. The high growth of these two GDP outputs will also affect to transportation condition of the city.

Projection of population (by age group composition) and GDP (Gross Output)
• The city’s population growth, economic characteristics, transportation condition has lead to the high GHG emission level: 3.84 ton CO₂e per capita (2005), of which energy used accounted for 89% of total GHG emission and transportation contribution was 20%.

• As comparison, the national level is 3.01 ton CO₂e per capita.
MITIGATION OPTIONS IN TRANSPORT SECTOR AND THE ASSOCIATED GHG EMISSIONS REDUCTION
Drivers of GHG Emissions can be identified from “IPAT identity”:

\[ \text{Impact} = \text{Population} \times \text{Affluence} \times \text{Technology} \]

\[ \text{CO}_2 \text{ Emissions} = \text{Population} \times \left( \frac{\text{GDP}}{\text{Population}} \right) \times \left( \frac{\text{Energy}}{\text{GDP}} \right) \times \left( \frac{\text{CO}_2}{\text{Energy}} \right) \]

(“Kaya” multiplicative identity)

\[ \text{Net} \ C = P \left( \frac{\text{GDP}}{P} \right) \left( \frac{E}{\text{GDP}} \right) \left( \frac{C}{E} \right) - S \]

\[ \downarrow \quad \downarrow \]

Energy Efficient \quad \text{Clean Energy/ Technology}

Climate Change Mitigation Actions are to reduce Nett GHG Emissions
LOW CARBON DEVELOPMENT STRATEGIES

LCS Actions

Clean Energy (Residential and Commercial)
- Renewable energy or Less CO2 Emission Energy
- Less CO2 Emission Energy Technology

Low Carbon Style (Residential and Commercial)
- Society Behavior in Residential/Commercial
- Efficient energy technology appliances

Low Carbon Electricity
- Efficient energy technology of power generation
- Less CO2 Emission Energy Technology (Coal IGCC + CCS)
- Increasing Efficiency of T & D
- Renewable energy or Less CO2 Emission Energy

Low carbon energy system in industry
- Efficient energy technology appliances
- Efficient energy process and processing technology

Sustainable transport
- Renewable energy or Less CO2 Emission Energy
- modal shift (public/mass rapid transport utilization)
- Energy Efficiency Improvement
- Reduce trip generation and distance (improve Infrastructure, telecommunication, new urban design, traffic management)
THE PROJECTION OF ENERGY SECTOR

Final energy demand projection of the city (by energy type and sector)

Energy supply mix projection and corresponding sectoral GHG emission
PROJECTION OF GHG EMISSION OF ENERGY SECTOR IN DKI JAKARTA UNDER BAU SCENARIO

2005

- Power supply: 30.0
- Commercial: 15.2
- Industrial: 0.1
- Residential: 4.8
- Freight Transport: 2.8
- Passenger Transport: 1.9

BaU 2030

- Power supply: 140.3
- Commercial: 85.4
- Industrial: 0.6
- Residential: 19.3
- Freight Transport: 6.7
- Passenger Transport: 7.4

- Electricity: 28.7
- Gas: 0.3
- Oil: 33.2
- Coal: 35.6
- Gas: 35.5

- Electricity: 39.9
- Gas: 33.2
- Oil: 16.4
- Coal: 0.6
GHG EMISSION PROJECTION OF ENERGY SECTOR UNDER BAU AND MITIGATION SCENARIO

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2030 BaU: 140.3 million ton CO₂
- Commercial: 36 million ton CO₂
- Industrial: 36 million ton CO₂
- Residential: 40 million ton CO₂
- Freight Transport: 7 million ton CO₂
- Passenger Transport: 21 million ton CO₂

2030 CM: 114.0 million ton CO₂
- Commercial: 30 million ton CO₂
- Industrial: 29 million ton CO₂
- Residential: 35 million ton CO₂
- Freight Transport: 5 million ton CO₂
- Passenger Transport: 14 million ton CO₂

26.3 million ton CO₂ (19% reduction) → 30%
Energy Technology Options for Sustainable Transport

1. Deployment of energy efficient devices
2. Transport fuel change from oil fuels to low carbon emitting fuels (biofuel/gas),
3. Mode change (private to public): MRT/mono rail, train/double track, bus-way
4. Increase of non motorized transport (bike/ walk): pedestrian improvement
5. Efficiency improvement in cars through flue gas monitoring,
6. Traffic management (parking management, freight transport scheduling, etc.)
7. Promotion of eco-driving.
Share of transportation mode distribution of passenger transport

(a) Inside DKI Jakarta

(b) Cross border

Transportation mode distributions of passenger and freight transports

(a) Passenger

(b) Freight
LESSON LEARN

The Projection of GHG Emissions from Energy Sector at City Level (DKI Jakarta)
LESSONS LEARN

- Modeling using ExSS GAMS has been implemented to explore development path of DKI Jakarta that will lead to development with low carbon emission in energy sector in 2030.
- This development is expected will bring DKI Jakarta become Low Carbon City in the future. As of now, there is no specific definition in terms of number of Low Carbon City.
- GDP growth used in this modeling results in increase of GDP in 2030 by 5 times compared to 2005. There is also shift in sectoral GDP product, where the share of commercial (tertiary industry) will increase from 66% to 71%. This is inline with the expectation that capital city like DKI Jakarta will rely more on commercial sector as compared to manufacturing industry and other sector.
- Energy intensity in commercial sector as not as high as in manufacturing industry sector. And therefore such shift will lead to less energy demand growth rate. The type of energy used in this sector is mainly electricity. Mitigation actions related electricity utilization can be applied in end-use side since power generator side is beyond of the authority of DKI Jakarta.
Mitigation actions for DKI Jakarta has been explored using Provincial RAD GRK of DKI Jakarta (2012) as reference. The selected mitigation actions result in 26 million ton CO₂ reduction in 2030 compared to emission in BaU. This reduction is equivalent to 19% of BaU level in 2030. As comparison the RAD target is 30%.

Transport reduces GHG emission significantly (7 Mton CO₂ from passenger transport and 2 Mton CO₂ from freight transport), followed by industrial (7 Mton CO₂), commercial (6 Mton CO₂), and residential (5 Mton CO₂).

Mitigation in transport includes improvement of transport infrastructure, transport management, regular emission test (enforce the use more efficient vehicle), deployment of energy efficient vehicles (BAT), transport mode shift from individual vehicle to mass public transport (MRT, bus-way, bus-feeder, train, mono-rail, and promoting eco-driving).

The utilization of ExSS model may be disseminated to evaluate mitigation actions and to explore development paths toward low carbon city for other cities with sufficient data (comprehensive socio economic data, IO table/SAM energy, and detail energy data) like DKI Jakarta.
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Thank You

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