Integration of Local Actions into National Development Towards Achieving SDGs in Asia and the Role of Science and Technology: Development and Application of Models and Monitoring Technologies to Evaluate Transition to the SDGs

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

Low Carbon Asia Research Network (LoCARNet)
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Retno Gumilang Dewi

Center for Research on Energy

NSTITUT TEKNOLOGI BANDUNG

OUTLINE

1. Introduction
2. Overview of Energy Sector
3. GHG Emission Model Using ExSS-GAMs
4. Mitigation Options in Transport Sector and The Associated GHG Emissions Reduction
5. Lesson Learn

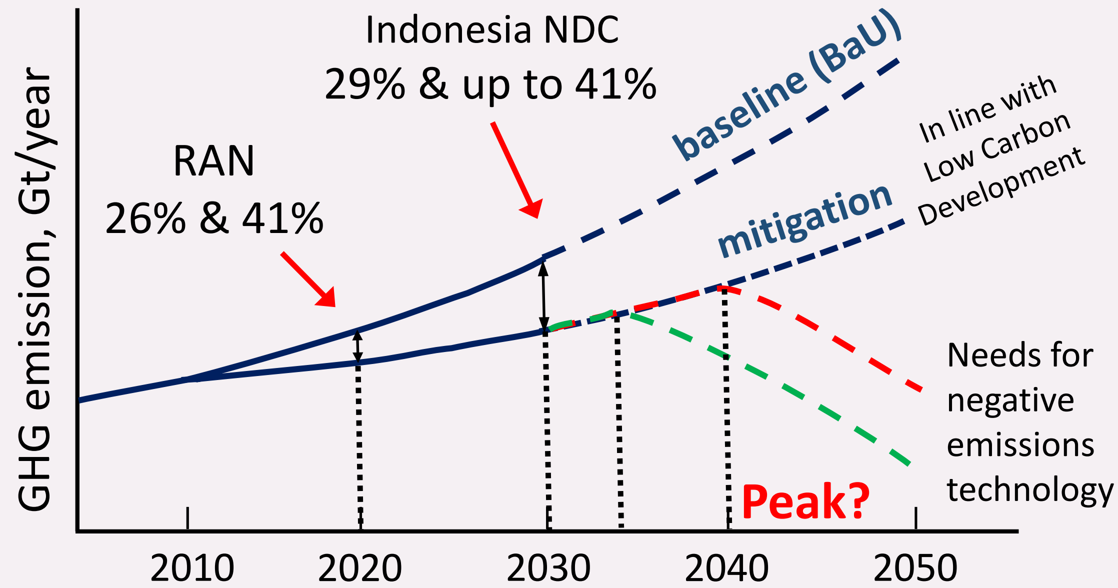



INTRODUCTION

GHG Emission Reduction Target of Indonesia's NDC and The Potential Area for Contribution of DKI Jakarta Mitigation Action

1

Indonesia First NDC and Long Term Mitigation Actions



Indonesia NDC (Nationally Determine Contribution)

Sector	Base Year, 2010 (MTon CO2-e)	GHG Emission 2030 ($Mton\ CO_2$-e)			% reduction of BaU	
		BaU	CM1	CM2	CM1	CM2
Energy*	**453.2**	**1,669**	**1,355**	**1,271**	**11%**	**14%**
Waste	88	296	285	270	0.38%	1%
IPPU	36	69.6	66.85	66.35	0.10%	0.11%
Agriculture	110.5	119.66	110.39	115.86	0.32%	0.13%
Forestry**	647	714	217	64	17.20%	23%
Total	1,334	2,869	2,034	1,787	29%	38%

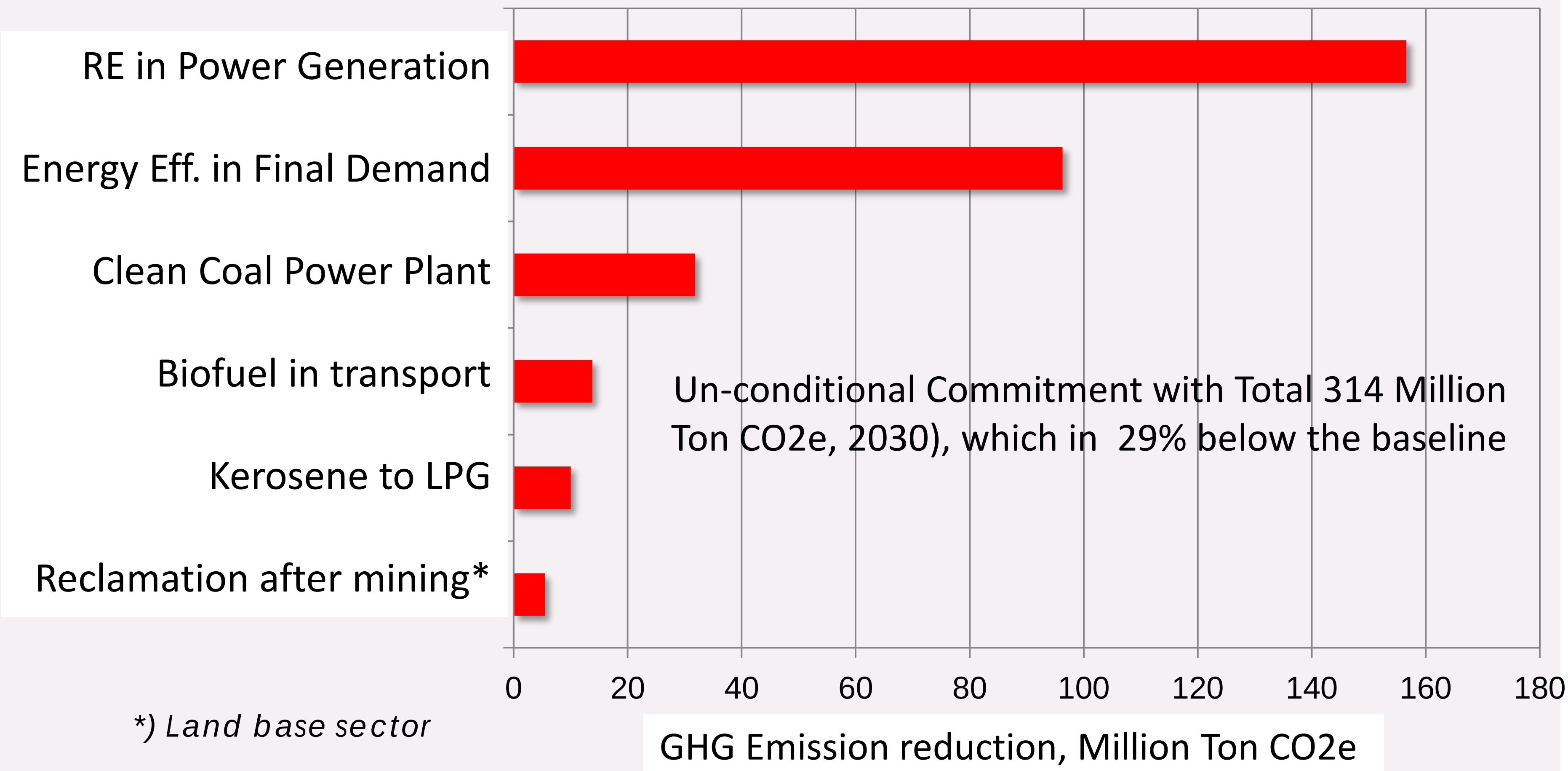
*Including fugitive; **Including peat fire; CM1 = unconditional, CM2 = conditional

Remarks

BaU	Development Path <u>not</u> deliberated the mitigation policies
CM1	Mitigation scenario & considers sectoral development target (Unconditionally)
CM2	Ambitious mitigation scenario + International support available (conditionally)

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

NDC INDONESIA: REDUCTION TARGET ENERGY SECTOR 2030



**) 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

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

Waste

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

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

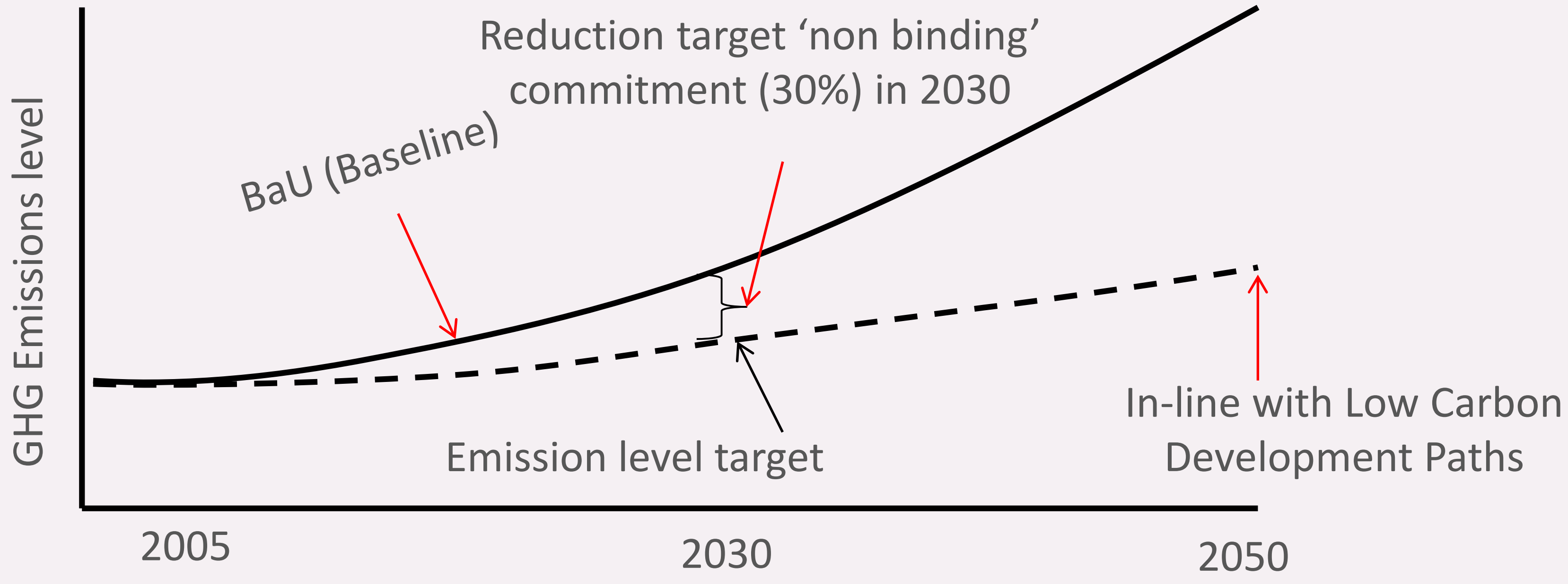
LULUCF

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

Key Policies and Plans

1. Indonesian NDC
2. National Action Plan for GHG Emission Mitigation
3. National Energy Policy (KEN)
4. National Electric Power Expansion Plan (RUPTL-PLN)
5. National Energy Conservation and Efficiency (RIKEN and Various Government Regulations)
6. Mandatory for Biofuel utilization in various sectors
7. National Forestry Plan 2011-2030 (RKTN)
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 anounce "non binding commitment" to reduce GHG emissions 30% below the baseline by 2030, which was estimated about **35,24 million ton CO_2e** → 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

Transport Infrastructure in DKI Jakarta to Achieve Low Carbon City in 2030

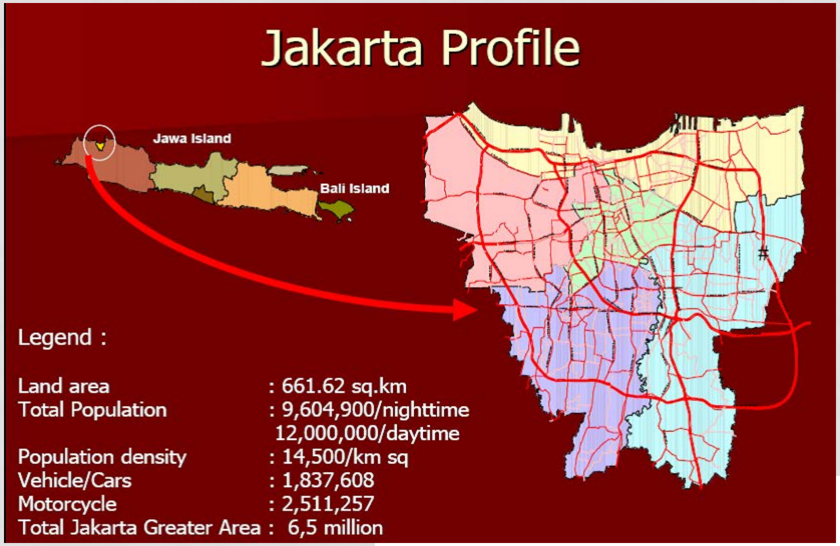
- The paper presents result of a modeling study concerning development paths of transport infrastructure in DKI Jakarta in 2030.
- Transportation is one of improtant issues during dicussion of Low Carbon Development for a City, particularly city such as DKI Jakarta, one of megacities in the world.
- 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

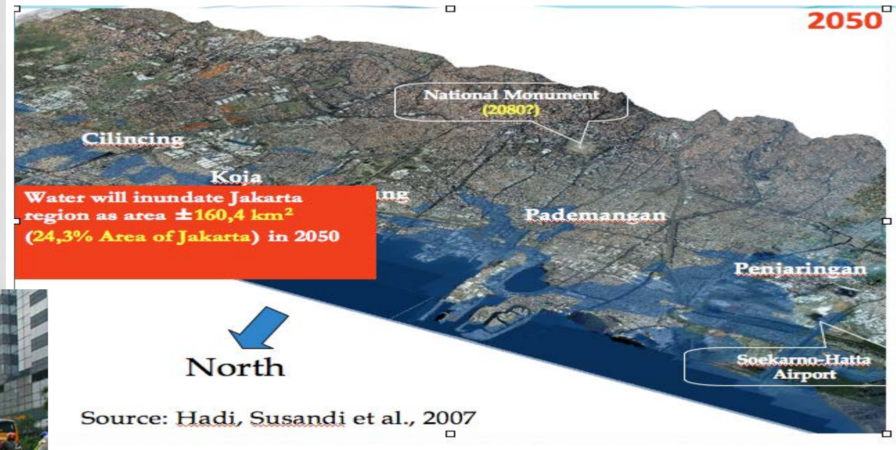
The Associated GHG Emission form Energy Sector

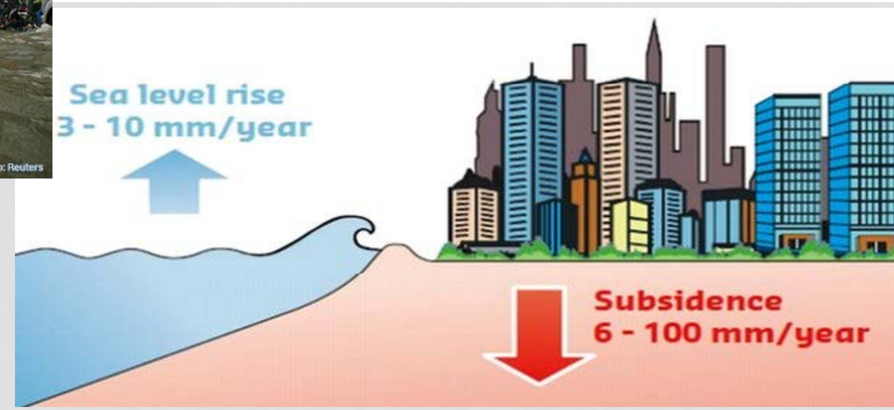
2

Overview of Jakarta Characteristics



- The Jakarta city is caracterized by:
  - high economic activity.
  - very dense city's population (> 10 million population living in 662 km^2 of land area),
  - limmited public transport infrastructure and having high motorized vehicle density (mostly cars and motorcycles), and

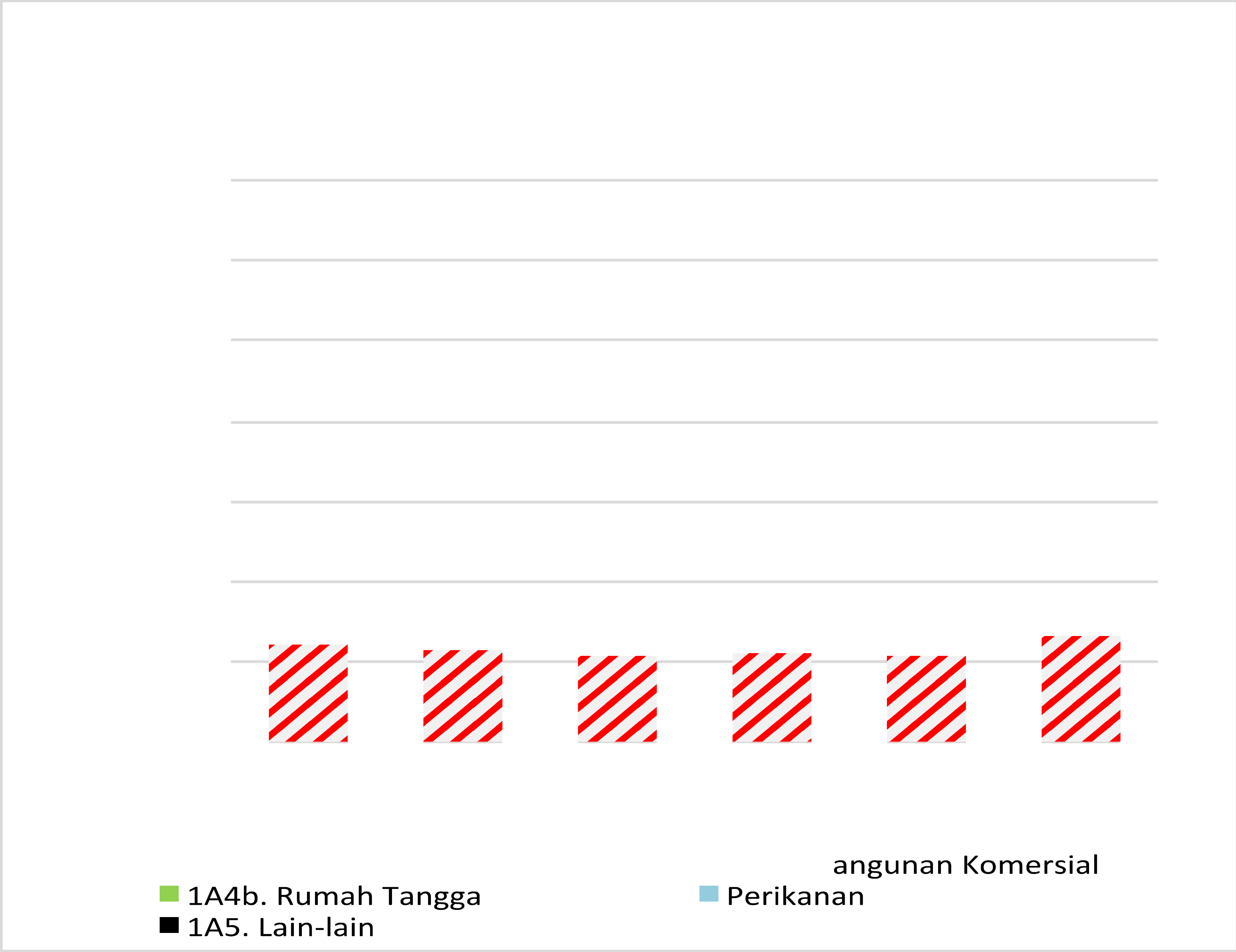


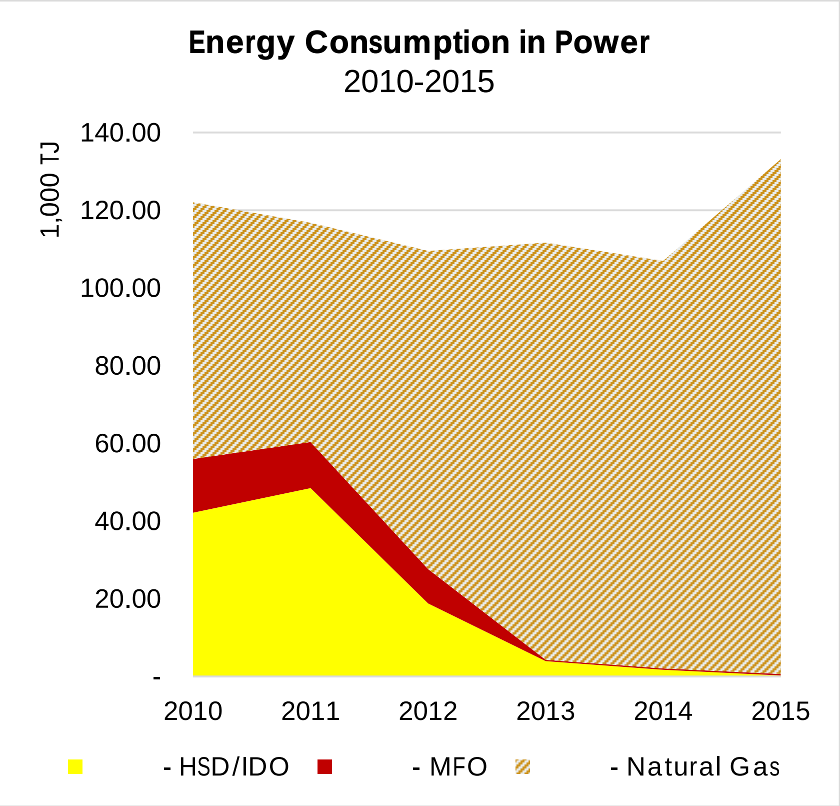


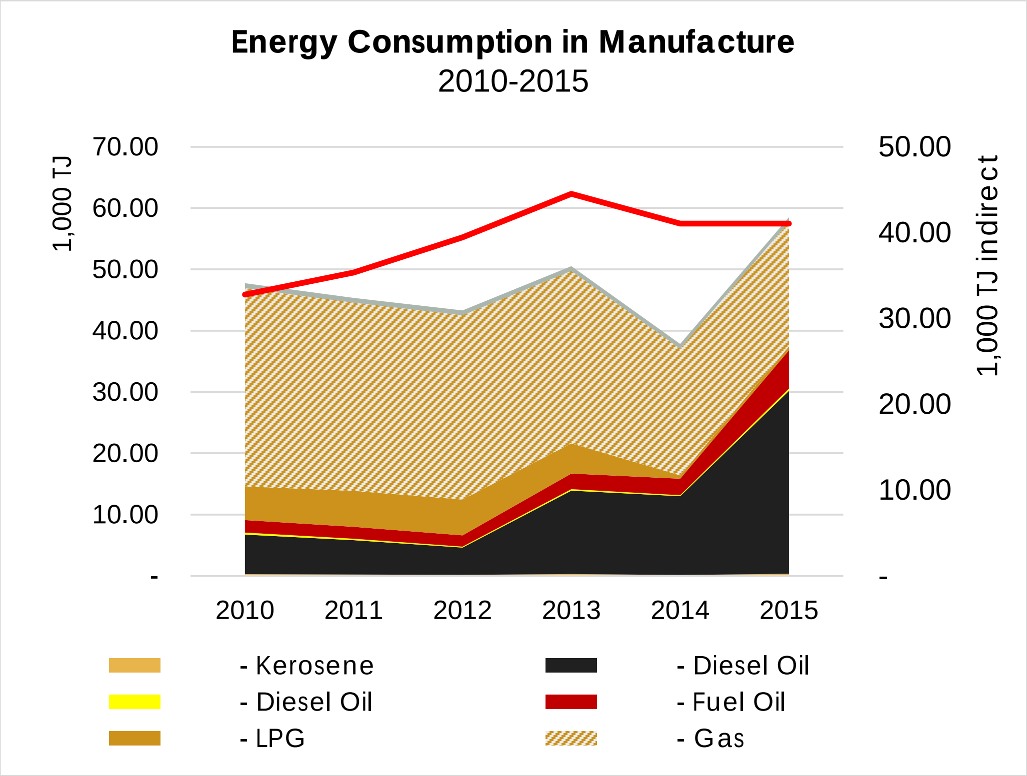
DKI Jakarta is a coastal city with several rivers flowed accross the city. Combined with the low topography (40% of land area is below sea level) makes Jakarta prone to flooding from swollen rivers in wet season and high sea tides.

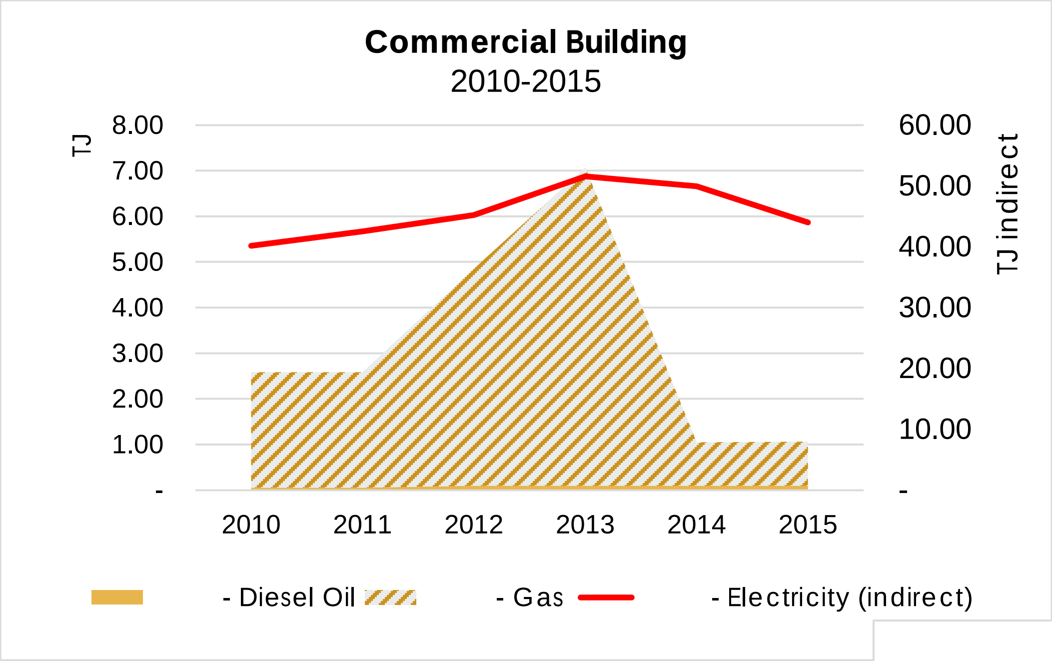
Lack of water level control infrastructure, deforestation in surrounding area of DKI Jakarta, and complex socio-economic problems indirectly contribute to triggering a flood event.

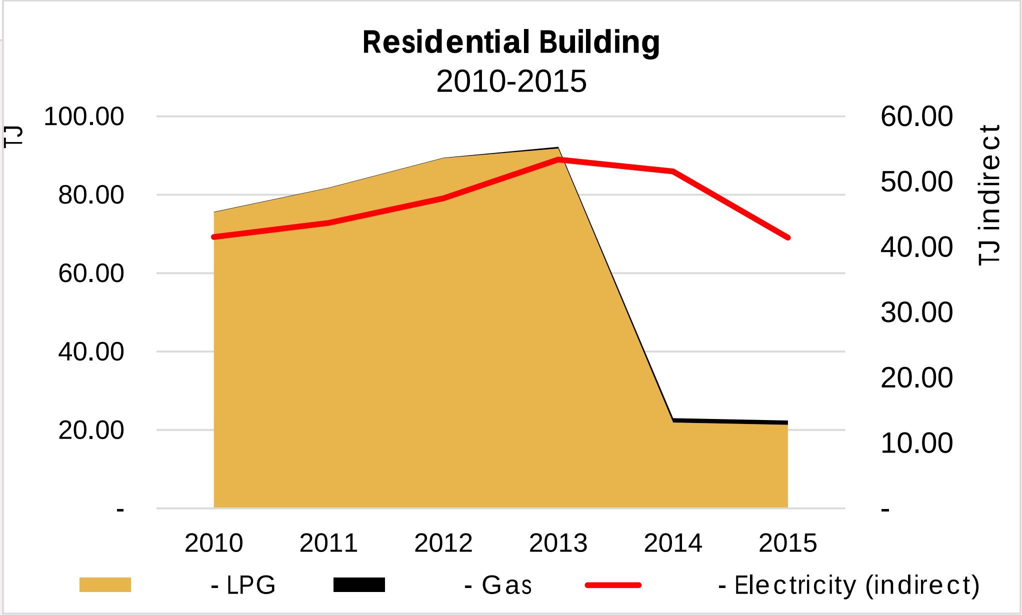
This situation makes the city **vurnerable** to the impact of climate change, especially the rise of sea level and rainfall intensity.

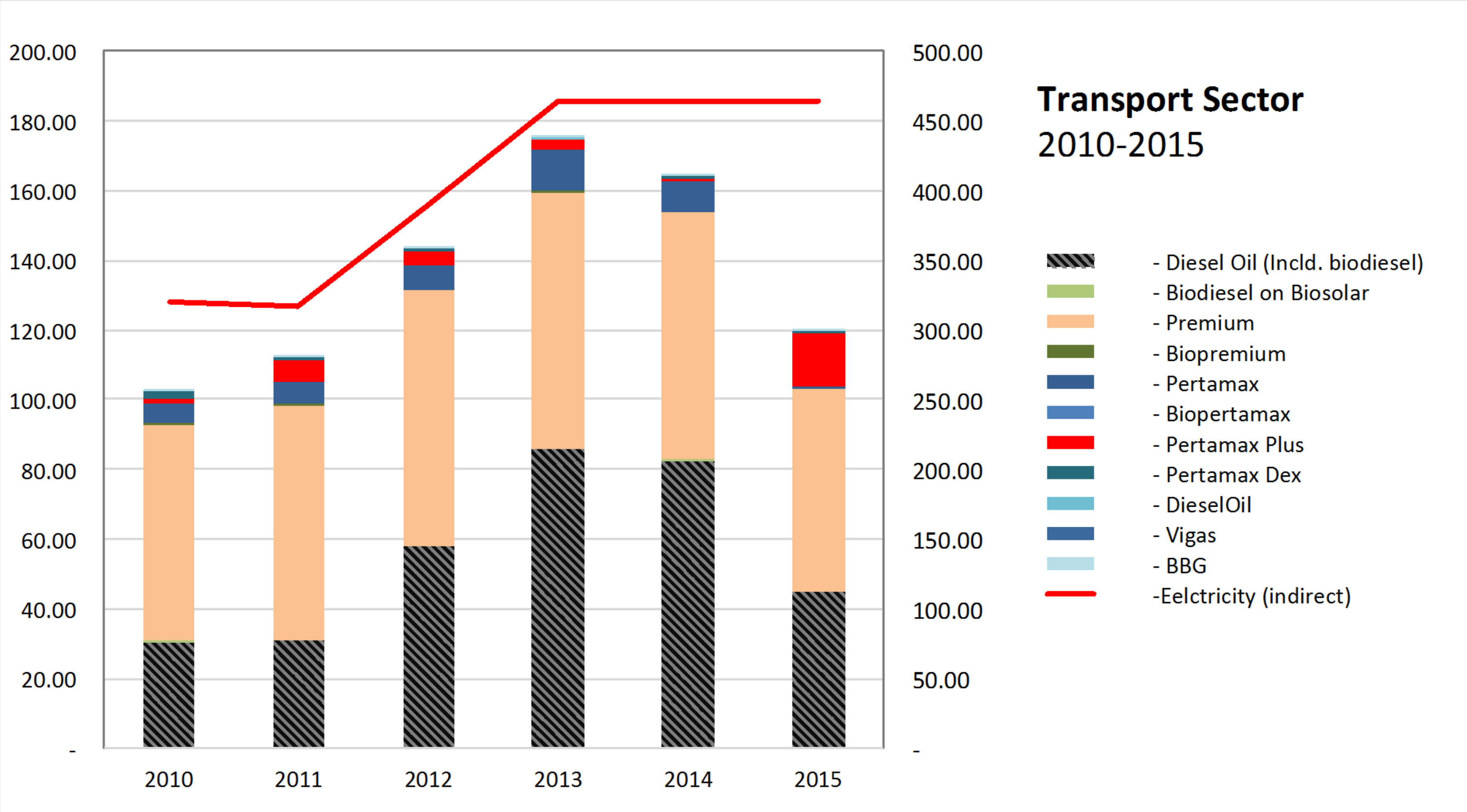

angunan Komersial
1A4b. Rumah Tangga
Perikanan
1A5. Lain-lain

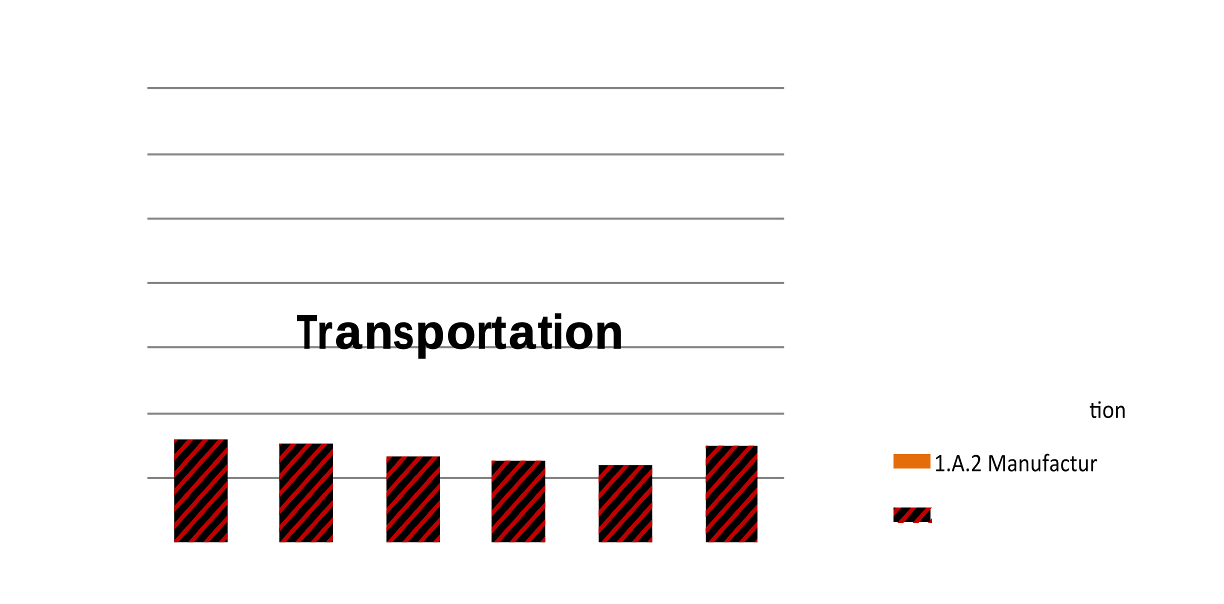

Energy Consumption in Power
2010-2015
1,000 TJ
140.00
120.00
100.00
80.00
60.00
40.00
20.00
-
2010
2011
2012
2013
2014
2015
- HSD/IDO
- MFO
- Natural Gas


Energy Consumption in Manufacture
2010-2015
1,000 TJ
70.00
60.00
50.00
40.00
30.00
20.00
10.00
-
50.00
40.00
30.00
20.00
10.00
-
1,000 TJ indirect
2010
2011
2012
2013
2014
2015
- Kerosene
- Diesel Oil
- LPG
- Diesel Oil
- Fuel Oil
- Gas


Commercial Building
2010-2015
TJ
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
-
60.00
50.00
40.00
30.00
20.00
10.00
-
TJ indirect
2010
2011
2012
2013
2014
2015
- Diesel Oil
- Gas
- Electricity (indirect)

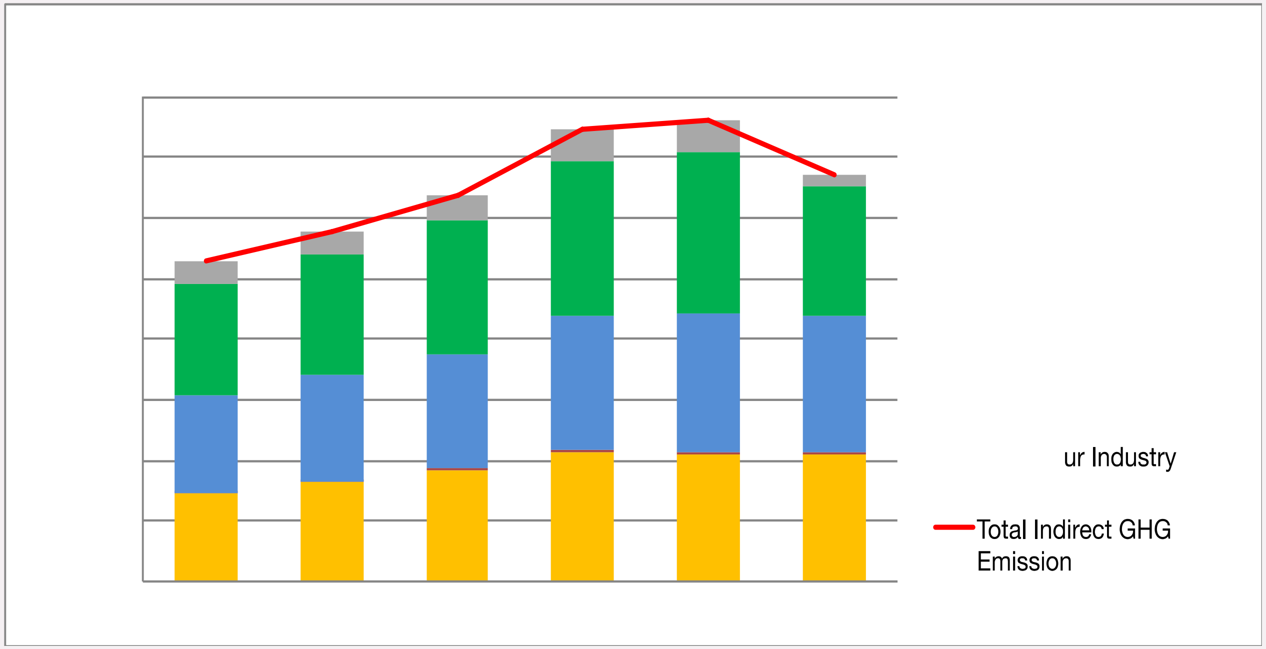

Residential Building
2010-2015
TJ
100.00
80.00
60.00
40.00
20.00
-
60.00
50.00
40.00
30.00
20.00
10.00
-
TJ indirect
2010
2011
2012
2013
2014
2015
- LPG
- Gas
- Electricity (indirect)


200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
-
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
-
2010
2011
2012
2013
2014
2015
Transport Sector
2010-2015
- Diesel Oil (Incld. biodiesel)
- Biodiesel on Biosolar
- Premium
- Biopremium
- Pertamax
- Biopertamax
- Pertamax Plus
- Pertamax Dex
- DieselOil
- Vigas
- BBG
-Eelctricity (indirect)



Fossil Fuel Combustion

The use of electricity



GHG EMISSION MODEL USING EXSS-GAMS

The Projection of GHG Emissions in Energy Sector

3

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.

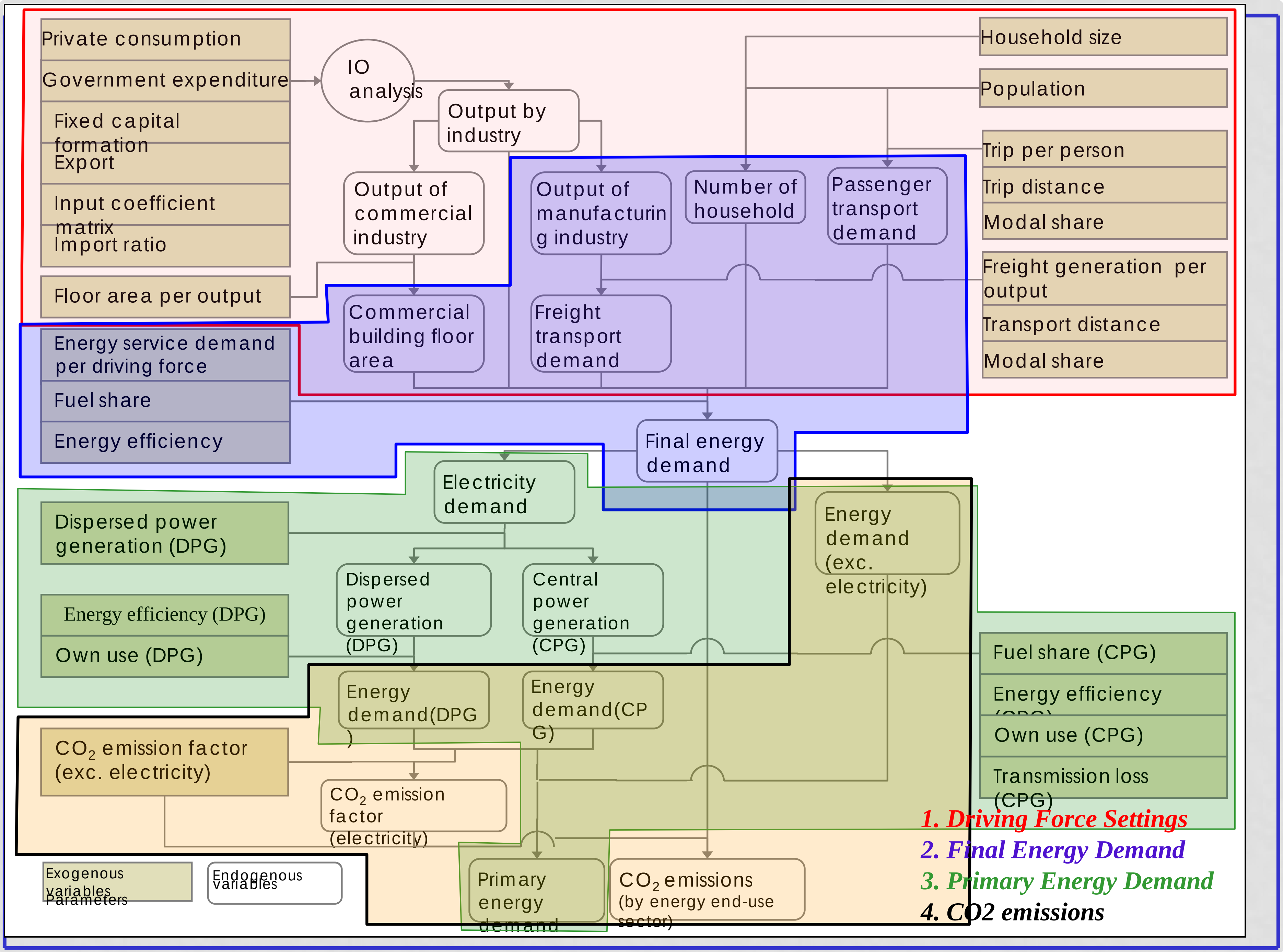
Two projection scenarios are developed:

- 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)

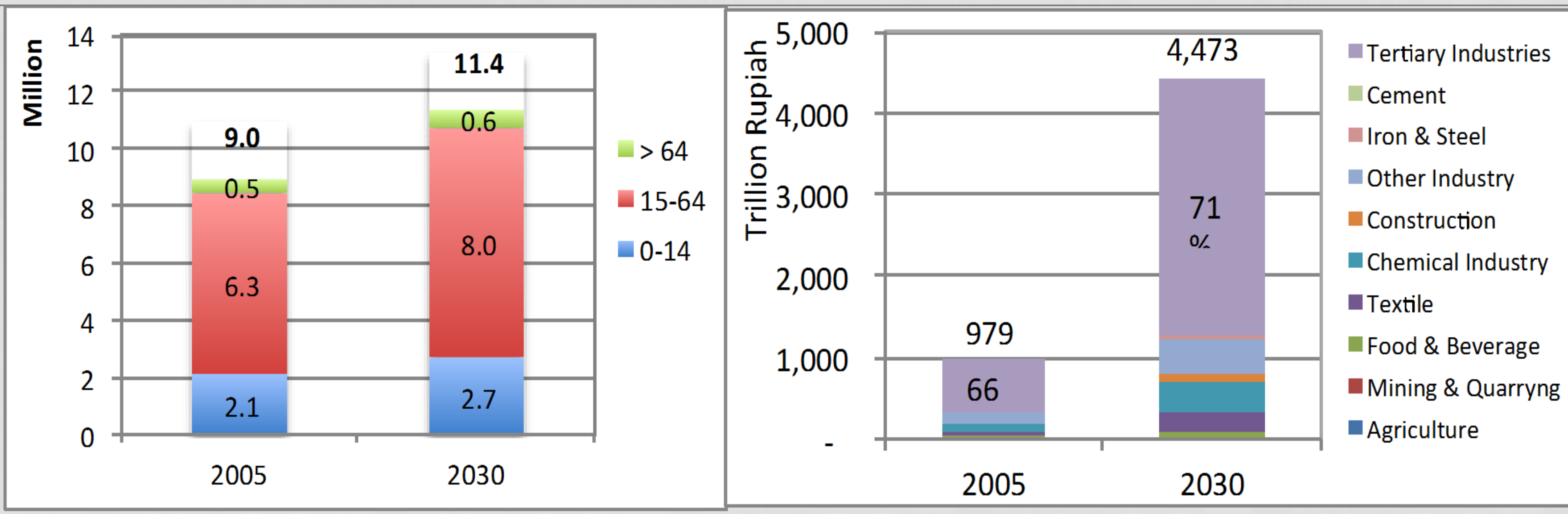
Socio Economic Parameter	Base year 2005	Target year 2030	Ratio 2030/2005
Population, Million	8.9	11.4	1.3
Number of household, Million	2.2	2.85	1.3
GDP (at constant price 2000), trillion IDR	474	2,347	5
GDP per capita, million IDR	53	206	3.9
Gross output, trillion IDR			
- Primary	5.2	18.8	3.6
- Secondary	305	1,250	4.1
- Tertiary (commercial/floor area)	594	3,367	5.3
Passenger-transport demand, billion psg. km	49	192	3.9
Freight-transport demand, billion ton km	15.8	61	3.8



Private consumption
Government expenditure
Fixed capital formation
Export
Input coefficient matrix
Import ratio
Floor area per output
IO analysis
Output by industry
Output of commercial industry
Output of manufacturing industry
Number of household
Passenger transport demand
Household size
Population
Trip per person
Trip distance
Modal share
Freight generation per output
Transport distance
Modal share
Commercial building floor area
Freight transport demand
Energy service demand per driving force
Fuel share
Energy efficiency
Final energy demand
Electricity demand
Energy demand (exc. electricity)
Dispersed power generation (DPG)
Energy efficiency (DPG)
Own use (DPG)
Dispersed power generation (DPG)
Central power generation (CPG)
Fuel share (CPG)
Energy efficiency (CPG)
Own use (CPG)
Transmission loss (CPG)
Energy demand(DPG)
Energy demand(CPG)
CO_2 emission factor (exc. electricity)
CO_2 emission factor (electricity)
Primary energy demand
CO_2 emissions (by energy end-use sector)
Exogenous variables Parameters
Endogenous variables
1. Driving Force Settings
2. Final Energy Demand
3. Primary Energy Demand
4. CO2 emissions

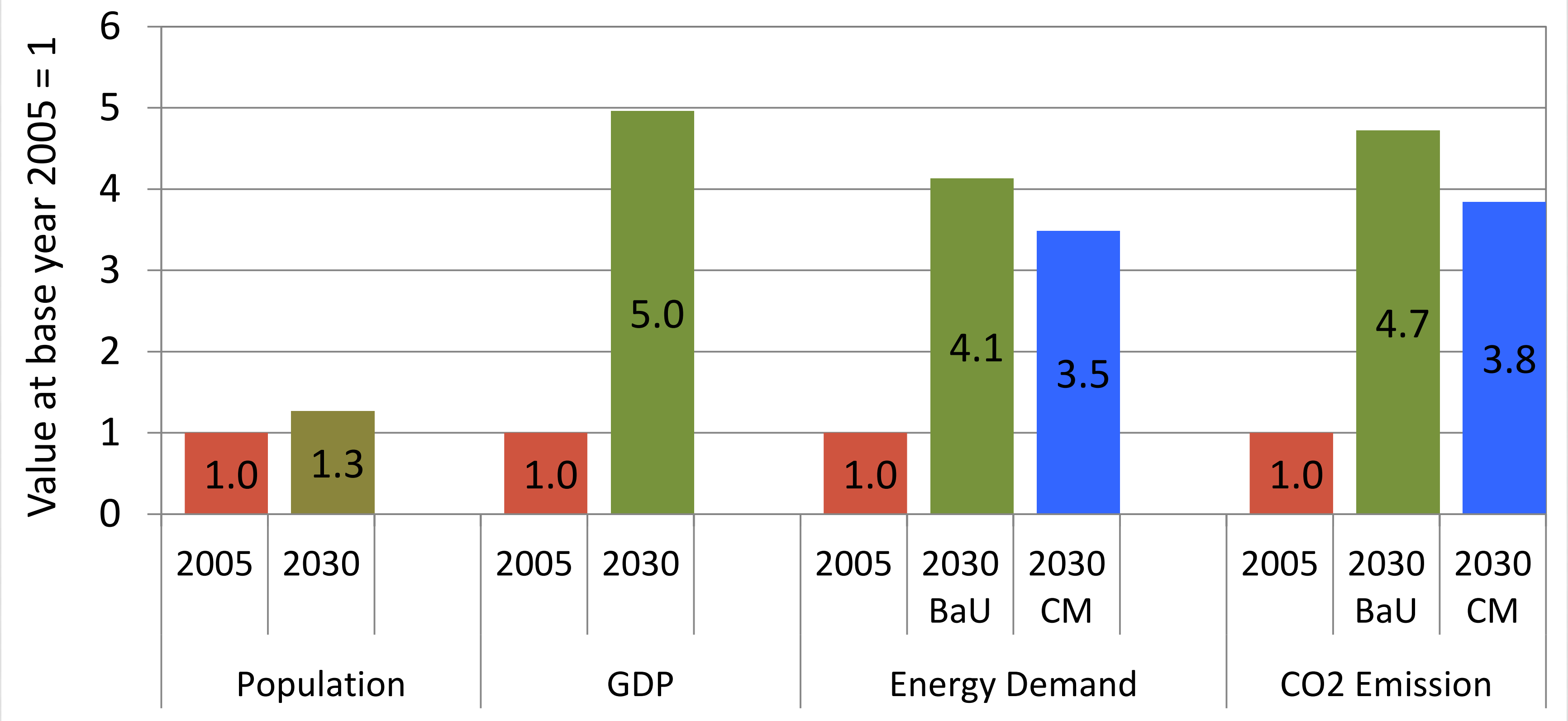
Socio Economic Condition and Projection

- 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 acounts 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)

ENERGY AND GHG EMISSION PROJECTION OF DKI JAKARTA



- The city's population growth, economic charactristics, transportation condition has lead to the high GHG emission level: 3.84 ton CO_2e 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 CO_2e per capita.

MITIGATION OPTIONS IN TRANSPORT SECTOR AND THE ASSOCIATED GHG EMISSIONS REDUCTION

Mitigation Options in Transportation

4

Drivers of GHG Emissions can be identified from "IPAT identity":

$$Impact = Population \times Affluence \times Technology$$

$$CO_2\ Emissions = Population \times (GDP/Population) \times (Energy/GDP) \times (CO_2\ /Energy)$$

("Kaya" multiplicative identity)

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

Energy Efficient

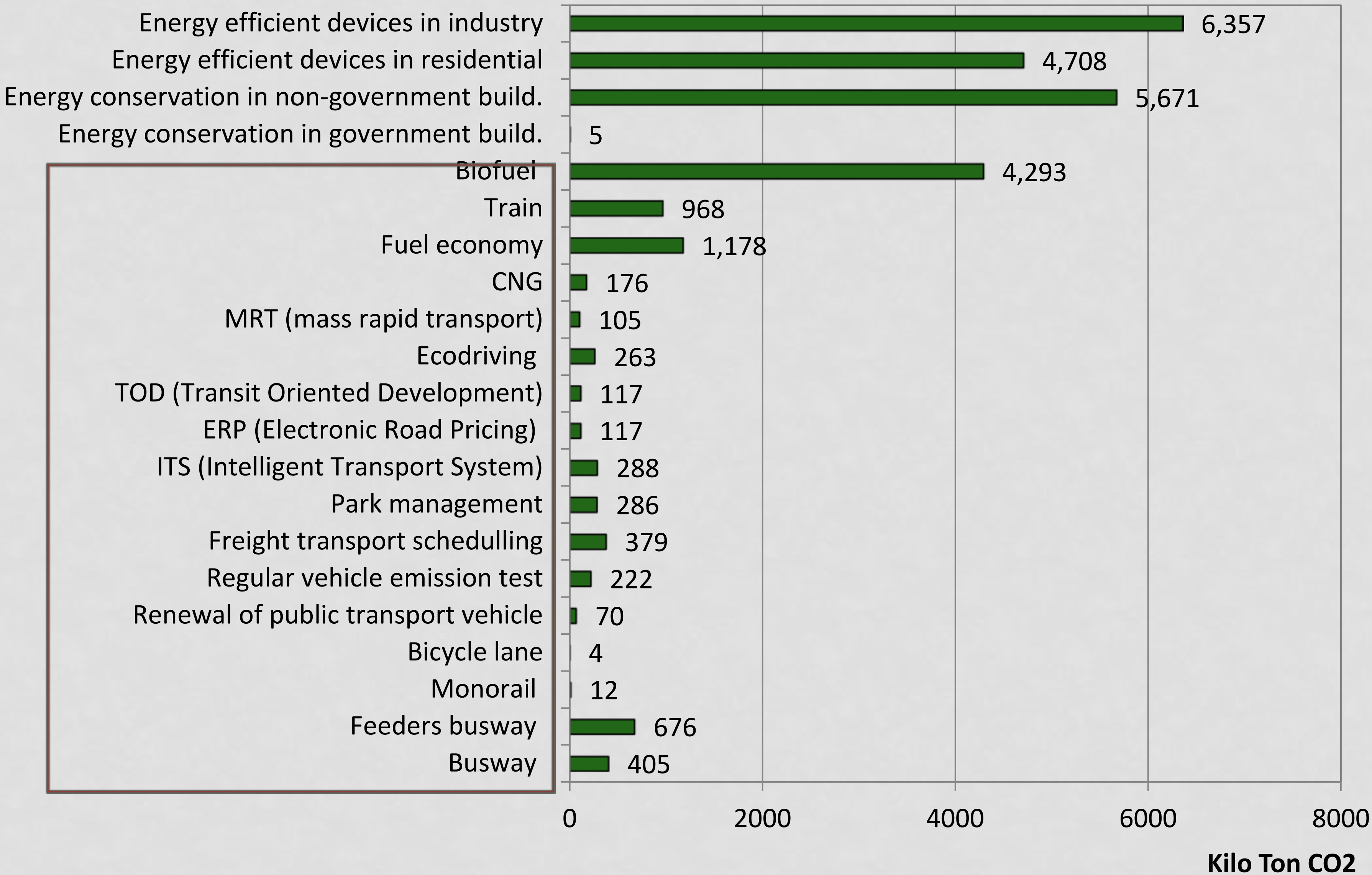
Clean Energy/ Technology

Climate Change Mitigation Acions are to reduce Nett GHG Emisions

LOW CARBON DEVELOPMENT STRATEGIES

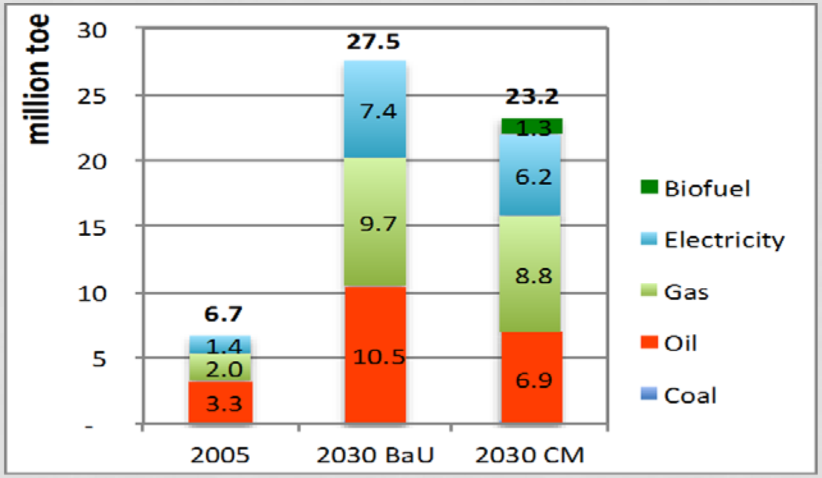
- LCS Actions
  - Clean Energy (Residential and Commercial)
    - Renewable energy or Less CO2 Emission Energy
    - Less CO2 Emission Energy Technology
  - Low Carbon Style (Residential and Commercial)
    - Society Behavior in Residential /Commercial
    - Efficient energy technology appliances
  - Low Carbon Electricity
    - Renewable energy & Less CO2 Emission Energy
    - Efficient energy technology of power generation
    - Less CO2 Emission Energy Technology (Coal IGCC + CCS)
    - Increasing Efficiency of T & D
  - Low carbon energy system in industry
    - Renewable energy or Less CO2 Emission Energy
    - 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

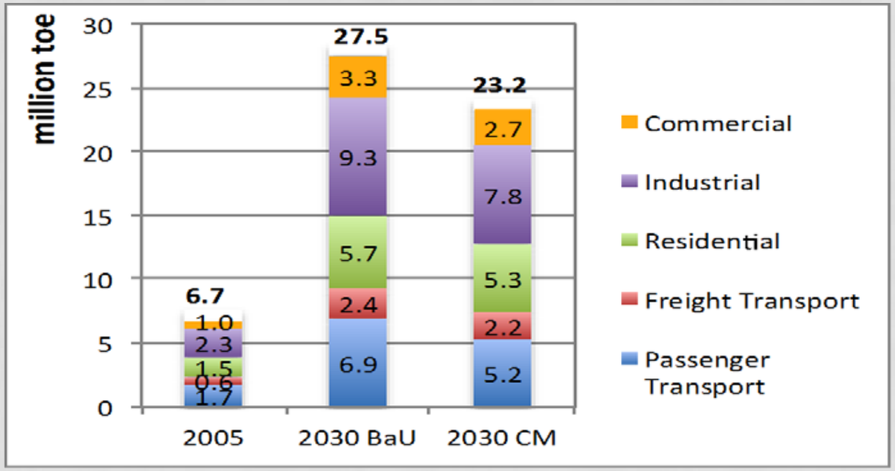
GHG Reduction Potential in Energy Sector under RAD GRK in 2030



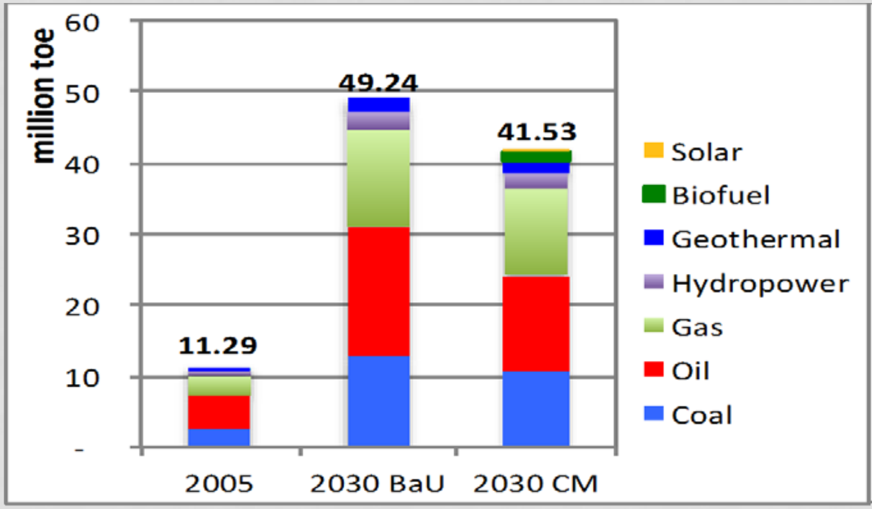
THE PROJECTION OF ENERGY SECTOR

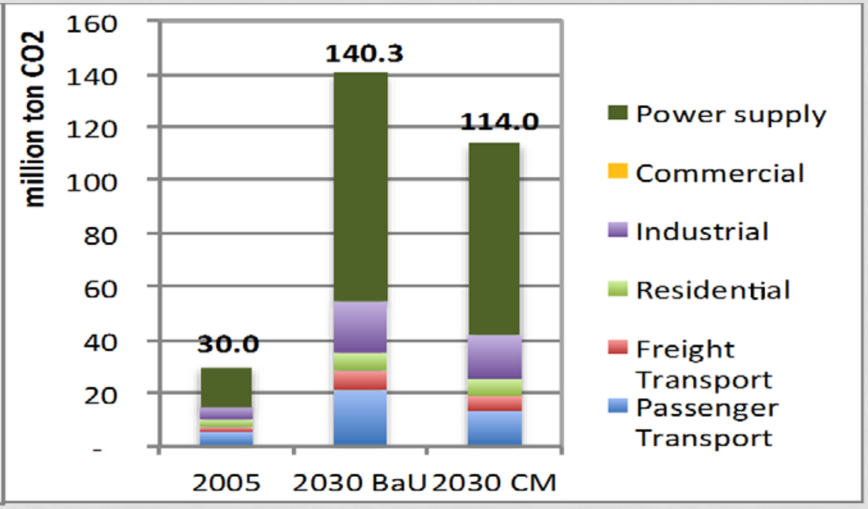
Final energy demand projection of the city (by energy type and sector)





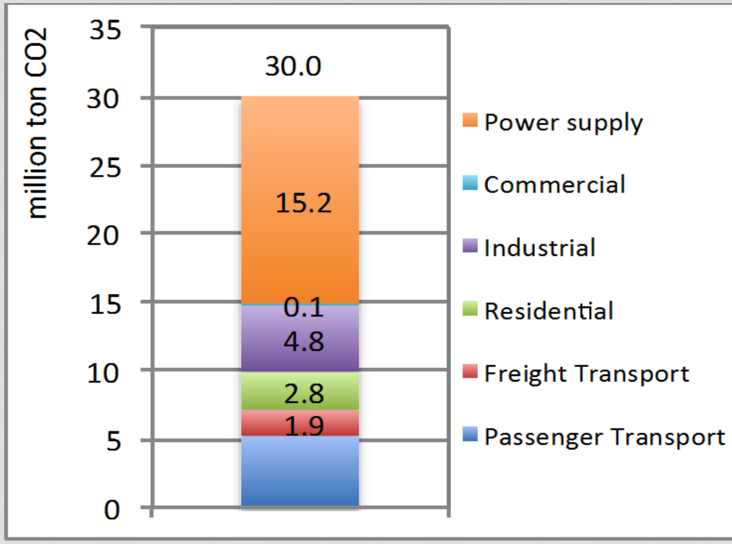
Energy supply mix projection and corresponding sectoral GHG emission

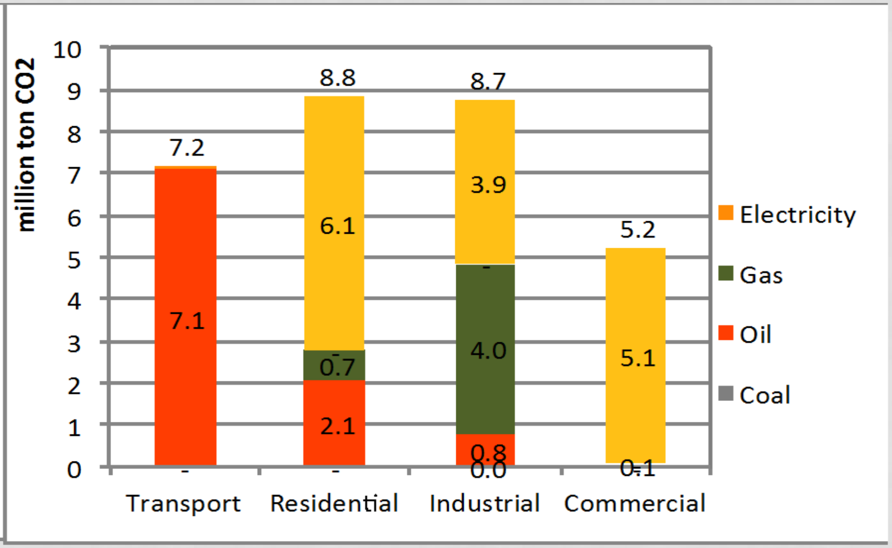




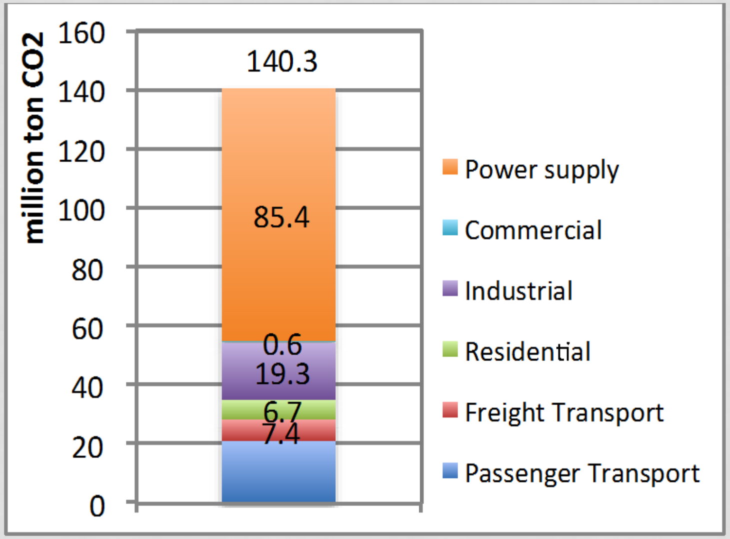
PROJECTION OF GHG EMISSION OF ENERGY SECTOR IN DKI JAKARTA UNDER BAU SCENARIO

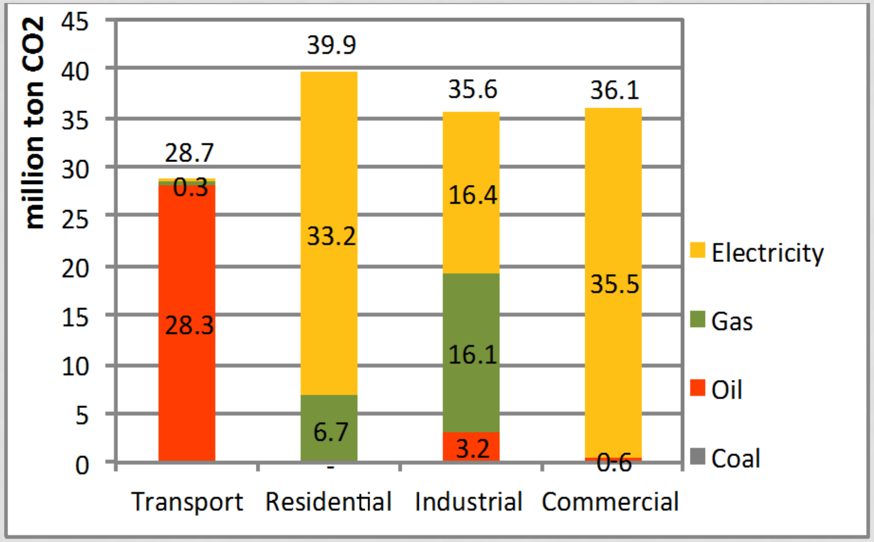
2005



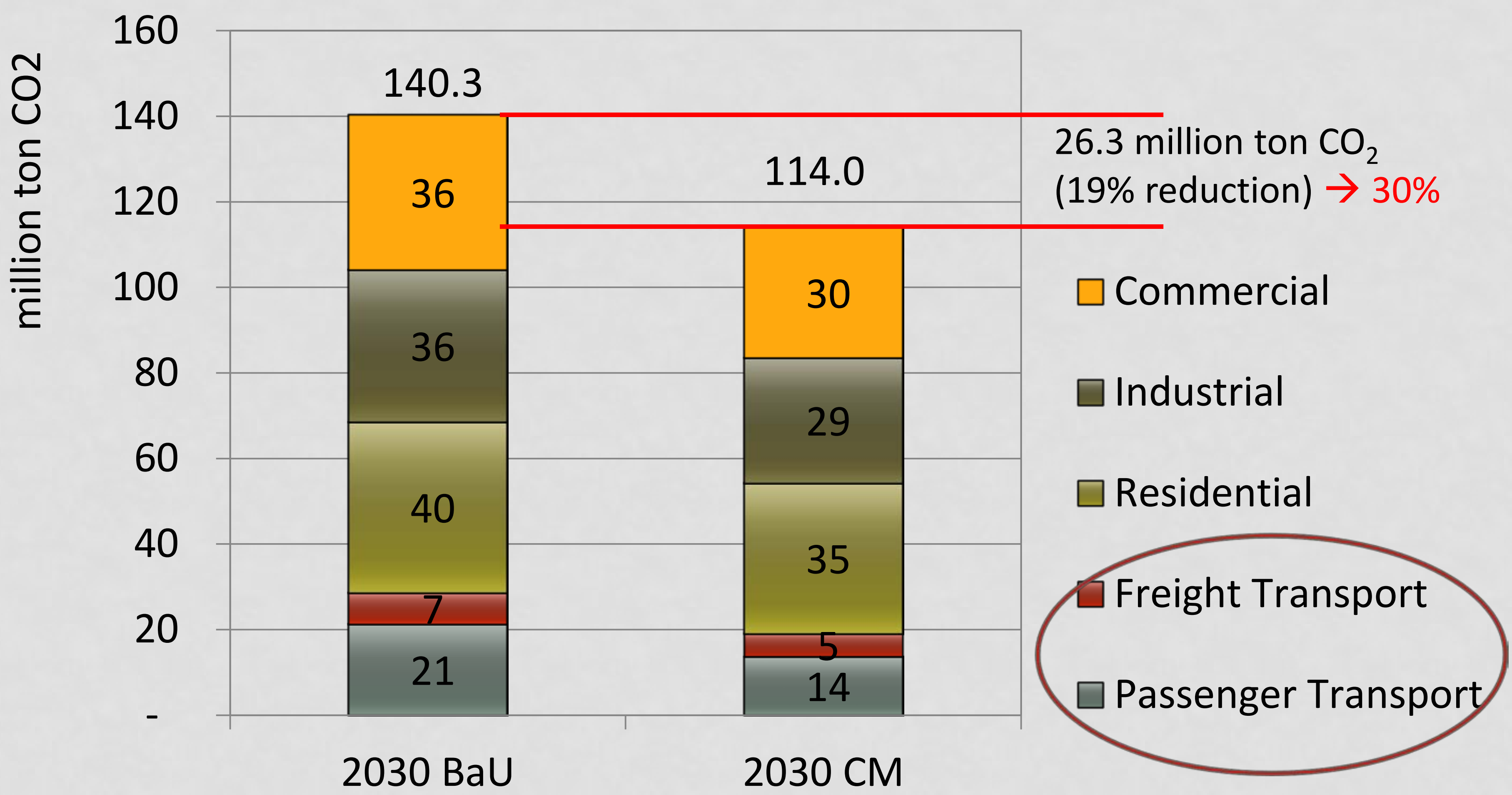


BaU 2030





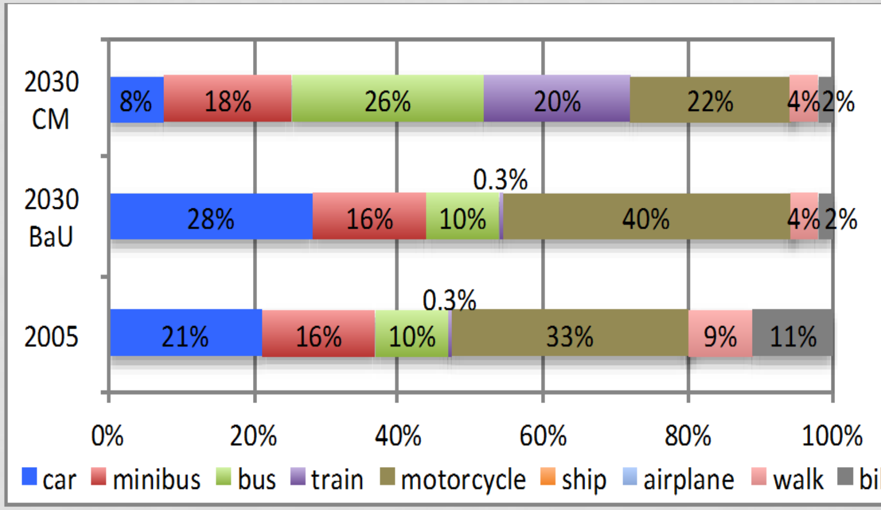
GHG EMISSION PROJECTION OF ENERGY SECTOR UNDER BAU AND MITIGATION SCENARIO



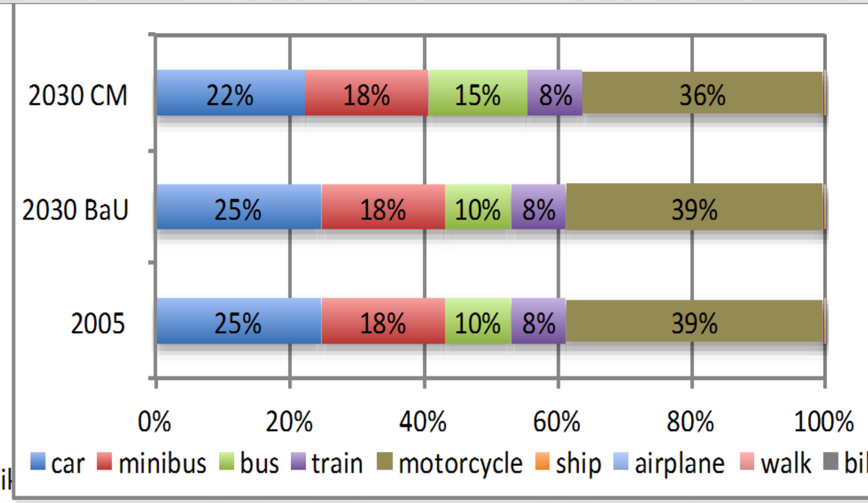
Energy Technology Options for Sustainable Transport

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

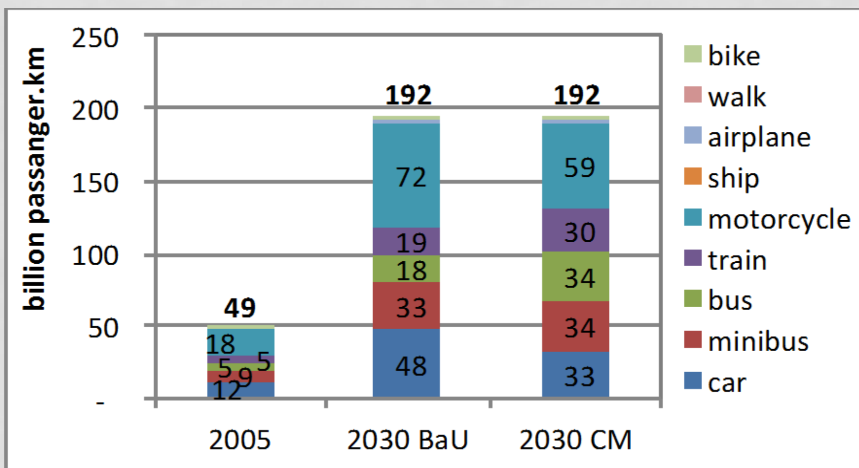


(a) Inside DKI Jakarta

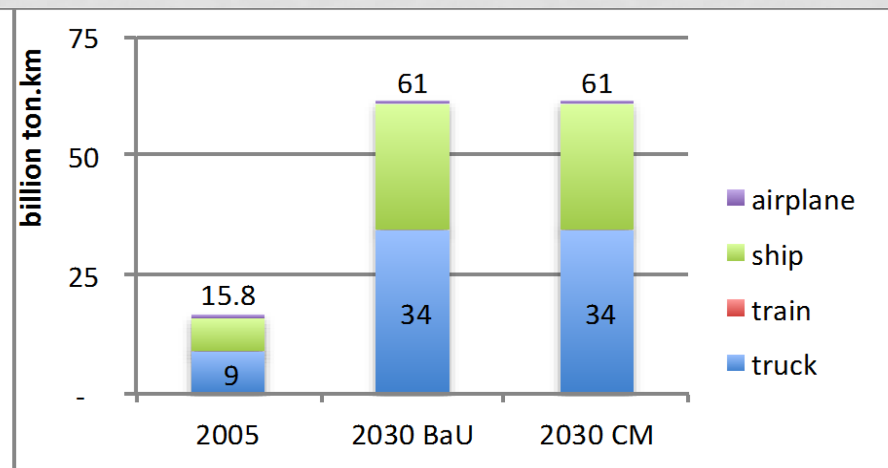


(b) crossboader

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)

5

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 explore using Provincial RAD GRK of DKI Jakarta (2012) as reference. The selected mitigation actions results in 26 million ton CO_2 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 CO_2 from passenger transport and 2 Mton CO_2 from freight transport), followed by industrial (7 Mton CO_2), commercial (6 Mton CO_2), and residential (5 Mton CO_2).
- 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.

Acknowledgment

Institut Teknologi Bandung (ITB) - Indonesia
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Kyoto University – Japan
Mizuho Information & Research Institute – Japan
National Institute for Environmental Studies (NIES) – Japan
UN University Institute of Advance Studies – Japan


Thank You
gelangdewi@yahoo.com