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Deep Decarbonization Pathway
Case: Indonesia Energy Sector

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Outline

- Introduction
- GHG emissions: current levels, drivers, and past trends
- Decomposition of CO2 emissions
- Drivers assumptions
- Energy pathways by source
- Element of decarbonization
- Decarbonization Pillars
- Results of decarbonization
- Closing remarks

Introduction

- This presentation: the interim results of a research concerning how Indonesia energy sector can technically contribute in global effort to achieve steep declines in carbon intensity in all sector of the economy.
- The research is part of The Deep Decarbonization Pathways Project (DDPP) i.e. collaborative initiative to understand and show how individual countries can transition to a low-carbon economy and how the world can meet the internationally agreed target of limiting the increase in global mean surface temperature to less than 2 °C.
- To achieve the target, drastic transformation of energy systems by mid-century through steep declines in carbon intensity is needed.

Achieving the 2°C limit:

- Global net emissions of greenhouse gases (GHG) should approach zero by the second half of the century.
- "Carbon Budget" to 2050: 825 Giga Ton
- Staying within this CO2 budget requires very near-term peaking and a sharp reduction in CO2 emissions thereafter, CO2-energy emissions in 2050 :11 – 15 Giga ton/year
- Assuming a world population of 9.5 billion people, countries would need to sharply decrease CO2 yearly emission from today's global average of 5.2 tons/capita to 1.6 tons/capita in 2050

Indonesia : 1.4 ton/capita (2010)

Lead/co-founder Institutions of DDPP:

- The Sustainable Development Solutions Network (SDSN)
- The Institute for Sustainable Development and International Relations (IDDRI)

Study team:

Researchers from 15 countries: Australia, Brazil, Canada, China, France, Germany, India, **Indonesia**, Japan, Mexico, Russia, South Africa, South Korea, the UK, and the USA.

The 15 countries:

- Major emitters - 70% of world GHG emission
- Different stages of development.

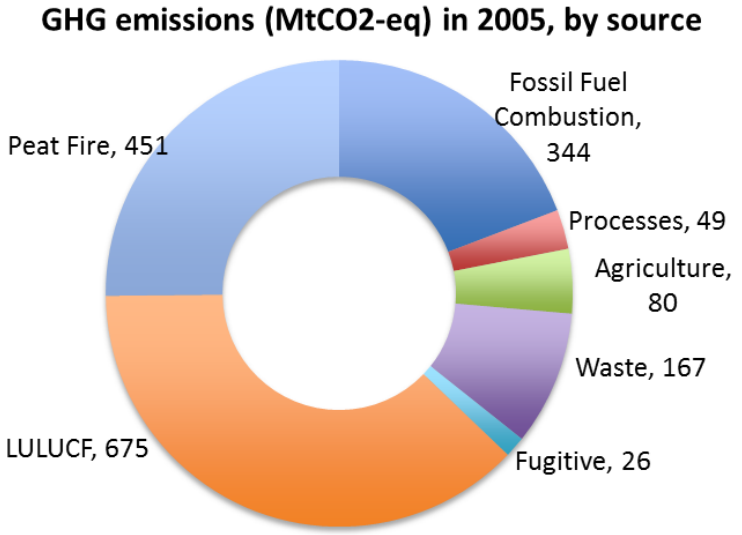
DDPP is an ongoing initiative; will issue periodic reports on deep decarbonization.

The focus of 1st stage: pathway analysis to identify technically feasible pathways that are consistent with the objective of limiting the rise in global temperatures below 2°C.

In a second—later—stage :

- refine the analysis of the technical potential,
- take a broader perspective by quantifying costs and benefits,
- estimating national and international finance requirements,
- mapping out domestic and global policy frameworks,
- considering in more detail how the twin objectives of development and deep decarbonization can be met.

GHG emissions: current levels, drivers, and past trends

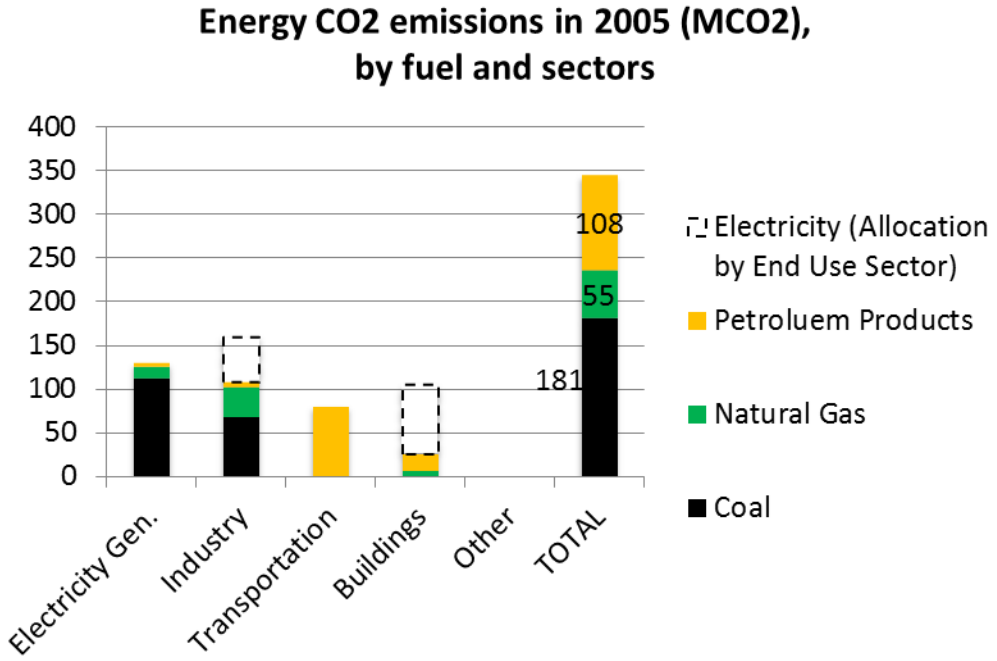


Indonesian SNC

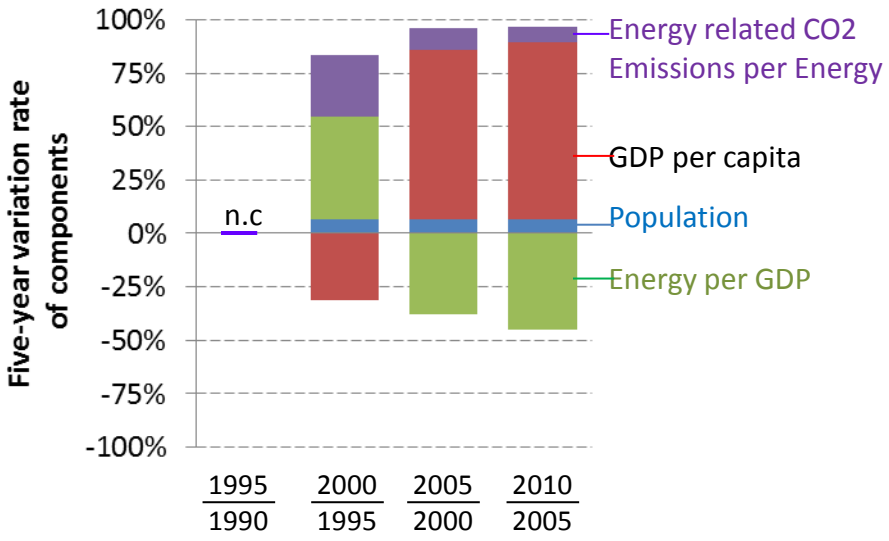
GHG emissions: 1,800 $MtCO_2e$ (2005), sharp increase from 400 MtCO2e di 2000.
Most (63%) from AFOLU and peat fire
Fossil fuels combustions: 19% dari total

Fuel Combustion

Major emission sources: coal, oil
Uses: Power gen. & industry, transport dan building
End-use sector: 50% from direct combustion emissions from fuel burning in industry; emissions from power generation come from the building (60%) and industry (40%) sectors.



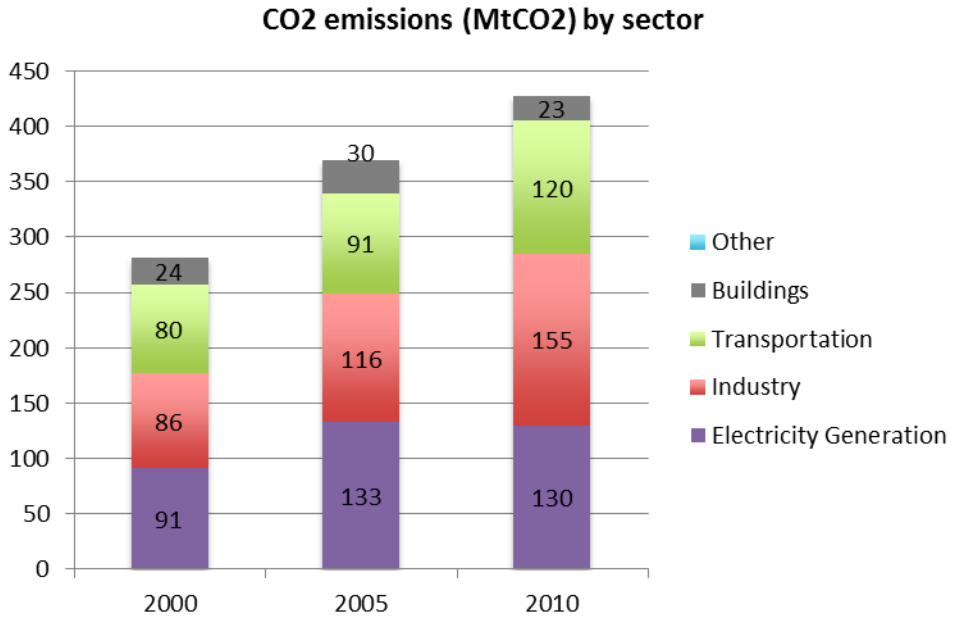
Decomposition of energy-related CO2 emissions, 1990-2010



Major drivers: economic activity (grew 5% - 6% per year). Increasing energy use per unit of GDP also contributed to the increase in emissions, showing that the economy simultaneously grew more energy-intensive

Major contributor:

- Power sector
- Industry
- Transport



Drivers of Indonesian Growth

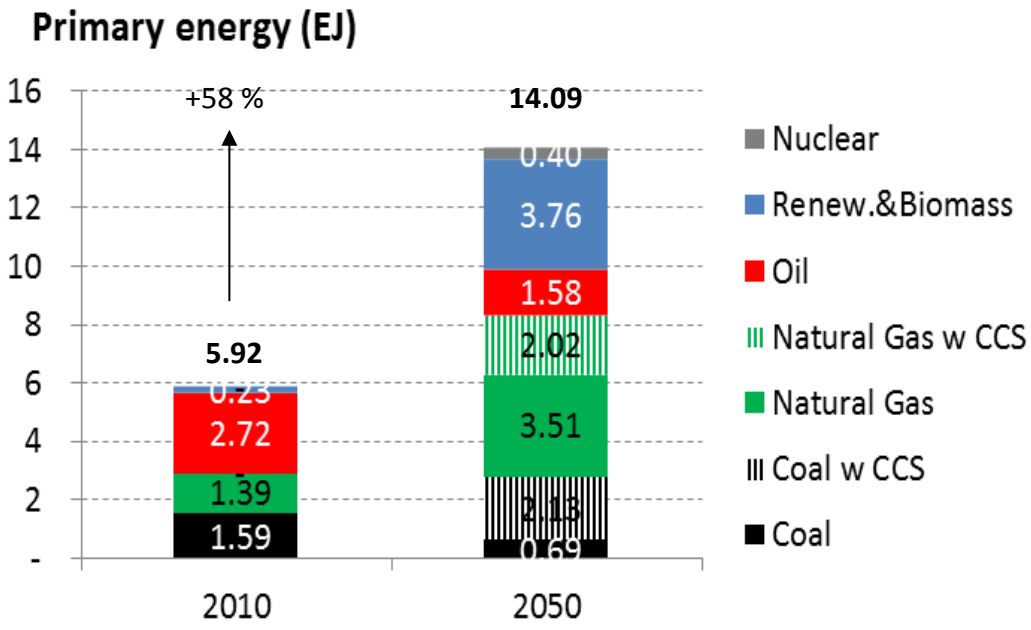
As a developing nation, the Indonesian economy and population are projected to grow significantly in the next four decades

Growth indicators and energy service demand drivers

	2010	2020	2030	2040	2050
Population [Millions]	234	252	271	289	307
GDP per capita [$/capita]	2,306	3,655	5,823	9,319	14,974
Electrification rate	70%	85%	99%	99%	99%
Poverty indicator	12%	8%	3%	3%	2%

Energy pathways by energy source

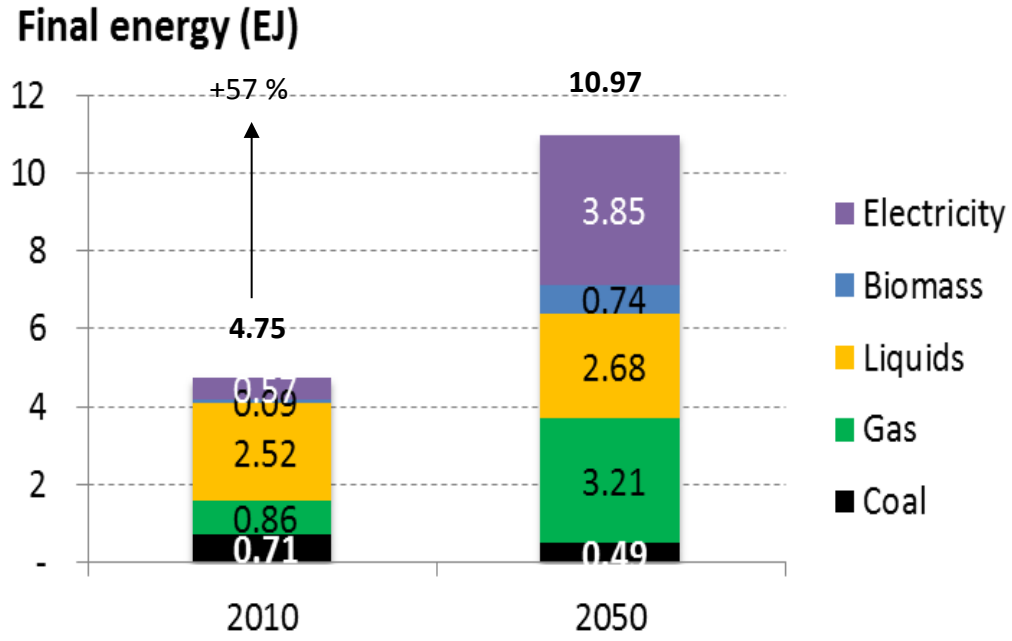
Decarbonization: has to drastically change its energy supply and demand mix



Decarbonization in primary energy:

- reduce oil consumption,
- reduce coal share; remaining coal plants with CCS,
- increase the share of natural gas; significant fraction with CCS,
- significantly increase the share of renewables, and
- begin to use nuclear power.

Energy pathways by energy source



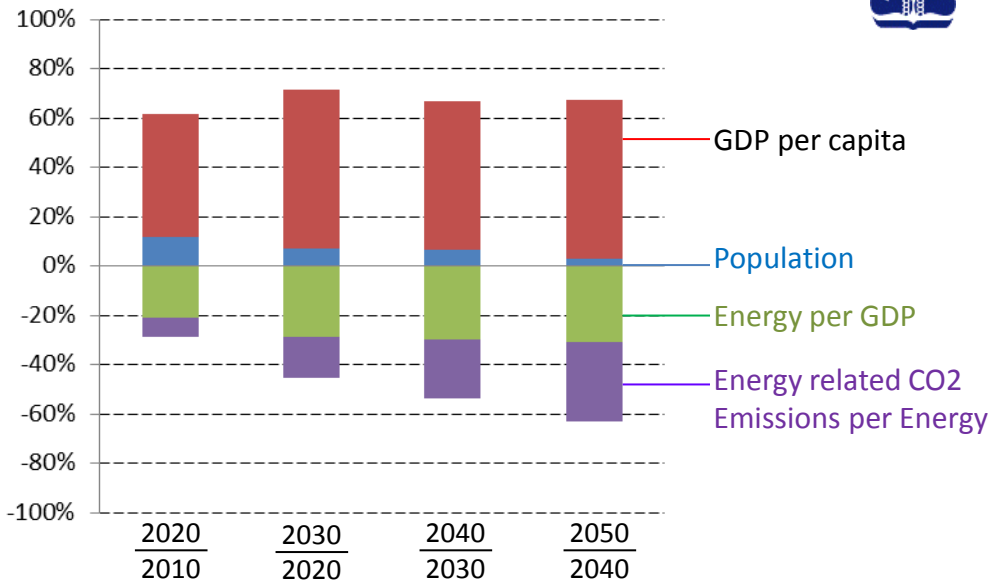
Decarbonization in final energy are:

- significantly decrease use of coal,
- increase the share of natural gas,
- significantly reduce oil consumption, and
- significantly increase share of electricity.

Element of Decarbonization

The drastic change is the result of many measures.
Decarb. is a combination of:

- energy efficiency,
- low- and zero-carbon emitting technologies, and
- structural changes in the economy.



Key elements:

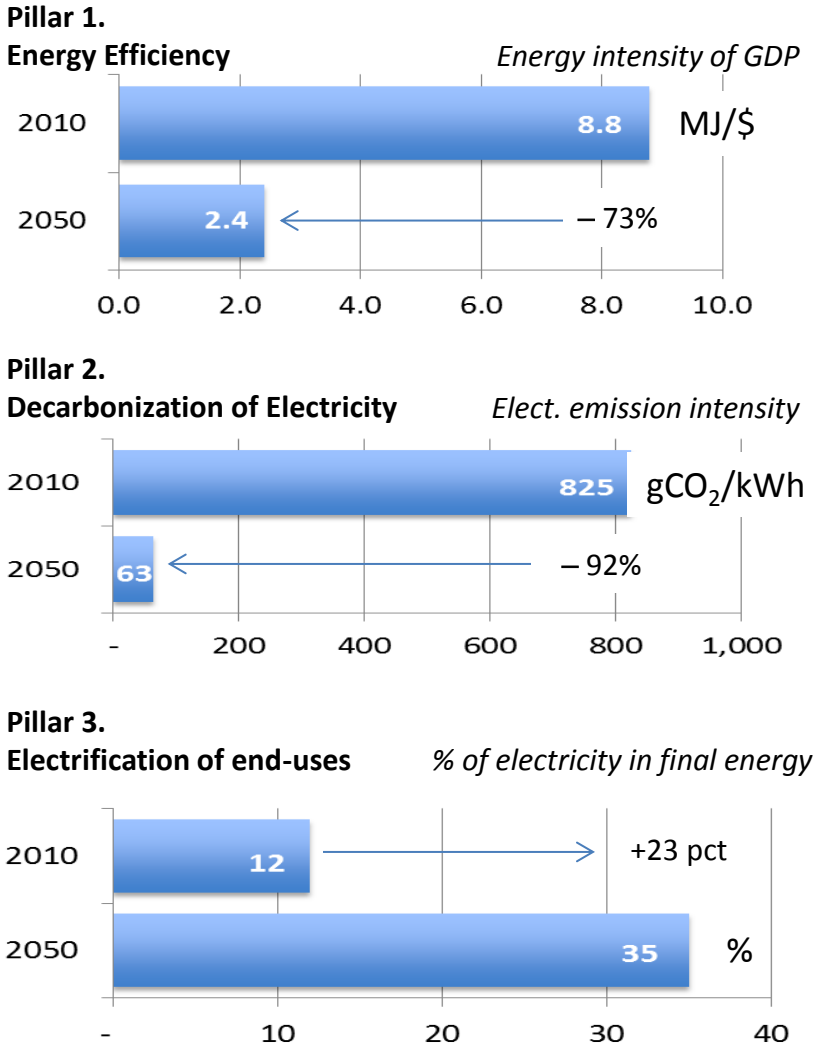
- Energy efficiency improvement in all sector.
- Use of lower-carbon emitting energy sources (switch to coal, oil to gas, switch from onsite fuel combustion to electrification). Large scale fossil combustion is equipped with CCS.
- Switching to renewable : solar, hydro, and geothermal for power, biofuels in transport, and biomass, biofuels and biogas in industry.
- Structural changes in the economy (i.e. decreased role of industry in the formation of national GDP through service sector substitution) are expected to contribute to the decarbonization of the energy sector

Decarbonization Pillars

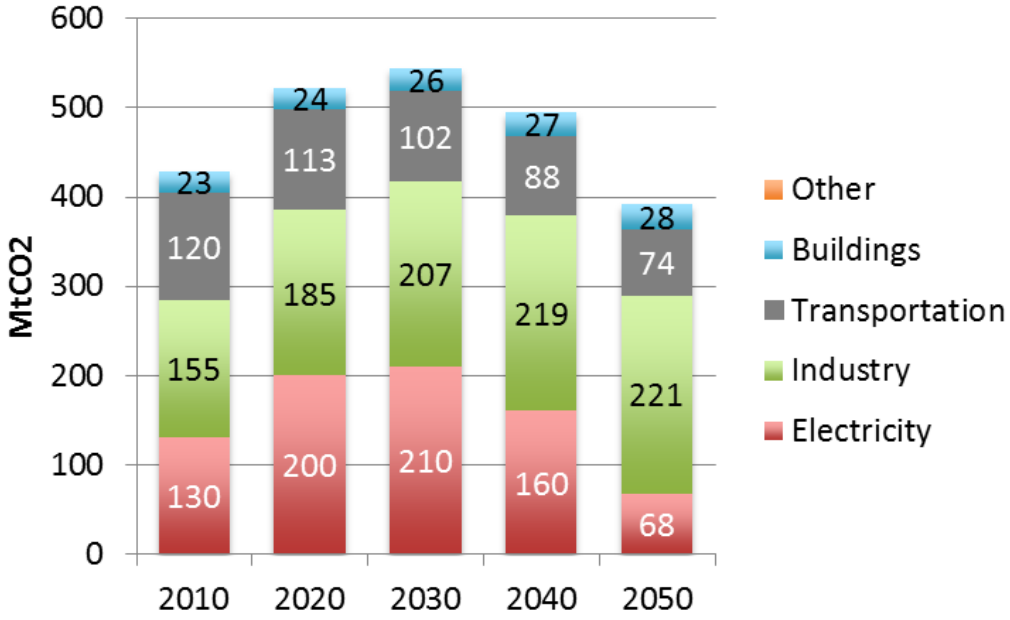
Pillar 1.
Energy efficiency measures would drastically decrease energy intensity of GDP (Energy per GDP)

Pillar 2.
Decarbonization of electricity: Use of low carbon emitting fuels and CCS would significantly electricity emission intensity (gCO2/kWh)

Pillar 3.
Electrification of end uses will reduce fossil fuel combustions and reduce emission (as long as the power generation is deeply decarbonized)



Results of Decarbonization

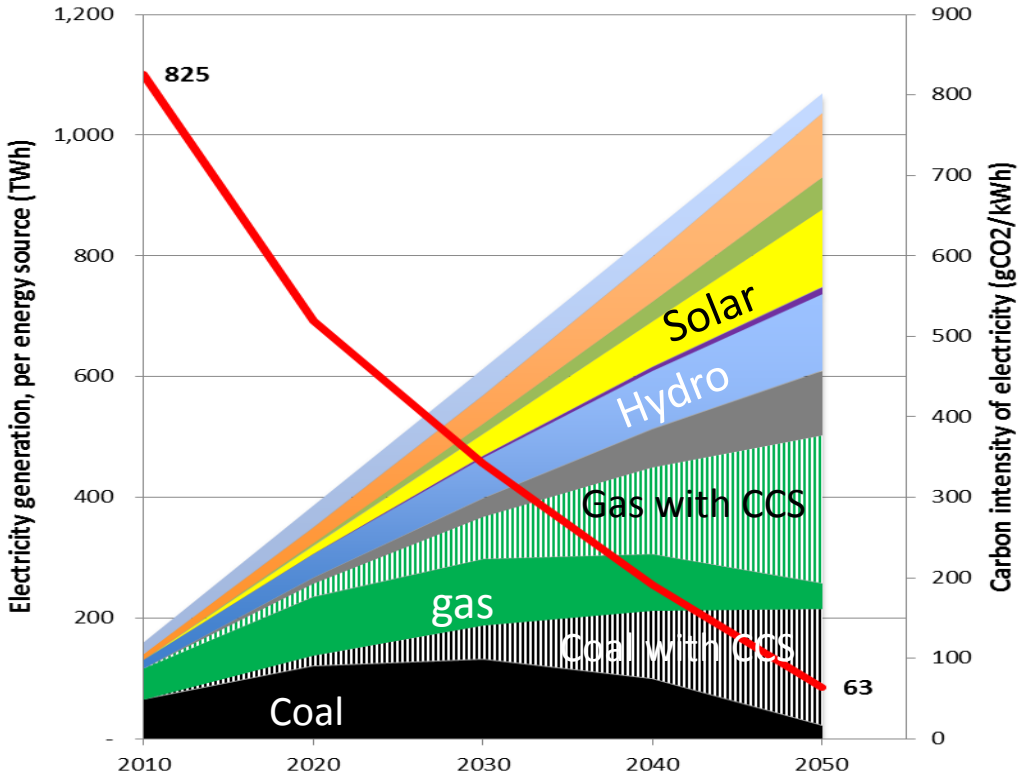


- Emission will increase (economic development) then decrease (results of decarbonization measures).
- Industry and power remain the major emission sources in 2050.
- Significant decarbonization in power, 130 $MtCO_{20}$ in 2010 to 68 $MtCO_2$ in 2050.
- Emission from industry continue to increase from 155 $MtCO_2$ in 2010 to 221 $MtCO_2$ in 2050.

Decarbonization by Sector

- Power
- Liquid fuels
- Industry
- Transport
- Bangunan

Power sector



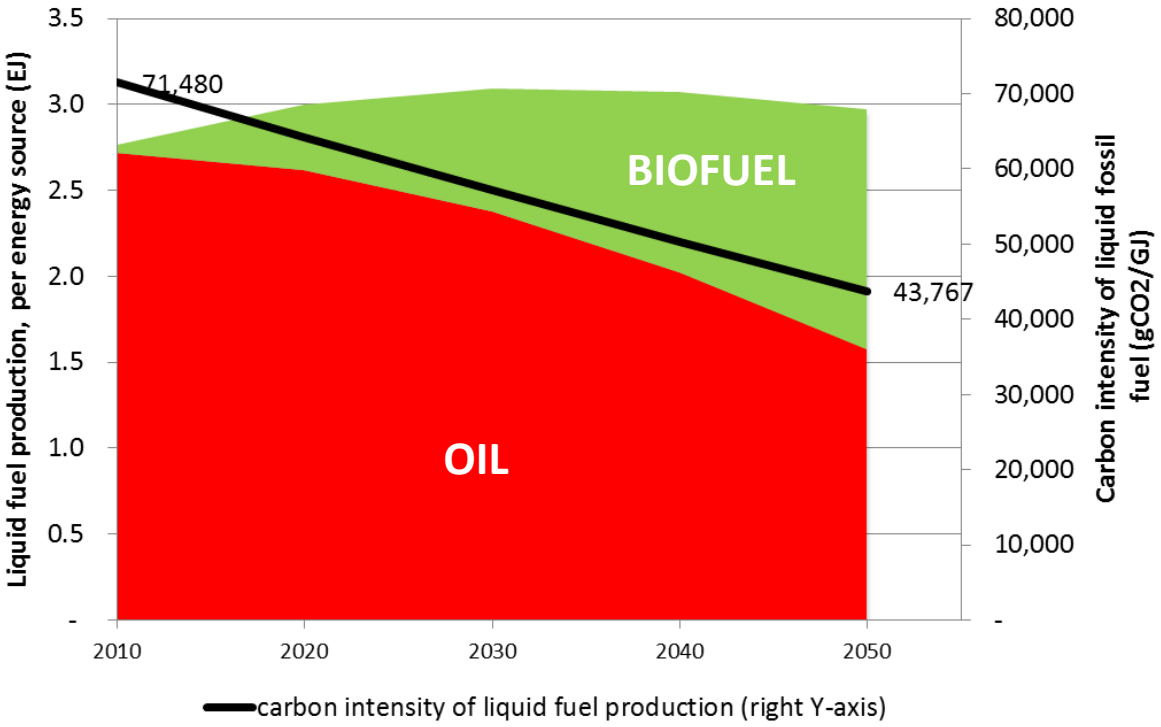
Electricity demand will increase significantly with economic development and a shift of energy use in residential, industrial, and transport toward electricity.

Decarbonization strategy:

- fuel switching to lower-carbon emitting fuels (coal to gas, oil to gas),
- massive deployment of CCS for remaining coal and gas power plants, and
- extensive deployment of renewables (solar, geothermal, hydropower, and biofuels).

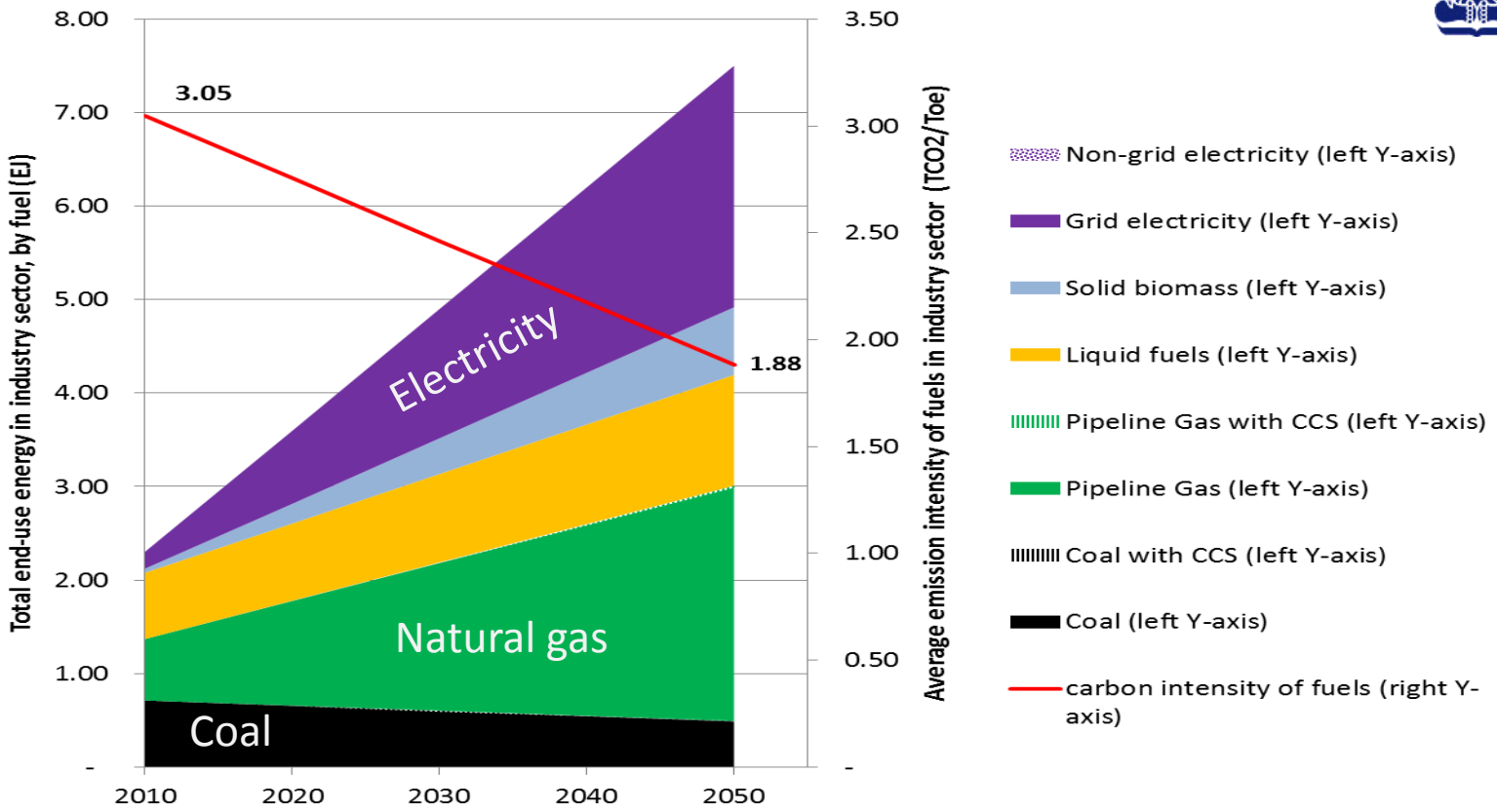
Deep decarbonization in power generation will also require deployment of nuclear power plants and efficiency improvements in existing power plants.

Liquid fuels (transport, industry, and electricity)



- To achieve deep decarbonization, there would need to be a significant switch from petroleum fuels to biofuels.
- Decrease of oil fuels due to end-use electrification (electric cooking, electric cars etc).
- Biofuels in liquid fuel mix will decrease carbon intensity.

Industry Sector

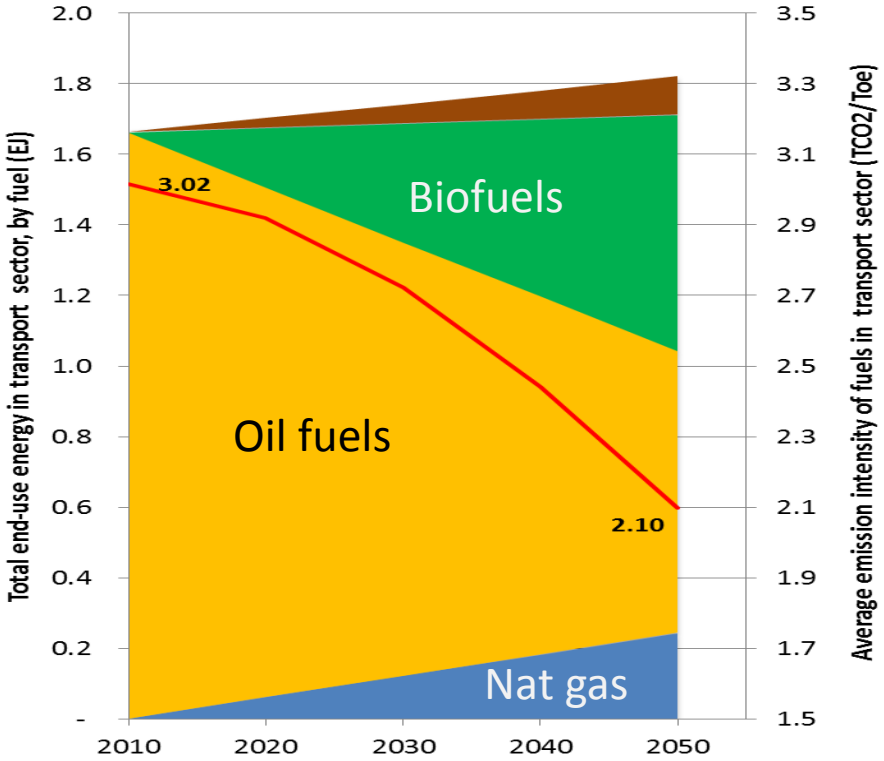


Component of decarbonization:

- Fuel switching to gas and bioenergy (solid biomass and biofuel)
- Electrification of end uses
- Reduce coal uses

Result: intensity decrease from 3.81 tCO2/toe to 1.88 tCO2/toe.

Transport Sector

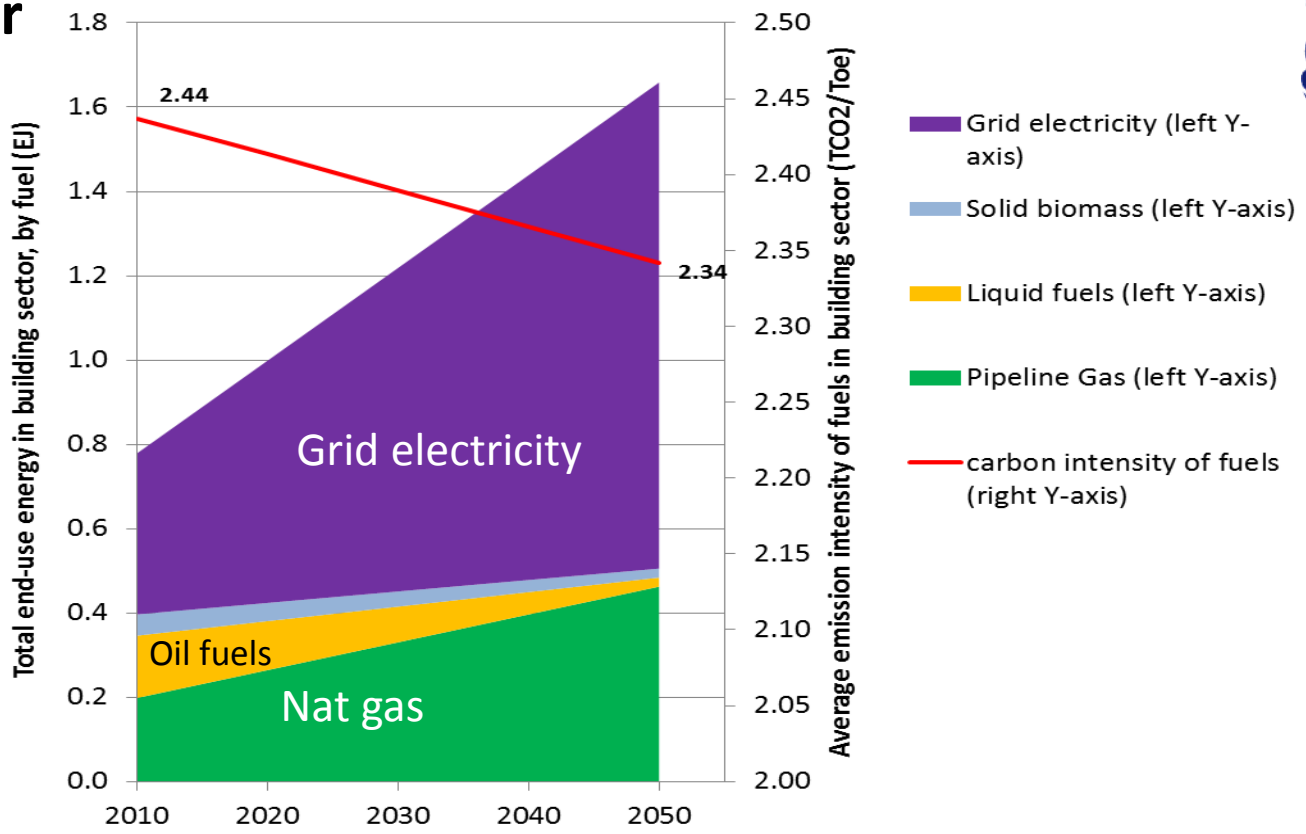


The decarbonization strategy:

- Modal shift ke mass transport, electrification, fuel switching ke gas dan biofuels, more energy-efficient vehicles, shift of freight transport dari road ke railway.
- Personal vehicles turun dari 60% in 2010 ke 40% in 2050.
- Share electric cars 30% di 2050

Hasil intensitas turun dari 3.02 tCO_2/toe ke 1.73 tCO_2/toe.

Building Sector



Decarbonization strategy:

- Fuel switching to gas/LPG and electricity
- Energy efficient devices

Residential sector: increase in per capita income increase energy consumption, but balanced by more efficient equipment

Closing Remarks

Deep decarbonization needs:

- Electrification in end-uses
- Clean coal technology and CCS
- Use all possible renewables (significant solar PV)
- Use of nuclear power plants

Implication (questions):

- At what cost, who will pay all of this?
- Economic impact?
- Compensation for not exploiting fossil resources?
- Negotiation in climate change?