Assessment of INDCs toward 2 degree target based on AIM (Asia-Pacific Integrated Model)

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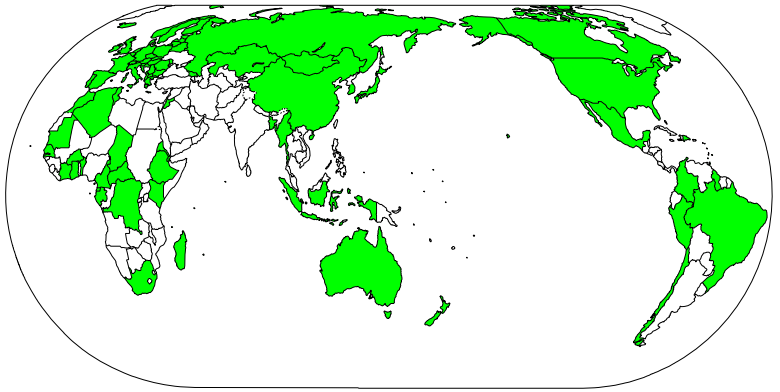
Countries submitting INDCs

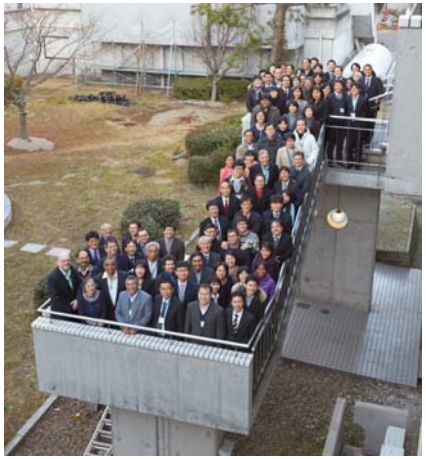


As of AM6:30, September 29, 2015 (India time)

GHG emissions in 2012 from submitted countries cover more than 75% of the total emissions.

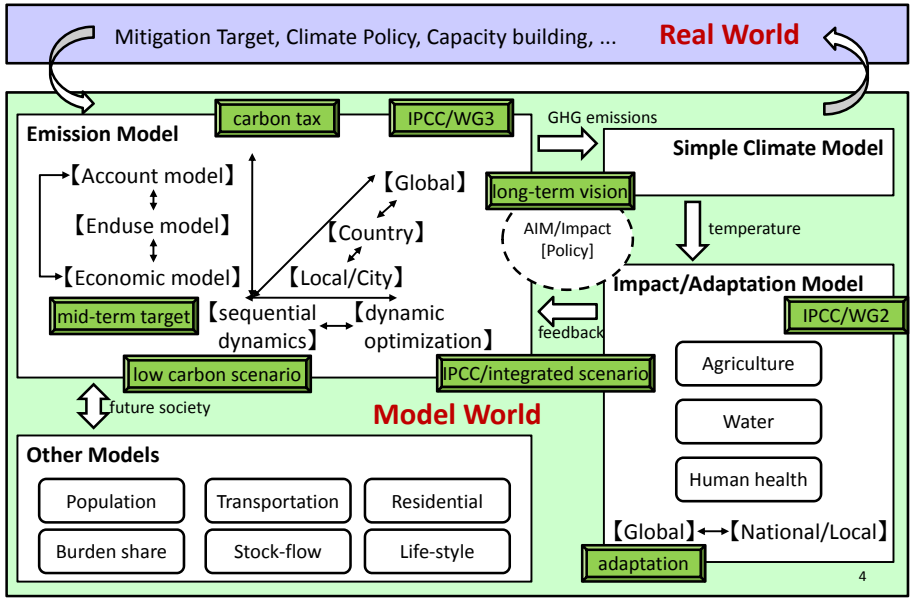
Asia-Pacific Integrated Model (AIM)

Asia-Pacific Integrated Model (AIM) is an integrated assessment model to assess mitigation options to reduce GHG emissions and impact/adaptation to avoid severe climate change damages. The model is extended to assess sustainable development policies together with Asian researchers.
http://www-iam.nies.go.jp/aim/



at the 20th AIM International Workshop in 2015

Overview of AIM



Research questions

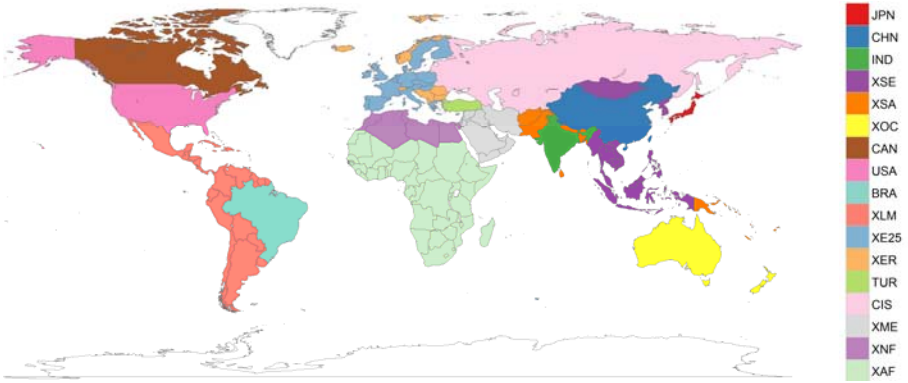
- Many countries have already submitted their INDCs.
- Some organizations have already assessed the submitted INDCs.
- By COP21 in Paris, the fundamental discussion will be done such as the relationship between INDCs' total commitment and 2℃ target in 2030.

- AIM team also tries to assess the INDCs toward 2℃ target using Global CGE model.
  - Difference of mitigation pathways to achieve 2℃ target?
  - Difference of economic impacts between optimal case and INDC case to achieve 2 ℃ target?

Our preliminary assessment of INDCs using AIM/CGE [Global]

- Global computable general equilibrium model with 17 regions, 43 sectors and 23 commodities developed by Dr. Shinichiro Fujimori.
- Emissions from both energy, land use and others can be covered.
- Recursive dynamics up to 2100.
- Gas types: CO2, CH4, N2O, SOx, NOx, CO, BC, OC, VOC, and NH3
- Simple climate model, MAGICC6, is linked to show the future climate condition.
- This model is utilized to assess SSPs (Shared Socio-economic Pathways) to show the future scenarios.
- The detailed model description, please see the following website; http://www.nies.go.jp/social/dp/pdf/2012-01.pdf

Definition of 17 regions of AIM/CGE [Global]

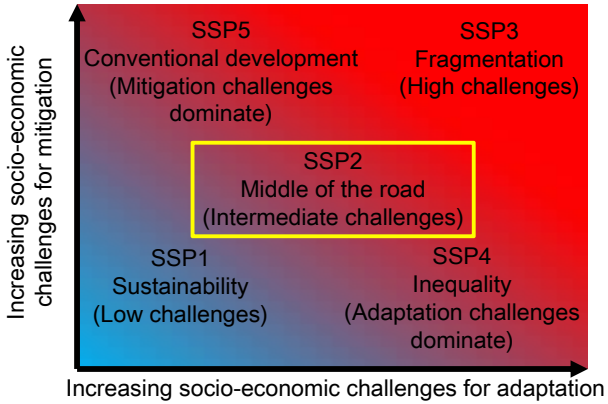


Main outputs from AIM/CGE [Global]

- Socio-economic activities
  - GDP
  - Population (exogenous)
- Emissions
  - Kyoto 6 gas
  - Air Pollutants
- Climate
  - Radiative forcing
  - Global mean temperature
- Mitigation costs
  - GDP loss
  - Consumption loss (welfare loss)
- Prices
  - Carbon price
  - Energy prices
  - Agricultural product prices
- Energy
  - Primary energy supply
  - Electricity supply by technologies
  - Final energy demands by sectors
- Agriculture and land use
  - Agricultural products and consumption
  - Land use change

Basic assumptions
Socio-economy up to 2100

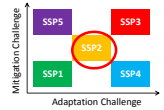
- Future changes of population, GDP, technology and preference will follow SSP2 "middle of the road."
  - New scenario sets to assess the future climate change mitigation and adaptation.
  - The basic assumptions of GDP and population are different from the forecasts by each national government.



Source: Brian O'Neill et al. (2012)

Concept of SSPs

SSP2: Middle of the road



In this world, **trends typical of recent decades continue, with some progress towards achieving development goals, reductions in resource and energy intensity at historic rates, and slowly decreasing fossil fuel dependency**. Development of low-income countries proceeds unevenly, with some countries making relatively good progress while others are left behind. Most economies are politically stable with partially functioning and globally connected markets. A limited number of comparatively weak global institutions exist. Per-capita income levels grow at a medium pace on the global average, with slowly converging income levels between developing and industrialized countries. Intra-regional income distributions improve slightly with increasing national income, but disparities remain high in some regions. Educational investments are not high enough to rapidly slow population growth, particularly in low-income countries. Achievement of the Millennium Development Goals is delayed by several decades, leaving populations without access to safe water, improved sanitation, medical care. Similarly, there is only intermediate success in addressing air pollution or improving energy access for the poor as well as other factors that reduce vulnerability to climate and other global changes.

Source: Brian O'Neill et al. (2012)

Basic assumptions
Mitigation target

- In this presentation, following countries mitigation targets submitted by August 18th are assessed.
- The final results will soon be uploaded at website of AIM; http://www-iam.nies.go.jp/aim/index.html

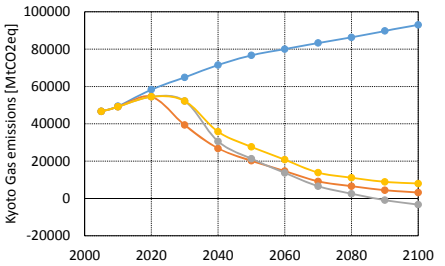
Switzerland	Morocco	Kenya
EU	Ethiopia	Monaco
Norway	Serbia	The former Yugoslav Republic of Macedonia
Mexico	Iceland	Trinidad and Tobago
USA	China	Benin
Gabon	Republic of Korea	Australia
Russia	Singapore	Djibouti
Liechtenstein	New Zealand	Democratic Republic of the Congo
Andorra	Japan	Dominican Republic
Canada	Marshall Islands	

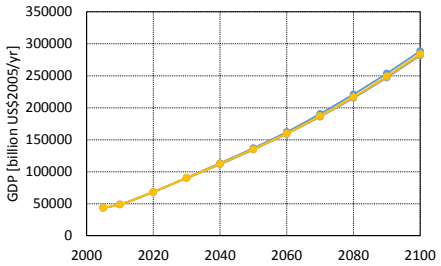
Mitigation scenarios

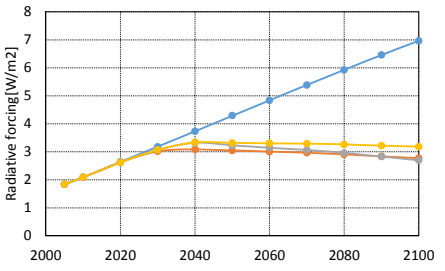
Scenario	Contents
Ref	Without climate policies (Business as Usual scenario).
26W_opt	Following Copenhagen pledge in 2020, and then immediately reducing GHG emissions to meet RCP2.6*.
26W_INDC	Following Copenhagen pledge in 2020 and INDC in 2030, and then reducing GHG emissions to meet RCP2.6 (cumulative emissions during the 21st century).
32W_INDC	Following Copenhagen pledge in 2020 and INDC in 2030, and then applying the same GHG reduction rate as "Opt26W". The emission path will be similar with that to achieve 3.2W of radiative forcing.

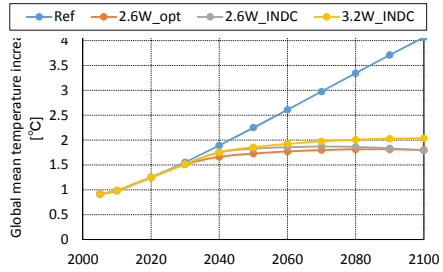
* RCP2.6 is the lowest emission scenario among the 4 RCPs (Representative Concentration Pathways). In this analysis, the cumulative emissions during 21st century should be the same with those in RCP2.6.

Preliminary results (1) Global

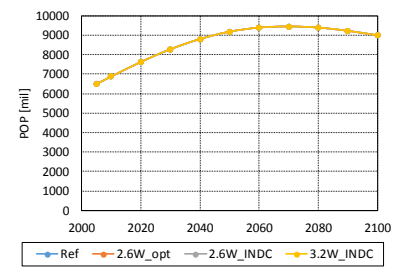




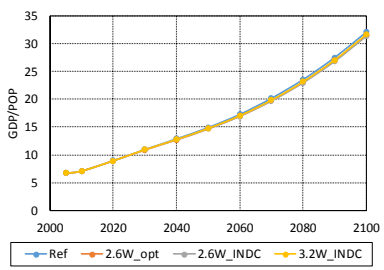




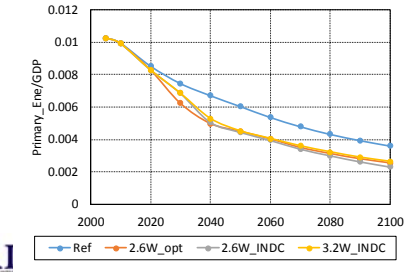
Preliminary results (1) Global



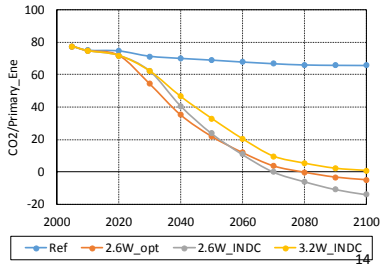
Population_World



GDP per capita_World

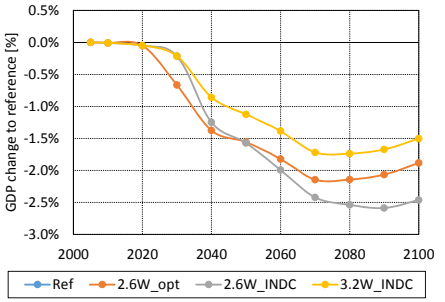


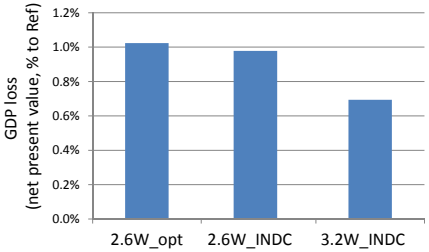
Energy intensity_World



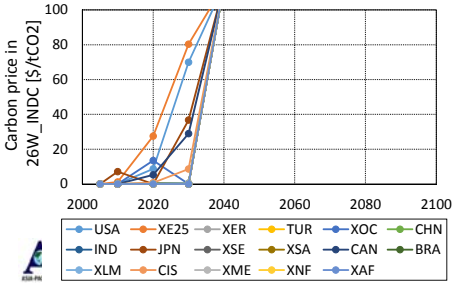
Carbon intensity_World

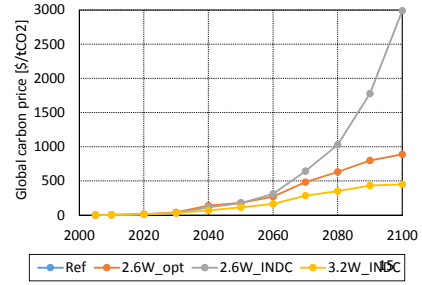
Preliminary results (1) Global



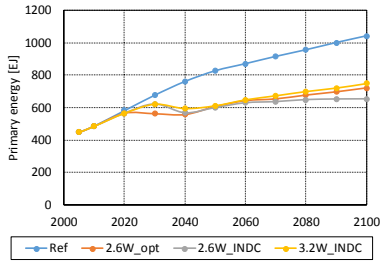


discount rate: 5%/yr

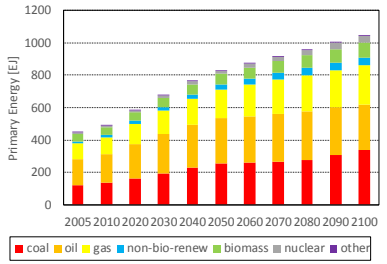




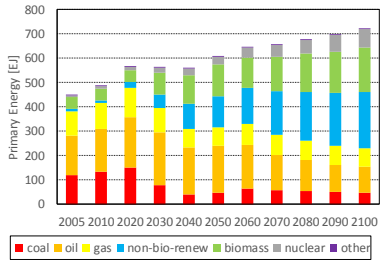
Preliminary results (1) Global



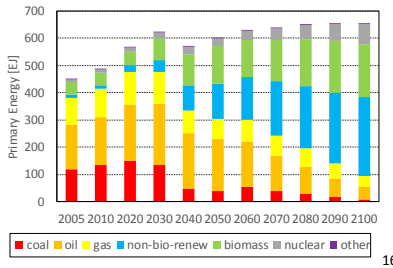
Primary energy_World



Primary energy_World_Ref

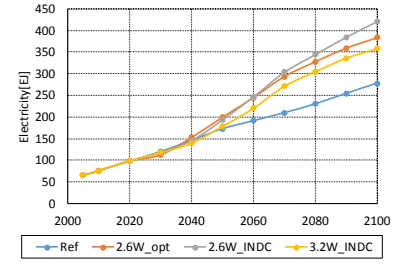


Primary energy_World_2.6W_opt

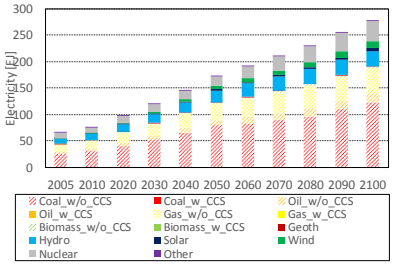


Primary energy_World_2.6W_INDC

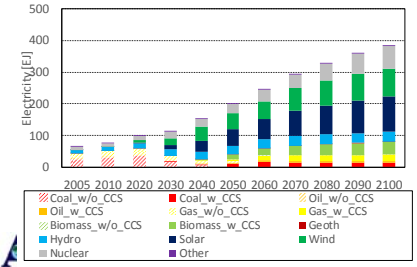
Preliminary results (1) Global



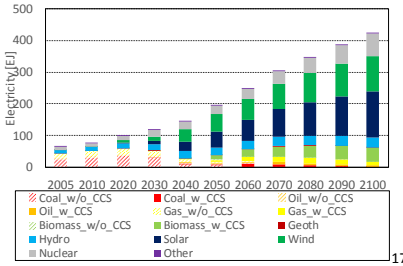
Power supply_World



Power supply_World_Ref

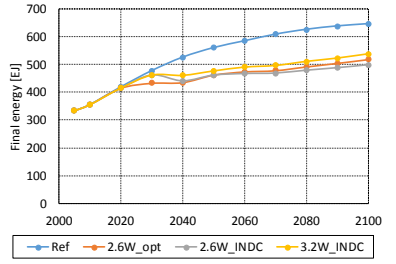


Power supply_World_2.6W_opt

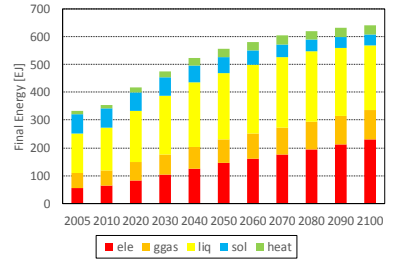


Power supply_World_2.6W_INDC

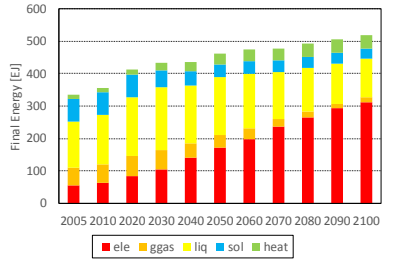
Preliminary results (1) Global



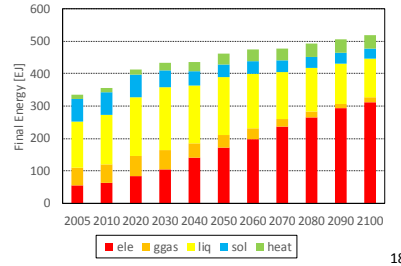
Final energy_World



Final energy_World_Ref



Final energy_World_2.6W_Opt

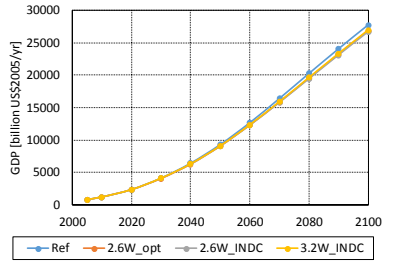


Final energy_World_2.6W_INDC

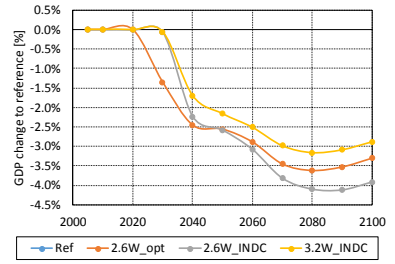
Preliminary conclusions from Global results.

- In order to achieve the 2 degree target under the present INDCs pledges, the more GHG emission reduction will be needed at the end of the 21st century compared to the earlier mitigation actions.
- If the emission reduction rate after 2030 will be the same as those in the earlier mitigation actions case to achieve the 2 degree target, the global mean temperature will reach 2 degree by 2100. (In the case of 2 degree target, the global mean temperature in 2100 will be 1.8 degree.)

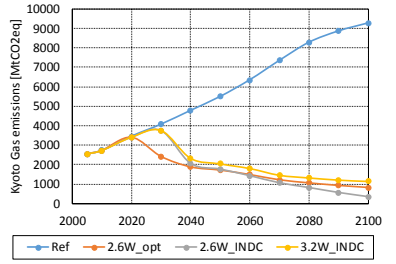
Preliminary results (2) India



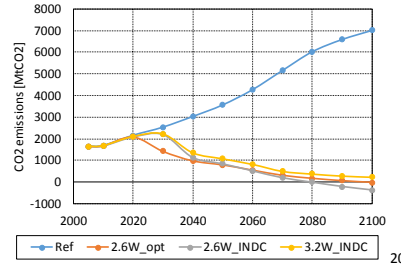
GDP_IND



GDP change_IND

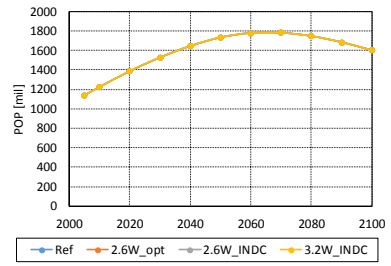


Kyoto Gas emissions_IND

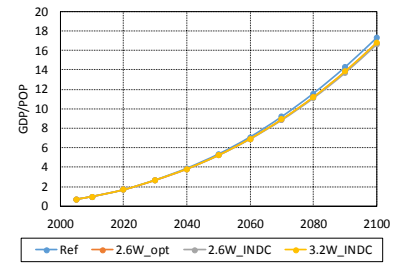


CO2 emissions_IND

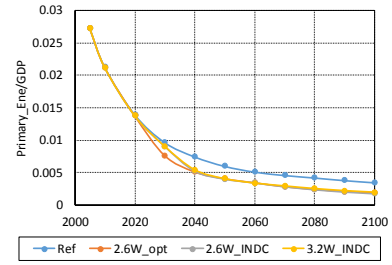
Preliminary results (2) India



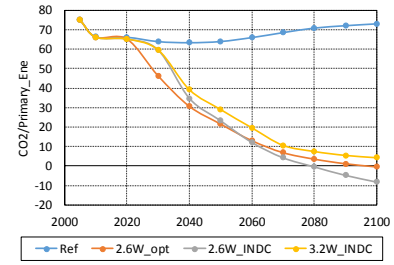
Population_IND



GDP per capita_IND

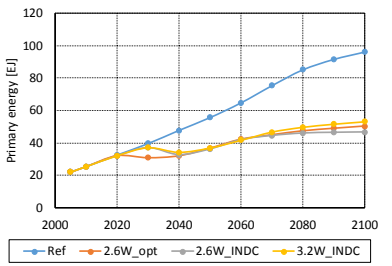


Energy intensity_IND

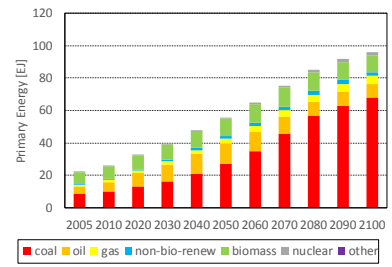


Carbon intensity_IND

Preliminary results (2) India



Primary energy_IND



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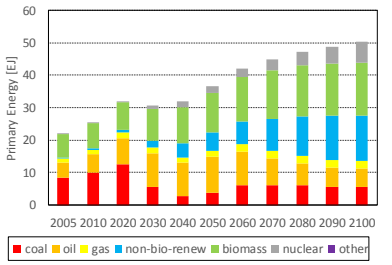
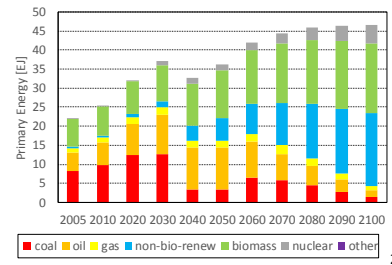
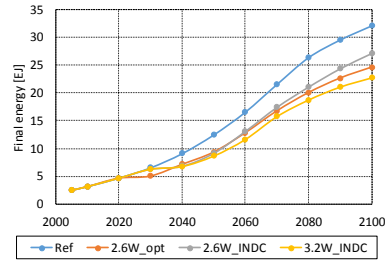


Primary energy_IND_2.6W_opt

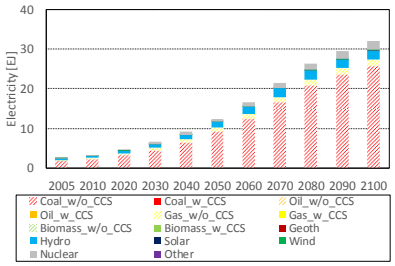


Primary energy_IND_2.6W_INDC

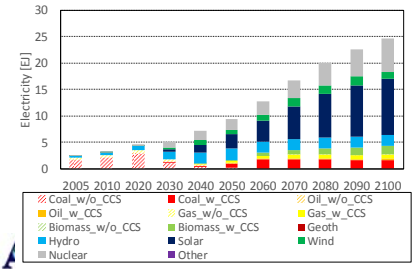
Preliminary results (2) India



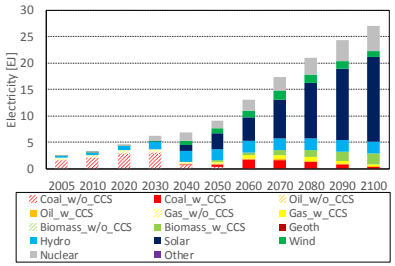
Power supply_IND



Power supply_IND_Ref

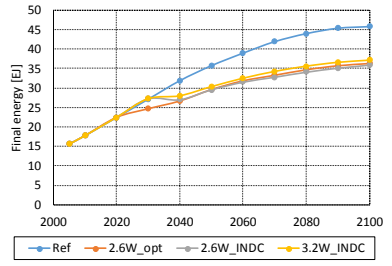


Power supply_World_2.6W_opt

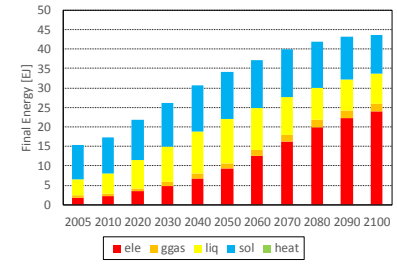


Power supply_IND_2.6W_INDC

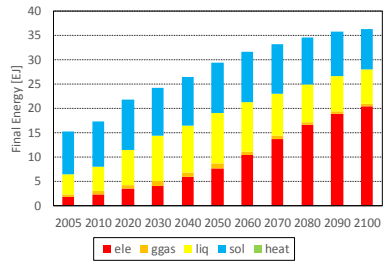
Preliminary results (2) India



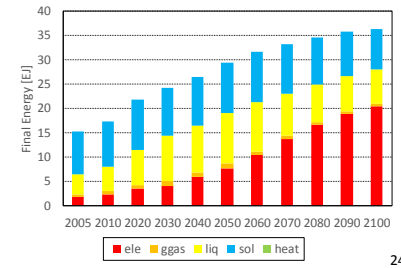
Final energy_IND



Final energy_IND_Ref

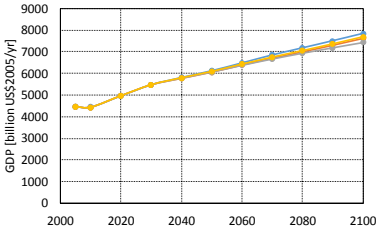


Final energy_IND_2.6W_Opt

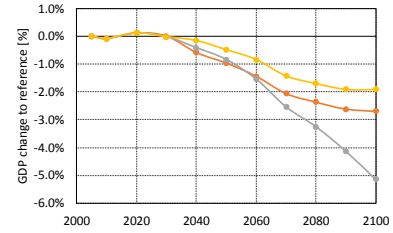


Final energy_IND_2.6W_INDC

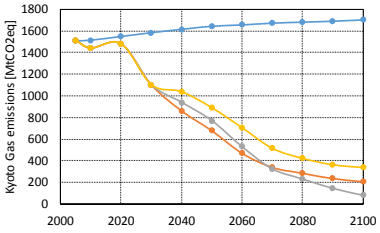
Preliminary results (3) Japan



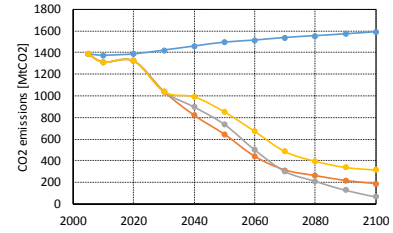
GDP_JPN



GDP change_JPN

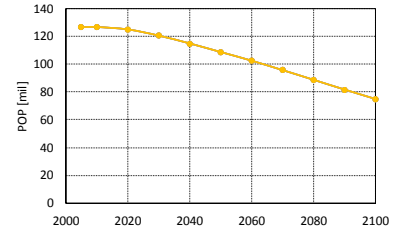


Kyoto Gas emissions_JPN

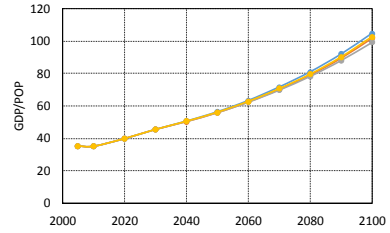


CO2 emissions_JPN

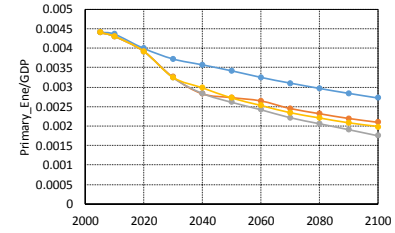
Preliminary results (3) Japan



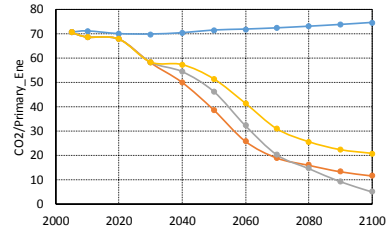
Population_JPN



GDP per capita_JPN

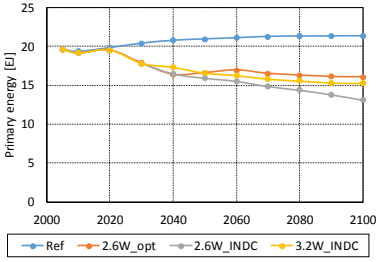


Energy intensity_JPN

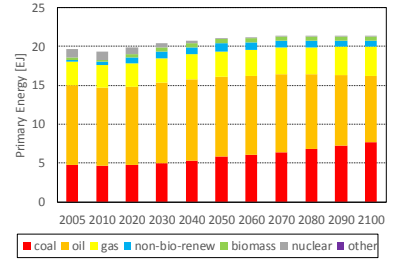


Carbon intensity_JPN

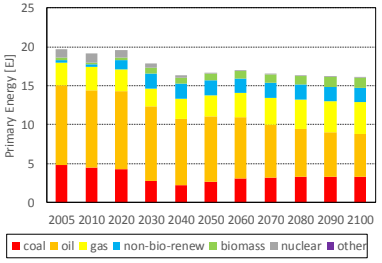
Preliminary results (3) Japan



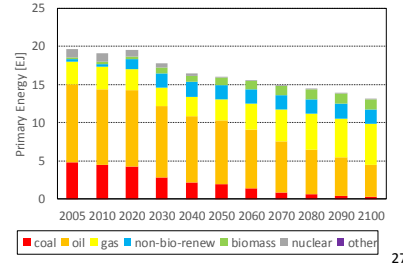
Primary energy_JPN



Primary energy_JPN_Ref

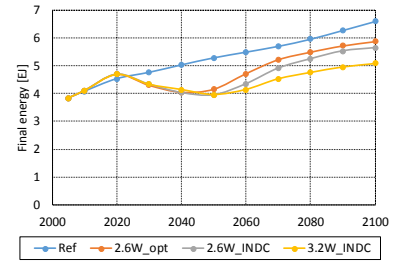


Primary energy_JPN_2.6W_opt

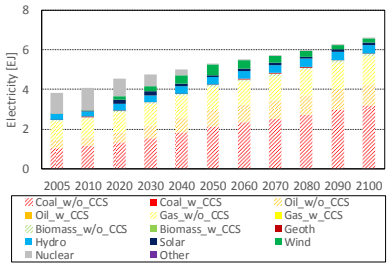


Primary energy_JPN_2.6W_INDC

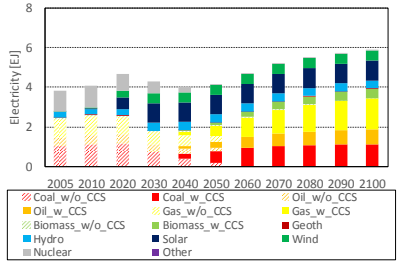
Preliminary results (3) Japan



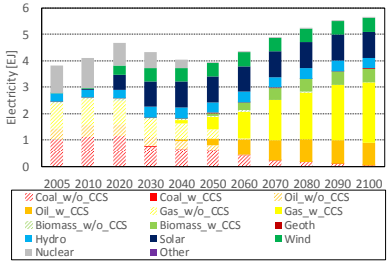
Power supply_JPN



Power supply_JPN_Ref

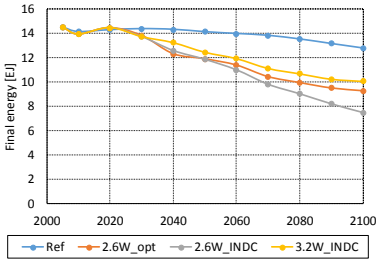


Power supply_World_2.6W_opt

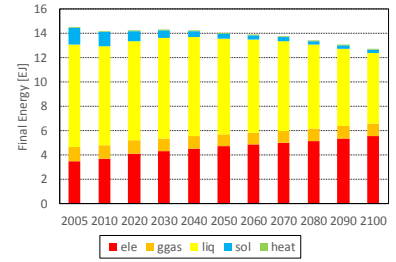


Power supply_JPN_2.6W_INDC

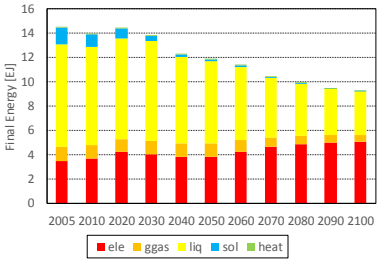
Preliminary results (3) Japan



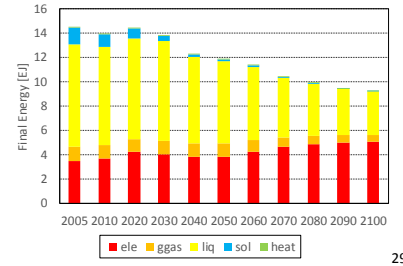
Final energy_JPN



Final energy_JPN_Ref

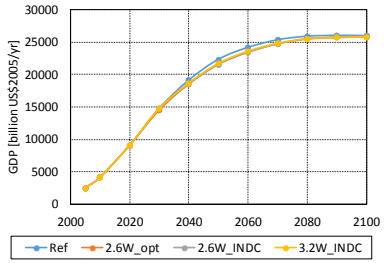


Final energy_JPN_2.6W_Opt

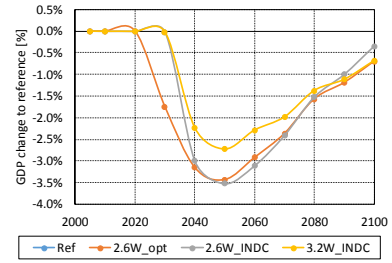


Final energy_JPN_2.6W_INDC

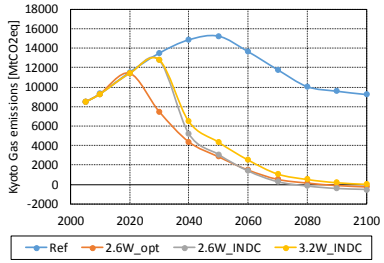
Preliminary results (4) China



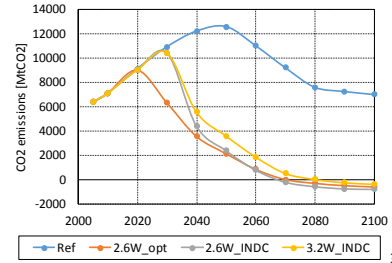
GDP_CHN



GDP change_CHN

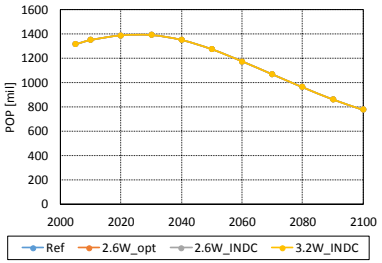


Kyoto Gas emissions_CHN

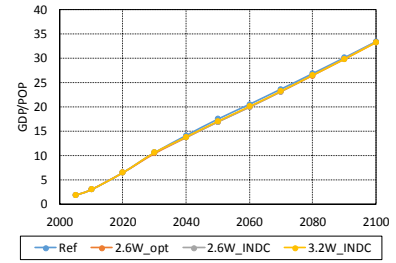


CO2 emissions_CHN

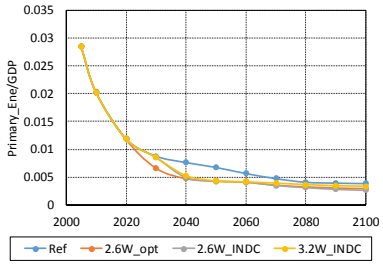
Preliminary results (4) China



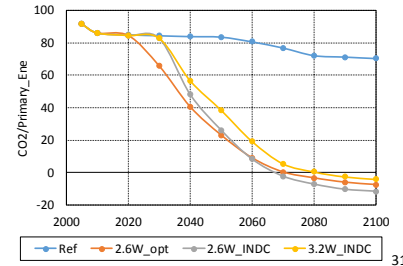
Population_CHN



GDP per capita_CHN

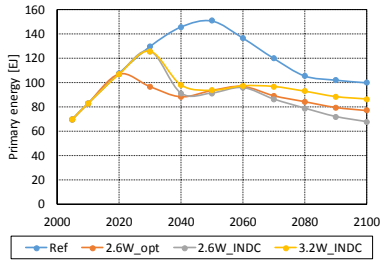


Energy intensity_CHN

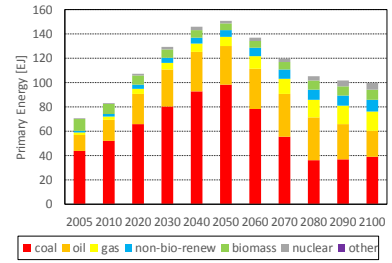


Carbon intensity_CHN

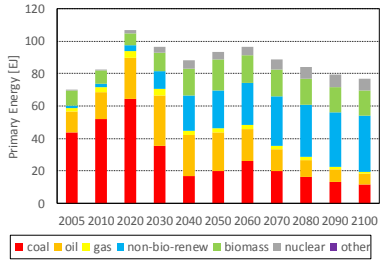
Preliminary results (4) China



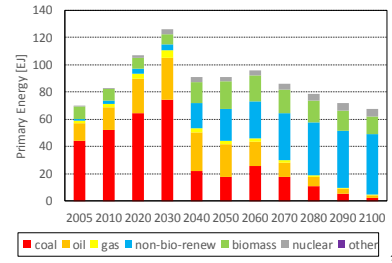
Primary energy_CHN



Primary energy_CHN_Ref

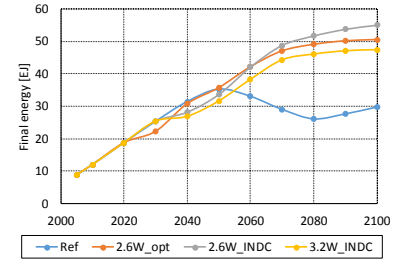


Primary energy_CHN_2.6W_opt

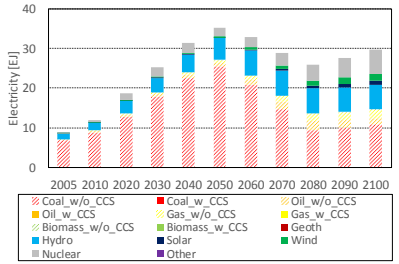


Primary energy_CHN_2.6W_INDC

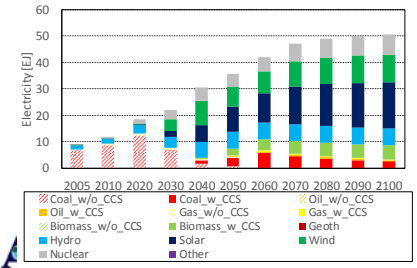
Preliminary results (4) China



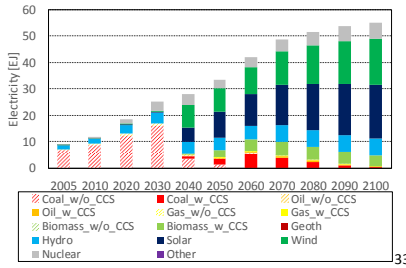
Power supply_CHN



Power supply_CHN_Ref

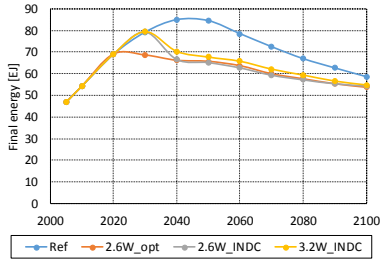


Power supply_World_2.6W_opt

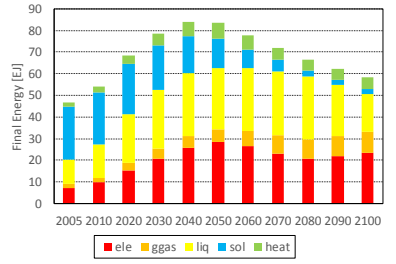


Power supply_CHN_2.6W_INDC

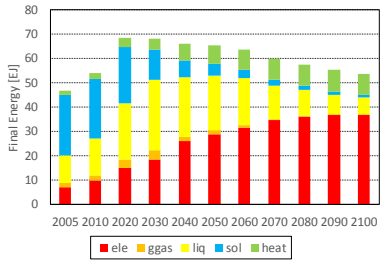
Preliminary results (4) China



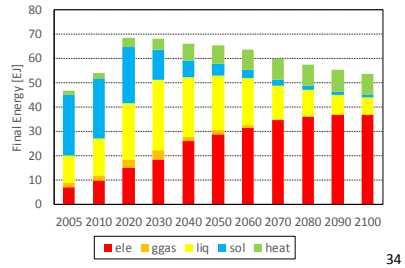
Final energy_CHN



Final energy_CHN_Ref



Final energy_CHN_2.6W_Opt



Final energy_CHN_2.6W_INDC

Further works

- Reflecting the latest INDCs.
- Exploring the more reliable emission pathway after 2030 to achieve 2 degree target.
- Checking the consistency between national socio-economy/energy forecasts and the SSP2.
  - Japan: economic forecast by government is too high, and power supply by technologies are determined by government.
  - Other countries such as China mention the renewable energy.
- Future technologies, especially technologies contributing negative emissions.
- Climate change impact among the scenarios.