CO_2 emission projection for South Korea

- AIM/Enduse model -

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CONTENT

01 Introduction

01 Introduction

Background

- Adverse impacts of climate change will be increased
- The studies to identify the relationship between GHG and impacts have been conducted
- There are limited study on these topics
- In order to mediate negative impact of climate change in Korea peninsula, identifying GHG substances in East Asia is necessary
- Korea-China-Japan collaborative study on relevant topic is in progress, and this is the result from Korea

Objective

- Estimating the amount of GHG and air pollutant emissions through developing the scenarios about forecasting socio-economic change in Korea

02 Scope and Methodology

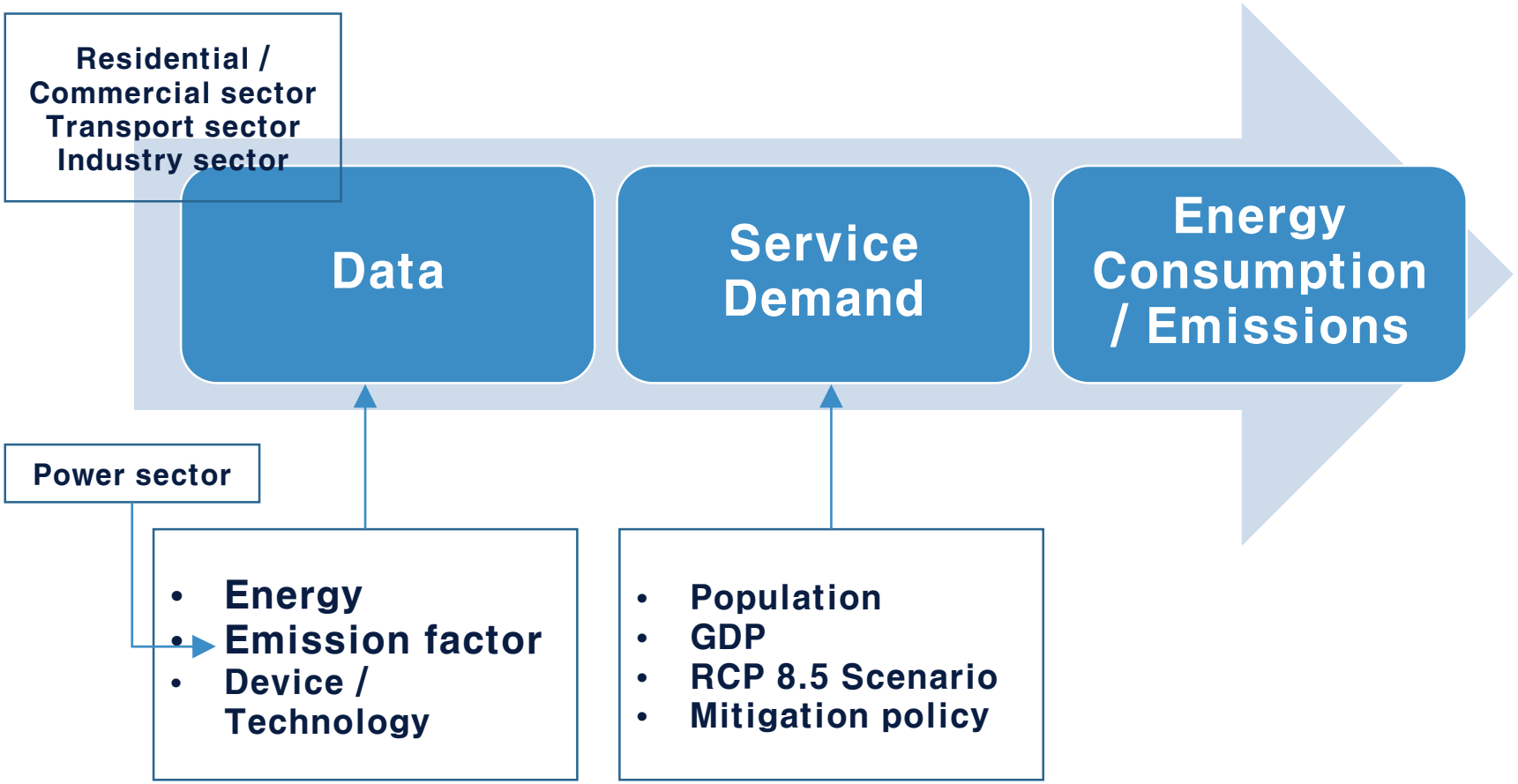
02 Scope and Methodology

Scope

- Time
  - 2010 – 2100
    - Base Year : 2010
    - Target Year : 2030, 2050, 2100
- Sectors
  - Residential sector
  - Commercial sector
  - Transport sector
  - Industry sector (Steel, Cement, Other industries)
- Data
  - Population, GDP : OECD, IIASA
  - Mitigation policy : National policy, National research institutes

02 Scope and Methodology

Methodology



02 Scope and Methodology

Methodology

1) Residential and Commercial sector

- **Service demand calculated as follow equation**

Energy service per capita
= service area x service time x service intensity

- **Specific factors**

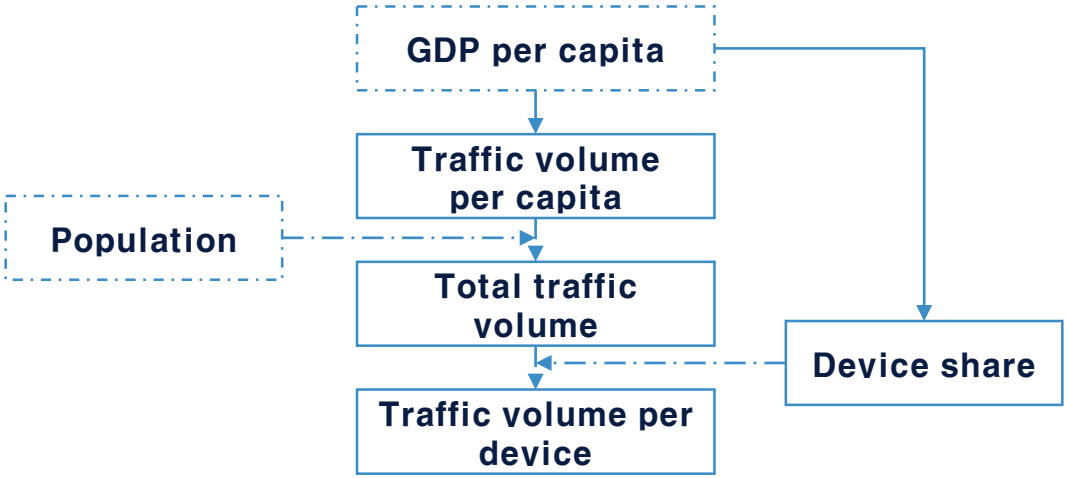
Services	Area	Time	Intensity
Heating	area per person	Staying time / Business hour	Heating days
Cooling	area per person	Staying time / Business hour	Cooling days
Hot water	-	Times of dish-washing and shower	-
Cooking	-	Ratio of eating at home	-
Lighting	area per person	Staying time / Business hour	
Others	-	-	GDP per capita

02 Scope and Methodology

Methodology

2) Transport sector

- **Service demand of transport sector are based on population and GDP**



- **Service demand of freight are calculated with logistic curve**

$$PKTOTP_{i,t} = \frac{pka_i}{1+\exp\left\{-pkc\cdot\left(\overline{GDPP}_{i,t} - pkb_i\right)\right\}}$$

02 Scope and Methodology

Methodology

3) Industry sector

- demand per capita are used to project the service demand in steel industry and cement industry
- 1.4 ton/person in steel industry, 1.1 ton/person in cement industry after 2050

Service demand
= service demand per capita x population

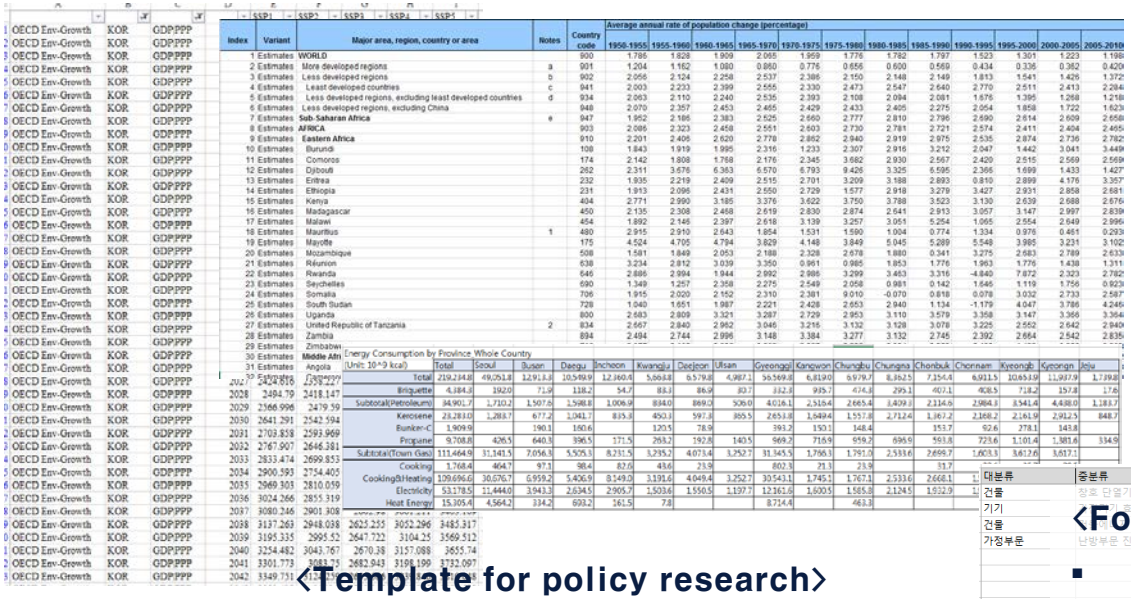
- In case of other industries, we used the rate of GDP change in Japan
- From 2010-2030 in Japan to 2030-2050 in Korea, from 2030-2050 in Japan to 2050-2100 in Korea

03 Results and Discussion

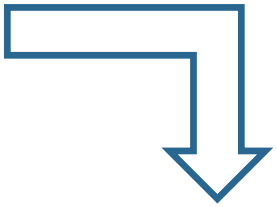
03 Results and Discussion

1) Mitigation Policies

- **BAU scenario contained the national policy of mitigation**



〈Template for policy research〉



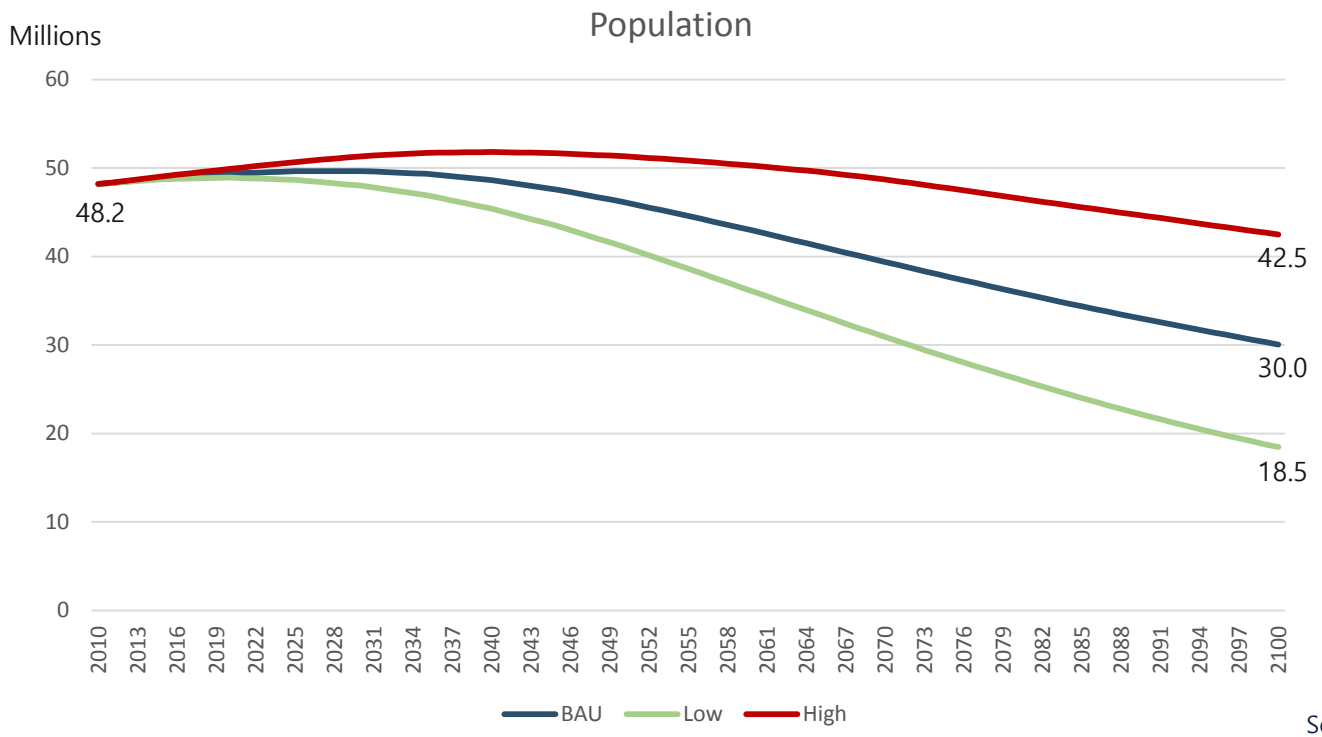
〈For example〉

- **Distribution rate of high efficiency electronic device in residential sector from 2010 to 2050**
- **Distribution rate of electric cars in transport sector from 2010 to 2020**
- **National development plan in power sector to 2020**
- **Energy plan in industrial sector**

03 Results and Discussion

2) Population projection

- **Population will be declined after 2030 in the most of scenarios**
- **Population in 2100 will be 62% in BAU, 38% in low emission scenario, 88% in high emission scenario**

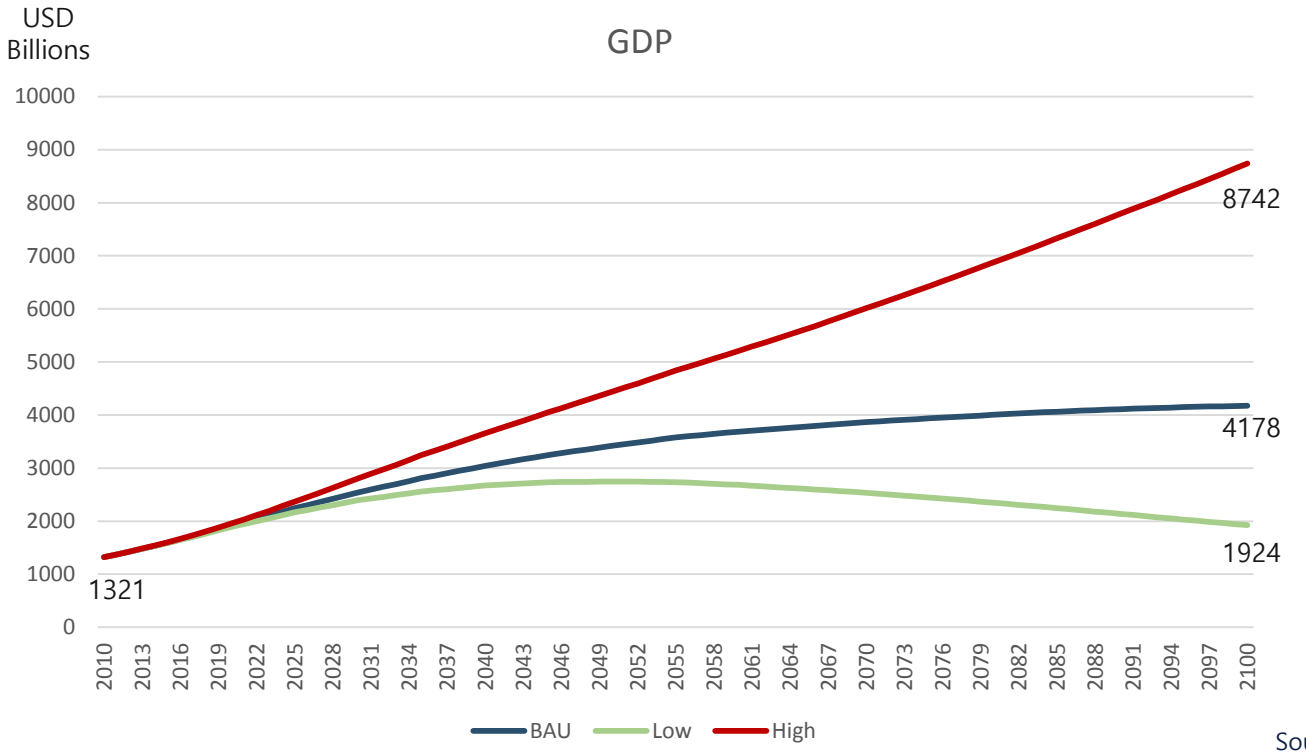


Source : IIASA

03 Results and Discussion

2) GDP projection

- **GDP in 2100 will be 316% in BAU, 146% in low emission scenario, 662% in high emission scenario**

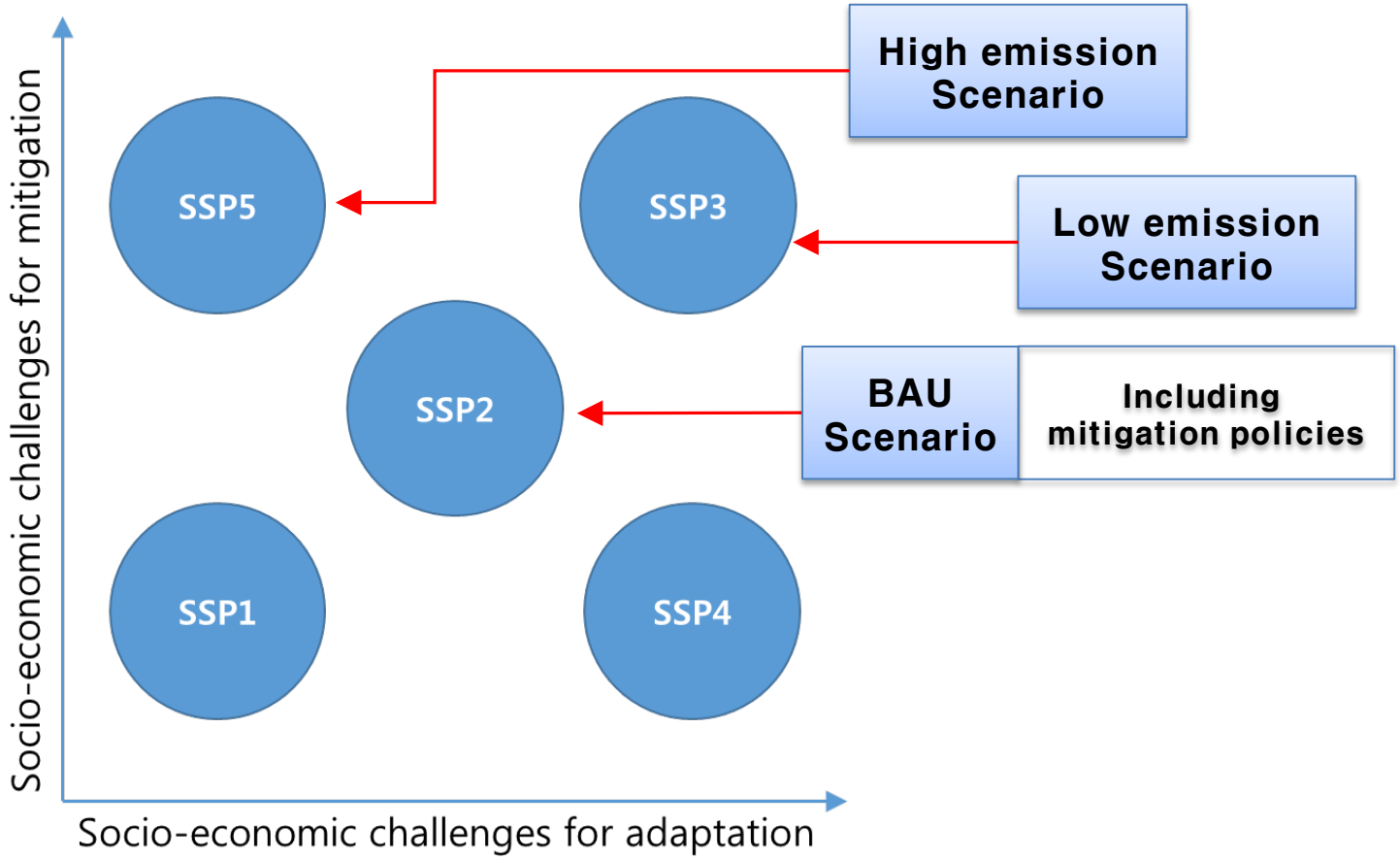


Source : IIASA

03 Results and Discussion

3) Social economic condition

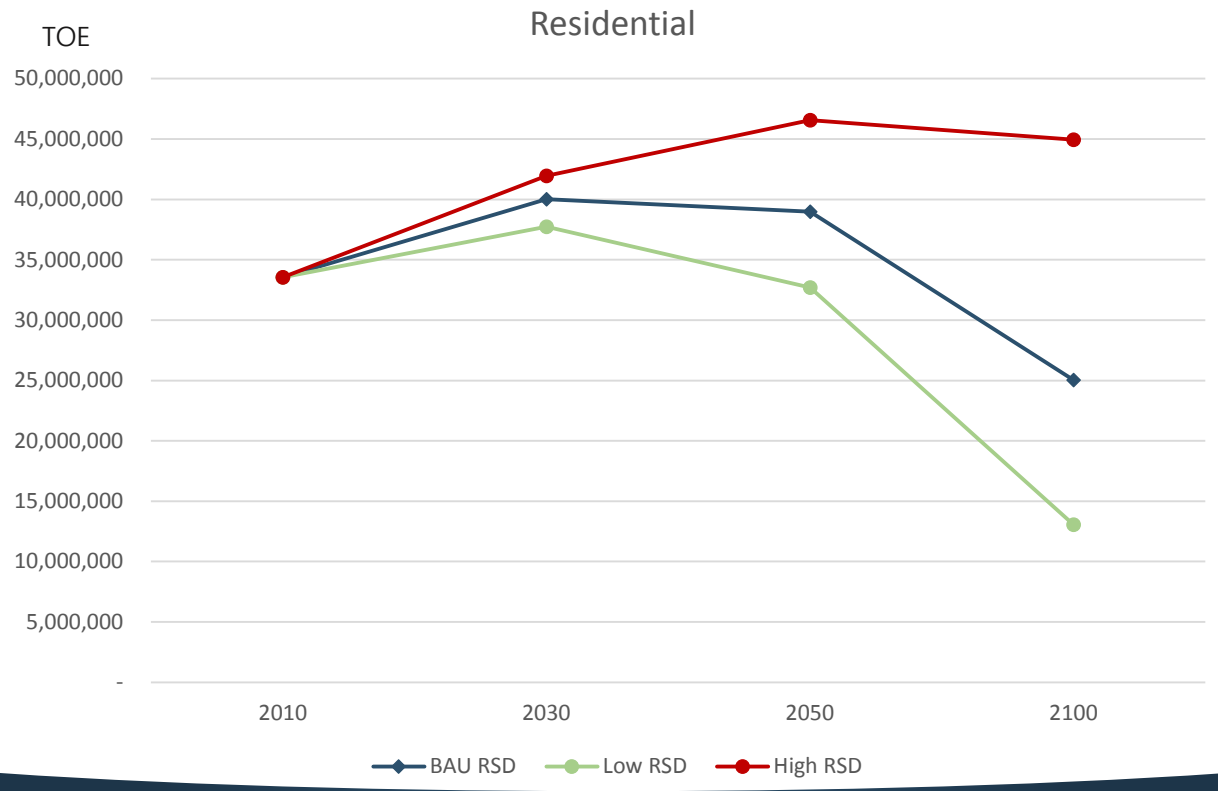
- **Socio-economic scenarios will be matched SSP2, 3, 5**



03 Results and Discussion

4) Service demand

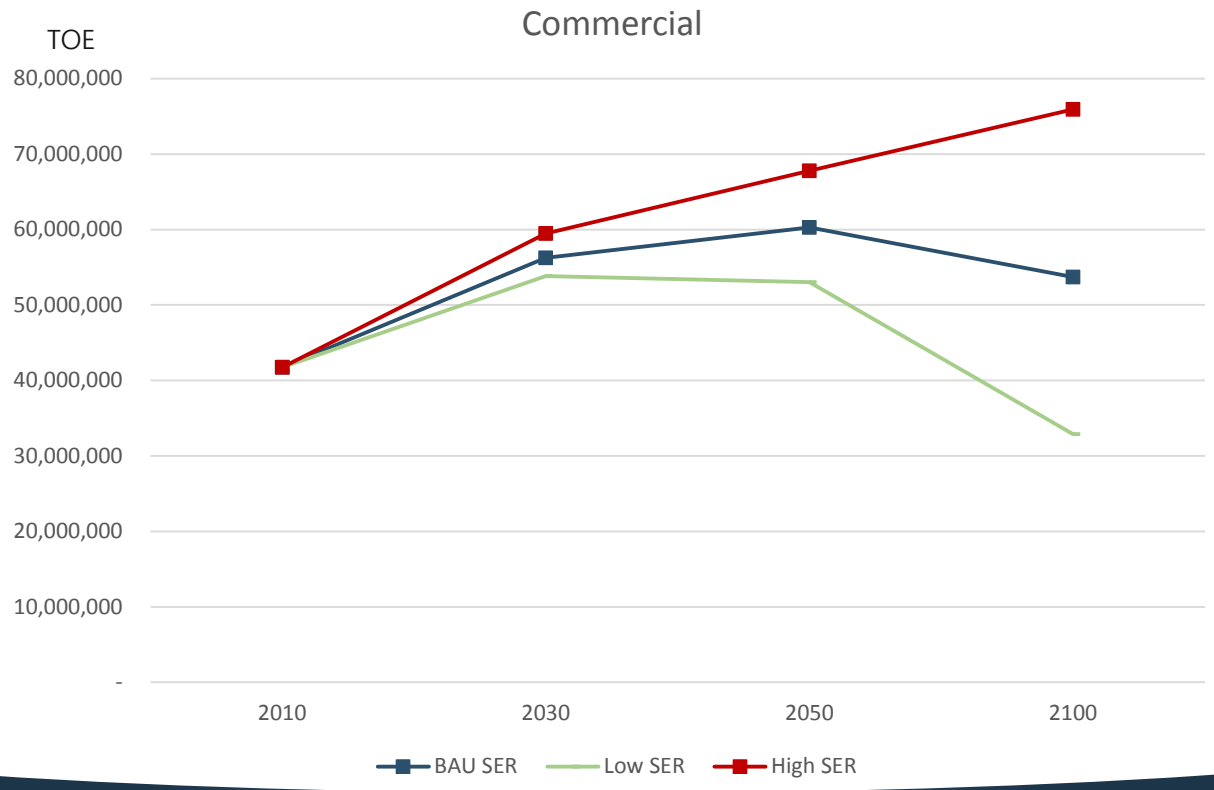
- **Residential sector**
  - **Service demand are based on population growth**
  - **Service demand will be decreased after 2030 in BAU scenario**
  - **Differences of service demand are caused from population in 2100**



03 Results and Discussion

4) Service demand

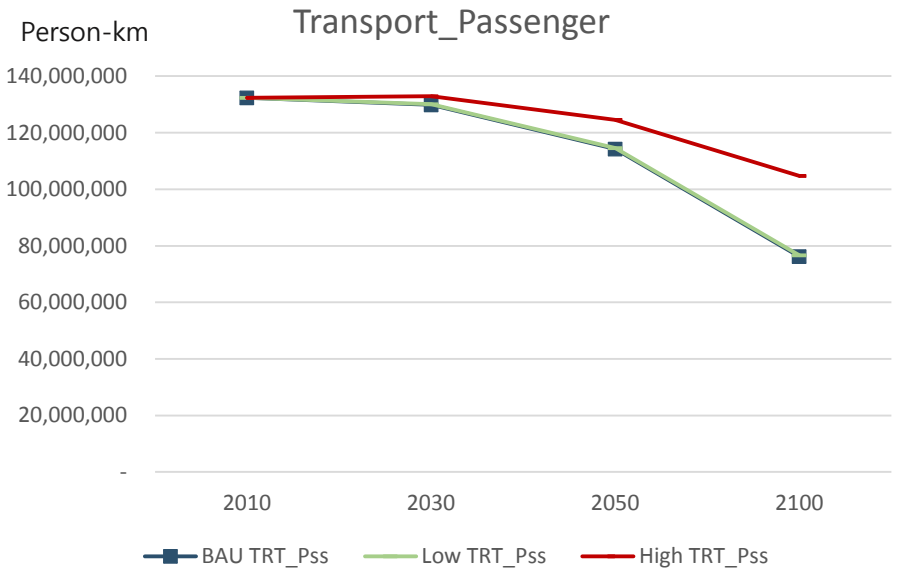
- **Commercial sector**
  - **Service demand is based on GDP and climate, and will be increased in BAU scenario**
  - **Differences of service demand is caused by GDP in 2100**

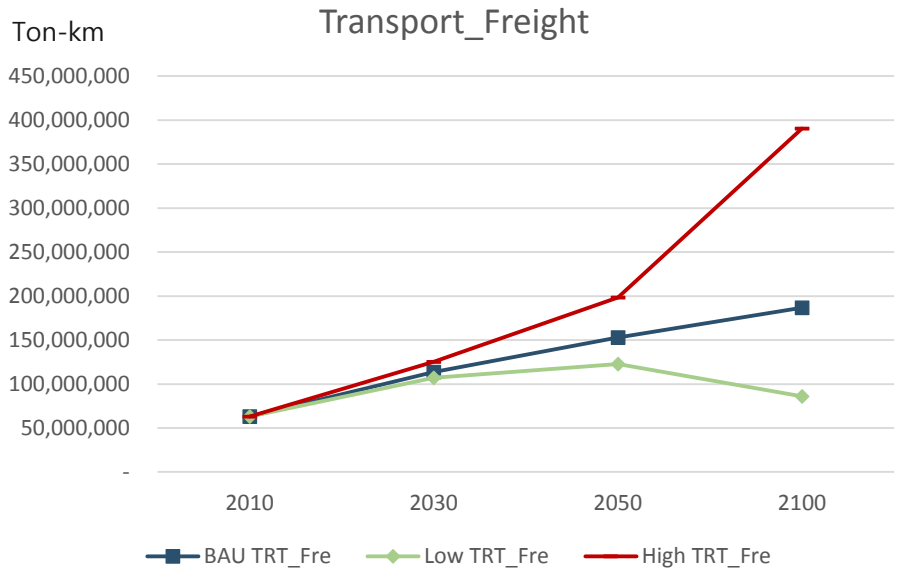


03 Results and Discussion

4) Service demand

- **Transport sector**
  - **Service demand of passenger based on population will be decreased**
  - **Service demand of freight based on GDP will be increased**

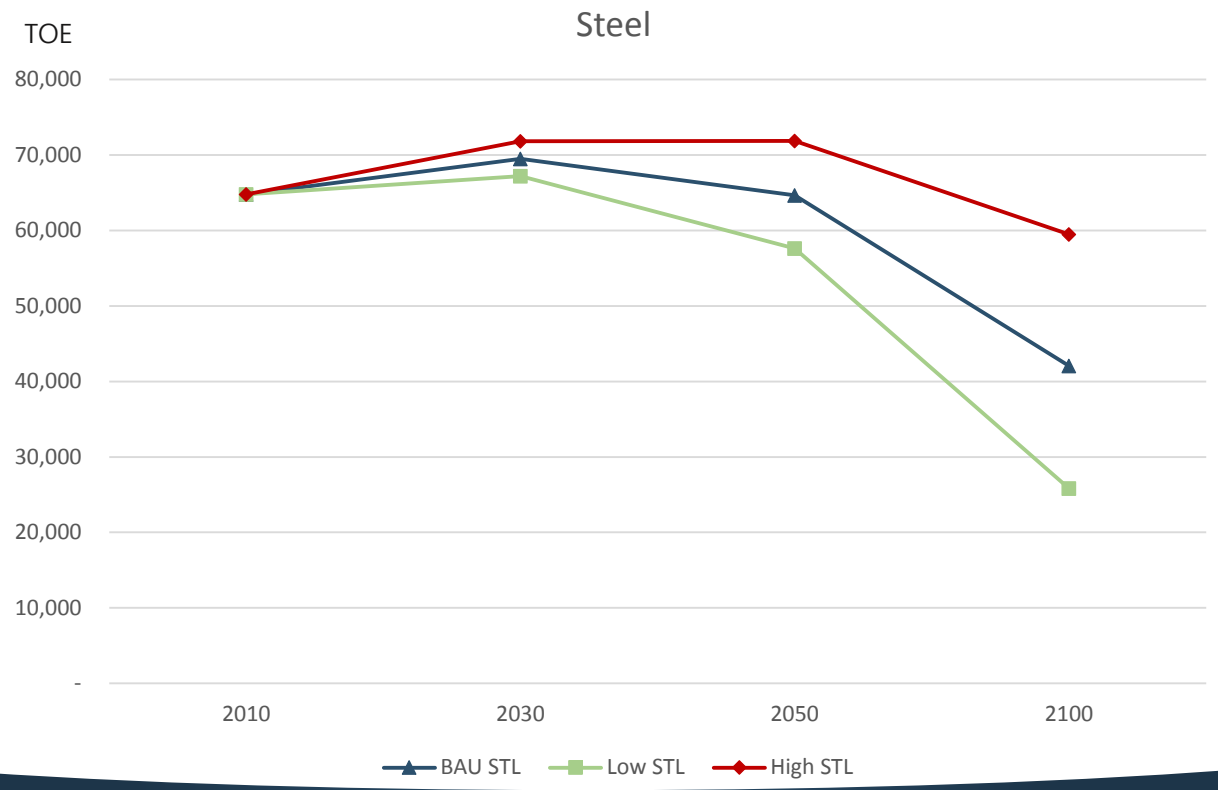




03 Results and Discussion

4) Service demand

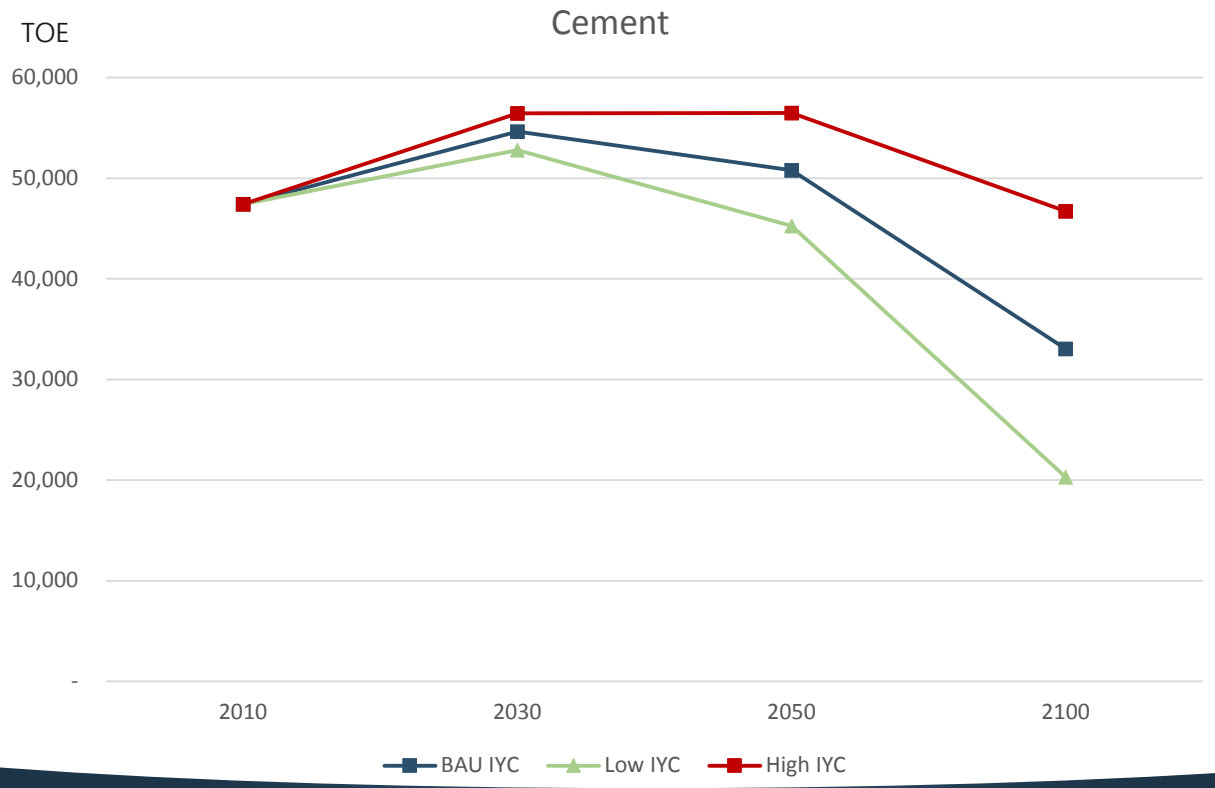
- **Industry sector (Steel)**
  - **Service demand is similar to population projection**
  - **Service demand will be declined after 2030 like population**



03 Results and Discussion

4) Service demand

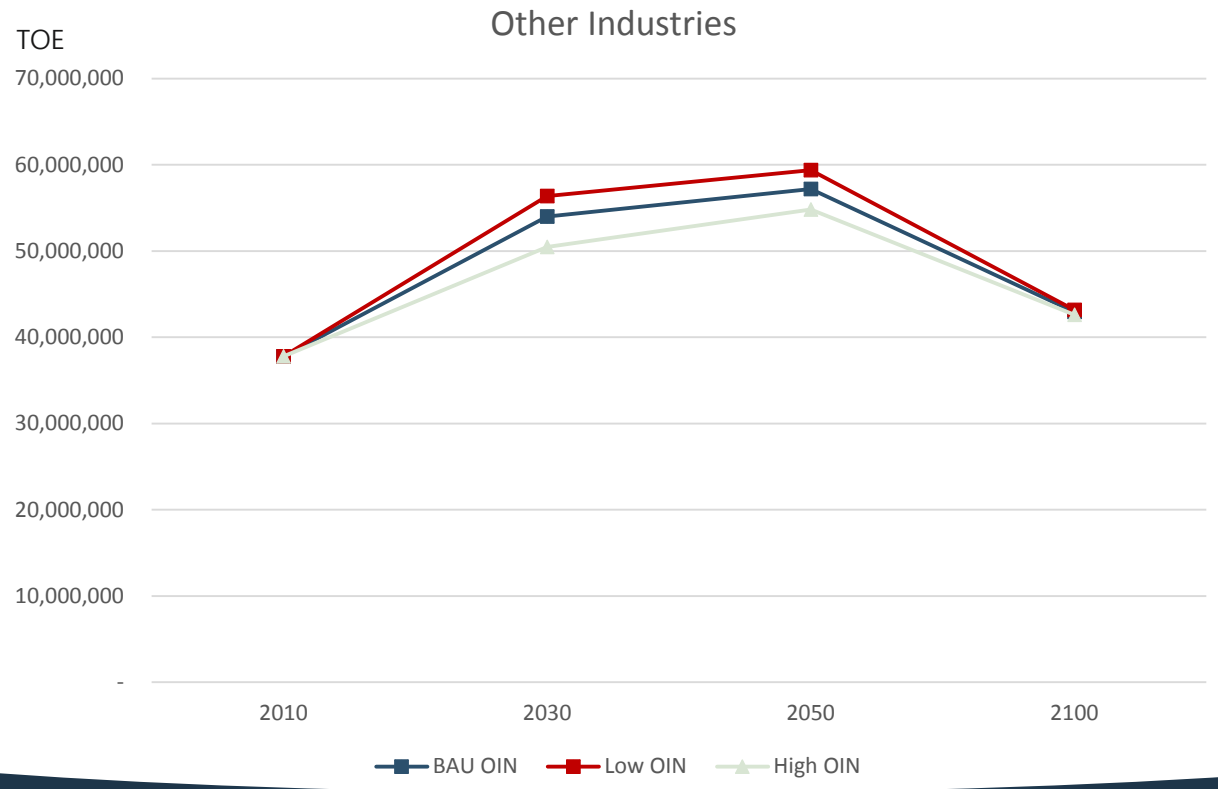
- **Industry sector(Cement)**
  - **Service demand shows similar pattern in steel industry**
  - **Service demand will be declined after 2030**



03 Results and Discussion

4) Service demand

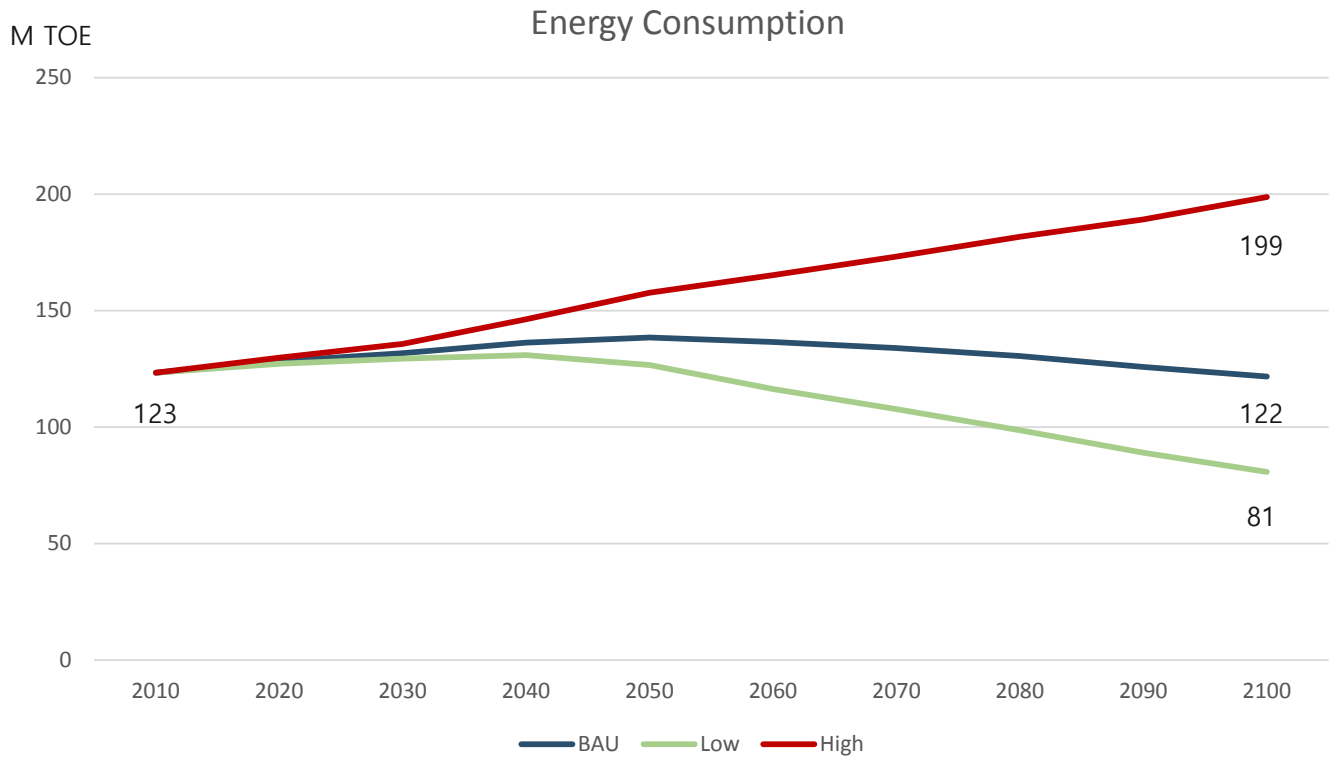
- **Industry sector (Other Industries)**
  - **Service demand of other industries based on GDP will be increased until 2050, after that will be decreased in 2100**



03 Results and Discussion

5) Energy Consumption (Total)

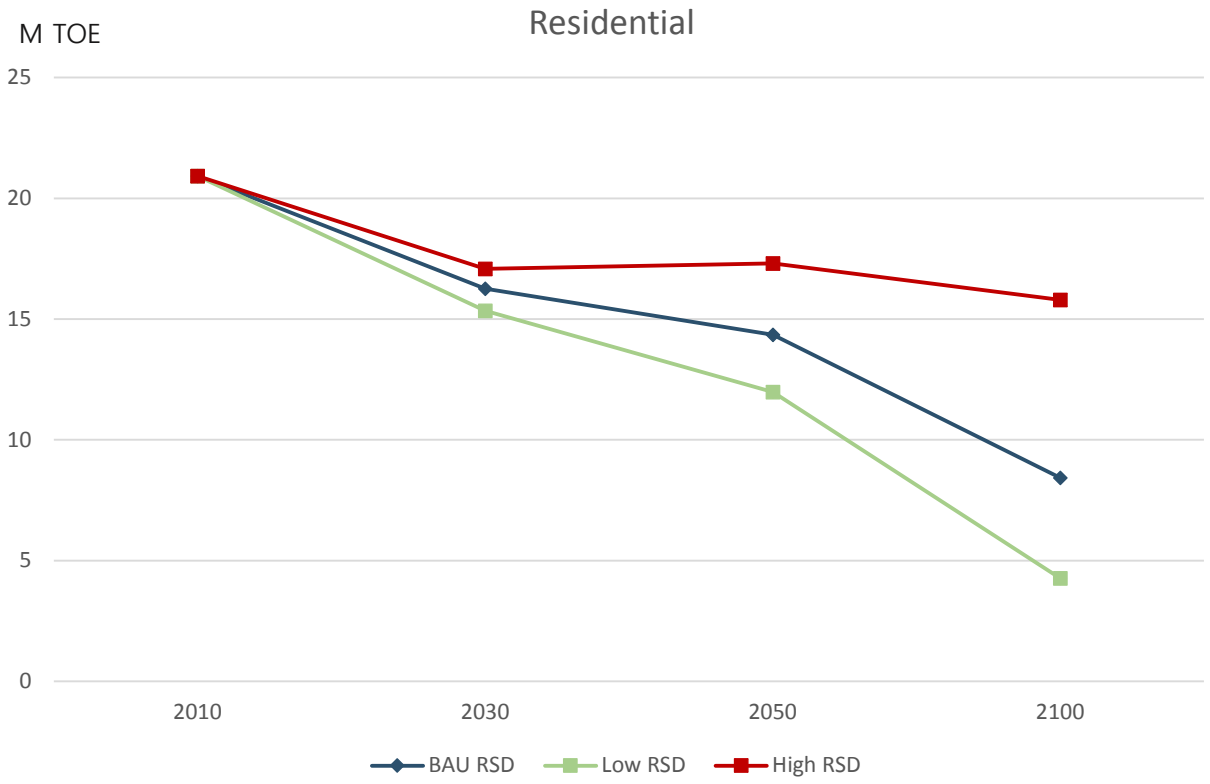
- **Energy consumption shows little change in BAU between 2010 and 2100**
- **Energy consumption in 2100 will be 65% in low emission scenario, 161% in high emission scenario**



03 Results and Discussion

5) Energy Consumption

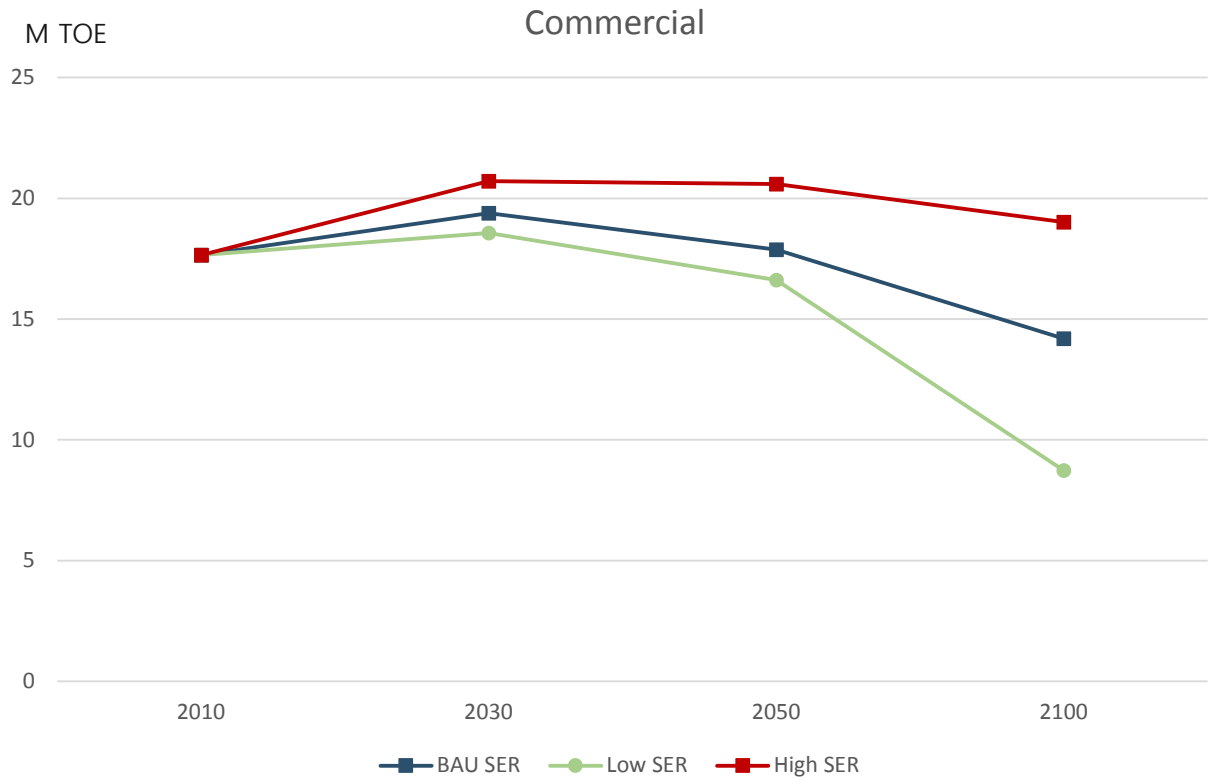
- **Residential sector**
  - **Energy consumption will be declined continuously**
  - **Improvement in technology and declining population contribute to the future energy consumption**



03 Results and Discussion

5) Energy Consumption

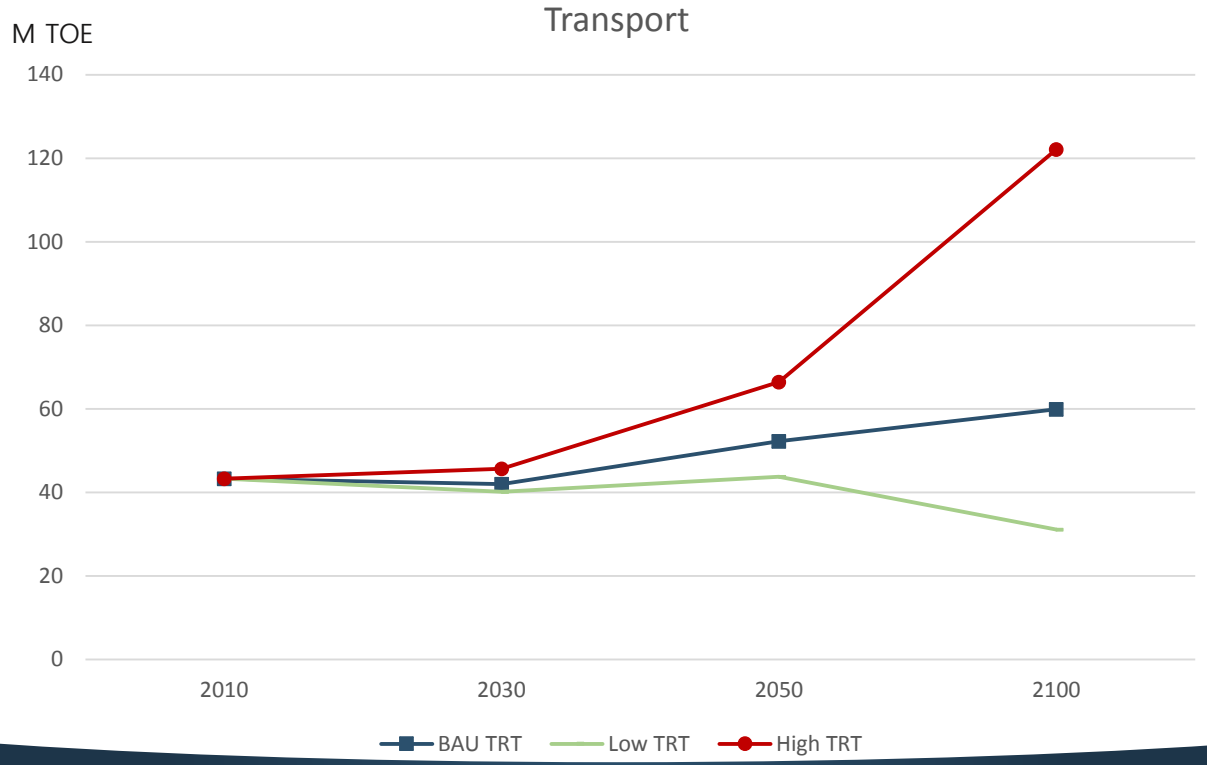
- **Commercial sector**
  - **Energy consumption is similar to service demand**
  - **Benefits of technology improvements have less contribution in results than residential sector**



03 Results and Discussion

5) Energy Consumption

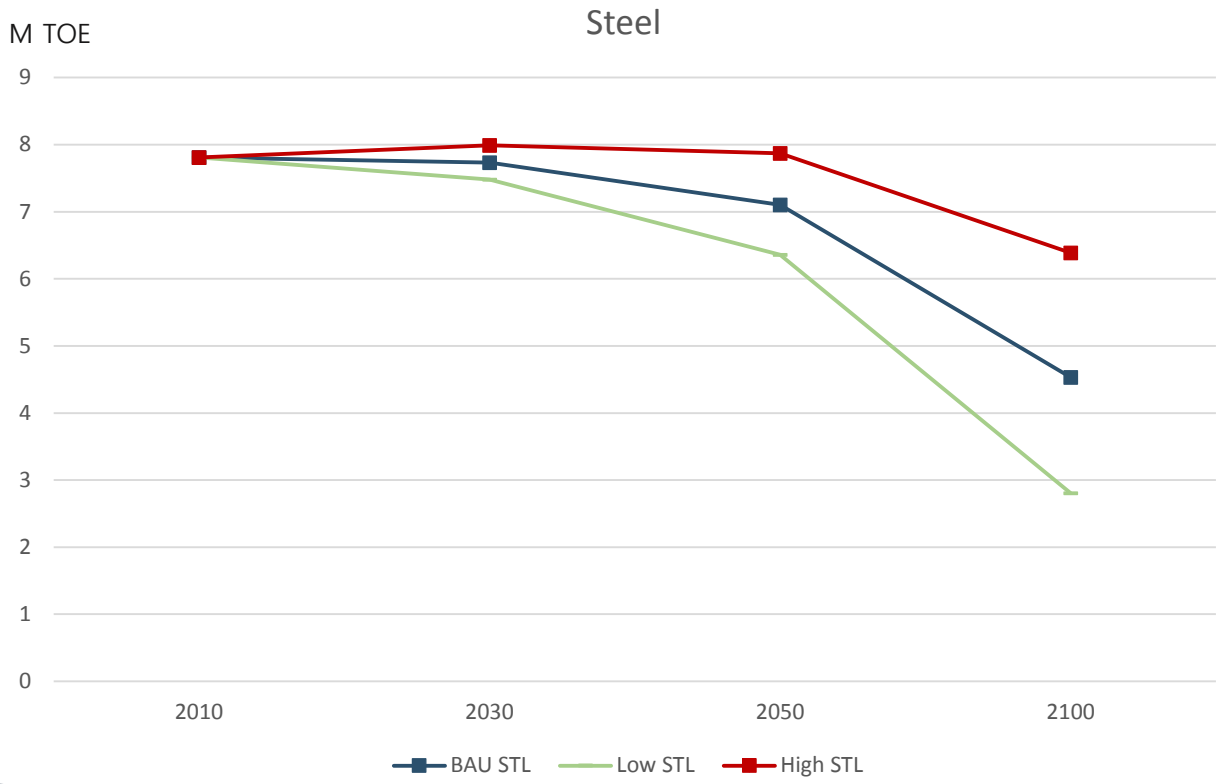
- **Transport sector**
  - **Energy consumption is more influenced by freight demand than passenger demands**
  - **Freight part has lesser benefit from technology improvement compare to passenger part**



03 Results and Discussion

5) Energy Consumption

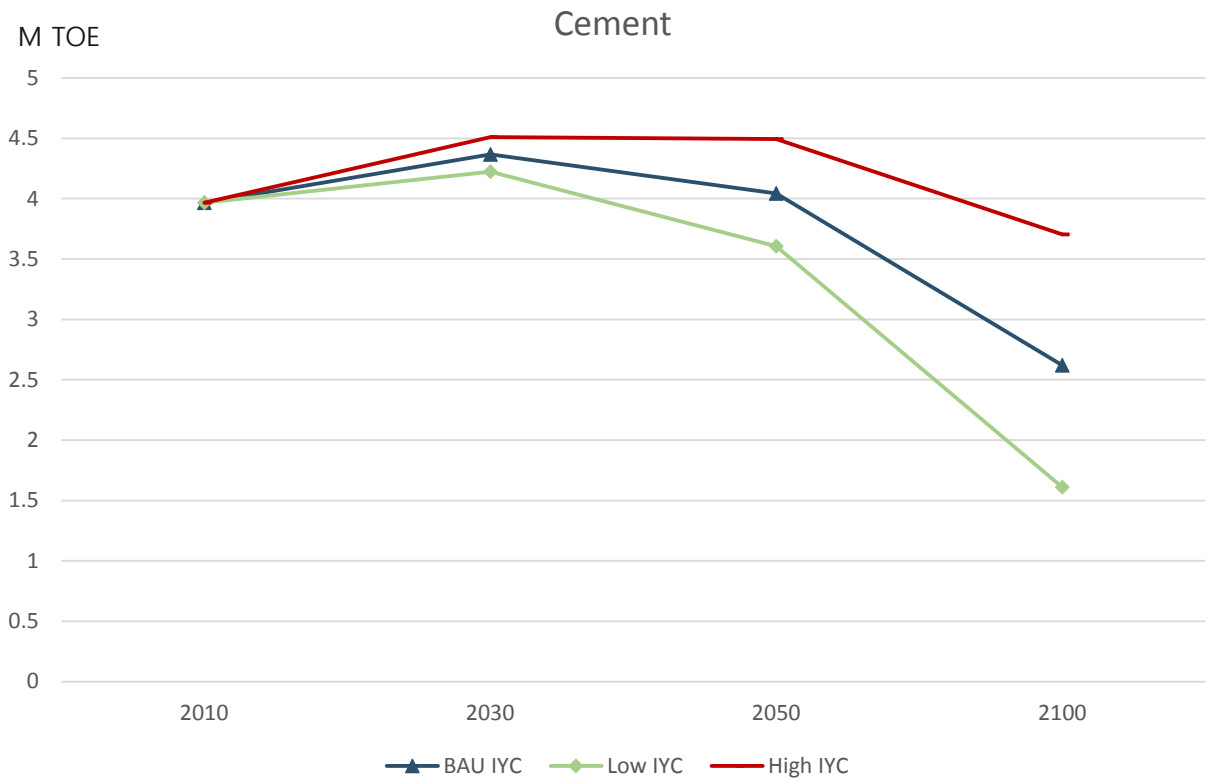
- **Industry sector (Steel)**
  - **Energy consumption in steel is maximum in present condition**
  - **Energy consumption will decline as population decrease**



03 Results and Discussion

5) Energy Consumption

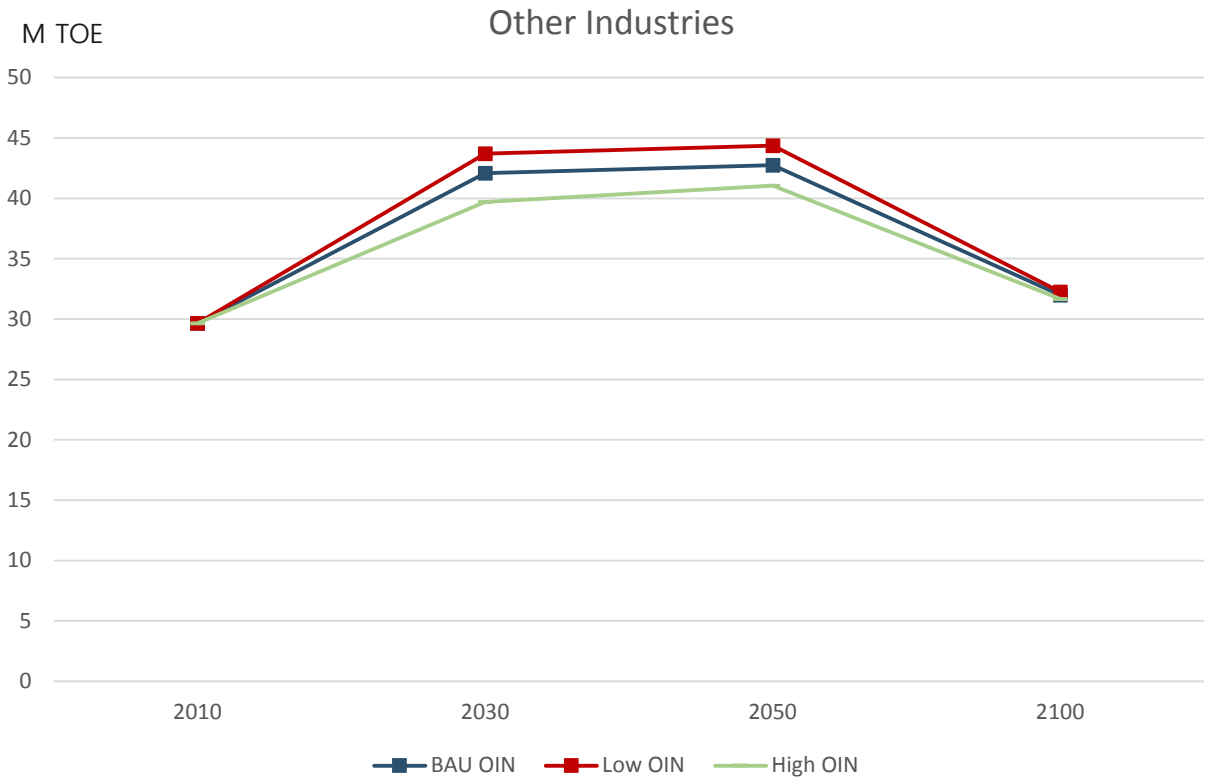
- **Industry sector (Cement)**
  - **Energy consumption shows similar pattern to population change**
  - **Energy consumption will be declined after 2030**



03 Results and Discussion

5) Energy Consumption

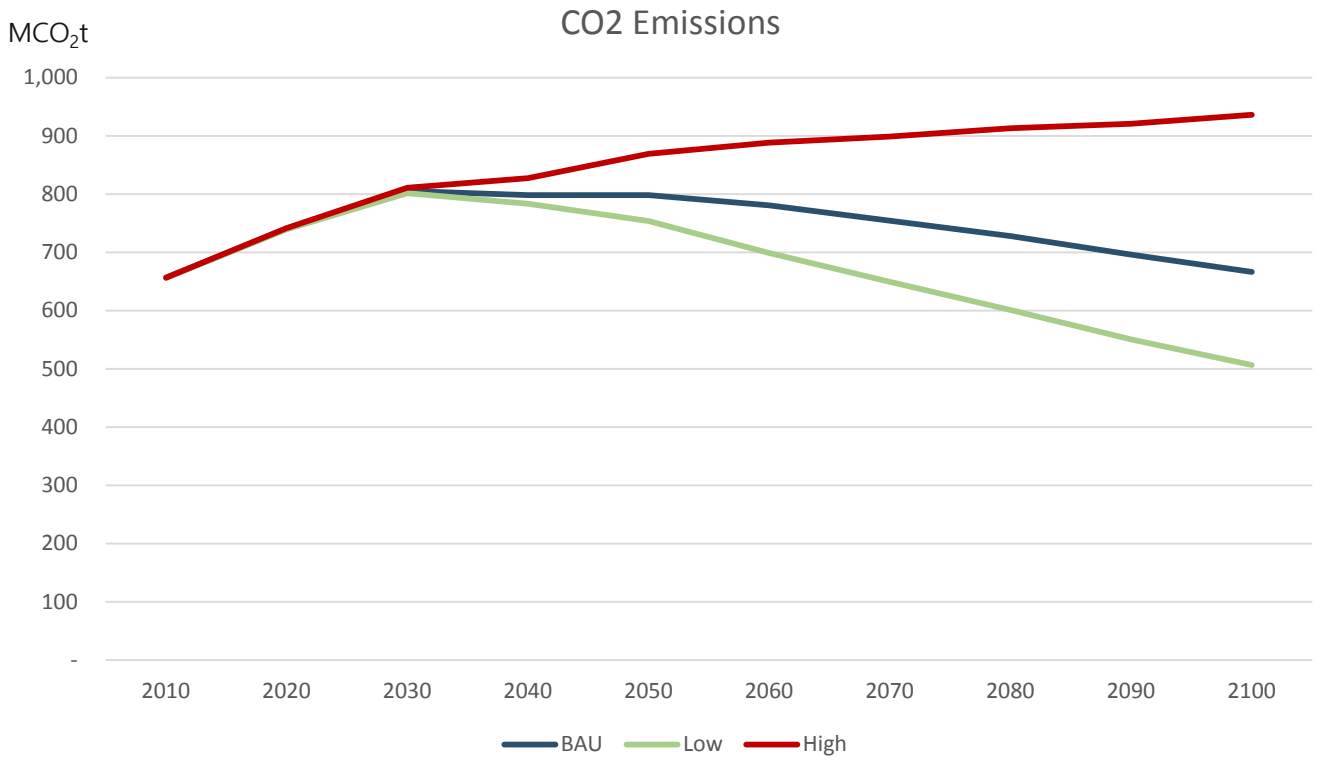
- **Industry sector (Other Industries)**
  - **Energy consumption will increase until 2050, and decrease in 2100 because of technology improvement**



03 Results and Discussion

6) CO_2 Emissions (Total)

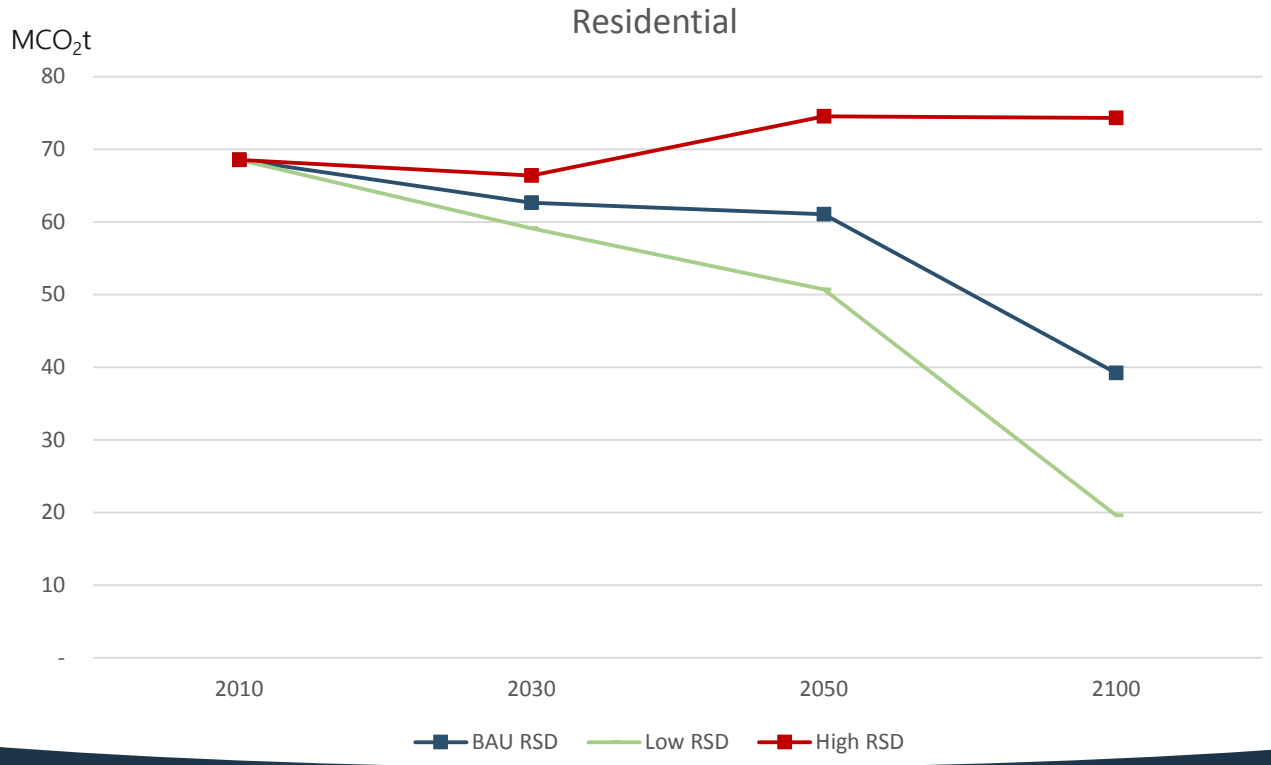
- **CO2 emission increase until 2030, regardless of the scenarios in Korea**
- **After 2030, emissions will be decreased in BAU and low emission scenario, and will be increased in high emission scenario**



03 Results and Discussion

6) CO_2 Emissions

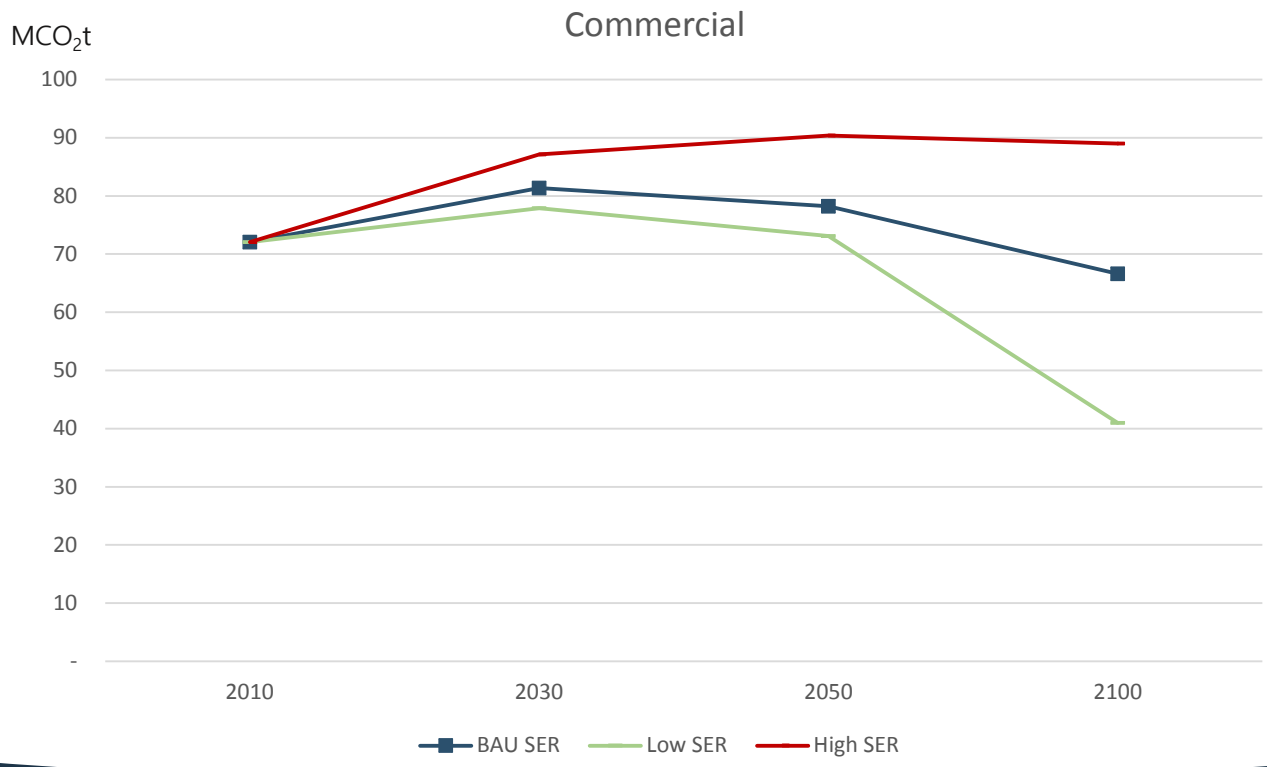
- **Residential sector**
  - **CO_2 emissions will be decreased because of technology development and decreasing population**
  - **In case of high emission scenario, the emissions in 2050 and 2100 will be increased due to increasing electricity**



03 Results and Discussion

6) CO_2 Emissions

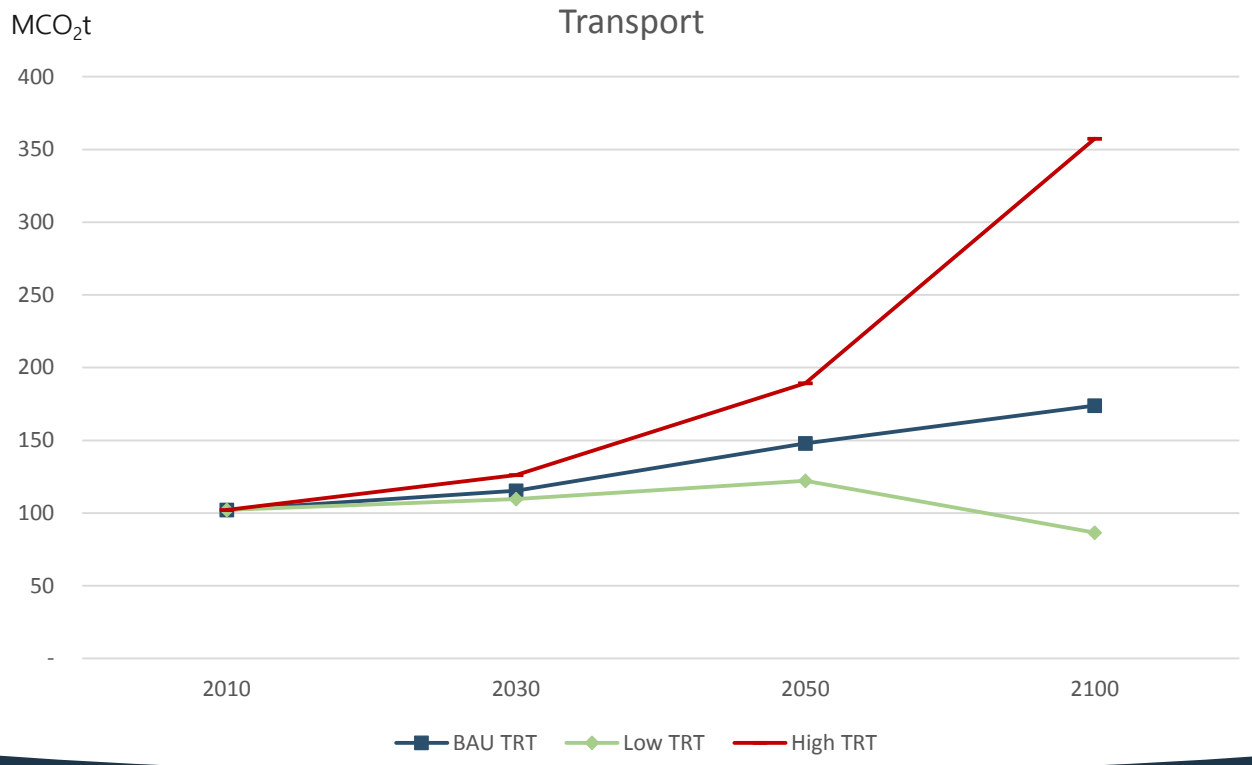
- **Commercial sector**
  - **Emissions will increase in 2030, but will be decreased in 2050 and 2100**
  - **In case of high emission scenario, emissions are similar between 2050 and 2100**



03 Results and Discussion

6) CO_2 Emissions

- **Transport sector**
  - **CO2 emissions will be increased in transport sector**
  - **Freights seem to be more affected by emissions than passengers**
  - **Especially, emissions in high emission scenario increase significantly**



03 Results and Discussion

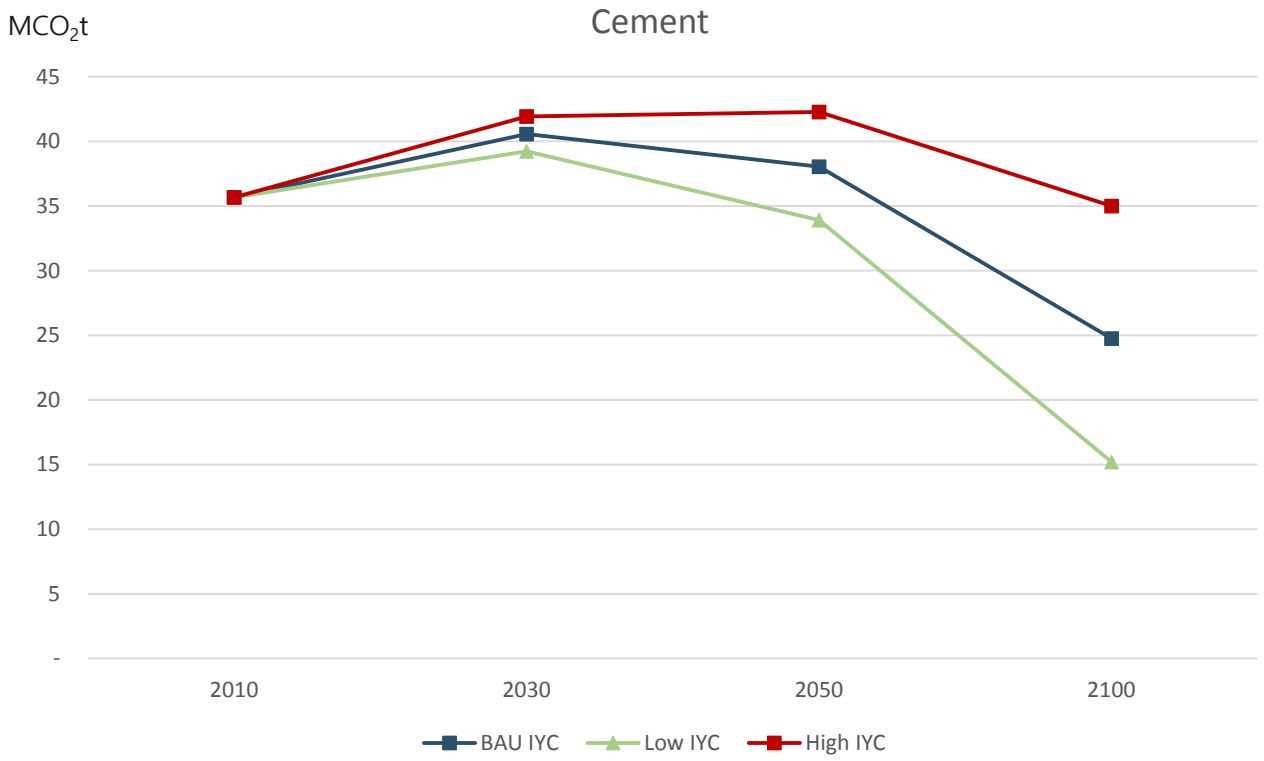
6) CO_2 Emissions

- **Industry sector(Steel)**
  - **Emissions show a tendency to reduce after 2030 because of decreasing steel demand**

03 Results and Discussion

6) CO_2 Emissions

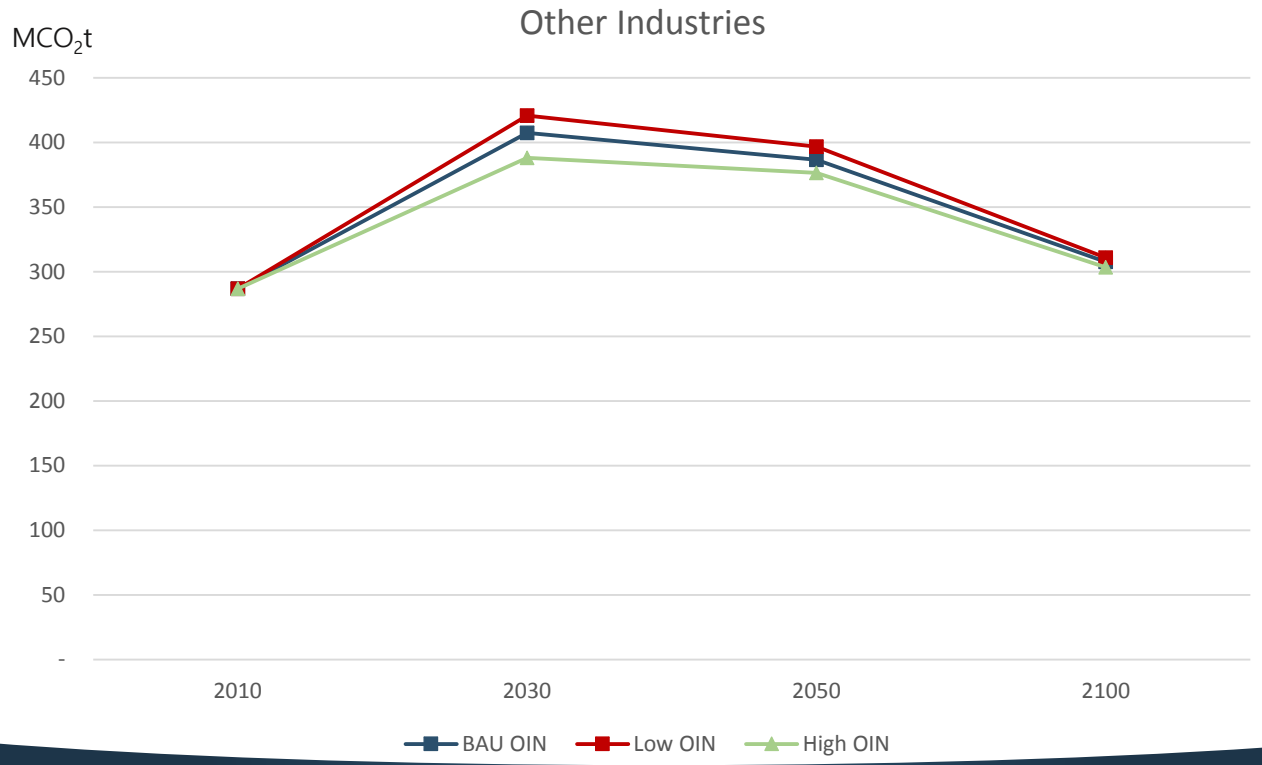
- **Industry sector (Cement)**
  - **After maximum emissions in 2030, it will be reduced as steel industry**



03 Results and Discussion

6) CO_2 Emissions

- **Industry sector (Other Industries)**
  - **Emissions in 2030 will be increased because of GDP and population growth**
  - **In case of 2050 and 2100, emissions will be decreased due to technology developments despite of the GDP growth**



04 Conclusion

04 Conclusion

- In transport sector, the emission differs significantly according to emission scenarios. Thus, technical improvement and energy advancement from fossil fuel to alternative energy are needed

- Technology improvement and dissemination are two most important factors to reduce emission (For example, residential sector could reduce emission by technology dissemination such as LED)

- This research could contribute to the designing the mitigation policy in Korea

Thank you