Development of Long-term Socioeconomic Scenarios

-Population, GDP-

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1. Introduction

RITE has been working on a comprehensive scenario development for climate change control and sustainable development in a project called ALternative Pathways toward Sustainable development and climate stabilization (ALPS).[1][2][3][4] In the comprehensive scenario development for climate change control and sustainable economy, long-term prospects of population and economic growth are formulated.[5] We suppose that these prospects are not an ideological scenario but could be realized as social consequences. We select two different prospects as they may more or less likely take place in the future as macroeconomic trends, considering from the past statistics. Technological innovation is identified as the important driving force of two scenarios in this paper and the two different prospects reflect the range of uncertainty: technological advances are uncertain and it is highly uncertain to make any prediction about innovative technologies in the future. Technological advances may vary to some extent depending on the policy but they naturally undergo great surprise. The developed scenarios would be a kind of guidelines of socioeconomic scenarios which do not incorporate any specific measures against global warming.

2. The narratives of the developed scenarios

In Scenario A, slow economic growth slows down after the miraculous past growth mainly in developed countries In Scenario B, technological advances keep ongoing as in the past and per capita GDP continues to grow quite rapidly.

Scenario A (Medium technological progress scenario)

- Though technologies in general make progress, mainly in developed countries where the society has been enjoying their lives with regards to material, innovation is not sufficient to produce new types of consumption utility and to facilitate high economic growth as in the past. Thus, mainly in developed countries, the economic growth rate is decreasing.
- In Scenario A people do not know the world with high economic growth as in Scenario B and the domestic income gap is not as wide as in Scenario B. Therefore, they may be well satisfied with the world in Scenario A. However, quite a few of them may feel the poorness with respect to economic growth.
- The economic growth in the least developed countries (LDCs) is smaller in Scenario A than in Scenario B, influenced by developed countries.
- After emerging economies continue to expand consumption and to reach a certain economic level, they withdraw from the mass consumption society, following developed countries.
- Overall, economic growth is relatively moderate. Accordingly, population continues to increase until around 2050 and stays around there from 2050 to about 2100.
- The potential energy demand per capita in developed countries shifts to decline.
- Population has larger impact on food demand in the late 21st century than economic

growth. Food is in greater demand under scenario A than Scenario B, since the world's population shrinks under Scenario B.

Scenario B (High technological progress scenario)

- The past technological innovation achievements such as agricultural revolution, industrial revolution, and IT revolution which transformed the society significantly have driven miraculous economic growth. In Scenario B, such technological innovations which revolutionize the society flourish also in the future, resulting in new types of consumption utility in great deal and high economic growth over the world.
- IT or transportation technologies continue to progress, leading to further advance of globalization.
- The income gap grows wider between people who have ability to provide higher value-added products or services and those who do not. Further progress of globalization is to boost the gaps. Though the governments try to redress the domestic income gap by taxation, globalization makes it difficult to support the policies against the gaps and puts limits on income inequality reduction.
- The current developed countries and emerging economies shift toward higher-value-added industries. Bases for the primary and secondary industries are transferred to the least developed countries such as African countries, and they can develop accordingly.
- Due to high economic growth throughout the world, low birth rate spreads rapidly. The world's population shrinks in the late 21st century, due to rapid fertility decline throughout the world.
- The urban-rural income gap widens further. Many countries experience further urbanization.
- The potential energy demand per capita, as ever, continues to increase.
- As food demand is influenced by population rather than economic growth, it is smaller than under Scenario A in the late 21st century, with decrease in population in Scenario B.

3. The development of population and GDP scenarios

Along with the two narrative scenarios described above, the prospects of GDP per capita, population and GDP are developed.

GDP per capita

The following trends in general are observed from the statistics of the past. The growth rate of GDP per capita is low in the least developed countries (LDCs). When GDP per capita is between a few hundred dollars and a thousand dollars, the growth rate of GDP per capita tends to become high. For the higher GDP per capita, the growth rate tends to decrease gradually, shifting toward moderate economic growth. The industrial structure has three big trends; in the first period the structure centers in primary industry, in high economic growth period heavy industry develops starting from light industry, and in gradual growth period the tertiary industry starts to grow such as service and information industries. Considering these trends to be universal basically, prospects for the future are developed (Figure 1, Figure 2). Please note that GDP per capita in this scenario is real and is estimated by converting the market exchange rate (MER).

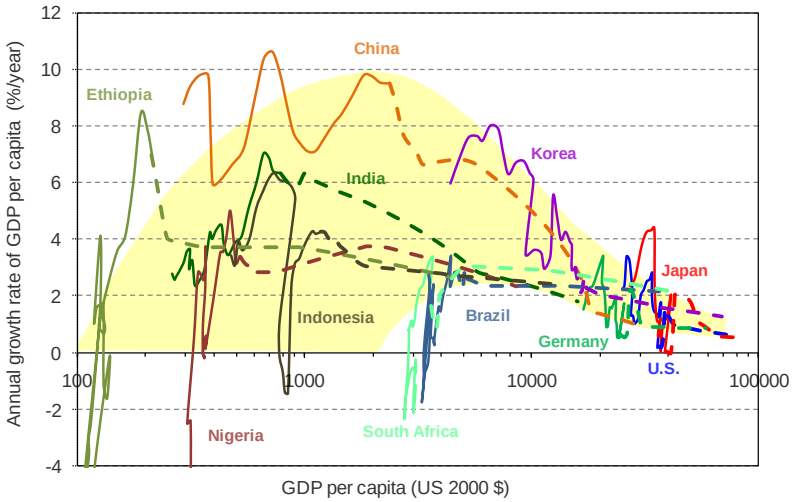


Figure 1 1980–2100 per-GDP and annual growth rate of per-GDP in Scenario A

Note: Solid lines and dashed lines indicate the historical and projected rate, respectively. Five year moving average is shown.

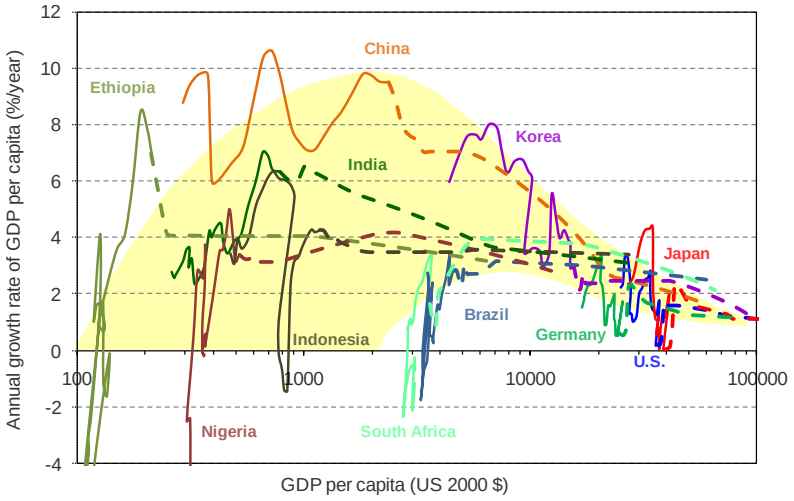


Figure 2 1980–2100 per-GDP and annual growth rate of per-GDP in Scenario B

Note) Solid lines and dashed lines indicate the historical and projected rates, respectively. Five year moving average is shown.

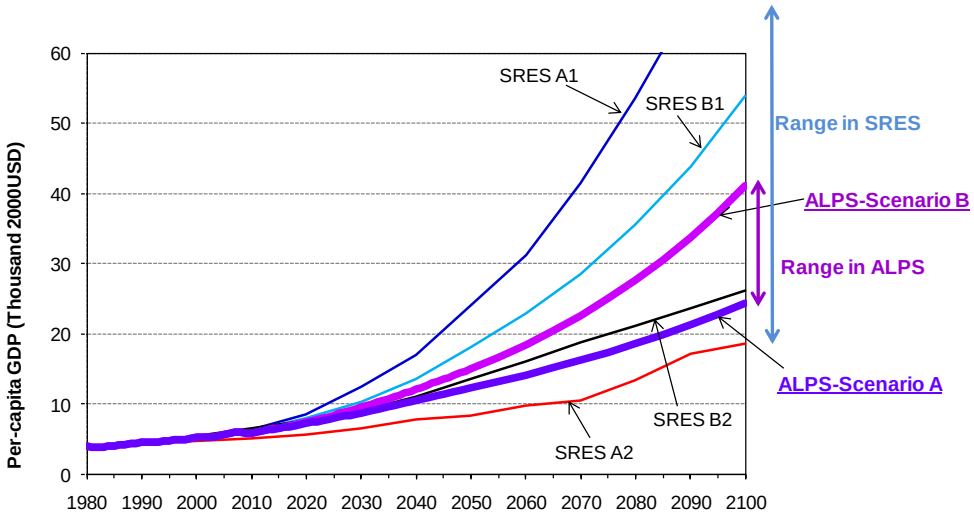


Figure 3 1980–2100 Global per-GDP scenario

Note) Statistics up to 2008, RITE projection from 2009. SRES stands for the scenarios described in IPCC Special Report on Emission Scenarios (2000).[7] As per-GDPs of SRES scenarios are prices in 1900, they are adjusted to be consistent with the estimated of 2000 GDPs at the time of 1990.

In Scenario A, the current developed countries slow down the GDP per capita growth until 2100 and the growth rate converges to 0.5% per year in 2100. Developing countries continue to grow steadily. The current emerging economies and least developed countries have the per capita GDP growth rates of around 1%/year and around 2%/year in 2100, respectively. The global average growth rate from 2000 to 2100 is 1.5% per year.

In Scenario B, the current developed countries continue to increase GDP per capita by 1.0%/year in 2100. Developing countries continue to grow rapidly. The current emerging economies and least developed countries grow at the rate of around 2%/year and around 3%/year even in 2100, respectively. The global average growth rate from 2000 to 2100 is 2.1% per year.

Both in Scenario A and B, economic gaps between developed and developing countries narrow steadily until 2100. Yet, the gaps in Scenario B are still bigger than in Scenario A. The GDP per capita ratio of OECD90 to Africa is 38.5 in 2000, and in 2100 6.4 in Scenario A and 6.7 in Scenario B.

Population

The world population scenarios were developed with reference to The UN Population Division; World Population Prospects (The 2008 Revision[6]) which have been used worldwide. UN scenarios of the world population are developed every two years and have been revised downward for every update. Therefore, in this scenario, even after taking account of the future population increase in developing countries such as in Asia or Africa, we judge it very unlikely that the future world population will be substantially over 10 billion.

Historical statistics explicitly show the trends that the fertility and population growth rates become lower with growing GDP per capita (Figure 4). ALPS population scenario is developed, assuming this trend to keep in the future, by replacing the relationship between fertility and per capita GDP by the relationship between annual change rate of population and per capita GDP (Figure 5). The population growth in Scenario B is assumed to be smaller than that in Scenario A, as per capita GDP is larger in Scenario B.

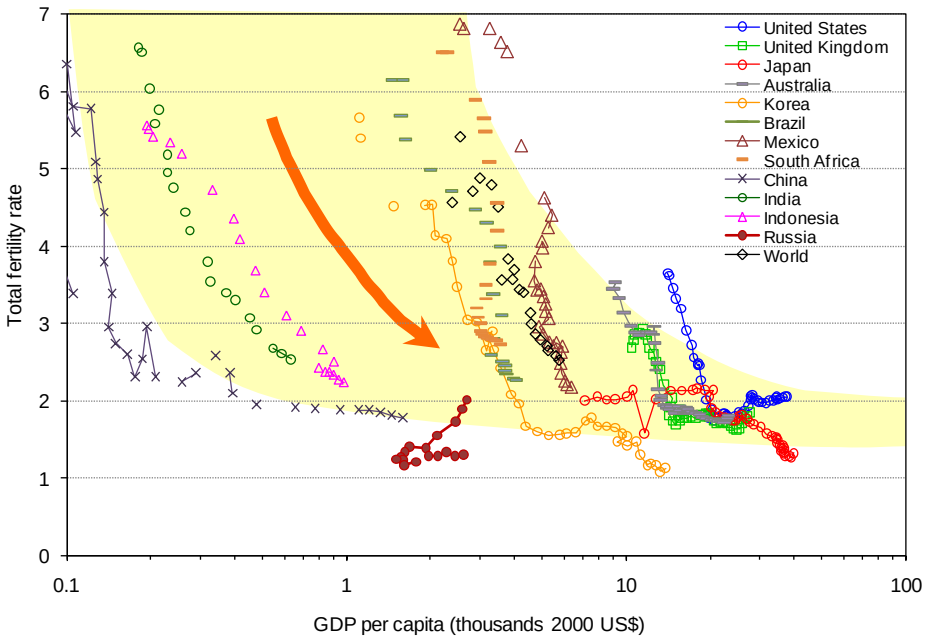


Figure 4 Total fertility versus GDP per capita from 1960 to 2006[8]

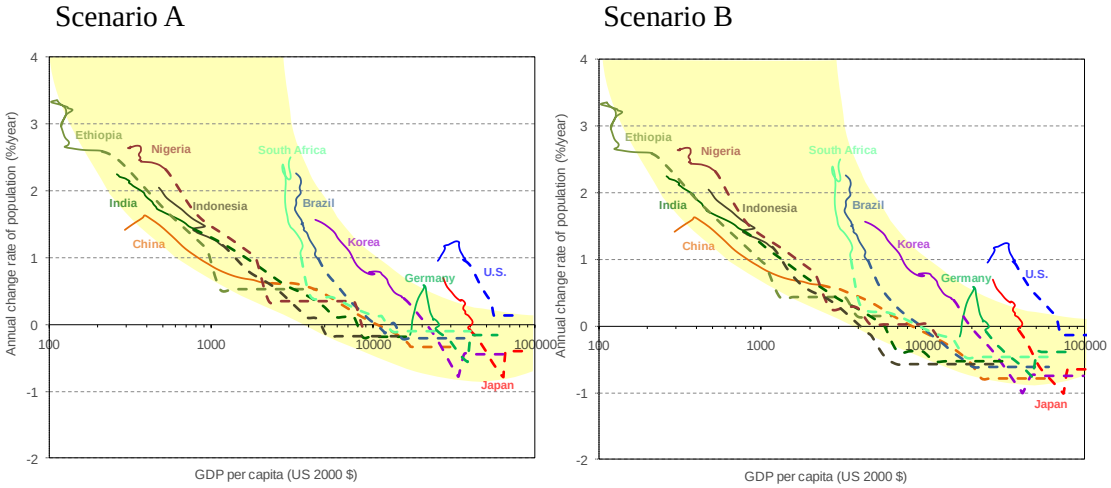


Figure 5 Annual change rate of population versus GDP per capita from 1980 to 2100

Note) Solid lines and dotted lines indicate the historical and projected rates, respectively. 5 year moving average is shown.

Figure 6 shows the world population scenarios and Figure 7 shows the population scenarios by major region. In Scenario A, the world population is assumed to have a medium growth rate and the UN medium variant scenario of the world population, the 2008 Revision[6] is adopted. After growing to 9.1 billion in 2050, the world population grows steadily to 9.3 billion by the year 2100. In Scenario B, the world population is assumed to have a low growth rate. This scenario is roughly equivalent to the average of UN medium variant and low variant scenarios of the world population, the 2008 Revision.[6] The world population grows slowly from 6.1 billion in 2000. After peaking at 8.6 billion around 2050, it declines to 7.4 billion by the year 2100.

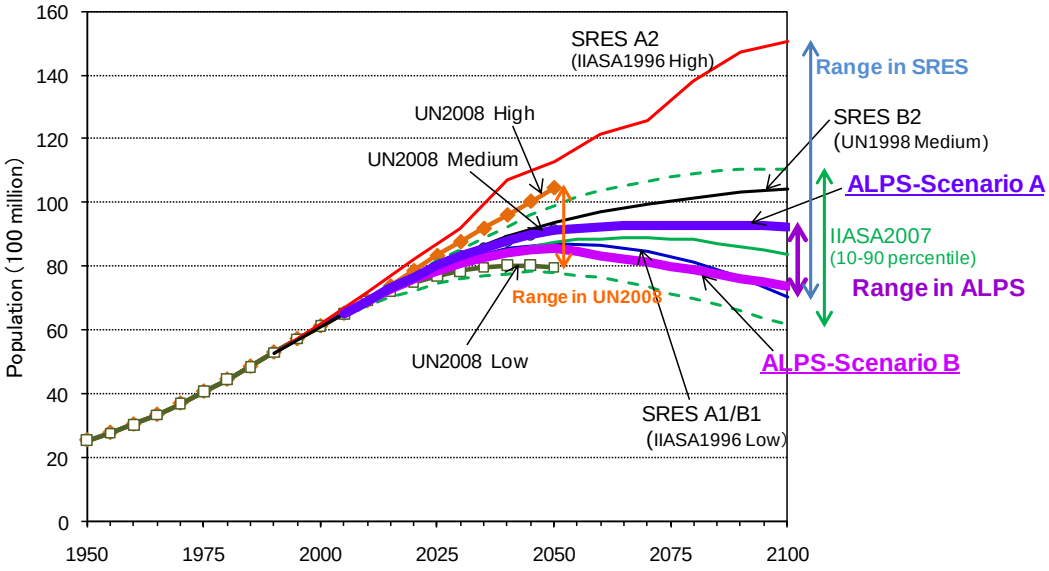


Figure 6 Outlook of the world population

Note) Statistics up to 2008, RITE projections from 2009

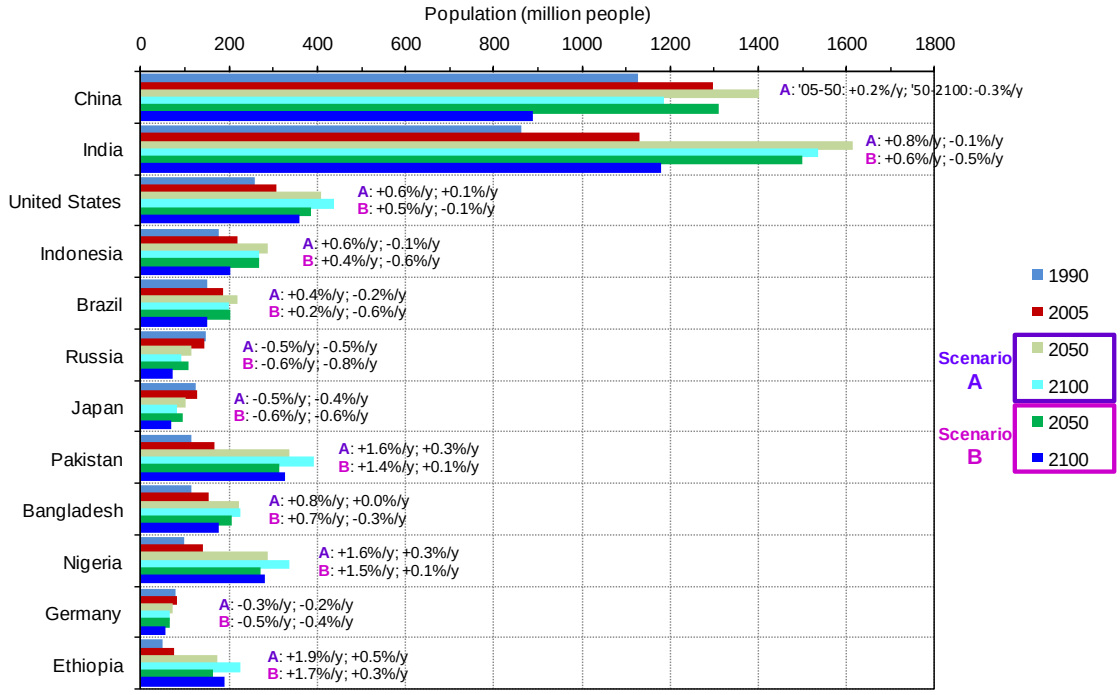


Figure 7 Population scenarios in major regions

Note) Statistics for 1990 and 2008, RITE projections for 2050 and 2100

GDP

Figure 8 shows the world GDP scenarios. The potential world GDP grows at a higher rate in Scenario B than in Scenario A. As mentioned above, GDP per capita growth at a higher rate in Scenario B makes the population smaller than the population in Scenario A, so that GDP difference between the two scenarios shrinks. The world average of GDP annual growth is assumed to be 2.0% per year in Scenario A and 2.3% per year in Scenario B from 2000 to 2100.

Figure 9 shows the regional share in GDP. In 2005 the total of developed countries (U.S., EU27, Japan, other OECDs) accounted for 77% in the world GDP, and thereafter they continue to lose share slowly. In 2100, they account for 36% in Scenario A, and 33% in Scenario B and the current developing countries account for large share, very different from the current GDP share. Emerging economics such as China rapidly develop until 2050, and afterwards the current least developing countries such as African countries develop their economy reasonably.

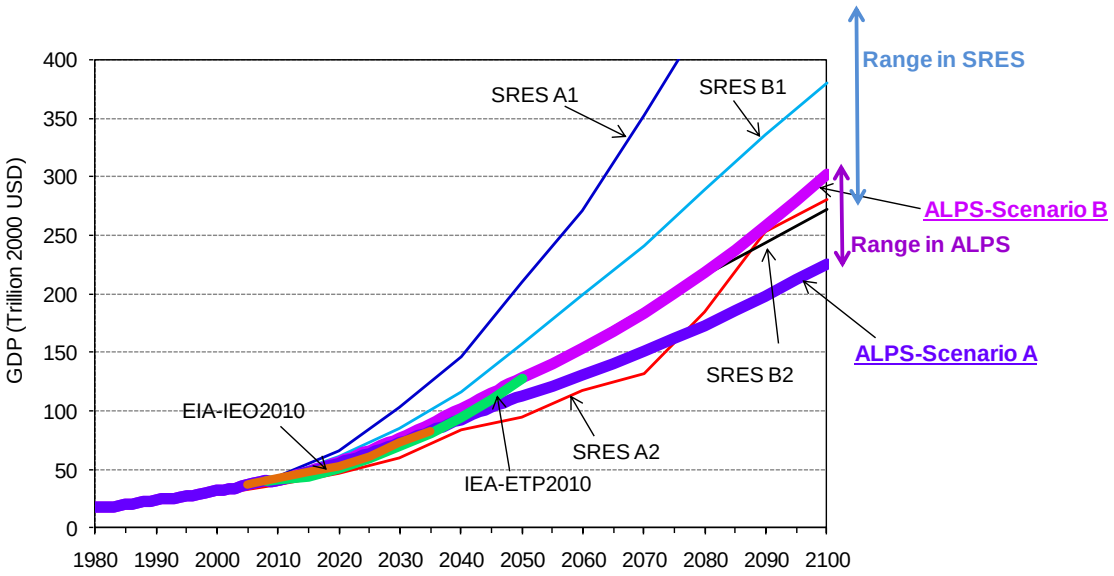
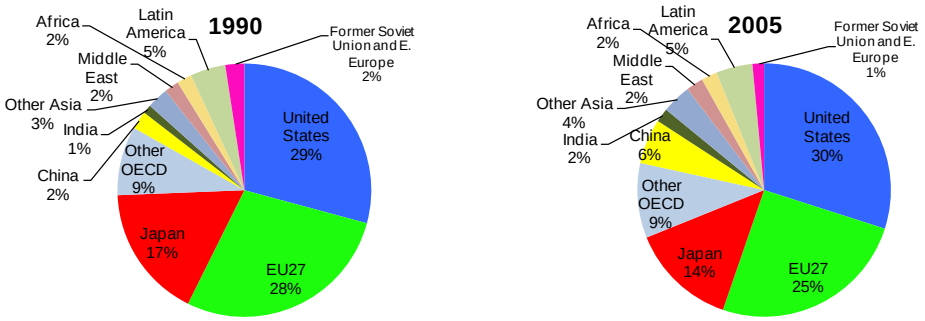
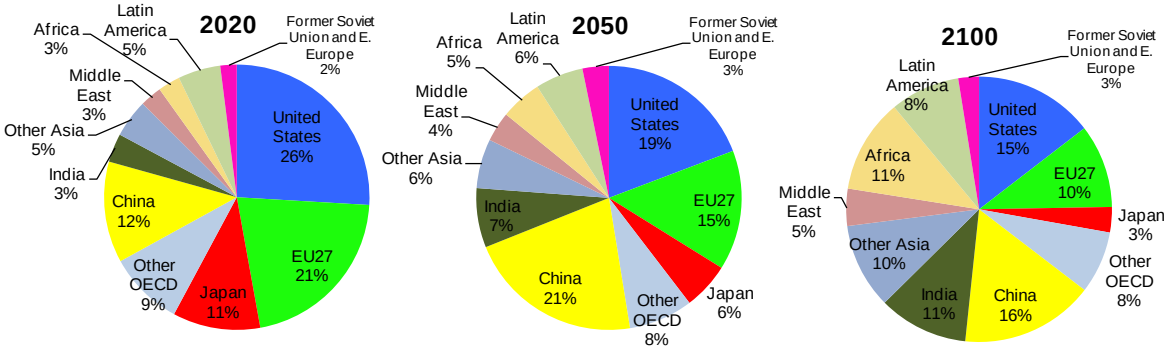


Figure 8 The world GDP scenario

Note) Statistics from 1980 to 2008, RITE projections after 2009. SRES is in IPCC Special Report on Emissions Scenarios 2000. SRES scenarios are adjusted to the price in 2000 from the one in 1990.



Scenario A



Scenario B

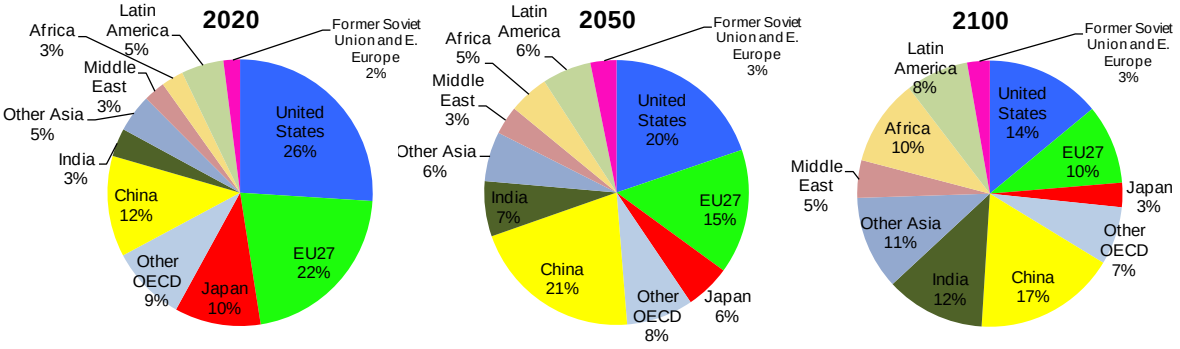


Figure 9 Regional GDP scenario (upper: statistics, middle: Scenario A, lower: Scenario B)

Note) OECD represents OECD90 (OECD countries in the year of 1990)

4. Notes

As mentioned above, within the same scenario, the population and GDP prospects are consistently developed. Please be sure not to develop new GDP prospects from per capita GDP of Scenario A and population of Scenario B or vice versa, which undermines consistency. The developed prospects of GDP and population are not intended for use in that way.

Let us note that the population and GDP prospects in this paper may be occasionally updated without prior notice so that the most recent economic conditions can be reflected in the prospects.

Reference

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[10] DOE/EIA, International Energy Outlook 2010, http://www.eia.doe.gov/oiaf/ieo/

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