2.2 Assessment of innovative options for meeting both millennium development goals and climate change objectives

Millennium development goals (MDGs) comprise eight socio-economic developmental goals which all 191 United Nations member states have pledged to meet by the year 2015. United Nations Development Programme (UNDP) links and coordinates global and national efforts to reach these goals. It helps countries integrate the MDGs into their national development frameworks. Global and national MDGs have direct implications for the environment and climate change, since they involve changes in the drivers of socio-economic development and sustainability. Table 3 illustrates these relationships for India. IEA tools are being used to carry out analyses of such interactions to assess the impacts of MDGs on the environment and, conversely, the potential for meeting MDGs under various scenarios.

Table 3. Illustration of linkages among MDGs, India's national targets, and climate change

MDGs and global targets	India's national plan targets	Interface with climate change
Goal 1: Eradicate extreme poverty and hunger Targets: Halve, between 1990 and 2015, the proportion of people with income below $1 a day and those who suffer from hunger.	Double the per capita income by 2012. Reduce the proportion of people with income below $1 a day by 15% by 2012. Contain total population growth between 2001 and 2011 to 16.2%.	Income effect would enhance choices for cleaner fuels and adaptive capacity. GHG emissions would be reduced due to lower population.
Goal 7: Ensure environmental sustainability Targets: Integrate sustainable development principles in country policies and programs to reverse loss of environmental resources. Target: Halve by 2015 the proportion of people without sustainable access to safe drinking water.	Increase forest cover to 25% by 2007 and 33% by 2012 (from 23% in 2001). Enable sustained access to potable drinking water to all villages by 2007. Electrify 80,000 additional villages by 2012 via decentralized sources. Clean all major polluted rivers by 2007 and other notified stretches by 2012.	Enhanced sink capacity; reduced GHG and local emissions; reduced fossil fuel imports; reduced pressure on land, resources, and ecosystems. Higher adaptive capacity from enhanced supply of water, health, and education in rural areas.

Figure 5 illustrates such an analysis at global and country (India) scales. Global emissions scenarios developed for the purpose of climate change analysis are used as references in analyzing the potential for meeting global MDGs. For instance, the IPCC's A2 scenario will not leave reasonable scope for meeting the MDG of the number of people suffering from hunger in 2012. This target can be met under the B2 scenario, but only with additional economic support for hunger alleviation programs. Different emissions scenarios, translated for India, signify different trajectories for water consumption and other parameters critical for MDG. Since different emissions scenarios correspond to different socio-economic developmental pathways, this implies that the future development path of a country determines the scope and effort required for meeting MDGs and environmental and climate targets. Thus, environmental improvement actions need to be integrated within the development decisions of various countries. Elements of innovative strategies, such as financial budgeting or investment plans, must be designed for multiple dividends to development and the environment.

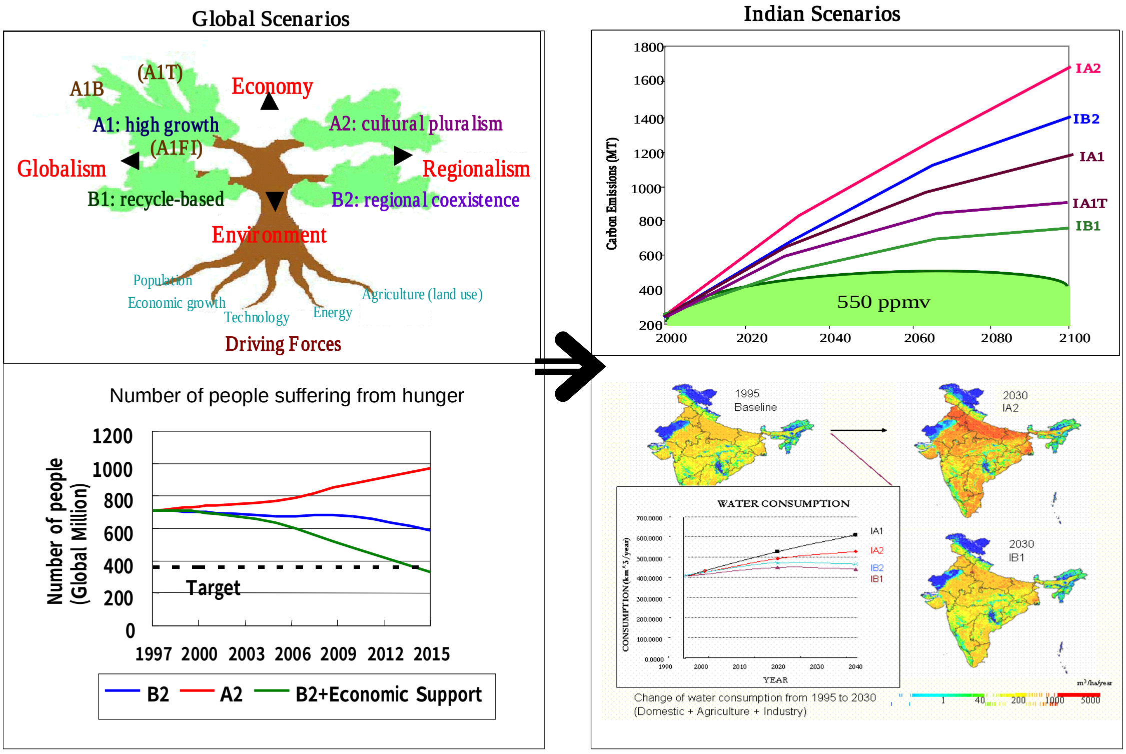

Figure 5. Linking global scenarios, Indian scenarios, and MDGs

2.3 Water management model linking the SDB and AIM/Material

The water management model has been developed within a framework that externally links the SDB and the AIM/Material model (Figure 6). Salient features of this framework are as follows:

- Water demand is estimated in the SDB on the basis of water supply and sanitation conditions
- Services with a safe piped water supply are distinguished from those without a safe water supply
- Services with sanitation are distinguished from those without sanitation
- Unaccounted for water and efficiency of water management are distinguished from actual water use by households and commercial users served by piped water
- A decision to install facilities for improved water supply and sanitation is linked to investment by government and households in the AIM/Material model
- Dynamics of inter-temporal decisions, such as investments, are considered
- Urban and rural areas are treated separately
- Potential health impacts and impacts on costs of strategies to increase water supply, improve sanitation, reduce unaccounted for water, and improve water management efficiency can be estimated using the SDB

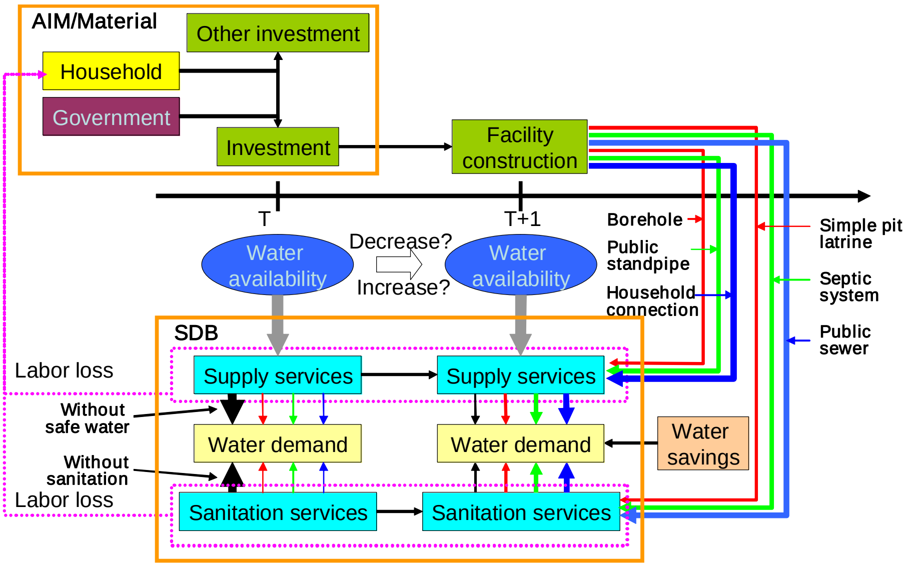

Figure 6. Water management model linking the SDB and AIM/Material

The water management model has been applied to India, China, and Thailand. Figures 7 and 8 show some of the results. For all three countries, the greatest decline in the relative risk of diarrhea mortality over the 2000–2025 period will come when all households are supplied with safe piped water and have a centralized sewer connection (Case 2). However, the increase in the annual cost of supplying water and sanitation is the highest in this case. For Case 3, where water is supplied to new households by cheap options such as wells, ponds, or boreholes, and cheap sanitation options are provided, such as ventilated improved pits (VIP) or simple pit latrines, annual costs will be lower but the risk of diarrhea mortality will decline less than in Case 1, where there is no change in the technology mix of water supply and sanitation systems. Thailand is not expected to witness any decline in diarrhea mortality risk in Case 3. This is because its population is not likely to increase significantly from 2000 to 2025, and almost all of its existing households have septic tank systems for treating waste water that have a similar impact on diarrhea mortality as cheaper sanitation options (Figure 7).

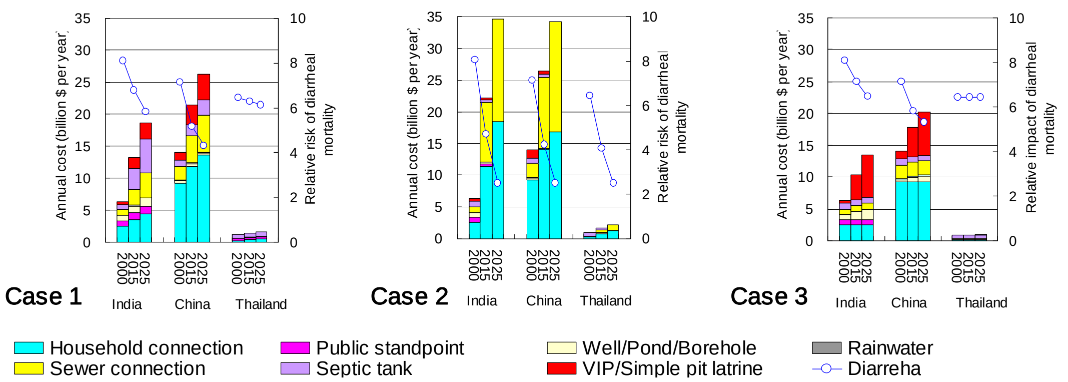

Figure 7. Annual cost of water supply and health risk in 2000, 2015, and 2025 in India, China, and Thailand under three scenarios
(Case 1: No change in technology mix. Case 2: Piped water and sewer connection to all households in 2025. Case 3: Provision of cheap water/sanitation technologies to new households from 2000 onwards.)

For India, the annual cost of providing a centralized connection of piped water to households is expected to decline more by improvement to the efficiency of water supply management than by reduction of unaccounted for water. However, it is the other way round for Thailand. This is because the existing manpower cost of supplying 1 m^3 of piped water and the existing proportion of unaccounted for water are both very high in India, whereas in Thailand, the former is very low and the latter is high. For the same reason, the reduction in annual volume of piped water is expected to be higher in India than in Thailand in scenarios where unaccounted for water is reduced. China is expected to witness a very low decline in both annual cost of connected systems and annual volume of piped water supply because of its existing low unit cost of piped water supply and low proportion of unaccounted for water (Figure 8).

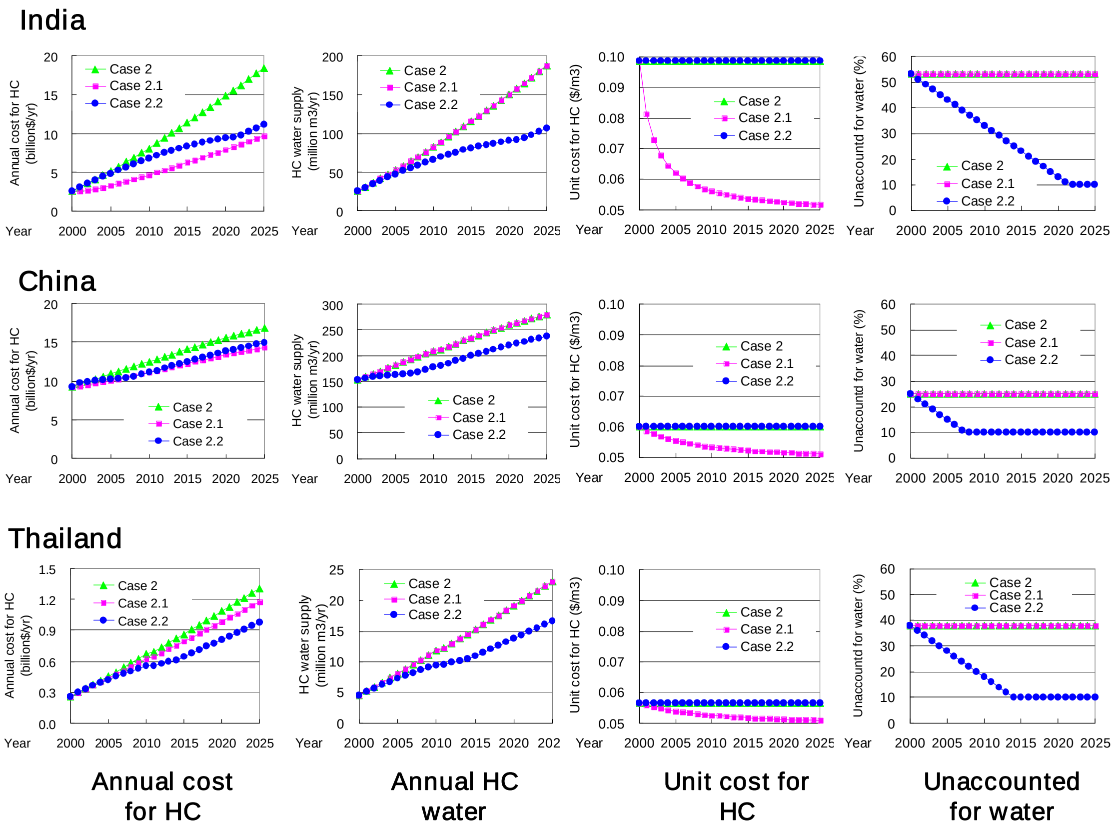

Figure 8. Comparison of three water management scenarios in India, China, and Thailand
(Case 2: Same as Case 2 in Fig. 7. Case 2.1: Improved water supply efficiency over Case 2 as measured by an increase in manpower productivity of 5% per year. Case 2.2: Reduction in unaccounted for water of 3% per year over Case 2 due to improved management, up to a minimum limit of 10% of total water supply. HC: Household connection of centralized piped water and sewer system.)

2.4 Use of the SDB to assess innovative options in Thailand and Korea

The SDB has been used extensively to assess multiple innovation options in the transportation, residential, and commercial sectors of Thailand and Korea. Figure 9 illustrates the concepts of innovations considered in various sectors, and the interlinkages among them, for urban Thailand. The SDB was used to analyze the biofuel program in Thailand, covering bio-diesel and gasohol options (Figure 10). It was found that bio-diesel is competitive in road transport but not in water transport in Thailand. Gasohol is not competitive at current production costs. At existing costs, the biofuel program in Thailand has the potential for reducing CO_2

emissions by 1.6 Mt and SO_2 by 1.9 kt in 2011. With additional policy and institutional support, its impact could be significant.

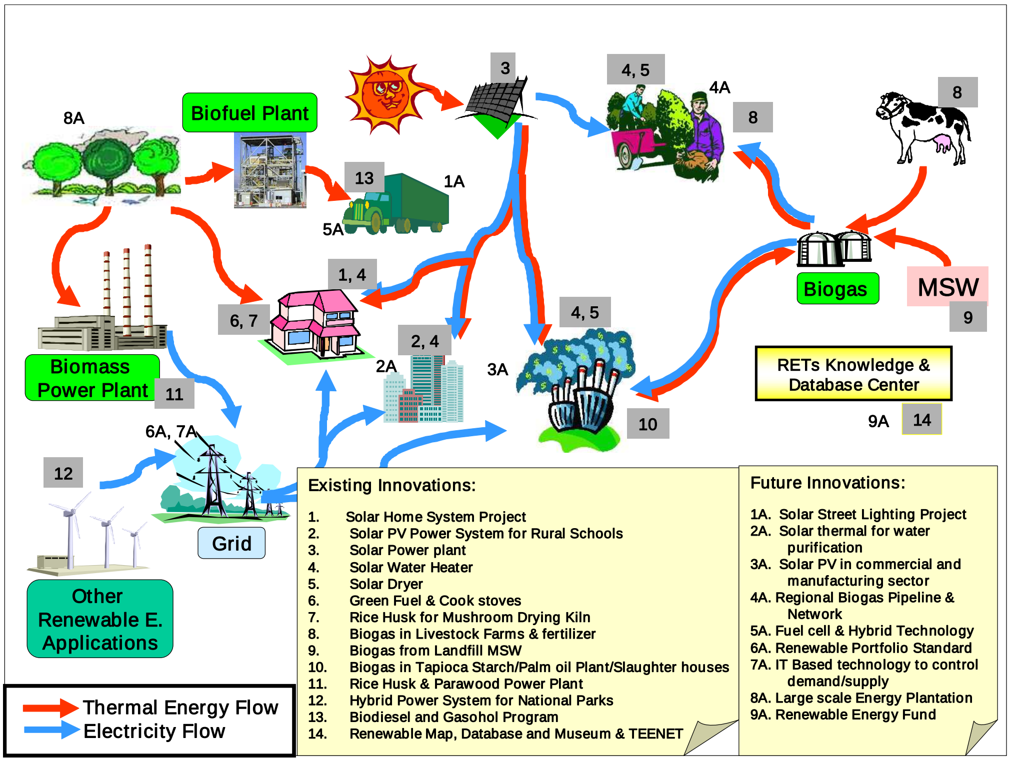

Figure 9. Existing and future innovations assessed in SDB for Thailand

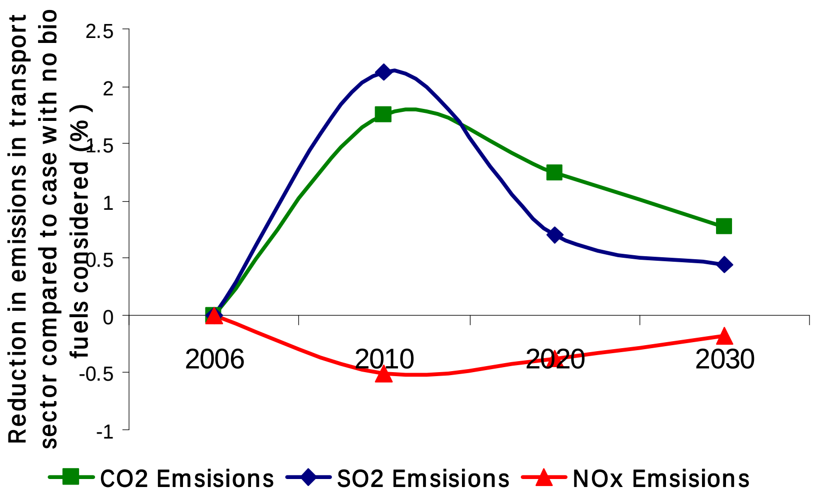

Figure 10. Assessment of the Thai biofuel program with the SDB

Several innovations have been analyzed using the SDB for the residential and transport sectors of Korea. Figure 11 shows the SDB card and result of a scenario where green roofs are installed on 30% of Korean houses. Green roof is a light weight roof garden system involving layers of volcanic stone mulching, artificial lighting soil, filtration non-woven fabric, drain insulating bricks, PVC water proof sheet, slope control EPS panel and insulating board. The green roof technology saves about 9.8% of the energy requirement of a house. This scenario is expected to result in an approximately 2.5% reduction in energy consumption in Korea.

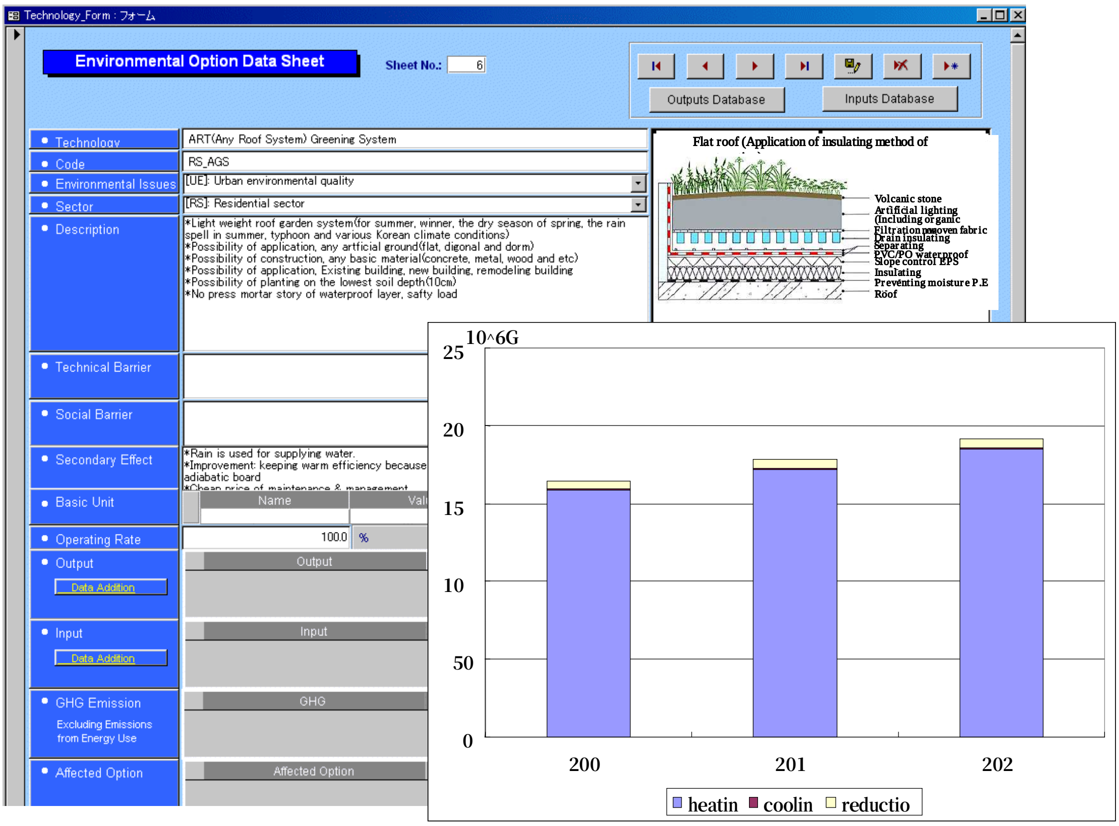

Figure 11. Assessment of a green roof scenario in Korea with the SDB

2.5 Application of AIM/Air to China

The AIM/Air model has been used to simulate air pollution from various sources in Beijing. Figure 12 shows the distribution of PM concentration estimated from the distribution of traffic volume in a winter night. Significant seasonal variation was observed in the concentrations of SO_2 and NO_x, with very high concentrations occurring in winter. On 63 days in a year, the SO_2 concentration in Beijing was above the 24-hour standard of 0.15 mg/m^3 for residential areas, and on 35 days it was above the standard of 0.25 mg/m^3 for industrial areas. The NO_x concentration crossed the residential area standard of 0.10 mg/m^3 on 64 days, and the industrial area standard of 0.15 mg/m^3 on 11 days. Although the commercial and power sectors were the main contributors of SO_2, the power sector alone was primarily responsible for most of the NO_x emissions (Figure 13).