3. Baseline Socio-economic Scenarios

3.1 Overview

This chapter summarizes the design, development and application of baseline socio-economic scenarios for use in V&A assessments. More details are given in Lim et al. (2005) and in Malone et al. (2004), from which much of the information in this chapter is drawn. It should be noted from the outset that developing and applying baseline scenarios (i.e., scenarios of changes in socio-economic and natural conditions *not* caused by climate change) can be very complex and time consuming. The point of the exercise is to help understand how future development paths can affect vulnerability to climate change. The exercise of developing baseline scenarios should not be so time and resource consuming as to divert the V&A assessment from its main focus: addressing climate change.

In examining vulnerability and adaptation to climate change, it can be tempting to just focus on how a change in climate would affect society and nature. Taking today's social and natural conditions and imposing a future climate change may be a relatively simple way of proceeding to identify vulnerabilities and analyse adaptations. Although we do not dissuade such an analysis, it is important that the climate be projected to change over many decades. During this time, it is reasonable to expect that socio-economic and natural conditions will change, in some cases quite dramatically. As a result of these changes, *vulnerability to climate change and effectiveness of adaptations* could also change.

For example, increased population growth may place more people and property at risk from increased frequency or intensity of extreme climate events. On the other hand, economic growth and development may increase the wealth and the capacity of a community to withstand and adjust to future changes, thus reducing the measured impact compared to current circumstances.

Baseline scenarios approximate some of the key elements of an ever-changing backdrop of technology, infrastructure, social conditions and natural environments, and establish a consistent and structured base for comparing the impacts of climate change.

Analysts are probably well aware that there is tremendous uncertainty about future socio-economic conditions. Whether and how much such key variables as population, income, technology, wealth distribution, laws and the environment will change can have large uncertainties associated with them. In addition, there can be surprises, such as the emergence of HIV/AIDS, that can substantially affect socio-economic conditions. So, analysts are advised not to try to develop "predictions" of future socio-economic conditions. Rather, analysts are encouraged to explore how plausible changes in key socio-economic variables can affect vulnerability. In other words, the real benefit of using socio-economic scenarios is to identify what socio-economic variables are most likely to increase or decrease vulnerability to climate change.

Analysts are also encouraged not to devote too much time, energy and financial resources to this exercise. Preparing baseline scenarios can become very complicated and time consuming. Developing these scenarios is not an end in itself. It is best to remember the ultimate use of scenarios and to use relatively simple approaches in developing them. Educated judgement can be fine in an exercise such as this.

3.2 Recommended Steps to Developing and Applying Baseline Scenarios

The following four steps are recommended for developing and applying baseline scenarios. Note that it is not necessary to conduct all four steps. Analysts are encouraged to go as far as time and resources permit. Keep in mind that time and money devoted to developing and applying baseline scenarios may result in less time and money available to analyse adaptation to climate change.

Step 1: Analyse vulnerability of current socio-economic and natural conditions to future climate change.

Step 2: Identify at least one key indicator for each sector being assessed.

Step 3: Use or develop a baseline scenario approximately 25 years into the future.

Step 4: Use or develop a baseline scenario 50 to 100 years into the future.

3.2.1 Step 1: Analyse vulnerability of current socioeconomic and natural conditions to future climate change

The most straightforward and relatively easy thing to do is to first examine what impact climate change would have on today's conditions. We recommend this for three reasons:

1. Today's conditions are known. The population, where people live, income levels, technology levels, economy, and natural conditions are known or can be determined.

2. It will likely be easier to communicate risks about today's conditions than risks regarding a hypothetical future set of socio-economic conditions. It should be easier for people to understand how current conditions could be affected by climate change scenarios than

first imagining how socioeconomic conditions could change and then trying to impose climate change on top of those socioeconomic conditions.

3. Analysing vulnerability of today's conditions essentially is a starting point against which analysts can compare the effect of socio-economic changes on vulnerability. For example, one could say if a half metre sea rise happened with today's socio-economic conditions, then a particular number of people would be at risk. If the coastal population grows and the same sea level rise happens, then an additional number of people would be at risk. The advantage of this is that variables that increase or decrease vulnerability to climate change can be identified. This can be useful in addressing adaptation, i.e., trying to reduce or minimize change in variables that increase vulnerability and encourage change in variables that decrease vulnerability.

A word of caution here: we do not expect current socio-economic conditions to remain unchanged over time. This should be clearly communicated when presenting results.

3.2.2 Step 2: Identify at least one key indicator for each sector being assessed

An indicator is a socio-economic variable, factor or condition that can determine or be closely related to vulnerability to climate change. Population in coastal zones can be an indicator of vulnerability to sea level rise or increased coastal storms. Box 3.1 gives some examples of indicators. The reason for selecting indicators is to help estimate how vulnerability of a sector can change. As we will see below, indicators can be a link between socio-economic scenarios and vulnerability in specific sectors.

Ideally indicators should be quantifiable. Thus, their changes could be measured and, potentially, that change could be used to estimate change in vulnerability. Of course, not all indicators are quantifiable. Adger (2003) mentions social capital as a key factor affecting society's vulnerability to climate variability and change. Quantifying social capital may be challenging (e.g., see Yohe and Tol, 2002).

The challenge in the next two steps is to develop socio-economic scenarios that will aid in estimating how indicators could change in the future.

Box 3.1. Example indicators.

Examples for the agricultural sector include degree of food security (i.e., percentage of the population with access to sufficient quantities and qualities of food for health and nutrition), share of food imported, and production of key crops. In the water sector, examples include the extent of available water supplies that are diverted or consumed, share of the population with ready access to potable water, and per capita water use (see Malone et al., 2004, for some explicit examples; this is available at).

3.2.3 Step 3: Use or develop a baseline scenario approximately 25 years into the future

The further in the future baseline scenarios are developed, the less credibility they have, because the potential for change multiplies the further in the future one looks. There is no magical point in the future at which socio-economic scenarios become dramatically less credible (or even incredible). Developing them beyond approximately 25 years generally becomes unrealistic. We suggest as a first step that a quarter century baseline scenario be developed.

If such scenarios have been developed (e.g., a national or regional government may have made such projections), analysts should consider using them. The scenarios or projections should be evaluated to determine their usefulness. In particular, do they provide estimates of variables that can help in estimating how indicators could change? Using an estimate that has already been developed can save much time.

Otherwise, we suggest the following three-step process:[1]

1. Obtain United Nations population projections for your country (available at http://esa.un.org/unup/). Use the projections for total population change. Also use the projections of change in workforce population. This is the population of people between the typical age at which workers join the workforce and the typical age at which they retire.

2. Estimate change in labour productivity. Increases in labour productivity from the "Mini-Cam" model (which is one of the models used in developing SRES scenarios; see below) are given in Attachment I (Hugh Pitcher, Pacific Northwest Laboratory, personal communication, September 21, 2005). Note that other estimates of changes in labour productivity may exist. Analysts are advised to compare actual productivity changes with the 1995–2005 numbers in the table. Results may be calibrated accordingly. Also note that countries with gross domestic product (GDP) higher than the average for their region may have slower growth rates and countries with GDP lower than the average could have higher growth rates. The change in labour productivity can be multiplied by the change in the workforce to estimate economic growth. For example, if the workforce is estimated to grow by 1% per year and labour productivity is estimated to grow by 2% a year, then economic growth would grow by 3% per year ($1.01 \times 1.02 = 1.03$).

3. Relate these variables to indicators or estimate changes in other variables that can be used to estimate changes in indicators. If indicators can be related to these variables (e.g., an increase in income can be related to the percentage of population with access to sufficient quantities of food), then changes in indicators can be estimated. Attachment II to this

[1] Dr. Hugh Pitcher, Pacific Northwest Laboratory, provided very helpful suggestions on this section.

chapter explains how this can be done. It may be that population or economic growth is insufficient to estimate changes in indicators. Then other socio-economic variables may need to be estimated. This can be done quantitatively by examining past changes in these variables relating to population or income or by using expert judgement.

Note these scenarios could be developed in 5- or 10-year increments to assess relative rates of change.

3.2.4 Step 4: Use or develop a baseline scenario 50 to 100 years into the future

The final step, which is optional, is to develop baseline scenarios beyond the middle of the 21st century and even up to approximately the end of the century. The advantage of doing so is that baseline scenarios can be on the same time scale as scenarios typically coming out of climate models (which often project out to 2100; see Chapter 4). The disadvantage is that socio-economic scenarios covering such long periods of time have very low credibility.

The IPCC developed a Special Report on Emission Scenarios (SRES). These scenarios were developed to estimate how different development paths could affect emissions of greenhouse gases over the 21st century. Developing such scenarios required estimating how socio-economic conditions would change. The SRES scenarios estimate how population, income, productivity and other factors could change over the 21st century. Attachment III describes the SRES scenarios in more depth.

Because these scenarios are published by the IPCC, they can be a good source of information that can help in developing up to century-long socio-economic scenarios. There are two important caveats:

1. The SRES scenarios are at a regional scale. Estimates are not provided for most countries. To develop a socio-economic estimate for a specific country (or region within the country), the analyst will need to either assume that the same regional changes will happen at the national or sub national scale or apply some judgement about how change at the national level could differ from the regional level.

2. The SRES scenarios may not represent all possibilities. All the SRES scenarios assume economic growth in all regions, and some assume relatively high levels of growth. For various reasons, some countries or regions may not have continuous economic growth and it may be desirable to include a relatively pessimistic scenario.

Gaffin et al. (2004) provide an interesting and detailed discussion about downscaling population and GDP data from the SRES scenarios to the country level.

3.3 Data Sources

Data for indicators are available from a variety of sources, depending on the particular sector under consideration. Many multinational organizations, such as the World Health Organization (WHO), the Food and Agriculture Organization of the United Nations (FAO), the UNDP, and the World Bank have readily accessible data on many variables that might be appropriate for indicators. General data that may be particularly relevant for one or more indicators include the following:

- *Economy*: GDP, important sectors, comparative advantages, technology, infrastructure, institutions
- *Demography*: population, age structure, education, health
- *Environment*: land, water, air, biota, principal and unique resources, quantity and quality.

Table 3.1 lists selected data sources for indicators, socioeconomic data, and developing baseline and socioeconomic scenarios.

Table 3.1. Selected data sources for developing baseline and socio-economic scenarios, socio-economic data, and indicators

Description	Source and availability
Baseline and socio-economic scenarios	
Good primary reference on methods and approaches. Excellent general guidance on the process. Good description of indicators and characteristics.	Malone, E.L. and E.L. La Rovere. 2004. Assessing current and changing socio-economic conditions. In *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures,* B. Lim, E. Spanger-Siegfried, I. Burton, E.L. Malone, and S. Huq (eds.). Cambridge University Press, Cambridge, UK, pp. 147-163. http://www.undp.org/gef/undp-gef_publications/publications/apf%20technical%20paper06.pdf.
Good primary resource that describes the concepts, nature of the process, and some clear examples for several indicators.	Malone, E.L., J.B. Smith, A.L. Brenkert, B.H. Hurd, R.H. Moss, and D. Bouille. 2004. *Developing Socioeconomic Scenarios: For Use in Vulnerability and Adaptation Assessments*. United Nations Development Programme, New York. http://www.undp.org/cc/WORKBOOK_SES%20(B)/Socio-economic%20Scenarios_Master_April%202004.pdf.

Table 3.1. Selected data sources for developing baseline and socio-economic scenarios, socio-economic data, and indicators (cont.)

Description	Source and availability
Socio-economic data	
Primary source for concepts and discussions relating to the SRES scenarios.	Nakicenovic, N. and R. Swart. 2000. *Special Report on Emissions Scenarios.* Cambridge University Press, Cambridge, UK. http://www.grida.no/climate/ipcc/emission/023.htm.
CIESIN is a centre within the Earth Institute at Columbia University; it specializes in online data and information management, spatial data integration and training, and interdisciplinary research relating to human interactions in the environment.	Center for International Earth Science Information Networks (CIESIN). 2000. http://www.ciesin.columbia.edu. URL for SRES data: http://sres.ciesin.columbia.edu/final_data.html.
Indicator sources	
Source for country-level data on a range of possible indicators	WRI. 2000. *World Resources 2000-2001: People and Ecosystems: The Fraying Web of Life.* World Resources Institute in collaboration with UNDP, UNEP, and World Bank, Washington, DC. http://pubs.wri.org/pubs_pdf.cfm?PubID = 3027.

Attachment I: Projected Increases in Regional Productivity by SRES Scenario

The data in Table I.1 were provided by Dr. Hugh Pitcher, Pacific Northwest Laboratory. Estimates are from “Mini-Cam”, a model that estimates global greenhouse gas emissions. Mini-Cam is one of the models used in development of the SRES scenarios.

Table I.1 Labour productivity for the four SRES storylines for the 11 regions used in the Mini-Cam version of the SRES scenarios

	A1 family of scenarios (%)	A2 (%)	B1 (%)	B2 (%)
United States				
1990-2005	1.51	1.51	1.52	1.52
2005-2020	1.59	0.75	1.18	0.88
2020-2035	1.58	0.72	1.15	0.80
2035-2050	1.60	0.75	1.16	0.83
2050-2065	1.59	0.75	1.15	0.83
2065-2080	1.59	0.77	1.16	0.84
2080-2095	1.55	0.76	1.13	0.83
Canada				
1990-2005	1.51	1.51	1.51	1.51
2005-2020	1.77	0.86	1.35	1.01
2020-2035	1.72	0.74	1.25	0.84
2035-2050	1.73	0.79	1.26	0.89
2050-2065	1.69	0.79	1.24	0.89
2065-2080	1.67	0.81	1.23	0.89
2080-2095	1.64	0.80	1.20	0.88
Western Europe				
1990-2005	1.64	1.64	1.65	1.64
2005-2020	1.78	0.95	1.45	1.10
2020-2035	1.71	0.73	1.23	0.83
2035-2050	1.73	0.78	1.24	0.88
2050-2065	1.69	0.78	1.22	0.88
2065-2080	1.67	0.80	1.22	0.89
2080-2095	1.63	0.79	1.19	0.88

Table I.1 Labour productivity for the four SRES storylines for the 11 regions used in the Mini-Cam version of the SRES scenarios (cont.)

	A1 family of scenarios (%)	A2 (%)	B1 (%)	B2 (%)
Japan				
1990-2005	1.79	1.78	1.79	1.79
2005-2020	2.13	1.32	2.12	1.63
2020-2035	1.46	0.68	1.03	0.73
2035-2050	1.50	0.72	1.04	0.78
2050-2065	1.50	0.72	1.04	0.78
2065-2080	1.51	0.74	1.06	0.79
2080-2095	1.51	0.73	1.05	0.79
Australia and New Zealand				
1990-2005	1.76	1.76	1.76	1.76
2005-2020	1.94	0.84	1.38	0.95
2020-2035	1.87	0.81	1.39	0.93
2035-2050	1.84	0.85	1.36	0.96
2050-2065	1.77	0.84	1.32	0.94
2065-2080	1.74	0.85	1.30	0.94
2080-2095	1.69	0.84	1.26	0.93
Former Soviet Union				
1990-2005	-0.71	-0.71	-0.71	-0.71
2005-2020	5.19	2.59	4.92	3.94
2020-2035	5.23	2.26	4.37	3.15
2035-2050	4.17	2.04	3.39	2.56
2050-2065	3.34	1.84	2.72	2.14
2065-2080	2.82	1.71	2.31	1.88
2080-2095	2.46	1.58	2.01	1.68
China and centrally planned Asia				
1990-2005	7.46	7.45	7.46	7.46
2005-2020	6.84	4.54	6.61	5.59
2020-2035	6.21	2.96	5.62	4.39
2035-2050	5.21	2.57	4.39	3.40
2050-2065	4.10	2.24	3.38	2.69
2065-2080	3.33	2.03	2.76	2.27
2080-2095	2.78	1.83	2.31	1.96

Table I.1 Labour productivity for the four SRES storylines for the 11 regions used in the Mini-Cam version of the SRES scenarios (cont.)

	A1 family of scenarios (%)	A2 (%)	B1 (%)	B2 (%)
Middle East				
1990-2005	0.28	0.28	0.28	0.28
2005-2020	2.30	1.25	2.35	1.80
2020-2035	4.38	1.70	3.60	2.37
2035-2050	3.63	1.57	2.86	2.02
2050-2065	2.99	1.47	2.40	1.79
2065-2080	2.59	1.38	2.09	1.62
2080-2095	2.32	1.32	1.88	1.49
Africa				
1990-2005	0.65	0.65	0.65	0.65
2005-2020	3.65	2.59	3.71	3.15
2020-2035	6.37	3.71	6.32	5.14
2035-2050	6.41	3.28	5.71	4.57
2050-2065	5.35	2.77	4.40	3.48
2065-2080	4.23	2.41	3.40	2.76
2080-2095	3.38	2.12	2.74	2.29
Latin America				
1990-2005	1.39	1.39	1.39	1.39
2005-2020	3.81	2.04	3.76	2.93
2020-2035	4.76	1.83	3.88	2.62
2035-2050	3.79	1.72	3.07	2.23
2050-2065	3.10	1.59	2.53	1.93
2065-2080	2.67	1.50	2.20	1.74
2080-2095	2.37	1.41	1.96	1.58
South and Southeast Asia				
1990-2005	3.81	3.81	3.81	3.81
2005-2020	5.93	3.50	5.81	5.06
2020-2035	6.14	2.93	5.49	4.17
2035-2050	5.10	2.55	4.26	3.24
2050-2065	4.01	2.23	3.29	2.59
2065-2080	3.25	2.00	2.68	2.18
2080-2095	2.75	1.81	2.27	1.90

Note: Percentages are based on use of market exchange rates. Results should not be used to compare wealth across countries or regions.

Attachment II: A Brief Example: Steps for Developing the Socio-economic Scenarios for Agriculture

Annex 1 in Malone et al. (2004) gives a relatively clear and concise data set and example indicators to illustrate and apply the concepts behind the baseline socio-economic scenario. The example below, excerpted from Malone et al., is numeric; in practice, however, the most useful analyses and assessments will also most likely involve qualitative information and supportive judgements.

Step 1: Use SRES scenarios to develop estimates of population and GDP percentage changes from base year (e.g., 1990).

Step 2: Estimate percentage changes in total food consumption from base year. This is likely to follow population changes, but can be adjusted up or down to reflect anticipated improvements or decreases in overall diet and nutrition.

Step 3: Estimate total cereal needs in thousands of tonnes. WRI (2000) reports, by country, the "average production of cereals" and the "net cereal imports and food aid as a percent of total cereal consumption." Together, these two measures can be used to estimate total cereal needs, assuming that, if there are imports, all the country's production is also consumed internally. For example, the estimates for Developing Country 1 are 847,000 tonnes produced, and 43% of consumption met with imports in 1995. Therefore, the share met by internal production is 57%, which, divided into total production, yields 1,486,000 tonnes of cereal needed in 1995. This number is then adjusted by population growth to reflect demand in 2000 and is estimated at 1,872,000.

Step 4: Estimate import and food aid shares. Food imports begin at 43% for Developing Country 1, as reported in WRI (2000) for 1995 (available at http://pubs.wri.org/pubs_pdf.cfm?PubID = 3027). One way to proceed is to choose a target import share for 2100 that is consistent with the relevant SRES storyline. These targets were set at 25% and 35%. These particular estimates were arrived at subjectively by the authors, and illustrate consistency with the SRES scenarios – not necessarily accuracy or consistency with Developing Country 1's own situation. Having both endpoints (i.e., estimates for 2000 and 2100), the intervening years can be estimated by proportional scaling with the estimated changes in income (based on the assumption that changes in either agricultural production or imports is enabled by GDP growth). For example, the following equation is used to interpolate import shares:

$I_{2010} = I_{2000} - (I_{2000} - I_{2100})$ H [$(GDP_{2010} - GDP_{2000})/(GDP_{2100} - GDP_{2000})$]

where I_{2000}, I_{2010}, and I_{2100} = estimated import/food aid share in 2000, 2010, and 2100, respectively, and GDP_{2000}, GDP_{2010}, and GDP_{2100} = estimated GDP percentage changes from 1990 for 2000, 2010, and 2100, respectively.

Step 5. Estimate in-country production. This estimate is calculated by subtracting from 1 the import share calculated in Step 4. This gives the share of total cereal needs that is met by in-country production. This number is then multiplied by estimated total cereal needs to give the estimated level of agricultural production implied by the scenario.

Step 6. Estimate crop yields and percentage changes. Cereal crop yields are estimated based on required in-country production and the assumption that planted area is constant. Cereal crop planted area is estimated from data in WRI (2000) in which total cereal production in Developing Country 1 in 1996–1998 is 847,000 tonnes, and average cereal crop yields are given as 719 kg/ha. Therefore, estimated planted area in Developing Country 1 in 1996–1998 is 1.18 million ha. Using this land base and dividing into the estimated production level gives the required crop yield. The percentage change in crop yields is then estimated using 719 kg/ha in 1995 as the base. An estimate of annualized yield changes is also helpful. This example, which suggests that yields will rise by 491% by 2100, implies an annual rate of change of 1.6% – consistent with recent technological changes but highly speculative that this rate can persist indefinitely. Table II.1 presents the information and data used in this illustrative example.

In addition to the use of SRES storylines, analysts could also consider using standard scenario approaches, such as both "optimistic" and "pessimistic" scenarios. The intent of such scenarios is to identify a range of plausible outcomes. Certainly, the longer the time frame used in the analysis, the greater the uncertainty inherent in the scenario.

Table II.1. Estimated basic food demand for Developing Country 1: SRES A2 scenario

Developing Country 1	2000	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Percentage change in population from 1990	26	58	94	133	172	212	248	281	309	329	349
Estimated percentage change in GDP from 1990	47	126	226	421	673	989	1,452	1,978	2,578	3,284	4,073
Estimated percentage change in total food consumption from 1990	26	58	94	133	172	212	248	281	309	329	349
Estimated total cereal needs (thousands of tonnes)	1,872	2,348	2,883	3,462	4,042	4,636	5,171	5,662	6,078	6,375	6,672
Estimated import and food aid share (%)[a]	43	43	43	42	41	40	38	36	33	30	25
Estimated in-country production (thousands of tonnes)	1,067	1,338	1,643	2,008	2,385	2,782	3,206	3,624	4,072	4,463	5,004
Average cereal crop yields (kg/ha)[b]	906	1,136	1,395	1,705	2,025	2,362	2,722	3,076	3,457	3,789	4,248
Estimated percentage increase in crop yields from 1995	26	58	94	137	182	229	279	328	381	427	491

Note: Net cereal imports and food aid as a percentage of total cereal consumption, 1995–1997 (WRI, 2000): Developing Country 1: 43%.

a. Estimated import and food aid share is based on taking current share and using judgement to estimate the target share for 2100 under the given SRES scenario. In this case, the A2 scenario suggests greater self-reliance. Therefore, a goal might be to reduce food imports from 43% to 25% by 2100. Capacity to reduce imports is a function of income; therefore, estimated food import share is scaled by the percentage change in projected income. For example, 2% of the overall increase in income occurs between 2000 and 2010; therefore, we estimate that 2% of the total 33% change in import share (i.e., -0.6%) occurs in this decade. Caution must be used here to ensure overall consistency – falling import shares must be matched by increasing in-country agricultural production, which implies an increase in the intensity of agricultural production or in the cultivated land area.

b. Cereal crop yields are estimated based on required in-country production and assume that planted area is constant. Cereal crop planted area is estimated from data in WRI (2000) in which total cereal production in 1996–1998 is 847,000 tonnes, and average cereal crop yields are given as 719 kg/ha. Therefore, estimated planted area in Developing Country 1 in 1996–1998 is 1.18 million ha. Production levels, however, are also subject to increases by increasing the land base.

Attachment III: SRES Scenarios – Storylines

To provide more consistent projections of greenhouse gas emissions – projections that considered the complex social, economic, and technological relationships that underlie energy use and resulting emissions – the IPCC developed the Special Report on Emission Scenarios (SRES). The SRES approach aims to present a short "history" of possible future development expressed in a combination of key scenario characteristics based upon an underlying consistency of the complex economic relationships that underlay energy use. The result was a set of logical storylines that encompass the social and physical relationships driving greenhouse gas (GHG) emissions (Nakicenovic and Swart, 2000).

At the core of the SRES approach are four poles along two major axes:

- Economic versus environmental
- Global versus regional.

As shown in Figure III.1, combinations of these four poles give rise to four primary storylines:

- A1 – Economic growth and liberal globalization
- A2 – Economic growth with greater regional focus
- B1 – Environmentally sensitive with strong global relationships
- B2 – Environmentally sensitive with highly regional focus.

Each storyline describes a global paradigm based on prevalent social characteristics, values and attitudes that determine, for example, the extent of globalization, economic development patterns and environmental resource quality. The storylines are by their nature highly speculative. Nonetheless, they do provide identifiable starting points that are defined and consistent with available data sets for projecting some variables (most notably population, income, land use, and emissions). They have been used in previous and ongoing assessments and provide a basis for inter-country comparisons. Finally, they illustrate the degree of creative imagination that this scenario building embraces. It is certainly appropriate to consider these storylines as

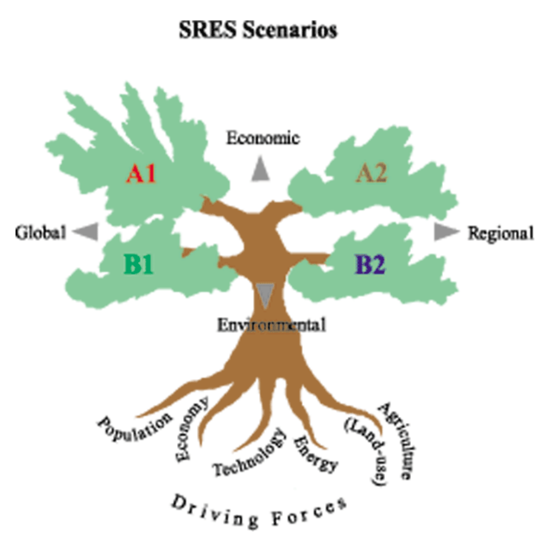

Figure III.1. Conceptual relationships underlying the SRES scenarios.

Source: Nakicenovic and Swart, 2000.

appropriate or desired, based on national and regional outlooks and goals and plausible futures.

The A1 and B1 scenarios focus on global solutions to economic, social and environmental sustainability, with A1 focusing on economic growth and B1 focusing on environmental sensitivity. A2 and B2 focus on regional solutions with strong emphasis on self-reliance. They differ in that A2 focuses on strong economic growth and B2 focuses on environmental sensitivity. The IPCC describes their differences as follows: “While the A1 and B1 storylines, to different degrees, emphasize successful economic global convergence and social and cultural interactions, A2 and B2 focus on a blossoming of diverse regional development pathways.”

The A1 scenario assumes strong economic growth and liberal globalization characterized by low population growth, very high GDP growth, high-to-very-high energy use, low-to-medium changes in land use, medium-to-high resource availability (of conventional and unconventional oil and gas), and rapid technological advancement. The A1 scenario assumes convergence among regions, including a substantial reduction in regional differences in per capita income in which the current distinctions between “poor” and “rich” countries eventually dissolve; increased capacity building; and increased social and cultural interactions. A1 emphasizes market-based solutions; high savings and investment, especially in education and technology; and international mobility of people, ideas, and technology.

The A2 scenario describes a world with regional economic growth characterized by high population growth, medium GDP growth, high energy use, medium-to-high changes in land use, low resource availability of conventional and unconventional oil and gas, and slow technological advancement. This scenario assumes a very heterogeneous world that focuses on self-reliance and the preservation of local identities, and assumes that per capita economic growth and technological change are more fragmented and slower than in other scenarios.

The B1 scenario describes a convergent world that emphasizes global solutions to economic, social and environmental sustainability. Focusing on environmental sensitivity and strong global relationships, B1 is characterized by low population growth, high GDP growth, low energy use, high changes in land use, low resource availability of conventional and unconventional oil and gas, and medium technological advancement. The B1 scenario assumes rapid adjustments in the economy in the service and information sectors, decreases in material intensity, and the introduction of clean and resource-efficient technologies. A major theme in the B1 scenario is a high level of environmental and social consciousness combined with a global approach to sustainable development.

The B2 scenario, like the A2 scenario, focuses on regional solutions to economic, social and environmental sustainability. The scenario focuses on environmental protection and social equality and is characterized by medium population and GDP growth, medium energy use, medium changes in land use, medium resource availability, and medium technological advancement.

The four standard SRES scenarios

A1 – Economic growth and liberal globalization

- Utilitarian values, affluence oriented
- Rapid economic growth (3% globally)
- Low population growth, long life, small families
- Rapid introduction and adoption of efficient technologies
- Intermediate GHG emissions
- Personal wealth emphasized over environmental quality
- Reduced differences in regional incomes
- Cultural differences throughout the world converge

A2 – Economic growth with greater regional focus

- Local, community, and family centred values
- Greater regional emphasis both culturally and economically
- Less rapid economic growth (1.5% globally)
- High population growth
- Low per capita incomes
- Technology change and adoption depends on resources and culture
- Highest GHG emissions
- Focus on agricultural productivity to feed rapidly rising populations

B1 – Environmentally sensitive with strong global relationships

- High level of environmental and social concern and value
- Emphasis on globally sustainable and balanced development with investments in social infrastructure and environmental protection
- Moderate economic growth (2% globally)
- Low population growth
- Moderate per capita income, slightly less than A1
- Services emphasized over material goods, quality over quantity
- Mitigation technologies rapidly adopted and rapid decline in use of fossil fuels
- Low GHG emissions

B2 – Environmentally sensitive with highly regional focus

- High level of environmental and social concern and value
- Emphasis on decentralized decision-making and local self-reliance
- Moderate economic growth (1% globally)
- Moderate population growth
- Moderate per capita income, slightly less than A1
- Less technology development and adoption, declining global investment, and less international diffusion
- Regional differences in energy use and innovation, transition out of fossil fuels is gradual
- Moderate GHG emissions