Annex A: Alternative approaches to analysis of long term futures

As Lempert *et al*. (2003) point out, advances in long term policy analysis rest on solid methodological foundations. Numerous methods of considering the impacts of present actions on the long term future have been used over time.

Narratives offer an aid to imagining different futures, often devised using expert elicitation methods such as Delphi or Foresight. Narratives are often associated with a particular scenario, based on how alterations in particular key drivers will affect future conditions. There are numerous examples of these kinds of analyses, most of which focus on contrasting futures resulting from socio-economic changes, technological advances, impacts of climate change, and different approaches to governance. A brief example of three of these studies is given below covering global climate change, global sustainability and national Foresight analyses (for the UK).

THE SRES FRAMEWORK FOR CLIMATE CHANGE

The Intergovernmental Panel on Climate Change (IPCC) have produced a series of assessment reports (Special Reports on Emissions Scenarios – SRES) which group a number of emissions scenario models into four families, depending on the implications on climate change of a range of economic, demographic, and technological driving forces (IPCC, 2000). Each scenario family represents a distinct storyline, depending on the degree of global integration versus regionalism and the relative regard for economic versus environmental concerns, as shown in Table 1.

We are aware of the new Representative Concentration Pathways (RCP) and associated socio-economic scenario being developed as part of the IPCC 5th Assessment (Moss *et al*., 2010; Arnell *et al*., 2011) and these will be considered in future ITRC assessments as they are developed and 'road-tested'.

Table 1: SRES scenario family descriptions	
A1: Rapid convergent growth (Economic emphasis / Global integration)	Very rapid economic growth, low population growth, and the rapid introduction of new and more efficient technologies. Regional convergence, capacity building, and increased cultural and social interactions. The A1 scenario family was developed into three groups that are consistent with one socio-economic future, but recognise alternative directions of technological change in the energy system, distinguished by their technological emphasis: A1B – Balanced energy; A1FI – Fossil-fuel intensive; A1T – High-tech renewables.
A2: Fragmented world (Economic emphasis / Regionalism)	Heterogeneous world. Self-reliance and preservation of local identities. High population growth. Economic development is primarily regionally oriented and per capita economic growth and technological change are more fragmented and slower than in other storylines.
B1: Convergence with global environmental emphasis (Environmental emphasis / Global integration)	Same low population growth as in A1, but with rapid changes in economic structures toward a service and information economy, with reductions in material intensity, and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social, and environmental sustainability, including improved equity, but without additional climate initiatives.
B2: Local sustainability (Environmental emphasis / Regionalism)	Emphasis is on local solutions to economic, social, and environmental sustainability. It is a world with moderate population growth, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the scenario is also oriented toward environmental protection and social equity, it focuses on local and regional levels.

SOCIO-ECOLOGICAL CHANGE AND SUSTAINABLE DEVELOPMENT

The Global Scenario Group (GSG) focused on the potential impacts of socio-ecological change on sustainable development. They originally suggested three broad classes of scenarios, each with two variants (Gallopin *et al*., 1997), but have recently distilled this into four alternative futures (Raskin *et al*., 2010), each with varying patterns of resource use, environmental impacts, and social conditions, as shown in Table 2.

These GSG studies highlight the risks of complacently following conventional development without policy reform, and the real danger of disastrous global crises. They conclude that without the deep collective cultural and political shift required to achieve their Great Transition scenario, it will be difficult to secure a sustainable future.

Table 2: GSG scenario structure (adapted from Raskin *et al*. 2010)	
Conventional Worlds: Continuity of institutions and values, rapid economic growth, convergence toward industrialised country norms	
Market Forces Market-centred growth-oriented globalisation **Characteristics:** Mid-range population and development projections, typical technological change assumptions	**Policy Reform** Government-led redirection of growth toward sustainability goals **Characteristics:** Strong, comprehensive and coordinated government action to achieve greater social equity and environmental protection
Alternative Visions: Diverse futures resulting from a fundamental restructuring of the global order	
Fortress World An authoritarian path in response to mounting crises **Characteristics:** Elites control an impoverished majority and manage critical natural resources, while outside the 'fortress' there is repression, environmental destruction, and misery	**Great Transition** A fundamental transformation **Characteristics:** Visionary solutions to the sustainability challenge, including new socio-economic arrangements and fundamental changes in values

FORESIGHT NATIONAL SCENARIOS

The UK Foresight programme (Berkhout *et al*., 2002) framed futures in the context of two basic dimensions of change: social values (i.e. community vs consumerism) and governance systems (i.e. regionalism vs globalism), as shown in Table 3. This approach was widely applied, including in the Foresight Assessment of Flood and Coastal Defence (Evans *et al*., 2004a,b).

One of the limitations of the use of scenarios and narratives is the potential lack of quantitative analysis, and reliance on subjective analysis can result in the natural pitfalls of introducing fallacies associated with human reasoning. To avoid such pitfalls, further analytical methods such as simulation models and formal decision analyses can be used, while scenario planning offers a framework which stresses the importance of considering multiple views of the future and inherent uncertainties. However, such methods fail to provide systematic methods of comparing alternative policy choices, and since there are a great many plausible futures, systems which consider only a limited number of possible futures are likely to be wrong, and any policies adopted which might optimally address a 'best guess' forecast are in danger of failing due to unseen or unconsidered future circumstances.

Table 3: Foresight Futures scenarios	
World Markets (Consumerism and Globalisation)	A world defined by an emphasis on private consumption and highly developed and integrated world trading systems.
Global sustainability (Community and Globalisation)	A world in which social and ecological values are considered in economic decisions, and in which strong collective action through global institutions tackles environmental problems.
National Enterprise (Consumerism and Localism)	A world in which people aspire to personal independence and material wealth within a nationally rooted cultural identity. Liberalised markets, together with a commitment to build capabilities and resources to secure a high degree of self-reliance and security, are believed to best deliver these goals. Political and cultural institutions are strengthened to buttress national autonomy in a more fragmented world.
Local Stewardship (Community and Localism)	A world of highly devolved political structures where actions are decided on and implemented at the community and neighbourhood level. Conservation of natural resources is a key concern. Labour-intensive activities are preferred to capital-intensive ones in order to conserve fuel, provide work and boost local economies.

REFERENCES

Arnell, N.W., van Vuuren, D.P. and Isaac, M. (2011). The implications of climate policy for the impacts of climate change on global water resources. *Global Environmental Change* **21**(2): 592–603.

Berkhout, F., Hertin, J. and Jordan, A. (2002). Socio-economic futures in climate change impact assessment: using scenarios as 'learning machines'. *Global Environmental Change* **12**(2): 83–95.

Evans, E.P., Ashley, R., Hall, J., Penning-Rowsell, E.C., Saul, A.J., Sayers, P.B., Thorne, C.R. and Watkinson, A. (2004a). Foresight. *Future Flooding. Scientific Summary: Volume 1 – Future Risks and their Drivers*. London: Office of Science and Technology.

Evans, E. P., Ashley, R., Hall, J., Penning-Rowsell, E.C., Sayers, P.B., Thorne, C.R, and Watkinson, A. (2004b). Foresight. *Future Flooding. Scientific Summary: Volume 2 – Managing Future Risks*. London; Office of Science and Technology.

Gallopin, G., Hammond, A., Raskin, P. and Swart, R. (1997). Branch Points: global scenarios and human choice. A Resource Paper of the Global Scenario Group, Stockholm Environment Institute.

IPCC (2000). Special Report on Emissions Scenarios: A Special Report of Working Group III of the Intergovernmental Panel on Climate Change, IPCC. Geneva, Switzerland.

Lempert, R.J., Popper, S.W. and Bankes, S.C. (2003). Shaping the next one hundred years: New methods for quantitative, long term policy analysis. RAND Corporation.

Moss, R. H., Edmonds, J.A., Hibbard, K.A., Manning, M.R., Rose, S.K., van Vuuren, D.P., Carter, T.R., Emori, S., Kainuma, M., Kram, T., Meehl, G.A., J. Mitchell, F.B., Nakicenovic, N., Riahi, K., Smith, S.J., Stouffer, R.J., Thomson, A.M., Weyant, J.P. and Wilbanks, T.J. (2010). The next generation of scenarios for climate change research and assessment. *Nature* **463**(7282): 747–756.

Raskin, P. D., Electris, C. and Rosen, R.A. (2010). The century ahead: searching for sustainability. *Sustainability* **2**(8): 2626–2651.