Global Scenarios and Implications for Constructing Future Livestock Scenarios

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1. Overview of Scenarios and Definitions

A scenario is a story with plausible cause and effect links that connects a future condition with the present, while illustrating key decisions, events, and consequences throughout the narrative.

Scenario is probably the most abused term in futures research. What usually passes for a scenario today is a discussion about a range of future possibilities with data and analysis. Such a discussion of futures research is perfectly fine and should be done, but does not constitute a scenario. It is like confusing the text of a play's newspaper review with the text of the play written by the playwright.

Often "projections" are confused with scenarios. For example, the UNEP GEO-3 Outlook Section says: "Scenarios can be told in many ways. The two most common methods used in scenario analysis have been descriptive, written narratives (qualitative scenarios) and tables and figures incorporating numerical data, often generated by sophisticated computer models (quantitative scenarios)." No, the latter are not scenarios, they are projections. Good scenarios include projections and forecasts, discussing the cause and effect linkages of the scenario. Computer models give alternative projections based on different assumptions or inputs to a mathematical model. If you change inputs to a model, like grazing patterns, rainfall, disease, fire, etc., then you change the output of the model in terms of livestock production. These give projections, not scenarios.

A related approach is to make group-related projections for a given subject, labelled as being high, low, and middle, such as the FAO's *Long-Term Scenarios of Livestock-Crop-Land Use Interactions in Developing Countries*.[1] Projections are perfectly fine, but they are not scenarios. One can use the projections from models as either input to construct scenarios or to check the quantitative consistency of scenarios over time. Models and their projections are helpful to inform potential cause and effect relations, but, in themselves, they are not scenarios.

Herman Kahn was the father of scenario construction for futures research and policy analysis. He introduced the term "scenario" into planning in connection with military and strategic studies conducted by the RAND Corporation in the 1950s. Often he would think in terms of three alternative scenarios applied to any subject: 1) surprise-free or business-as-usual that simply extrapolates current trends with interplay of the trends; 2) worst case scenario based on mismanagement and bad luck; and 3) best case scenario based on good management and good luck.

Later, futurists began to criticize this approach, saying that people would believe the surprise-free scenario as a "prediction," and would make decisions accordingly. As a result, the scenario could become self-fulfilling. Ironically, Herman Kahn said that the biggest surprise would be that the surprise-free scenario (or business-as-usual scenario) would actually occur. Nevertheless, the criticisms did give birth to the idea of writing sets of four scenarios that would not include a business-as-usual scenario. This approach can force more serious and

[1] This 1997 report is available at http://www.fao.org/docrep/W5146E/W5146E00.htm

flexible thinking about alternative possibilities for which one would have to create more flexible strategies to adjust to changing futures.

Exploratory or *descriptive* scenarios describe and explore events and trends as they could emerge or evolve from the present to some specific future condition. Each alternative scenario is based on a different set of assumptions such as high or low economic growth, war or peace, and/or rates of change in various domains like environmental degradation, technological advances, globalization, etc. Using these assumptions different estimates are given about common characteristics for each scenario. They can be the items about which the stakeholder is most interested, such as meat or energy consumption per capita, technological changes, water availability, etc. Specific events are used to illustrate the trends that may influence the future in the scenario.[2]

Normative scenarios describe how a desirable future can emerge from the present. Normative scenarios are based on norms of the stakeholders that clearly illustrate how goals are achieved while using the values of the stakeholders. This should not be confused with normative statements such as "vision statements," international declarations, or political polemics that do not show the cause and effect relationships that actually cause the positive future to be achieved. Very few normative scenarios exist in public.[3] Corporations will sometimes use exploratory scenarios to determine what has to be taken into consideration when writing their internal normative scenario of strategies and tactics.[4] It would be interesting to have alternative scenarios constructed for the future of livestock, and then construct a normative livestock scenario taking all the factors from the exploratory scenarios into account. Good normative scenarios are not romantic dreams about a wonderful future, but describe how the problems are overcome and the opportunities are used to make the preferred future a reality.

The goal of generating scenarios is to understand the mix of strategic decisions that are of maximum benefit in the face of various uncertainties and challenges posed by the external environment. The scenario construction process itself can alter the way participating planners think about the future. Hence, the process of constructing the scenario may be as or more important in affecting decisions than the actual text of the scenario.

Scenarios have been developed and utilized to:

- Discover what is unknown that ought to be known, before making decisions
- Understand the significance of uncertainties
- Illustrate what is possible and what is not possible
- Identify what strategies might work in a range of possible scenarios
- Make the future more real for decision makers to force new thinking and new decisions
- Learn what has to be avoided and uncover new opportunities

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[2] For an overview of various approaches to scenario construction, see Chapter 10 *Scenarios* by Jerome C. Glenn and the Futures Group International in Futures Research Methodology Version 2.0, of the Millennium Project, published by the American Council for the United Nations University available via http://www.acunu.org/millennium/FRM-v2.html

[3] One exception is the Global Normative Scenario available at http://www.acunu.org/millennium/normscen.html

[4] For an overview of normative scenarios see, Chapter 17 *Normative Forecasting* by Joe Coates and Jerome C. Glenn, also in Futures Research Methodology Version 2.0.

A weakness of scenarios is that they can be given to non-participants, who can then see the scenarios as the "official set of possible futures" and consequently control or limit their thinking to some degree. They have great ability to influence the reader in subtle ways due to the writer's assumptions about cause and effect. The writer's mental model of how the world works is transferred to the reader, and possibly unconsciously accepted. The struggle to be interesting and the dynamic of the story can make it difficult to include important but boring details of connecting cause and effect.

A way to avoid this problem is to involve stakeholders in the scenario construction process. This is often addressed by creating a committee that periodically reviews the work. Another approach is the use of Delphi studies, which allows for a much larger number of stakeholders and other related experts to provide input and feedback at each stage of the construction process, including comments and additions to the draft text of the scenarios.[5]

Scenarios can fail to be useful when their authors either fear criticism for saying too many things that seem too "far out" or fear that they will lose credibility with decision makers. Sometimes editors take out the controversial items. This defeats a key reason for doing futures research: to stimulate new thinking in an environment where "truth" is not discernable; hence, possibilities are acceptable for discussion. If only the conventional can be discussed, there is no reason to try to show alternatives. Even when the unconventional is discussed, it is often forgotten later, when the events occur.

For example the Outlook Section of GEO-3 report of UNEP says "Enormous social, economic and political changes have shaped and transformed present-day realities over that period, not least the oil crises of the 1970s, the end of China's isolation and the collapse of the Soviet system, that were not — and perhaps could not have been — predicted." Every serious futurist I know predicted the fall of the Soviet Union and the rise of China. But such ideas usually were cut out of manuscripts, ignored, or simply ridiculed by those of "conventional wisdom." I had the 1979 oil price hike as well as the Chernobyl melt down in print before the events, as did other futurists about airplanes flying into buildings, etc. So when people write that something was not predicted, it may well be that they just do not know the futurist literature and futurist community. It is important to understand that "conventional wisdom" tends not to "hear" these early warnings, in order that steps can be taken to make them more "audible"!

Another example is closer to the livestock industry in developing countries. I gave a talk for USAID and the World Bank in Maputo, Mozambique in 2000 at the annual private sector development conference saying that stem cells could be used to produce beef, pork, or poultry meat (muscle tissue) directly without growing the animals. People have laughed at that idea ever since, yet they are at a loss to explain how enough more water, land, and materials can be found to produce enough animal protein for an additional 2.7 or so billion people by 2050 (and a greater number in the middle class by 2050 who will want more meat).

Those who request scenarios should request that the scenarios be indeed futuristic. Scenarios should have some surprises in them – even in surprise-free or business-as-usual scenarios, because the rate of change is accelerating, making the last 25 years of change appear slow compared to the next 25 years. Hence, what we think is possible should also change.

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[5] Two examples are the 2025 Science and Technology Management Scenarios Delphi at http://www.acunu.org/millennium/st-scenarios-rd2.html, and the normative scenarios for the Middle East at: http://www.acunu.org/millennium/MEPS-rd3.html

However, few make that mental adjustment. Instead we get inane comments like "no one could have predicted…." When the real issue is: how do you know whom to listen to, about what? What methods can help the mind imagine future possibilities? The basic method of professional futurists is the use of some variation of an environmental scanning system; sometimes called an early warning system or futures intelligence system. There are a variety of ways to create such systems.[6] Such systems can inform the scenario team about what is important to write. Establishing such a system should be an initial step for any organization attempting to be more future-oriented.

Again from the UNEP GEO-3 Outlook Section: "The record of the past three decades shows how tricky it can be to foresee the future course of events on such a time scale." This is not the right point; it should be: … how difficult it can be to know whom to listen to about what. For example**:** In 1967, Herman Kahn along with Anthony Weiner examined the future possibilities of world order, describing potential power alignments and international challenges to American security in a book entitled *Toward The Year 2000*. One of their scenarios in that book depicted an arms control agreement between the United States and the former Soviet Union; another assumed the former Soviet Union would lose control of the Communist movement; a third projected construction of new alliances among countries. In the book, Kahn and Weiner also described the technology "hardware" of the future, which included centralized computer banks with extensive information on individuals as well as parents able to select the gender and personal characteristics of their children through genetic engineering." So, just as there are plenty of examples of where futurists got it wrong, there are plenty of examples of where they got it right.

The~~y~~ key is adjusting one's mental model when getting it wrong (why were you wrong?) and reinforcing it when one gets it right (why were you right). Granted the purpose of futures research is not to know the future, but to learn how it can be shaped. Nevertheless, forecasting the important "if then" issues more correctly will make alternative scenarios more useful. We cannot predict when and where a bioterrorist might attack the livestock industry, but we can write vignettes within scenarios about the potential impacts on the meat industries, if they occur. This gives us lead-time to begin to plan on how to prevent them and/or reduce their impacts on the livestock industry.

It should also be remembered that sometimes scenarios are written so that they will turn out to be wrong – scenarios about WWIII were written to explore how they could happen, allowing analysis of how to intervene in events to prevent the war. In the same way, the livestock scenarios should take terrorism into account. So, the question about what is a futurist's percentage of accuracy misses the point. The point is to be useful in improving thought about the future to make better decisions today.

[6] For an overview of how to create futures intelligence systems see Chapter 2. *Environmental Scanning*, Theodore J. Gordon and Jerome C. Glenn in Futures Research Methodology Version 2.0

2. Examples of Recent Major Scenarios Exercises

The Millennium Project of the American Council for the UN University has produced the largest annotated scenario bibliography with over 650 scenario sets[7]. It is updated annually. These are organized in the "Futures Matrix" in the following domains: Demographics and Human Resources; Environmental Change and Biodiversity; Technological Capacity; Governance and Conflict; International Economics and Wealth; Integration or Whole Futures. Examples of some of the scenario annotations related to the environment and agriculture are available in Appendix C of this paper. Several full scenarios are available in Appendix A. An overview of how to construct scenarios is in Appendix B.

The following section lists several key scenario construction exercises with summaries, assumptions, methods, and comments that may prove useful to livestock future scenarios.

These scenario sets are:

- Global Environmental Outlook 3 (GEO-3) Scenarios
- Future S&T Management Policy Issues -- 2025 Global Scenarios
- The Shell Global Scenarios to 2025
- Global Trends 2015
- Global Normative Scenario to the Year 2050 - for Sustainable Development
- European Energy Delphi study: EurEnDel - Technology and Social Visions (Scenarios)
- Intergovernmental Panel on Climate Change reports on global change

2.1 Global Environmental Outlook (GEO-3) Scenarios United Nations Environmental Programme

UNEP-GEO-3 produced four alternative scenarios to the year 2032 with both global and regional attention:

- The **Markets First** scenario envisages a world in which market-driven developments converge on the values and expectations that prevail in industrialized countries;

- The **Policy First** scenario is driven by strong governmental actions to reach specific social and environmental goals;

- The **Security First** scenario assumes a world of great disparities, where inequality and conflict prevail, brought about by socio-economic and environmental stresses;

- The **Sustainability First** scenario pictures a world in which a new development paradigm emerges in response to the challenge of sustainability, supported by new, more equitable values and institutions.

[7] A portal to the complete text of the scenario bibliography, organized by domains, is available at http://www.acunu.org/millennium/information.html

The GEO-3 Outlook process began by identifying a set of indicators for the seven GEO sub-regions and using teams of experts to describe key drivers for the scenarios. I have participated in GEO-2 and GOE-3 Outlook studies. The main scenario team and the regional teams met separately and periodically to discuss ideas and related papers and drafts. Questionnaires were used to collect data, however, not in the form of a repeating questionnaire for the international panel's feedback as in a Delphi study. The drivers that were finally selected for the scenarios were: demography, economic development, human development, science and technology, governance, culture, environment.

The global and regional scenarios were partly built on previous work by the Stockholm Environmental Institute. UNEP assembled a core scenario team for the global review and regional experts. These face-to-face meetings are very expensive, and are being replaced by Internet tools for GEO-4 Outlook studies (I am a member of the core UNEP scenario team for GEO-4).

The GOE-3's scenario development process is described in Chapter 4's Technical Annex as:

"Drawing from previous work of the Global Scenario Group (see Raskin and Kemp-Benedict 2002), four global storylines were designed by a core scenario team of global and regional experts. An initial quantification for a small set of indicators was prepared at the level of the GEO sub-regions. Teams in each of the seven major GEO regions then elaborated the storylines at regional level and provided input to the quantitative analyses, particularly with respect to key driving forces. The results of the regional efforts were used to refine the global narratives and to undertake the subsequent quantitative analyses associated with the scenario narratives. Further refinement of both the narratives and the quantitative analyses was achieved through an iterative process involving the core scenario team and the modelling groups. During the development process the work underwent two formal rounds of review and was scrutinized at a special workshop with a group of scenario experts from around the world."

Four quantitative models were used to augment expert judgments of the scenario team members during the scenario construction process.

- AIM (Asian Pacific Integrated Model) was used to help assess the effects of environmental policies both in the Asian region and globally. IPCC also used this method of augmenting expert judgements. For more about AIM, see http://www-iam.nies.go.jp/aim/

- GLOBIO (Global methodology for mapping human impacts on the biosphere) was used to help visualize cumulative environmental impacts of human activities at a scale of 1_1 km. For more information on GLOBIO see http://www.globio.info.

- IMAGE 2.2 (Integrated Model to Assess the Global Environment), was used to model driving forces for 17 world regions, partly via the WorldScan general equilibrium model and showed future impacts by printing maps (0.5°_0.5° latitude-longitude grid). IMAGE was also used by IPPC. Further information is available at http://www.rivm.nl/image.

- PoleStar was used as a flexible accounting modeling environment to help develop the alternative scenarios by integrating both socio-economic and environmental information. For more information on PoleStar see http://www.gsg.org

- WaterGAP 2.1 model (Water — Global Assessment and Prognosis) computed water availability and use over the land surface of the globe on a 0.5°_0.5° latitude-longitude grid. For more information on WaterGAP 2.1 model see www.usf.uni-kassel.de/usf/archiv/dokumente/kwws/5/ew_2_watergap.pdf

The scenario construction process was very good for collection of data and information, and building some consensus around key ideas among team participants, but not very good at weaving the information into real scenarios. Instead they are more discussions about scenario themes, which is very useful and helpful to decision makers, but are not really scenarios as such.

As mentioned above, the holding of series of international meetings can be very inefficient and costly. In addition to the costs of airplane tickets and hotels, there is also the cost that not all participants are able to meet at the same time; hence, the process can lose some valuable input. There is also the cost of inefficient use of time. In conventional meetings only one person talks at a time, while in asynchronous Internet-based collaborative meetings, one "talks" only when ready to say something, and listens only when ready to hear something. I attended the core group meeting in Paris for the GEO-4 scenario meeting, raised this point and was told it will be different this time, using Internet more, and the expensive and less efficient face to face meetings less.

2.2 Future S&T Management Policy Issues -- 2025 Global Scenarios Millennium Project, American Council for the UN University

The Millennium Project of the American Council for the UN University created four science and technology scenarios (S&T) to the year 2025 over a three-year process (2001-2003). The first year explored future issues of S&T via a two-round Delphi. The second year interviewed R&D managers and related policy advisors on S&T as to the management implications of the issues. Year three constructed the scenarios to make these issues explicit. A steering committee augmented by science attachés from Washington embassies provided oversight and advice to the process.

The objective of this scenario exercise was to seek a broad range of international perspectives on the emerging issues and forces that are likely to influence science and technology programs and their management over the next 25 years. S&T ministries in several countries used the results to update their national priorities.

The study began by asking science attachés to Washington, "What are the most important questions to ask about the future of science and technology that are worth the time of your leading scientists to answer?" The results formed the basis of the first round of the Delphi,[8] which invited participants selected by the Millennium Project Nodes around the world to rate the proposed questions and suggest others. The participants were also asked to judge some

[8] The invitation and text of the first round is available at: http://www.acunu.org/millennium/rd1-st.html

staff-generated answers to these questions in terms of importance, likelihood and their confidence responding, and to suggest others. The second round[9] fed back the results and asked for answerers to these questions.

About 250 scientists, futurists, and business planners selected by the Millennium Project's Nodes around the world filled out the Delphi questionnaires during the first year and 100 R&D managers and S&T policy advisors were interviewed by the Nodes during the second year (40% from governments, 24% from universities, 20% from corporations, and 16% from NGOs or international organizations). A different interviewee-sample was suggested to each Millennium Project Node, depending on the size and character of the S&T management of the country or countries in the Node. The sample sought balance between basic and applied sciences and among the fields of physics, biology, computational sciences, interdisciplinary sciences, and S&T policy. Science Attachés in Washington were also invited to send the interview protocol to those who had senior S&T management responsibilities in their countries.

The results of the interviews plus the science and technology issues were used in 2003 to write S&T scenarios to the year 2025. A two-round Delphi was used to identify and rate the drivers and potential events for the scenarios. A new approach to the Delphi method was used in the second round: draft scenario text was provided with blanks for the participants to fill, so that the scenario team could see the patterns among the responses and improve the final scenario drafts. Here is a livestock-related quote from the first scenario of this set:

> *Of the 7.8 billion people in 2025, just under 1.4 billion lived in India and just over 1.4 billion lived in China. As incomes rose in these two nations, the global demand for animal protein outstripped conventional supply until breakthroughs in stem cells for meat production successfully produced muscle tissue on a massive scale without the need to grow animals. This lowered costs and the environmental impacts of protein production. Meanwhile, other forms of genetically modified foods accounted for easily 50% of the world's food because nanotechnology and bio-engineering merged—creating all kinds of organic compounds that were considered safe. This made it possible to produce more food at lower cost. Farmers were running out of agricultural land in any case and hence could not supply enough for the growing population, who preferred genetically modified food to starvation.*

The following are brief summaries of the scenarios.

Scenario 1. S&T Develops a Mind of its Own
The rate of scientific discoveries and technological applications accelerates human knowledge, which in turn further accelerates S&T. Collective intelligence increases via advances in nutrition, education, and TEF (Tele-Everywhere-Feedback protocol) with CyberNow clothing and glasses. This helps achieve miracles in human performance, social stability, and economic growth for much of the world. However, government regulatory systems cannot keep up with the pace of S&T innovations. They adapted by using the International Science and Technology Organization (ISTO), which began as a global information and feedback system, as a de facto regulatory body that today is automating so many governing functions that one wonders if S&T is developing a mind of its own.

[9] The invitation and text of the second round is available at: http://www.acunu.org/millennium/rd2-st.html

Scenario 2. The World Wakes Up
The murder of 25 million people in the mid-2010s by the self-proclaimed Agent of God, who created the genetically modified Congo virus, finally woke up the world to the realization that an individual acting alone could create and use a weapon of mass destruction. This phenomenon became known as SIMAD (Single Individual Massively Destructive) and led to global controls on science and technology. The International Science and Technology Organization (ISTO) was formed using the advice of an eminent group of scientists and world leaders. When the group reached a consensus on some element of the strategy, it was discussed around the world to form a broad social consensus. This led to treaties and establishing the regulatory power of ISTO in concert with the UN Security Council, which, on occasion, authorizes intervention in lines of scientific inquiry. Educational and security systems have been linked to increase tolerance for diversity and to detect incipient terrorists. Human security - freedom from fear - is the new organizing principle for world affairs. Individual acts of mass destruction have thus far been prevented and the international S&T regulations and enforcement appear to be working.

Scenario 3. Please Turn off the Spigot
Science is attacked as pompous and self-aggrandizing. The opposition argues that the science/corporate complex locks the world into a neo-colonialism based on consumption, for people that live in rich countries as well as poor. Particularly worrisome are scientific "slip-ups" that provide- intended or not- means for killing large numbers of people, capturing or controlling behavior, and forming or distorting broadly accepted norms. The world's poor are ignored. Against this background, a science Luddite galvanizes the public to take action. A global commission is established to control the directions of S&T but it fails because of corruption. However, a new, cleaner commission is established. Anti-corruption strategies include very high salaries for the Commissioners, term limits, transparency, and public visibility. This new approach finally seems to be working.

Scenario 4. Backlash
Control over the directions of science is based on self-regulation. Under self-regulation, the disciplines themselves determine acceptable risks. Science blossoms. The media hypes the golden age of science and they say, and the public believes, that “more is better and change is good.” But this era of accelerated science has a dark side. Developments needed by society have low priority. Some of the new capabilities cost security and privacy, and produce an imposed rationality that is antithetical to many cultures. Unthinking consumption rules lives. Rogue nations take advantage of the low level of control and under the guise of research develop world-threatening weapons. The level of concern rises and the media, once the friend of science, now attack it. Mobs form in front of university and government research labs, as they once did in protest over globalization. Self- regulation of S&T fails and is replaced by centralized control. This also turns out badly. Progress stalls, and poverty continues growing. What’s next?

The full text of the first scenario is in the appendix, while the other scenarios are available at: http://www.acunu.org/millennium/scenarios/st-scenarios.html.

2.3 ***The Shell Global Scenarios to 2025 The Future Business Environment: Trends, Trade-offs and Choices*** © Shell International Limited (SIL), 2005.

The Future Business Environment: Trends, Tradeoffs, and Choices
The Shell Global Scenarios to 2025 (June 2005) http://www.shell.com/scenarios/

This report provides detailed implications of three scenarios:

1. **"**Low Trust Globalization" assumes a world run by litigation, treaties, regulations, and international lawyers. It has moderate economic growth due to cautious investors. "The absence of market solutions to the crisis of security and trust, rapid regulatory change, overlapping jurisdictions and conflicting laws lead to intrusive checks and controls, encouraging short-term portfolio optimisation and vertical discontinuities limit cross-border economic integration. Complying with fast-evolving rules and managing complex risks are key challenges.

2. "Open Doors" assumes a world of freer trade, greater economic growth, and technological investment. "'Built-in' security and compliance certification, regulatory harmonisation, mutual recognition, independent media, voluntary best-practice codes, and close links between investors and civil society encourage cross-border integration and virtual value chains. Networking skills and superior reputation management are essential.

3. "Flags" assumes a world of nation-states focused on their own self-interest, slower economic growth and international investment. "Zero-sum games, dogmatic approaches, regulatory fragmentation, and national preferences, conflicts over values and religion give insiders an advantage and put a brake on globalisation. Gated communities, patronage and national standards exacerbate fragmentation, and call for careful country-risk management."

An imaginative triangular model is used to show three focuses shaping potential futures: market incentives, community, and regulation. Making a triangle, one can chose a point anywhere along the lines or within the triangle to generate potential scenarios. The report has three sections: 1) presents the Trilemma Triangle, the analytical framework developed to map relations between market participants, civil society, and states; 2) presents the Global Scenarios to 2025 themselves; and 3) analyses critical trends common to all scenarios with contrasting economic, political, and regulatory features and distinct implications for the energy system.

The use of 'Trilemmaps' to summarize implications of the Global Scenarios for key aspects of the global business environment is a unique approach. The executive summary of the scenarios and their analysis is available at no cost at:
http://www.shell.com/static/royal-en/downloads/scenarios/exsum_23052005.pdf

The reader is encouraged to refer to the 2001 Shell Global Scenarios (including the scenarios that were developed over a thirty year history of the Shell scenario project), for an apt and coherent background leading up to the 2005 work. In the 2001 scenarios, Shell presented two global scenarios that explored the challenges of a globalizing, deregulated, market-centric world. Today, the tensions captured in 2001 remain valid, but societies also face more complex choices on the nature of regulation, the framework for corporate governance, and welfare reforms. The key questions asked in 2001 were, "Will the resolution of dilemmas arising from globalization be dominated by global elites or by the people of the heartlands?"

In 2001, the "Business Class" and "Prism" scenarios highlighted the "connections that matter" and "multiple modernities". The 2005 Shell scenarios continues the work of 2001 and use an air navigation metaphor to show a chart of routes across three interrelated levels:1) the Jet Stream level of long-term, predetermined trends, uncertainties, and forces; 2) the Weather Systems level that reflects key regions as influenced by the Jet Stream context; and, 3) the Market-level of trends and turbulences. Part I of the 2005 Shell Scenarios present a "Trilemma Triangle,"which is a unique analytical framework developed to map relations between market participants, civil society and states. Part II presents the scenarios themselves. Part III provides an analysis of critical trends common to all of the scenarios, starting with the international scene (emphasizing the US, China, the EU, Africa, and India), then matters of demography and patterns of economic growth. Part III concludes with a study on energy security and the move toward an energy and carbon industry. Key differences between the three scenarios are captured in Trilemmaps which compare specific features of Shell's business environment that capture key dimensions. The following are scenario abstracts of Part II's completed versions of the *Shell Global Scenarios to 2025:*

Scenario 1) Low Trust Globalization: A Legalistic Prove it to me World:
"The absence of market solutions to the crisis of security and trust , rapid regulatory change, overlapping jurisdictions, and conflicting laws lead to intrusive checks and controls, encouraging short-term portfolio optimisation and vertical integration. Institutional discontinuities limit cross-border economic integration. Complying with fast-evolving rules and managing complex risks are key challenges."

Scenario 2) Open Doors: A Pragmatic, "Know Me" World:
"Built-In" security and compliance certification, regulatory harmonization, mutual recognition, independent media, voluntary best-practice codes, and close links between investors and civil society encourage cross-border integration and virtual value chains. Networking skills and superior reputation management are essential."

Scenario 3) Flags: A Dogmatic, "Follow Me" World: "Zero-sum games, dogmatic approaches, regulatory fragmentation, and national preferences, conflicts over values and religion give insiders an advantage and put a brake on globalization. Gated communities, patronage and national standards exacerbate fragmentation, and call for careful country-risk management."

2.4 *Global Trends 2015: A Dialogue About the Future With Nongovernment Experts.*

National Intelligence Council. The National Intelligence Council (NIC) is the Intelligence Community's (IC's) center for midterm and long-term strategic thinking.

In undertaking this comprehensive analysis, the NIC worked actively with a range of nongovernmental institutions and experts. We began the analysis with two workshops focusing on drivers and alternative futures. Subsequently, numerous specialists from academia and the private sector contributed to every aspect of the study, from demographics to developments in science and technology, from the global arms market to implications for the United States. The second workshop developed four alternative global futures in which these drivers would interact in different ways through 2015. Each scenario was intended to construct a plausible, policy-relevant story of how this future might evolve: highlighting key uncertainties, discontinuities, and unlikely or "wild card" events, and identifying important policy and intelligence challenges.

Scenario 1: Inclusive Globalization:
"A virtuous circle develops among technology, economic growth, demographic factors, and effective governance, which enables a majority of the world's people to benefit from globalization. Technological development and diffusion—in some cases triggered by severe environmental or health crises—are utilized to grapple effectively with some problems of the developing world. Robust global economic growth—spurred by a strong policy consensus on economic liberalization—diffuses wealth widely and mitigates many demographic and resource problems. Governance is effective at both the national and international levels. In many countries, the state's role shrinks, as its functions are privatized or performed by public-private partnerships, while global cooperation intensifies on many issues through a variety of international arrangements. Conflict is minimal within and among states benefiting from globalization. A minority of the world's people—in Sub-Saharan Africa, the Middle East, Central and South Asia, and the Andean region—do not benefit from these positive changes, and internal conflicts persist in and around those countries left behind."

Scenario 2) Pernicious Globalization:
"Global elites thrive, but the majority of the world's population fails to benefit from globalization. Population growth and resource scarcities place heavy burdens on many developing countries, and migration becomes a major source of interstate tension. Technologies not only fail to address the problems of developing countries but also are exploited by negative and illicit networks and incorporated into destabilizing weapons. The global economy splits into three: growth continues in developed countries; many developing countries experience low or negative per capita growth, resulting in a growing gap with the developed world; and the illicit economy grows dramatically. Governance and political leadership are weak at both the national and international levels. Internal conflicts increase, fueled by frustrated expectations, inequities, and heightened communal tensions; WMD proliferate and are used in at least one internal conflict."

Scenario 3) Regional Competition:
"Regional identities sharpen in Europe, Asia, and the Americas, driven by growing political resistance in Europe and East Asia to US global preponderance and US-driven globalization and each region's increasing preoccupation with its own economic and political priorities. There is an uneven diffusion of technologies, reflecting differing regional concepts of intellectual property and attitudes towards biotechnology. Regional economic integration in trade and finance increases, resulting in both fairly high levels of economic growth and rising regional competition. Both the state and institutions of regional governance thrive in major developed and emerging market countries, as governments recognize the need to resolve pressing regional problems and shift responsibilities from global to regional institutions. Given the preoccupation of the three major regions with their own concerns, countries outside these regions in Sub-Saharan Africa, the Middle East, and Central and South Asia have few places to turn for resources or political support. Military conflict among and within the three major regions does not materialize, but internal conflicts increase in and around other countries left behind."

Scenario 4) Post-Polar World: "US domestic preoccupation increases as the US economy slows, then stagnates. Economic and political tensions with Europe grow, the US-European alliance deteriorates as the United States withdraws its troops, and Europe turns inward,

relying on its own regional institutions. At the same time, national governance crises create instability in Latin America, particularly in Colombia, Cuba, Mexico, and Panama, forcing the United States to concentrate on the region. Indonesia also faces internal crisis and risks disintegration, prompting China to provide the bulk of an ad hoc peacekeeping force. Otherwise, Asia is generally prosperous and stable, permitting the United States to focus elsewhere. Korea's normalization and de facto unification proceed, China and Japan provide the bulk of external financial support for Korean unification, and the United States begins withdrawing its troops from Korea and Japan. Over time, these geostrategic shifts ignite longstanding national rivalries among the Asian powers, triggering increased military preparations and hitherto dormant or covert WMD programs. Regional and global institutions prove irrelevant to the evolving conflict situation in Asia, as China issues an ultimatum to Japan to dismantle its nuclear program and Japan—invoking its bilateral treaty with the US—calls for US reengagement in Asia under adverse circumstances at the brink of a major war. Given the priorities of Asia, the Americas, and Europe, countries outside these regions are marginalized, with virtually no sources of political or financial support."

Generalizations Across the Scenarios

The four scenarios can be grouped in two pairs: the first pair contrasting the "positive" and "negative" effects of globalization; the second pair contrasting intensely competitive but not conflictual regionalism and the descent into regional military conflict.

- In all but the first scenario, globalization does not create widespread global cooperation. Rather, in the second scenario, globalization's negative effects promote extensive dislocation and conflict, while in the third and fourth, they spur regionalism.
- In all four scenarios, countries negatively affected by population growth, resource scarcities and bad governance, fail to benefit from globalization, are prone to internal conflicts, and risk state failure.
- In all four scenarios, the effectiveness of national, regional, and international governance and at least moderate but steady economic growth are crucial.
- In all four scenarios, US global influence wanes.

2.5 *Global Normative Scenario to the Year 2050* - for Sustainable Development

The Millennium Project, American Council for the UN University (1999)

The Millennium Project used an international Delphi panel to identify global norms around the world with which to write a global normative scenario. The international panel identified and rated norms that formed the core of the normative scenario. In order of preference, the participants selected the following top four norms around which to form the scenario: environmental sustainability, plenty, global ethics (the identified and accepted), and peace. The others in order of preference were health, freedom, universal education access, equity, preservation of the human species, enlightenment, exciting and meaningful life, self-actualization, longevity, everyone has everything they want, and security.

The staff then selected and integrated policies and positive events identified and rated by previous global Delphi panels over a several year period. It then wove all these inputs together into a global scenario for 2050 with three themes of technology, human development, and political economic policy. See:
<http://www.acunu.org/millennium/normscen.html>.

The body of the normative scenario was composed of the actions to address the Global Challenges in Chapter 1. These actions connected the present world to the normative future of 2050 and gave another medium to share the thinking of the Global Lookout Panel. A scenario review panel was formed of long-term normative-oriented participants of the Project to review and improve the draft of the scenario. Even though the following normative scenario takes into account many of the world's pressing problems, it is intended to illustrate very optimistic possibilities for our common future over the next two generations.

Normative scenarios represent desirable future worlds. They employ credible cause, effect and feedback relationships to get from the present to a desirable future – in this case the achievement of sustainable development by 2050. To be plausible, the scenario had to address the 15 Global Challenges. These were created via a series of Delphi studies and interviews with policymakers around the world. Each challenge has a description of what had to be overcome and potential strategies to address them plus a range of views on both. This body of information was used to select key decisions, which were woven into a plausible scenario to connect the present to sustainable development by 2050. Three themes represent different perspectives on how change occurs. Some believe technology is the key force that has made change occur. Others argue that changing consciousness and the human capacity is more fundamental to long-term systemic change. Still others say that political and economic policies create the conditions for changes in both technology and human capacity. The global normative scenario (available in full text in the Appendix) assumes that all three themes are important to the realization of the normative future of 2050.

2.6 European Energy Delphi study: EurEnDel - Technology and Social Visions (Scenarios) for Europe's Energy Future

by Timon Wehnert, Institut für Zukunftsstudien und Technologiebewertung, Berlin, Institute for Futures Studies and Technology Assessment, Berlin.
http://www.izt.de/eurendel/ (Published on May 25, 2005, European Energy Day)

700 European energy experts from 48 countries, mostly European, participated in a two-round Delphi on technological energy developments, market trends, and social visions for Europe's Energy Future. In addition to making judgments about the time at which certain technologies would be available, the study inquired about the desirability (importance) of the developments from the standpoint of three social "visions":

1) The vision of **Individual Choice** placed emphasis on individual needs, liberalised markets and consumer sovereignty in the choice of products and services.

2) The vision of **Ecological Balance** valued protection of the ecosystem, ecological awareness and sustainable production and consumption.

3) The main features of the vision of **Social Equity** were a reduction of income disparities and of social exclusion, accompanied by community balance and cohesion at the European level, while allowing for regional solutions.

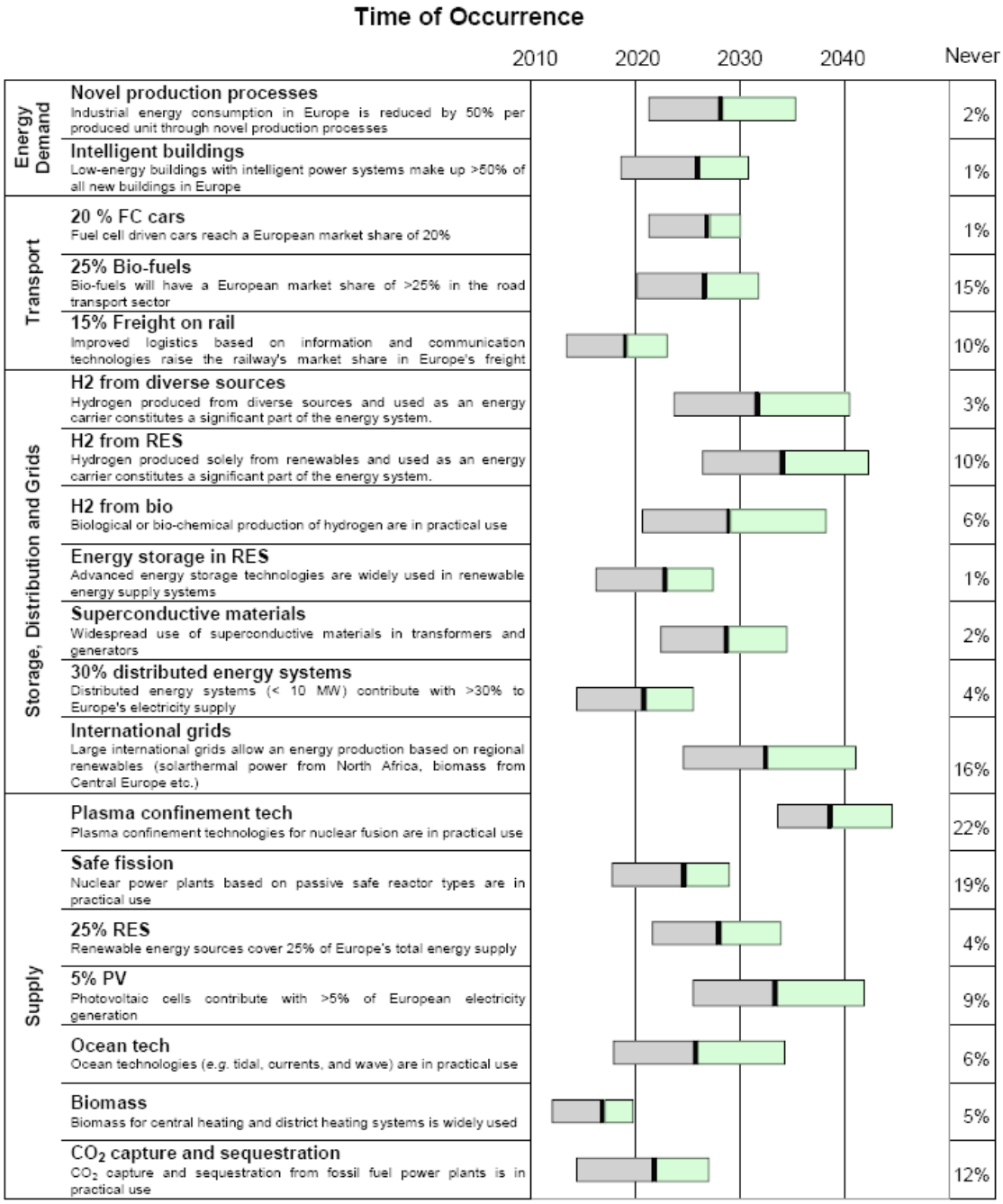
The principal technological forecasts appear in the chart below. In summary (from the report):

Energy Demand
Doubling the energy efficiency in industrial production is considered to be likely before 2030 by 65% of the respondents. An even higher percentage, 75% of the respondents, anticipates 50% of all new buildings in Europe to be low-energy buildings before 2030.

Transport
A 20% market share of fuel-cell-driven cars is expected by the respondents in the late 2020s. Note that this is well before hydrogen is expected to play a significant role in Europe. On the issue of a 25% share of biofuels for transportation the experts' opinions are divided: The majority expects this to happen before 2030. However quite a large share (15%) of respondents consider 25% a too larger number.

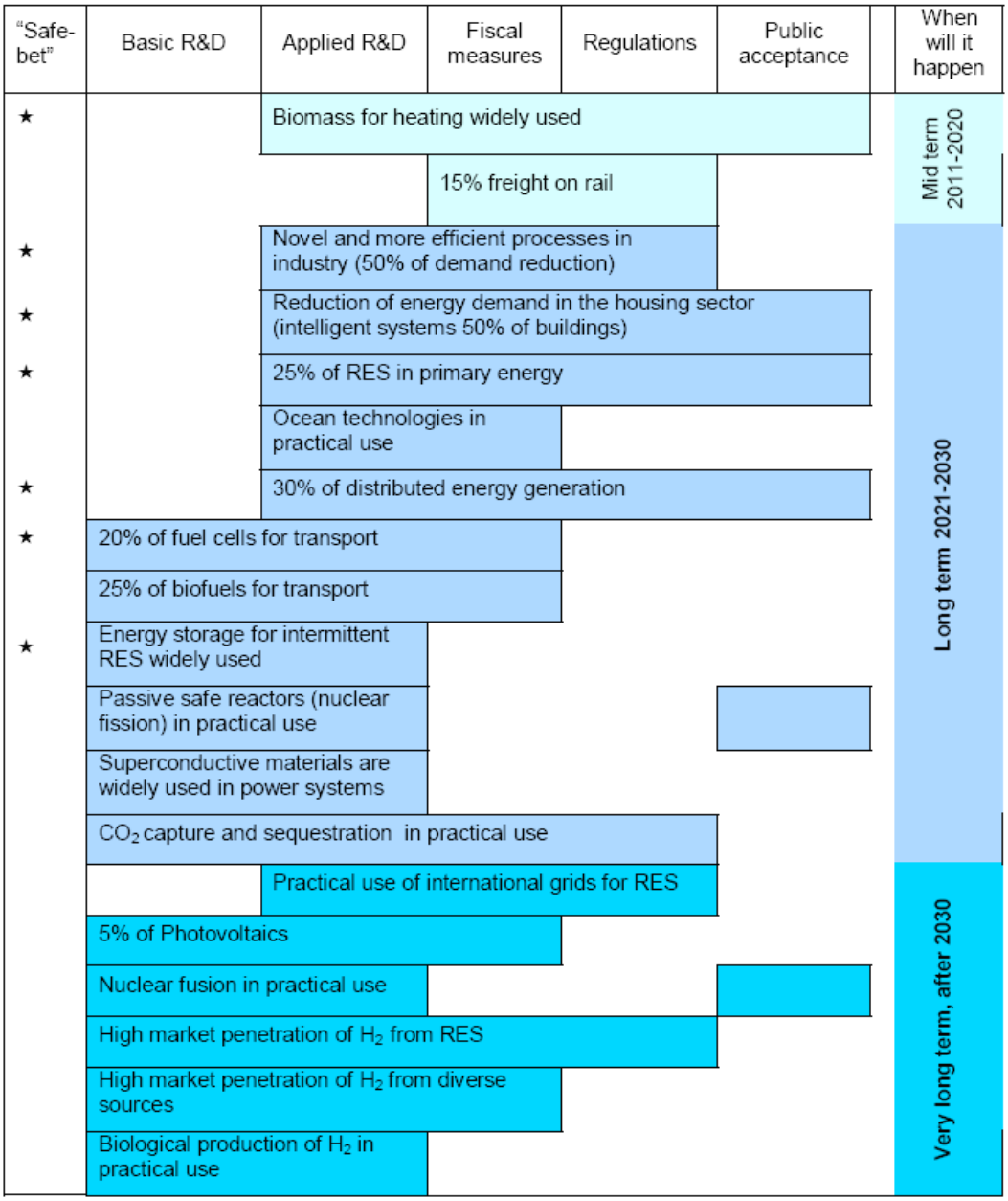
Storage, Distribution and Grids
There is a consensus that the trend towards a decentralized electricity supply prevails. A 30% share of decentralized generation is expected by 2020. In contrast there is a controversy when, if at all, large international grids will allow for energy transportation of regionally produced renewable energy. 16% of the experts do not believe that *e.g.* solar-thermal power from North Africa or biomass from Central Europe will be used beyond those immediate regions. Energy storage is considered to be in widespread use by the early 2020s to support renewable energy systems. Hydrogen, as one storage option, is considered to constitute a significant part after 2030.

Energy Supply
The respondents are split concerning the future of nuclear energy. Both statements, on fusion and on fission, received the highest .never. shares. … Fusion is considered a very long-term option. Plasma confinement technologies, a prerequisite for fusion reactors, are not considered to be in practical use before 2040. (There were) country-specific differences on this issue… As for renewable energy sources, there is little doubt that a 25% share of Europe's total energy supply is possible for them. 66% of the respondents consider it likely that this share is reached before 2030. A high contribution of photovoltaic to this share is a truly long-term goal. The majority of respondents consider a 5% contribution of PV to Europe's electricity supply realistic only after 2030.



Graph 5: *Mean value of Time of Occurrence of technology statements in the second Delphi round. Left hand side of the bar indicates 25% quartile and right hand side 75% quartile.*

The following chart shows the precursor actions deemed important by the participants:



Graph 7: *Summary of actions considered most important for faster developments in the respective fields.*

Analysis of the three scenarios or "visions" led to the following conclusions:

• **Energy conservation technologies** and demand-side management techniques are considered to be of highest importance **and reached the highest ranking** in each of the three visions.

• In the vision of **Individual Choice**, fuel cells were given very high importance, presumably as an option to develop individually tailored energy solutions.

• In the vision of **Ecological Balance**, wind and biomass were rated second, seemingly reflecting their perceived limited impact on environment.

• In the vision of **Social Equity**, biomass was rated highly, probably because of its high labour intensity and potential for regional wealth creation.

• The role of **hydrogen** was considered to be rather independent of social values and achieved intermediate ratings in all three visions.

• **CO_2 sequestration** received a low rating, except for the vision of Environmental Balance, in which it was assigned intermediate importance.

• **Nuclear fission** was rated lowest in importance in all three visions.

An excellent PowerPoint presentation can be found at:
http://www.izt.de/pdfs/eurendel/eurendel_koenigswinter.pdf.

2.7 Intergovernmental Panel on Climate Change reports on global change

The first IPCC reports were produced in 1990, and then a major effort was carried out in 1992, producing the ***IS92 scenarios*** used for the Second Assessment Report (SAR). There was an update in 1994 and then the Third Assessment Report (TAR) produced the Special Report on Emissions Scenarios (SRES) in 2000. The SRES was prepared for future emission scenarios to be used for driving global circulation models to develop climate change scenarios.

These "scenarios" then to be more groups of projections that full scenarios, nevertheless, their use is fundamental or should be fundamental to all global scenarios that reference environmental factors such as livestock futures. The input in terms of models, observations, and related research is the most extensive for any scenarios construction progress in history.

The IPCC report *Climate Change 2001* (the Third Assessment Report) consists of four reports, three of them from the Working Groups:

- Working Group I: *The Scientific Basis*
- Working Group II: *Impacts, Adaptation and Vulnerability*
- Working Group III: *Mitigation*
- *Synthesis Report* (www.ipcc.ch/pub/un/syreng/spm.pdf)

The SRES has four scenarios constructed from a two dimensional matrix based on a horizontal axis (more global vs. more regional) and a vertical axis (more economic vs. more environmental). The four scenarios are called A1, A2, B1 and B4, and include different sub-scenarios up to the year 2100.

The lists of likely events and probable impacts give the cause and effect linkages that are very useful for creating scenarios.

The IPCC average temperature forecast of 5.8C by 2100, may be changed in the next report to be released in 2007 as the Fourth Assessment Report (FAR or AR4), because warming is

proceeding faster than previous estimates. James Lovelock's forthcoming book *The Revenge of Gaia* explains that it may be too late to reverse global warming.[10]

3. Implications for the Future Livestock Scenarios

As mentioned at the beginning of this paper, Herman Kahn (inventor of the scenario method in futures research and policy analysis) tended to think in terms of three alternative worlds: one getting better, one getting worse, and one a mix of both (business-as-usual scenario). More often today, scenarios are created in groups of four to prevent the simple better/worse framework of thinking and reinforce a range of alternative scenarios. Nevertheless, it is our nature to think of the future in terms of what is getting better and what is getting worse. Examples of major trends in the global scenarios can be divided into improvements and problems such as:

Some global trends/improvements:

- Decreasing number of military conflicts
- Increasing calories per capita
- Increasing life expectancy
- Increasing literacy
- Decreasing infant mortality
- Increasing access to fresh water
- Increasing health care
- Increasing GDP per capita
- Increasing school enrolments
- Increasing Internet access

All of these trends point to more demand for meat.

Some global trends/problems

- Increasing CO_2 emissions
- Decreasing healthy agricultural lands
- Increasing unemployment
- Decreasing forestlands
- Decreasing grain production per capita
- Increasing rich-poor gap
- Increasing AIDS deaths
- Increasing developing country debt
- Increasing organized crime

All of these trends point to increasing difficulty in producing meat

3.1 Broad concepts and drivers that should be taken into account while developing specific scenarios for the future of livestock:

The United Nation's Millennium Ecosystem Assessment found that 60% of our life-support systems are gone or in danger of collapse. As human encroachment on the natural environment continues, increased interspecies contacts may lead to the spread to humans of infectious diseases known previously only in wild animals.

[10] http://news.independent.co.uk/environment/article338878.ece

Most people still do not appreciate how fast science and technology will change over the next 25 years and would be surprised to learn about recent breakthroughs. For example, several years ago light was stopped in an yttrium-silica crystal and then released; it has also been slowed in gas and then accelerated. Adult stem cells have been regressed to embryo-like flexibility to grow replacement tissue, and computers have been controlled by thought via implanted computer chips in the brain. To help the world cope with the acceleration of change, it may be necessary to create an international S&T organization to arrange the world's science and technology knowledge and forecasts of it potential consequences into a form accessible via a better Internet-human interface.

About a billion people are now connected to the Internet and most of the remaining people will be so within 15 years, making cyberspace an unprecedented medium for civilization. This new distribution of the means of production in the knowledge economy is cutting through old hierarchical controls in politics, economics, and finance. It is becoming a self-organizing mechanism that could lead to dramatic increases in humanity's ability to invent its future. Hence, that which would normally take generations to change in the past, like eating habits and agricultural practices, could take just years to change in the future.

Business-as-usual will not meet world needs for increased food, energy, and water supply. Although world leaders give some lip service to this realization, the changing conditions will force leaders and the general public to make new decisions whether, they like it not. China already consumes 67 million tons of meat per year. Assuming an average 8% annual economic growth, Lester Brown projects in *Plan B 2.0* that its consumption per capita could equal the U.S. by 2031.

A potential environmental backlash against "factory farms" may be brewing. As these massive meat production methods becomes better known to the world via cell phone cameras, Internet public information campaigns, and books such WorldWatch's *State of the World 2000,*[11] which has a chapter on meat production, demands for new national and international regulations and techniques seem likely

There is an increasing awareness that the meat industry is vulnerable to bioterrorism.[12] However, when looking at the future, the concept of individual terrorists acting alone rather than as groups, increases in likelihood with every year. SIMAD (Single Individuals Massively and Destructive) attacks on trade in livestock products will be very difficult to prevent and hence, could reduce confidence in international trade in these products.

Since computer capacity improves faster than biology, some authorities have argued that we must take seriously the future possibilities of robots taking over, nanotech self-organizing machines covering everything with a "gray goo," and "artificial life" growing beyond human control. Genetically engineered bioweapons development and proliferation over the next 25 years could become far more pervasive and difficult to manage than nuclear weapons technology. Consider AIDS or Ebola engineered to become airborne. Applications of genetic engineering that become inheritable social traits could alter humanity. These and other potential unintentional (as well as intentional) future threats go far beyond almost anything

[11] Danielle Nierrenberg, *Rethinking the Global Meat Industry*, State of the World 2005, WorldWatch Institute, Washington, D.C.
[12] Food and Drug Administration of the US has a counterterrorism Internet site at: http://www.fda.gov/oc/opacom/hottopics/bioterrorism.html

experienced in the past. Governments and the global community seem unsure how to manage such risks.

Future synergies among nanotechnology, biotechnology, information technology, and cognitive science could dramatically improve the human condition by increasing the availability of food, energy, and water and by connecting people and information anywhere. However, it is not clear how much wisdom, goodwill, and intelligence will be focused on making these capacities improve the prospects for the developing world.

3.2 Some innovative concepts for livestock futures

3.2.1 Seawater agriculture for animal feed, biofuels, and land reclamation.

Vast desert coastlines like those of Somalia could become salty Gardens of Eden growing salt-tolerant plants on beaches for human as well as livestock feeding, biofuels, fertilizer, raising water tables, and absorbing CO_2. The greening of coastal deserts could eventually "reclaim" or desalinate land. Seawater has a wide variety of important minerals, about 80% of the nutrients required for agriculture [need to add nitrogen, phosphorus, and iron]. According to Dr. Dennis M. Bushnell, Chief Scientist, NASA Langley Research Center and author of several memos on Seawater Agriculture,[13] there are more than 10,000 natural halophyte plants of which at least 250 are potential staple crops for humans and animal feed. With genetic modifications, many more – such as tomatoes and rice - could grow in salty conditions. Over 100 halophyte plants are currently being studied for commercial applications.

The following excerpts from Dr. Bushnell's draft paper "Seawater/Saline Agriculture for Energy, Warming, Water, Rainfall, Land, Food and Minerals" for a forth-coming March 2006 conference in Cairo sponsored by the U.S. State Department and National Science Foundation were drawn with permission from the author:

"Biomass grown on less than the landmass of the Sahara could supply/replace the worlds Fossil energy requirements… Biomass availability is currently limited by a combination of shortages in arable land/sweet water and suitable processing plants…These [Africa's] aquifers are often saline and becoming more so. Their utilization is causing land salinization with some 20% of irrigated land in the region affected by salinity and the percentage growing rapidly… A review of the "resources" of the Sahara region indicates coastlines and sunlight as major advantages. The sunlight could be utilized either for direct electricity production via the emerging nano plastic inexpensive and potentially highly efficient photovoltaics or, given suitable water, Biomass Production. The electricity could be utilized to produce H2 directly via electrolysis using saline or salt water. Direct photocatalytic electrolysis could also be utilized on the Sahara for H2 Production… Nearly 20 countries are involved with Saline Farming experiments for food production. In particular the Chinese have reported Genomic versions of Tomatoes, Eggplant, pepper, wheat, rice and rapeseed grown on beaches using seawater… By substituting in many cases seawater for fresh/sweet water in agriculture seawater agriculture "returns" some of the 66+% of the available fresh water we now use for conventional agriculture crop irrigation back to/for other human uses…"

[13] Dennis Bushnell has agreed to share some of his memos and draft papers on seawater agriculture with FAO upon request to him at: <d.m.bushnell@larc.nasa.gov>

Although oil prices will fluctuate over the foreseeable future, it is reasonable to assume that they will be much higher over the next 20 years than the past 20 years. Hence, the price of oil will remain high enough to make the economics work for biofuels from halophyte plants in deserts near seawater. Feedstuffs for the live stock industry could be part of the output of this new energy-led approach to agriculture in wastelands.

3.2.2 Use of stem cells to produce muscle tissue without the need to raise an animal

Stem cells can be taken, for example, from the umbilical cords of cows, goats, pigs, etc. and used to grow muscle without the need to grow the entire animal. The Netherlands has created a systematic approach to developing this concept. It has invested two million Euros in the Universities of Eindhoven, Utrecht and Amsterdam for this research and development, as have other investors such as Sara Lee in the United State. A Dutch citizen now owns one patent for the process.[14] The University of Maryland is also working on laboratory meat production.[15]

It remains to be seen how successful this approach will be, but if commercially viable it should greatly reduce the environmental demands of livestock production for meat consumption. Any FAO long-range scenario construction exercise should take this high impact possibility into account.

3.2.3 Biomimicry

This is the study of applying nature's methods to human manufacturing. This has some overlap with nanotechnology, stem cell manufacturing of meat as mentioned above, observing what plants animals eat to stay healthy for pharmaceutical implications, and other biological engineering research. This concept should help focus future research and development to find many implications for livestock industries.

For example, the 2002 announcement of Harper Collins book *Biomimicry: Innovation Inspired by Nature* by Janine Benyus suggests that, "Perhaps the most intriguing possibility is a re-engineered prairie that would produce about as much grains and legumes as current cropland with much reduced needs for water, machinery, planting, fertilizing, weedkilling, and tending in general, and with much improved erosion control and sustainability. This would come about from perennial, polyculture agriculture rather than the current annual, monoculture model of today.[16]"

3.3 Innovative methodologies

There are three new approaches to the Delphi method to provide input for scenario construction.

3.3.1 Fill in the blank approach to address uncertainly

[14] http://www.new-harvest.org/article09102005.htm
[15] http://service.spiegel.de/cache/international/spiegel/0,1518,373796,00.html
[16] http://www.harpercollins.com/global_scripts/product_catalog/book_xml.asp?isbn=0060533226

When writing draft scenarios, choices are not always clear about what events or actors should make what decisions – even with all the pre-writing inputs obtained by various methods. When that occurs, instead of making something up, leave it blank. There could be five to ten blanks like this in a scenario draft that would be submitted to a international panel who would be invited to "fill in the blanks." The pattern that emerges would be used in the final draft. This also helps to include the "stakeholders" and experts into the process, and should improve the value of the final draft. This was used in the 2025 S&T scenarios.[17]

3.3.2 Fill in the blank approach to address plausibility

Another approach to filling in the banks in draft scenarios via Delphi questionnaires was used in the normative scenarios for the Middle East.[18] After each three or so paragraphs a black would be inserted. Participants were invited to fill-in-the-blanks, saying what would make the section above more plausible. Since these were to be normative scenarios, the participants from various sides, had to believe their suggested improvements to the events and the cause and effect relationships were possible. That pattern of responses helped the scenario writer make these peace scenarios more believable to the stakeholders.

3.3.3 "Roundless Delphi"

Another innovation being tested during the writing of this paper is a "Roundless – Real Time Delphi" for scenario construction and characteristics matrix[19] This approach to performing a Delphi study does not involve the use of sequential "rounds" and, as a result, can improve the efficiency of the process and shorten the time to perform such studies. The Millennium Project first used this on a simple application for the Ford Motor Company referred to as the Executive Decision Matrix. Its next application was for the more complex task of creating input for four alternative global energy scenarios.

In this approach each respondent accesses a website at any time and as many times as desired to input both numeric estimates and text. Participants can change their inputs the next time they access the website and see others' responses – hence, using feedback to change thinking. If the respondent's answer to any question is beyond a pre-specified distance from the average or the median, an attention-getting indicator flags the question for the respondent. When the flag is "up" the respondent is asked to give reasons for their response which, when saved, become an entry in the "reasons window" and are seen later when anyone opens that window.

There is no explicit second round. When the respondent comes back to the study in a minute or a day, the original input form is presented to him or her. Of course, by then others may have contributed judgments, the averages or medians may have changed, and other questions may be flagged since the group response may have changed sufficiently to move the respondent's previous answers outside of the pre-specified distance from the average or the median since the last time the input page was viewed. Hence, only one round is involved. The respondents view their own earlier responses when they return to the study. As they continue to watch their input form (or later on a return visit) they also see the new averages, medians, distributions, and reasons given by other participants for their positions. This information appears whenever new inputs are received from other participants.

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[17] See the text with the fill-in-the-blanks at: http://www.acunu.org/Delphi/SciTechScenariosRnd2.html
[18] See the text with the fill-in-the-blanks at http://www.acunu.org/millennium/MEPS-rd3.html
[19] 2020 Global Energy Scenario Real Time Delphi is available at: http://delphi1.acunu.org/energy/dlogin.jsp

3.3.4 State of the Future Index

Since the mission of FAO is to improve conditions, their use of scenarios should not only be exploratory to describe potential futures, but it should also be normative to describe how to get to a more desirable future while overcoming the situations described in the alternative exploratory scenarios. One new tool for input to bring both exploratory and normative scenarios together is the State of the Future Index (SOFI). It forecasts the state of the future of some subject ten years in the future based on previous data over the past twenty years. To create a SOFI for the livestock industry for a country, region, or the world, the follow tasks should be performed:[20]

Task 1 SOFI selection of variables involves the choice of time series that might be considered as components of the SOFI. A Delphi questionnaire should ask what variables ought to be included in an index that depicts the state of the future. The persons invited to participate to identify the variables should be selected on the basis of prior publications in the field, positions in decision-making, recommendations by professional societies, etc. The questionnaire should also ask for the best anticipated value of each of the variables in the time period of interest and the worst plausible value—these values will be used in normalizing the value of the variable when it is aggregated into the index. The questionnaire should also ask for the weights that should be applied to the variables at the norm or dystopian extremes. Finally, participants should be asked to provide information about sources where data might be obtained for variables they recommend.

Task 2 SOFI data collection involves the collection of time series data for the variables that are to be included in the index. Ideally, 20 years of annual historical data will be incorporated. In selecting the variables, one ought to be aware of how often the data is updated and whether it will continue to be available and updated, since in many cases the SOFI analysis will be repeated periodically to track changes over time.

Task 3 forecasting the data will result in10-year forecasts of each variable. The simplest approach is to use time series methods; in the Millennium Project, the following equations were used in the fitting process[21]:

1. Linear	$v= m*t + b$
2. Exponential	$\ln(v)=m*t + b$
3. Power function	$\ln(v)=m*\ln(t) + b$
4. Logarithmic	$v= m*\ln(t) + b$
5. Inverse v	$1/v=m*t + b$
6. Inverse t	$v=m/t + b$
7. S Shaped	$\ln\{(v/L)/[1-(v/L)]\}= m*t + b$

[20] This is drawn from Theodore J. Gordon, *The State of the Future Method*, Futures Research Methodology version 2.0, Millennium Project of the American Council for the UNU, Washington, 1993.
[21] The statistical package used in the analyses is Statplan 5.0, developed by The Futures Group.

where v is the value of the variable, L is the variable's upper limit when one can be discerned, m is the slope of the fitted curve, and b is the intercept at t=0

Task 4. Analysis involves the computation of the index and the study of its behavior. This helps understand what should be the most cost effective foci to improve the whole of the livestock industry.

SOFI for Livestock would

- Challenge one to answer what it means that the future of livestock is better or worse in ten years – in specific, quantifiable terms.
- Aggregate a number of quantitative variables that, when forecasted, "add up" to the future outlook for livestock
- Answer the question: does the livestock future seem to be improving or worsening?
- Provide a means for determining why worsening or improvement has occurred in the past or is expected in the future
- Provide a new tool for livestock policy analysis and direction
- Identify points of leverage for policy, and achieve some balance in answering questions about the outlook for the future

4. How to make scenarios and futures research in general effective in decision-making

More than 250 futurists, scholars, business planners, and policymakers from over 50 countries participated in AC/UNU Millennium Project questionnaires and interviews that provided input used to produce the following check list for how to make scenarios and futures research in general effective in decision-making.[22]

It is not reasonable to expect that all of the following recommendations can be implemented in every application of futures research for decision-making. Nevertheless, the more of these that can be done, the greater the likelihood of successful implementation of futures research in decision-making will be.

1. Make sure leaders or decision-maker(s) to whom the information is intended know what futures research is and is not, are interested in the process, have requested the activity, and all those involved in the process are clear about the objectives and mission of the activity. Ideally, this would include a statement of what the decision-maker(s) would consider to be a successful outcome.

2. Confirm that futures research has or will have a formal connection to the strategic planning process that is understood by all involved and that they understand that futures research provides a framework for thoughtful discussion, rather than predictions.

[22] These insights are drawn from Chapter 10 *Factors Required for Successful Implementation of Futures Research in Decision-making*, 2005 State of the Future CD by Jerome C. Glenn and Theodore J. Gordon, published by the American Council for the UNU, Washington, D.C. 2005.

3. In addition to the decision-maker(s), identify and work with a champion of the activity within the organization.

4. If the decision-maker(s) lack the knowledge or do not understand the complexities of the issues about which they must decide, include workshops or training during the research. As appropriate, use simulations or models showing complex interdependence of events, policies, and consequences of actions that can challenge stereotypical thinking. If possible, include discussion of the moral barriers to timely decision-making.

5. Integrate the producers of futures research and the decision-maker(s) into the overall process as much as possible.

6. Information should not be limited to quantifiable projections, but should include rich subjective descriptions of alternative futures that makes future possibilities more real for the decision-maker(s).

7. Include diverse different interest groups and key actors in the research process to make sure that the information is created about how a contemplated decision may affect stakeholders and to reduce subsequent political impediments. Enlist the support of people in this process who will use or be affected by the activity.

8. If there is a lack of clear-cut strategy and goals for the futures research to address, then include this as an issue in the research.

9. Determine who has the responsibility to act on the information; if no one, then make this an issue in the research, and if appropriate, bring this to the news media. Similarly, determine if there is adequate coordination among responsible departments, if not, then make this an issue in the research as well.

10. Include the decision-maker(s) in the research process to counter any lack of long-term views, and short-term dominance over more distant future considerations.

11. Use at least one formal method that is understandable to all involved.

12. Provide information that demonstrates unequivocally that a crisis is pending to counter institutional inertia.

13. Include knowledge about what is possible, such as technological changes, to counter disbelief that change is impossible. Include information about the success or failure of other institutions and countries that had similar problems and have attempted to implement policies. If possible cite inspiring success stories.

14. Make options or recommendations simple, clear, and precise and deliver them in political, cultural and social (non-technical) terms, connected to goals and strategies.

15. Demonstrate the technical feasibility of recommendations including required personal, institutional, and technological changes to counter decision-makers' fear of failure.

16. Connect the costs to the benefits of the recommendations to increase the willingness to pay. Decision-makers and political leaders have used “financial impediments” as an excuse not to act; but tend not to see finance as the primary reason for inaction.

17. If the information and data are inaccurate, unreliable, conflicting, and/or insufficient, then expose the problem, collect best judgments, and suggest ways of making decisions within the uncertain environment.

18. If possible, include the intended actions of related institutions, lobbyists, and decision-makers related to the recommendations.

19. Develop and popularize appropriate indicators in coordination with other related institutions in the design and implementation of policy recommendations.

20. Use testimony of eminent scientists, including information of their estimates about probability and risks associated with issues and their policy solutions.

21. Clarify the forecasted condition with and without action, as a set of long-term scenarios, ranging from dreadful to positive.

22. Establish linkages to other similar activities in government and industry, here and abroad, so that diverse inputs are possible and inputs can flow from non-conventional sources.

23. Be innovative in the method of presenting findings to avoid information overload.

24. In addition to more analytic methods, include a workshop toward the end of the research to give time for individuals, including the decision-maker(s), to integrate the concepts in their thinking in a group setting.

25. Consider how to include the media in the issue in consultation with the decision-maker(s). Examples include making the research available on the Internet, holding press conferences, opening communications with public communities and other research institutions, and even consider how to popularize the work via cooperation between artists (e.g. Spielberg) and futurists in film, television, and other media.

26. Make the work continuous and cumulative so that what is learned in one iteration is carried over to the next. It should not be a one-time event, but an on-going process of feeding information to the decision process and responding to feedback from impacts.

Appendix

A. Full text of two scenarios one exploratory, the second normative
B. How to construct scenario.
C. Annotated scenario bibliography of scenarios with some relationship to agriculture and livestock or the natural environment

A. Full text of an exploratory scenario and a normative scenario

A.1 Scenario - S&T Develops a Mind of Its Own

Most people in 1975 would never have believed that by 2000, millions of people would simultaneously search millions of computers through many intermediaries at no cost in less than one second. Similarly, the general public in 2000 would have been quite surprised that just 25 years later collective human-machine intelligence would be dramatically increased. But customized neural nutritional supplements, genetic medicine, universal cognitive development access, and TEF (Tele-Everywhere-Feedback protocol) with CyberNow clothing and glasses achieved miracles in human performance, social stability, and economic growth. The forces behind Moore's law not only accelerated computer capacity, they also accelerated all phenomena connected to computers.

TEF-CyberNow affected or connected only about 10% of the world in 2015, but by 2025 the economies of scale brought the price so low that many people were given CyberNow glasses or clothing free as part of employee benefits, rights of citizenship, insurance policies, marketing programs, and credit systems. This accelerated diffusion within poorer countries. UNICEF, the World Health Organization, UNESCO, and international development agencies also helped with distribution in poorer regions. Speech recognition and synthesis, integrated in nearly everything, made technology transfer far more successful than originally deemed possible by the UN Development Programme's Tele-volunteers, who did much to help the poorest regions understand and use the benefits from these new technologies. As a result, many remote villages in the poorest countries have cyberspace access for tele-education, tele-work, tele-medicine, tele-commerce, and tele-nearly-anything.

By 2025, nearly 70% of the world was connected via TEF and 44% wore some form of CyberNow at least once a week. More than half the world spent more than half its waking hours in cyberspace. At this rate, it would be only a matter of time until the self-organizing properties of intelligent software complete the connectivity of humanity, except for those remaining neo-Luddites forming and living in historical theme parks, who enriched the world with historical and intellectual depth.

People used to think that Internet's World Wide Web was the most powerful force for global change in history, but TEF-CyberNow went far beyond those crude connections of text and images by becoming a continuous virtual reality, as user-friendly as breathing. Between 2010 and 2015 the massive international S&T cooperative research program on human-computer intelligence was initiated by the largest research transinstitution in history (composed of governments, corporations, NGOs, universities, and international organizations). It was named the Brain Trans-science Service (BTS). This identified the factors and systems that ultimately enhanced human-machine collective intelligence. Since the effort was more complex than the Human Genome Project, older organizational structures were not acceptable

to the many different actors. Finally they had to form a transinsitution to prove that it would be of common benefit to all of humanity.

Major funding came from the United States, China, the European Union, India, Japan, Russia, and United Korea. The initial corporate leaders were Oil World, GM, Mitsubishi, ChinaMind, IBM, Merc, MicroWorld, Nestlé, and Sony.

An NGO association of university, government, and private research centers around the world was specially created as the NGO participant in BTS. The transinstitution was incorporated in Switzerland, and its inaugural tele-meeting was held under the auspices of the Office of the UN Secretary-General, UNESCO, and the International Science and Technology Organization (ISTO). The R&D collaborators of Brain Trans-science Service produced the foundation for inexpensive genetic medicine, customized neural nutritional supplements, and universal cognitive development access, and they built synergies with TEF and CyberNow that enhanced cognitive development even in many remote areas or the world. BTS also helped further multidisciplinary approaches among the natural and social sciences, engineering, and medicine. An offshot of this was ecoscience that tries to combine hardware, software, and mindware into a single normative framework to further human, cyber, and environmental conditions.

Businesses and universities that used the early brain-computer interfaces prospered and stimulated more R&D for even better products, which led to wider public acceptance. However, it was in the area of entertainment where the prices fell fastest and the numbers of users really accelerated. Global cyber games engaged millions. The distinctions among work, play, and leisure blurred in cyberspace. Some thought it was not natural and resisted, but many parents around the world who wanted the best for their children pushed for the use of TEF and CyberNow in schools and home entertainment.

Once people believed it was possible to enhance human intelligence by computer augmentation, the corporate R&D race took off to create the mass products for everyone to use. Just as Mosaic and Netscape accelerated the use of the World Wide Web in the 1990s, TEF and CyberNow accelerated the human-machine continuum in the early 2020s. By 2025 CyberNow clothing monitored health to alert the user and medical systems about potential health problems.

Computational chemistry, simulation biology, and genetic engineering customized medicine and reduced cost. Tele-medicine became a commonplace for over half the world, who diagnosed and treated themselves for many problems via DNA diagnostic options through their CyberNow clothing. Genetic medicine eliminated inherited diseases from the human gene pool. Tele-care, fought by many, was now more accepted as TEF and CyberNow systems improved. Low-cost robotic systems provided medical care support in both homes and hospitals. It did not replace human contact, but with 2 billion people over the age of 60 and the growing shortages of medical personnel, it was inevitable that these Tele-care systems would augment medial staff. Even poorer nations unable to handle an aging population were forced to introduce Tele-care.

Nanotechnology lowered the cost and increased the reliability of many products, which contributed to improving the standard of living—even in the poorest areas of the developing world. For example, nanotech drill bits and tubes allowed deeper water access, preventing

massive water shortages. This bought some time to develop more lasting solutions, such as nanotech desalinization filters and precision agriculture.

TEF and CyberNow provided the basis for the best educational programming the world could make. Since there was a vast array of materials and beliefs, standards of education differed around the world. It became common practice to spend $100 million to develop just 10 minutes of educational software that was used by 2 billion people—a cost of 5¢ per person. Many of these programs were subsidized by UNESCO, national development agencies in the poorer regions, and advertising agencies in the richer areas. The most effective science education programs were the interactive cyber games with role-playing possibilities for millions of students inside virtual reality bio-chemical reactions created by a Disney-MIT spinoff. Students with the best bio-chemical strategies were offered jobs and scholarships. Other programs for the slightly younger students were BANG (Bits, Atoms, Neurons & Genes), a primer for fundamental science concepts that relied mainly on advanced VR representations, and the Evolutionary Game, which encouraged pupils to role-play various parts throughout Earth's history.

These games allowed the student to go from a state of relative ignorance to the cutting edge of the field through on-line data, information, and knowledge. Problem sets were continually changed not only by teachers, but also by students who programmed their own experiments within the software's simulation environment. As students progressed toward the state of current scientific research, they might begin interacting with real scientists working on real problems. Activities that taught electronics contained means for students to construct circuits, and if they met specifications, their files could be exported to actual professionals. Hence, this was a source of job offers.

Some people resisted all this change and hence, unfortunately, there were still poorly paid teachers in broken down classrooms with out-of-date textbooks, providing expensive and inferior education in some of the poorer regions of the world. But for those who welcomed it, the computer-aided brain became as normal to many children around the world as the desktop computer was to their parents and the telephone was to their grandparents.

These educational systems diagnosed cognitive difficulties via analysis of inquiry patterns and automatically altered the curriculum. They also diagnosed the potential for violent anti-social behavior, and automatically notified child development and mental health authorities, which may have prevented many forms of destructive behaviors—even terrorism—later in life. Many accepted the loss of privacy for the gain in human security. Others did not, but their protests were ineffective, and some joined neo-Luddite historical theme parks.

Progress in neuroscience and biocomputing provided the technology for implanting computer chips into the human brain, but most people did not like this concept and prefered to continue improvements in the TEF-CyberNow alternative. Yet success with nano-bio-transceivers for health maintenance, flowing with blood through the veins, gave rise to new speculation about future nano-computer-transceivers that can flow through the ventricles in the brain's tissues to enhance brain functioning.

Customized intelligent personal software agents became integrated with so many systems that it was no longer clear who was giving instructions and who was answering questions. Sometimes it seemed that human brains were like little neurons in a global cyber brain. Although human and machine intelligence are quite different, the synergies between them

accelerated collective human-computer intelligence. Some scientists trying to reverse-engineer the human brain and complete mathematical models of cognitive processes claimed that their work would make it possible to accelerate learning dramatically, create robots with a form of self-awareness, create real artificial intelligence, build a completely artificial human brain, store backup copies of human brains that could be later downloaded into an artificial brain, and create a self-evolving human-machine global-brain.

Computers had the same computational capacity as the human brain and were able to simulate much of the neural activity of an entire human brain. The senses of sight, hearing, smell, taste, and touch were all duplicated in virtual reality communications. Rumors persisted that some humans used some AI-created technologies to copy their brain patterns into computer simulations in which their copies or uploads "lived" in some VR version of paradise. Meanwhile, the International Science and Technology Organization evolved over the years into a body with a unique influence on S&T developments. ISTO was organized and managed differently than previous UN institutions.

With a small staff and large information systems, it was more accurate to think of the organization as a framework for others to use and to contribute improvements to rather than a bureaucracy holding up decisions. Its information systems were composed of data banks of other international organizations, governments, corporations, NGOs, universities, and independent researchers.

ISTO helped organize the world's S&T knowledge, information, and data. It made the content in these systems far more user-friendly through state-of-the-art virtual reality interfaces and knowledge visualization software. For example, it became possible to quickly "swim" through three-dimensional menus, understand relationships through knowledge visualizations, and "dive" into specific research status with a full range of threats and opportunities detailed via linked data bases of virtual reality around the world. Someone could quickly zoom in from a general overview of carbon sequestration to some cost/benefit/time-to-impact calculations from several experimental nanotech carbon processing labs working on fossil fuel energy plants.

Investors found these databases helpful in picking smart investments. It was not ISTO staff who updated the information, but a vastly complex set of national academies' peer review teams, professional self-organized groups, university consortia, corporate R&D associations, and combinations of all these, each updating very specific elements of the system. But ISTO staff gave the information a comprehensive cyber skin that made it feel like one giant integrated system of the world's S&T knowledge. Constant cross-referencing and feedback continued to improve the accuracy, utility, and intelligence of ISTO's systems.

Multinational corporations with large R&D budgets were interested in getting their product and research intentions well documented and clearly communicated to the world, so they cooperated from the beginning in establishing ISTO. Corporations used it as a source of information to help establish strategic alliances for better international market access and lower production costs.

As intelligence increased, science and technology accelerated, which in turn further accelerated collective intelligence. With an increased number of intelligent people, the rate of scientific discoveries and technological applications became so fast that by the time government regulations were put into place, the science and technological capacities had

moved far beyond the conditions called for in the original regulations. In addition, S&T activities outlawed in one country quickly moved to others. Globalization and advanced cyberspace via TEF-CyberNow made it simple to bypass rules by constantly redistributing activities around the world.

Although ISTO started as an information system, governments began to rely on it so heavily that it became an informal regulatory and priority-setting agency by default. In the past, sustainable development depended on the ability of government leaders to implement intelligent vision. ISTO became more dependent on the synergies and feedback among computer systems. Yet it was unclear if ISTO would continue to be so as S&T dramatically accelerates even further in the coming years, developing what may become a "mind of its own." For example, some potential disasters were successfully avoided by early warning software that had been integrated into various products and processes. In addition to providing early warning, this intelligent technology managed self-diagnostic and repair systems, and also prompted governments and international organizations to act on their responsibilities. Which brought up the question of who was really in charge—humans or technology?

It also brought up the question of who determines the directions in which science evolves and to what end technology is applied. Such questions were raised in university courses on S&T ethics required for science and engineering students. Students also had to learn codes of conduct and sign the Scientist's Oath.

This interest in ethics resulted in the growth of S&T special interest groups (SIGs) linked with intelligent software that created standards and attempts to monitor the S&T enterprise, as part of ISTO's effort to manage scientific risk. No one really "allowed" these SIGs to monitor S&T; they emerged and generated their own power by the quality and responsibility of their work.

ISTO was originally designed to make it easier for anyone to gain access to the world's S&T knowledge, along with conjecture about future S&T threats and opportunities. As a result, unexpected as it was, scientists and engineers became less likely to pursue dangerous activities since the bright light of publicity and information made apparent who was pursuing science for the betterment of the human condition in a rational way and who was flouting the rules. This exposure influenced funding, university hiring, collegial cooperation, and publication within the world S&T community. Basic science still remained relatively free and benefited from this international information utility.

Because the rate of scientific discoveries and technological applications became so fast, some governments became afraid that other countries would develop faster than their own. They tried to create international regulations to slow down S&T. But these efforts failed, just as the anti- computer communications efforts failed in the 1980s. Anti-science backlash movements were also attempted, but the speed of S&T developments was just too fast and the objections became irrelevant.

Of the 7.8 billion people in 2025, just under 1.4 billion lived in India and just over 1.4 billion lived in China. As incomes rose in these two nations, the global demand for animal protein outstripped conventional supply until breakthroughs in stem cells for meat production successfully produced muscle tissue on a massive scale without the need to grow animals. This lowered costs and the environmental impacts of protein production. Meanwhile, other forms of genetically modified foods accounted for easily 50% of the world's food because

nanotechnology and bio-engineering merged—creating all kinds of organic compounds that were considered safe. This made it possible to produce more food at lower cost. Farmers were running out of agricultural land in any case and hence could not supply enough for the growing population, who preferred genetically modified food to starvation. Also, 20 years of experience with genetically modified food convinced most people that any initial concerns had been addressed in a transparent way through ISTO.

The world environment computer simulation (WECS)—from cloud tops to under the sea—was integrated with the Global Environmental Monitoring System (GEMS) and was publicly accessible so that anyone could know who was polluting what natural resource and so that local observers could provide feedback to help improve the system's cause-and-effect calculations. GEMS automatically notified the news media, environmental NGOs, and relevant legal bodies if the impact according to WECS was sufficient to be considered an environmental crime. In a similar fashion, patterns of financial transactions provided early warnings of potential economic problems as well as identifying money laundering patterns, helping to counter transnational organized crime.

By 2015 global warming had increased weather-related damage and changed agricultural and disease patters enough that powerful groups of insurance companies and agricultural industries lobbied for changes, pointing to increasing famines and the AIDS-C pandemic. Some even brought lawsuits against governments and industries that were the major greenhouse gas producers—and won. There were some benefits to climate change, however. For example, the Canadian Northwest Passage became open to shipping, saving many months of travel through the Panama Canal and adding to the global economy by opening new trade routes between Japan and Europe. Nevertheless, more comprehensive international action finally began to seriously address global warming. Hence, cleaner energy systems received greater attention.

Wireless energy transmission began to connect new geothermal, wind, and solar energy sources on earth with the orbital power grid via relay satellites and ground receivers. The orbital power grid was also strengthened with the first five solar power satellites in orbit, which reduced resources and maintenance per unit of production. Nearly 56% of the cars in the world ran on hydrogen, electricity, natural gas, or a combination of these. Deepwater offshore wells became electricity exporters. They produced oil and natural gas to feed power plants at the drilling site, which generated electricity that is beamed to the orbital power network for global distribution. Such global power access and distribution kept competition high and prices low. As twentieth-century futurist Buckminster Fuller predicted, connecting the world's electric power grids helped to make a more peaceful world.

Bundles of nanotubes were strong enough to connect satellites in geosynchronous orbit to earth via "space elevators." Gondolas of people and equipment were lifted into orbit by the counterforce of earth-bound loads gliding back down the nanotubes of the space elevator. These drastically reduced the cost of many space programs. The International Space Station (ISS)-III that was originally intended to house the space solar power satellite construction crews was expanded to support construction of tourist hotels, gravity-free health facilities, and retirement centers. Plans were under way for ISS-IV to be a mobile space station to supply Mars settlements and experiment with long-term space flight.

In the twentieth century, economists said that the rising tide lifts all boats; by 2025 the accepted wisdom was rising TEFs increase all intelligence. Unfortunately not all ethicists

were raised as well, as sometimes the distinctions blurred among competitive business intelligence, advanced marketing, information warfare, and various forms of organized crime. Privacy and security of information could not be guaranteed, and attempts to do so might lead to artificial intelligence beyond humanity's control. Yet most people seemed more prepared to accept software's invasion of privacy than a human's invasion. Some others objected to the abuse of CyberNow by governments and companies who attempted to manipulate consumer behavior. As a result, the "Unplug-and-Relax" movement was born as an attempt to temporarely retreat from "the system." This proved more difficult than it might seem, especially for urban dwellers. They could certainly wear non-CyberNow clothing and unplug from personal computing, but CyberNow was integrated throughout much of the built environment. As people walked through the cities, their infrared patterns triggered sensors that played personal audio and video signals to them from the buildings, making it difficult to "drop out."

Individuals and software agents crossed political and corporate boundaries in pico-seconds, forming new alliances unknown to traditional power structures. Because the convergence and synergies of genetic engineering, nanotechnology, computational intelligence, and cognitive sciences improved the human condition for the majority of the world by 2025, people became more habituated than hostile to such advances. The world appeared to be moving from political hierarchies to knowledge ecologies that some speculated might evolve beyond human control.

Although religious and political hierarchies still had much ceremonial control and many social maintenance responsibilities, the real growth of the human mind, technologies, and actions that were building the future seemed far too complex, self-organized, and creative to be understood by older institutions. The TEF-CyberNow and all that it connects might evolve a global mind, which could overcome previous ethnocentrisms. However, there was an increasing fear that biological-human intelligence and even human-computer combinations would eventually be outstripped by pure computer intelligence. Interconnections of intelligent software agents acted like group behavior of neurons in the human brain typically associated with thought. Although constant access to knowledge and feedback systems increased functional intelligence, and although decision efficiencies seemed to have improved with increased transparency and feedback for accountability, it was not clear that humans would have the wisdom to manage affairs in an increasingly complex civilization. Would the technologies that people created end up managing them, just as children do when they grow up to take care of their parents in the later years of their life? Or would human-computer symbioses evolve into a conscious-technology continuum for peace and plenty?

A.2 Scenario: A Normative World in 2050

By 2050 the world had finally achieved a global economy that appears to be environmentally sustainable while providing nearly all people with the basic necessities of life and the majority with a comfortable living. The resulting social stability has created a world in relative peace, exploring possible futures for the second half of the 21st century. Different explanations have been given for the series of astounding successes achieved by 2050. Some believe that breakthroughs in science and technology were the keys, others that development of the human potential was more fundamental, and still others that political and economic polices made the difference. All three themes were important and mutually reinforcing."

Technological theme: Internet has become a right of citizenship. Businesses give free accounts to all customers; employers give them as an employee benefit. The connection of virtually all people to the global information and communications systems accelerated the pace of scientific research and the introduction and diffusion of new technology. Biotechnology, nanotechnology, and closed-environment agriculture fed the world. New and improved sources of energy made cleaner economic growth. Brain-like intelligent systems used neural networks to augment human intelligence and improve decision making. Molecular manufacturing (nanotechnology) lowered manufacturing unit cost, requiring less volume of materials and energy usage, and hence, lowered the environmental impact of a population that had almost reached 10 billion. Vaccinology and genetic engineering eliminated most acquired and inherited diseases further reducing the need for more frequent pregnancies to have a similar sized family. This was a factor in further lowering fertility rates, even though generational mini-booms have continued from the great population explosion in the mid-20th century. Cyberspace had become a major medium of civilization creating a constantly growing, non zero-sum economy and had changed day-to-day life as significantly as the industrial revolution had changed life 200 years earlier. The success of the International Space Station had led to other orbital habitats, the lunar base, and the pioneer communities on Mars. Nearly 250,000 people now work in space communities in orbit, on the moon, and on Mars, giving a new frontier for human imagination and advances in civilization. Breakthroughs in the unified theory of matter and energy have led to a deeper understanding of mass, inertia, gravity and quantum behavior. Health is a widely accepted human right; equity in coverage and accessibility to quality health services and health information exist regardless of capacity to pay, culture, race, geographic location or social ascription. Tele-health and tele-medicine is widely available and easily accessible. Health care providers adopt new paradigms to forecast and prevent potential health problems through personal and public health approaches; early detection through biomonitoring and management of problems that do occur. The invention of secure electronic money revolutionized retail transactions, international trade, and provided extraordinary growth of employment. The synergy of telematics and micro-genetics provided a jump in human evolution eliminating many diseases and increasing human capabilities. Biotechnology has created high yield plant species that are disease and pest-resistant, use less fertilizer and are more tolerant of drought and brackish water. The mapping of bacterial, human, and plant genomes, provided knowledge of genetic processes and to some extent, information about how to control them. The World Energy Organization, created in the early 21st century, coordinated research and helped improve policy leading to today's safer mix of sources that have reversed the greenhouse effect. Space-related inventions have created new industries, tax sources for social programs, improved living standards, expanded access to tools by miniaturization and production processes that have lowered the costs of many technologies from satellite communications to medical diagnostic techniques. Income from satellite communications, solar power satellites, orbital energy relay satellites (orbital electricity grid), lunar and asteroid mining, weightless manufacturing, and space tourism has led to an enormous growth of private sector ventures in space. This acceleration of the privatization of space applications has avoided the public cycles of interest and disinterest in space support, so common in the last century. Despite the technological progress and scientific insight in which today's society is based, most scientists and engineers believe that there is still more to come, that the future holds further excitement, progress and discovery."

Human Development Theme: "The acknowledgment that education was the solution to many problems and that the knowledge economy was spreading rapidly, stimulated governments and corporations worldwide to increase their investments in education, training,

and applications of cognitive science. The race to educate the world began after the World Summit on Cognitive Development in 2010. Most institutions that had even a peripheral association with education began debating the most equitable and cost/effective ways to make everyone knowledgeable, virtuous, and intelligent. Internet access became a right of citizenship. Educational software was imbedded into nearly everything that could hold a computer chip. The World Cyber Games permeating daily life blending entertainment and education. The transition from a mostly illiterate global population to a mostly educated world was achieved by the mid-2040s. The interconnection of many separate programs into a global system of education created a cyberspace in which all could get the best education at their own pace, learning style, and in their own language. In addition to the vast improvements in educational technology, the content of conventional public education also changed during the early 21st century. Education successfully linked human ecology to decision-making in an increasingly global society. Advances in cybernetics and human cognitive development increased the use of machine intelligence to augment human intelligence, while emphasizing social and emotional development for improved decision-making. In short, it became fashionable to be intelligent and virtuous.It was not enough to learn and understand the history and current status of an item; in the world of 2050 an educated person also knew a range of possible futures for that item. The millennium provided the focus to foster collaboration among the various inter-religious dialogues on human values and morals that continued over several decades and through all forms of media. Although cultural and religious conflicts will still need more time to fully disappear, these new initiatives have help to keep them in sufficient check to prevent the kinds of wars so prevalent in the last century. Changes in global frames of reference and philosophies due in part to understanding of the interaction of population and economic growth with environmental degradation gave rise to the more enlightened age of today. The merger of the environmental movements and human rights groups in collaboration with many leading multinational corporations made possible the global educational campaign that made clean air, water, and land to be accepted as a human right. As a result, many changes in environmental policies and behaviors have been made. It became unthinkable to establish an environmentally dangerous project. With global consciousness (awareness that everyone is aware of the world as-a-whole) institutional forms continuously reinvented themselves. Few hierarchical or network institutions existed in a continuous sense as in the 20th century. Instead they became fields for collaborative actions of varying time duration. Every four years the Olympic movement re-enforced this consciousness through its games in both cyber and three-dimensional space. In 2040, when the Mars Pioneers won the first Olympic competition in solar sailing between earth and lunar orbit, humanity seemed to pass some threshold of consciousness. We became aware that we were no longer an earth-only species but will become a space faring one. Our human capacity is just now beginning to be understood. The current debate about a possible signal from extraterrestrial intelligence is revolutionizing our values, philosophy, and views of the human potential as we enter the second half of the 21st century."

Political Economic Policy Theme: "The number of wars decreased as democracies and respect for cultural diversity increased in the early 21st century. Although old cultural conflict wounds of the past still flare occasionally, we can successfully avert and prevent them for growing into larger conflicts. The resulting social stability nurtured economic growth and created 2 billion people in the global middle class by 2010. This increased conditions for further stability and sustainable growth that moved over 5 billion people in the middle class by 2050. The transition from dictatorships to democracies is now complete. Authoritarian regimes cooperated in the transition realizing that democratic processes were increasingly necessary for social stability and the generation of wealth en par with global norms. Improved

information technology helped make UN Electoral Units instrumental in this transition by providing effective election design, management, and monitoring. Threats to make development assistance and loans from international organizations dependent on progress toward democracy sometimes proved counterproductive. The incentive of participation in the Global Partnership for Development (GPD) proved effective as a partnership between high income countries and those with less industrial and entrepreneurial cultures to improve economic development. GDP membership required respect for human rights and policies to address environmental security. If they were abridged or thwarted sufficiently, intervention by UN peacekeeping forces could be authorized by the Security Council. A little noticed article in the GPD called for acceptance of periodic NGO assessments of progress on democratization and the reduction of corruption. The corruption reports have become an annually anticipated event and have proven to be an effective instrument through which countries have reduced corruption. As the world progressed toward peace, the reduction in arms R&D, production, stockpiling, trade, and military personnel was accelerated along with the efforts to convert military technology to civilian uses. The World Sustainable-development Organization (WSO) was created to provide a global focus for business, government, and individual efforts to invest into sustainable development. The International Court of Environmental Arbitration and Conciliation has become the key instrument for advising the UN Security Council on environmental security actions. UN Peacekeeping forces were deployed when the ICEAC ruled against a state that was unwilling to stop the leakage of nuclear waste that endangered several countries. Since then the threat of UN military intervention has been sufficient to cause remedial actions. Intergenerational equity has become a major global value and legal principle. Similarly, there are now government incentives for smaller and healthier families, effective long-term contraceptives, low infant mortality rates. Since family planning or spacing has become acceptable in nearly all cultures, it is unlikely that birth rates will increase in the near future. Birth rates have fallen sufficiently that now more people worry about sufficient population growth to the support the world's increasingly aging population. The synergies among the successes in political economic policies, human development, and technology have resulted in a better world in 2050 that few at the turn of the century believed was possible."

B. How to Construct Alternative Scenarios[23]

Numerous methods have been developed to create scenarios, ranging from simplistic to complex, qualitative to quantitative. Many methods have similarities, although they may have unique features and use different terminology. Most approaches recognize the need to understand the system under study and identify the trends, issues, and events that are critical to this system. While each is not feasible to explain in detail, a brief description of several and a lengthier description of one is worthwhile.

Coates & Jarratt of Washington, D.C., U.S., uses the following process to develop scenarios for a variety of clients, including countries and businesses. Coates & Jarratt begins by

[23] Quoted with permission by the authors Jerome C. Glenn and The Futures Group of "Scenarios," *Futures Research Methodology version 2.0*, Millennium Project of the American Council for the UNU, Washington, 2003

defining the universe of the area of interest. Key variables shaping the future are identified using a wide range of sources. Usually some 6 to 30 variables affecting the future situation are nominated. This list is then winnowed down by eliminating redundancies, a process that usually results in 6 to 20 variables. In the next step, the scenarios to be created are defined. One scenario usually presents a continuation of the present forces at play. Other scenarios may include an optimistic or positive scenario, which may be based on one or two of the particularly prominent variables. These scenarios may involve such occurrences as a technological breakthrough or change in government policy. Other scenarios can be framed around important futures, such as business booms, collapses, or other important occurrences. In general, three to six scenarios are usually sufficient. The variables are then reviewed to determine what is a plausible qualitative and quantitative range of the value for that scenario. The scenarios can then be assigned to individuals for creation. Once completed, the scenarios should be reviewed for comprehensiveness and completeness, then edited to ensure consistency in approach, layout, style, and format.

Coates & Jarratt emphasizes that scenarios can be used to achieve different goals. Whereas some are designed to present a completed future, others may be used as points of departure for future discussions, such as policy implications. On some occasions, transition scenarios may be appropriate to development that describe the process of getting to certain end states. These transition scenarios can be either a separate set of scenarios of part of the primary scenarios themselves.

Peter Schwartz of Global Business Network, a think tank in Emeryville, California, often compares the initial process of creating a scenario with writing a movie script (Schwartz 1992). Often in creating a scenario, a team of people considers such questions as: What are the driving forces? What is uncertain? What is inevitable? As scriptwriters formulate an idea and develop characters, Schwartz uses the driving forces as the building blocks of scenarios. He describes several steps in the scenario development process in his work *The Art of the Long View*. These steps include: identify the focal issue or decision; identify the key forces and trends in the environment; rank the driving forces and trends by importance and uncertainty; select the scenario logics; fill out the scenarios; assess the implications; and select the leading indicators and signposts for monitoring purposes (Schwartz 1991, pp. 226-234).

Thomas Mandel and Ian Wilson of SRI International wrote an excellent description of scenarios in a report entitled “How Companies Use Scenarios: Practices and Prescriptions.” (1993). In this SRI report, the authors explain the scenario development process. In the first two steps, management decides what they need to know in order to make business decisions, and a scenario team describes the events, trends, and uncertainties that could impact the decision-making process. The team then analyzes forces that will shape the future business environment, both from within their own industry (competition) and outside of it (social, political, economic, etc.). The team then develops scenario theories or “logics,” which are differing views of the way the world might work in the future. Each theory takes into account critical drivers and uncertainties. Using the theories already developed as a guide, the scenarios are then described in sufficient detail to identify implications of decisions and to help develop and assess strategy options.

Michel Godet, from the Laboratory for Investigation in Prospective Studies in Paris (Godet, 1993), begins the scenario development process by constructing of a base image of the present state of a system. This image is described as broad in scope, detailed, and

comprehensive, dynamic, and descriptive of forces for change. The base image is constructed by delineating of the system being studied, including a complete listing of the variables that should be taken into consideration as well as subdivisions of these variables (i.e., internal and external, as descriptive of the general explanatory environment). This step is followed by a search for the principal determinants of the system and their parameters, often using structural analysis. The scenario process involves examining the current situation and identifying the mechanisms and the leading actors (influencers of the system through variables) that have controlled or altered the system in the past. This process continues with development of actors' strategies. Construction of the database is followed by construction of the scenarios.

Godet combines various futures research techniques in scenario development. For example, he finds that morphological analysis can be used in scenario construction since scenarios are, in essence, a configuration of identified components. Godet cites the large number of possible combinations as a drawback in this application of morphological analysis, but offers a solution in the form of computer software that helps limit the field.

Ute Von Reibnitz of Strategische Unternehmensberatung makes the case that the ability to create different futures situations allows planners to deal with scenarios that fall between two extremes. In his book *Scenario Techniques* (1988), Von Reibnitz describes the process of scenario techniques. Step 1 entails an analysis of an organization's structure, strengths and weaknesses, and goals and strategies. Step 2 involves an examination of areas and factors of external influences with attention to their interrelationship and dynamics in the system. Step 3 is an analysis of the development of the future of influence factors. Step 4 clusters different alternatives to form logical and plausible structures for future scenario. Step 5 incorporates these structures into scenarios that describe system dynamics and changes. The process concludes in Step 6 with an analysis of opportunities and risks.

In *Business Futures,* the Institute for Futures Research presented yet another approach that began with the identification of key issues. This step is subdivided into definition of mission, objectives and aims, and description of strategies and key decision-making parameters, followed by identification of key environmental forces composed of environmental scanning, spotlighting of crucial issues, and predetermined events and forces for change. In the next step, the scenario logic is defined, the actors identified, and their likely behavior examined. Multiple scenarios are then created, and the implications of each are tested. The concluding step involves presentation of these scenarios to planning forums in order to evaluate their implications for action programs.

The Millennium Project uses large scale participatory processes. To construct a global normative scenario, hundreds of futurists, scholars, business planners, scientists, and policy makers who work for international organizations, governments, corporations, NGOs, and universities identified and rated norms that formed the core of the normative scenario. In order of preference, the participants selected the following top four norms around which to form the scenario: environmental sustainability, plenty, global ethics (the identified and accepted), and peace. The others in order of preference were health, freedom, universal education access, equity, preservation of the human species, enlightenment, exciting and meaningful life, self-actualization, longevity, everyone has everything they want, and security.

The body of the normative scenario was composed of the actions to address the 15 global challenges identified through several rounds of global questionnaires to the Millennium

Project participants. These actions connected the present world to the normative future of 2050 and gave another medium to share the thinking of the participants. A scenario review panel was formed of long-term normative-oriented participants of the Project to reviewed and improve the draft of the scenario.

The Millennium Project global exploratory scenarios to the year 2025 also used a participatory process of questionnaires and interviews to collect information, but added the use of a computer model to add quantification assure self consistency. The developments and policies found to be important by the participants provided fodder for the scenarios; these developments and policies were incorporated in each of the projected worlds. The method of incorporating the global model was also novel. Rather than having the model drive the scenario, the scenario drove the model.

As usual, the drafting of exploratory scenarios began with the choice of the principle independent dimensions (axes) that seemed to force the worlds under examination to differ. Future "worlds" were formed around these choices using techniques described below.

In the next step, these explicit scenarios were used to provide the backdrop for the choice of the values of the exogenous variables in the selected model. Therefore, when the model was run, it's output was consistent with the scenario on which the exogenous variables were based and the model provided quantitative estimates of the value of variables that were then incorporated within the scenario. While several different global models were considered, International Futures by Barry Hughes, University of Denver was selected. It was well documented, relatively easy to use, and made freely available to the Project. For a more complete description of this approach see:
http://www.acunu.org/millennium/scenarios/index.html

The development of scenarios can range from a lengthy and intricate process to an abbreviated workshop. Peter Bishop, for example, has used the SRI/Shell/GBN scenario technique in introductory futures workshops. These workshops in a four- to six-hour period can complete a full scenario's development sequence. The primary purpose of these workshops is to experience the process, not to utilize the actual results of the scenario. During this process, Bishop takes the group through the process of setting up scenarios, developing scenario logic, and drawing out scenario implications. By asking focused questions—such as, "What is the most important issue concerning human resources for health care over the next 10 years?" "What will stay the same about this issue that will limit its alternative futures?" "What is changing about this issue that will alter its future?"—Bishop sets up the scenarios and develops the scenario logic. During the process workshop, participants come to appreciate a wide range of variables that affect the future, as well as the interrelationships among those variables and the existence of alternative, plausible scenarios for the future.

The following three-step process developed by The Futures Group illustrates scenario construction in greater detail:

1. Preparation

Define the scenario space. A scenario study begins by defining the domain of interest. Given a clear statement of the domain, analysts list key driving forces thought to be important to the future of the domain. In a study performed by The Futures Group for MITRE Corporation

about the social environment of crime, driving forces of law enforcement funding and social attitudes toward crime were defined as ultimately important. To the degree possible, these driving forces should be independent "axes" in a scenario space. If three such forces were defined, the space would be three-dimensional. With two forces, scenario space is two-dimensional. In the law enforcement case, these axes helped define four scenarios of interest:

a. High funding, permissive attitudes toward crime;
b. High funding, repressive attitudes toward crime;
c. Low funding, permissive attitudes toward crime; and
d. Low funding, repressive attitudes toward crime.

Defining a large number of alternative worlds is often neither necessary nor desirable. A smaller set of choices that encompass the range of major challenges and opportunities usually suffices. A few possibilities may need to be excluded as illogical or insufficiently plausible over the planning horizon. The final selection of worlds should be sufficient to present a range of opportunities and challenges, but should be small enough in number to handle. Four to five "worlds" seems ideal to capture a range of future challenges and opportunities.

2. Development

Define the key measures. Within each scenario, certain key measures are described. These measures might include forces such as economic growth, legislative environment, technology diffusion and proliferation, or competitive capability, among others. The key measures need to be selected with care. They should have the potential for great impact on the outcome of the scenario; a factor is largely irrelevant if it could develop over a wide spectrum of future values but have little impact on the issue at hand. Every scenario in the set will include projections of the same measures.

Define the events. This list of events will also appear in each scenario. These events shape the scenarios in several different ways: they can impact the key measures, change the chains of causality that lead from the present to the future, and/or make certain policies more or less likely to work. The probabilities of the events are different in each scenario and depend on their position in the scenario space.

Project the key measures. Trend Impact Analysis (TIA) is a useful technique for projecting the key measures. (A methodology paper in this series describes this technique.) Briefly, the historical data for each of the measures is projected using time-series methods. The events, expressed probabilistically, are combined with the extrapolation using Monte Carlo methods to produce a new median forecast and a range of uncertainty. Since events within a scenario impact several measures wherever they are used, they have the same probability; thus, internal consistency is promoted.

Prepare descriptions. Now, given the quantitative forecasts of the measures based on the probabilistic description of the impacting events, many chains of causality become apparent, and cohesive narratives describing the future histories can be prepared.

3. Reporting and Utilization

Document. In most cases, the best documentation is a simple series of charts and narratives describing the future history represented by each scenario. As thinking surrounding the scenarios is driven farther down in the organization, several levels of documentation for each of the scenarios is often useful. A top-line summary gives readers a quick, intuitive feel for the characteristics of a world from the perspective of a selected future time (say, 2003)—how it developed, and what the decisive events were that caused the world to develop as it did.

Contrast the implications of the alternative worlds. How different are the business decisions and planning goals you would pursue considering each alternative world? What actions and commitments offer your organization the most resilience in the face of these uncertainties?

Testing policies. The range of scenarios can be used to test policies. In any study, a list of alternative action is prepared. This list may come from the decision-makers after reading the scenarios. Each is defined as precisely as possible. Then, using quantitative techniques if possible, the policies are "tested" in each of the scenarios. When a particular policy produces desirable results in all cases, it is clearly a good bet. The other scenarios may give rise to contingent policies that can be called on if the circumstances develop that the scenarios depict.

Key Points in Scenario Construction

The most useful scenarios are sharply focused. They focus on critical issues facing the organization. The number of issues for consideration and the number of possible scenarios are almost endless. Without a clear direction, the discussion of drivers is difficult to limit. The number of alternative worlds expands exponentially, and the list of variables can become unworkably long. The best defense is to define the focus from the outset. Ask yourself: "What planning questions need to be addressed? What variables are we most likely to forecast in order to address these concerns?"

Be careful NOT to get caught up too much in the structure of making a logical set of scenarios that you are prevented from writing potential future conditions that you know have to be addressed. If a scenario is important for decision-makers to face, but somehow it does not fit in the scenario space, then write it anyway and add as an extra scenario.

Emphasize qualitative analysis at the start. While numbers and formal models are often valuable sources for understanding future prospects, they can be distracting at the early stages of scenario development. Quantification can be valuable in later stages. Formal models also can provide an effective way of separating the many parts of a complex system for close consideration. See: <http://www.acunu.org/millennium/scenarios/explor-s.html> for an examples of using a model after writing qualitative draft scenarios.

Most futurists advise against finding a "most likely" scenario. The best scenarios reflect many variables and possible turns of events that shape the dynamics of a system under study. Any single scenario that purports to define the most likely particular path through this maze is unlikely. Fortunately, the scenario-building process does not focus on uncovering the "most likely" forecast but, rather, on identifying the range of feasible outcomes.

Writing scenarios is only the beginning. Using them to assess policies is the only way they become useful.

Case Study: Defense Markets in an Era of Geopolitical Change*

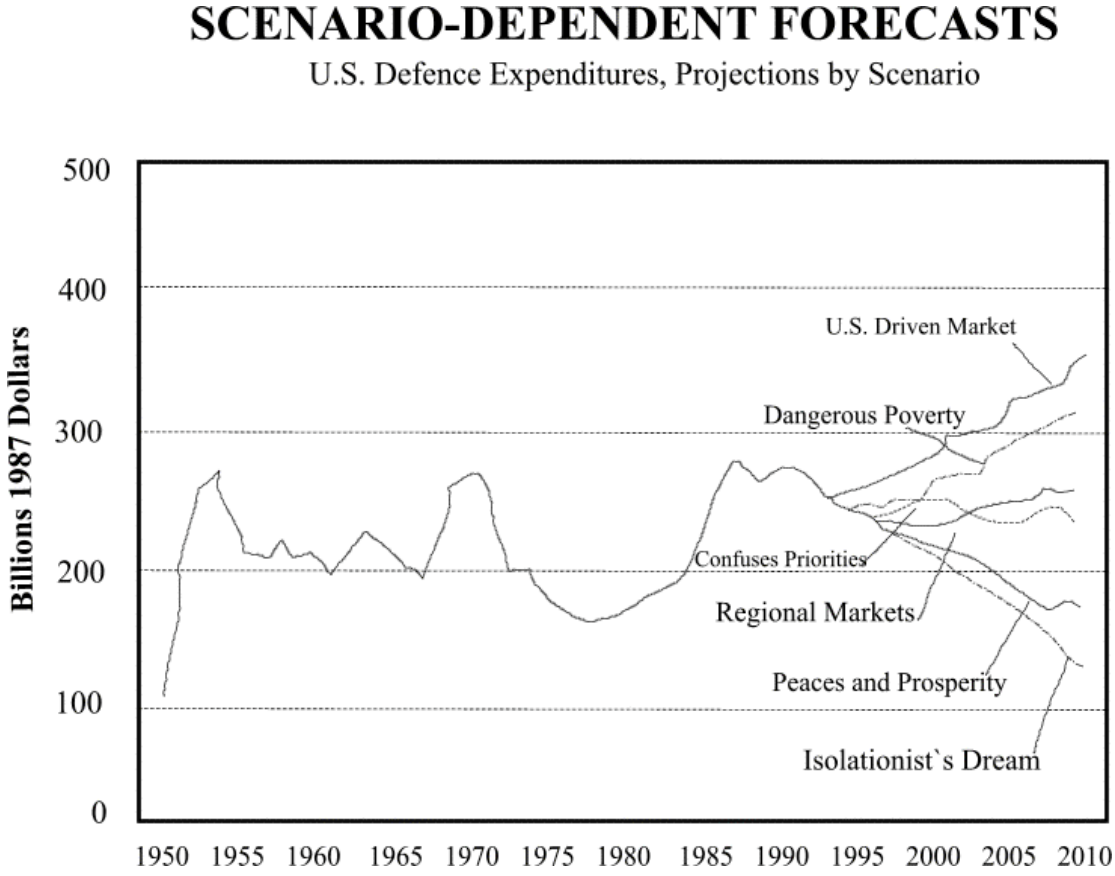
The U.S. defense sector is an industry on the verge of major restructuring. Epochal changes in international political, economic balances of power, and escalating globalization of defense production are creating significant changes in markets for defense goods and services. In several recent planning assignments, The Futures Group used the scenario method with defense firms trying to gauge the strategic implications of this altered business climate on the future of their markets. (This case has been thoroughly edited to conceal the identify of clients and to protect their interests.)

Defense Industry Background

Many segments of the defense industry achieved steady growth all through the Cold War. The security of the United States and its NATO partners required a stream of innovative high-technology equipment and heavy weapons. However, the breakup of the United Soviet Socialist Republic and the tilting of economic power toward the Pacific Rim have profoundly challenged the long-standing concepts and assumptions that have guided the nation's security objectives. During the past decade, worldwide capacity for defense production has expanded at a significant pace. And some of the newly industrializing nations have entered the defense goods and services business.

As a result, most U.S. defense firms are questioning the longer-term vitality of their traditional markets. Many anticipate the need to pursue new opportunities aggressively, such as expanded foreign sales and diversification into nondefense businesses. Yet, at the moment, all that is really clear is that change is under way. No one knows what the industry will be like when the dust of the Cold War finally settles. Perhaps peace will reign. Or perhaps chronic regional and ethnic conflicts, with their potential to spawn catastrophic terrorism in nations a world away from the battle zone, will intensify the security concerns of even the most nonaggressive nations. The defense industry's decision-makers and planners face enormous uncertainties.

*The following application is as appeared in the *Planning Review*, May/June 1992, was written by Charles W. Thomas, a senior scientist for Policy and Strategy at The Futures Group, an international business strategy and policy research firm, and Mark A. Boroush.



Thor Industries, Inc.

The key questions that The Futures Group's composite client, Thor Industries, Inc., needed to address concerned the future global demand for a number of defense products and services. (An analysis of opportunities in nondefense areas was scheduled to be undertaken after the defense market scenario was completed.) Thor's planning horizon spanned the mid-1990s through 2005 so that the client could take a look at the industry in the era beyond current acquisition programs. A key assumption that needed to be re-examined was: Suppose the U.S. government ceased to be the primary customer?

Thor established an internal working group—including members of the corporate leadership, division managers, and the firm's planners—to consider these issues and develop a set of planning scenarios. The group first identified the driving forces that could affect security priorities and defense requirements and then determined how likely they were to occur during the planning period.

The scenario group produced a long list of possible future developments spanning such issues as: geographic incidence of political tensions; the nature of alliances and diplomacy; ease of arms and technology transfer worldwide; technological improvements in equipment and practices; and degree of national economic support for the defense production sector.

The working group then edited this somewhat cumbersome list and organized it into constellations of possible outcomes with four principal dimensions:

a. extent of U.S. diplomatic, economic, and military involvement in the

world;

b. character of countervailing military power;
c. vitality of the U.S. economy; and
d. level of global instability.

The resulting "scenario space," illustrated in Exhibit 1, charts 13 plausible alternative worlds. Only six are described in detail in this case. Each world is based on different assumptions about the future impact of trends and evolving conditions on national security needs. (Given the dimensions of the scenario space, 16 alternative worlds are mathematically possible; but three combinations were excluded because they were illogical or utterly implausible.)

This exercise offered Thor's management a variety of feasible future settings for their business. While some depicted conditions resembling the present, others illustrated quite different horizons. The essential issue for planning was: How would the defense market be affected if any of these alternative worlds actually came to be?

The answers involved preparing a series of detailed forecasts for each alternative world. For Thor, these included: future trends in U.S. and foreign government defense budgets; the growth in demand for several kinds of defense goods and services; and the character of terms and conditions governing sales to domestic and foreign customers.

The details of every alternative world are not usually necessary to describe in order to grasp planning or strategic implications. A representative set can adequately illustrate the range of possible challenges and opportunities. Thor's working group decided that six of the alternative worlds offered a diverse and likely group of business settings against which they could compare the company's current planning assumptions.

EXHIBIT 1: SCENARIO SPACE - *FUTURE GLOBAL DEFENSE MARKET TO 2005-2010*[1]

Name[2]		Plausible[3]	Level of U.S. Global Involvement[4]		Countervailing Military Power[5]		U.S. Economic Vitality		Level of Global Instability	
			High	Low	Focused	Diffuse	Vibrant	Weak	High	Low
1	U.S. Driven Market	Y	x		x		x		x	
2		Y	x		x		x			x
3	Dangerous Poverty	Y	x		x			x	x	
4		Y	x		x			x		x
5	Regional Markets	Y	x			x	x		x	
6	Peace and Prosperity	Y	x			x	x	x		x
7	Confused Priorities	Y	x			x		x	x	
8		Y	x			x				x
9		N		x			x		x	
10		Y		x	x		x			x
11		N		x	x			x	x	
12		N		x	x			x		x
13		Y		x		x	x		x	
14	Isolationist Dream	Y		x		x	x			x
15		Y		x		x		x	x	
16		Y		x		x		x		x

[1]Average weapon system R&D cycles in the defense industries are between 10 and 15 years. This planning horizon was chosen to take the analysis beyond consideration of products currently "in the pipeline."

[2]Named worlds are those chosen for analysis. They are selected to represent the plausible range of opportunities and constraints to be faced.

[3]Is the world plausible in the sense that the driver combinations make internally consistent and logical sense.

[4]Includes military, economic and diplomatic involvement.

[5]Is military power in the world "focused" on counteracting the "American preponderance" or is it more generally aimed at various local and regional threats.

Six Possible Market Settings for Thor

The U.S.-driven market is a strong and relatively traditional planning environment. Consensus is clear that military forces should be ready to respond to instability. Many world actors arm themselves for the specific purpose of containing U.S. power. The economy can support military spending, and the U.S. government is the principal buyer.

In this future, highly competitive trading blocs form in Europe, Asia, and North America. All three must cope with tensions and instability in the developing world as they compete for access to energy and resources. The rise of Third World power centers—most with their own arms industries—raises the risk that regional disputes could escalate. Nations of the developed world will need to command substantial forces if they intervene in local disputes.

Dangerous poverty produces a cost-conscious but security-minded world. Here, instability is high with much animosity directed at the United States. While a clear need exists for spending large sums on defense, an economy in long-term recession, facing unresolved deficits, makes marketing extremely challenging. This world is wrecked by unresolved economic issues that first surfaced in the early 1990s.

Continuing instability in Eastern Europe, disappointing progress in the European Community, continuing Japanese-American trade disputes, the U.S. deficit, and the collapse of the multilateral General Agreement on Trade and Tariffs (GATT) accords have produced a long-term global recession with accompanying political and economic instabilities. Nationalism and ideology, fed by poverty, create dangerous tensions in the developing world and the Middle East.

Regional markets is a scenario that offers a nontraditional but active defense market for U.S. suppliers. With instability high, a strong global market persists for armament. The focus of security threats is regional, and most aggressors and defenders can afford what they want. Since the United States may not be the principal buyer, securing a foothold in regional arms sales is probably critical to Thor's survival.

Although global tensions run high, this world is one in which the United States declines the role of policeman and concentrates on economic recovery. Trade and integration are now at the center of European interest. (Trade never left the center of Japanese interest.) International conflicts, and the resulting arms markets, tend to be regional. The local balance of power revolves around nationalism and the containment of expansionist regional powers with sporadic Great Power involvement.

Peace and prosperity is a world of low military priorities. National security is focused on economic vitality. Military conflicts are principally regional. The global economy is thriving because of growing trade and interdependence. The defense industry is depressed, and indications are it will stay that way for awhile. The global explosion of trade and productivity in Asia and Europe are matched by a new U.S. educational and economic rebirth. Although the world has turned away from using force as the key instrument of national policy, nationalism remains a force to be reckoned with in global politics. As a consequence of expanding economic growth, access to natural resources and environmental pollution fans increasing international hostility.

Confused priorities is a future in which the defense market is driven by a poorly performing economy in tandem with an unfocused set of defense priorities for maintaining regional stability. With no definitive enemy or issue, U.S. government defense spending vacillates widely. As a result, supplying regional markets becomes crucial to the stability of the defense industry.

The principal dilemma shaping this world is the inability of the U.S. government to make hard choices about national priorities. Plans are proposed to address global defense needs and to restructure the economy. But both plans suffer from competition for scarce resources as well as from indecisive, vacillating policies. Meanwhile, the global economy continues to grow, along with political tensions in the developing world over control of resources and containment of regional powers.

The isolationist's dream depicts a future with a political mandate to "avoid entangling alliances." Low instability, diffused global threats, and a strong economy bring about a defense market in which the U.S. government can afford what it wants—but it does not want much. This low-growth but stable and predictable U.S. niche market is concerned with maintaining a credible defense but is reluctant to buy material designed to project military force around the globe.

Many armament industries face having to move offshore to survive. Spending on arms drops after a near-total U.S. withdrawal from foreign defense commitments. These pullbacks are made possible in some cases by regional security agreements and in other cases by the local influence of regional powers. These savings fuel a long-term economic recovery substantially dependent on a North American Common Market. Although the United States remains an active global trading partner, it involves itself in world politics only where major economic issues are at stake. Challenges to U.S. interests that cannot be solved in trade forums go unanswered or require resolution by others.

Scenario Projections of Key Variables

Exhibit 2 charts the defense expenditure forecasts developed for each of the alternative worlds. Obviously, these worlds present sharply different defense business conditions. However, because Thor's working group considered each world to have plausible elements, the scenario process raised issues with serious implications for the company's longer-term planning and strategy.

C. Annotated scenario bibliography of some additional scenarios to illustrate a range of assumptions and approaches

C.1 *Sustainable Consumption of Food: A Framework for Analyzing Scenarios about Changes in Diets* Faye Duchin Department of Economics Rensselaer Polytechnic Institute, Journal of Industrial Ecology 99, Massachusetts Institute of Technology and Yale University, Volume 9, Number 1.2

The implicit hypothesis lying behind the scenarios are: ***Scenario 1)*** If the meat-based diets favored by today's affluent populations were replaced by a palatable, nutritious, plant-based diet, and if the latter rather than the former were emulated in the developing countries, it would be possible to feed a growing global population without substantial increases in either the cost of food or pressures on the environment. One example of these hypothetical dietary assumptions is the Mediterranean-type diet, and the simplest scenario would have all diets converging to a common one. This could be a good choice for an initial analysis at a relatively aggregated level of representation of crops and foods. One could also define distinct regional versions of plant-based diets that make the most intensive use of customary, locally available items and further disaggregate to distinguish the current and possible future diets of different categories of households in each region. By contrast, ***Scenario 2)*** a business-as-usual scenario would assume that regional average diets will remain basically unchanged from current patterns. It is unclear whether this scenario is feasible because the world population is growing and changes in the climate system increasingly affect the mixes and yields of crops in different regions. An analysis would have to be studied on a model framework used to describe the impact of climate change on agriculture and its ability to satisfy the demand for food. Another plausible scenario, ***Scenario 3)*** is that diets of growing segments of the populations of developing countries will shift toward the current diets of the affluent: more calories per capita and a larger share of calories from animal products and added fats and sweeteners. The physical feasibility of such scenarios for the future and their environmental and economic consequences has barely begun to be explored. ***Conclusion:*** It is conceivable that the American diet could be emulated in all parts of the world. Relative to that baseline, a global shift toward a Mediterranean-type or other plant-based diet could be expected to have a more favorable impact on the environment and on health. The upgrading of nutritionally deficient diets, though, especially in developing countries, could more than offset the environmentally beneficial impacts of adopting a plant-based diet in the rich countries. The outcomes will depend not only on dietary choices but also on changes in the current practices of the food production, processing, handling, and service sectors. Better understanding of the implications of these changes will facilitate the identification of specific agricultural, trade, or other policies that could promote effective dietary innovation and indicate the extent of changes that will be required.

C.2 Global Energy Scenarios to 2050 and beyond, Energy Data Centre, World Energy Council http://www.worldenergy.org/wec-geis/edc/scenario.asp

This set of scenarios is often referenced in other energy-environment research as more authoritative than others.

"…In Case A, energy efficiency improvements were strong. Case B was a Reference, or middle-of-the-road evolution (but not simply Business As Usual), to which a Modification - B1 - was added which reflected stronger growth in energy consumption in developing countries and poorer performance in the improvement of energy efficiency. Finally, Case C was Ecologically Driven, with policy makers and other actors in society succeeding in promoting energy efficiency, technology innovation and transfer, non-fossil fuel development, and the reduction of institutional barriers. Case C had the lowest energy consumption and greenhouse gas emissions trajectories of the three Cases.

"From 1993 the WEC worked with IIASA (International Institute of Applied Systems Analysis) to move from these three Cases or "families of scenarios" to six variants. Three variants were scenarios within the A family: A1 with its strong emphasis on oil and natural gas use; A2 which is coal-intensive (with implications for severe local and regional pollution, and high carbon emissions, unless major and costly efforts are taken to tackle these); and A3 which emphasizes the roles of natural gas, new renewables and nuclear in averting serious problems from emissions. Case B became the single Scenario B - a Middle Course. And Case C was divided into C1 with its emphasis on energy efficiency improvements, new renewables (especially solar in the longer run), but with nuclear power phased out by 2100 because unable to satisfy its critics; and C2 where nuclear power plays an expanding role. In Scenarios A3, C1 and C2 there is relatively rapid progress along technology learning curves."

The main features of the scenarios are shown in the tables below:

Table 1:
Summary of Cases for Global Energy Scenarios

	Case A High Growth	Case B Middle Course	Case C Ecologically Driven
World Population 2050 (10^9)	10.1	10.1	10.1
World economic growth 1990-2050	2.7%p.a.	2.2%p.a.	2.2%p.a.
World energy intensity improvement	medium	low	high
1990-2050	-1.0%p.a.	-0.7%p.a.	-1.4%p.a.
Primary energy demand (Gtoe) 2050	25	20	14
Resource availability			
Fossil	high	medium	low
Non-fossil	high	medium	high
Technology Costs			
Fossil	low	medium	high
Non-fossil	low	medium	low
Technology Dynamics			
Fossil	high	medium	medium

	Fossil	high	medium	medium
CO_2 emission constraint	Non-fossil	high	medium	yes
Carbon emissions (GtC) in 2050		9-15	10	5
Environmental taxes		no	no	yes

Table 2:
Projections of Global Primary Energy Consumption under Cases A, B & C

		(Gtoe)		
	1990	**2050**		
		A	**B**	**C**
OECD	4.2	6.7	5.6	3.0
Economies in Transition	1.7	3.7	2.4	1.7
Developing Countries	3.1	14.4	11.8	9.5
Total	**9.0**	**24.8**	**19.8**	**14.2**

Table 3:
Projections of the Composition of Global Primary Energy Supply and Carbon Emissions to 2050 for the Six Scenarios

		(Gtoe)					
	1990	**2050**					
		A1	**A2**	**A3**	**B**	**C1**	**C2**
Coal	2.2	3.8	7.8	2.2	4.1	1.5	1.5
Oil	3.1	7.9	4.8	4.3	4.0	2.7	2.6
Gas	1.7	4.7	5.5	7.9	4.5	3.9	3.3
Nuclear	0.5	2.9	1.1	2.8	2.7	0.5	1.8
Hydro	0.4	1.0	1.1	1.1	0.9	1.0	1.0
New Renewables	0.2	3.7	3.8	5.7	2.8	3.8	3.2
Traditional Biomass	0.9	0.8	0.7	0.8	0.8	0.8	0.8
Total	**9.0**	**24.8**	**24.8**	**24.8**	**19.8**	**14.2**	**14.2**

New World Energy Council Energy Scenarios to be completed by 2007 also by the World Energy Council will look to the year 2050 be based on updated assumptions about the main (http://www.worldenergy.org/wec-geis/wec_info/work_programme2007/studies/studies.asp) drivers of energy supply and demand, following earlier WEC work such as *Energy for Tomorrow's World* (1993) and *Global Energy Perspectives* (1998).

In most previous scenarios, the annual increments of energy consumption were increasing over time, at least up to 2050, and therefore giving birth to "concave" evolutions. However, "drivers" suggested that "convex" energy paths were plausible, but never negated the possibility of "concave" paths. In fact, many believe that the world will not face energy supply constraints that could prevent an exponential energy demand growth for a long time (http://www.worldenergy.org/wec-geis/publications/default/speeches/spc050628gd.pdf).

Energy drivers can be evaluated in three groups (http://www.worldenergy.org/wec-geis/publications/default/speeches/spc050519gd.asp):

The *GDP Driver*, which describes the demographic, institutional and technology feedbacks on GDP growth:

The *Energy Demand Driver*, which covers the nature and evolution of energy consumption in stationary, mobility and electricity services and how they impact the environment; and,

The *Energy Supply Driver*, which deals with the availability and cost of energy and their feedbacks on prices or the prospects for economic growth and energy demand.

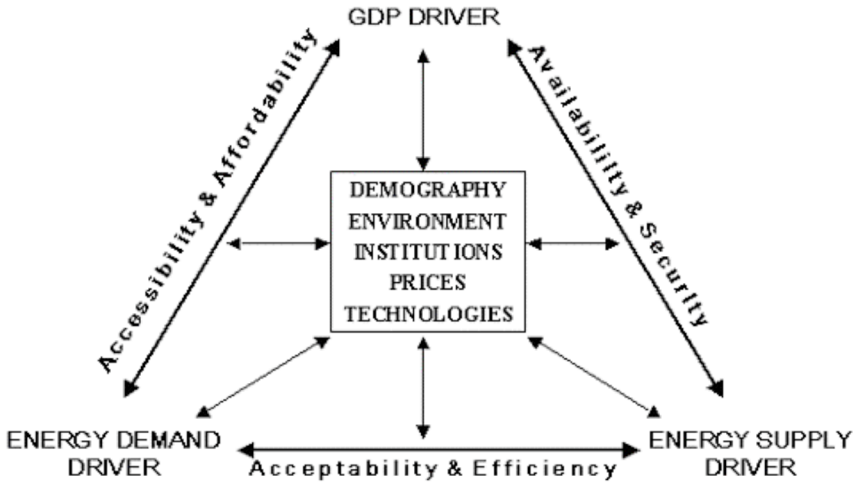
These energy drivers play a key role in achieving the WEC mission of sustainable energy development for the greatest benefit of all. Past trends demonstrate that:

energy accessibility is central to economic development, but improved access and reliability in developing countries seems to have slowed down or stopped in the last 30 years;

energy acceptability is linked to energy demand. Over time, demand tends to evolve towards cleaner and more sophisticated energy uses, thus driving primary supply in the direction of cleaner and more versatile fuels; and,

energy availability is the key for the first two drivers, because sustained energy supply shocks or crises hamper economic development and force societies to adapt to a more costly energy world.

The drivers, feedbacks and energy goals are interdependent and may be described using the simplified diagram which follows. There is no doubt that improved institutional capacity will foster economic growth, but it cannot prevent an economic crisis if energy prices skyrocket. New technology can result in the improved efficiency of energy services or an increased range of supply options, but it may be expensive and require the costly replacement of capital stock. In a similar way, new energy sources may be encouraged, but the full costs could be much greater than existing cheaper and abundant fuels. Last but not least, individual and collective behavior plays an important role, for example, by favoring energy-intensive uses such as sport utility vehicles, or by opposing the further development of specific energy sources based on public perceptions which may not be well-informed (such as nuclear power in some European countries).



C.3 *International Trade and the Doha Development Agenda.*

Authors: Michael Garrett, Ian Goldin, and Dani Redrik in collaboration with the World Economic Forum, January 29, 2003 http://worldbank.org

In this document, the authors set forth four possible scenarios for the WTO's Doha development agenda.

Best Case Scenario: "A successful agreement results in substantial multilateral tariff reductions. Agricultural export subsidies are sharply reduced and strong disciplines place on domestic market insulation and distorting market support. Textile and clothing quotas are eliminated.

Increased movement of service workers is allowed and trade and investment in services booms. Reform discourages anti-dumping measures and improves the functioning of the safeguard regime.

Developing countries obtain sufficient aid for trade and strengthen domestic institutions. Greater openness stimulates foreign and domestic investment. Success at the multilateral level reduces the emphasis on existing regional arrangements, and new regional structures act as building blocks to non-discriminatory liberalization. Greater market access reduces the risk of macroeconomic imbalances. World market integration, particularly in agricultural commodities, creates more stable prices. Negotiations on the new issues on the Doha agenda are well managed. There are no new disciplines that raise the cost of complying with rules without compensating benefits.

Reduced trade barriers stimulate domestic reform, leading to a substantial increase in world trade, particularly in developing countries.

With a 50% reduction in tariffs, the World Bank model suggests a real income gain for developing countries of US $83 billion or 1%, and an exports life of 14.6%. High income countries see a 0.3% real income gain of US $67 billion and a 2.8% increase in exports."

Baseline Scenario: "Modest multilateral tariff reforms are achieved including some progress in agriculture and textiles. However, developing countries see many import areas excluded. Resistance to agricultural reform limits reductions in domestic and export subsidies.

Limited progress is made in improving market access for services, but anti-dumping measures and safeguards increase as developing countries apply them unilaterally and retaliate against their imposition elsewhere. Aid for trade is only modestly successful with developing countries reluctant to offer strong or binding policy commitments.

Some progress on regional arrangements helps to reduce trade barriers, but inconsistency makes it difficult to use these arrangements as building blocks for further liberalization. Regional macroeconomic instability inhibits the acceptance of major liberalization.

With a 10% reduction in tariffs, the World Bank model suggests real income gains for developing countries of US$ 16 billion or 0.2%, with exports up by 2.5%. High income countries see a real income gain of US$ 14 billion or 0.1%, and a 0.5% increase in exports."

Worst-Case Scenario: "There are two worst-case scenarios involving either a poor outcome from the Doha negotiations or a collapse of the process.

A Poor Outcome: Negotiations are concluded, but developing countries sign on reluctantly and only after strong-arm tactics by the European Union and the US. Modest multilateral tariff reforms are achieved including some progress in agriculture and textiles. However, major agricultural exporters capture most gains with many developing countries reaping few returns.

Developing countries are forced to agree to new disciplines in investment, competition policy, government procurement and trade facilitation. The impact on growth, particularly of poor countries, is disappointing and the credibility of the WTO is eroded.

Doha Negotiations Collapse: There is wholesale backsliding in commitments to abolish quotas on textiles and clothing, reducing market access for developing countries and the credibility of the system. Anti-dumping, safeguards and product standards are used extensively to restrict imports.

Regional arrangements become inward-looking fortresses. Labour standards and environmental measures are used in blatantly protectionist fashion to reduce penetration by developing countries.

Macroeconomic imbalances reinforce the downward spiral in investment and trade. The integrity of the system is undermined and weaker countries become even more fragile in trade and other global engagements.

With a 20% increase in tariffs, the World Bank model suggests the real income of developing countries is reduced to US$ 32 billion or 0.4%, with exports down 4.6%. High income countries see real income down by US$ 27 billion or 0.l%, with exports down 0.9%.

Either scenario results in a reversal in real income and trade. These results highlight, but understate, the consequences of a breakdown in international cooperation."

C.4 *Three Scenarios of a Deregulated Energy Marketplace* Cambridge Energy Research Associates (CERA). March, 2004.

Will the deregulated energy landscape resemble a checkerboard or Silicon Nation? Or are we headed for a "service plus" approach to retail competition? These three scenarios are sketched by Cambridge Energy Research Associates in a report, "Customer Choice in the Information Age: North American Retail Energy Scenarios to 2015," cosponsored by Arthur Andersen and EDS.

"The struggle in the coming years will be over whether retail competition continues to evolve in a patchwork quilt fashion or whether financial forces, new technologies, e-business and other forces cause the industry to move even more rapidly to competitive markets," says Claire Behrens, CERA director of retail energy. She adds, "The question becomes whether the majority of customers are served under a regulatory framework that only supports the principles of competition or one that fosters practical competition."

The CERA report describes the three scenarios as follows: ***Scenario 1) Checkerboard:*** A long and uncertain transition to retail competition leads to massive utility industry consolidation into super-regional distribution companies. The regulatory rules governing the transition to competitive retail energy markets effectively inhibit "practical" energy competition from emerging for almost a decade. Most mass-market customers continue to be served under regulated utility company sales rates or default service rates for the majority of the period, with all customers getting choice only at the end of the period. ***Scenario 2) Service Plus:*** Low stock market prices relative to earnings pressure utility holding companies to exit the regulated merchant function. Their exit creates new growth opportunities in both unregulated retail energy sales and services for retail energy markets and new entrants that favor established, high-profile brands. These players bundle energy with other product and service offerings. All customers get choice by the middle of the scenario period, and by the end of the period, one-third of power customers and half of natural gas customers have switched providers. ***Scenario3) Silicon Nation:*** The development of e-commerce auction exchanges and portals, robust wholesale markets, and national standards for retail natural gas and electricity transactions pressures utilities to exit the regulated merchant function and provides customers with an opportunity to gain direct access quickly to wholesale markets through Internet portals and auctions. As a result, most customers have access to choice before 2010. Switching rates are high, with two-thirds of natural gas customers having switched by the end of the period and almost half of power customers exercising choice.

C.5 *The Pentagons Weather Nightmare: The Climate Could Change Radically and Fast. That Would be the Mother of all National Security Issues.* David Stipp, Fortune Magazine, February 9, 2004. This article is about a recent study on global warming commissioned by the Pentagon with consultant Monitor Group's Global Business Network.

There is growing evidence suggesting the ocean-atmosphere system that controls the world's climate can lurch from one state to another in less than a decade—"like a canoe that's gradually tilted until suddenly it flips over." Scientists don't know how close the system is to a critical threshold. But abrupt climate change may well occur in the not-too-distant future. If

it does, the need to rapidly adapt may overwhelm many societies--thereby upsetting the geopolitical balance of power." How will this world look in 2020? Or perhaps, 2010?

Scenario of the 21st Century: ***A National Security Nightmare.*** "A TOTAL SHUTDOWN of the ocean conveyor might lead to a big chill like the Younger Dryas, when icebergs appeared as far south as the coast of Portugal. Or the conveyor might only temporarily slow down, potentially causing an era like the "Little Ice Age," a time of hard winters, violent storms, and droughts between 1300 and 1850. That period's weather extremes caused horrific famines, but it was mild compared with the Younger Dryas. For planning purposes, it makes sense to focus on a midrange case of abrupt change. A century of cold, dry, windy weather across the Northern Hemisphere that suddenly came on 8,200 years ago fits the bill--its severity fell between that of the Younger Dryas and the Little Ice Age. The event is thought to have been triggered by a conveyor collapse after a time of rising temperatures not unlike today's global warming. Suppose it recurred, beginning in 2010. Here are some of the things that might happen by 2020:

At first the changes are easily mistaken for normal weather variation--allowing skeptics to dismiss them as a "blip" of little importance and leaving policymakers and the public paralyzed with uncertainty. But by 2020 there is little doubt that something drastic is happening. The average temperature has fallen by up to five degrees Fahrenheit in some regions of North America and Asia and up to six degrees in parts of Europe. (By comparison, the average temperature over the North Atlantic during the last ice age was ten to 15 degrees lower than it is today.) Massive droughts have begun in key agricultural regions. The average annual rainfall has dropped by nearly 30% in northern Europe, and its climate has become more like Siberia's. Violent storms are increasingly common as the conveyor becomes wobbly on its way to collapse. A particularly severe storm causes the ocean to break through levees in the Netherlands, making coastal cities such as the Hague unlivable. In California the delta island levees in the Sacramento River area are breached, disrupting the aqueduct system transporting water from north to south. Megadroughts afflict the U.S., especially in the southern states, along with winds that are 15% stronger on average than they are now, causing widespread dust storms and soil loss. The U.S. is better positioned to cope than most nations, however, thanks to its diverse growing climates, wealth, technology, and abundant resources. That has a downside, though: It magnifies the haves-vs.-have-nots gap and fosters bellicose finger-pointing at America. Turning inward, the U.S. effectively seeks to build a fortress around itself to preserve resources. Borders are strengthened to hold back starving immigrants from Mexico, South America, and the Caribbean islands--waves of boat people pose especially grim problems. Tension between the U.S. and Mexico rises as the U.S. reneges on a 1944 treaty that guarantees water flow from the Colorado River into Mexico. America is forced to meet its rising energy demand with options that are costly both economically and politically, including nuclear power and onerous Middle Eastern contracts. Yet it survives without catastrophic losses. Europe, hardest hit by its temperature drop, struggles to deal with immigrants from Scandinavia seeking warmer climes to the south. Southern Europe is beleaguered by refugees from hard-hit countries in Africa and elsewhere. But Western Europe's wealth helps buffer it from catastrophe. Australia's size and resources help it cope, as does its location--the conveyor shutdown mainly affects the Northern Hemisphere. Japan has fewer resources but is able to draw on its social cohesion to cope--its government is able to induce population-wide behavior changes to conserve resources. China's huge population and food demand make it particularly vulnerable. It is hit by increasingly unpredictable monsoon rains, which cause devastating floods in drought-denuded areas. Other parts of Asia and East Africa are similarly stressed. Much of Bangladesh becomes nearly uninhabitable

because of a rising sea level, which contaminates inland water supplies. Countries whose diversity already produces conflict, such as India and Indonesia, are hard-pressed to maintain internal order while coping with the unfolding changes. As the decade progresses, pressures to act become irresistible --history shows that whenever humans have faced a choice between starving or raiding, they raid. Imagine Eastern European countries, struggling to feed their populations, invading Russia--which is weakened by a population that is already in decline--for access to its minerals and energy supplies. Or picture Japan eyeing nearby Russian oil and gas reserves to power desalination plants and energy-intensive farming. Envision nuclear-armed Pakistan, India, and China skirmishing at their borders over refugees, access to shared rivers, and arable land. Or Spain and Portugal fighting over fishing rights--fisheries are disrupted around the world as water temperatures change, causing fish to migrate to new habitats. Growing tensions engender novel alliances. Canada joins fortress America in a North American bloc. (Alternatively, Canada may seek to keep its abundant hydropower for itself, straining its ties with the energy-hungry U.S.) North and South Korea align to create a technically savvy, nuclear-armed entity. Europe forms a truly unified bloc to curb its immigration problems and protect against aggressors. Russia, threatened by impoverished neighbors in dire straits, may join the European bloc. Nuclear arms proliferation is inevitable. Oil supplies are stretched thin as climate cooling drives up demand. Many countries seek to shore up their energy supplies with nuclear energy, accelerating nuclear proliferation. Japan, South Korea, and Germany develop nuclear-weapons capabilities, as do Iran, Egypt, and North Korea. Israel, China, India, and Pakistan also are poised to use the bomb. The changes relentlessly hammer the world's "carrying capacity"--the natural resources, social organizations, and economic networks that support the population. Technological progress and market forces, which have long helped boost Earth's carrying capacity, can do little to offset the crisis--it is too widespread and unfolds too fast. As the planet's carrying capacity shrinks, an ancient pattern reemerges: the eruption of desperate, all-out wars over food, water, and energy supplies. As Harvard archeologist Steven LeBlanc has noted, wars over resources were the norm until about three centuries ago. When such conflicts broke out, 25% of a population's adult males usually died. As abrupt climate change hits home, warfare may again come to define human life."

C.6. ***Striving to Have it all in Sustainable Rural Development*** Institute for Alternative Futures. Newsletter. June, 2004.

It is possible to develop rural areas in a way that brings economic prosperity, maintains social cohesion, and promotes environmental sustainability - all at the same time. But the social science research required to help reconcile these objectives must be interdisciplinary and must go beyond the boundaries of conventional rural studies. Topics that need to be dealt with range from environmental impacts of new technologies, migration, and changing land use patterns to impacts of ageing and growing diversity in the UK's population, to developments in global trade policy, food security, and "joined up" government. The research agenda for fostering sustainable rural development is large, but so are the potential benefits.

This insight emerges from a project on Rural Futures: Scoping SOcial Science Research Needs carried out by the Institute for Alternative Futures (IAF) and the Institute of Innovative Research (IiIR) at the University of Manchester. The project was commissioned by the UK's Economic and Social research Council (ESCR) to develop recommendations on priorities for long-term econojmic and social research.

Scenarios were used to stimulate creative thinking about research proorities. IAFs President, Clem Bezold, says "This approach enabled project participants to look at a wider "possibility space" of plausible futures conditions than they would have simply working from current conditions, outlooks and assumptions. The scenarios, adapted from the Countryside Agency's previous scenario study, State of the Countryside 2020, explored thee challenges presumed to be inherent in rural development: ***Scenario 1) Growing On:*** High economic growth at the expense of social cohesion and environmental sustainability. ***Scenario 2) Growing Together:*** Rapid growth done in a way that maintains social cohesion, but at the expense of environmental sustainability; ***Scenario 3) Green in Pieces:*** The countryside becomes more environmentally sustainable, but also more economically divided and socially fragmented. ***Scenario 4) Green Together:*** Economic growth, social cohesion, and enviornmental sustainability come together and prove mutually reinforcing.

C.7 Renewable Energy Scenario to 2040

European Renewable Energy Council (EREC)
http://www.erec-renewables.org/publications/scenario_2040.htm

According to EREC, renewable energies will dominate the world's energy supply system as there is simply no alternative to that. The question is rather: how fast can the transformation into a carbon-free energy supply system based on renewable energy sources happen?

An ambitious but realistic scenario was published by EREC and its member associations (EPIA, ESHA, ESTIF, EUBIA, EUREC Agency, EWEA, AEBIOM and EGEC). This briefing shows that a global share of renewable energy up to 50% of total primary energy consumption by 2040 is possible

This scenario that presents the possible evolutions of annual installations growth rates for the different renewable energy technologies has been made in reaction to the two most quoted existing scenarios: the IEA scenario and the Shell scenario, both being rather conservative and reluctant on the development of renewables. The present EREC scenario is based on experiences and cumulative knowledge from the different RE (Renewable Energy) association members of EREC.

Renewable sources of energy are in line with an overall strategy of sustainable development:

- increased security of energy supply
- clean technologies, locally available
- improving competitiveness of industries
- electrification of remote areas, especially in developing countries
- increasingly cost-effective

If combined with the improvement of energy efficiency and the rational use of energy, renewable energy can provide everything fossil fuels currently offer in terms of energy services: heating and cooling, electricity and transport fuels.

An Advanced International Policy (AIP) scenario developed by EREC and its member associations that makes the assumption that additional support measures to the existing ones are put into place and that therefore there are advanced cumulative growth rates for

renewables shows that renewable energy sources can contribute to total primary energy consumption of nearly 50% by 2040.

The contribution of Renewable Energy Sources (RES) to the world energy supply in 2040 – Projections in million tons of oil equivalent (Mtoe) - Advanced International Policy Scenario

	2001	2010	2020	2030	2040
World Primary Energy Consumption (IIASA)	10038.3	10549	11425	12352	13310
Biomass	1080	1313	1791	2483	3271
Large Hydro	222.7	266	309	341	358
Small Hydro	9.5	19	49	106	189
Wind	4.7	44	266	542	688
PV	0.2	2	24	221	784
Solar Thermal	4.1	15	66	244	480
Solar Thermal Electricity	0.1	0.4	3	16	68
Geothermal	43.2	86	186	333	493
Marine (tidal/wave/ocean)	0.05	0.1	0.4	3	20
TOTAL RES	1364.5	1745.5	2694.4	4289	6351
RES Contribution	**13.6%**	**16.6%**	**23.6%**	**34.7%**	**47.7%**

If the advanced cumulative growth rates as outlined in this briefing are reached, renewable energy sources will have a contribution to total primary energy consumption of nearly 50% by 2040.

The advanced international policies scenario will however only be realised if governments from all the world increase efforts in implementing necessary minimum policy measures in favour of further deployment of renewable energy technologies. This includes:

- the establishment of legally binding RES targets
- increase awareness of RES of decision-makers, politicians and general public
- emphasize the importance of RES in any development policy
- shift financial resources from International Financial institutions from conventional energy to renewables
- internalisation of social and environmental costs of polluting energy
- change of subsidies-policy from conventional to renewables
- increase direct public spending on research and development for renewables and energy efficiency
- the ratification and fulfillment of the Kyoto-Protocol commitments and additional commitments to climate protection have to be adopted

Scenario 2. The "Dynamic Current Policies" scenario (DCP) is also presented in the briefing and assumes less international cooperation in the field of RES than in the AIP scenario, but still ambitious policy measures on national level at least in the industrialized part of the world. Predictions lead in this case to 27% of global energy consumption to be supplied by renewable energy sources by 2040. This so-called "middle-course" scenario is more ambitious than a "business as usual" scenario would be.

C.8 The Future of Life, Edward O. Wilson, 2002, Random House.

(Note on author: Edward Wilson is author of two Pulitzer Prize winning books on science and conservation. Currently he is the Pellegrino University Research Professor and Honorary Curator in Entomology of the Museum of Comparative Zoology at Harvard. He lives in Lexington, MA)

The Future of Life: ***A Scenario:*** In The Future of Life, author Edward Wilson presents a scenario describing the ecological state of the world in 2100, if current trends continue. Wilson envisions a world supporting a global population of nine to ten billion that occupies all remaining habitable areas on the plant. The "techno-scientific" civilization of the wealthy and elite countries has resulted in populations that better fed and more educated than during the previous century. But the majority of the world population remains living in developing countries and remains poor. Although war is rare, tensions and conflicts exist between the elite countries and "resentful poor countries."
Generally, humanity is living longer; post-centarians are commonplace. Birthrates, however, have plummeted, particularly in the richest countries. Young people are recruited to these countries from the poor. The genetic homogenization of the world population has accelerated and individual biological races grow fainter as each generation passes.
By 2100, the natural world is considerably degraded. "Frontier forests are typically gone" as are most of the world's biodiversity "hotspots" and half of the plant and animals species. There is no Amazon, no Congo, no New Guinea wilderness; "coral reefs, rivers and other aquatic habitats are badly deteriorated." The few remaining wild habitats are closely guarded. "The fragmentary biodiversity that survived to 2100 has also become much more geographically simplified" thanks to easy migration of organisms. "To travel around the world along any chosen latitude is to encounter mostly the same small set of introduced birds, mammals, insects, and microbes." The human population understands, too late, "that Earth is a much poorer place than it was back in 2000, and will stay that way forever."
"Such is likely to be the world of 2100—if present trends continue."

C.9 *Sustainable Food and Farming in the Connecticut River Valley: A Vision*.

Author: Small Systems Company, 1995. http://www.smsys.com/pub/cisa/part4.htm

Note: Small Systems Company provides design, consulting, and production services in four general areas: 1) technology and enterprise, 2) environmental restoration and planning, 3) architecture and construction, and 4) community and business development). Small Systems Company created a series of scenarios on the topics of farming and sustainability. The scenarios are set in the year 2020.

Scenario 1: The Farm and Food Council is holding its regular monthly meeting. The Youth Farm Service Corps director reports that urban youth have enrolled for mandatory two year programs and one teen in the group indicates they are now "compost-certified." The Valley Farmland Trust reports it is purchasing 1400 developed acreage that will be returned to farmland and discusses the possibility of installing "bubbles" over land creating greenhouse so the growing season can be extended to year-round. The Grow Local campaign is reported a success.

Scenario 2: Sixty Minutes is doing a segment on the successs of the farming effort in the valley. Mike Wallace reports that food production in the area has doubled over the last 25 years thanks to two programs: the Grow Local campaign and teen education and training in farming. He also reports that this community has no jails; lawbreakers are put to work on local farms instead of in jails.

Scenario 3: The setting is an auction of the last premium space for farming and recreation in the area. The closing bid: 150 million dollars (US).

Scenario 4: Town Meeting is scheduled for tonight. On the agenda: a proposal to increase subsidies to farm workers. The proposal is expected to pass without any problems.

scenario 5: Malls no longer exist in the valley; they have been replaced by farms. Residents now predominately buy foods that are locally grown. Kids belong to very active 4-H clubs. The bike path gets lots of use; waking is a favorite mode of transportation. People are now more environmentally conscious.

SCENARIO 6: Grandparents describe the 20th century to their grandson. It was a time when people ate something called a hamburger, at a place called McDonald's, but McDonald's no longer exists; and when Styrofoam was heavily used and is still cluttering the landfills. Grandfather describes his involvement in setting up the clustered housing they now live in and Uncle Terry's work to rid the river of jet skis and other mechanized vehicles. The youth asks about taxes. Grandfather explains that there are no longer taxes.

scenario 7: At a gathering at a local restaurant, where, of course only locally grown food is served, participants are electronically communicating with farmers from all over the world. They are reporting that the area is importing substantially less food than it did 25 years ago and that most of the food in stores here is now locally grown. The farmers, sporting an average age of 35 years, are solvent, crops are stable and provide them with a good return. Organic farming has replaced chemical-intensive farming. Agriculture is taught in the schools; even the youngest understand the food and waste systems. Ninety-five percent of waste is composed.

Scenario themes: In the year 2020 - Composting and recycling are practiced diligently; resources are renewed; the "grow local/buy local" campaign has paid off; wisdom and expertise are routinely imparted via the Internet - advances in communications technology allow the exchange of ideas, advice and knowledge on an international level with "sister cities; financial support is provided through bank loans, barter, collectives, development corporations; first-time farmers receive the aid that was not available a quarter-century earlier; farmland is passed on through families, and continues to be used for agricultural purposes; farming no longer relies solely on petroleum and pesticides; advances in biotechnology have improved the quality quantity and shelf life of crops; genetic engineering has created disease- and pest-resistant livestock and crops; the growing season is extended, and we can grow fruits and vegetables that once flourished only in tropical climates; children are an integral part of the farming community; agriculture is incorporated in the curriculum in all grades; a career in farming has prestige; housing is clustered; there is a shift toward more human, family, community values; the extended family is once again a visible component of the community; the community is more self-sufficient.

C.10. *Our Posthuman Future, Consequences of the Biotechnology Revolution.*

Author: Francis Fukuyama, 2002, Farrar, Straus, and Giroux Pub.

Francis Fukuyama takes the position that "biotech will have profound and potentially terrible consequences for our political order and belief that human beings are equal by nature." Biotech's most significant threat, he states, is the possibility that it will alter human nature and thereby move us into a "posthuman" stage that will have "malign consequences for liberal democracy and the nature of politics itself." He argues for regulatory limits on biotech advances and believes such limits can be enforced by the global community.
Fukuyama puts forth a number for future scenarios for the next one or two generations:

"The ***first scenario*** has to do with new drugs. As a result of advances in neuropharmacology, psychologists discover that human personality is much more plastic than formerly believed…..But in the future, knowledge of genomics permits pharmaceutical companies to tailor drugs very specifically to the genetic profiles of individual patients and greatly minimise unintended side effects. Stolid people can become vivacious; introspective ones extroverted; you can adopt one personality on Wednesday and another for the weekend. There is no longer any excuse for anyone to be depressed or unhappy; even "normally" happy people can make themselves happier without worries of addiction, hangovers, or long-term brain damage.

"In the ***second scenario,*** advances in stem cell research allow scientists to regenerate virtually any tissue in the body, such that life expectancies are pushed well above 100 years. If you need a new heart or liver, you just grow one inside the chest cavity of a pig or cow; brain damage from Alzheimer's and stroke can be reversed. The only problem is that there are many subtle and some not-so-subtle aspects of human ageing that the biotech industry hasn't quite figured out how to fix: people grow mentally rigid and increasingly fixed in their views as they age, and try as they might, they can't make themselves sexually attractive to each other and continue to long for partners of reproductive age. Worst of all, they just refuse to get out of the way, not just of their children, but their grandchildren and great-grandchildren. On the other hand, so few people have children or any connection with traditional reproduction that it scarcely seems to matter.
"The social impact of ever increasing life expectancies will depend …..on the "evenness" of future life-prolonging advances.

The best scenario would be one in which technology simultaneously pushes back parallel ageing processes - for instance, by the discovery of a common molecular source of ageing in all somatic cells, and the delaying of this process throughout the body. Failure of the different parts would come at the same time…."The worst scenario would be one of highly uneven advance, in which, for example, we found ways to preserve bodily health but could not put off age-related mental deterioration. Stem cell research might yield ways to grow new body parts. But without a parallel cure for Alzheimer's, this wonderful new technology would do no more than allow more people to persist in vegetative states for years longer than is currently possible. "An explosion in the number of people in category two might be labeled the "national nursing home scenario", in which people routinely live to be 150 but spend the last 50 years in a state of childlike dependence on caretakers.

"In a ***third scenario***, the wealthy routinely screen embryos before implantation so as to optimise the kind of children they have. You can increasingly tell the social background of a young person by his or her looks and intelligence; if someone doesn't live up to social

expectations, he tends to blame bad genetic choices by his parents rather than himself. Human genes have been transferred to animals and even to plants, for research purposes and to produce new medical products; and animal genes have been added to certain embryos to increase their physical endurance or resistance to disease. Scientists have not dared to produce a full-scale chimera, half human and half ape, though they could; but young people begin to suspect that classmates who do much less well than they do are in fact genetically not fully human. Because, in fact, they aren't."

C.11 *North American Transportation Energy Futures Study – Long Term Scenarios to 2050.*

Office of Transportation Technologies Department of Energy, July 2002
www.ott.gov/future_highway.htnl

The North American Transportation Energy Futures Study outlines three long-term scenarios for the evolution of the North American transportation sector through the period 2000-2050. Based on three drivers – energy interdependence, environmental responsiveness and the pace of innovation – the scenarios are designed to estimate the energy, oil carbon and economic impacts of introducing alternative technology/fuels into the North American market over the next 50 years.

Scenario 1) Greening the Pump: "This is a world with a slow pace of innovation, full of energy interdependence and high environmental responsiveness. Fuels such as natural gas are preferred for the North American market while conventional, offshore and oil sands resources are extracted processed and used in incrementally cleaner and more efficient ways. Technology investment is mainly for the demonstration and deployment of off-the-shelf technologies. This focus on deployment and nearer term activities resulted in a very uneven pattern of investment along the innovation chain. The lack of commitment to longer-term planning and R&D in transportation left North American with limited pools of technologies from which to draw on."

Scenario 2) Rollin' On: "Full energy interdependence and a revolutionary pace of innovation with low environmental responsiveness have led to a North American transportation sector with a high reliance on fossil fuels. North Americans growing demand for passenger and freight transportation are met by a concerted effort of governments and industry. Rapid growth and capital stock turnover result in the new technologies being developed and deployed as rapidly as possible and North American energy sources tapped and delivered to market."

Scenario 3) Go Your Own Way: Rapid innovation, limited energy interdependence and high environmental responsiveness have led to regions in North America seeking their own solutions to the development of a sustainable energy system. Rapid innovation has produced a variety of fuel and vehicle choices; however, many of the individual country solutions are constrained by the slate of vehicles and drive trains produced by the U.S. who continues to be one of the major vehicle suppliers. This world sees the greatest strides in renewable energies, fuel cell technology and biofuels."

C.12 *Plotting Corporate Futures: Biotechnology Examines What Could Go Wrong.*

Author: Barnaby J. Feder. New York Times Business/Financial Section. June 24, 1999.

Montsanto invited Jeremy Rifkin and 13 members of the World Business Council to lead a scenario planning session about the future landscape of biotechnology to the year 2030. It increased awareness of the vital importance of challenging assumptions

Scenario One: Unheeded. **"**In the first scenario, none of the critics' warnings about health and environmental hazards prove warranted and biotechnology products gain widespread acceptance. It is not a happily-ever-after story for the companies, though, because success brings wide-ranging consequences and challenges. This scenario includes examples of the social and political impact of large numbers of people living past the age of 100. There are pressures to divert public spending and product development to the needs of the elderly. Some biotechnology products in this story become unprofitable because they become so widespread that they turn into low-margin commodities."

Scenario Two: Chaos Theory**.** "Complex systems can be changed radically by tiny disruptions that have dramatic ripple effects. This story turns on an event such as publication of a small research report attributing an environmental setback to genetically engineered crops. This in turn kicks off a string of public reactions leading to drastic regulations that stifle many biotechnology applications. A Presidential candidate who is courting environmentalists is cast as the leader of the anti-biotech charge. One plot twist to this story : the perceived threat to the environment is the result of faulty research. The lesson for the industry: the same science that serves you so well today can trip you up in the hands of critics."

Scenario Three: The Market Decides. **"**In the third story, which might be summarized as "thanks but no thanks," consumers and financial markets decide that most biotechnology applications simply are not as appealing as the alternatives. Insurers balk at liability risks and investors flee the industry's meager returns. Agricultural biotechnology markets shrink as farmers and consumers embrace organic food. Biotechnology becomes a tool to improve breeding techniques rather than to move genes among different species. At the same time, health care companies conclude there is limited profit in engineering new drugs and in harvesting organs for transplants in humans from genetically engineered animals. Instead, they use their expertise to analyze people's vulnerability to certain diseases and then reap profits from advising people how to avoid getting sick."

C.13 IEA-OECD: Energy to 2050: Scenarios for a Sustainable Future

IEA and OECD
http://www.iea.org/textbase/nppdf/free/2000/2050_2003.pdf

The International Energy Agency and the Organization for Economic Co-operation and Development published in 2003 an excellent study about energy scenarios for 2050 http://www.iea.org/textbase/nppdf/free/2000/2050_2003.pdf.

"Energy to 2050: Scenarios for a Sustainable Future" is a combined effort to review energy scenarios and propose new ones. The report compares international energy-related scenarios

like the famous Shell scenarios and the IPCC (Intergovernmental Panel on Climate Change) with other general scenarios like those produced by the Millennium Project of the American Council of the United Nations University. There are also some national scenarios considered, like those produced by Energy Technology Futures for Canada and by Energy Futures for the United Kingdom.

The report then produces three exploratory scenarios, namely: Clean But Not Sparkling, Dynamic But Careless and Bright Skies. Those exploratory scenarios were based on seven main factors or drivers, in descending order of importance: technology, environment, economic growth, population growth, globalization, structure of power and global security issues. Two major axis (technology and environment) are selected for plotting the scenarios in two dimensions, and in order to track the possible futures for both developed and developing countries.

Then, a normative scenario to 2050 is considered: the sustainable development (SD) vision scenario. This SD normative scenario is based on three particular drivers: climate change mitigation, energy security and diversification, and energy access. The SD scenario includes considerations about renewables, nuclear energy, hydrogen and carbon capture and storage. This study ends with some policy implications for moving towards the proposed SD vision scenario.

C.14 *The Environment in Geopolitical Relations.*

RAND Corporation, www.hf.caltech.edu/hf/scenarios/envgeo/envgeo.html
Authors: Ike Chang and Lloyd Dixon

In this scenario set in 2050, "a new paradigm of geopolitical relations emerges in which the environment acts as the basis of political, economic and military relations between rich and poor countries emerges in the 21st century. National leaders of rich countries couch their foreign policies in terms of environmental protection." Polluting countries are labeled environmental terrorists, prompting the use of power to enforce environmental regulations on a worldwide basis. "The rise of the UN EPA begins with the proliferation of international treaties, summits and other agreements among world leaders. Elaborate monitoring and enforcement protocols are adopted...with violating countries incurring punitive tariffs and threats of military action. The UN emerges as a supernational agency with jurisdictional powers above and beyond those of secular governments characterized by the 19th and 20th centuries. Economically, the greatest benefactors of the new regime are the middle-tier countries of South America
, East Asia and Eastern Europe, which by 2150 achieve a level of economic prosperity and environmental sustainability comparable to that in North America and Western Europe.

C.15 Reappraising the Future – Scenarios for 2012, Accenture.

http://www.accenture.com/xd/xd.asp?it=enweb&xd=ideas\wef\wef_scenarios.xml

Accenture, a consultancy to businesses worldwide, has developed four scenarios related to the future of globalization and its potential implications for businesses. The scenarios, presented below, are set in the year 2012.

1. Common Ground: "In this relatively stable and integrated world, tensions between different countries and different social groups are increasingly resolved by collaboration and negotiation. Economic growth is relatively slow but steady, and wealth is shared more equally within and between countries. Business is better connected with the rest of society. Most people are more secure and better off, and there is greater tolerance of diversity. But in richer countries in particular, concerns are growing about the high costs of this stability, which include rising inflation, high taxation, and excessive bureaucracy.

Business implications: Global supply chains tailored for local partnering; low cost of capital; new mass consumer groups in emerging markets; emphasis on co-regulation; common international standards and platforms; ethical consumers highly profitable; corporate focus on connecting with society."

2. Survival of the Fittest: "Free markets have spread to many countries. Regulation and taxation are light and competition is fierce, forcing firms to be efficient and dynamic. Rewards are high for those who do well and many people are better off, but life is hard for those who do not succeed. Inequalities within and between countries continue to widen. The influence of the United States in business and in international security has grown stronger as other countries focus on more internal matters. While the world is in many ways quite stable, resentment of the influence of 'big business' and the perceived dominance of US culture sometimes spills over into hostility and violence.

Business implications: High levels of M&A activity; trade and investment liberalization; supply chains truly global; volatile financial markets; high levels of foreign investment; increasing wealth, but inequalities; move to self-regulation; low cost of capital."

3. Tempestuous Times: "Economic integration and liberalization have continued but at the cost of greater tension as social and economic divides have widened sharply. Effective dialogue between governments, business and the rest of society has ceased. A few people have become more prosperous but many have been left behind. Global corporations take over many services previously provided by governments. Instability has grown and erupted into violence and conflict in many countries, and security has become the prime concern of both business and individuals.

Business implications: Focus on short-run returns; tight global supply chains; devastating customer boycotts of certain brands; minimal government regulation and taxation; conflicting standards and platforms; cost of capital increasing; high expenditure on security; backlash against certain new technologies."

4. Worlds Apart: Driven by political and economic insecurities, countries have withdrawn into themselves. They still co-operate in a limited way, particularly on a regional basis, but make little attempt to address global problems. There have been sharp increases in protectionism and a partial reversal of market reforms in many countries. Countries with large internal markets have coped reasonably well with isolation and some groups have found cause for cautious celebration in this new world. But overall, economic growth has been slow and uneven and living standards for many people, especially among the world's poorest, have fallen sharply.

Business implications: Local supply chains and local markets; high cost of capital; skills shortages in key sectors; fragmented infrastructure and standards; import substitution; multinationals focus on localizing their products; government intervention high."

Will we Still Eat Meat?
Author: Ed Ayers, Time Magazine. November, 1999. Special Issue on the 21st Century.

Article discusses a scenario of how humanity 'awakens' to problems of the unnecessary mass production of animal flesh and what it is doing to health – and the planet's. It foresees a huge global shift in food habits from one in which the developing world today consumes more meat in rising out of poverty to realizing the environmental and social costs of this habit.
Imagining the future of meat: "The developing world leads the charge in conserving freshwater and other scarce resources through production of creative meat-less foods indigenous to cultures. India, China, North Africa, and the US continue to run freshwater deficits, and are, for that reason, at the forefront of new policies of sustainability. Protein sources supplement with a wide variety of vegetables in the average diet. Mankind begins to move down the food chain; eating foods that take less water and land, and that pollute far less, than cows and pigs. In the long run, some theorists believe, society can lose its memory of eating animals and discover the intrinsic satisfactions of a diverse plant-based diet, as millions of people already have. However, this world doesn't spell the end of meat eating. Decades from now, cattle will still be raised, perhaps in patches of natural rangeland, for people inclined to eat and able to afford a porterhouse, while others will make exceptions in ceremonial meals on special days like Thanksgiving, which link us ritually to our evolutionary and cultural past. But the era of mass-produced animal flesh, and its unsustainable costs to human and environmental health, is forecast by the authors to be over before the next century is out."

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