

WORLDWIDE EMERGING ENVIRONMENTAL ISSUES AFFECTING THE U.S. MILITARY
Contract No: DAAD19-02-D-0001/ Delivery Order 0456 with Battelle Columbus Operations for the U.S. Army
Environmental Policy Institute

MARCH 2007 REPORT

Note to Readers: Pages 1-14 comprise the summary and analysis of this report. Expanded details for some items are in the Appendix beginning on page 15.

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Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE MAR 2007		2. REPORT TYPE		3. DATES COVERED 00-00-2007 to 00-00-2007	
4. TITLE AND SUBTITLE Worldwide Emerging Environmental Issues Affecting the U.S. Military. March 2007				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) The Millennium Project ,4421 Garrison Street, N.W. ,Washington,DC,20016-4055				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 30	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Item 1. China to Pass U.S. in CO₂ Emissions this Year Making U.S. and China Target for Changing Climate Change Policies

A strategic focus on just the U.S. and China is the most efficient use of environmental lobbying power, said Dr. Jessica Matthews, President, Carnegie Endowment for International Peace, at a recent session at the Woodrow Wilson International Center for Scholars' Environment and Security Program. The magnitude of changes necessary to affect the growth of greenhouse gas emissions will require the leadership of the top two emitters. Without them, she argued, the changes in other countries are of insufficient significance. China may pass the U.S. in annual CO₂ emissions before the end of 2007.

Military Implications:

If a strategic partnership between the U.S. and China could be created to provide world leadership on climate change policy, then what role should their militaries play in such cooperation? This question should be put to relevant policy personnel, in order to be prepared for such an eventuality.

Sources:

Looking Forward: Sustaining the Earth and Humanity—Implications for the New UN Secretary-General
http://www.wilsoncenter.org/index.cfm?topic_id=1411&fuseaction=topics.event_summary&event_id=218883
China seen topping U.S. carbon emissions in 2007
<http://www.alertnet.org/thenews/newsdesk/L22726612.htm>

Item 2. International Polar Year 2007-2008

The International Polar Year, the largest polar research program for 50 years, officially started on 1 March 2007 and will involve thousands of scientists, from more than 60 countries, working on 220 projects focused on the Arctic and Antarctic regions. Its purpose is to enhance the understanding of physical, biological and social processes of those regions, and Earth's climate and ecosystems. The outcomes are expected to improve assessments and forecasts, and eventually generate recommendations for further research and policies. In 2009, after the IPY ends, ESA will launch the Cryosat 2 spacecraft to continue monitoring the Polar Regions mainly for changes in the thickness of the polar ice sheets and floating sea ice.

Military Implications:

In view of the increasing importance of the Arctic in military planning and the oil reserves that will eventually be accessible due to climate change in the Arctic, overlapping national boundaries of the U.S., Russia, Norway, Denmark, and Canada, appropriate military personnel should liaise with the body of IPY researchers to exchange information and ideas. They should focus especially on the environmental impact of military operations in the polar regions and to be updated on such developments as new scientific discoveries, long-range oil issues, and possible emerging new policies.

Sources:

ESA contribution to International Polar Year 2007-2008
http://www.esa.int/esaCP/SEMG1DN0LYE_Protecting_0.html
U.S. Launches International Polar Year on Feb. 26
http://www.nsf.gov/news/news_summ.jsp?cntn_id=108408

Huge polar study ready to begin

<http://news.bbc.co.uk/2/hi/science/nature/6389857.stm>

Item 3. New Research Finds Human Energy Usage is a Long-Term Heating Problem Independent of Greenhouse Gases and Solar Radiation

In addition to greenhouse gases and rises in solar radiation, the planet could continue to be warmed by the increasing number of people who are using ever larger amounts of energy that add heat from their use (combustion engines, nuclear reactors, etc.). In a briefing by Professor Eric Chaisson of Tufts University to the Foundation for the Future this month [March 2007], he demonstrated that human energy use will continue to warm the planet: 1) *If global non-renewable energy use continues increasing at its current rate of ~2% annually and nothing else changes, then a 3 degree Celsius rise will occur in ~8 doubling times, or ~280 years (or ~350 years for a 10 degree Celsius rise); and 2) More realistically, if world population plateaus at 10 billion inhabitants by 2100, developed (OECD) countries increase non-renewable energy use at 1% annually, and developing (non-OECD) countries do so at ~5% annually until east-west energy equity is achieved in mid-22nd century after which they too continue generating more energy at 1% annually, then a 3 degree Celsius rise will occur in ~300 years, or 10 degrees Celsius in ~450 years.* Hence, it is necessary to find energy sources, such as geothermal, tidal, wind, and photovoltaics that, unlike fossil or nuclear sources, do not add heat as they convert energy for human usage.

Military implications:

Long range military R&D should find and explore ways to use energy sources and applications that generate little heat.

Source:

Energy, Ethics, and the Far Future DRAFT #2 by Eric J. Chaisson (see [Appendix](#) for full text)

Item 4. Marine Environment Needs More Protection

4.1 New Marine Protected Areas Proposed

New proposals aim to protect critical marine ecosystems and whale and dolphin habitats in several Mediterranean Sea areas and the Black Sea from excessive fishing, intense shipping traffic, and maritime pollution. The proposed areas include (see map in the [Appendix](#)): the entire Alborán Sea and Straits of Gibraltar; the Strait of Sicily; the Amvrakikos Gulf (NW Greece); two Black Sea areas; and seven other Mediterranean areas—5 in Greece, 2 in Italy. The proposals will be put forward to the 20-country parties Agreement on the Conservation of the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS) by its Scientific Committee at the Meeting of the Parties to be held in Croatia, in October. Meanwhile, the Spanish Navy has asked ships to slow to 15 knots and sail "in a maximum state of vigilance" to avoid colliding with whales in the Strait of Gibraltar. [Note: *The state of World Fisheries and Aquaculture 2006* report released this month by FAO warns that several species of fish in high seas outside of national jurisdictions are in danger.] The World Wildlife Fund (WWF) launched a campaign for creating a network of conservation areas in the Southern Ocean by 2012, to protect it against unsustainable fishing, marine pollution, and effects of climate change. WWF will put forward the Southern Ocean protection proposal at the next Antarctic Treaty Consultative meeting, to be held from 30 April to 11 May 2007 in New

Delhi, India. [Note: see item 8.3 *Website for Marine Protected Areas and Cetaceans' Sanctuaries* further in this report]

Military Implications:

The military should study the proposals' impact on its activities in the respective areas and be prepared to comply with possible new restrictions.

Sources:

Whale Protections Proposed for Strait of Gibraltar

<http://www.ens-newswire.com/ens/mar2007/2007-03-05-02.asp>

Urgent protection proposed for whale and dolphin habitats in the Mediterranean and Black Seas

http://www.cetaceanhabitat.org/view_all_news.php#

The state of World Fisheries and Aquaculture 2006

<http://www.fao.org/docrep/009/A0699e/A0699e00.htm>

Slow Down and Watch Out for Whales, Spain Tells Ships in Strait of Gibraltar

<http://www.enn.com/today.html?id=12286>

WWF launches marine protection campaign in the Southern Ocean

http://www.panda.org/news_facts/newsroom/index.cfm?uNewsID=95080

4.2 Malacca Straits Need Increased Protection from Various Security Threats

The Malacca Strait, one of the most important shipping lanes in the world, faces many challenges, including piracy, terrorists' attacks and environmental degradation. If terrorists were to sink a ship at the shallowest part of the strait, no ship could pass through, and all traffic would be blocked. At the same time, increased traffic volumes add pressures to the ecosystem of the straits. In an address jointly hosted by the embassy of Malaysia and the Institute of Foreign Affairs and National Security, the Hon Dato' Sri Najib Tun Abdul Razak, Deputy Prime Minister of Malaysia, urged the need for united efforts by all users of the straits to address these challenges.

Military Implication:

Relevant military personnel should liaise with counterparts in the region and explore opportunities for collaboration in both counter-piracy/terrorism measures and environmental protection and cleanup.

Source:

Malacca, Asia's Most Important Sea Lane

<http://theseoultimes.com/ST/?url=/ST/db/read.php?idx=4957>

Item 5. Argentina Redeploys Military to Defend Water and Oil

The Argentine government is changing its military strategy based on the forecast that conflicts over water and oil are the most likely long-term national security threats. The most vulnerable area is the Guarani aquifer that neighbors Uruguay, Brazil, and Paraguay. The Army "Plan 2025" was launched last year and includes parceling the country into regions based on their resource potential—mainly oil and fresh water. "Each division will be based in the geographical areas where the natural resources that we hypothetically must defend are located," Argentine Army Commander-in-Chief Roberto Bendini said in revealing the plan.

Military Implications:

In addition to recognizing the increased role natural resources are playing in possible conflicts, Argentina's "Plan 2025" might establish new protected or controlled areas that are important for planning future international actions in Argentina.

Sources:

Argentina's New War Doctrine for Resources

<http://visionesalternativas.com/article.asp?ID=%7bA7C2A077-ED2E-4B52-B75B-AEAE8AA0713F%7d%29&language=EN> (by subscription only; full text in the [Appendix](#))

The Ugly American Environmentalist

<http://www.time.com/time/world/article/0,8599,1595221,00.html>

Eco-millionaire's land grab prompts fury

<http://www.guardian.co.uk/argentina/story/0,,2005494,00.html>

Item 6. Technological Breakthroughs with Environmental Security Implications**6.1 Portable Mass Spectrometer and Gas Chromatograph**

Researchers at Brigham Young University in Utah have developed a portable mass spectrometer and gas chromatograph for detecting biological and chemical agents. This easy to use and portable instrument can analyze a sample and—based on an internal library of known chemicals and biological agents—identify the material and the level of danger. The researchers intend to create a palm-sized version of the device.

Military Implications:

Such testing units would be indispensable to military, local authorities, and civilian companies in conflict and post-conflict areas, or regions under threat. The military should consider following and supporting the research and have the instruments available as soon as possible for its own use and distribution to other organizations in affected regions.

Source:

BYU Scientists Create Portable Spectrometer

<http://newsnet.byu.edu/story.cfm/63705>

6.2 FAO/IAEA Meeting Discusses Portable Disease Detection Devices

A five-day meeting in Verona, Italy discussed new mobile rapid disease detection technology that experts say could revolutionize the fight against bird flu and many other livestock disorders. One of the topics at the conference, sponsored by the Joint FAO/IAEA Programme, a Vienna-based partnership between FAO and the International Atomic Energy Agency, was a \$1,000 mobile test system and reader the size of a small portable television. Further work is in progress to reduce it to what researchers call a "laboratory in a pen".

Military Implications:

Relevant military personnel should contact the FAO/IAEA Programme and obtain information on the techniques and devices presented at the meeting, so that they can be evaluated for possible use in environmental surveillance systems for human and animal disease detection.

Source:

Portable lab could revolutionize bird flu detection

<http://www.fao.org/newsroom/en/news/2007/1000517/index.html>

6.3 Photonic Crystal Provides 50% Cost Reduction

StarSolar, in Cambridge MA, has developed a technology which allows a solar cell to produce the same amount of electricity with much less silicon, thereby cutting the cost of the energy by up to half, according to the developing organization, a licensee of MIT. The technique uses a so-called photonic crystal to reflect the incident light in such a way that more of it reaches the silicon layer, which can therefore be thinner.

Military Implications:

The military should investigate this development for its possible use in energy-saving systems for military applications.

Source:

Cheaper, More Efficient Solar Cells

<http://www.technologyreview.com/Energy/18415/>

6.4 Refrigerator Temperature Sensor Mod Saves Energy

The UK firm eCube Distribution Ltd., of Ilford, Essex, is marketing a device that modifies the operation of a refrigerator's temperature sensor in a way that may significantly reduce the unit's energy consumption. It consists of a wax sleeve that fits around the sensor and which has the thermal characteristics of a solid like food. An unmodified refrigerator senses the temperature of the air in the unit, rather than that of the contained food. When the door is opened, the temperature of the air rises rapidly, often triggering the cooling element to start, even though that of the food remains unchanged. The modified sensor causes cooling to be activated only when the temperature of the actual contents exceeds the preset limit. In a test in a hotel, where the doors are frequently opened and closed, the device reduced energy consumption by 30%.

Military Implications:

The military should investigate whether and where this device could be installed to reduce energy consumption.

Source:

£25 fridge gadget that could slash greenhouse emissions

<http://environment.guardian.co.uk/climatechange/story/0,,2036183,00.html>

Item 7. Updates on Previously Identified Issues**7.1 UN StEP Initiative for Reducing E-Waste**

Solving the E-waste Problem (StEP) is a global public-private initiative coordinated by the United Nations University with the overall aim of improving e-waste management by creating global standards for e-scrap and recycling. The partnership includes various UN organizations, major high-tech manufacturers, and governmental, NGO and academic institutions, along with recycling/refurbishing companies. Five task forces will help shape new e-waste standards: Policy & legislation (assessment of current e-waste policies and recommendations for future strategies);

ReDesign (improve electronics design for better reuse, repair, refurbishment and recycling); ReUse (development of a global reuse system to minimize environmental impacts) ReCycle (develop sustainable e-waste recycling systems); and Capacity building (globally accessible documentation on e-waste). The initiative was officially launched on March 7. [See also *UN E-Waste Forum and Basel Convention's Conference of Parties* in December 2006, *Toxic Waste Disposal of Global Growing Concern* in September 2006, *WEEE Comes into Effect* in August 2005, and other related items in previous environmental security reports.]

Military Implications:

Relevant military personnel should follow the StEP developments to identify opportunities for international cooperation and to better anticipate potential new directives. This applies particularly to the Defense Reutilization and Marketing system, which sells and disposes of “excessed” electronic materiel for all Services.

Sources:

<http://www.step-initiative.org/index.php>

Formal Launch of StEP 2007-03-06

<http://www.step-initiative.org/news.php?id=63>

7.2 Progress Made on Banning Cluster Bombs

At the Conference on Cluster Munitions held last month [February 2007] in Oslo, 46 states and several international organizations decided to develop, by 2008, a legally binding international instrument to ban the use, production, transfer, and stockpiling of cluster munitions, as well as to create a framework for dealing with the consequence of cluster munitions' use in the affected areas. Environmental damage and civil casualties are the highest concern for banning cluster bombs. Next meetings are planned for May/June in Lima, November/December in Vienna and early 2008 in Dublin. Last year Belgium has become the first country to ban cluster bombs, and this month [March 2007] the Belgian Senate passed legislation that criminalizes investment in companies that make cluster munitions. The Belgian Parliament plans to publish a list of companies that manufacture such munitions. Austria announced a moratorium on the use, production, or trade of cluster munitions. Canada promised to destroy its stockpile of cluster munitions. The U.S. Democrats recently introduced a bill in the U.S. Senate proposing to “restrict federal funds for the use, sale or transfer of cluster bombs.” Presently there are 34 countries producing cluster munitions and about 75 countries that stockpile them. [See also related item *CCW Protocol V on Explosive Remnants of War Entered into Force* in November 2006, *NGOs Launch Campaign to Ban Cluster Bombs* in November 2003, and *Draft Protocol on Cluster Bombs Cleanup Liability* in June 2003 environmental security reports.]

Military Implications:

The military should be prepared for possible requirements to phase out cluster munition use and to intensify efforts for helping other countries and regions do the same and/or deal with the after effects.

Sources:

Oslo Conference on Cluster Munitions, 22-23 February 2007

<http://www.regjeringen.no/en/ministries/ud/Selected-topics/Humanitarian-efforts/The-Norwegian-Governments-initiative-for/conference.html?id=449312&epslanguage=EN-GB>

Declaration - Oslo Conference on Cluster Munitions, 22 - 23 February 2007

<http://www.norway.org.et/policy/cluster/Declaration+on+Cluster+Munitions.htm>

Cluster Munitions: Statement to the Canadian Standing Committee on Foreign Affairs and International Development (by Steve Goose co-chair of the Cluster Munition Coalition)

<http://hrw.org/english/docs/2007/03/01/canada15442.htm>

Belgium criminalizes investment in cluster bomb manufacturers

<http://jurist.law.pitt.edu/paperchase/2007/03/belgium-criminalizes-investment-in.php>

Cluster Munitions Civilian Protection Act of 2007 (Introduced in Senate) S 594 IS

<http://thomas.loc.gov/cgi-bin/query/z?c110:S.594:>

7.3 New Energy and Climate Change Policies

7.3.1 Britain to Push on Adding Climate Change to Security Council Agenda

Britain intends to put climate change on the UN Security Council agenda in April—when it assumes the presidency. The intention is to stress that climate change is a matter of international security—from disputes over diminishing natural resources to mass migrations that could exacerbate conflicts. AIDS was similarly put on the Security Council agenda in 2001 and had positive results. Britain began lobbying the other 14 Security Council member states but seems to meet resistance from countries such as the U.S., China, and South Africa.

7.3.2 EU Energy and Climate Change Policy

The European Council adopted its new Energy Policy to reduce CO₂ emissions by 20% of 1990 levels by 2020—a target that could rise to 30% if the U.S., China, and other economic powers agreed to comparable reductions; and by 2020 to have 20% if its energy from renewable sources and 10% of its transport fuel be biofuels. The EU Conference of Presidents decided on March 15 to set up a temporary committee on climate change to provide clear information and suggest strategies to address the issue.

On March 28, the Commission unveiled its “green taxes” strategy that suggests splitting the EU-wide minimum excise duties into an energy tax and an environmental tax to reflect products’ impact on the environment and encourage environmentally friendly goods. [See also *EU Plans Tougher CO₂ Emissions Cuts* in February 2007, and *New European Energy Policy Developments* in March 2006 environmental security reports.]

Britain’s draft Climate Change Bill is pushing for a drastic emissions’ reduction policy and could make the country the first to limit greenhouse gases by law. The proposal—to become law next year if it passes public and parliamentary consultation—stipulates that an independent panel should set a “carbon budget” every five years, with the goal to cut CO₂ emissions by 60% by 2050, from 1990 levels, and between 26% and 32% by 2020. Governments that miss the set target could be held liable.

7.3.3 U.S. Created Committee to Address Climate Change and Energy Security Issues

The U.S. Congress created a 15-member Select Committee on Energy Independence and Global Warming to provide information and advice on the best policies to address America’s energy security and climate-change issues. “Energy independence and climate change are issues of national security and national urgency,” said House Speaker Nancy Pelosi (D-Calif.) announcing the creation of the committee. [Note: A nationwide poll conducted for the Yale Center for Environmental Law and Policy revealed that 63% of Americans agree that the U.S. “is in as much danger from environmental hazards, such as air pollution and global warming, as it is from terrorists” and 81% of Americans are ready to take action personally in response to climate change.]

7.3.4 Post-Kyoto Negotiations

EU environment minister Stavros Dimas wants to increase European efforts to help advancing international post-Kyoto negotiations for limiting the world's greenhouse gas emissions. The most important next steps are the June G8 meeting in Germany and the December conference in Bali, Indonesia, where world environment ministers should agree on a mandate to start negotiations for a post-Kyoto Protocol. Denmark offered to hold a UN climate summit in December 2009, when—it hopes—a new global climate deal will be launched.

7.3.5 Sustainable Development Strategies

The Intergovernmental Preparatory Meeting for the 15th session of the Commission on Sustainable Development (CSD-15) took place February 26-March 2, 2007 and discussed policy options and possible actions related to four thematic areas: energy, industrial development, air pollution/atmosphere, and climate change in the context of sustainable development, as well as the situation of small island developing states (SIDS), and inter-linkages and cross-cutting issues in the framework of the thematic areas. The draft Chair's "negotiating document" that will be transmitted directly to CSD-15 has six sections, covering the four thematic areas, inter-linkages and crosscutting issues, and review and follow up. The 15th session of the CSD will be held April 30-May 11, 2007, in New York. Climate change also topped the agenda of the G-8 meeting held in Potsdam, Germany, March 16-17. The meeting, attended by environmental ministers of the G-8 countries plus China, India, Brazil, Mexico and South Africa, aimed to prepare for the G8 summit to be held in June, in Heiligendamm and the discussions for the December Climate Change Conference. Although consensus was reached on the need to protect the world's environment, consensus was not yet achieved on either post-Kyoto strategies nor on a global carbon emissions trading scheme like the one used in the EU.

Military Implications:

The military should follow the developments of these proposals that might result in new environmental regulations and new standards policies, and consequently emerging strategies, to ensure that military activities comply with the new requirements.

Sources: (see a more expanded list in the [Appendix](#))

Britain puts climate change on UN agenda

http://www.timesonline.co.uk/tol/news/world/us_and_americas/article1485323.ece

European Council conclusions

http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/93135.pdf

Parliament sets up Climate Change Committee

<http://www.euractiv.com/en/climate-change/parliament-sets-climate-change-committee/article-162509>

EU to use green tax in fight against climate change

<http://euobserver.com/9/23802/?rk=1>

'Binding' carbon targets proposed

http://news.bbc.co.uk/2/hi/uk_news/politics/6444145.stm

Pelosi Announces Members of Select Committee on Energy Independence and Global Warming

<http://speaker.gov/newsroom/pressreleases?id=0091>

Environmental Poll: March 2007

<http://www.yale.edu/envirocenter/environmentalpoll.htm>

Intergovernmental Preparatory Meeting (26 Feb - 2 Mar 2007)

http://www.un.org/esa/sustdev/csd/csd15/csd15_ipm.htm

7.4 International Early Warning Programme to Begin Operations

The First Advisory Group Meeting of the International Early Warning Programme (IEWP) was held March 26-27, at the UN Campus in Bonn, Germany. Relevant representatives from 20 specialized UN agencies attended the meeting to set a framework for the program's operations, discussing the best strategies to help mitigate the impact of natural disasters—from earthquakes, tsunamis and hurricanes to floods and wildfires—and to decide how the early warning system could be implemented worldwide. The outcomes of the meeting were not yet available at the time of this writing. [See also *Tsunami Warning and Mitigation System in the Indian Ocean* in December 2005, and other related items in previous environmental security reports.]

Military Implications:

Relevant military personnel should review the Strategic Plan of the International Early Warning Programme (IEWP) and the outcomes of the First Advisory Group Meeting to find implications for military cooperation. Military logistics personnel should consider making recommendations for national preparedness plans and eventually update previous military plans to support disaster responses.

Sources:

International Strategy for Disaster Reduction. Platform for the Promotion of Early Warning
<http://www.unisdr.org/ppew/>

The International Early Warning Programme (IEWP) Strategic Plan
[http://www.unisdr.org/ppew/iewp/pdf/IEWP\(I\)-7.pdf](http://www.unisdr.org/ppew/iewp/pdf/IEWP(I)-7.pdf)

Pushing ahead with global disaster early-warning system, UN convenes experts meeting
<http://www.un.org/apps/news/story.asp?NewsID=22010&Cr=disaster&Cr1=>

First Advisory Group Meeting, 26-27 March 2007, Bonn, Germany
<http://www.unisdr.org/ppew/iewp/meetings.htm>

7.5 China Calls for Enhanced Cooperation on Environmental Protection in Northeast Asia

At the Opening of the 12th Senior Officials Meeting of the North-East Asia Sub-regional Program for Environmental Cooperation, Cui Tiankai, Assistant Foreign Minister of China, said environmental protection is an integral part of international and regional cooperation as nations face a number of traditional and non-traditional security threats. He urged six member countries (China, Japan, North Korea, Mongolia, Russia and South Korea) to enhance cooperation on environment and sustainable development. [See also *Asia-Pacific Should Intensify Green Growth Efforts* in December 2006, *New Environmental Think Tank for Asia* in August 2006, and *Meeting of Asia-Pacific Partnership on Clean Development and Climate* in January 2006 environmental security reports.]

Military Implications:

Environment protection, especially management of air pollution at the regional level, can serve as a platform for stable and long-term cooperation in a region where political and historical issues often hamper communication among countries. Military personnel should monitor activity in regional cooperation on environmental issues. Progress could help improve regional (traditional) security. The monitoring would position the US military to assist through North-East Asian partners and allies.

Sources:

North-East Asia Sub-regional Program for Environmental Cooperation

<http://www.neaspec.org/index.asp>

Address by Mr. Cui Tiankai

<http://www.fmprc.gov.cn/eng/zxxx/t305589.htm>

7.6 Climate Change—Research Developments

The UN report *Confronting Climate Change: Avoiding the Unmanageable and Managing the Unavoidable*, by the Scientific Expert Group on Climate Change and Sustainable Development, outlines strategies for mitigating and adapting to climate change. It calls for international policies that would limit global temperature increases to 2-2.5°C above the 1750 pre-industrial level, which would require reducing greenhouse gas emissions, mainly CO₂, which shouldn't rise above current levels by 2020 and decline to a third of this level by 2100. The measures include implementing energy-efficient technologies and standards, designing adaptation and preparedness strategies including coping with climate refugees, and accelerating negotiations for an international framework for addressing climate change and its consequences. The report is the result of the two-year work of a team of 18 distinguished scientists from 11 countries and was prepared for the 15th session of the CSD.

Projected distributions of novel and disappearing climates by 2100 AD is an analysis of ecological consequences of climate change by the end of the century, in two case scenarios outlined by the Inter governmental Panel on Climate Change's (IPCC) 4th Assessment report [see last month's item 9.3.1 *IPCC Assessment Report Intensifies the Debate on Global Warming*], business-as-usual, and reduced-emissions scenarios. The findings include radical transformation of some existent climate regions (mainly in tropical mountain areas, Amazon and Indonesian rainforests, and towards the poles) and the prospects of appearance of completely, yet unknown, new climate conditions (primarily in the tropics and subtropics), with the associated respective implications for the ecosystem, including emergence of new species and the extinction of those that can't adapt or migrate. The analysis was published in the *Proceedings of the National Academy of Sciences*, 10.1073/pnas.0606292104.

Other reliable climate studies speak about new findings on effects of global warming and pollution on the polar environments and their implications. It is estimated that Greenland and Antarctica are each losing mass overall, and their combined imbalance is about 125 gigatons per year of ice, determining a rise in sea level by 0.35 millimeters per year. A review of the latest data reveals that melting ice from Antarctica and Greenland is responsible for just 12% of the current rate of global sea level rise, the remaining 88% being due to the expansion of warming waters, and melting of glaciers and ice caps outside Greenland and Antarctica. Although it is difficult to predict Greenland and Antarctica melting behavior, the researchers note that they hold enough water to make sea levels rise by 70 meters.

Military Implications:

Increasingly more compelling evidence and warnings on climate change amplify international discourse on the issue and increase the emergence of international policies trying to tackle the causes and develop strategies to mitigate climate change effects. These policies will inevitably change the milieu in which military operations take place and the rules by which they will be conducted.

Sources: (see an expanded list in the [Appendix](#))

Confronting Climate Change: Avoiding the Unmanageable and Managing the Unavoidable (UN report)

<http://www.unfoundation.org/SEG/>

100-Year Forecast: New Climate Zones Humans Have Never Seen

<http://www.sciam.com/article.cfm?articleid=90A5DC7C-E7F2-99DF-320EEF89EB22219C&chanId=sa022>

Climate studies show polar warming trend

http://www.usatoday.com/weather/climate/2007-03-16-polar-studies_n.htm

Recent Sea-Level Contributions of the Antarctic and Greenland Ice Sheets

<http://www.geos.ed.ac.uk/geography/ShepherdEtAl.pdf>

INTERVIEW - Scientist Says Sea Level Rise Could Accelerate

<http://www.planetark.com/dailynewsstory.cfm/newsid/40821/story.htm>

7.7 Water Scarcity

This year's World Water Day theme was 'Coping with Water Scarcity' to highlight limited water resources and the imbalances between availability and demand. If today water scarcity affects 700 million people around the world, by 2025, this could rise to more than 3 billion. Since many of the world's rivers and aquifers are shared among countries, conflicts are likely to be exacerbated, unless integrated cross-border water management systems are implemented. Several reports released on the occasion of World Water Day reveal today's realities, suggesting policies and future possible developments. The WWF report, *World's Top Rivers at Risk*, warns that global warming and man-made causes destroy some of the world's largest rivers, threatening ecosystem and people's livelihood. The report assesses pollution, development, and water management of ten of the world's most important rivers: the Nile, the Danube, the Rio Grande, La Plata, Yangtze, Mekong, Salween, Ganges, Indus, and Murray-Darling. It is calling on policymakers to take notice of the emergency nature of the situation and to set up strategies to reverse damage to freshwater sources. "Conservation of rivers and wetlands must be seen as part and parcel of national security, health and economic success," stressed Jamie Pittock, WWF Global Freshwater Programme Director. The IPCC report *Impacts, Adaptation and Vulnerability*, forecasts that "hundreds of millions of Africans and tens of millions of Latin Americans who now have water will be short of it in less than 20 years. By 2050, more than 1 billion people in Asia could face water shortages. By 2080, water shortages could threaten 1.1 billion to 3.2 billion people, depending on the level of greenhouse gases that cars and industry spew into the air." The report will be released at the beginning of April. As Peru's glaciers are melting, the country might run out of water. In China, air pollution is causing reduced rainfall, increasing drought in northern China. [See also *World Water Forum* in March 2006, *Unless Water Management Improves, Conflicts over Water Are Inevitable* in August 2006, and other previous environmental security reports on the water issue.]

Military Implications:

The military should intensify efforts to improve and accelerate dialogue and cooperation for an international water management system and the design of an international adaptation and mitigation strategy addressing increased water scarcity and its effects.

Sources: (see an expanded list in the [Appendix](#))

World Water Day 2007 <http://www.unwater.org/wwd07/flashindex.html>

Going nowhere fast: Top rivers face mounting threats

http://www.panda.org/news_facts/newsroom/index.cfm?uNewsID=96520

Climate Report Warns of Drought, Disease

<http://www.physorg.com/news92763803.html>

Peru's alarming water truth

<http://news.bbc.co.uk/1/hi/world/americas/6412351.stm>

Polluted air 'triggering drought' in northern China

<http://www.scidev.net/News/index.cfm?fuseaction=readNews&itemid=3469&language=1>

7.8 European Lamp Companies Push Compact Fluorescents, as Does the EU

The European Lamp Companies Federation, whose members include the world's three largest light bulb manufacturers, has said they will push European consumers to switch to energy-saving compact fluorescent bulbs (CFLs). According to an AP dispatch, "The European Union is already encouraging its 27 member governments to promote the use of efficient lights on streets and in offices. The ELC Federation statement said its members 'urge the European Commission to adopt a similarly proactive approach to domestic lighting'." [See also *Compact Fluorescent Light Bulbs (CFLs) May Surge to Fore* in February 2007 environmental security report.]

Military Implications:

These steps indicate that the military should give a high priority to planning for worldwide conversion to CFLs.

Source:

European Lighting Industry Agrees to Push Energy-Saving Bulbs

<http://www.enn.com/today.html?id=12318>

7.9 Nanotechnology Safety Issues

Nanotechnology safety assessment activities are increasing. Some noteworthy ones are: (more detailed description of each is available in the [Appendix](#))

- NIOSH Releases Nanotechnology Research Progress Report, Progress Toward Safe Nanotechnology in the Workplace
- US National Nanotechnology Initiative report *Understanding Risk Assessment of Nanotechnology*
- EPA White Paper on Nanotechnology
- Cenarios system (Certifiable Nanospecific Risk management and Monitoring System) developed by the Swiss firm The Innovation Society
- Virtual Journal of Nanotechnology Environment, Health & Safety (VJ-Nano EHS).
<http://icon.rice.edu/virtualjournal.cfm>
- The 2nd Nanotoxicology Conference will be held in Venice in April 19-21, 2007
- Nanotechnology – Products for Environmental Benefit meeting will be held in London, May 16-17, 2007

Military Implications:

[Same as previous on similar issues] Relevant military personnel should review information generated by these assessments on nanotech environmental health and safety to improve military and contractor practices, as well as to assist and cooperate with the organizations working on those issues for enriching their studies.

Sources:

NIOSH Update: NIOSH Releases Nanotechnology Research Progress Report

<http://www.cdc.gov/niosh/updates/upd-02-27-07.html>

Understanding Risk Assessment of Nanotechnology

http://nano.gov/pdf/Understanding_Risk_Assessment.pdf

Industry should become familiar with EPA white paper on nanotechnology

<http://www.nanowerk.com/news/newsid=1512.php>

U.S. Environmental Protection Agency Nanotechnology White Paper (EPA 100/B-07/001)

<http://www.epa.gov/osa/pdfs/nanotech/epa-nanotechnology-white-paper-final-february-2007.pdf>

Nano coalition launches virtual journal on risk research

http://www.eurekalert.org/pub_releases/2007-03/ru-ncl032207.php

Progress Toward Safe Nanotechnology in the Workplace (NIOSH Publication No. 2007-123)

Report: <http://www.cdc.gov/niosh/docs/2007-123>

Nanotoxicology 2007 <http://www.informaworld.com/smpp/nanotoxconference>

‘Nanotechnology – Products for Environmental Benefit’ (16-17 May 2007, London)

<http://www.nano.org.uk/newsletter/environment/index.htm>

Item 8. Reports Suggested for Review

8.1 Netherlands Environmental Institute Publishes Report on Environment, Security, and Sustainable Development

The *Inventory of Environment and Security Policies and Practices* report by the Institute for Environmental Security (IES) in the Netherlands "provides an easy to use comparative overview of existing governmental and inter-governmental positions and actions dealing with the relationship between environment, security and sustainable development." The report describes the environmental security activities of 13 (largely OECD) countries and 7 international NGOs. It also furnishes background information on IES's program, Greening European Security, which focuses on mainstreaming environmental and sustainable development factors into European foreign and security policy.

Military Implications:

The IES report is worth reviewing, as a source of information on European environmental security policies and activities, as well as for influences leading to establishment of future strategies. It might also provide useful ideas for other regions.

Source:

Inventory of Environment and Security Policies and Practices (IESPP)

<http://www.envirosecurity.org/ges/inventory/>

Inventory of Environment and Security Policies and Practices

http://www.envirosecurity.org/ges/inventory/IESPP_Full_Report.pdf

8.2 Population and Resources Affecting the Risk of Conflict

The UN *Population Prospects, the 2006 Revision* report reveals that most of the countries that top the birthrate list are those already affected by the world's worst wars. Growing pressure of people on land and resources is likely to exacerbate conflict in those areas. At a Woodrow Wilson Center event, 'Demography and Conflict: How Population Pressure and Youth Bulges Affect the Risk of Civil War', Henrik Urdal, Researcher at the Centre for the Study of Civil War, International Peace Research Institute, Oslo (PRIO), discussed the results of an empirical research on the links among global demographics and the potentials for civil unrest (see map in the [Appendix](#)). Concluding that certain forms of population pressure—particularly youth bulges—increase the risk for conflict, he

makes several recommendations for attempting to minimize conflict, including: measures to enhance local resource management capacity; programs aimed at curbing population pressure, and more research focusing on youth bulges and political stability and conflict prevention.

Another Woodrow Wilson Center event, 'Climate-Security Connections: An Empirical Approach to Risk Assessment,' analyzed the potential relationship between environment and conflict by integrating environment data with conflict data and using the results to improve conflict risk assessments. The outcomes show that although environmental scarcity doesn't necessarily represent a cause of conflict, it might become an important reason in poor and war-torn societies or with other inter-group (horizontal) inequalities. Hence, it is important for preventing and mitigating escalating conflicts to map and watch different environmental anomalies that might lead to food and/or water scarcity and vice-versa and to identify conflict-prone zones that might be exposed to destabilizing environmental factors. Such a world map of areas worth watching for possible crises situations that might lead to conflict was presented (see map in the [Appendix](#))

Military implications:

The military should consider some of the recommendations such as: performing more research on youth bulges and political stability; age composition and exclusion in urban centers; micro-level studies of rebel recruitment; and youth bulges in post-conflict settings.

Sources:

New Population Projections Underline Urgency of Family Planning Needs in Developing Nations

<http://www.unfpa.org/news/news.cfm?ID=943>

World population may reach 9.2 billion by 2050

<http://www.msnbc.msn.com/id/17605186/>

Demography and Conflict: How Population Pressure and Youth Bulges Affect the Risk of Civil War

http://www.wilsoncenter.org/index.cfm?fuseaction=events.event&event_id=219250

Climate-Security Connections: An Empirical Approach to Risk Assessment

http://www.wilsoncenter.org/index.cfm?fuseaction=events.event&event_id=219458#

8.3 Website for Marine Protected Areas and Cetaceans' Sanctuaries

A new website, cetaceanhabitat.org, sponsored by the Whale and Dolphin Conservation Society, provides comprehensive information on the nearly 600 proposed and existing marine protected areas and sanctuaries for cetaceans. It has summaries and links to international treaties on MPAs; definitions of key MPA terms; updated news on proposals for new MPAs, and other related resources.

Military Implications:

The cetaceanhabitat.org site might be a valuable "one stop shop" for information on protected marine areas. Relevant military personnel should consider consulting it regularly for possible new proposals and information relevant to its high sea activities.

Sources:

Whale Protections Proposed for Strait of Gibraltar

<http://www.ens-newswire.com/ens/mar2007/2007-03-05-02.asp>

Urgent protection proposed for whale and dolphin habitats in the Mediterranean and Black Seas

<http://www.cetaceanhabitat.org>

APPENDIX

This Appendix contains expanded background information on some items.

Item 3. New Research Finds Human Energy Usage is a Long-Term Heating Problem Independent of Greenhouse Gases and Solar Radiation

Energy, Ethics, and the Far Future DRAFT #2

Eric J. Chaisson

Introduction

Humans are now the only species able both to communicate culturally and to construct technologically. We are the only ones capable of knowing our past and worrying about our future. Just how wise we are, however, is an issue of considerable uncertainty.

This meeting explores the subject of energy, notably humankind's use and abuse of it, as well as our future reliance upon it. Energy helped bring us forth, it now maintains our well being, and it will likely determine our destiny. We do know some potential fates, but these are irrelevant for today's world:

- Our Sun will ultimately stop emitting much energy, balloon into a red-giant star and engulf some planets, perhaps even Earth; that will doubtless end life in the solar system, but it won't happen for ~5 billion years, a time so remote as to be nearly incomprehensible.
- Much of life on Earth will likely be doomed earlier than this, probably within 1 billion years, solely due to a slow rise in luminosity of the Sun as it ages; the Sun now brightens at a rate of ~1% for each hundred million years, implying that Earth's surface temperature will increase ~7oC in a billion years—even if civilization did nothing to harm the planet.

The Foundation for the Future seeks to address the plight of humankind during the next 1,000 years—to explore the steps likely needed to ensure a healthy, wealthy and wise future for our species. Will life on Earth, especially human life, be continuously threatened with extinction throughout the next millennium, all the while ransacking our land, polluting our atmosphere, and worsening our global security? Or will our civilization accelerate onward, using technology to muddle through complex predicaments one after another, eventually perhaps evolving toward a symbiotic merger of men and machines?

Soberingly, this paper suggests that, even if we do get our act together and stop harming our biosphere, there may be hell to pay for survival—almost quite literally—for as long as we remain on this planet. Well within 1,000 years, our civilization may find itself up against a fundamental limit to growth—an energy challenge that ironically both drives growth yet checks growth: Relatively soon, humankind could well be awash in too much energy.

The Need for Energy

Today's civilization runs on energy for the simple reason that all ordered, complex systems need energy to survive and prosper. Whether galaxies, stars, planets, or life forms, it is energy that keeps these open, non-equilibrium systems functioning—to keep them, at least locally and

temporarily, from achieving a disordered state (of high entropy) demanded by the second law of thermodynamics. Whether living or non-living, dynamical systems need flows of energy to endure. If stars don't convert gravitational potential into heat and light, they would collapse; if plants don't photosynthesize sunlight, they would shrivel and decay; if humans don't eat, we too would die. Likewise, society's fuel is energy: Resources come in and wastes go out, all the while civilization goes about its daily business.

Throughout the history of the Universe, as each type of ordered system became more complex, its normalized energy budget increased. This is the subject of cosmic evolution, wherein the energy rate density—that is, energy per unit time per unit mass [erg/s/g]—has generally risen with the increase of complexity within those ordered systems:

- stars and galaxies have small energy rate densities, ranging from 1 to 102 erg/s/g
- plants and animals have larger energy rate densities, between 103 and 105 erg/s/g
- humans and society have the largest known energy rate densities, of order 106 erg/s/g.

This quantity—effectively per capita energy flow—is correlated with the evolution of each of these different kinds of systems. Whether physical evolution of galaxies, stars and planets, or biological evolution of plants and animals on Earth, or cultural evolution of our technological civilization, a rather remarkable ranking order is apparent among all known organized structures. None of this rise in energy density with system complexity is a violation of physics' most cherished second law, for while such systems do become increasingly and locally ordered, their surrounding environments inexorably become globally disordered.

Of direct relevance to this particular meeting is the rise of energy use within the relatively recent past among our hominid ancestors, continuing on to today's digital society and presumably into the future as well. For example (and giving energy rate densities in Watts per capita as well):

- hunter-gatherers of a few million years ago used ~104 erg/s/g (or 0.05 kW/person)
- agriculturists of several thousand years ago used ~105 erg/s/g (or 0.5 kW/person)
- industrialists of a couple of centuries ago used ~5x105 erg/s/g (or 2.5 kW/person)
- citizens of the world today, on average, now use ~5x105 erg/s/g (or 2.5 kW/person)
- residents of the energy-crazed U.S. now use ~3x106 erg/s/g (or 15 kW/person).

Clearly, there is a trend here. All energy *rate* metrics have risen over the course of recorded and pre-recorded human history. The cause of this rise is not population growth; these are per capita values caused by the cultural evolution and technological advancement of our civilization.

The Apparent Problem: Not Enough Energy

Energy is a principal driver among the bricks, chips, and machines we've built. Undeniably, much of today's industrial production and economic vitality require the use of energy. From automobiles and aircraft to our homes and the many technical gadgets within them, much of human activity has come to rely on energy. Furthermore and for three reasons, the *total* energy budget of planet Earth will inevitably and perhaps indefinitely grow:

- world population is still rising
- developing countries are maturing economically
- per capita energy flow rises with continued cultural evolution of the human species.

The first growth factor, population, is active at least until late-21st century, perhaps then leveling off at ~10 billion people, according to the best UN/World Bank estimates (though no one really

knows the human carrying-capacity of planet Earth). The second growth factor will likely continue for several centuries, until the 3rd world catches up economically, thereby achieving full equity among the world community of nations. The third growth factor above will probably continue rising for as long as there is a human species—which means, even if the first two growths end, the third keeps increasing society’s energy budget, however slowly.

Where in the world—or beyond the world—is humanity going to find enough resources to power our voracious appetite for energy?

Oil, gas, coal: All these non-renewable sources of energy both rape the land and pollute the air. Even if we learn to sequester the by-product greenhouse gases, oil and gas will be practically gone within a century, and coal within at most a few centuries thereafter. Given the 1,000-year charge of this meeting, let’s move beyond these hydrocarbons, whose fossil fuels provide ~80% of today’s total world energy supply but whose relevance should be nil within a millennium.

Wind, tides, geothermal, conservation and other renewable sources are all useful, but even together they will insufficiently energize our future world. Biofuels (especially ethanol) will also help and burn clean, but their production still yields CO₂, and besides greatly enhanced bioenergy creation would likely destroy forest ecosystems and disrupt food supplies to make way for more fuel-rich renewable crops. Nuclear fission might energize our society indefinitely, but nukephobia greatly bothers the general populace and fission’s radioactive wastes are too damn dangerous.

Let’s cut to the chase, think big, and embrace fusion—the ultimate hydrogen economy (but not one that runs on H₂O-based fuel cells). Either energy from fusion that we master in our nuclear labs on Earth or energy from fusion captured directly from the Sun will do. Sadly, neither of these methods that use hydrogen as their main energy source seem imminently on the horizon.

Nuclear fusion has had significant startup problems ever since the atomic pioneers declared in the 1950s that nuclear energy would soon be “too cheap to meter.” It just hasn’t happened, and the \$10-billion International Thermonuclear Experimental Reactor (ITER) project now underway in Cadarache, France, may be the last great effort to master on Earth what the Sun does naturally. But critics might be right that “fusion is the power of the future and always will be.” So, since the Sun has *already* mastered this method of energy production, why not abandon nuclear efforts here on Earth altogether, save a helluva lot of money and decades of grief, and instead initiate a major solar-energy R&D effort to efficiently acquire, store and utilize the Sun’s rays?

Fusion is indeed already at work within our Sun, its principal by-product of emitted sunlight ready and waiting for the taking. It would seem foolish for any intelligent civilization to scour its own planet for sources of energy, when boundless amounts of it can be captured from its parent star.

Although photovoltaic technology is hardly economically viable presently—the global solar electricity market currently tops \$10 billion/year and grows at more than 30% annually, but is still a poor cost competitor compared to current fossil-based power generation—its development does seem to be the wisest direction in which to invest capital funds. Let’s face it, if dumb plants can harness solar energy, then intelligent animals ought to be able to do as well.

More energy from sunlight strikes Earth’s surface every hour than all 6.5 billion humans use in an entire year. Alternatively stated: the Sun rains down on Earth ~10,000 times as much energy as all of civilization now uses. Which means it’s a no-brainer, and not just because I’m an astrophysicist: Solar energy is the way to go, especially when considering the 1,000-year period of this meeting. Our civilization cannot afford to ignore the clean and plentiful power of the Sun, one-thousandth of which would provide us with nearly 10 times more energy than we currently use—and with its ubiquity, a measure of global security as well, since wars will not be fought

over sunlight. Solar energy is not the solution in the near term (because it's impossible to pour it directly into our cars), but it surely is an answer to humankind's thirst for energy in the long term. For either type of fusion program to succeed when needed—the generation of nuclear fusion on Earth or the capture of fusion's fruit from the Sun—a major R&D effort will be necessary comparable to the Manhattan or Apollo projects, probably at wartime speed and intensity. Yet even if either of these techniques do become cost-effective, a major issue looms.

The Real Problem: Too Much Energy

A central quandary confronting humankind would seem to be that there is now, and especially in the future, not enough energy to go around. But that's only a superficial concern, expressed by a selfish society mainly worried today about filling its gas tanks tomorrow. When the big energy picture is examined, we realize that the real problem is much the opposite: Our civilization may eventually utilize too much energy. Here's the surprise—and the dilemma:

Current fears of energy shortfalls aside, many people lack the foresight to appreciate the crux of our true energy predicament. At issue is not which energy alternatives to adopt as society marches with time into the future. The real problem concerns our unremitting and increasing use of energy from any source and by any technique. Why? Because energy is heat. All energy—both that inefficiently wasted in conversion to useable power and that successfully used to operate our technological devices—is eventually dissipated as heat at various temperatures.

Heat is an unavoidable by-product in the use of energy extracted from wood, coal, oil, gas, atoms, and *any* other non-renewable source. (The renewable sources, including solar, wind and geothermal energy, already heat Earth naturally.) Regardless of the kind of energy utilized, Earth is constantly subjected to heat generated by our industrial society. We already experience it in the big cities that are warmer than their suburbs, and near nuclear reactors that warm their adjacent waterways. Even our everyday appliances produce heat owing to their thermodynamic inefficiencies: toasters, boilers, and lawn mowers are all far from their Carnot efficiency limits (which explains why my Volvo heats its passengers so poorly; its engine is actually more efficient than typical automobiles). Electricity production is currently ~37% efficient, automobile engines ~25%, and incandescent bulbs only ~5%; the rest is immediately lost as heat.

Even every Google search creates heat at the web server, and each click of the keyboard generates heat in your laptop. Information data processing of mere bits and bytes causes a miniscule rise in environmental temperature (owing to flip/flop logic gates that routinely discard bits of information)! Individual computer chips, miniaturized yet arrayed in ever-higher densities and passing ever-higher energy flows, will someday be limited by the danger of self-immolation—perhaps not so unsuitable a model of future civilization itself, especially if our technological society is indeed heading toward a robust symbiosis of humankind and machinery. Excess heating is becoming particularly noticeable in urban settings. Tokyo researchers, for example, have found that city streets are 2-4°C warmer when air-conditioning units in office buildings are running at maximum. Not only do those machines suck hot air out of all those offices, but also extra waste heat is emitted from the backs of those conditioners while electricity powers them inefficiently—which also explains why an open refrigerator door will not cool your kitchen, in fact its lossy motor will do just the opposite.

Such widespread inefficiencies would seem to present major opportunities to better energy conversion and storage, but there are limits to advancement. No device will ever be perfectly efficient, given friction, wear, and corrosion that inevitably create losses. Conversion and storage devices that are 100% efficient are reversible and ideal, and they violate the laws of real-world

thermodynamics, like perpetual motion machines; they cannot exist. To give but one example, today's photovoltaics currently achieve 10-20% efficiency, when optimized they might someday reach 40%, yet the absolute theoretical (quantum) limit for any conceivable solar device is ~70%. While, admittedly, waste heat is currently an imperceptible burden on the global environment, it is on the rise, obeying a classical exponential curve, and thus potentially destined to become troublesome almost after it's too late to do anything about it. Significant human-induced heating will disrupt the delicate balance between energy arriving from the Sun and that reradiated by the Earth, possibly destroying the natural thermal balance that keeps our planet reasonably comfortable. Though few people realize it, we are polluting the air with heat.

Here, we assume the deleterious effects of rising heat: Melting polar caps, coastal flooding, scorched deserts, more cloudiness, intense storms. All this could occur, *even in the absence of additional greenhouse gases in the air*. Might the excesses of technological civilization really trigger such dire ramifications? How much energy can all our cultural devices—automobiles, stoves, factories, whatever—produce before Earth's surface temperature increases enough to make our planet potentially hellishly uncomfortable? Well, let's do the numbers.

The temperature at Earth's surface is governed by the thermodynamics of energy balance, meaning that it will reach equilibrium between the energy acquired on the dayside and that radiated away isotropically as a black body:

$$\text{energy in} = \text{energy out}$$

$$(k/r^2) \pi R^2 (1-A) = (\epsilon \sigma T^4) 4\pi R^2$$

where, k is the solar constant at Earth (1370 W/m²), r is the distance from the Sun (in Astronomical Units = 1), A is Earth's albedo (0.31), R is Earth's radius (6400 km), ϵ is the surface emissivity (~1), σ is Stefan's constant (5.7x10⁻⁸ W/m²/K⁴), and T is the planet's equilibrium temperature. The result for Earth is 256 K, or -17°C. That's well below the freezing point of water, of course, which is why we can be thankful for some natural greenhouse heating. That heating, given the H₂O, CO₂, CH₄ and other gases that absorb infrared radiation in our atmosphere, amounts to ~32°C, since the current globally averaged temperature at Earth's surface is now measured to be 15°C (or 60°F). This is the surface temperature value that has been ever-so-slowly rising since the start of the Industrial Revolution; during the 20th century, according to the Intergovernmental Panel on Climate Change (IPCC), this value rose 0.7°C. And it is this value that is expected to rise more sharply in the future.

Nature's power budget at Earth's surface is dominated by the Sun. Compared to our planet's solar insolation of 120,000 TW (absorbed by the land, sea and air, and accounting for Earth's albedo of 31%), our global civilization currently produces ~18 TW, approximately 2/3 of which is wasted. (TW is a terawatt, or a trillion watts, and 1 watt = 10⁷ erg/s.) It is this lost energy that directly creates heat, quite independent of any greenhouse gases. Furthermore, humanity's power usage is on the rise—as it must since civilization runs on energy and, as our species both multiplies and complexifies, we need more of it each and every day. According to the CIA Factbook, society's energy production now increases annually by ~2%, implying a total energy expenditure doubling-time of ~35 years. All of which means that at the close of the 21st century, society's energy demands will likely be nearly 150 TW, much of which will heat our environment.

If we were to embrace solar energy today, without generating any further energy via non-renewable supplies, we would be in good shape, for plenty of renewable solar energy is available and utilization of it would not create additional heat. The world's total installed solar cells currently capture a miniscule ~5 GW, or <0.00001% of the solar energy naturally reaching Earth's surface. Even the plants, undergoing photosynthesis daily and throughout Earth's

biosphere, use ~0.1% of the Sun's rays averaged globally and yearly—so there is plenty of opportunity to improve solar energy efficiency, and thereby make some money as well. But, if we do generate heat from other, non-renewable energy sources, in addition to the Sun's heat arriving daily—or if we employ space-based arrays to redirect additional sunlight to Earth that would normally bypass our planet—then surface temperatures will rise. And this rise owes simply to “thermal pollution,” not to any greenhouse gas. For example, suppose we embrace coal and sequester all of its carbon emissions, or perhaps nuclear methods (either fission or fusion) which emit no greenhouse gases, to run our civilization for the indefinite future. These energy sources would spawn additional heat, above and beyond what the Sun delivers naturally to Earth's surface. To determine how much heat and how quickly, let's do the numbers again. Here are some ways to heat the Earth, independent of the greenhouse effect:

- Increase the Sun's luminosity (which does occur naturally, at the above-noted rate of ~1%, or ~0.5oC at Earth's surface, in 100 million years).
- Move Earth closer to the Sun (which is unlikely, in fact just the opposite might slowly happen as the Sun loses mass and the planets migrate outward).
- Decrease Earth's albedo (in the extreme case, when $A = 0$, temperature would rise ~23oC, for total surface temperature ~38oC, or globally averaged 100oF).
- Augment Earth with additional solar energy captured in orbit and beamed to Earth's surface (not a good idea, if done robustly—see below).
- Continue our civilization's love affair with liberal energy use (a real possibility).

Let's examine numerically this last possibility—namely, that society's business-as-usual attitude will cause Earth to heat, even if our atmosphere is no longer polluted with additional greenhouse gas (beyond the current 380 ppm CO₂). Knowing that the solar flux scales as σT^4 , we can ask how much power will cause Earth's surface temperature to rise by, say, 3oC, from the current 15oC to 18oC? Compute, in Kelvins, $(291/288)^4 = 1.04$, which means if only 4% more than the Sun's daily dose is *additionally* produced on Earth, then the energy usage by society will have reached 4800 TW. In other words, if the energy needs of all of civilization's inhabitants increase from its current 18 TW to 4800 TW, the heat at the surface will rise a few degrees. How far in the future might this be? That depends on assumptions:

- If global non-renewable energy use continues increasing at its current rate of ~2% annually and nothing else changes, then a 3oC rise will occur in ~8 doubling times, or ~280 years (or ~350 years for a 10oC rise).
- More realistically, if world population plateaus at 10 billion inhabitants by 2100, developed (OECD) countries increase non-renewable energy use at 1% annually, and developing (non-OECD) countries do so at ~5% annually until east-west energy equity is achieved in mid-22nd century after which they too continue generating more energy at 1% annually, then a 3oC rise will occur in ~300 years, or 10oC in ~450 years.
- If greenhouse gases continue rising owing to additional air pollution, all these projected times decrease (in particular, if coal is embraced without CO₂ sequestration, even after the oil is gone, our descendents could be nearly frying in little more than a century).
- If 4% *additional* solar energy is beamed to Earth, the surface temperature would rise 3oC nearly instantaneously (or 10oC for an additional 14% solar energy beamed to Earth).

Note that all these timescales are well within the 1,000-year timeframe stipulated by the Foundation for the Future. Even acceding that our assumptions are only approximate, the above

consequences seem unavoidable within the next millennium—a short period in the cosmic scheme of things. After millions of years of being subjected to the whims of the environment, humans are now gaining the ability to change that environment. But heating it is not the way to do it!

The bottom line is that solar energy hits Earth's surface each and every day. That energy is clean, renewable, and usable without added heating; it is already landing on Earth naturally. By contrast, if we generate (or redirect) additional amounts of energy (and thus heat) in order to fuel our burgeoning civilization, then we shall raise the equilibrium temperature of our planet by means of the social tasks that we undertake daily. Solar energy is scientifically, economically, and politically our ticket to the future—either sooner if we're smart or later if we're desperate.

The Need to Think Long, Broad, and Ethically

Energy is the lifeblood of technological and economic development, indeed of our very own species in the modern world. Furthermore, the thirst for more energy around the world will not soon end, alas at any foreseeable future time. Yet it would be a potentially fatal delusion to think that we can employ unlimited amounts of energy to support the daily needs of Earth's high-tech, fast-paced civilization. Being bullish on growth is not a solution to our problems; bullishness itself will create new problems—or at least more heat! To avoid the unhealthy heating of our environment, the total energy used by society will eventually need to level off. This could be done in several ways:

- reduce per capita energy use—not likely
- increase energy efficiencies—a marginal gain
- stabilize world population—a necessity.

Since the energy needs of a complex society will likely continue rising per capita—as for any complex, evolving system—and since machine efficiencies will likely improve by only about a factor of two or three before reaching quantum limits, the total energy budget on Earth can be kept in check only by at least leveling, and probably reducing, world population.

We have a dilemma: More than any other single quantity, energy has caused the changes that brought forth life, intelligence, and civilization. Energy also now not only sustains life but also drives our economic growth, indeed grants our species untold health, wealth and security. Yet it would seem that less energy use, sometime in humanity's relatively near future, is vital for its future well-being, lest our world simply overheat. This is not rocket science; it's merely thermodynamics.

So, can ethics help sustain the present human condition and aid the future human prospect? Which ethics, whose ethics? For my whole career, I've struggled with the notion of ethics, even arguing that "ethical evolution" might be the next great leap forward in the cosmic-evolutionary scenario of who we are and whence we've come. Yet, is it realistic—in contrast to idealistic—for members of today's society to sacrifice some of our well-being for the good of future generations? In a Darwinian world—and it is, still, and more quickly for cultural evolution—I'm not so sure. The current trajectory of today's society does display sensitivity toward a kind of planetary citizenship needed to achieve a global ethic, as exemplified by enhanced awareness of human rights, environmental progress, and energy policy. That is, I do not hold that civilization's decline is already underway. But is there enough time to embrace the needed ethics before an array of worldly problems do make sentient life on Earth untenable?

The question looming large for us right now on Earth is: How can we reconcile the need for secure and reliable energy with human competitiveness and economic growth without damaging the environment? Alas, science does not prescribe what we ought to do, just what is possible—or impossible. Here are some options to address present and future global energy issues:

- push energy R&D at wartime speed and intensity—big governmental efforts
- pull viable energy sources to fruition with market forces—small entrepreneurial efforts
- muddle through global energy crises—just-in-time solutions, one after another.

I worry about the cost and disruption of the first option, I am skeptical about the viability of the second option, and I sense the third option will most likely prevail.

To my mind, the most likely way forward obliges us to *think big and act small*. Big thinking over long timescales is hard to do, given that people alive at any given time do not live long—but that is the spirit of evolutionary ethics, to cause us to stretch beyond what we cannot achieve individually. Acting small is equally difficult, given that we all want to live life to its fullest—yet it is a plain truth that humankind’s footprints on Earth need to be softened.

To survive as a species, we shall indeed need to change our way of life on Earth, or leave the planet. Change is good; it is the essence of all increasingly ordered things. Adaptation is also good; it is one of life’s key features that we need to accept. *Change or perish*—that’s as valid an ethical mantra as any.

Perhaps the needed change will be upon us dramatically and soon, or by contrast only gradually and eventually. If the former, then our descendants are slated for trouble, for it is great and sudden upheaval that often leads to species extinction. If the latter, then we shall likely develop adequate energy technologies only when we really need them, and not before. Humanity will likely change and adapt only when it must in order to survive.

General References

Brown, L., *Plan B 2.0*, W.W. Norton, New York, 2006

Chaisson, E., *Cosmic Evolution*, Harvard Univ. Press, Cambridge, 2001

Martin, J., *The Meaning of the 21st Century*, Riverhead, New York, 2006

Scientific American, special issue on “Energy’s Future: Beyond Carbon,” September, 2006

Vaitheeswaran, V., *Power to the People*, Farrar, Straus and Giroux, New York, 2003

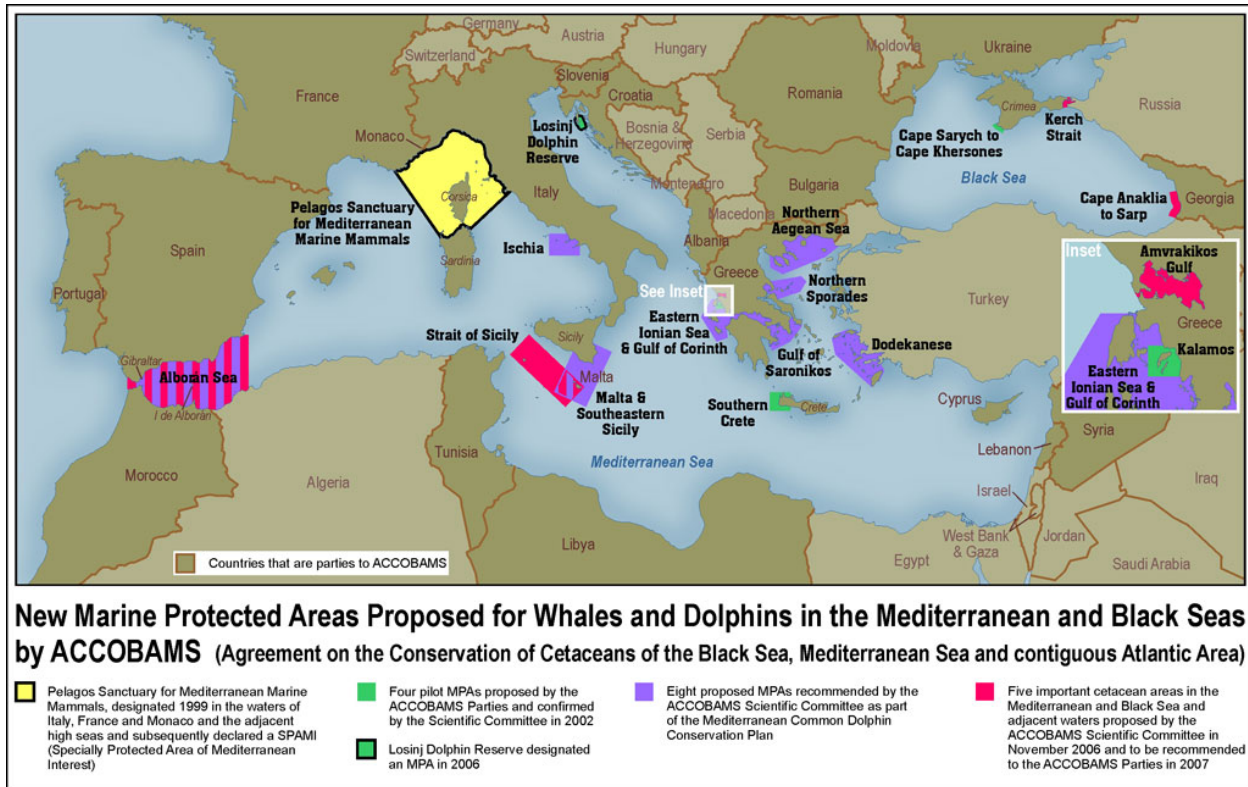
von Heorner, S., in *Einheit und Vielheit*, pp221-247, Gottingen, 1972

All statistics in this paper are taken from the United Nations, the World Bank, the CIA Factbook, and the International Energy Agency. The calculations are my own.

Item 4. Marine Environment Needs more Protection

4.1 New Marine Protected Areas Proposed

New Marine Protected Areas Proposed in the Mediterranean and Black Seas



Item 5. Argentina Redeploys Military to Defend Water and Oil

Argentina's New War Doctrine for Resources

Buenos Aires, Feb 25 (Prensa Latina)

<http://visionesalternativas.com/article.asp?ID=%7bA7C2A077-ED2E-4B52-B75B-AEAE8AA0713F%7d%29&language=EN> (by subscription only)

Buenos Aires, Feb 25 (Prensa Latina) The Argentine Army has assumed a new military doctrine aimed at defending natural resources from a potential threat, La Nacion daily reported Sunday.

The Battle for Resources is the name of the method, conceived by the military institution in the face of a possible conflict over fresh water in Argentina in the coming few decades.

Based on a theoretical work that envisages probable risks in the country up to 2025, the Army decided to change its combat guidelines.

According to the daily, a possible aggression by a foreign country would target natural resources, particularly the Guarani water-bearing area, which comprises 84,942 square miles in the Argentine region between the Parana and Uruguay rivers, over 308 square miles in Brazil, and sectors in Uruguay and Paraguay.

From the military point of view, a dispute over that natural resource would be the main trigger for a war conflict in the country. That possibility would leave a likely border dispute behind, due to the

strong economic, political ties the country has consolidated with those nations over the last few years.

Military sources told the daily the first step of the Army 2025 Plan was already made, by taking the Rosario First Corps to Curuzu Cuatia.

Having analyzed the possibility of facing an enemy with superior technology and resources, the Army planned dynamic movements, without established fronts, and trained the population over the likely conflict.

The publication affirms the new war doctrine for resources is based on the defensive strategic stance imposed by the government of Nestor Kirchner as military guideline.

Item 7. Updates on Previously Identified Issues

7.3 New Energy and Climate Change Policies

Sources: (more expanded list)

British push on CO2 at Security Council

<http://environment.guardian.co.uk/climatechange/story/0,,2028872,00.html>

Britain puts climate change on UN agenda

http://www.timesonline.co.uk/tol/news/world/us_and_americas/article1485323.ece

European Council conclusions

http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/93135.pdf

Hope for major headway on climate protection

http://www.eu2007.de/en/News/Press_Releases/March/0309BKER.html

Business: 'Climate action useless without global support'

<http://www.euractiv.com/en/climate-change/business-climate-action-useless-global-support/article-162543>

Statement attributable to the Spokesperson for the Secretary-General on climate change

<http://www.un.org/apps/sg/sgstats.asp?nid=2474>

Parliament sets up Climate Change Committee

<http://www.euractiv.com/en/climate-change/parliament-sets-climate-change-committee/article-162509>

EU to use green tax in fight against climate change

<http://euobserver.com/9/23802/?rk=1>

'Binding' carbon targets proposed

http://news.bbc.co.uk/2/hi/uk_news/politics/6444145.stm

EU's 2020 energy goals to cost over €1 trillion

<http://euobserver.com/9/23800>

Pelosi Announces Members of Select Committee on Energy Independence and Global Warming

<http://speaker.gov/newsroom/pressreleases?id=0091>

Pelosi on House Vote to Create Select Committee on Energy Independence and Global Warming

<http://speaker.gov/newsroom/pressreleases?id=0090>

Environmental Poll: March 2007

<http://www.yale.edu/envirocenter/environmentalpoll.htm>

Polling the People (interview with Dan Esty)

<http://www.loe.org/shows/shows.htm?programID=07-P13-00011#feature6>

Global talks on new climate deal must start now, commissioner says

<http://euobserver.com/9/23797/?rk=1>

Intergovernmental Preparatory Meeting (26 Feb - 2 Mar 2007)

http://www.un.org/esa/sustdev/csd/csd15/csd15_ipm.htm

Summary of the Intergovernmental Preparatory Meeting for the Fifteenth Session of the Commission on Sustainable Development

<http://www.iisd.ca/vol05/enb05243e.html>

Climate change conference of key nations achieves 'important progress' – UN official

<http://www.un.org/apps/news/story.asp?NewsID=21929&Cr=&Cr1=>

G8 climate consensus emerging, U.S. odd man out

http://thestar.com.my/news/story.asp?file=/2007/3/18/worldupdates/2007-03-17T215237Z_01_NOOTR_RTRJONC_0_-291368-2&sec=Worldupdates

7.6 Climate Change—Research Developments

Sources: (a more expanded list)

Intergovernmental Preparatory Meeting (26 Feb–2 Mar 2007)

http://www.un.org/esa/sustdev/csd/csd15/csd15_ipm.htm

Confronting Climate Change: Avoiding the Unmanageable and Managing the Unavoidable (UN report)

<http://www.unfoundation.org/SEG/>

Summary of the Intergovernmental Preparatory Meeting for the Fifteenth Session of the Commission on Sustainable Development

<http://www.iisd.ca/vol05/enb05243e.html>

Projected distributions of novel and disappearing climates by 2100 AD

<http://www.pnas.org/cgi/content/abstract/0606292104v1> (abstract)

100-Year Forecast: New Climate Zones Humans Have Never Seen

<http://www.sciam.com/article.cfm?articleid=90A5DC7C-E7F2-99DF-320EEF89EB22219C&chanId=sa022>

Climate studies show polar warming trend

http://www.usatoday.com/weather/climate/2007-03-16-polar-studies_n.htm

Recent Sea-Level Contributions of the Antarctic and Greenland Ice Sheets

<http://www.geos.ed.ac.uk/geography/ShepherdEtAl.pdf>

Perspectives on the Arctic's shrinking sea-ice cover

<http://www.citeulike.org/article/1178289> (abstract)

Antarctic melting may be speeding up

http://ca.today.reuters.com/news/newsArticle.aspx?type=topNews&storyID=2007-03-23T103106Z_01_SYD275118_RTRIDST_0_NEWS-OCEANS-COL.XML

INTERVIEW - Scientist Says Sea Level Rise Could Accelerate

<http://www.planetark.com/dailynewsstory.cfm/newsid/40821/story.htm>

Ice sheet complexity leaves sea level rise uncertain

<http://www.newscientist.com/article/dn11396-ice-sheet-complexity-leaves-sea-level-rise-uncertain.html>

European Marine Species Displaced by Warming Climate

<http://www.ens-newswire.com/ens/mar2007/2007-03-05-01.asp>

7.7 Water Scarcity

Sources: (a more expanded list)

World Water Day 2007 <http://www.unwater.org/wwd07/flashindex.html>

Water for Life Decade <http://www.un.org/waterforlifedecade/>

Going nowhere fast: Top rivers face mounting threats

http://www.panda.org/news_facts/newsroom/index.cfm?uNewsID=96520

Climate Report Warns of Drought, Disease

<http://www.physorg.com/news92763803.html>

World Bank urges action to manage water scarcity in Middle East and north Africa

<http://www.iht.com/articles/ap/2007/03/11/africa/ME-GEN-Water-Scarcity.php>

Peru's alarming water truth

<http://news.bbc.co.uk/1/hi/world/americas/6412351.stm>

Polluted air 'triggering drought' in northern China

<http://www.scidev.net/News/index.cfm?fuseaction=readNews&itemid=3469&language=1>

EU targets water as foreign policy tool

<http://euobserver.com/875/23634/?rk=1>

Pollution decreases rainfall

<http://www.planet2025news.net/ntext.rxml?id=4231&photo=>

Asian air pollution is changing the global climate

<http://www.scidev.net/News/index.cfm?fuseaction=readNews&itemid=3461&language=1>

7.9 Nanotechnology Safety Issues -- Details

NIOSH Releases Nanotechnology Research Progress Report

CDC's National Institute for Occupational Safety and Health (NIOSH) has announced the release of a new progress report, *Progress Toward Safe Nanotechnology in the Workplace*, which, according to the release, details the advancements made by NIOSH in advancing scientific knowledge in understanding the occupational safety and health implications of engineered nanoparticles, and also suggests potential areas where future research could further expand this knowledge.

NIOSH Update: NIOSH Releases Nanotechnology Research Progress Report

<http://www.cdc.gov/niosh/updates/upd-02-27-07.html>

Progress Toward Safe Nanotechnology in the Workplace (NIOSH Publication No. 2007-123)

<http://www.cdc.gov/niosh/docs/2007-123>

National Nanotech Initiative Issues Risk Assessment Report (REPORT)

The US National Nanotechnology Initiative has issued a report, *Understanding Risk Assessment of Nanotechnology*, which manages in eight pages to offer a comprehensive, technically oriented introduction to nanotech risk assessment. The document contains 44 endnotes, listing hundreds of Web sites and paper citations.

Understanding Risk Assessment of Nanotechnology

http://nano.gov/pdf/Understanding_Risk_Assessment.pdf

EPA Publishes White Paper on Nanotechnology (REPORT)

The US Environmental Protection Agency has issued a Nanotechnology White Paper. The 132-page document describes nanotech and its benefits and risks, and discusses risks assessment issues and research needs and priorities. An appendix contains a description of EPA's framework for nanotechnology research.

Industry should become familiar with EPA white paper on nanotechnology

<http://www.nanowerk.com/news/newsid=1512.php>

U.S. Environmental Protection Agency Nanotechnology White Paper (EPA 100/B-07/001)

<http://www.epa.gov/osa/pdfs/nanotech/epa-nanotechnology-white-paper-final-february-2007.pdf>

Swiss Firm Offers Nanotech Risk Assessment Data and Safety Certification

According to an article from www.in-pharmatechnologist.com, the Swiss firm The Innovation Society "has developed the Cenarios system (Certifiable Nanospecific Risk management and Monitoring System) ... to collate risk related information from scientific, regulatory, technological and market sources and to generate a database of material to be applied to specific products and processes using nanotechnology." The system includes capabilities for managing risk assessment, and a continually updated database of current scientific and technical results.

World's first nanospecific safety label

<http://www.in-pharmatechnologist.com/news/ng.asp?n=74792-the-innovation-society-cenarios-nanotechnology-safety-drug-delivery>

CENARIOS® - Managing Nano Risks

http://www.innovationsgesellschaft.ch/images/publikationen/Factsheet_CENARIOS_english_arial2.pdf

New Monthly Online Review Journal of Nanotech EHS Work

The International Council on Nanotechnology (ICON) and Rice University's Center for Biological and Environmental Nanotechnology (CBEN) have been maintaining an online database of references to current work in nanotech environmental health and safety issues. They have now announced the launch of a new monthly online review journal, The Virtual Journal of Nanotechnology Environment, Health & Safety (VJ-Nano EHS). The new publication will contain primarily items added to the database during the current month, so that users can easily keep up with progress in the field. The site will also provide a series of occasional papers, access to the whole database, and a capability for search by a number of different aspects of the work reported, such as risk exposure group, particle type, and exposure pathway. The journal may be accessed at <http://icon.rice.edu/virtualjournal.cfm>.

Nano coalition launches virtual journal on risk research

http://www.eurekalert.org/pub_releases/2007-03/ru-nc1032207.php

Nanotoxicology Conferences to Be Held in Venice in April

The 2nd Nanotoxicology Conference will be held 19-21 April 2007, on the island of San Servolo, Venice, Italy in conjunction with the Informa Healthcare Journal, Nanotoxicology. Coverage will include the latest ideas and results in nanomaterial pharmacokinetics, (eco)-toxicity, exposure assessment, and risk assessment.

Nanotoxicology 2007

<http://www.informaworld.com/smpp/nanotoxconference>

Nanotech Products Meeting in London in May (MEETING)

A meeting, Nanotechnology – Products for Environmental Benefit, will be held in London, 16-17 May 2007, by The Royal Society, Carlton House Terrace. The meeting will examine nanotechnologies that are described as offering real environmental benefit, and will also review the findings of the recently published STOA report on the Role of Nanotechnology in Chemical Substitution. '

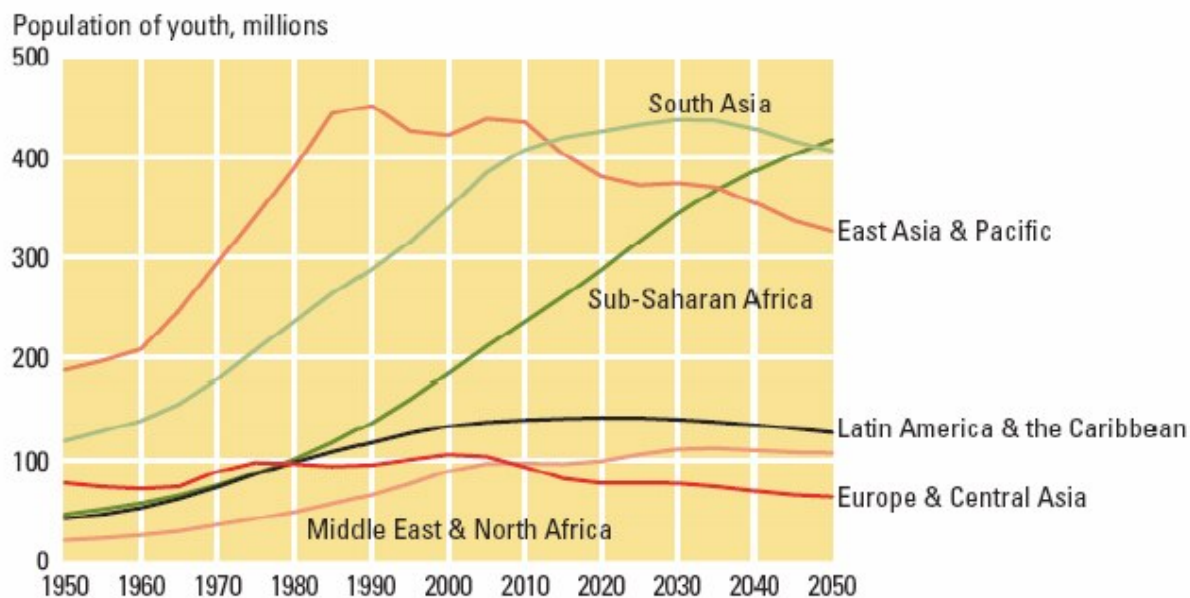
'Nanotechnology – Products for Environmental Benefit' (16-17 May 2007, London)

<http://www.nano.org.uk/newsletter/environment/index.htm>

Item 8. Reports Suggested for Review

8.2 Population and Resources Affecting the Risk of Conflict

Regional youth population trends



Source: United Nations (2005b), medium variant.

Conflict Hotspots and Rainfall Anomalies

