



American Council for

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Millennium Project 2020 Global Energy Delphi

On behalf of the Millennium Project of the American Council for the United Nations University, we have the honor to invite you to participate in an international study to construct alternative global energy scenarios to the year 2020.

The study has three phases. During the first phase, the Millennium Project's staff produced an annotated bibliography of global energy scenarios and related reports. This was used to design the attached Delphi questionnaire for Phase 2. Your judgments are sought about potential developments that might affect the future of the global energy situation. The results of this survey will be shared with the participants and used to construct draft scenarios which will be circulated to you for comments in the third and final phase.

The Millennium Project is a global participatory system that collects, synthesizes, and feeds back judgments on an ongoing basis about prospects for the human condition. Its annual *State of the Future*, *Futures Research Methodology*, and other special reports are used by decision-makers and educators around the world to add focus to important issues and clarify choices.

You are invited to use a new "real-time" (or "roundless") approach to the Delphi method in this study at <http://RTDelphi.Energy.org>. This method allows you to provide and revise your judgments about potential future energy developments until the study is completed on January 11, 2006. The new approach allows you to return to the questionnaire as many times as you like to view other participants' comments during this same period (no attributions will be made). You may revise your comments as often as you wish up to the deadline. If for any reason you do not want to use this approach, or stop in the middle of using it, a more standard questionnaire is attached to this invitation and is available at: <http://www.acunu.org/millennium/energy-delphi.html>, which can be also filled out online or downloaded to be filled out at your leisure and returned as an attached file prior to the deadline.

The results of all three phases of this international study will be published in the 2006 *State of the Future*. Complimentary copies will be sent to those who respond to this questionnaire. **No attributions will be made**, but respondents will be listed as participants.

Please return your responses by January, 11 2006. We look forward to including your views in the construction of alternative global energy scenarios.

Jerome C. Glenn, Director, AC/UNU Millennium Project
Theodore J. Gordon, Senior Fellow, AC/UNU Millennium Project

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2020 Global Energy Delphi Introduction

A series of new global energy scenarios will be written on the basis of responses to this questionnaire. You are invited to provide judgments about statements that will help construct those scenario, such as:

- Estimates of when certain developments may occur.
- Narrative suggestions about elements that should be considered for the scenarios
- Expectations about the contribution of various energy sources
- Recommendations for energy policies.

Your answers will remain anonymous although your name will be listed in the final report as a participant. Please answer only those questions about which you are expert or feel comfortable. Leaving sections blank is a very acceptable answer.

This questionnaire refers to four scenario themes:

- 1. *Business as usual.*** This scenario assumes that the global dynamics of change continue without great surprises or much change in energy sources and consumption patterns, other than those that might be expected as a result of the change dynamics and trends already in place.
- 2. *Environmental backlash.*** This scenario assumes that the international environmental movement becomes much more organized; some lobbying for legal actions and new regulations and suing in courts, while others become violent and attack fossil energy industries.
- 3. *High tech economy.*** This scenario assumes that technological innovations accelerate beyond current expectations, and have impacts in the energy supply mix and consumption patterns, to a similar magnitude as the Internet initiated in the 1990s.
- 4. *Political turmoil.*** This scenario assumes increasing conflicts, wars, and several countries collapsing into failed states, leading to increasing migrations and political instabilities around the world.

Some factors are common to all scenarios, although they may differ in importance and magnitude. You are invited to judge how they differ. So that we may send you the results and or demographic analysis please enter:

Name: _____

Address: _____

Country: _____

Primary employment:

Government Business University Non-profit organization (NGO)
 International Organisation (OECD, UN, etc.) Private Consultant, author
 Female Male

Section 1. Developments that might affect future energy conditions

Please provide your judgments about the year you think the following developments might occur in each scenario. In the same space, you are invited to make any comments about your estimate that you wish. An example is provided in the first development. You are welcome to change that.

The last row of the matrix invites your additional suggestions of other developments that you think should be considered in constructing the scenarios. You may enter as many new developments as you like.

Four Alternative Global Energy Scenarios for the year 2020

When might these developments occur in each scenario	Scenario 1. Business-as-Usual	Scenario 2. Environmental Backlash	Scenario 3. High Tech Economy	Scenario 4. Political Turmoil
1.1 Hubbert Peak when half the conventional oil is gone (but conventional may one day in the future include deep drilling, tar sands, and shale)	2020	2030	2050 advanced tech changes definition of reserves, and different sources, and efficiencies	2015 conflicts use oil and destroy oil
1.2 Affordable photovoltaic cells with >50% efficiency are available				
1.3 First demonstration of cost-effective generation and delivery of base load electricity from solar earth orbital satellites				
1.4 A solution is found for long-term safe storage or destruction of radioactive waste				
1.5 One million electric cars per year are produced, plurality manufactured in China				
1.6 New credible fission technologies are developed to solve problems of nuclear generation; improved security, reduced risk of malfunction				
1.7 High efficiency				

engines power 25% of new cars; e.g. using Stirling engines				
1.8 30% of electrical power is generated at the point of use				
1.9 Significant portions of urban centers in most major cities are closed to private vehicle traffic, or have a system of tolls for entry by cars.				
1.10 The amount of energy consumed per dollar of GDP worldwide drops 25% from today's value				
1.11 Industry consolidation continues, resulting in only a few large oil companies in the world				
1.12 Water problems destabilize India and China, lowering economic growth, and causing coal and oil demands to fall.				
1.13 The geopolitics of gas becomes as central to energy growth as the geopolitics of oil was in the last 30 years of the previous century				
1.14 Carbon trading practiced by 30 of top 50 emitting countries				
1.15 Carbon taxes in one form or another in more than 50 countries				
1.16 Terrorist attack on oil production and/or delivery systems disrupts supply by 5-10% for at least 1 month				
1.17 Majority of major new buildings in developing countries are designed for low energy consumption				

1.18 Most countries have policies to achieve significant shifts in fuel mix, including removal of subsidies on coal and other fossil fuels				
1.19 Please enter additional developments that you believe should be considered in these scenarios:				

Section 2. Global Energy Scenario Elements

The table below suggests four global energy scenarios and elements that should be considered in each of these scenarios. Initial suggestions have been provided in the cells. You are invited to provide your judgments about these initial suggestions in the space provided in the cells below the given suggestion. If you agree with it, please type “agree” or if you want to change it and/or provide a comment, please enter it also just below the given suggestion in the cell. You do not have to fill in all the cells, just those about which you have expertise or feel comfortable providing your judgments.

Potential elements, to be considered for each scenario	Scenario 1. Business-as-Usual	Scenario 2. Environmental Backlash	Scenario 3. High Tech Economy	Scenario 4. Political Turmoil
2.1. Economic Growth Global GDP World depressions? Recessions? Growth spurts/accelerations?	Moderate to high economic growth until oil prices go so high they cause recessions, and depressions	Moderate to low economic growth, oil price fluctuates with environmental actions, supply disruptions	New tech and great efficiencies prevent oil peak prior to 2050	Low economic growth, recessions/ depressions
2.2 Demand - per region and/or economic grouping	China and India continue to drive prices and supply of oil	Environmental action reduces demand mostly in Europe and US	Technology advances affect mostly First World demand and usage	Wars consume energy resources and prevent development of new sources

2.3 Economies successfully adapt to factor of 50% increase in energy prices without undue inflation.	Not initially, but adjustments by 2015	Inflation occurs but adjustments by 2020	Prices moved lower by 2020 not requiring adjustment	Inflation occurs as the result of both energy cost and conflicts
2.4 Changes in human values, wealth and expression of status	Moderate to low	Moderate to high conservation	Moderate	Little to none
2.5 Motivations, social purposes	Economic and social status focus, expansion of Corporate Social Responsibility (CSR)	Sustainable development energy conservation, environmentalist development paradigm	Positive high tech meme epidemics	Survival, security
2.6 Global GDP/Capita				
2.7 Possible price of oil in 2020 (in today US\$)	Around US\$ 50/barrel	Over US\$ 100/barrel	Below US\$ 50/barrel	Over US\$ 125/barrel
2.8 Environmental Movement Impacts	Some impact. Irregular focusing on legislation and treaties	Larger impact on regulations and treaties. International coordination of strikes on fossil fuel key points	Full range of cooperation with high-tech and environmental movement to various forms of resistance	Focus on environmental security issues

2.9 Key environmental events/developments	Many environmentalist accept nuclear power as counter global warming alternative	Nuclear power plant accident in India pollutes Indian Ocean	Environmental-High Tech Summit	Pipelines and refineries attacked during political problems in Saudi Arabia and Nigeria
2.10 Amount of carbon emissions in metric tonnes	20 billion tonnes	5 billion tonnes	3 billion tonnes	30 billion tonnes
2.11 Status of carbon sequestration, capture, storage, science, policy	Some moderate progress	Very aggressively pursued. Carbon trading cost exceeding CO ₂ capture/sequestration costs increase the latter	Aggressively pursued	Little
2.12 Key Technological Breakthroughs	NextGen Coal Plant, Nuclear Ocean and land wind farms, solar towers	Ocean wind cities (nanotech 3-layer sheets change photovoltaic efficiencies)	Wireless energy transmission. If coal can be burned with low CO ₂ emissions, then US, China, Russia, Nigeria benefit	Military portable energy production, storage and transmission systems
2.13 Artificial bacteria and other micro-organisms are created	Likely	Some cases. Environmentalist split on the issues	Very likely	Not likely

to produce fuels and chemicals by 2020.							
2.14 Main transportation energy sources	Gasoline, dual fuels (gasoline and ethanol), and hybrids	Mix of gasoline, electric, natural gas, biofuels, hydrogen	Electric vs. hydrogen, new hybrids	Gasoline and hybrids			
2.15 Percentage of all new vehicles powered by hydrogen in 2020	5%	10%	15%	0%			
2.16 Percentage of all new vehicles powered by biofuels in 2020	15%	20%	25%	3%			
2.17 Percentage of all new vehicles powered by electricity in 2020	5%	15%	10%	2%			
2.18 Percentage of all new vehicles that are hybrid in 2020	20%	30%	30%	10%			
2.19 Percentage of all new vehicles powered by gasoline in 2020	60%	25%	30%	85%			
2.20 Total energy efficiency gains 2006 to 2020	15%	20%	40%	5%			
2.21 Conservation gains From base 2005	Moderately pursued	Very aggressively pursued and forms of rationing and regulation	Not pursued, but realized by more elegant technological design	Not pursued			
2.22 Energy Transmission	Electric grids become more efficient, some nanotech batteries, little hydrogen	Electric grids more efficient, many innovations in batteries, some wireless energy transmission, little hydrogen	Greater efficiencies in electric grids, new kinds of batteries, wireless energy transmission begins, some hydrogen cars	Electric Grids moderately improved, military spin-offs for new kinds of batteries			

2.23 Geopolitics of war, peace, terrorism and changes emerging power dynamics	OPEC increases political power due to dramatic drop in non-OPEC supply by 2015	Green parties dominate European politics, increasing regulatory power	Political Transhumanists and technological optimists increase in power	Military industrial complexes, semi-regional trading blocs
2.24 Conflicts and terrorism	Increasing diversity of groups and methods Regional war over oil, pipeline sabotage	Some coordination between eco- and political-terrorism hits fossil fuel systems	Dramatically increased surveillance and sensor systems reduce terrorist events and conflicts	Several national wars over energy and water. New failed states, more terrorism. Water problems destabilize India and China, lowering economic growth, coal and oil demands fall.
2.25 Oil and gas pipeline construction factors	Russia to Japan implications for China both tapping and investing in Siberia (Putin's offer) Also Sakhalin Island off Russia's Pacific coast. US\$7 billion Japanese offer for Taishet-Nakhodka pipeline. Canada to US pipeline with Alaskan oil as well	Targets for environmental terrorists	Wireless energy transmission. Hydrogen transportation	Political/conflict implication of pipeline deals. New pipelines through Palestine and Israel as sources of both conflicts and potential peace settlements

2.26 Key Global/National Policies	Carbon trading, renewable portfolio standards, enhanced CAFE	Carbon taxes (US\$50/ton?) Product labeling, Tri-car fuels, legally binding renewable goals with subsidies and incentives for cleaner cars, stock market strategies, Alt. S&T Fund, global warming lawsuits begin with Greenpeace on Exxon	International Solar Satellite Consortium, ISTO, S&T Fund	International systems lack support
2.27 Major energy players (e.g. Will Saudi Arabia keep its dominance or will Canada challenge its position with the sand oil, and by what year?)	Middle East increases its role in world affairs. US-Japan-China increase energy dependence	Middle East decreases role with increasing roles from alternative energy tech from Europe-US-Japan	US – Japan on nanotech, Space Solar Power, Hydrogen suppliers	Conflicts in Saudi Arabia, China, Nigeria, Venezuela could benefit Russia's role.
2.28 Number lacking electricity in 2020 (today it is 2.3 billion)	1 billion	1 billion	0.5 billion	2.5 billion
2.29 Other economic elements to be considered for each scenario?				
2.30 Other environmental elements to be considered for each scenario?				

2.31 Other technological to be considered for each scenario?				
2.32 Other Geo-Political, War, Peace, Terrorism economic elements to be considered for each scenario?				

Section 3. Global Energy Sources

The current value per energy source is provided in the table below. Please enter your estimates in column 4 and 5 for these sources in the year 2020, assuming the business-as-usual scenario. You do not have to fill in all the blank cells – just those for which you feel comfortable providing your judgments. You may enter your estimate as a total amount in millions of tonnes (metric) of oil equivalent (Mtoe), as a percent of the total world sources by 2020, or both. Please also add any comments about your estimate you wish. For example, what might increase or decrease your estimate? Even if you did not provide an estimate, you are still most welcome to add comments about the status of that energy source for the 2020.

<u>Energy Sources</u>	Total amount now (Mtoe)	Percent world now	Total amount 2020 (Mtoe)	Percent world 2020	Comments:
Total world amount and percent of energy, (<u>not % electricity</u>)					
3.1 Total from all sources	11,411				
3.2 Oil (conventional ranges)	3678.4	32			
3.3 Unconventional oil from tar sands and shale	88.0** 0.7**	>0.1 >0.01			
3.4 Natural gas	2420.4	21			
3.5 Methane gas hydrates	0	0			
3.6 Coal (conventional)	2778.2	24			
3.7 Coal processes total from liquefaction, oxygenated, gasification					
3.8 Nuclear fission	624.3	5.5			
3.9 Nuclear fusion	0	0			

3.10 Solar (Photovoltaics on earth, solar power towers, solar thermal, and space solar power)	10.9*	>0.1			
3.11 Wind	8.5*	>0.1			
3.12 Hydro	634.5	5.6			
3.13 Geothermal	4.8*	>0.1			
3.14 Tides	0.08*	>0.01			
3.15 Traditional Biomass and waste	793*	6.9			
3.16 Other biomass	285*	2.5			
Methanol	39	>0.5			
Ethanol	45	>0.5			
3.17 Others? ▶ ▶					

Data Source: Unless otherwise specified, the data is based on BP Statistical Review 2005

* 2004 estimates based on the 2002 data and growth rates in World Energy Outlook 2004, International Energy Agency

** Data quoted in Wired News, Why \$5 Gas Is Good for America, <http://www.wired.com/wired/archive/13.12/gas.html>

*** Estimated Methanol and Ethanol consumption in mtoe based on its energy contents.

Section 4. What new policies would make a significant difference for improvement in the global energy condition?

Thank you very much for your participation. Please email this document as an attached file by January 11, 2006 to: acunu@igc.org with copies to jglenn@igc.org and tedjgordon@att.net.