Instructions and Group Worksheet

Thank you for being part of our discussion! It may be helpful to have someone read these instructions out loud to all the participants at your table.

Take time to hear how each of the individual members of your group would choose to allocate the research funding and **why**.

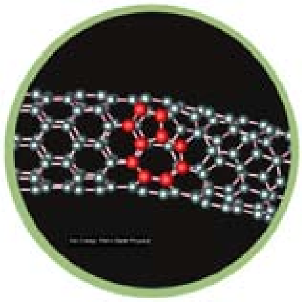
It is time for you to act as the NSF Board and come to a consensus about the allocation of energy funding for the coming year. This will require you to consider the points made by the speakers as well as the other members of your group. Be sure to consider and discuss the potential **benefits** and **drawbacks** of all of the options presented before making your final decision as a group.

Please elect one person to record the allocations decided on by your group.

1. Use the time allotted to make a group funding decision, and **record your funding allocations** on the **Initial Group Consensus Allocations Line** of the chart.
2. After making this decision, we ask your group to take a **discussion card** out of the envelope. Please read the card and as a group, discuss how, if at all, the information on the card changes your energy funding allocations. You will have five minutes to decide what your new allocation should be. After this time, record the new allocation on this sheet, making sure to record the card number in the left hand column.
3. Repeat step 2 and continue onto the next card (6 cards total).

ALLOCATIONS

PERSONAL ALLOCATIONS

Names of Group Members	Nanotechnology-Dependent Energy	Conservation and Energy Efficiency	Existing Alternative Energies
			
Initial Group Consensus Allocation	$	$	$

GROUP ALLOCATIONS

Card Number	Nanotechnology-Dependent Energy	Conservation and Energy Efficiency	Existing Alternative Energies
	$	$	$
	$	$	$
	$	$	$
	$	$	$
	$	$	$
	$	$	$

What were the reasons for your final funding decisions? You may include as many discussion points as you wish: feel free to include those at the bottom of this sheet.

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Background Information

We will be discussing energy issues and the emerging field of nanotechnology throughout this forum. The information below provides a brief introduction to the potential benefits and drawbacks of nanotechnology, and to how nanotechnology might address current and future energy concerns.

Rising energy costs, dwindling natural resources, pollution, and climate change concerns have drawn increasing attention to the relationship between human activity and the earth's environment. Alternative and renewable energy sources and efforts towards conservation are in the public eye and in the priorities of public service officials and industry leaders as never before.

Policymakers face difficult choices when deciding how to allocate funding for energy and the environment. Should the bulk of research funding be dedicated to the implementation of existing technologies, or should more effort be dedicated to designing new technologies that could be of greater long-term impact?

The field of nanotechnology presents special considerations. Nanoparticles could allow us to build ultra-efficient transmission lines for electricity[1], produce far more effective and inexpensive solar cells[2], make cheaper and more efficient biofuels from a wide variety of sources[3], improve hydrogen storage options[4] and performance of hydrogen fuel cells, and improve the safety and efficiency of existing nuclear reactors[5]. Nanoparticles have also demonstrated the ability to pull chemical pollutants out of the ground. These and other developments which could be made possible by nanotechnology might one day do far more to lessen human impact upon the environment than current alternative and renewable energy options. Despite its immense promise in the area of alternative and renewable energies, nanotechnology presents at least two points of major concern:

1. The scope and timetable of nanotechnology's contribution to alternative and renewable energies is uncertain. In a time when immediate action to address increasing energy costs and global climate change may be necessary, the ultimate benefit and risks and short-term promise of nanotechnology is still unknown.

2. Nanotechnology may adversely effect the environment and human health on its own. The toxicity of nanoparticles is not yet fully understood. For example, in some studies, nanoparticles have shown the capability to reduce pollutants in groundwater, but there is concern that they may end up in the groundwater themselves. Nanoparticles may also have as-yet unknown effects upon the health of humans and other animal and plant life. Buckyballs, which are one type of nanoparticle, have caused brain damage in fish, according to research done at Southern Methodist University, and carbon nanotubes have caused respiratory disease in mice and rats in several studies in recent years.

REFERENCES

1. http://www.sciencedaily.com/releases/2004/10/041019092642.htm
2. http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2005/07/11/BUG7IDL1AF1.DTL
3. http://www.physorg.com/news69944274.html
4. http://www.nist.gov/public_affairs/techbeat/tb2005_1201.htm#cages
5. http://web.mit.edu/newsoffice/2006/reactors-0920.html

MISSION STATEMENT OF THE NATIONAL SCIENCE FOUNDATION

NSF's continuing mission is set out in the preamble to the National Science Foundation Act of 1950 (Public Law 810507):

TO PROMOTE THE PROGRESS OF SCIENCE; TO ADVANCE THE NATIONAL HEALTH, PROSPERITY, AND WELFARE; TO SECURE THE NATIONAL DEFENSE; AND FOR OTHER PURPOSES

The Act authorizes and directs NSF to initiate and support:

- Basic scientific research and research fundamental to the engineering process,
- Programs to strengthen scientific and engineering research potential,
- Science and engineering education programs at all levels and in all fields of science and engineering, and
- An information base on science and engineering appropriate for development of national and international policy.

Over time, the following additional responsibilities were added to the agency's mission: (1) foster the interchange of scientific and engineering information nationally and internationally; (2) support the development of computer and other methodologies; (3) maintain facilities in the Antarctic and promote the U.S. presence through research conducted there; and (4) address issues of equal opportunity in science and engineering.

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Personal Sheet/Scenario

Please take a few minutes to read this scenario, and then record your reactions.

Imagine you are a member of the board of the National Science Foundation (NSF), the largest federal funding agency for energy research in the United States. How much funding would you provide to nanotechnology-dependent energy versus other existing alternative energies, versus conservation and energy efficiency?

$100 million is available for funding energy-related research and implementation in the coming year. These funds could be used to research new technologies, implement existing ones, or learn more about the potential hazards that these technologies present. The board must decide how it wants these resources allocated. You can decide to fund all, some, or none of the options below with the funding available to you, but you must decide how much money to spend on each and give reasons for your recommendations.

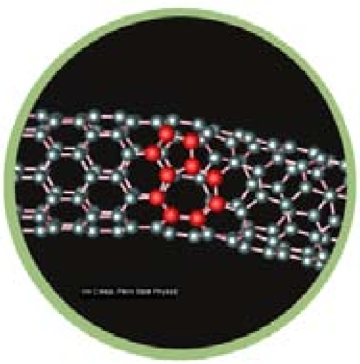
1. **Allocate funding towards existing alternative energies.** Wind and hydroelectric energy, nuclear energy, silicon-based photovoltaic cells, solar hot water systems, biofuels, and many other technologies exist today without the use of nanotechnology. Putting research into expanding and improving these areas might produce a faster impact upon the environment compared with research into nanotechnology. The long-term effects of these more conventional alternative and renewable energy sources might be less than nanotechnology can deliver… or they might be greater.

2. **Allocate funding towards conservation and energy efficiency by improving existing conventional technologies.** According to the EPA, the fuel economy of the average passenger vehicle is the same in 2007 as it was twenty years ago. People across the world are using more energy for their appliances and household electricity each year. Many advocates recommend that the greatest impact would

involve putting research into improving existing technologies such as the gasoline internal combustion engine, and educating the public on ways to cut their own electricity and fuel usage whenever possible.

3. **Allocate funding towards nanotechnology-dependent energy.** The field of nanotechnology could deliver world-altering changes in the ways we create, transmit, store, and use energy. Nanotechnology could produce super-efficient batteries, low-resistance transmission lines, clean up water, or make solar cells far more efficient and less expensive than they are today. However, the likelihood and time frame of these developments is unknown. In addition, the toxicity and regulation of nanotechnology is not well understood.

BEFORE discussing with the other members of your group, please write how much of the **$100 million** YOU would choose to allocate towards each of the following research options.

Nanotechnology-Dependent Energy	Conservation and Energy Efficiency	Existing Alternative Energies
		
$	$	$

After the members of your group have had time to record their personal allocations, you will have time to share and discuss your decisions with the others at your table.