EXPERT DEBATE AND DISCUSSION

"NUCLEAR POWER: WHAT DOES THE FUTURE HOLD?"

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MR. JOHN PODESTA: Welcome. I'm John Podesta, the president of the Center for American Progress and welcome this morning. The title of our program today is "Nuclear Power and Nonproliferation: What the Future Holds."

We know that to some this might, I guess, sound a little bit provocative. After all, it wasn't long ago that suggesting nuclear power might have a place in America's energy future would have been a little bit laughable. The economics, combined with safety, storage, and proliferation questions made new construction out of the question. Well, today I guess people aren't laughing anymore, and I think there are some reasons for that. According to the latest climate science, since the mid-1800s the temperature of the earth has risen by .8 degrees Celsius, 1.4 degrees Fahrenheit, for those of you who need the conversion. The Intergovernmental Panel on Climate Change projects an additional increase of 1.4 to 5.8 degrees Celsius by 2100.

So even under the best case scenario, average surface temperatures are going to rise by 2.5 degrees Fahrenheit, even if we actually got started, which we don't seem to be doing today. What we know what that means; it means drought, disease, changes so catastrophic few of us can envision them. Let me give you one example. As a result of climate change, the world's glaciers are literally disappearing before our eyes. As they do, the prospect that sea levels will rise to dangerous levels looms larger by the day.

We know that if Greenland's ice sheet were to completely melt, the ocean would reclaim the Everglades. If warming were to progress so far as to melt Antarctica's western ice sheet, Florida would end at Lake Okeechobee; Miami and the New Orleans would become America's Atlantis. How likely is this? Well, the reality is that the great ice sheets are melting and the more – (audio gap) – nuclear energy comes in and nuclear power comes in.

In 2002, the most recent year that we have complete data for, the world used over 14,000 terawatt hours of electricity; nuclear power provided 17 percent of the total. Of the 3,600 terawatt hours of electricity used in the United States that year, nuclear power generated about 20 percent, yet that same year the world emitted over 24 billion metric tons of greenhouse gas carbon dioxide into the atmosphere from the use of fossil fuels.

The U.S. was responsible for nearly six billion tons of that total, two billion of which came from burning coal for electricity. And by the year 2020, forecasters estimate the world's energy consumption will have grown by 75 percent, with China and India leading the way.

What all these numbers add up to is a simple proposition: in order to prevent dangerous climate change and meet the world's growing demand for energy, we must

increase the use of low and no-carbon energy sources. Against that backdrop, nuclear power and new plant construction are back on the table. Of course, that has its own challenges. There was periods of time when the industry claimed that nuclear power would generate some electricity so cheaply that it would hardly be worth metering. We know just how fanciful that notion was. The truth is that in a world which freely burns pulverized coal, nuclear power will never be cost competitive. However, by limiting greenhouse gasses, the cost of carbon dioxide emissions will grow, making nuclear power more economically competitive, but the economic challenge of nuclear power may be the easiest thing to solve.

This month is the 26th anniversary of the partial meltdown of the reactor core of Unit Two at Three Mile Island nuclear power plant in Pennsylvania. Since that accident, no new nuclear power plants have been built and the public still remains wary of nuclear energy.

Now, in a process guided more, I think, by politics than geology today, more than 23 years after passage of the Nuclear Waste Policy Act, the United States does not yet have a viable, functioning repository or method of disposal for nuclear waste, and the question still remains as to whether generating stations can ever be as well protected as they must be. These issues take on even greater urgency in the wake of 9/11 and the growing threat of terrorism involving radiological or nuclear weapons.

In this regard, I'd like to draw your attention to the latest installment of a series that we're putting out called Progressive Priorities at the Center for American Progress. We issued today a new report which addresses the alarming spread of nuclear weapons worldwide. On March 5, 1970, 35 years ago this Saturday, the cause of world peace took a giant step forward with the enactment of the Nuclear Nonproliferation Treaty. In our *Agenda for Security: Controlling the Nuclear Threat*, we outline a series of measures that can build on the success of the NPT and enable us to meet today's nuclear threat.

And meet it we must, because in spite of its challenges, nuclear energy has to be viewed as an alternative to control and even reduce carbon dioxide emissions. So the question we're going to hear today is whether nuclear power is still a genie best kept in the bottle or faced with the reality of global warming has nuclear energy now become, to coin an old phrase, an appropriate technology?

To help is considered the question, we brought together three leaders of the field of energy policy who each have markedly different perspectives on the issue. Our panel includes Dr. John Deutch, who's an institute professor at the Massachusetts Institute of Technology. He co-chaired MIT's 2003 Interdisciplinary Study of the Future of Nuclear Power. Both Tom Cochran and I served as part of the citizens committee that reviewed that report. Dr. Deutch has served as the Director of Central Intelligence, the Deputy Secretary of Defense, Undersecretary of Defense for Acquisitions and Technology. From 1977 to 1980 he served in the U.S. Department of Energy as the Director of Energy Research, acting Assistant Secretary of Energy Technology, and Undersecretary of the

Department. He also serves as a member of our – of the Center for American Progress's board of trustees.

Dr. Burton Richter is the Paul Pigott Professor of Physical Sciences at Stanford University. In 1976 he received the Nobel Prize in physics. He's been professor at Stanford since 1967 where he served as the director of the Stanford Linear Accelerator Center. He's a member of the National Academy of Sciences and the American Physical Society, which he served as president in 1994. He also served as the president of the International Union of Pure and Applied Physics. Presently he's a member of the Department of Energy's Secretary of Energy Advisory Board on laboratory operations, and on its nuclear energy task force.

Dr. Tom Cochran is director of the Nuclear Program and holds the Wade Greene Chair for Nuclear Policy at the NRD – the Natural Resources Defense Council where he initiated NRDC's Nuclear Weapons Databook Project. He is a member of the Department of Energy's Nuclear Energy Research Advisory Committee. He served on numerous advisory committees at the Department of Energy. He's the recipient of the American Physical Society's Szilard Award, and the Federation of American Scientists' Public Service Award. Because of his work, NRDC received the 1989 Scientific Freedom and Responsibility Award from the American Association for the Advancement of Science. Dr. Cochran is a Fellow of the American Physical Society and the AAAS.

I've asked each panelist to make about a ten-minute opening statement, and then I'm going to pose a few questions to the panel, let them interact a little bit, and then we're going to open it up to the floor. So it's my pleasure to turn it over to my esteemed colleague and friend to talk a little bit about the study that he conducted at MIT last year and to keep some reflections on the NPT.

Dr. John Deutch.

DR. JOHN DEUTCH: Thank you very much. John Podesta is right: this panel has a lot of different views on it. And Burt and Tom are old friends of mine, but I want to help you decode – you the audience – one person on this panel is good-looking, one person is intelligent, and one person is wrong. (Laughter.) I'm leaving it up to you to decide which is which. (Laughter.)

Now, why should we care about giving nuclear power another chance? The answer is simple: if you care about the environment, you have to be willing to relook at nuclear power. First point is that nuclear power has no criteria pollutant emissions, no emissions of NOx, $S0_2$, particulates, or Mercury. And the second, and in my judgment more important, reason is it avoids carbon emissions. CO_2, carbon dioxide from power plants, represent about 30 percent of the emissions of greenhouse gasses throughout the world, and the possibility exists of using nuclear power to displace some of those emissions.

It was that concern with constraining carbon emissions that led a group of faculty at MIT to undertake the study on the future of nuclear power that John referred to. John and Tom served on the advisory committee of that study to look at what might be done responsibly about nuclear power to avoid these carbon emissions.

And let me tell you the way we thought about it. Today's there are about 300 large reactor equivalents of nuclear power around the world. They represent roughly 14 or 15 percent of the world's electricity use. Let's go to mid-century. And at mid-century if nuclear were to maintain its same proportionate share; that is, not to grow at a greater share compared to coal or natural gas for electricity generation, just maintain that 15 or so percent share, it would avoid about four billion tons of CO_2 emissions, about one sixth of today's emissions, and one sixth of the increment that is expected if there's business as usual around the world.

So nuclear energy can make a significant contribution to limiting CO_2 emissions, but by itself it cannot solve the problem. In order to solve the problem, we're going to have to put all measures together. We'll have to reduce demand for energy, improve our energy efficiency, we're going to have to use renewables, and we're going to have to continue to use coal and turn to carbon capture and sequestration. So there's no silver bullet here, but nuclear energy has the potential of making a real contribution.

One of the problems, the problems that John – as already has been mentioned by John, one is poor economics. Nuclear energy today is very costly. The second is safety. The third is responsible waste management, and the fourth is nonproliferation. Because of my limited time, I just going to make a word statement about economics and then turn to the issue of proliferation on this occasion of the 35th anniversary of the Nonproliferation Treaty.

Our best estimates in the MIT study were that a new plant operated under commercial circumstances, the cost of electricity for nuclear power would be about 6.7 cents per kilowatt hour at the plant gate. By comparison, business as usual with no special controls on CO_2 emissions, the cost of carbon of a coal plant would be about 4.2 cents, so nuclear power is at least 50 percent more expensive. Natural gas used to be much cheaper, but of course now with the huge spike in natural gas prices, which I don't think anyone anticipates going away, it would be more expensive than a coal plant and similar to the nuclear plant.

If you take all improvements that are promised about reducing the cost of nuclear power, reducing construction costs, construction times, reducing operations and maintenance expenses, you might get that cost down to the level of carbon – of a coal plant. But what makes nuclear power potentially more economic is that a carbon charge will be – carbon emission charge will be imposed in the United States, as I eventually think it will, and if there is a carbon charge – a charge for carbon emissions, then nuclear power becomes a very economic and attractive choice. But there are other issues as well: safety and waste and proliferation.

Let me say a word about proliferation because in some sense, in my mind, that's the most important barrier to the expansion of nuclear power. The growth I mentioned from 300 plants worldwide to a few thousand plants worldwide at mid-century would have maintained the same share of the electricity generating market. Many of those plants will be built in parts of the world which are growing very rapidly, but are in countries where there might be concern about the possible misuse of nuclear energy to produce materials and technology useable in bombs. So it's very important we take into account more stringent proliferation measures that are currently available if we are going to expand the use of nuclear energy.

And this study, the MIT study, dwelt a lot about how we could strengthen our proliferation barriers to assure that commercial power does not become a source of proliferation of technology or materials. This means, basically, restricting enrichment and restricting reprocessing, the most dangerous parts of the fuel cycle because they – the access to enriched uranium, not useable in bombs, but as an important source material for bombs, and reprocessing where plutonium is available, which is directly useable as bombs.

It is important that we do not let these barriers get smaller, and that means a specific proposal has been made in this study and later by a group of us and others that we should today have a moratorium on any new enrichment or reprocessing facilities for a period of time to avoid the highest proliferation risk. That means countries like Iran or countries like Brazil, who are considering the operation of new enrichment facilities, should stand down, and in exchange for that there should be an assured – assured supply of fuel to these countries at low prices – at attractive prices so these countries do not have an incentive to build these dangerous facilities. It's very important that the supply of uranium fuel be assured so the country who decides not to build an enrichment facility or reprocessing facility has the confidence that the international community will provide them with fuel.

What are the implications for government policy? Well, let me conclude on that. First, government policy at the Department of Energy today should be focusing all of its efforts and all of its available resources on today's once-through nuclear technology. It should be especially paying attention to helping industry reduce costs of construction and management – reduce costs of construction and operation. It should work on getting an effective and licensed and operating waste management facility, waste disposal facility, and of course continue to support the safety measures as much as possible for nuclear power. It's got to focus on today.

Any assistance for new nuclear plants which might be considered by the Congress in legislation should be similar to those incentives that are offered to any carbon-free technology, such as wind; that is, production tax credits of about the same magnitude over the lifetime of the plant.

And third, the Department of Energy should avoid research and development on advanced fuel cycles which involves reprocessing itself, which are not going to be needed

by the industry in this country for well over a half a century, perhaps more like a century; and avoid giving the impression to the rest of the world that we are taking advantage of dangerous technologies while we're asking others to forego them.

So I ask for all Americans who care about environmental quality, who are concerned about a secure and growing demand for energy to fuel our economy over the next decades to consider both the potential of nuclear energy, but also to be assured that these important matters of safety, waste management, and proliferation are managed as well.

Thank you very much.

MR. PODESTA: Thank you.

We'll next turn to Dr. Burton Richter.

DR. BURTON RICHTER: Well, as John said that only one of us three was wrong and John and I agree on many things, that leaves Tom – (laughter) – as someone who has to be wrong.

Considering the rapidly increasing world demand for energy and the effect on the environment of world energy use, nuclear energy is clearly part of the solution, not part of the problem. Our projections of primary energy demand show that over the next 50 years, primary energy demand is going to double from 14 terawatts today to 27 terawatts, and it's going to go on to something like 46 terawatts in 2100. And this increase in demand, as John said, is mainly driven by economic growth in the developing nations, which is now and is projected to continue to be much larger than in the industrialized nations.

In 2025, China will be using as much primary energy as the United States. The great increase of demand is leading to supply constraints for oil where oil demand is increasing by 1.5 million barrels per day per year, and natural gas where transportation constraints are the problem. People don't like liquid natural gas parts.

The world will use a lot more energy, and if we are to limit global climate change, most eventually has to be carbon free. John mentioned the latest report of the Intergovernmental Panel on Climate Change: we are heading in a business-as-usual scenario to 750 parts per million of carbon dioxide in 2100. That's nearly a tripling of the preindustrial level with a consequent big increase in temperature.

We need to begin to deal with this soon. The longer one waits, the harder it gets. It takes about 100 years for carbon dioxide to come out of the atmosphere naturally. If you let it build up, it's a lot harder to handle, and there are only two energy sources available today to make an impact on a large scale. One is conservation and efficiency. Energy that you don't use is nonpolluting. The other is nuclear power, which emits no greenhouse gasses and where the fuel supply is not constrained.

The renewables, which everybody has a lot of hope for are simply not ready for prime time now. And they are not going to be ready until somebody figures out how to handle energy storage. The sun doesn't shine all the time and the wind doesn't blow all the time, and you cannot run a society on an energy system that turns on and off. Coal with carbon dioxide sequestration will eventually play an important role, but that won't happen for decades.

That nuclear energy can reduce greenhouse emissions is demonstrated by France. France has the largest fraction of nuclear electricity in the world and if you look at CO_2 emissions per unit GDP – this is purchasing power parity GDP, France is half the average of the world. We run at the average of the world, so if you nuclearize the economy as much as France, you would decrease CO_2 emissions by a factor of two. This dwarfs anything you can do with this Kyoto treaty.

But if nuclear power is going to expand, three issues have to be dealt with. The public has to be convinced that there's a satisfactory way to deal with spent fuel and safety, and governments have to be convinced that nuclear power can be expanded without easy proliferation of weapons. There's not much argument about the safety of the kind of reactors used outside the old Soviet bloc. The newest designs are simpler than the old and easier to operate.

Most people don't realize that there are over 30 nuclear power plants now under construction around the world. Twenty of them are in Asia. Two of them are in Europe. Sweden, which had originally planned to shut down all its nuclear reactors, did shut down one and now doesn't plan to shut down any more. It's only in the U.S. that nuclear power is not yet restarted.

Safe disposal of radioactive waste, I think the science community would agree, is more a political problem than a technical one. The technical problem comes from one of the three components of spent fuel. Fission fragments generate most of the radioactivity in the beginning. They only give problems for about 200 years, and everybody thinks it's easy to contain. Uranium is most of the waste, and it has negligible radioactivity and a long-lived component amounts to about 1 percent and has to be isolated for 300,000 years or somehow treated to allow it to be isolated for shorter than that, and that long-lived component is primarily plutonium, americium, neptunium, and curium.

Technically, there are ways to keep the hazardous waste out of the biosphere for as long as they're hazardous. I think everybody would agree that missteps by Congress, the Department of Energy, and by the EPA have left us with a confused mess that will need considerable political as well as technical efforts to straighten out. But tied into dealing with spent fuels are concerns about proliferation of nuclear weapons. We have restricted ourselves to the once-through fuel cycle, keeping the spent fuel whole, and sending it straight to a geological repository.

The theory is that the intense radiation from fission fragments blocks access to the plutonium, but you should note three things. The once-through fuel cycle leads to continuing buildup of plutonium in the world. As the fission fragment radiation decays away, this plutonium becomes more accessible. You are turning your repository into plutonium mines in about 200 years. And the once-through fuel cycle requires that you do more uranium enrichment, thus increasing the chances for diversion.

And what you've got to do is balance all of these things. There no sharpness (inaudible). Most of the world disagrees with us about the proliferation risk. Most of the world reprocesses spent fuel separating out the plutonium, mixing it with uranium to make what's called MOX, mixed oxide fuel. That can be loaded and burnt into current reactors and it's possible this way to stabilize plutonium to stop its buildup and even, in fact, to build it down. Disposing of the residue can be done. You can mix it with fission fragments, vitrify it, and tests on the glass, at least in France, show you have something that will last about a million years. Reprocessing also opens the possibility of transmutation, which has the potential, if it all works out, to decrease the isolation time to on the order of 1,000 years.

When you think about proliferation, I believe you have to think about it from two different directions. One is proliferation by nation-states. As we've seen from the weapons developed in such programs as North Korea, and in a recently terminated program in Libya and in others, the only way to prevent nation-states from proliferating is by strong and binding international agreements. A new international regime is needed, and for a change our president and Mohammed ElBaradei, the head of the International Atomic Energy Agency, completely agree that what you need to do is international the fuel – internationalize the fuel cycle, both the front end of the fuel cycle in the enrichment and the back end in however you're going to treat it.

If such a scheme were ever to be implemented, the group of nations or international organizations that supply fuel has to be strictly limited, but we really ought to face the fact that it has to be politically diverse. Any country interested in nuclear power has got to believe that there will be a secure source of fuel if that country gives up the right to make its own. So the United States gets mad at them, the European Union gets mad at them, or China gets mad at them, they still can get the fuel from someplace. That's something for the politicians.

Proliferation by nongovernmental organizations such as Al Qaeda is a problem of concern to all. It is far more likely that these organizations will attempt to get nuclear weapons by stealing them or buying them, rather than by reprocessing spent fuel by trying to set up a plutonium separation system in a cave in Afghanistan and making a plutonium implosion weapon, which is a pretty sophisticated job.

An effective international system to reduce proliferation is needed, but that's more an issue for governments in the fuel cycle than scientists. And internationalization would be a great boon to smaller countries in using nuclear energy. An expanded nuclear future is both more secure and less polluting, and we should get on with it, and we must

recognize that we are only part of the world. We have 100 of the 300 reactor equivalents that John Deutch mentioned, and if nuclear power expands, we will have 300 of the projected 1,000, and it's time we recognize that what we do is not necessarily what everyone else is going to do, and we've got to reach an international consensus on how to proceed.

Thank you.

MR. PODESTA: Thank you.

Dr. Tom Cochran?

DR. THOMAS COCHRAN: Hi. You have some of my slides and you can get the PowerPoint electronically if you send me an email or send John an email. I have more slides than I can go through in ten minutes, so I'm going to hurry through these and – some of these, and you can look at them more carefully at your leisure.

Of course, nuclear power would be a great solution to greenhouse gasses but for the four problems that have been mentioned: it's uneconomical, it has a safety problem, it has a horrendous proliferation problem on the global level, and it has a long-term waste problem that hasn't been solved. So I want to sort of look at where we are on some of these issues.

John Podesta is right that the issue here is global warming, and so the – and the issue for us is which way are we going to go? Are we going to attack global warming by capping greenhouse gas emissions, which is the economically-efficient way to solve this problem, or are we going to try to attack it by subsidizing nuclear power – one to six nuclear power plants, which in the end I don't believe will lead to any significant reduction in greenhouse gas emissions?

As John Deutch mentioned, nuclear power – existing plants are economical, but new plants are not. We haven't had a new plant since 1973. As John said, the MIT study – I agree nuclear, at least in 2003, was 60 percent more costly than coal or gas plants. What's the proposed solution from the industry? To have the government pay for a few nuclear plants, and they'll do this through the DOE program, through sharing the costs of early site permits and construction and operating licenses, and then the big money comes in the energy bill where they will subsidize the cost difference between nuclear plants and fossil plants.

The budget for nuclear in the DOE energy budget for this year is half a billion dollars. When you look at the – who gets the money, the R&D money, nuclear and fossil get about 70 percent of it. You ask why are renewables not ready; well, because historically we've been dumping our R&D money into a nuclear program and not sufficient money in renewable budgets.

I'm going to focus on the nuclear power 210 program, which is not really a R&D program at all. It's a direct subsidy to the industry. The purpose of this program is to get the industry to build one new nuclear plant. And here's the budget, the total subsidy over nine years is about $365 million. This is just the beginning of the subsidies to get a new nuclear plant. DOE is sharing the cost of early site permits and then sharing the cost of construction and operating licenses with energy-generating companies. Here are the companies that sought the subsidy from the early site permits.

By the way, they don't agree to construct a new nuclear plant when they get these subsidies, and why should they? If they don't, they stand to gain additional subsidies at the construction and licensing stage and then even more at the construction stage. These early site permits that the company is paying for are just financial assets that these companies can bank and sell.

DOE has asked for solicitations for – to share in the cost of the construction and operating licenses and they have substantial responses from two consortia: Dominion and a consortium called New Start. Dominion, by the way, has six nuclear plants – is trying to buy two more. New start, if you add up the eight U.S. participants – generating companies, they own or operate 60 plants in the U.S., so what we're looking at is the government funding a bunch of energy-generating companies who already own 60 percent of all of the nuclear assets in the country; hardly people that need government funding to fund the licensing of new plants. Just in the way of their own net income, Dominion Resources' net income for this last year was $1.2 billion; GE $16.5 billion. Dominion was handed $9 million in DOE money for the licensing.

Here's the New Start folks. A combined net income of about $9 billion. They have assets of about $400 billion, so their net annual income is 25 times the budget – the entire DOE budget for this particular subsidy program. Again, they don't make any commitments. They take this money without any commitment to build a nuclear reactor, and why should they if there's money yet to come?

I just want to point out these early site permits have a 20-year lifetime and renewed for another 20 years, so your grandchildren will not be able to challenge any siting issues resolved in this early site permit stage; similarly with the safety issues with the construction plant.

Most of the construction subsidy will go to the reactor vendors: General Electric and Westinghouse. When General Electric was just passed as the largest company in the United States by Exxon Mobile, so it's now only the second largest company in the United States, perhaps the world, and we're to use DOE R&D money to subsidize this company. Whereas Westinghouse is actually a British company, so we're going to subsidize the British company so they can market nuclear power plants in China.

These are the reactors, and I won't go through these. I'll simply point out that the Westinghouse reactor has received its final design approval last year and is on schedule for certification. They're going to get – they're going to get the thing licensed because

they're marketing it in China. DOE says we are supposed to use this federal money to test the licenseability of these reactors. Meanwhile, for 25 years the industry had been redesigning the licensing process. It's a process of their own design, and it's largely to eliminate public participation in the process.

The – while Westinghouse has – while DOE is saying we want to subsidize this licensing process to make sure we can get this through the new NRC licensing system, meanwhile the chairman of the NRC is in China flacking (ph) the design that he hasn't licensed yet.

Just a little bit on the integrity of the Nuclear Regulatory Commission. The Nuclear Regulatory Commission permitted the sole owner of a low-level waste repository to maintain his license when they knew and it had been demonstrated in courts that he had paid the regulator – this is through a state regulation program monitored by the Nuclear Regulatory Commission – paid for his nuclear license by giving the state regulatory – state regulator $600,000 in gold coins, cash, and a ski condo. He was allowed to maintain his license under the current Nuclear Regulatory Commission licensing system.

Now, the big money – the construction money. It isn't enough to just give these guys the money to subsidize the permitting and licensing of these plants. The big money comes next. My friend, John, over here, he just wants to give them $2 billion dollars, but John Sununu and the former chairman of the NRC organized a task force under DOE and brought in the Wall Street bankers. They propose $3.6 billion dollars for subsidy. Oh, but that's not enough: you go to the energy bill and listen to what the industry is really trying to get out of the Congress; it's $5.7 billion. Is that enough? No. New Start – one of its (inaudible) say they want more. They want two tax credits supporting the (inaudible).

Now, let's talk about the proliferation issue. Why are we subsidizing expansion of nuclear power to solve global warming without first solving this proliferation issue? In order to have a global impact on CO_2 emissions from nuclear, as John's study proposed or examined – looked at expanding nuclear to around 1,500 gigawatts by the middle of the century. By the way, that's introducing two plants a month globally; two plants a month. Two new plants a month. And if you use the ratio of plants globally to plants in the United States just as a benchmark, that would be roughly one nuclear – new nuclear plant in the United States every two months. That isn't going to happen, friends.

Nuclear power is the only technology that requires an international safeguards regime to try to prevent people from making nuclear weapons with the fuel. This safeguards regime has some serious loopholes as evidenced by what's gone on in – particularly in Iran. The IAEA doesn't judge a country's intent. You have to have the smoking gun before they'll blow the whistle on the country. And the timely warning criteria is not met. In other words, you can get extremely close to having a nuclear weapon through the civilian fuel cycle under the existing IAEA safeguards regime.

Now, let me just remind you that the first weapon that was dropped on Japan, the highly enriched uranium for that weapon had not been produced when the weapon was sitting in (inaudible) and ready to be launched. The final shipment of uranium went to the weapon, and then the plane took off and went to Japan, so there's not – if a sophisticated country like Iran is clever, they can have a weapons program essentially under the IAEA's nose.

Now the waste problem. Yucca Mountain. Yucca Mountain's geology leaks like a sieve. Therefore, the real containment of the radionuclides in Yucca Mountain is through the engineered containers and not through the geology itself. What's the government's solution to this? Well, they've already done it. They adjusted the EPA licensing criteria to ensure that the project would be licensed. First gerrymandering the control boundaries so that they could allow for a big radioactive cesspool to be created downstream from the reactor, and they wouldn't have to meet the drinking water standards within that cesspool. They also limited the dose calculations to 10,000 years rather than to life of the hazard of the material.

Here is the control boundary around Yucca Mountain set by EPA, and the federal courts upheld this. But if this had been a – like the WIPP facility, the control boundary would be five kilometers in every direction, and you see how EPA gerrymandered this – the boundaries south of the facility so you could create this large underground cesspool of radioactivity without – and still meet the drinking water standards outside of the boundary.

What's the industry solution? It's to use advanced reprocessing technology and transmutation. In my judgment, this is a bad idea. They first proposed to do this with accelerators. That was too expensive. DOE rejected that. They had proposed fast reactors, which are really necessary for transmutation. This is uneconomical. The world community spent about $40 billion trying to develop breeder reactors and found that they were one and a half to two times more expensive than light water reactors. The fuel costs more. So today they're falling back on just reprocessing and recycling fuel in thermal reactors, and what you're basically doing is, say, if you're going to Yucca Mountain, you need a big reprocessing plant.

There's no evidence that transmutation has a net gain in terms of overall health effects. It may or may not. Even R&D – and by the way, DOE has a $70 million R&D program on reprocessing and transmutation. John Deutch has just said we shouldn't be doing this at all, but we are. And this program has been internationalized through something called the International Generation IV Forum, so that other nonweapons states participate, but when you study the reprocessing R&D on a global level, what are you doing? You're training cadres of scientists in actinide chemistry and plutonium metallurgy. You're setting up hot cells so that they can have a breakout capability, so you're providing these hot cells with spent fuel so that they can work with this and have an additional breakout capability.

Five of the nonweapons states that are participating in the DOE program used to have clandestine nuclear weapons programs. And under the DOE program we've even invited South Korean experts to Argonne to teach them advanced reprocessing, which they're forbidden to do – under a U.S. government agreement forbidden to do on the Korean Peninsula.

So what is the conclusion? We shouldn't be subsidizing this technology to solve the greenhouse gas problem until we solve these other major problems that nuclear is saddled with. The best policy is to rely on the free market and have all of these pollution costs internalized. And so the most economically efficient way to attack the green – the global warming problem is to cap greenhouse gasses. It's not to use subsidies to buy one to six nuclear plants and just simply pay the cost difference between these plants and fossil plants. So in my view, if you go that route, you're going to end up with instead of 104 licensed plants, 103 operating plants, you're going to have 110 plants; and you want to solve the greenhouse gas problem.

Well, that concludes my remarks.

MR. PODESTA: Thank you.

Well, I feel like I should just probably duck and get out of the way, but I'm going to do one – a bit of a commercial, and then I'm going to turn it over to John and Burt to sort of reply, and then maybe ask a couple of questions, and then turn to the audience.

The Center in cooperation with two think tanks, one in the UK, the IPPR, and the Australia Institute in Sidney just issued recently a report called *Meeting the Climate Challenge*, which was the recommendations of an international panel that was chaired by Stephen Byers, who's a member of parliament from the UK, and Senator Olympia Snowe from the United States. And in addition to calling for a long-term objective of trying to control the temperature of – from rising two degrees Celsius above pre-industrial levels, we called for – the task force called for a major G8 initiative around advanced vehicles, coal capture and sequestration, which we've talked about a little bit, and bio fuels.

My friend John Deutch thinks that I've gotten a little happy about bio fuels and thinks I've been spending too much time with his predecessor, Mr. Woolsey, but I raise that because obviously nuclear is not the only solution to these issues. And we've talked about some of those technologies as well as the introduction of wind and other renewables. But I think with that what I'd like us to do to start off is basically let John and Burt react a little bit to the other panelists. Then we'll have some questions.

DR. DEUTCH: You will recall that I said there would be differences. Well, it's pretty clear that Cochran is the good-looking one. Let me tell you, he rails against nuclear and he suggests the right way to do this is to put on a carbon cap and let the market go, and I want to say to you that that's exactly right, but I don't think it's going to happen too soon in this town, but I don't live in area code 202, so I can't predict.

But let's say you put on a $75-per ton CO_2 emissions tax. Now, that's an interesting number because it's not only what makes – it's certain to have a tremendous effect on reducing demand for energy. It will also make the carbon alternative to coal and carbon sequestration – capture and sequestration probably, although that's not known, an economically attractive thing for a utility to do. Rather than pay the tax, they will actually capture the CO_2 from the flue gas, and then hopefully sequester it better than we are doing with nuclear waste today.

But in any event, this type of carbon tax would have the free market – if that's what you mean by free market – response that is being advocated for, and that's a good way to go. And under those circumstances, nuclear is going to be enormously economically attractive – enormously economically attractive. So if you put on the carbon tax and let the free market go, the nuclear plants are going to look fabulous. And then it's even more urgent we turn to these safety and proliferation issues.

But meanwhile, China is building one brand new, big coal plant a week and so is India, and so we have to do something about those, and if people don't take care of nuclear, they're going to have to live either with that big tax or with a lot more carbon.

Now, having told you who the good-looking one is, let me turn for a moment to a guy who's wrong, which is Burt Richter – the great Burt Richter. You can get cholesterol taken out of your arteries cheaper at the (Mass?) general hospital, than you could separate plutonium from spent fuel. That's how expensive it is. We have no need to take on that additional expense to what is already a costly technology. Not only during my lifetime or your lifetime, but I'm happy to say my new grandchild's lifetime, we're not going to need to do this. Beyond that, you are going to in a reprocessing plant have separated plutonium metal, which is directly useable in bombs.

I want you to imagine a world where there's a reprocessing plant in Taiwan, South Korea, Turkey, Indonesia, Iraq, Brazil, India, Pakistan, around Southeast Asia, perhaps in Egypt, perhaps in Algeria. We don't need to move to that world anytime soon. And to argue that there are advantages to reprocessing today which gives you enormous waste management issues at the reprocessing plant, in order for some flighty, theoretical transmutation of actinides – and incidentally, I want to say how remarkably I am impressed Professor Richter with his command of chemistry and knowing all those species.

DR. RICHTER: It's all in a book. (Laughter.)

DR. DEUTCH: Let me tell you, following what he does in making particles is a lot harder, but he is (nutso?). We should not be doing this. And when we say the rest of the world – okay, so great. So I want to talk to the word international. We must internationalize these facilities so as to make them safe.

First of all, I want to remind you – and this is a professional point – not everything which is international is safe. That's one thing. But there are two ways to

internationalize. One is to say that it is actually run by an international organization like the IAEA, not a notably efficient organization, or the other thing is to say that it is run by commercial arrangements, but under the stringent criteria, inspection, and rules which are set up by the international community, let's say the IAEA, and even something like the Security Council or like President Bush's initiative among (inaudible).

I would say to you very, very strongly that if we have international organizations running these facilities, it will be a catastrophe. If we have commercial, private sector arrangements run under strict international rules, then we have a prospect for success in nonproliferation going forward with respect to enrichment and reprocessing.

Thank you, Mr. Chairman.

MR. PODESTA: Thanks. For those of you who haven't broken the code, he's a chemist and they're physicists.

DR. RICHTER: But chemistry is a subset of physics. (Laughter.) Let me say, where do we agree? Internationalizing the fuel cycle is something that the world should be working on, and the world should be focusing on that now and we should get to a few secure places to take care of the front and the back end of the fuel cycle.

On North Korea's bomb, North Korea's bomb came from taking the spent fuel from the research reactor that they built themselves – they didn't get it given – reading the famous book by Glenn Seaborg on actinide chemistry, which gives the full, detailed recipe for the Purex fuel separation system; and then they went and built it. So talking about reprocessing or not reprocessing, it's not the issue. You've got to get this thing under control.

All three of us agree that the carbon tax is the right thing to do, but it isn't going to happen in the United States. It isn't going to happen because the coal industry has too much influence in Washington. You can take John's numbers and you can parse them a little bit differently. If you take the best estimate of CO_2 sequestration and say, what would it cost to sequester all the CO_2 from the present coal plants if we could do it? With that estimate it would cost $60 to $100 billion a year. This dwarfs the subsidy for nuclear power that Tom Cochran talks about. One of the problems with CO_2 sequestration is we don't know if we can do it. We don't know if the reservoirs leak and we don't know how big the reservoirs are down below.

Bio fuels. Bio fuels would be wonderful if we had a bio fuels program and not an agribusiness subsidy program. Corn-based ethanol uses as much fossil energy to produce the alcohol as you get from burning the ethanol. Brazilian sugar cane-based ethanol produces eight times more energy from the ethanol than is used to make it, but we put on a 60-cent-a-gallon tariff so that you can't import Brazilian ethanol and use it for anything. Our program on energy is driven by a whole bunch of rather insane politics, and it would nice if the general public caught on to this.

Nuclear power in today's plants, we have a benchmark for new plants. The Finns just ordered one. One of things we got on the Nuclear Energy Task Force is a conversion to build a Finnish plant in the United States. It will cost you 4.2 cents per kilowatt hour for the electricity. It's already competitive with coal.

I think we've got an R&D program that is a little bit – well, shall we say, misdirected. We have an incentives program that is very misdirected. How we're going to straighten that out, I don't know, but I'd like to go back to something I said at the end of my remarks. We are part of a bigger world. The rest of the world is going ahead. Let us get together with the rest of the world where everybody agrees, and let's international fuel cycle at number one – and as far as carbon taxes, let's put a carbon emission charge, and let's up R&D for CO_2 sequestration because if it works it's really an enormous help.

MR. PODESTA: Just one point of agreement. I actually think that Burt's statements about our current structure of the way we support ethanol and bio fuels is accurate, but I think that what we're calling for is a fundamental restructuring and movement towards bio-diesel and (cellulose?) based ethanol that would have a fundamentally different structure and has the potential to back out and replace a fair amount of liquid fuels, which deals with a different security issue that we're talking about, which is our dependence on foreign oil.

Everyone's been talking about internationalizing the fuel cycle. Let me just sort of begin by saying that – and I noted at the outset we're at the 35th year mark of the NPT. John, you sort – you kind of got right up to it and I know that you have a couple new articles out on this. What is it – what does it look like in terms of actually amending the NPT to internationalize the fuel cycle. What's the right model for that and does the – do the Iranians and the Brazilians going to really have trust in a system that has a limited number of national parties that are actually going to be able to supply the fuel, even if Russia is one of them?

DR. DEUTCH: The only hope about getting countries to avoid building their own enrichment and reprocessing facilities is if you make them confident there would be a sure source of supply; that they won't be subject to the whim of the United States Congress, who one day may change their views. And the right way, it seems to me, to accomplish that is to establish within the IAEA a stockpile basically of enriched uranium, which they will use to back up agreements that are made between supplier states and consuming states.

What is the wrong way to go about it is to tell the IAEA, you build your own enrichment facility. So I prefer an international regulatory system that gives a – would make the IAEA more like a bank with, you know, the actual enriched uranium commodity available to back up promises which – agreements which have been made between supplier countries and consuming countries. That's the way, it seems to me, to make the IAEA play a constructive role here.

MR. PODESTA: Tom, your NPT amendments?

DR. COCHRAN: Well, the first thing you should do is have no civil use of nuclear weapons, useable materials, period. You can't produce them. You can't stockpile them. Civil use. So that means no reprocessing. You would still have to deal with enrichments plants, which is the – one of the principal ways Iran is pursuing nuclear weapons or would be able to. And so you would have to have some mechanism that would prohibit the construction of bulk handling facilities, such as enrichment plants or reprocessing plants in nonnuclear weapons states. I think it's a tall order. You've got Japan who's just spent something like $20 billion on a reprocessing plant, which it hasn't started up. But the plant shouldn't be allowed to start up.

You have Brazil trying to get into the enrichment plant – in the enrichment business. And Brazil used to have a clandestine nuclear weapons program. You've got South Korea mucking around in transmutation and reprocessing. You shouldn't have a reprocessing plant in South Korea. I mean, you know, it's going to be extremely difficult to make these improvements in the IAEA safeguards system. Even the additional protocol, which was instituted following the debacle in Iraq where Iraq was developing nuclear weapons under the IAEA safeguards regime without being caught, they made the additional protocol voluntary, so that all the member states the IAEA could either take it or leave it. Well, all the good guys signed up for the additional protocol and the bad guys didn't.

MR. PODESTA: All right. Burt, do you want to –

DR. RICHTER: Well, I think we're all agreed on internationalization. It's sort of interesting if you look at the history of who's got nukes now that isn't one of the declared weapons states, Israel took a French heavy water research reactor and clandestinely reprocessed the spent fuel. India took a Canadian heavy water reactor and did the same thing. South Africa developed its own unique uranium enrichment and actually built bombs and then gave them up and dismantled them. Pakistan did a clandestine centrifuge program. North Korea, I already said, took a research reactor which they designed themselves and reprocessed the spent fuel, and maybe are enriching uranium. And Libya started down the same road as Pakistan and then gave it up.

The moral to this story? This is a complicated thing and to devise an international scheme means that you've got to not just look at the uranium supply, but you've got to look at the spent fuel. One of the problems is right when it comes out of the reactor it is literally too hot to handle, so it's got to sit in the cooling pond for a certain amount of time before you can take it away. An international scheme has got to arrange to take the spent fuel back and to do something about the period of time when it sits in the cooling pond to make sure that people don't fool around with it. I think we're all agreed upon the need for a new international regime.

MR. PODESTA: Let me open it up to the audience and to questions. Why don't we start in the back and we'll come up.

Q: Thank you.

MR. PODESTA: Will you identify yourself, please, and –

Q: Sure will. Yeah. My name is Larry Hecht. I'm the editor of *21st Century Science and Technology* magazine. Thank you for having me here.

I want to introduce something that hasn't been addressed by any of the speakers. Of any of the speakers, I'm probably closest to the one on my right. But we have a world population of five to six billion people and it's growing, and 80 percent of that population is living in a degree of misery that most of us here can't even fathom. And a reliable and cheap source of power is one of the absolutely crucial elements of – to those people's development and welfare. And most of the developing countries, especially the more larger developing countries, know this. They know they need nuclear power.

Now, it's been – I'll try to be brief in this.

MR. PODESTA: Yeah, no speeches please. If you could get to a question.

Q: Yes. What – okay. So we're also – I'm a Democrat. One of the great principles of the Democratic Party has been the commitment to the general welfare. And that means the general welfare of the people of the United States and the people of the world.

We once had a program called Atoms for Peace, which was implemented under a Democratic president but in clearly a bipartisan way. We've fallen away from that, and I believe the speaker on the right has come closest to addressing this, but I believe we have such a degree of brainwashing of our population that we've got to break out of this assumption of dangers of nuclear power in so many ways. There has to be a – there – I want to see an address to some – address. I want to hear from Mr. Cochran to the question of undoing that, and of getting back to that – addressing this question on a higher level of the principle of development for the United States and the world.

MR. PODESTA: Look, let me reframe the question just slightly, and to say that I think the speaker's raised a very good point about energy poverty, and I think if you look at the people who lack access to energy, it mirrors the three billion people that are living on $2 a day or the billion or two that are living on $1 a day. And I'll just ask all the panelists, what do you think the long-term solution to that is? And maybe I'll make a comment on the end.

Burt?

DR. RICHTER: Well, the long-term solution is economic development. That's what's going on in China and India now, and so we're going to take 2.5 billion people and their income is growing, and they're moving out of poverty. The energy problem is a problem of getting energy to a population. The only energy supply that we've got now

that is assured through the end of the century is coal. There's plenty of coal all over the world. It's in China, it's in India. Any place you want it, there's plenty of coal, and that's the one that we don't want to use, and so that is our argument. What are we going to do to subsidize – excuse me, to change this thing from coal?

For that 20 percent of the world population that doesn't have access to any commercial form of energy, that's a very different kind of problem, and it has to start with a different technology, a local technology that doesn't require a grid, and that may in fact be the best place to start with things like solar power.

MR. PODESTA: Tom?

DR. COCHRAN: The nuclear study that we did at MIT had in it a very beautiful graph which goes directly to this point. There is a tremendous correlation between the UN social economic welfare of individuals in every country, and electricity consumption per capita. So countries where people have economic and social opportunity and greater (inaudible), if you like, the electricity per capita is higher. So the point is that there's a real need to bring electricity to people around the world, not just the fat cats in Europe and the United States.

Now, let me say, you've got do it at the lowest possible cost, and the lowest possible cost in those regions of the world is not going to be nuclear power.

MR. PODESTA: Right. Why don't we come up to the front and work our way back?

Yeah?

Q: I think –

MR. PODESTA: Please identify yourself.

Q: I'm Theodore Rockwell with MCR Associates and with the public interest group Radiation, Science, and Health.

The arguments against nuclear power are all based on what-ifs – on things that haven't happened; of terrible things that are going to occur, accidents and leakage and pollution of the air from the waste and so forth and so on. And the arguments for nuclear are all in terms of what is and what's really happening, with one exception. Tom Cochran's comments about the industry milking the government and not wanting to move ahead until they've milked it dry is absolutely right, and it's long overdue. They ought to get off of it. They don't need it.

MR. PODESTA: Question?

Q: The point is that all of these realities, you say that this waste is such a problem because it stays toxic for so long. The fact of the matter is that the advantage of radioactive toxins versus others is that the others maintain their toxicity forever: mercury, selenium, arsenic. All those things stay toxic forever, and yet it's been posed that these things – nuclear waste – are somehow rather uniquely a problem because the total amount of –

MR. PODESTA: Okay, I can't let everybody do a speech now. Do you have a question? I think we're done. We have one on the aisle right there. Questions please. Then we'll come across the aisle.

Q: I'm Mark Reinhart representing the American Nuclear Society. I was interested in your comments on nationalization of the fuel cycle. And that seems like a good idea. My question is, is it a broader question? Nuclear technology is more than just a fuel cycle: there's research, there's education, chemical, industrial. What is your thought on industrializing the integration and coordination of the entire use of the nuclear technology?

DR. DEUTCH: I hope I didn't give the impression that I was for nationalizing any part of the fuel cycle. I think it's important that the private sector do these activities under proper international rules. But you touch a very good point. The Department of Energy in this country has a tremendous obligation, which it doesn't always, to my mind, fulfill as aggressively as it should to support the training of professional scientists and engineers, of men and women who are going to serve in this community whether it's in electricity generation or in the safety and waste management aspects. And I would certainly support and advocate the Department of Energy being serious about keeping that pipeline of individuals necessary to run a responsible industry.

If you are going to build a power plant – a nuclear plant a week or a month, you are going to need a lot of capable people running and operating those plants to see that they are safely and efficiently deployed, so I'm with you on the need to look at that as well.

Q: Can I be provocative since you're (inaudible)? What the impact of U.S. visa policy has been on – in terms of training a new corps of nuclear scientists – people who are working in this area?

DR. DEUTCH: I think it's loopy, but it's not just nuclear. I mean, it is loopy. The constraints that you could put on foreign scientists and engineers who want to come to study or work in the United States, I just think that it's been a catastrophe for – both for industry and for universities. I do think there's been some improvement in that in the last years, but we've confused. Both the right and the left in this country are confused about whether we want to welcome scientists and engineers from abroad to come and study and work here. But it is – it's had a very bad effect.

MR. PODESTA: A question up here, and then come over here.

No, the gentleman who had his hand up.

Q: Thanks for looking at energy –

MR. PODESTA: Could you identify yourself, please?

Q: Oh, yes. My name is Richard Strange. I'm just a member of the public.

Since we're looking at the energy requirements over the next 50 to 100 years, I wonder whether we should also consider whether and when commercially feasible fusion might become online. It's my understanding that the ITER – international thermonuclear research plant is not coming on line until 2015.

Does the panel think that an increase in research dollars could be effectively used by the research community and could we bring forward that date?

DR. DEUTCH: You'll have to call on Burt Richter, who is my –

DR. RICHTER: Okay. I think looking at this thing in pretty great detail. I think it's 50 years for fusion if fusion works, and the problem with the ITER project right now is not money. It may turn into money. It's the fact that the world can't agree on where to put it, but you can think of the following cycle. If you're going to do ITER, it's going to take 10 years to build, 10 years to run, and then you'll understand whether a continuously burning plasma is feasible.

Then you're going to have to design and build a prototype power plant. Ten years to build, 10 years to run; and that will tell you whether energy from fusion is commercially feasible. If you can build a prototype burning plasma thing and it costs 10 times as much as electricity from coal, nobody's going to use it. And then you start on the first commercial one to deploy.

But we should certainly go ahead with ITER. We need to find out what conditions can be set up to sustain a burning plasma, and we can't do it without that facility. But ITER is necessary, but not sufficient on the road to fusion energy.

DR. COCHRAN: I just – I think it's probably time for you to pull the plug on magnetic fusion R&D in the United States. I think the handwriting is on the wall that this technology is never going to be economic in our lifetimes. The problem is it's just too expensive to build. They make nuclear plants look cheap, and there's no known way to get there from here, so I – you know, if you want to keep some university programs alive, that's one thing, but building these big demonstration plants that are not going to get us to a useful technology I don't think is really helpful.

DR. RICHTER: Let me make one more comment on Tom's. I think Tom is too pessimistic, but he may very well be right. The ITER project is 500 megawatts thermal,

and it's advertised at running at about $5 billion to build it. I don't know whether that money will – that number will be right. If you take that and compare it to a standard plant, that's 30 times the cost of a standard power plant. But if you look at solar cells and you look at those things 30 years ago, they cost 100 times as much as they cost today and they're still going to go down.

Fusion has a nice potential. We ought to find out if it's going to work. And frankly for the world, the industrialized nations of the world, to take a first step of $5 billion to find out whether magnetic confined fusion can ever work, I think it's a worthwhileendeavor.

DR. COCHRAN: There's a big difference between fusion and solar systems. It's very easy to introduce new technologies and refinements in solar systems because they're cheap and they're small and so forth. But to make a refinement in the magnetic fusion business, you've got to build a new – a new (inaudible) reactor. And that – so every refinement is going to cost you several billion dollars a pop, and so you're just never going to get there simply from an economic standpoint.

MR. PODESTA: Right here.

Q: My name is David Hoffman with the Campaign for American's Future. The gentleman in the back said that the American public has been brainwashed against nuclear power. When I stop to think about the PR budget of the NRDC or critics of nuclear power compared to the industry promoting nuclear power, of course it's a pittance. Twenty-five years ago on Capitol Hill at the time of Three Mile Island, I was working for a congressman that Dr. Cochran kindly advised often at the time of Three Mile Island. I would say that (inaudible) and looking back over the quarter century, Dr. Cochran's advice to us has been proven – well proven.

My question to the panel is this: if the American people have been brainwashed by (inaudible) and by the PR agenda of the NRDC, what will it take politically – what will it take as a communications – a public education effort? What will it take to unbrainwash the American people?

DR. RICHTER: Can I comment from California? As a Californian, I can tell you that there's been a shift in the opinion of the importance of nuclear energy, and that shift in favor of nuclear energy happened because of what happened to electricity prices in California. It was a shortage. Prices were manipulated, whatever. California's electricity costs went through the roof, and California is now saddled with something like $20 billion of long-term debt, all because of that. And the only electricity prices that didn't go through the roof were those from the nuclear power plants and the geothermal fields and from the wind power supply.

California, I think the last poll I saw – I believe it was 63 percent of the population thought a new nuclear power plant would be good for California. I don't know about the rest of the country.

DR. COCHRAN: Let me just say, unfortunately, I don't – what the American public thinks is irrelevant to whether we're going to build new nuclear plants or not. The decision on whether these big, consolidated energy generating companies like Exxon and (inaudible) Dominion and Southern, the decision on what kind of plant they're going to build is going to be decided in the board room, and it's going to be decided on the basis of the bottom line. And there – many of these companies are operating in a competitive market. The decision whether the United States government is going to hand over billions of dollars to these guys to try to get them to do something they otherwise wouldn't do is going to be decided by a bunch of lobbyists in this town, and frankly the American public is not participating in that political debate. So –

MR. PODESTA: And I thought after my career I would have become a cynic, but – (laughter).

I want to take a couple of more in order. Just please, if you could limit them to questions. I've right now got five hands up. I'm going to do them all, and then just really quick questions, and then we're going to wrap up and let everybody respond to them at once. One, two, three, four, five.

Q: I was a little concerned about your pessimism in saying that this fusion isn't going to happen in our lifetimes, so I'd like the panel to address the fact that human life is going to go beyond your lifetimes, and we need to figure out what to do in the next century and work towards that. And if we don't do our R&D and if we don't train our cadre of scientists, this isn't going to happen. Could you please address that?

MR. PODESTA: Okay. Let's – we're going to take a bunch of questions and then we have just one consolidated set of answers.

The lady in the blue in the back. She's standing up.

Q: Thanks. Molly Farneth with Physicians for Social Responsibility.

The panel didn't talk a lot about domestic security, but there is a low probability, high-risk possibility of a catastrophic attack or sabotage of a power plant. And in particular, I'd like Dr. Deutch to talk about how his report tried to quantify and address that risk and what the panel thinks the responsibility of experts on nuclear power is to talk about that risk. Thank you.

MR. PODESTA: Okay. Neil?

Q: Thank you. Neil Newmark, Newmark Associates.

I'm glad to hear the consensus for internationalizing the fuel cycle and for carbon policy. My question is – it's interesting to go an hour and a half about nuclear power and not talk about clean air; only talked about carbon. We've got tens of thousands of people

dying a year in the United States due to various forms of pollutants that are out there. Carbon is very important to address, but I'd like to hear some thoughts about going beyond the carbon policy to an improved clean-air policy, something more than the abomination called the Clear Skies, which seems to be the best thing that we can come up with so far.

Q: Diane Perlman. I'm a political psychologist and I'm part of the Global Council for the Abolition Caucus preparing for the NPT review conference.

The – and I think that Thomas Cochran in addition to being good looking is also intelligent. (Laughter.)

DR. : But he could still be wrong. (Laughter.)

Q: I think (inaudible). Well, actually, there's another dimension that – it's a (inaudible) necessity for nuclear power in that we don't have other alternatives within certain paradigms, and there is like so many other things (inaudible) paradigms, I'm wondering, (a), what you think – what you think if you read Jeremy Rifkin's *Hydrogen Economy*. I know it's a lot of work to do that. And also the assumption that our energy needs are going to increase in the future is if we keep doing things the way that we're doing and that it is a matter of design, and there is certainly – that what we're doing – the way we're doing everything is not the best and only way and there's other ways of developing. Could you address that?

MR. PODESTA: Okay. I'm going to have to cut it off. I apologize. We'll try to stay around a little bit, but we've got the obligation to future generations; the terrorist threat at existing plants, and I think I would add to that the terrorists threat at existing reprocessing and other kind of fuel facilities, and whether that's even greater; the clean air question of what do we do about getting on with the other set of pollutants; and then the future of the hydrogen economy and maybe even the context of whether nuclear is a part of that future in the hydrogen economy.

John, I'll let you.

DR. DEUTCH: Well, on the case of fusion I share both these views. I think they're certainly worthwhile to continue the fusion R&D. Fusion does avoid two of the main problems of nuclear power. One is the proliferation risk and the second is the waste management problem, so I'm all for the fusion R&D program.

Domestic terrorist threat question – we contemplated the question. We have no clear answer on the relative risk except to note that compared to other things in our society power plants are relatively hard targets. So it's not clear to me that they are actually – they're (not places?) to be attractive to terrorists, but they still, as far as I know, could add to the issue about the vulnerability of our nuclear power plants. Of course, reprocessing plants are much, much more vulnerable and there's nothing like money to get the material out rather than bombs.

But the clean air act – I started off my comments by saying that nuclear satisfied all the criteria pollutants (inaudible) mercury, and I can guarantee you the reason that China is interested in nuclear power is principally because of their atmospheric air quality improvements which they desperately need in their cities.

Other alternatives – another excellent question. It is the view of the faculty group that does the studies at MIT that there is no silver bullet. There is no single technology which is going to save you here. It's not going to be coal – carbon capture and sequestration. It's not going to be nuclear. You're going to need to do all of these things if you're going to provide the energy that is going to be required for a whole world, including, as was earlier mentioned, those people in the world who are more disadvantaged.

So we are all for taking advantage of the least cost energy alternatives, and if it's hydrogen or fuel cells or his beloved bio-diesel, we're all for it. We just happened to begin looking at nuclear, and we are going to continue to march through and look at the other alternatives as well.

DR. COCHRAN: Fusion from an environmental standpoint is marginally better rather than existing nuclear power plants because the waste disposal problem, while it's similar, is less. And the proliferation problem, while it has some aspects that may be there – it's more manageable. The problem with fusion is, it's – you can't get there economically, and when you start seeing that in that fusion community the projection to when this technology may be of value to the society – when it may enter economically. When that recedes faster than the time you put in on the R&D, it's time to start thinking about whether you're going to get there at all, and I just don't think you can get there at all.

Terrorist threats at existing plants: there is a serious issue. All the important documents are classified, so it's hard to have an intelligent public discussion about it, but there is an issue about the vulnerability of spent fuel pools at some nuclear plants. All nuclear plants are not the same with regard to how they store their spent fuel. These issues have been studied by the National Academy and the NRC, but the reports are classified.

Other pollutants, I mean – you know, we should internalize the cost of these pollutants, particularly of coal, which is – from an environmental standpoint is an awful industry both in terms of coal mining, particulate emissions from power plants, and the CO_2 emissions.

Hydrogen economy and mercury. The hydrogen economy, there is – hydrogen is not a new fuel that you can go out and mine. You have to make it, and so you have to make it with other fuels. You can make it with nuclear power, but if you're going to make it with nuclear power, that's kind of silly because you're taking a power plant that can make electricity, you're turning it into hydrogen to pump it through some nonexistent

infrastructure to your automobile and then going to convert it back into electricity to run your automobile. So why not just, you know, use fuel cells which are going to happen a lot sooner and electric vehicles rather than spend a great deal of effort on the hydrogen economy at this stage?

MR. PODESTA: Burt?

DR. RICHTER: Okay. Some quick things. Hydrogen. Hydrogen, as Tom said, is an energy storage medium and it may be the answer to solar and wind power: what to do when the sun doesn't show and the wind doesn't blow. There's a lot of R&D that needs to be developed on to turn up the production of hydrogen into an efficient source of energy. I think it's got a good future, and I'm not sure that it's in running your automobile.

Health effects of various forms of energy. A very interesting study was done in Germany a few years ago which looked at all the health effects from all the energy sources they could find. The most benign was wind. The next most benign was nuclear. The worst is coal. Solar was worse than nuclear because of all the horrible (inaudible) that are used in making solar cells. If John wants, I'll find a reference and I'll send it to him and he maybe can post it here.

Conservation efficiency, I put in my talk as an absolute number one in the energy system. For 100 years in the United States, the amount of energy used per unit GDP has gone down by 1 percent a year. If you could turn it into 2 percent a year, you'd go a very long way toward alleviating the problems of our energy supply, and it may be the easiest place to do that is in the developing countries which don't have a big infrastructure now, where you can look at putting in the most efficient from the beginning instead of starting the way we did.

MR. PODESTA: Well, I said that Burt would have the last word, but I actually want to start where I – I want to end where I began, which is that we better get serious about dealing with the problem of climate change and the problem of CO_2 in the atmosphere. I think this is an academic debate among some wonderful academics, so please help me in thanking them for what has been a really lively discussion. (Applause.) And we put a lot of information on the table and I want to thank all of our panelists.

Thank you.

(END)