



## 1.3 KEYNOTE ADDRESS

Honorable Ray Mabus

I am glad to be back at Hopkins after a 40-year gap since my master's. My topic today will be a discussion of quark-gluon plasma

---

*Ray Mabus is the 75<sup>th</sup> Secretary of the U.S. Navy, where he is responsible for conducting all Navy affairs, including recruiting, organizing, supplying, equipping, training, and mobilizing. He also oversees the construction, outfitting, and repair of naval ships, equipment, and facilities and is responsible for the formulation and implementation of policies and programs consistent with the national security policies and objectives established by the President and the Secretary of Defense. Previously, Mabus served in a variety of top posts in government and the private sector. In 1988, Mabus was elected governor of Mississippi, and he stressed education and job creation, passing B.E.S.T. (Better Education for Success Tomorrow), one of the most comprehensive education reform programs in America and was named one of Fortune Magazine's top 10 education governors. He was appointed Ambassador to the Kingdom of Saudi Arabia in 1994 for the Clinton Administration. While he was Ambassador, a crisis with Iraq was successfully averted, and Saudi Arabia officially abandoned the boycott of U.S. businesses that trade with Israel. He also was Chairman and CEO of Foamex, a large manufacturing company, which he led out of bankruptcy in less than 9 months, paying all creditors in full and saving equity. Before becoming governor, he was elected state auditor of Mississippi and served as a surface warfare officer in the U.S. Navy aboard the cruiser USS Little Rock. Secretary Mabus has a bachelor's degree from the University of Mississippi, a master's degree from The Johns Hopkins University, and a law degree from Harvard Law School. He has been awarded the DoD Distinguished Public Service Award, the U.S. Army's Distinguished Civilian Service Award, the Martin Luther King Social Responsibility Award from the King Center in Atlanta, the National Wildlife Federation Conservation Achievement Award, the King Abdul Aziz Award from the Kingdom of Saudi Arabia, and the Mississippi Association of Educators' Friend of Education Award.*

---

and its importance as a testing ground for finite-temperature field theory within the broader field of quantum chromodynamics.

Wait, wrong speech. I thought I had to do that since I am here at the Applied Physics Laboratory. I wanted to say that I lectured on physics to my friend and colleague Dr. Steven Chu, Secretary of Energy. But once I tell him that and give him the topic, I'll have to change the course of the conversation pretty fast because it took me about 30 minutes of reading just to come up with that one sentence. Steven Chu was flying with Secretary of Agriculture Tom Vilsack who tells the story that Steven Chu had a large textbook on gravity. Vilsack asked Chu what he was doing, and he said, I think I can prove Einstein's theory of relativity using gravity—certain constructs around gravity. Vilsack said, yeah, I think I can do that too.

So, I am happy to be here, not to talk about chromodynamics but to talk about energy. First I want to thank those of you at the Applied Physics Laboratory: Thank you for what you do for our country every day. Your work with the Navy in putting together the Radar Hull study helped us determine the best shape for our future fleet, and your work with the Naval Integrated Fire Control–Counter Air System will drive integration of all of our Fleet Air Defense capabilities over the near future.

Those of you who are here for the conference, it is great to see this crowd turn out to discuss the incredible importance that energy and the harmful effects of climate change will have on our Navy, our Marine Corps, and our nation in the coming years. It is an area that I have talked a lot about and focused on in the 10 months that I have been in this job.

How we as a military and we as a country deal with the ramifications of these issues will have dramatic impacts on our military strategy, our military capabilities, and our force structure throughout this 21<sup>st</sup> century. Changing the way we use and produce energy, and the fallout from climate change, are fundamentally issues of national security.

This is not a new fact. Last week I was privileged to go to a premier of the HBO series *The Pacific*, which brings the campaign, particularly for the Marines, across the southern and central Pacific

to the screen in a very vivid and graphic way. But when you watch the show, you are reminded that one of the chief underlying causes of the war in the Pacific was the competition to control the natural resources of Southeast Asia and ensure access to the sources of petroleum necessary to sustain the economic expansion and military might of Japan. That competition, in the 1930s and 1940s, manifested itself in military operations and, ultimately, open conflict between the United States and Japan.

Today, competition for natural resources, specifically oil, still exists. We know that the global supply of oil is finite; we know it is getting harder to find and to exploit and that much of it comes from volatile areas of the world susceptible to price and supply shocks largely outside the scope of our control. Demand for energy continues to rise, and, although competition for additional energy has largely manifested itself as economic competition as opposed to military action over the past few decades, the potential exists that some triggering event could set off a chain reaction and bring parts of the world once again into open conflict based not on ideology but on a desire for resources and the corresponding desire to ensure access to those resources. Add in the additional pressures that are likely imposed by a summer arctic free of ice in the next quarter century and loss of access to clean water—you add those in, and you have the potential powder keg of security challenges that have to be realistically confronted and deliberately addressed.

These geopolitical and strategic concerns are amplified by the tactical complications associated with energy use and the dependence of our ships, our aircraft, and our tactical vehicles on fossil fuels. Take, just for example, a Marine platoon operating from a forward operating base in Helmand or Nimroz Province in Afghanistan. In order to get fuel to them, in order to get a gallon of gasoline, first you have to take it by ship to Pakistan, get it into trucks, and truck it through the Hindu Kush, move it to the forward operating base, and only then does that fuel go into the tank of a fighting vehicle, an airplane or generator, or a water purifier. At every stage of that process, you add incremental cost, and more importantly you take a Marine away from doing the things a Marine ought to do—patrolling a city or conducting development—and

you expose them to one of the most dangerous tasks in the theater: guarding a fuel convoy.

For the Navy, the argument is broadly similar—the less fuel that a ship or aircraft uses to do the same tasks, the more operational capability you provide to the tactical and fleet commander. To put it simply: fuel efficiency improves warfighting capability.

These arguments are absolutely compelling, and it is for these strategic and tactical reasons that I have committed the Navy and Marine Corps to meeting five comprehensive energy goals over the next several years. The most important of these targets requires that, by 2020, half the Department of the Navy's total energy consumption comes from alternative sources. The other major goal changes the way we award contracts. It requires industry to be contractually accountable for meeting energy goals—and, beyond that, we are also looking at the individual energy performance and energy footprint of competing companies when we make procurement decisions.

I have said before, these goals are ambitious, but it has been my experience that people tend to meet expectations. If you set high expectations, people will surprise you to reach beyond them. You set low expectations and that becomes a self-fulfilling prophecy, and it becomes the standard. "Small dreams have not the power to move the hearts of men."<sup>1</sup>

Nothing big was ever accomplished without taking some bold first steps. And we are taking those first steps across the Navy and Marine Corps now.

Next month, April 22—very appropriately, Earth Day—we will conduct an airborne test of the Green Hornet, one of our F/A-18s, using a biofuel blend made with camelina. For those of you who do not know what camelina is, and I was certainly in your number until a few months ago, it is a grain related to mustard that can be grown in crop rotation with wheat all across the United States. This test will build on successful ground tests that we conducted last year and is critical as a proof of this concept. It will demonstrate

---

<sup>1</sup>Johann von Goethe, 1749–1832.

that our systems can work on biofuel. After it is successful, and we are absolutely confident that it will be, we will move to expand biofuel testing to our marine gas turbine engines and to the engines of our tactical vehicles.

It is important to note that we are not doing this alone. We are working with a lot of partners in industry and in academia across America to improve biofuel production and continue research into both grain-based and algae-based biofuels. The Defense Advanced Research Projects Agency (DARPA) has been looking at algae-based biofuels over the past couple of years, and they have pioneered some very promising work in Hawaii. If their work meets its objectives, their algae ponds will be able to produce, at scale, an algal biofuel at affordable prices, prices perhaps approaching what we buy gas for today. That is amazing, and the commercial and security possibilities of this technology are fascinating.

Our partners in government see these possibilities. I have had meetings and conversations, we have signed agreements with both Secretary Vilsack at Agriculture and Secretary Chu at Energy, and we have resolved to work together for more alternative energy, more biofuel research, and move these sources of energy forward. All three of us, and all across government, we recognize that there are tremendous economic and agricultural opportunities in alternative energy that our country has only begun to tap. We recognize that there is a new economy that can be based on these alternative fuels and that America cannot be left as a nonparticipant in this new economy.

There are two objections that get raised in opposition to biofuel development. One is that they cost too much, and the other is that the infrastructure is not available to support them. But as folks like DARPA are proving, these challenges can be, and are being, answered. In supporting biofuels, we are providing one of the most important economic incentives to production: we are creating demand. Just for a moment imagine you are an energy company, and there is a customer that wants a specific kind of product. And that customer owns 4.4 million acres of land; that customer has 72,500 buildings, 50,000 commercial vehicles, 3800 aircraft, 286 ships, and more than 900,000 employees. That customer is the

Department of the Navy. You as that energy company and you as the people who finance energy development might want to investigate what the customer wants to buy. The market power of the Navy and Marine Corps is pretty big.

Together, these two services consume about a third of the petroleum power used in the federal government. And the federal government consumes 2% of all petroleum that the United States uses. So it is like the reverse of *Field of Dreams*, if we come, they will build it. As we build demand, the supply will come. And with this additional supply we will be able to reap the benefits of some basic economics—greater supply will create some economies of scale and drive the price down. It becomes economically and fiscally responsible to do once the supply reaches a critical point. What we are doing is providing that demand for the supplier to meet.

There are two parts to this. The first is looking at alternative ways of producing and using energy. The second is making the energy that we use more efficient. Doing the same jobs, just using less energy to do it. We have made some significant strides there. Last year we commissioned the USS *Makin Island*. On its first voyage from my home state of Mississippi, around South America to its home port in San Diego, the *Makin Island*, which has a hybrid drive system that switches to electric power at speeds of 10 knots or less, saved almost \$2 million in fuel costs. If you take the price of fuel today, the *Makin Island*, over the lifetime of that ship, will save about \$250 million in fuel. If fuel prices increase, that savings will only go up. We are now investigating and prototyping similar systems on some of our DDG-51s, our Arleigh Burke destroyers.

Ashore, we have invested a good bit in a lot of different alternative energy sources, including solar power. Through the stimulus act, the American Recovery and Reinvestment Act, we have been able to contract more than 20 MW of additional solar power. We could add another 40 MW at Navy and Marine Corps installations in the Southwest through contracts we have signed this year. We started small, we had a baseline of 5 MW, and we are increasing our solar capacity by another 60 MW over the next few years, which is the equivalent of powering 41,000 homes or about half

the homes in Arlington, Virginia. Our other initiatives—wind, solar, ocean, and geothermal—across our bases are also looking promising, and I think you'll begin to see the results of these over the next few years.

Tactically, the Marine Corps is moving forward. That is really the only way the Marine Corps ever moves, is forward. Once they get a project, they are focused, and they are aggressive in meeting that project. The Commandant of the Marine Corps and all Marines take energy seriously, because every Marine that guards a convoy is a Marine lost to the fight—and every dollar spent on gasoline is a dollar that could be better spent on armor, or weapons, or ammunition, or equipment. To fix this, the Marines have established an experimental expeditionary forward operating base at Quantico, and they are testing the power, durability, and savings of new energy-saving systems. As these systems prove reliable, they will be pushed forward to our Marines on the ground in Afghanistan. One has already made it. The Corps has deployed several solar-power water-purification units across the country, and they are providing cleaner, cheaper water.

While these measures are certainly a start in the right direction, it is important for of us to realize that they are *only* a start. To reach these goals, a lot more has to be done between now and 2020. It is up to the people in this room, the people who work in the Department of the Navy, to the individual Sailors and Marines in the fleet, to make this future happen. I have spent a lot of time talking about this on the road to any audience that I can find, but words do not get stuff done. We have to get down to a lot more serious work now. One of the things I want to make sure the Department of the Navy does is to be absolutely open to any idea, absolutely open to anything that will help us meet these goals. To not have some predetermined idea that this is exactly the way we are going to get there. We are going to look at solar and biofuel; we are going to look at wind, nuclear, ocean, and geothermal energy. We are going to look at technological-based efficiency measures, and, by doing so, we are going to improve the range and endurance of our aircraft and our ships. We are going to reduce their vulnerability to a fragile supply chain, we are going to

create a resistance to external shocks that come from overreliance on the global oil infrastructure, and we are going to bring down the carbon footprint of the Navy and the Marine Corps.

The stakes could not be higher. It will make us better fighters. But in the end, it is a matter of energy independence, and it is a matter of national security. Our dependence on foreign sources of petroleum makes us vulnerable in too many ways. The stakes are clear, and the stakes are high. Our response has to be equal to that challenge.

## Q&A SESSION WITH SECRETARY MABUS

**Q:** *Secretary Mabus, in your talk, you mentioned all sources of energy that the Navy is reevaluating and considering. Is there a larger, more prominent role for nuclear energy, maybe to fill the gaps until we see ourselves through to other alternatives?*

**HONORABLE RAY MABUS:** I think the Navy has demonstrated its reliance and faith in nuclear power, given that all our aircraft carriers and all our submarines are nuclear-powered today and given the fact that 17% of all our energy is produced from nuclear sources. And one of the reasons I mentioned nuclear specifically when I was speaking was that is certainly a technology that we are willing to use in other capacities—ashore, perhaps—if it proves to be economical and that we can do it in the way that we need to do it. But it is certainly an alternative form of energy, and we have a lot of experience dealing with it.

**Q:** *You say that you are going to be funding more work in wind power and geothermal and other renewable sources. Is one aspect of that research going to focus on regionalism and where certain renewable sources would work best, as opposed to others?*

**HONORABLE RAY MABUS:** Obviously, things like solar we are looking at first in the Southwest, where they make more sense. On some of our bases that are on the water, which is most of them, you know, we can look at hydrothermal. We can look at wave

action. Some of our other bases, China Lake, for example, we are using geothermal, and it is already producing more energy than China Lake uses. So we are better than net zero in terms of energy usage there. But whatever the location gives us, but also for things like biofuels, there is going to have to be an infrastructure built, and that is why we think putting the demand signal out there will help get that infrastructure built pretty fast.

For those of you who have heard me talk before, you know that I have stressed that the Navy is usually at the forefront of changing energy sources: from wind to coal in the 1850s, from coal to oil in the early part of the 20th century, and then to nuclear in the early part of the 1950s. Every single time there were people who said you are trading one source of very proven energy for another that is not proven, and every time those naysayers have been wrong. And every time the Navy's changing has led to bigger changes in our society.

**Q:** *Mr. Secretary, could you address something that I do not think I heard a lot about in your talk today, and that is challenges to changing culture. To see the Commandant of the Marine Corps sitting at the front of a room multiple times for 12 hours at an energy meeting sends quite a message to the Marine Corps. I was recently at a Navy base for a meeting, and, at the end of a late day, I decided just to play a game, and I walked around, and I turned off roughly 8 kW of lights in empty rooms with no indication that they were going to be turned off otherwise. Let's switch now to your partners in industry. Industry reacts to the dollar figure. It is what they are legally required to do. When are energy considerations going to start showing up in the Navy's requests for proposals? In other words, how are you going to try to drive the cultures both within the service and with your partners?*

**HONORABLE RAY MABUS:** It is an excellent question, and that Navy base must be populated by folks like my children, since I do that every night at the house. Several ways. One is to allow bases or ships as they save power to keep part of those savings in terms of dollars. To give them incentive to do some of those things. Second is we are conducting an energy audit to see what the baseline is of energy that we are using, and we are installing stuff like

smart meters. We are also installing things that if there is no movement in the room for a while, the lights go out automatically.

We are installing solar panels for swimming pools and on tops of garages for homes. And I think that the cultural change comes as there are incentives and also as there are some rewards for doing some of these things exceptionally well. We have got Secretary-level awards for bases, for ships, for individual activities, and we are trying to make those very much in demand and trying to set up a competition, which is beginning to happen there. You are right when you say that when the Commandant of the Marine Corps starts talking about energy, as he does on a very routine basis, starts hosting energy conferences, builds an experimental forward operating base at Quantico that you can see right as you go in down there, that sends a pretty powerful message.

I think it is fair to say that Marines have not been seen as environmentally sensitive over the years. And I think that having the Commandant, and *this* Commandant—if you were in Hollywood and you said send me the Commandant of the Marines, they would send you Jim Conway. To have his presence there talking about energy, but also having the Chief of Naval Operations doing exactly the same thing. And not only having the people at that level, but having the captains of ships, the commanders of bases, having your senior enlisted personnel talk about it. To be able to show to a Marine, a lance corporal, that instead of being out there on convoy duty he is doing what he was trained to do in Helmut or Nimruz or Marja, wherever he is, that when he looks up and sees that water purifier being powered by solar power so that he does not have to put gasoline in there, to see his tent being insulated by spray-on insulation instead of having to power a generator to do that, then I think you are beginning to see that culture change. Finally, I said that we have got 50,000 noncombat commercial vehicles in the Department of the Navy. We are changing what we buy. We are going to buy more hybrids. We are going to buy more electric vehicles.

I think as you begin to see more and more of these on our bases along with the infrastructure to support them, you are going to see

more of these begin to spill out into the surrounding communities, which I think will drive the culture change as well.

**Q:** *Mr. Secretary, I want to ask you about the mechanisms for providing feedback to the individuals. One of the things that we really understand is that if you have a miles-per-gallon gauge on your car, you can see how well your car is doing. When you build in meters, are you going to have them so they can locally reflect what individuals are doing or what is happening in specific rooms? If you just have one meter on the base, that does not tell you where to go fix it.*

**HONORABLE RAY MABUS:** That is absolutely true. We are putting smart meters in much the same way you put meters in in any community, at individual buildings, individual houses, so you can tell what the usage is. We are doing that so that the smart meters can drive usage at non-peak times, so that we can make better use of the energy that we do have. But you are absolutely right. You have to first establish a baseline and then key off of that baseline, and I think we are. We are in the early stages, but we are moving pretty aggressively to do that.

**Q:** *Using the example you gave earlier of China Lake, as the Navy moves forward in looking for alternative sources, there is the likelihood that more and more installations will become not only self-sufficient but actually become sources of power. How is the Navy working with local and regional power distribution organizations to become part of that initiative to plug into the power grid?*

**HONORABLE RAY MABUS:** Well, we are at the early stage of this, but that is one of the things that is going to have to happen. In a state like California, where we are doing a good bit of our work, there is already a state structure to feed excess energy into the local grid, or into the state grid there. In states that do not have that yet, or other places that do not have that yet, we are working to do that. This is related but not exactly on point. The first place, for example, where we are looking at doing our combined research with the Department of Agriculture and it will be announced officially 2 weeks from now, is in Hawaii.

We are doing that for two reasons. First, Hawaii's the most petroleum-dependent state in America. And, second, Hawaiian farmers are not doing well, and if they can grow biofuels—whether it is algae or camelina or whatever—there, we are going to solve a couple of problems at the same time.

**Q:** *Sir, some in the international community are concerned that if we do develop a large market for biofuels, that is going to divert a lot of croplands from feeding the world's hungry. How would you assess the risk that we might actually exacerbate regional instability by building a large national market for biofuels?*

**HONORABLE RAY MABUS:** I think they are correct only if you look at first-generation biofuels. Corn-based ethanol, for example, clearly uses a lot of land. It has diverted acreage into crops specifically for fuel. The other downside, and it is significant for corn-based ethanol, the first generation of these ethanol products, is it takes almost a gallon of gasoline to make a gallon of corn-based ethanol. You cannot make that up in volume. But if you look at second- and third-generation biofuels, what you are looking primarily at are things like camelina, if you are looking at crops.

Camelina's a rotational crop. You plant it on the same land you plant wheat, for example. It is land that otherwise would be lying fallow, so you are not taking any food out of the food chain. But you are also looking at waste products: you know, wheat stalks, any sort of biological waste, timber tops, grass, McDonald's grease. Any sort of organic waste is being looked at to be turned into that. Finally, algae would not; it is a completely different structure and would not take up the croplands that you are worried about. So I think that those two things can coexist very, very well if we move as we are to the second- and third-generation biofuels.

Again, I want to thank you all for coming today. Thank you for listening to me, but thank you primarily for helping us get to where we need to be, not only as a department in the Department of the Navy, but particularly as a country. America simply cannot afford to not be a part of this from a strategic sense and from a sense of energy independence and national security. Thank you for your work. Thank you for what you do for America.