



US Fusion Program Recommendations



ASP

American Security Project



Roundtable Report

—
Caroline Julia von Wurden
Andrew Holland

December 2014

BOARD OF DIRECTORS



The Honorable Gary Hart, Chairman

Senator Hart served the State of Colorado in the U.S. Senate and was a member of the Committee on Armed Services during his tenure.



Norman R. Augustine

Mr. Augustine was Chairman and Principal Officer of the American Red Cross for nine years and Chairman of the Council of the National Academy of Engineering.



The Hon. Donald Beyer

The Hon. Donald Beyer is the former United States Ambassador to Switzerland and Liechtenstein, as well as a former Lieutenant Governor and President of the Senate of Virginia.



The Hon. Jeffery Bleich

The Hon. Jeffery Bleich heads the Global Practice for Munger, Tolles & Olson. He served as the U.S. Ambassador to Australia from 2009 to 2013. He previously served in the Clinton Administration.



Lieutenant General John Castellaw, USMC (Ret.)

John Castellaw is President of the Crockett Policy Institute (CPI), a non-partisan policy and research organization headquartered in Tennessee.



Brigadier General Stephen A. Cheney, USMC (Ret.)

Brigadier General Cheney is the Chief Executive Officer of ASP.



Lieutenant General Daniel Christman, USA (Ret.)

Lieutenant General Christman is Senior Vice President for International Affairs at the United States Chamber of Commerce.



Robert B. Crowe

Robert B. Crowe is a Partner of Nelson Mullins Riley & Scarborough in its Boston and Washington, DC offices. He is co-chair of the firm's Government Relations practice.



Lee Cullum

Lee Cullum, at one time a commentator on the PBS NewsHour and "All Things Considered" on NPR, currently contributes to the Dallas Morning News and hosts "CEO."



Nelson W. Cunningham

Nelson Cunningham is President of McLarty Associates.



Admiral William Fallon, USN (Ret.)

Admiral Fallon has led U.S. and Allied forces and played a leadership role in military and diplomatic matters at the highest levels of the U.S. government.



Raj Fernando

Raj Fernando is CEO and founder of Chopper Trading, a technology based trading firm headquartered in Chicago.



Vice Admiral Lee Gunn, USN (Ret.)

Vice Admiral Gunn is the President of the Institute of Public Research at the CNA Corporation, a non-profit corporation in Virginia.



Lieutenant General Claudia Kennedy, USA (Ret.)

Lieutenant General Kennedy was the first woman to achieve the rank of three-star general in the United States Army.



General Lester L. Lyles, USAF (Ret.)

General Lyles retired from the United States Air Force after a distinguished 35 year career. He is presently Chairman of USAA, a member of the Defense Science Board, and a member of the President's Intelligence Advisory Board.



Dennis Mehiel

Dennis Mehiel is the Principal Shareholder and Chairman of U.S. Corrugated, Inc.



Stuart Piltch

Stuart Piltch is the Co-Founder and Managing Director of Cambridge Advisory Group, an actuarial and benefits consulting firm based in Philadelphia.



Ed Reilly

Edward Reilly is CEO of Americas of FD International Limited, a leading global communications consultancy that is part of FTI Consulting, Inc.



Governor Christine Todd Whitman

Christine Todd Whitman is the President of the Whitman Strategy Group, a consulting firm that specializes in energy and environmental issues.

In this Report:

ASP hosted a roundtable discussion of fusion experts on December 4, 2014. The roundtable discussion, held under “Chatham House Rules,” informed this report. ASP and the authors are solely responsible for the contents of this report.

Interact:

Join our discussion on Twitter with the hashtag #ASPFusion

Discuss America’s plans for fusion with the authors at @CarolineWurden and @TheAndyHolland

Learn more about ASP at @amsecproject

IN BRIEF

- Fusion energy is clean, safe, and has the potential to be a key secure energy source for the long term.
- To have a successful fusion energy program, the United States needs strong leadership and an energy-driven mission.
- ASP recommends creating the position of “Deputy Under Secretary for Fusion Energy” within the Office of the Under Secretary for Science and Energy. This person would be politically responsible for and oversee the development of fusion as an energy source, with the goal of developing a fusion energy pilot plant in a short time-frame.

About the Authors

Caroline Julia von Wurden is a graduate of the University of California, Berkeley. She received a B.A. in physics and has worked at the Los Alamos National Laboratory and the ALPHA Antihydrogen Collaboration at UC Berkeley.

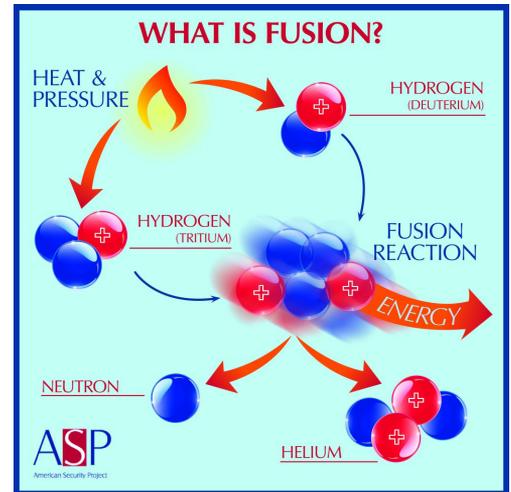
Andrew Holland is the Senior Fellow for Energy and Climate at the American Security Project. He is an expert on energy, environment, and infrastructure policy.

Introduction

A modern and thriving economy depends on its energy supply. Choices we make today will decide America’s energy mix for the next generation. Over the next several decades, almost all of our country’s power plants will have reached the end of their life and will need to be replaced. We need to make the choices today on what those future plants will be. We must develop energy technologies that will power America’s economy for the next generation – technologies that are also clean, safe, secure and abundant. One technology holds great promise in meeting our needs: energy from fusion. It is a national security imperative that America demonstrates practical fusion power in a short timeframe. This will set the stage for full-scale commercial power that will drive American prosperity for the next century.

Fusion is energy released by forcing atomic nuclei together—the same process that powers the sun. The primary fuel for fusion is derived from ordinary water. By fusing together two hydrogen atoms, enormous amounts of energy are produced. The heat from a fusion reaction could be used, like ordinary power plants today, to spin a steam generator to make electricity.

Fusion is clean. Energy from fusion produces no greenhouse gases or air pollutants. Fusion is secure. The only byproducts of the fusion process are helium and a fast neutron, which carries the heat to make steam, meaning there is none of the long-lived radioactive waste produced by conventional nuclear fission reactors.



Fusion will spark monumental scientific achievements. The positive spillover effects of the US fusion program are already being felt. Fusion scientists are making advancements in superconductors, which have a wide range of industrial applications. They are also developing super-power lasers and new high-efficiency semiconductor light sources, large and small-scale robotics, and pushing the progress of supercomputing and modeling.

When thinking about fusion as a future energy source, it is important to remember that the energy mix of tomorrow will not look like the one today. The [price of carbon emissions](#) (either explicit or implicit) will go up, making standard fuels more unattractive over time (see figures TS-12 and TS-19 in the IPCC Mitigation Report). The demands for large scale electrical generation will continue to increase around the world. Fusion holds promise in addressing these future needs. As an emissions-free power source, fusion energy would become economically attractive.

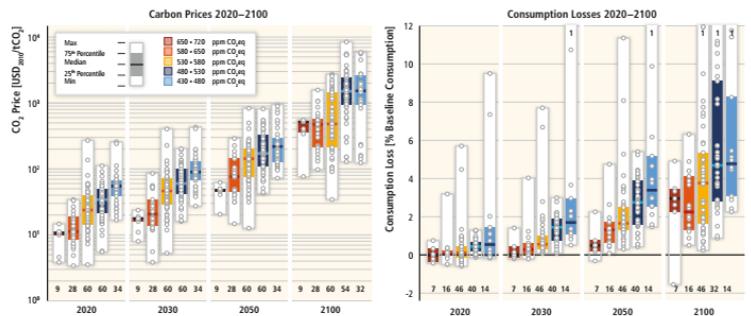
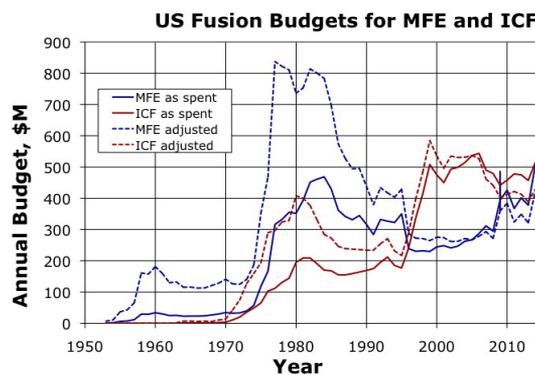


Figure TS.12| Global carbon prices (left panel) and consumption losses (right panel) over time in cost-effective, idealized implementation scenarios. Consumption losses are expressed as the percentage reduction from consumption in the baseline. The number of scenarios included in the boxplots is indicated at the bottom of the panels. The 2030 numbers also apply to 2020 and 2050. The number of scenarios outside the figure range is noted at the top. Note: The figure shows only scenarios that reported consumption losses (a subset of models with full coverage of the economy) or carbon prices, respectively, to 2050 or 2100. Multiple scenarios from the same model with similar characteristics are only represented by a single scenario in the sample. (Figure 6.21)

Source: IPCC Mitigation Report

Scientists have made extraordinary progress on fusion energy over the past few decades. Exponential increases in power generation have been achieved – from only a few watts in the 1980’s to 16 million watts (16 megawatts) in 1997. Further progress is possible, but budget cuts have caused significant delays. **To have a successful fusion energy program, the United States needs strong leadership and an energy-driven mission.**

The US fusion program has large challenges to overcome. Political will, good management, and sufficient funding are needed to develop it into an energy program. Because the development of fusion is a long-term goal, it is difficult to get lasting political will and financial support.



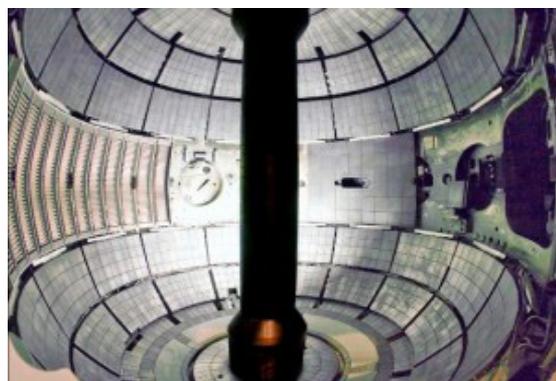
Source: Fusion Power Associates

America’s Competitors

Fusion is a national priority for America’s foreign competitors. China, South Korea, and Europe all have specific goals, timescales, and funding to implement successful fusion energy programs. South Korea is designing a fusion power demonstration reactor, in collaboration with Princeton Plasma Physics Laboratories, called K-DEMO. The country’s National Fusion Research Institute has plans to complete it in the 2030’s. South Korea is running K-STAR, a superconducting tokamak, and contributing to ITER. The South Korean Ministry on Education, Science, and Technology said in 2012 that developing technologies to build K-STAR would be a priority for the next 10 years. This puts them on track to build a commercial fusion power plant between 2022 and 2036.

Background on US Fusion

Fusion was once a national priority. In the 1970’s, in response to the oil crisis, fusion funding increased and there was more political support for fusion energy in Congress. Washington, New Mexico, Maryland, New Jersey, Massachusetts, California, Wisconsin, Florida, New York, and Tennessee had DOE funded fusion experiments. As the program suffered budget cuts, multiple experiments were shut down. Now the states that have major fusion experiments are California (DIII-D tokamak at General Atomics and NIF at LLNL), Massachusetts (Alcator C-Mod at MIT), and New Jersey (NSTX-U at PPPL).



NSTX-U tokamak at PPPL

Fusion experiments are housed in two offices in DOE. Magnetic Confinement Experiments (tokamaks) are housed in the Office of Science, and Inertial Confinement Experiments are housed in the National Nuclear Security Administration. In the Office of Science, the United States has no plans to develop a comparable

superconducting experiment (in the next 10 years) to the Asian superconducting machines.

The US is not advancing fusion as an energy program. Fusion technology must be advanced along with fusion science. It is a problem that fusion is thought of as a science experiment, not an energy program. The level of seriousness to develop technology is not high in the US, and focus is not on fusion energy, but rather on science.

The Development of Nuclear Fission as a Case Study

The United States has developed nuclear energy before. The first nuclear fission reactor (Chicago Pile 1) was built in 1942. Less than a decade-long effort developed the new technology to a working nuclear powered submarine (the USS Nautilus, authorized in 1951 and launched in 1954). Admiral Hyman Rickover was instrumental in managing that transition, and the path he set us on still defines the US nuclear plan. **We must get the United States back on track to build nuclear fusion power plants in a short time frame.**

The fusion community needs strong political leadership to develop it as an energy program. At the moment, due to declining budgets, there is in-fighting between different experiments and no unified plan for how to advance the US fusion program. Just as the Manhattan project had Lieutenant General Groves to direct the development of the nuclear bomb, and the nuclear fission program had Admiral Rickover to direct the creation of the Nuclear Navy, so too does the fusion program need a leader charged with the political directive to build a working fusion power plant.



Admiral Hyman G. Rickover

Recommendations

ASP recommends creating the position of “Deputy Under Secretary for Fusion Energy” within the Office of the Under Secretary for Science and Energy. This person would be politically responsible for fusion in both the Office of Science and in the National Nuclear Security Administration (NNSA), and would report directly to the Under Secretary for Science and Energy. It is appropriate for the position to be within the Department of Energy, because fusion directly fits within the declared mission of the Agency, as stated:

“The mission of the Energy Department is to ensure America’s security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions.”

We need a strong, inspiring vision on how to develop fusion energy – one that fits with this mission statement. The mission of the new official must be energy, not solely science. If this were the explicit goal for the official, that would then drive future evolution of the program and enable many changes.

It is possible to have a fusion experiment in the near term (a decade) that would produce energy. To achieve this, many parallel efforts and funding increases to as much as ten times the current level would be required, as outlined in the ASP Fusion White Paper. As a first step, until such funding could be authorized and appropriated, a new position leading the US fusion program could set the program on a path towards energy. This new official would have the authority to set direction of the fusion program in both the Office of Science and the NNSA, while remaining a key part of the Department of Energy.

Fusion must be an energy program; centered on developing a path to safe and economical fusion energy. It is a national security imperative that America demonstrates practical fusion power in a short timeframe. This will set the stage for full-scale commercial power that will drive American prosperity for the next century.

Further Reading

[Fusion White Paper 2014 – 10 Year Plan for American Energy Security](#)

[Powering the Future – Prospects for Fusion Energy](#)

[FY-15 Omnibus Supports Fusion](#)

[10 Key Facts About Fusion](#)

[White Paper: America's Energy Choices - 2014](#)

The American Security Project (ASP) is a nonpartisan organization created to educate the American public and the world about the changing nature of national security in the 21st Century.

Gone are the days when a nation's security could be measured by bombers and battleships. Security in this new era requires harnessing all of America's strengths: the force of our diplomacy; the might of our military; the vigor and competitiveness of our economy; and the power of our ideals.

We believe that America must lead in the pursuit of our common goals and shared security. We must confront international challenges with our partners and with all the tools at our disposal and address emerging problems before they become security crises. And to do this we must forge a bipartisan consensus here at home.

ASP brings together prominent American business leaders, former members of Congress, retired military flag officers, and prominent former government officials. ASP conducts research on a broad range of issues and engages and empowers the American public by taking its findings directly to them via events, traditional & new media, meetings, and publications.

We live in a time when the threats to our security are as complex and diverse as terrorism, nuclear proliferation, climate change, energy challenges, and our economic wellbeing. Partisan bickering and age old solutions simply won't solve our problems. America – and the world – needs an honest dialogue about security that is as robust as it is realistic.

ASP exists to promote that dialogue, to forge that consensus, and to spur constructive action so that America meets the challenges to its security while seizing the opportunities that abound.



American Security Project

www.americansecurityproject.org