U.S. House of Representatives Committee on Science and Technology
Subcommittee on Energy and Environment

Hearing on
Marine Hydrokinetic Technologies: Finding the Pathway to Commercialization

James G.P. Dehlsen, Chairman
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Mr. Chairman and members of the Subcommittee, it is my pleasure to appear before you today to discuss the role that the government can play in advancing marine-based renewable energy technologies to meet a significant part of the nation's future electricity supply.

I am Founder and Chairman of Ecomerit Technologies, which has a focus on developing reliable, competitively priced, utility-scale ocean current and wave-powered electricity generating systems. We are also actively developing and investing in other sustainability-related technologies. We are located in Carpinteria, California.

Ecomerit Technologies represents my third entry in developing industrial-scale renewable energy technology. In 1980, I established Zond Systems, Inc., which pioneered wind power technologies leading to three generations of advanced wind turbines, and grew to become one of the largest global companies in wind turbine manufacturing, project development and plant operation. Acquisition of this technology and manufacturing formed the basis for GE's entry into the wind energy industry in 2002. As of last year, GE had produced over 10,000 turbines with worldwide deployment.

I also founded Clipper Windpower in 2001 with my son, Brent, and serve as Chairman of the Board. Clipper manufactures a new generation wind turbine, the 2.5 MW Liberty – the largest turbine produced in the U.S. – which received the Department of Energy's 2007 Outstanding Research and Development Partnership Award for its contribution toward industry advancements. Clipper is now in development on a 10 MW offshore turbine – the world's largest – planned for introduction in 2012/2013. In its lifetime, one of these 10 MW turbines will have the equivalent electricity generation of about 2 million barrels of oil.

It is important to note that the breakthrough wind energy technologies developed by Zond and Clipper were made possible by DOE/NREL grant funding and technical support, and this support also accounts for a substantial part of the technological innovation that has led to the success of the present $40 billion per year global wind industry.

<u>Key Elements for Success in Marine Hydrokinetic Technology (MHK)</u>

Drawing on my three decades in developing and commercializing renewable energy technologies, it is clear to me that marine hydrokinetic power can now play a significant role in adding to our national energy security, our economic development, and meeting our environmental goals. However, as with wind and solar energy, it will take a serious, robust and sustained partnership between the federal government and technology developers in a number of areas, including:

- Technology advancement, verification and acceptance through support for research, development and deployment;

- Clear, timely, predictable, and workable regulatory framework for siting and permitting of marine renewable projects;

- Clear, timely, and predictable incentive regime structure that facilitates rapid advancement of technology deployment;

- Close federal agency coordination and benefiting from lessons learned here and abroad in both wind and hydrokinetic power technology development and deployment; and

- The development of standards and certifications to provide confidence to customers and the financial markets.

Marine Renewables Overview

Today's emerging marine renewables industry includes technologies with the potential to convert the power of wave, tidal and constant ocean currents into utility-scale electricity supply.

The U.S. is blessed with abundant marine renewable resources on our extensive coastlines. According to the Electric Power Research Institute, the commercially available U.S. wave energy potential, alone, is roughly equal to 6.5% of the nation's entire generating portfolio. That is approximately the amount of electricity being produced by *all traditional hydroelectric dams* in the U.S. Another example is the Gulf Stream, just 15 miles off the coast of Florida, which has a constant flow equal to 50 times all the rivers of the planet and presents an opportunity to adapt much of the mature technology developed for wind power to provide thousands of megawatts of clean baseload power to the eastern seaboard states. Clearly, marine renewable energy can play a significant role in expanding our homeland energy supply and the power needs of our marine-related military facilities around the world.

Federal commitment to creating a robust U.S. marine renewables energy industry will advance our national economic goals by creating high-quality employment in coastal communities, long-term production in shipyards, development of fleets of vessels for deployment and servicing, and strengthening the thousands of businesses that make up the U.S. industrial supply chain. The establishment and nurturing of a U.S.-based marine renewable industry would secure our nation's place in developing offshore renewable energy technologies thereby ensuring that the United States is an exporter, not an importer, of these technologies.

Federal Support and Industry Partnership

The formation and growth of a U.S.-based marine renewables industry is not a given. It is essential to understand that marine renewables face significant challenges before they can become a meaningful part of the nation's power supply. These challenges include the current limited federal support, lack of adequate regulatory framework, and the need for closer government agency cooperation.

At the same time, there is the opportunity for accelerated growth of a U.S. marine renewables industry by adopting the “lessons learned” and building on the successes of wind and solar development programs both in the U.S. and Europe.

I strongly support the current action in Congress that would address these issues head-on and with a strong sense of urgency. Specifically, I support the pending marine and hydrokinetic program reauthorization which would establish the following program parameters:

$250 million/five-year authorization of:

- Research, Development, Demonstration & Deployment (RDD&D)/separate program line for water power
- Device verification
- Five-year accelerated depreciation

I believe that this program could have a comparable success and payback to the nation as experienced with U.S. programs in support of wind power and solar energy technologies.

One of the key issues I would like to stress today is the need for a serious, sustained federal effort to develop, demonstrate, and deploy marine hydrokinetic technologies to economically help meet its needs for energy security and CO2 reduction and for gaining a global leadership position in the marine renewable energy sector and benefit from the major industrial opportunity that it presents.

The federal technology programs, particularly those at DOE, have over their 30-year history directly enabled the development and commercialization of new energy technologies such as geothermal, solar, biomass and wind. The Department's management - political and career - and the technical experts at headquarters and the national laboratories, can take much of the credit for helping to create today's global renewable industries. They closely collaborated with the emerging industry players to understand, and then mitigate risk; they requested the funds necessary to research, develop and demonstrate new technologies; they shared the pride when technology achieved commercial success and gritted through the setbacks along the way; and they promoted the new technologies, within the government, as well as with the nation's utilities, and their consumers. They helped launch major industrial activity and large-scale renewable power generation.

The U.S. renewable energy experiences shows that in a government/industry partnership, the most fundamental factor in success is a *sustained federal commitment* in the face of changing or uncontrollable events, such as global oil price fluctuations or shifting national priorities that come with each new administration or political appointee.

I share two examples:

In the 1990’s, the DOE/NREL support for wind energy technology development and verification

was highly effective and led to much larger and more efficient turbines. During that time, my company, Zond, developed three generations of turbines, greatly aided by technical and grant support from DOE/NREL. This enabled Zond's growth to a leading position in the industry, and eventually GE acquired the technology and manufacturing for its entry into wind energy. By 2008, GE had produced over 10,000 turbines, placing it among the top global wind turbine companies. The $32 million in DOE/NREL grant support has leveraged well in excess of $15 billion in direct economic activity.

In 2001, we launched Clipper Windpower to produce a new generation turbine based on advanced powertrain architecture and controls. In the same year, DOE/NREL solicited wind turbine technology proposals, and with good fortune, Clipper was selected for a $9 million matching grant. This was followed by over $150 million in private equity funding for the 2.5 MW Liberty turbine, which we started manufacturing in 2006. Clipper now has 800 employees, and there are 375 turbines deployed in 17 projects across the U.S., totaling 938 MW of generating capacity. This success would not have been possible without the DOE/NREL's assistance, from design to development, from demonstration to deployment, and yielding the "most advanced and efficient wind turbine in the industry" (DOE 2006 Report). Our DOE/NREL partnership again resulted in significant new manufacturing activity, created jobs, added to the Federal and State tax base, and helped grow the U.S. renewable power industry.

But there is the other side of the coin. Clipper Wind was also seeking to partner with DOE/NREL to develop offshore wind technology when the offshore wind program was suddenly terminated in 2006, significantly shifting the early offshore wind technology lead to Europe. With this, Clipper had to revert to overseas for support, where government incentive structures for technology development were robust and consistent. Today, we are engineering the 10 MW Offshore Wind Turbine in Blythe, England, where production is planned to start in 2013.

The UK now leads the world in offshore operating wind turbine capacity, and the European Union has accelerated their offshore wind program, expected to exceed $150 billion by 2020. They have set goals of 20% from renewable energy deployment in 2020, which now includes offshore wind, wave, and tidal currents. This is supported by robust technology development grants and energy pricing mechanisms. UK offshore renewable energy produces roughly double the revenue compared to U.S. energy pricing.

China has installed its first offshore turbines, and its land-based turbine deployment is expected to be the highest for any nation by 2010 and beyond.

Hydropower and Hydrokinetic Have Little in Common

The basis for establishing a marine hydrokinetic program, separate from hydropower, is based not only on major differences in requirements for offshore/marine vs. land-based system deployment and operation, but also very different technical, financial, and technology maturity characteristics. Traditional hydropower technology has remained relatively static for decades. These two hydros have little in common. Advances in the new marine technology will be far

more robust, and progress will occur more quickly with the marine hydrokinetic program apart from, and not subsumed under, the federal hydropower program.

Technology Verification Program

I firmly support the Congressional language that would establish a technology verification effort to increase marine-based power experience and to build and operate enough candidate devices to obtain statistically significant operating and maintenance data. The *technology verification program* for wave, tidal, and current energy systems is the bridge to commercial deployment of marine renewable energy devices. This program is modeled on DOE's successful wind turbine verification program of the 1990's, which lead to invaluable experience on siting, permitting and operations. In particular, the program significantly increased data collection to address the uncertainty regarding impacts of the then-emerging wind industry. A similar effort directed towards marine-based renewable energy technologies would also enhance DOE's ability to effectively manage an increased level of funding in a timely manner and with clear results.

Government Coordination

DOE should also work closely with other federal agencies that have an interest in marine renewables, particularly with the Department of Defense, the Department of Commerce (NOAA), and those agencies that have regulatory authority and can provide incentives.

Since 2002, DOD has provided funding for the development of marine renewable technologies. DOD facilities also offer a market for marine renewable products and services, particularly to reduce dependence on imported fossil fuels, which can be extraordinarily costly when supplied to DOD and remote bases.

The lack of a clear, timely, and predictable regulatory regime deters not only private investors in the technology, but also testing and near-term deployment funding. Federal agencies with regulatory authority or concerns related to marine renewables should work together to streamline deployment of MHK projects. The recent announcement by the Federal Energy Regulatory Commission that it has signed a Memorandum of Understanding (MOU) with nine federal agencies to streamline the siting of transmission lines provides an excellent model that should be applied to the marine renewable energy sector. Federal agencies should also coordinate with states that are either investing in this technology or will play a role in permitting and siting projects, including Maine, New York, Florida, California, Oregon, Washington, and Hawaii.

<u>Cost of Energy and Deployment</u>

Since 1998, I have engaged in an effort to advance utility-scale power generation technology for both wave energy and ocean currents. Based on this engineering, we are targeting a cost of energy for both technologies in the range of $0.10 to $0.12/kWh by 2015, a level that should enable commercialization, provided the U.S. government implements an effective program of

incentives for research, development, and deployment, that supports marine renewables more tangibly and consistently than the federal support for wind energy. Meaningful rates of deployment (several gigawatts/year) should come in the 2015-2020 timeframe in line with the forecast potential of 23 GW by 2025[1].

While this appears quite accelerated when compared to the history of wind, solar, and other renewable energy technologies, it must also be viewed in light of the advanced know-how, which is brought forward from marine engineering in shipbuilding, offshore oil, submersible vehicles, knowledge we now have of structural loads and control systems of wind turbines, the advanced numerical model design tools, and fabrication of large composite structures. This substantially reduces development costs and timeline. Furthermore, the urgency that is now upon us from climate change and energy security is driving development of marine renewable energy not just in America, but Europe as well. So we can expect a fast and competitive pace in technology advancement.

Learning from Wind Power Policy

The U.S. renewable energy experiences shows that in a government/ industry partnership, the fundamental success factor is a *sustained federal commitment* in the face of changing or uncontrollable events, such as global oil price fluctuations or shifting national priorities that come with each new administration or political appointee.

Perhaps the hardest public policy lesson that has come out of the American wind effort has been the repeated crippling effect, on the industry, from discontinuity in government support. The U.S. was in a clear leading position in wind power in the early 1980's due to the U.S. government's investment in renewable energy technologies, which started during the oil embargo in the 1970's. By the mid-1980's, government support ended and the U.S. wind industry virtually collapsed. A series of on again, off again programs followed. While the U.S. wind sector continued in its struggle for survival, strong European Union support stimulated rapid growth throughout the continent. Today, European companies enjoy the lion's share of the industry and have created several hundred thousand jobs, with a global wind industry generating upwards of $40 billion per year and growing at 20% annually. We are now seeing massive support for wind energy in China, which has initiated *ten* 10,000 megawatt regions representing ~$200 billion in industrial activity fully supported by the Central Government.

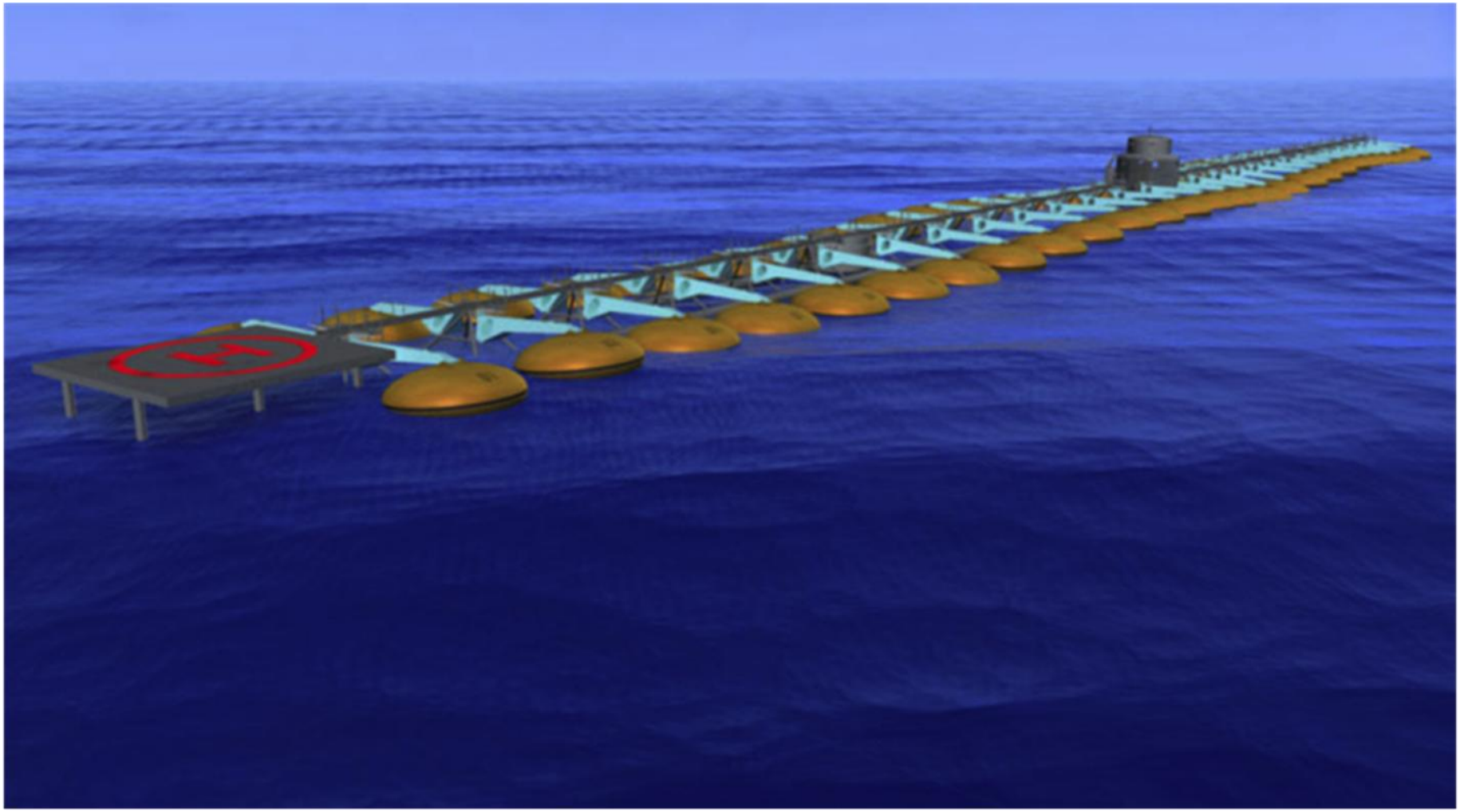
While America had the foresight and made the investment to launch the wind industry, discontinuity in federal support has allowed other nations to capture a major share of the long-term industry/energy benefits. We must not let this happen with marine renewables; government policy should be implemented quickly and sufficiently to sustain this emerging industry until it reaches industrial scale.

[1]American Council on Renewable Energy (ACORE), "The Outlook on Renewable Energy in America, Volume II: Joint Summary Report", March 2007; ACORE: Hydropower Industry Outlook, presentation to "Renewable Energy in America: Phase II Market Forecasts and Policy Requirements," November 29-30, 2006.

Summary

In summary, marine renewables offer enormous potential to stimulate our economy, address our environmental issues, and to provide an indigenous source of clean, renewable energy. I urge the Subcommittee to support a serious and sustainable federal investment to stimulate the continued development and ultimate deployment of U.S.-based marine renewables at home and around the world.

Thank you again for the opportunity to appear before you today and I am happy to take your questions.



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ECOMERIT TECHNOLOGIES

2.5 MW Aquantis C-Plane Ocean Current Generator

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