

STATEMENT OF
CYNTHIA J. WARNER, PRESIDENT, SAPPHIRE ENERGY
BEFORE THE
SENATE COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
HEARING ON “BUSINESS OPPORTUNITIES AND CLIMATE POLICY”
May 19, 2009

Madam Chairman, Ranking Member Inhofe, and Members of the Committee:

Good morning. Thank you for the opportunity to testify at this important hearing. My name is Cynthia Warner. I am the President of Sapphire Energy, an algae-based energy company established in California in 2007.

Sapphire Energy was founded with one mission in mind: to change the world by developing a domestic, renewable source of energy that benefits the environment and hastens America’s energy independence. Thanks to a supportive syndicate of respected investors, including The Wellcome Trust (the world’s largest biomedical research charity), Cascade Investment (an investment holding company owned by Bill Gates), Venrock (the venture capital arm of the Rockefeller family), ARCH Venture Partners, and other like-minded investors, Sapphire is well on its way to fulfilling this mission. Using algae as a feedstock, Sapphire has developed a breakthrough technology that produces fungible, drop-in transportation fuels – including 91-octane gasoline, 89 cetane diesel, and jet fuel - out of sunlight and carbon dioxide (CO₂).

Sapphire Energy is headquartered in San Diego, and we have established a growing presence in New Mexico. We currently have 107 employees who carry out our mission in both

states, and, as I will explain in my testimony today, we expect to employ many more in the near future.

The Sapphire Business Model

Sapphire Energy's goal is ambitious. It is to become the world's leading producer of renewable fuels and petrochemical products. To accomplish this we brought together a team of people who, as entrepreneurs, scientists, and concerned citizens, hold several shared beliefs. We believe that climate change is a threat to our environment and that dependence on imported oil is a threat to our national security. We believe that existing alternatives to imported transportation fuels are too slow to commercialize, too expensive to produce, and have their own harmful environmental trade-offs. We believe that, through the application of vision and technology, we have found a better way to achieve energy independence and minimize greenhouse gas emissions.

To focus our efforts, we established four benchmarks to guide our work.

- First, to produce “drop in” transportation fuels that have equivalent or better energy density than the petroleum fuels we currently use and are also compatible with the existing energy infrastructure, including the existing network of refineries, pipelines, and terminals and the existing fleet of cars, trucks, and jets. Americans have spent more than seven trillion dollars developing our transportation fuel infrastructure. The most economically practical renewable fuel, therefore, is a “drop in” transportation fuel that does not require us to recreate this infrastructure.

- Second, to produce fuels that can be grown on marginal desert lands, and in brackish or salt water. We did not want to produce energy crops that compete with food crops for agricultural land; nor did we want to divert precious fresh water resources.
- Third, to produce fuels that have a low carbon impact. We wanted to produce alternative fuels with a life cycle carbon impact that is roughly 2/3 less than that of petroleum-based fuels, and significantly lower than other conventional biofuels.
- Fourth, to produce fuels that are scalable in the near term and cost competitive in the long term. We wanted to be able to produce over one million barrels a day of a renewable crude-oil equivalent, within the next fifteen years. We also recognized the need for this alternative to be competitive with current and future crude oil prices, anticipating that over time, our alternative would become more competitive as crude oil's prices increase, and ours decrease.

I am here today to tell you that we are well on our way to meeting each and every one of these four benchmarks. After two years of dedicated research and development, fueled by the Department of Energy's conclusions regarding algae's suitability as an ideal energy crop, we have developed an algae-based fuel that is renewable, produced in the United States, has a low carbon footprint, has no adverse environmental side effects, is price-competitive, and fits seamlessly into our existing energy infrastructure. Let me be clear. I am not talking about an inferior substitute for gasoline, diesel, and jet fuel. Rather, I am talking about a renewable, domestically produced, and environmentally sustainable fuel that is chemically identical – and in

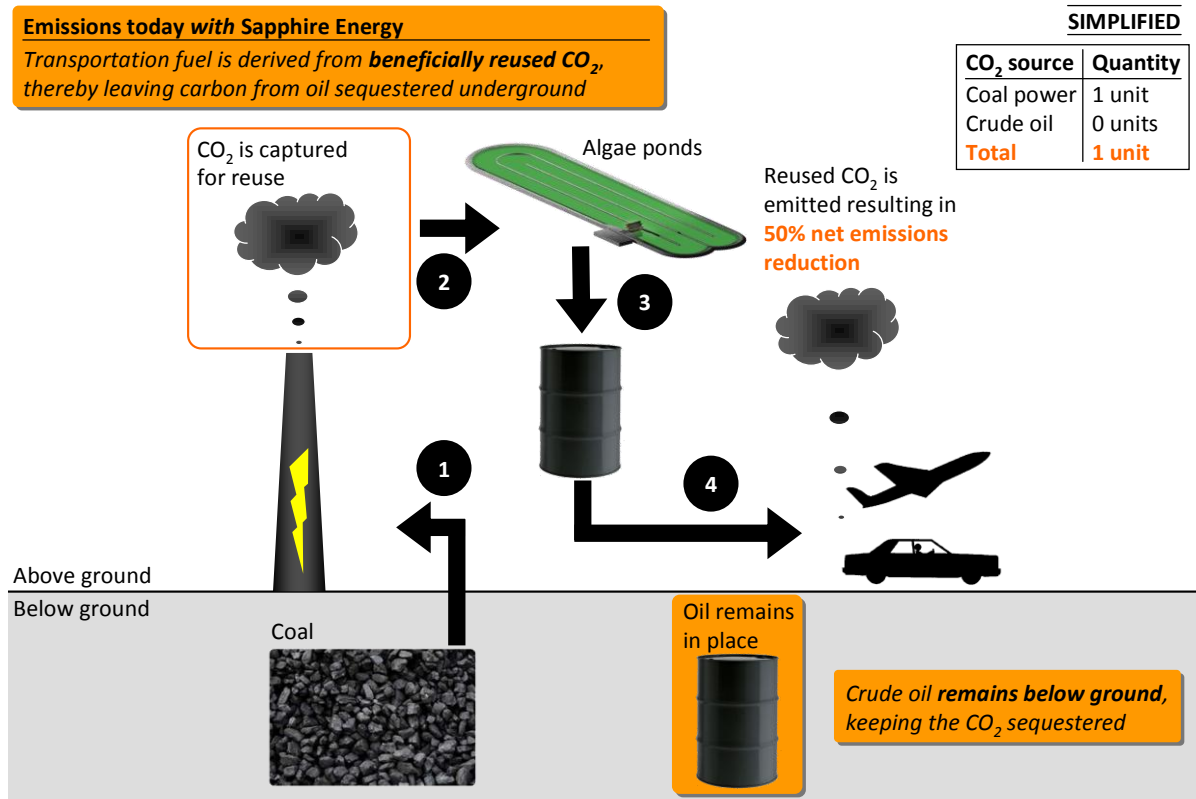
many ways superior – to gasoline, diesel, and jet fuel. That product is our algae-based “Green Crude.”

The Technology of Algae-Based Fuel

Algae is uniquely suited to serve as the foundation for a new generation of renewable and low carbon transportation fuels. Algae is one of nature’s most prolific and efficient photosynthetic organisms; in fact, it is the source, millions of years ago, of all of the earth’s crude oil. Nearly all of algae’s biomass is concentrated in the chloroplast—the engine that turns sunlight and CO₂ into organic carbon, so that algae does not “waste” time or energy making stalks, roots, leaves, or fruits. This efficiency leads to very high yields of oil. For example, while palm oil can yield 554 gallons of oil per acre, algae can yield 5,107 gallons per acre—increasing oil output by a factor of ten. Further, algae has a short growing cycle and does not require arable land or potable water—it can be grown quickly in brackish or salt water in the desert.

Drawing on years of algae discoveries in the academic and governmental realm, and building on that research with our high throughput biological experimentation with additional tens of thousands of strains, we have successfully developed algal feedstocks that turn sunlight and CO₂ into drop-in transportation fuels that are, in many aspects, superior to petroleum fuels we use today. For example, our green fuels are very low in sulfur, have no benzene, result in superior diesel fuels with high cetane levels, and are higher in energy density than traditional petroleum-based fuels. These elements of superiority will command a higher premium for green crude and make us more cost competitive.

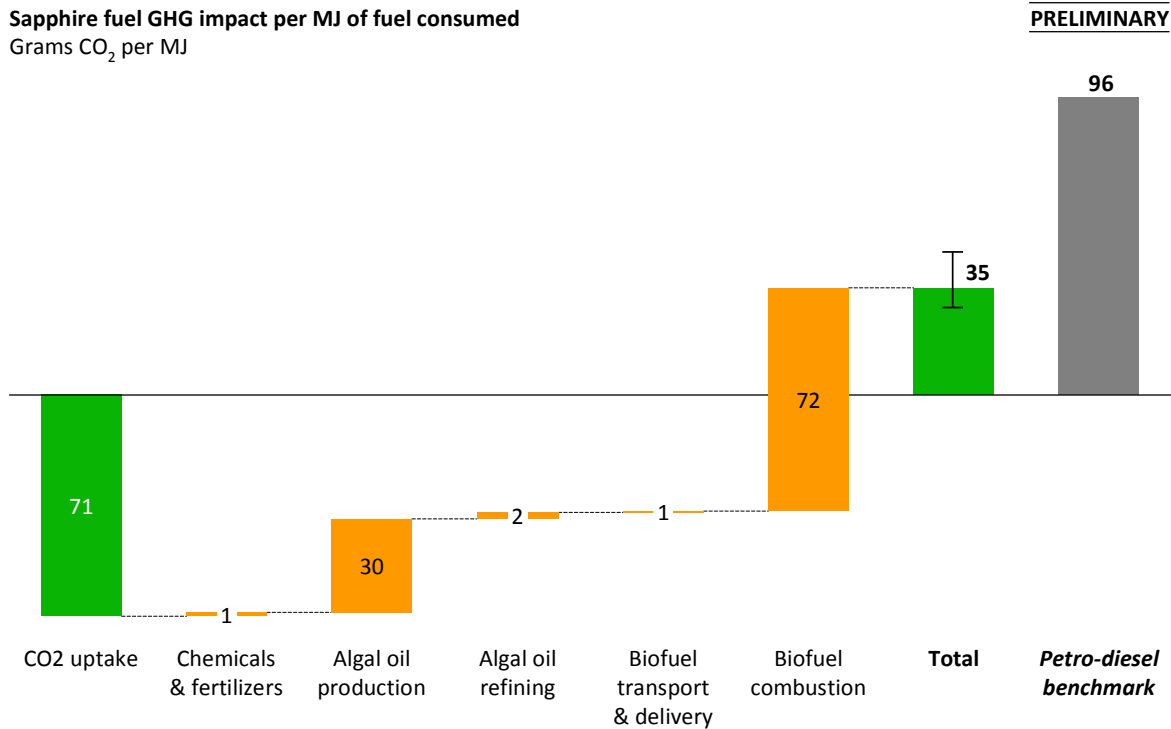
Furthermore, the environmental benefits of our algal fuels are exceptional. Carbon dioxide plays a critical role in the cultivation of algae. In other words, algae consumes enormous amounts of CO₂, drawn from both industrial and atmospheric sources, in its growth process. For example, the amount of algae it takes to extract one gallon of Green Crude consumes between 29 and 33lbs (13-15 kg) of CO₂. The environmental benefits of using algae as a feedstock are thus exceptional; algae-based green crude provides a “two for one” benefit from the use of fossil fuel, by using the CO₂ emitted by a facility (such as a coal-fired electric utility) as a feedstock for the production of green crude. Using algae to beneficially reuse CO₂ results in green electric power and a low carbon, drop-in hydrocarbon fuel.



Our green crude’s environmental superiority was recently confirmed by the results of a life cycle analysis conducted by Life Cycle Associates, a well-respected company that has

conducted numerous life cycle analyses for the California Air Resources Board. The company determined that Sapphire’s algae-based fuels emit approximately two-thirds less CO₂ than petroleum-based fuels at scale. When compared with conventional biofuels, such as corn ethanol and soy biodiesel, our green crude has significantly less than half their carbon impact, while delivering far greater energy density than either alternative.

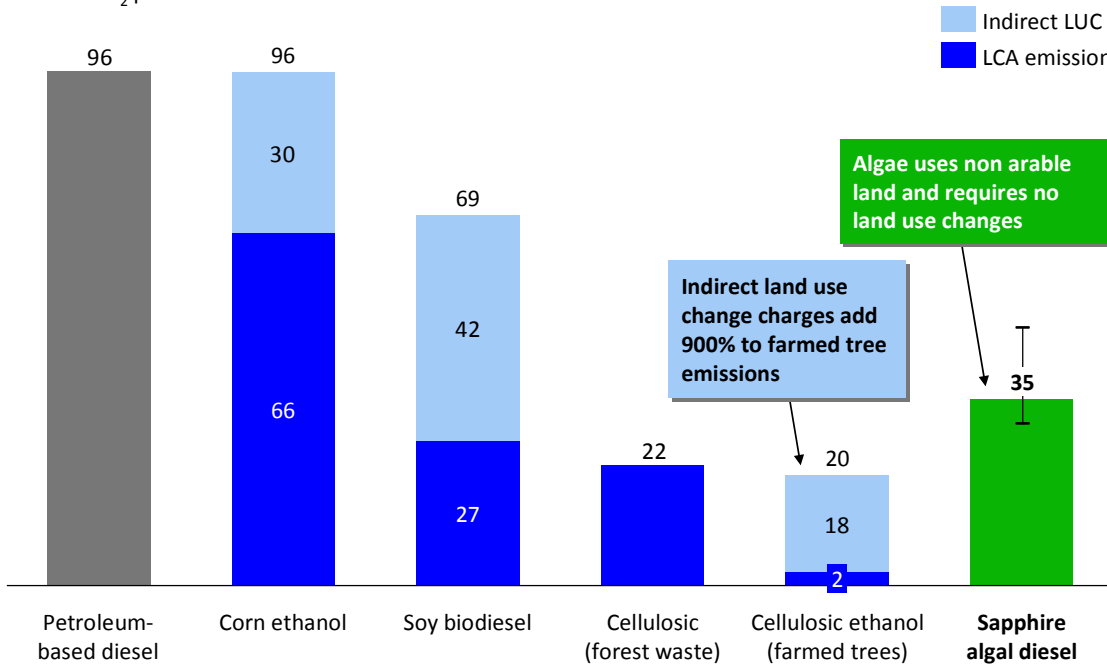
Sapphire fuel GHG impact per MJ of fuel consumed
Grams CO₂ per MJ



Source: Draft values from California Air Resources Board; Life Cycle Associates, LLC

Algae fuel LCA comparative emissions
Grams CO₂ per MJ

PRELIMINARY



Source: Draft values from California Air Resources Board; Life Cycle Associates, LLC

Putting all of this together, we agree with the assessment of a team of scientists from Utah State University, who said, in a report released last week,

Growing algae, the most productive of all photosynthetic life, and converting it into plastics, fuels, and or secondary feedstocks, could significantly help mitigate greenhouse gas emissions, reduce energy price shocks, reclaim wastewater, conserve fresh water (in some scenarios), lower food prices, reduce the transfer of U.S. wealth to other nations, and spur regional economic development.¹

¹ Utah State University, "Algae-Based Carbon Recycling," May, 2008, page 6. This study was released in conjunction with Jeff Muhs' testimony before the Senate Energy and Water Appropriations subcommittee's hearing on the Beneficial Reuse of Carbon Dioxide.

Government officials are excited about algae's promise as well. Just last week, Jonathan Trent, the lead researcher at NASA's Ames Research Center, proclaimed that "[a]lgae are the best source of biofuels on the planet that we know about."²

Most exciting, from Sapphire's "the fuel producer's" perspective, is the fact that our future customers – those who consume large amounts of fuel on a daily basis - are thrilled at algae's potential. Fred Smith, CEO of FedEx, was recently quoted as follows:

"Did you know that algae, which is a prolific eater of carbon dioxide, can double in mass quickly, sometimes in four to six hours? ...

"Algae has 30 times the amount of oil inside its molecular structure than cellulose ethanol does. That gives it big potential for the production of jet fuel. In fact, you could produce enough jet fuel for the entire world in a land mass about the size of West Virginia, as compared to other biofuels, which would take a land mass the size of the United States. Amazing what you can do with a little pond scum!

"Over the past year, there have been four successful demonstration flights with biofuels made from jatropha and algae, so this is not pie-in-the-sky thinking."³

These are just a few of the many quotes from those in academia, the government, and industry, who are excited about algae's ability to hasten America's energy independence, and improve our environment.

The Practical Prospects for Algae-Based Fuel

² Jonathan Trent, "NASA Bags Algae, Wastewater, in Bid for Aviation Fuel," GreenWire, May 12, 2009.

³ Fred Smith, "Keeping America Competitive: The View from the Commerce Street," TownHall Los Angeles, Feb. 10, 2009.

As Fred Smith noted, algae-based fuel is not some science fiction fantasy, or a theory that works on a blackboard or in a laboratory but has little practical application. To the contrary, algae-based fuel can have a profound impact on our economy in the near future.

One year ago, Sapphire successfully produced 91-octane gasoline that fully conforms to ASTM certification standards. Five months ago, we participated in a test flight with a Boeing 737-800 twin-engine aircraft. One engine used conventional fuel, the other a mix of algae-and jatropha based fuel. The flight was a success, with the algae-based jet fuel meeting all performance standards and burning approximately 4% more efficiently – thus saving 100 gallons of biofuel – as compared with the petroleum-based fuel. This incredible fuel savings was due to the higher energy density of the algae-based fuel. The test pilot said that the biofueled engine’s performance was “textbook.” This and other tests show that algae-based fuel works well in existing vehicles and planes.

In terms of production, we currently operate a 100-acre R&D facility in Las Cruces, New Mexico, and will soon open an additional 300-acres of processing capacity in rural New Mexico. We will continue to expand as production increases. We plan to meet ambitious milestones, producing one million gallons of fuel per year by 2012, 100 million gallons by 2018, and 1 billion gallons by 2025. We believe that it is realistic to expect that, by 2050, Sapphire’s algae-based fuel can replace more than 25% of conventional petroleum. The resulting reduction in cumulative CO₂ emissions between now and 2050 would be 3.6BN metric tons.

And I’m just talking about the output from one company – my company - Sapphire Energy. I haven’t even begun to touch upon the 90 plus algae-based fuel companies that have sprung up in the past two or three years. Noteworthy companies like Algenol – a Florida based

company with operations in Baltimore, Maryland – are developing other types of algae-based fuels, such as algae-based ethanol, as well as valuable co-products, such as plastics and animal feed. Solazyme, General Dynamics, LiveFuels, Aurora Biofuels, and OriginOil, are just a few of the many other prominent names in the algae-based fuel industry. Most are producing transportation fuels or developing fascinating algae-based biological carbon capture and beneficial reuse applications. As an industry, we're growing at an extraordinary rate.

We're also creating jobs - thousands of green collar jobs - all across the country. In San Diego alone, research on algae-based fuel employs about 272 scientists, and provides nearly \$16.5 million in payroll and \$33 million in economic activity for the region, according to a recent San Diego Association of Governments assessment.⁴ Add to that jobs and spending related to service industries, and algae is responsible for 513 jobs, \$25.4 million in wages and \$63.5 million in economic output in the region.⁵

In December 2008, President-elect Obama's transition team asked the Algal Biomass Organization (ABO), one of the algae industry's associations, to estimate the number of jobs that could be created over the next three to four years. The ABO estimated that approximately 11,700 direct jobs will be created, with an additional 30,000 jobs from indirect sources. Clearly, the algae industry already is having a significant impact on green collar job creation and is stimulating the economy. And Congress could further boost these numbers by adopting carefully tailored climate change policies that account for algae's unique role in beneficially reusing CO₂.

⁴"New Center to Focus on Algae, Biofuels," San Diego Union Tribune, April 29, 2009.

⁵ *Id.*

The Relationship to Climate Policy

Sapphire's commercial success is closely tied to the important work that this Committee has undertaken on climate policy. Our business model works best if this country is on a path towards reducing the emission of greenhouse gases and is doing so in the most economically efficient and environmentally sustainable way. Accordingly, we support legislation to establish a cap and trade system, and we have been working with this Committee and with others to assure that cap and trade legislation provides a proper carbon accounting for algae-based fuel.

Let me be more specific. As previously noted, CO₂ will be one of our principal feedstocks. Therefore, the price of securing enough industrial-source CO₂ to keep our algae growing at a steady rate is one of the primary factors determining the price of our algae-based fuels. Currently, CO₂ costs an exorbitant amount – somewhere in the range of \$130 per metric ton. This is particularly ironic, given the fact that so many industrial entities are desperately seeking methods to dispose of their CO₂ emissions!

We ask that this Committee adopt legislation that would allow the beneficial reuse of CO₂, through a medium like algae, to be added to the list of Congressionally-approved ways in which industrial emitters, like coal fired power-plants, can off-load their CO₂. This will incentivize emitters to capture their CO₂ and sell it to us at a substantially lower price, so that we can turn that CO₂ into renewable fuel. It will also allow algae-based fuels to become truly competitive with a petroleum industry that has received decades of governmental incentives and support. This simple legislative action would make all the difference to our nascent algae industry and would give us the boost we need to help America become truly energy independent.

Conclusion

Madame Chairman, Sapphire Energy believes that the business opportunity presented by climate policy can be transformative. By getting ahead of the curve, we can produce a new generation of transportation fuels for the world, that are low-carbon, produced right here in the United States, and that generate renewed economic growth and new green-collar jobs.

We look forward to working with this Committee to turn this opportunity into reality.

Thank you again for the opportunity to testify, and I would be happy to answer any questions.