

# Who's in the lead? Algae around the world : Biofuels Digest

## [Who's in the lead? Algae around the world](#)

Who's in front in the development of algal-based fuels and biomaterials? India, China, Japan, Australia, Taiwan, Israel, the EU, or the US. The NAABB's globe-trotting chief parses it out.



In New Mexico, Dr. Jose Olivares is head of the National Alliance for Advanced Biofuels and Bioproducts (NAABB), a consortium funded by the Department of Energy (DOE) to develop innovative technologies that will help bring algal biofuels to a commercial reality. Jonathan Williams sat down recently with Dr. Olivares after he had completed a wide-ranging tour of some of the algal hot spots around the globe.

For an overview of the NAABB itself? See our interview with Dr. Olivares, "[Spring Algae Bloom: an inside look at the NAABB.](#)"

**By Jonathan Williams**

*Dr. José Olivares is an analytical chemist at the Los Alamos National Laboratories (LANL) in New Mexico. His work these days doesn't have to do with the once prominent focus of creating weapons like the nuclear bomb that this lab is known for. No, Dr. Olivares works on another aspect of our national defense: energy security.*

**JW: O.K. Dr. Olivares, I hear you have been traveling a lot. Could you tell me what you've seen in the algae industry around the world?**

**JO:** Yes, I have been very, very fortunate in the past year to spend some time in Japan, India, Taiwan, China, Australia and Europe. Much of this travel has been by invitation and with the support of entities in these countries. I've been trying to understand the progress in these countries with respect to the development of an algal biofuels industry.

In particular, I'm trying to find out what is taking place with their research and also where their industrial and commercial efforts are focused. It's given me a fairly nice perspective on where we are in the mix of this global industry, and it is helping the National Alliance for Advanced Biofuels and Bioproducts (NAABB) develop some key collaborations with strategic partners around the world.

**JW: That sounds great. Could you go into detail, basically country to country, about what you saw?**

**JO:** Alright, let's start with India.

### India

India has a long history of working with algae, but mostly as a nutritional source or for wastewater treatment. They are trying to develop those areas into a biofuels industry to some extent. In fact, India and the United States have cooperated in the establishment of a funding opportunity for the development of biofuels in general, whether it is algae or cellulosic or some other energy plant that has yet to be determined. That funding opportunity is in development process and promises to put nearly a million and a half to two million dollars per year for research and development of biofuels in each country.

I think India is a force to contend with because of their long history with algae, but at this point they are trying to determine out how best to enter into the biofuels industry. We are very fortunate, from a NAABB perspective, to be partnering with Reliance Industries Limited, which is one of the largest petrochemical companies in the world and is located in India. They have two of the world's largest refineries and they are in

the top 20 petrochemical producers in the world. Reliance Industries is in the process of developing a strategy for biofuels and algae biofuels in particular. We are very privileged to be partnering with them in developing this strategy.

## **Japan**

Japan has had an even longer history than most countries in developing algae for commercial purposes, mostly macroalgae, for nutritional sources and food sources. They have also had a top phycological society and are very active in prospecting for new species of algae. The Japanese probably have some of the top researchers in the world looking at species such as *Botryococcus braunii*.

Much of this research is concentrated at the University of Tsukuba. There, they have actually identified a new species of algae that grows very, very fast and has fairly good oil productivity. It's very consistent and very fast growing in large numbers, so its overall productivity looks promising for the biofuels industry.

NEDO (New Energy and Industrial Technology Development Organization), which manages government, industry, and academic based energy research in Japan, is helping fund a few algae projects. With the University of Tsukuba and several other companies, they have formed a small consortium of industry leaders to push forward with the research and development of algae for biofuels. It is a fairly sizable effort overall, but you can point it to a few institutions.

## **China**

Within China, I went to visit the Qingdao Institute for Bioenergy and Biotechnology. The institute was founded to help the region around Qingdao develop a bioenergy infrastructure and they are well on their way to doing that. Within the last three years, they have put together an institute with about 200 researchers. It is kind of amazing to see the research power that they've been able to muster in that very short time.

The Chinese have a few projects in algae and we are, again, very fortunate within the NAABB to be partners. We are collaborating with Dr. Jian Xu in the sequencing and the annotation and analysis of *Nannochloropsis salina* strain 1776 which we are also sequencing here at Los Alamos. This collaboration also involves NMSU and Solix Biosystems which played a key role in developing our collaboration.

Another entity in China working in the algae industry is ENN, they have been developing some interests in photobioreactor-based systems for carbon sequestration and the development of algae for biofuels and bioproducts. This project looks like it is starting to take off, and they are well on their way with some test pilot units already developed.

## **Taiwan**

Taiwan is very similar to China. There is a very large steel plant in southern Taiwan, the Chinese Steel Corporation in Tungkang. One of the largest steel plants in the world with sizable CO<sub>2</sub> emissions. This plant is collaborating with the National Cheng Kung University to develop a photobioreactor sequestration system for CO<sub>2</sub>.

The Industrial Technology Research Institute (ITRI) itself is actually working very closely with Taiwanese universities in transformation of algae, photobioreactor systems, belt screen based harvesting technologies and supercritical extraction systems. NAABB, through Pacific Northwest National Laboratory, has recently entered into a research collaboration with ITRI in new membrane technologies for harvesting systems.

Overall, this is a significant effort for a very small country.

## **Australia**

Australia has been in the news for quite some time and has been developing quite an industrial interest in algae. Muradel, a small company forming in Adelaide and in Karratha (from a joint venture between Murdoch U., Adelaide Research and Innovation Pty Ltd and SQC Pty Ltd) is developing a small 10 acre facility and currently has about two acres under development. Additionally, Aurora Algae has started developing some facilities in Karratha, and MBD Energy is active in Queensland.

The University of Sydney is developing a number of technologies for the conversion of biomass into oils, in particular their hydrothermal liquefaction capabilities look very promising for algae.

The Australian government recently announced a \$23/ton carbon tax, which will be reinvested in renewable

energy development. This will make about \$23 B available for new developments. Much of the effort will be managed through the Clean Energy Finance Corporation and the Australian Biofuels Research Institute. Of course, we have all seen the interest from airlines such as Qantas and Virgin Air, and airplane manufacturer Boeing, in the Australian bioenergy initiatives.

All of this is a very, very nice level of development from Australia.

## Europe

There are four new algae projects being funded by the European Union. Three of them are located in Spain.

Specifically, I visited the Repsol Innovation Center in Madrid and University of Alicante. Repsol is a large Spanish petrochemical interested in the development of biofuels. Repsol has a number of algae projects developing around Spain, including at the University of Alicante. Their research is looking at plastics for photobioreactors, greenhouse containment systems, strain selection, photobioreactor design, and fuel conversion. At the U. of Alicante I was particularly interested in their work with hydrothermal liquefaction technologies.

Of course, there has also been great work by Rene Wijffels at Wageningen University in the Netherlands, in understanding different types of photobioreactor systems and cultivation systems for the European-type environment. There are also some efforts in other countries like Greece and Italy, but overall, Spain seems to be the one leading the development of the algae industry in Europe.

A nice, new technology just emerged out of a company called Evodos looking at a new centrifugal technology that is very low energy and fairly well developed. They are already being looked at very heavily by a lot of commercial entities and some research institutions. They have three different sized systems, from a research and development system to systems that can be taken out into the field for harvesting algae very, very quickly up to twenty thousand liters per hour flow rates for their largest systems.

## Israel and Korea

We've heard quite a bit from Israel who has had a long history in developing nutraceuticals and now are using their photobioreactor systems mostly for biofuels. This development has come primarily out of Ben-Gurion University. In fact, Ami Ben-Amotz and his company Seambiotic are just starting to develop a new facility in China for algal biofuels, from technology they developed in Israel.

Korea recently started the Advanced Biomass R&D Center (ABC) a consortium of universities, institutes and industry funded the Korea Ministry of Education, Science and Technology with an investment of more than \$200 M over nine years. This consortium will work to develop a number of new algae and cellulosic based biofuels technologies. NAABB partners, primarily led by Brooklyn College and Los Alamos National Laboratory, will be collaborating with ABC in algae strain selection and development.

## Conclusion

So when I look at all of the research and development that is taking place worldwide, I think the algae biofuels industry is starting to take off. In it, I also see that the U.S. continues to be a major force in helping drive that development. In many cases, the U.S. is involved in major collaborations in some way or U.S. industries are going into these countries because of their favorable environmental conditions for algae production (e.g., Australia).

We can see that the U.S is a major, major driver in those efforts. And since about two years ago with the stimulus funds coming into algal biofuels from a research and development aspect and biorefinery development, the U.S. is probably still the largest funding source for algal development from a public standpoint. Even from a private standpoint there are many more industrial and commercial efforts developing in the U.S. as compared to the rest of the world.

That's not to say that the rest of the world is not catching up, and it's great to see that all of these efforts are going on both in the U.S. and across the globe. As you well know, biofuels development is probably going to be very specific to regional conditions. Therefore, regional solutions are going to need to be developed in order to have economically and environmentally feasible biofuels efforts in each country.

Even within each country, I think we are going to see differences in the way we cultivate. For example, the way we cultivate in the southwest of the United States is going to be very different from Hawaii and from Florida, and much different than in the northern parts of the United States.

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