

WINTER 2014

# THE MAINE SUN

NEWSLETTER of the Maine Solar Energy Association



## Photovoltaic Cells from Berries

By Richard Komp

On my way back from Ghana in November, I stopped in England to spend several days at the University of Leeds in Yorkshire. I took part in a solar energy seminar and gave a lecture on photovoltaics (PV) but the main part of my visit was an all day workshop in one of their chemistry labs where we made PV cells from blackberry and black currants. We also tried blueberries, but they didn't work. Somebody had found a website that talked about blueberry PV cells, but that turned out to be false information (*Remember: Half the things you read online are not true. Your job is to figure out which half.* - RK)

We used a process called **Dye sensitizing of nanocrystalline semiconductors**. This process has been known since the nineteenth century when it was used to make silver halide emulsions work in the visible part of the spectrum, (making Ortho-and Pan-chromatic photographic film). At Xerox in 1965 I worked with these kinds of dyes, sensitizing zinc oxide but Gretzel in Switzerland discovered that titanium dioxide worked much better.

Several years ago, one of the student volunteers and I gave a workshop at Bowdoin College's **Solar Fest** where we had grade school children making this kind of PV cell as one of their chores.



**Child Making her blackberry PV cell at Bowdoin College Solar Fest in 2012.**

When she was working with us in Nicaragua, Lena Kruckenburg from the University of Leeds in England heard about this work and asked me *continued on page 3*

## Tidal Energy Project Update

By Walter Wefel

On October 9th Charles Ewing and Walther Wefel traveled to Sipayik, Pleasant Point Passamaquoddy Tribal Reservation with the SEADS Prototype Low RPM Dynamo. Our goal was to interface the dynamo with the Passamaquoddy Vertical Axis Tidal Turbine and perform some output tests. We met up with Dr. Normand LaBerge and Keith Moore at the Tribal Office and proceeded to the boat landing where the turbine was moored. After some delay due to ongoing construction work on the Tribal Landing, we were able to attach, with the help of Doug Leighton, the dynamo to the turbine and then tow the assembled unit on its raft out into the current for trials.



### Setting up the Passamaquoddy Tidal Power Raft

Some misalignment issues were discovered and the design of the turbine was reevaluated. The dynamo was then removed for storage in the Tribal Public Works Garage. On October 31 we had another work session at Sipayik. Normand, Charles and Walther began the day with an audience with Passamaquoddy Chief Fred Moore. The Chief gave his encouragement and support for the project which was greatly appreciated. We then proceeded to the Tribal Garage where we met up with Keith and Doug to modify the dimensions of the stator platform and encapsulate the magnet rotor with plastic film.

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## **The Maine Sun**

*Newsletter of the Maine Solar Energy Association*

The Maine Sun is published four times a year by the Maine Solar Energy Association (MeSEA), a non-profit organization (sister chapter to the North East Sustainable Energy Association).

### **Our Mission:**

We are dedicated to promoting the public awareness and use of:

- solar energy
- energy conservation
- other renewable non-polluting energy sources
- environmental and health awareness building practices throughout the state of Maine

Opinions expressed by authors or editors do not necessarily reflect the views of MeSEA. The publisher reserves the right to refuse advertising which is not consistent with the goals of this organization. Acceptance of advertising does not constitute endorsement of the advertiser, its products or services.

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## **Calendar of Events**

**MESEA Website [WWW.mainesolar.org](http://WWW.mainesolar.org)**

**Facebook: Maine Solar Energy Association**

## **The Real Cost of Oil – The HOPE Festival**

**By John Burke**

CIA Torture Report from the Senate... ? The Big Oil corps have been 'torturing' American citizens for decades, as their profits soar ! Deep-ocean drilling, hydro-fracking for oil and gas, and tar sands drilling, just a play on our fossil fuel addictions. We applaud the lower gas and oil prices while our drinking water, farming communities and ocean life is decimated, our future is in doubt. The global over-heating and climate crisis continues unchecked, and the pollution rates skyrocket.

Americans are 20% of the world population, and we use 80% of the world's resources, the wars for control of natural resources escalate ... "What can I do ?" ... Just change your lifestyle ... 'Go Solar' ... or not !

Is there any hope for the human race? This Earth Day 2015, will bring another **HOPE Festival**, with the Peace & Justice Center of Eastern Maine, April 25, at the University of ME Orono campus ! Details soon, the MESEA and DADS, with SEADS of Truth, again will present a low-tech, do-it-yourself solar approach. This year may include information on a 'tidal turbine' development; a 'new' innovation in solar PV / thermal hybrid collector; as well as the solar PV cell phone charger assembly, all at the MESEA booth !

## **MESEA April Workshops**

The following weekend, Fri, Sat, & Sun, May 1, 2, and 3<sup>rd</sup>, a three day opportunity, at the Solar Home in Jonesport, Maine. MESEA, DADS and SEADS facilitators, will help you get your 'hands-on' experience, with 65 W PV module assembly workshop and another solar PV cell phone charger assembly. You may assemble a cell phone charger for your own phone ! (extra phone charge cable required, I-phone may not work).

These workshop days are available for you to choose which day you would like to participate. \$75. for one day, \$125. for two or \$175. for all three days. Lunch is included., reservations required, so RSVP soon. There will be a minimum number of participants as well as a maximum, thank you. 'We can take control of our lifestyles' !

**For More Information or to Register:** Please call, John, 207-546-1639

## **\$1 per Watt PV Modules Bulk Purchase**

The Maine Solar Energy Association has a new set of 255 watt PV Modules available in our **Bulk Purchase Program**. These new modules are the same size as the previous set but are slightly more efficient and can be used for either a 12 volt or 24 voly system.

**For More Information or to Purchase:** [sunwatt@juno.com](mailto:sunwatt@juno.com)  
or call: 207-546-1639

**MESEA Website [WWW.mainesolar.org](http://WWW.mainesolar.org)**





**From Page 1.** If I was interested in doing the same workshop when I came to visit Leeds last month. She arranged with one of the chemistry professors to set up the workshop and find all the materials so that when I got to the University, everything was ready and 30 students were waiting for the workshop. Lena had bought two packages of frozen berries on sale and we sorted out the black ones for the workshop (we ate the red raspberries and strawberries on German style waffles with Cornish clotted ice cream).



**Workshop participants assembling the berry PV cells**

The participants did every step, mixing up the  $\text{TiO}_2$  powder with vinegar and coating the indium doped tin oxide collated glass with the mixture, sintering the coating to the glass, and soaking the mixture in the crushed berry juice. The tin oxide ( $\text{SnO}_2$ ) coating was so smooth that we had to cover it with soot from a candle instead of making the carbon counter electrode with a 6B drawing pencil like we could do with the rougher coating of the “Low-E” glass scraps we got from Portland Glass for free.

We mixed up the iodine solution and assembled the PV cell sandwiches. The Blackberry and Black Current PV cells worked exactly the same, getting an average of 0.4 volts at 3 mA under the LED test lamps we had available in the lab (since there was no sun that day, or any day I was in Yorkshire). I am pretty sure that both blackberries and black currents have the same type of rodamine molecule as their photoactive dye. Blueberries are missing that particular molecule but have other very important ones.

During the workshop I also explained the quantum physics of semiconductors and the different types of organic semiconductors as well as how to make the “paint on” PV cells I was making starting at Xerox back in 1966. We talked about chlorophyll and other porphyrin ring compounds like phthalocyanine that can be used to make PV cells and other photosensitive devices. On another day of the visit I took part in a round table discussion with U of Leeds faculty members, on the photovoltaic industry and the future of renewable energy. I also got to tour York and other parts of Yorkshire, eating and drinking in pubs that were hundreds of years old. We also walked around on the York City Wall (which was started by the Romans) and visited the railway Museum.

## A Large Biogas Plant in Yorkshire

Kirem, Lena’s boyfriend is the manager of a very large biogas plant and on Sunday he took me on a very comprehensive tour of the facility. The business collects scrap food from supermarkets, restaurants and other places that handle food commercially. They sort out the plastic packaging material, sterilize the food and then digest it anaerobically in six story digesters to produce methane rich biogas.



**Visiting the biogas plant - The large gas storage tank**



**Kirem showing me the digesters and heat exchangers.**

Nothing is wasted. The waste heat from the engines that make 5 MW of electricity from the gas is sold to the plant next door that takes all the **waste grease** and oils and processes them to sell to Fish and Chip shops. The spent yeast is sold to farmers and the plastic scrap is recycled. No garbage to dispose of.

After the tour, we went to a beautiful outdoor art museum at an old “stately estate. It had Henry Moore sculptures in a pasture full of sheep. They also had an exhibit of wooden sculptures by an artist from Brooklyn NY. The sun almost came out for a while that afternoon.



## The Third Trip to Ghana

By Richard Komp

This fall I made my third trip to Ghana. This was the second time this year I went to work with the Yeshua University in Accra. I had many of the same students in my hands-on class in solar energy as I did last April, but this time I was there longer, from the 9<sup>th</sup> of October until the 24<sup>th</sup> of November. Since most of the students had already had the preliminary course in both solar thermal and photovoltaics (PV), I only lightly touched these subjects before going into more advanced subjects such as the design of larger PV systems and the construction of a large solar cooker so we could hear cure bigger 65 watt PV modules using the conventional Ethylene-Vinyl-Acetate, (EVA) which is far cheaper than the liquid silicone encapsulant we used to use. Normally the large commercial manufacturers use half-million dollar laminating machines to do this encapsulation when they produce their Internationally Certified PV modules; but we had developed a far simpler method of doing the same thing using solar ovens and heavy blocks as weights to properly squeeze the air bubbles out of the final module. You can go to our [www.mainesolar.org](http://www.mainesolar.org) website to read the report on this on the *Solar Work in Colombia* page - RK.



**Assembling the solar oven. The students are learning precision carpentry**

We had all the wood cut locally and insulated the oven walls and floor with wood shavings produced by planing the wood. We bought a very large piece of 5 mm thick glass for all the PV modules and had it cut up into the sizes needed to make the PV modules and the solar oven glazing. One of the students found a newspaper printer who was willing to donate a large stack of aluminum printing plates so we had all the shiny metal sheets heeded to make the interior of the oven, the reflector and the roof on the oven lid/reflector, so the oven will be able to be left outdoors in the rain without damage.

### Building the large PV modules

During the first course at the Yeshua University, we only built small PV modules like solar cell phone and LED lantern chargers. These small modules could be assembled by gluing the little PV cells to the thin cardstock or plywood back with silicone caulk (The kind that smells like vinegar that you can buy at any hardware store). Now with the big solar oven finished and working, we could build the full size 1 meter x ½ meter modules. However, one of my students had continued to work at home while I was gone and built a large 65 watt module in three smaller sections to get around the problem with differential thermal expansion that precludes using the silicone caulk on bigger modules.



**Richard, my student explaining how to connect up the 100 watt PV system he built for his dwelling.**

We took this system to the TV station where several of us gave an hour long program explaining how to use solar energy in Ghana. The program was a great success with a lot of people calling the TV station wanting to know more about using the sun for power. However, I have never yet received my copy of the broadcast.

When we were finishing up the solar oven, we were told that the small University was moving to a new location and they changed my teaching schedule so that the last week before the move I taught every day of the week for 6 hours a day, instead of the three days a week before. Even so, it was difficult to get everything done before the end of the course. Generally I would give a lecture on a new aspect of solar in the morning and save the afternoons for the hands-on work. For instance, one morning we spent talking about solar water pumping, where I normally design custom PV modules to run the pump with no batteries or controller. We went over the theory of this process but didn't actually hook up a pump. The secret of this pumping system is knowing the current voltage characteristics of the DC pump motor at the different head and pump speeds to match the C-V curve of the PV cell.





to those requirements. We also spent a morning learning how to run Light-Emitting-Diodes (LEDs) directly from a 12 volt system and how to design the required current control resistor circuits. We built two LED lamp strings using these ideas.



**Stacking four of the 65 watt PV modules in the solar oven at one time**

Because we were running out of time, we cooked four of the big modules in the solar oven at the same time; the first time (as far as I know) anybody has done such a thing. All four modules came out crosslinked perfectly, but the students forgot to turn the center row of PV cells the proper direction on two modules so they had to cut in from the back and put in some jumpers to fix the problem. I let the students figure out what was wrong and how to fix them, so they wouldn't ever forget that detail in the future.



**Putting the frame on a module outdoors. After we had to leave the building we set up outside.**

Some of the students and I decided to stay in touch after the course is over so I could help them start the solar energy company they hope to organize. This project will be totally separate from the Yeshua University and they even discussed how to get PV cells to Ghana using their friends in the US.

Because of the change in the schedule, I had over a week left before I was to fly out of Ghana to England, and since changing the plane ticket would have been very costly; I spent the remaining time working with the University administration. We visited the set of buildings the university was planning on renting for a couple of years until the new campus they had planned was built. I also spent time with the architect working on the campus plan and visited the piece of land that the University has purchased.

I also accompanied Charles Ave-Addo to a couple of the churches where he was a special visiting preacher, blessing and "curing" people. The Evangelical sect that he belongs to has elevated him to a new position; so he is going around visiting all the "parishes" and collecting information for the Official history of the sect that he is writing. The theology is rather simple but he doesn't give the usual "Hellfire and Donation" sermons such preachers seem to specialize in. I did get into some trouble with the administration by mentioning evolution as a reality and talking about my three arguments against "Intelligent Design": Two knees and a backbone. I also was accused of being too close to my students. I have noticed that many 3<sup>rd</sup> World professors rely on "Positional Dignity", staying aloof from the students. Instead I work directly with the students in a real hands-on manor, which I feel is necessary in my kind of renewable energy teaching.



**Dr. Charles Aye Addo blessing people. He also lays hands on the congregation members with bad backs and other ailments to "cure" them. (Miracles or placebo effect?)**

After leaving Ghana I flew to England and took the train to Leeds where I spent several days giving solar workshops and seminars; but that is information on page 1 of this **Winter Maine Sun**. I got back to Maine on the 6<sup>th</sup> of December. For more information on this kind of 3<sup>rd</sup> World work, go to our [www.mainesolar.org](http://www.mainesolar.org) website..



## Climate Change Creates a New Geography of Food

Lima, Peru - The magnitude of the climate changes brought about by global warming and the alterations in rainfall patterns are modifying the geography of food production in the tropics, warned participants at the climate summit in the Peruvian capital.

That was the main concern among experts in food security taking part in the 20th session of the Conference of the Parties (COP20) to the United Nations Framework Convention on Climate Change (UNFCCC), held Dec. 1-12 in Lima. They are worried about rising food prices if tropical countries fail to take prompt action to adapt.

The **International Food Policy Research Institute** (IFPRI) estimates that climate change will trigger food price hikes of up to 30 percent.

The countryside is the first sector directly affected by climate change, said Andy Jarvis, a researcher at the **International Centre for Tropical Agriculture** (CIAT) who specialises in low-carbon farming in the CGIAR Research Programme for Climate Change, Agriculture and Food Security.

"Climate and agriculture go hand in hand and it's the climate that defines whether a crop will do well or poorly. The geography of where crops grow is going to change, and the impacts can be extremely negative if nothing is done," Jarvis told *Tierramérica* during the Global Landscapes Forum, the biggest parallel event to the COP20.

Crops like coffee, cacao and beans are especially vulnerable to drastic temperatures and scarce rainfall and can suffer huge losses as a result of changing climate patterns.

One example: In the Sacred Valley of the Incas in Peru, where the greatest biodiversity of potatoes can be found, higher temperatures and spreading crop diseases and pests are forcing indigenous farmers to grow potatoes at higher and higher altitudes. Potato farmers in the area could see a 15 to 30 percent reduction in rainfall by 2030, according to *ClimateWire*.

Another illustration: In Central American countries like Costa Rica, Guatemala and Honduras, a fungus called coffee rust is decimating crops. (*We have had success in beating this fungus with organic, shade-grown coffee in Nicaragua RK*)

The outbreak has already caused one billion dollars in losses in Central America in the last two years, and 53 percent of coffee plantations in the area are at risk, according to the International Coffee Organisation (ICO).

Latin America produces 13 percent of the world's cacao and there is an international effort to preserve diversity of the crop in the Americas from witches' broom disease, which can also be aggravated by extreme climate conditions. At the same time, switching to cacao can be a strategy for coffee farmers when temperatures are not favourable to coffee production, according to the CGIAR consortium of international agricultural research centres.

"At the COP, the idea discussed is to keep global warming below two degrees Celsius, as the most optimistic goal," Jarvis told *Tierramérica*. "But that practically implies the total displacement of the coffee-growing zone. Two degrees will be too hot. The current trends indicate that prices are going to soar. As production drops and supply shrinks, prices go up. The impact would also lead to a rise in poverty."

In Nicaragua, where coffee is a pillar of the economy, a two degree increase in temperatures would lead to the loss of 80 percent of the current coffee-growing area, he said. According to a CIAT study, "by 2050 coffee growing areas will move approximately 300 metres up the altitudinal gradient and push farmers at lower altitudes out of coffee production, increase pressure on forests and natural resources in higher altitudes and jeopardise the actors along the coffee supply chain."

As the climate heats up, crops that now grow at a maximum altitude of 1,600 metres will climb even higher, which would affect the subsistence of half a million small farmers and agricultural workers, according to the United States Agency for International Development (USAID).

The U.N. Food and Agriculture Organisation Assistant Director-General for Forestry Eduardo Rojas said at COP20 that climate change is already endangering the food security, incomes and livelihoods of the most vulnerable families.

"Resilient agriculture is more environmental because it doesn't use nitrogenous fertilisers. But no matter how much we do, there are systemic limits. We could reach a limit as to how much agriculture can adapt," he told *Tierramérica*. Rojas called for an integral focus on landscapes in the context of climate change, to confront the challenge of ensuring adequate nutrition for the 805 million chronically malnourished people around the world. However, agricultural production will at the same time have to rise 60 percent to meet demand.

The executive director of the U.S.-based **Earth Innovation Institute**, Daniel Nepstad, noted that the largest proportion of land available for food production is in the tropics.

"The growth in demand for food, especially, in the emerging economies is going to outpace the rise in production. The countries in the world with the greatest potential are in Latin America," said Nepstad, who added that the innovations to mitigate the impact of climate change on food are happening mainly outside the scope of the UNFCCC.

The director general of the **Centre for International Forestry Research** (CIFOR), Peter Holmgren, said agroforestry is an approach that reconciles agriculture, forest conservation and food production without generating greenhouse gas emissions.

"The main reason forests are disappearing in this region is agriculture, it is the expansion of commercial agriculture," he told *Tierramérica*. "We have a lot of research going on that seeks more resilient and more producing varieties of different crops and livestock. We call it climate-smart agriculture. There is a lot of political commitment to reduce deforestation and direct the investments in different ways."





## Microgrids Create Energy-Resilient Communities

Jennifer Runyon, Chief Editor, RenewableEnergyWorld Orlando -- Consumers who need resilient, reliable, “always-on” power that the utility can’t deliver are driving the growth of microgrids in the U.S. In addition, renewable energy and energy storage technologies are becoming essential components of microgrids. These were two of the many issues discussed during Wednesday’s Renewable Energy World Conference, North America session titled Microgrids: Opportunities, Challenges, and Innovative Solutions. John M. Carroll of IPERC explained that [the case for microgrids](#) is quite simple. He said that power outages are on the rise and expected to increase over the years and there are customers “up and down the east coast” who simply can’t afford to lose electricity. These include customers such as biotechnology research centers that must maintain refrigeration or freezers; fire and emergency service centers serving critical roles; and military bases that due to security implications cannot be without power. In the past, these enterprises wanted backup power but didn’t want to pay for it, but Carroll said that because of the way that renewables have increased the use of PPAs, now there are new ways to view who owns microgrids and how to pay for them. Traditionally when the grid goes down, renewables such as PV are taken offline so they don’t backfeed the grid and cause safety issues for line workers. With a microgrid and the right controllers in place, that’s no longer necessary.

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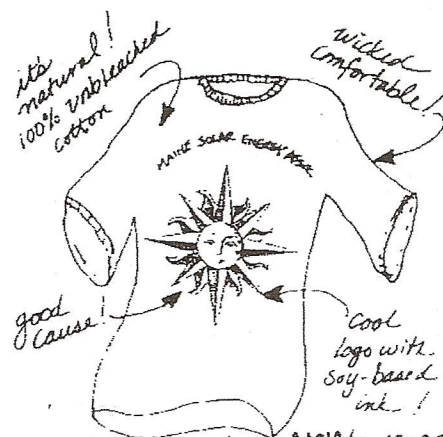
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