IGERT Europe Trip Report - Summer 2015

Benjamin Weaver

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1 Introduction

Over seven weeks this summer, I attended conferences, went on field trips and traveled through Europe. The goal of this trip for me was to gain exposure to the energy research community, energy industry, and to see the unique ways Europe is dealing with complex energy issues. My research focuses on electrochemical energy storage and all the conferences I attended had, among their many topics, sessions relating to this. One conference I attended was devoted to electrochemistry and the others offered sessions devoted to energy storage and offered opportunities to talk to people in the European research community. I was also looking for opportunities to see power stations that are hard to find in the U.S. such as the tidal power station in Brittany, France and the waste-to-energy plant outside of Amsterdam, Holland. Lastly, I wanted to use this as an opportunity to meet with students and researchers at TUM to discuss the work they do on developing new battery technologies. As well as the enriching academic and career opportunities I had in Europe, I was able to spend some time between conferences visiting friends of mine in Germany, France and Ireland.

In this report, I will detail these experiences and describe how I benefited from them and from and from my whole time in Europe.

2 EST conference - Karlsruhe, Germany

The first conference I attended began a few days after arriving in Munich and took place in Karlsruhe, the location of one of the more prominent technical schools in Germany, Karlsruhe Institute of Technology (KIT). While the proceedings took place in the city conference center downtown, and not on the KIT campus, KIT students and faculty were well represented. Of the conferences I attended, EST 2015 covered the widest number of scientific and engineering topics related to my research and to topics relevant to our IGERT program.

Over the three days of the conference, I attended many conference sessions, including sessions covering nuclear energy, electrochemical energy storage, biomass and biomass conversion technologies, geothermal energy, and airborne wind energy systems (AWES). In a handful of sessions devoted to nuclear energy, I learned from the mostly German perspective
the current state of nuclear energy in Europe. Germany is in the middle of mothballing their entire fleet of nuclear power plants and there are many challenges to accomplish this, not least of which are massive procedure of shutting down 17 nuclear power plants, as well as replacing them with other energy sources. Since 2010, Germany has permanently shut down eight of these plants. The scale of this undertaking is such that robots are being specially designed to perform tasks such as scraping the contaminated layer concrete wall in containment domes, a dangerous and highly tedious task for humans.

One of the most interesting sessions I attended was on airborne wind energy systems. AWES are intended to be lightweight, low materials cost alternatives to traditional turbines whose hub towers reach 100m and whose turbine blades exceed 20m. AWES are any type of turbine that, rather than being mounted on a tower, is tethered to the ground and stays aloft by acting like a kite. The primary advantages of this type of design are twofold: low materials cost, and the ability to take advantage of much greater and much steadier wind speeds at heights of 1000m and above. Two graduate students from the Technical University of Delft presented a wind energy turbine design that repurposed a 25m² parasail tethered to a generator. It operates like a yo-yo, generating energy as it is pulled out by the wind and using a portion of that energy as it is reeled back in. The net energy gain is comparable to about a 15kW generator. Initial test flights have been successful and the two plan to run their first continuous 24-hour test flight soon.

3 ISE conference - St. Malo, France

My second conference was on the coast of Brittany, in the historic walled port city of St. Malo. The conference was a topical meeting for the International Society of Electrochemistry (ISE) and featured presentations on Multiscale Analysis of Electrochemical Systems. The sessions were divided into those related to computational modeling of electrochemical systems and those related to application, or synthesis of electrochemical materials. I attended a number of sessions on modeling and sought out presentations on energy storage and energy conversion materials.

While in St. Malo, I spent the evenings walking along the wall and exploring the city,
(a) Horizontally mounted portable wind turbine. The turbine in this picture was one of the finalists in a student competition to design portable, small scale wind turbines and was designed to be folded up and reassembled on site, for example on a camping trip.

(b) Specifications for turbine.

Figure 1: Caption place holder

(a) Saint Malo as seen from Le Petit Bé, a tidal island that is accessible at low tide.

(b) Hotel within the historic city walls featuring typical Breton architecture.

watching parasailers in the water, and venturing out to high tide islands that are only accessible at low tide. Brittany is known for it’s seafood, most notably oysters and mussel, and I tried many kind of both.
3.1 La Rance Tidal Barrage

Saint Malo lies north of the Rance river, just at the mouth of its estuary as it spills into the English Channel. The Rance river is known for its tidal barrage that stretches the length of the estuary at a point about 5km upstream from Saint Malo. The barrage houses, which is about 750m in length, houses a tidal power station. This was the first tidal power station ever constructed, having opened in 1966, and to this day, remains one of the largest. It has continuously operated since opening, and generates an average of 520GWh per year, enough to power about 2/3 of the energy demand of Brittany. An information center allows visitors to enter into the barrage, which has educational displays about tidal power and the local marine environment, and to look at a full scale model of one of its 24 turbines that have a peak output of 240MW.
4 PowerGen Europe - Amsterdam, Holland

My third conference was held in Amsterdam and was a combination exhibit and conference and was the largest event I attended. Many of the participants came just for the exhibit, which was held on the ground floor of the RAI conference center and included booths from hundreds of firms and industry developers within the energy sector all across Europe. This is the main trade show attended by energy industry professionals around Europe and it was a great opportunity to talk to non-academics in the energy sector. I explored the exhibit floor to learn about new technologies in waste energy conversion, peaking generators and much more.

Throughout the event, small conference sessions took place upstairs and featured sessions on nuclear energy, biomass energy, and energy storage, among many others. The highlight of this event for me was a plenary panel hosted by a prominent British journalist who covers energy topics and featured 5 experts across the energy landscape, including industry leaders, academics, and members of the media. The topics focused on the current state of the energy industry in Europe, which seems to be very much in a state of transition, and on what the future holds. It was an especially interesting panel, because many different perspectives were represented and the debate among them was very lively and sometimes even heated. It was very informative to hear the concerns of European energy leaders as they are going through many of the same transitions we are here in the United States. One gets the general sense that Europe is more forcefully embracing the end of fossil fuel as the main energy source, while the energy sources Europe relies on are more limited. While we are facing many of the same challenges of transitioning here in the US, Europe’s challenges are more stark given the contrast between their accelerated pace of transitioning to renewable resources that are more limited than our own. This was a theme I found evident speaking to people throughout my time in Europe, but was especially apparent during this panel.

4.1 Waste-to-energy plant

Outside of Amsterdam, the waste and energy company Afval Energie Bedrijf (AEB) operates a waste-to-energy plant. It has two incinerators that converts the heat produces from
(a) Amsterdam has over 160 canals with a combined length of about 60 miles, 90 islands, 1500 bridges, and beautiful sunsets.

(b) Scenery in the town of Edam, outside of Amsterdam, famous for its cheese.

incinerating the city’s waste into electricity. This is one of the

Figure 5: Standing in front of incinerator.