**Goal Status:** Exceeded expectations. I felt like I received a genuine impression of the European solar energy market, with honest discussions about the challenges and goals for the future.

### 4.2 TUM IGSSE Forum

#### 4.2.1 Who

From the TUM IGSSE website [6]:

*The TUM International Graduate School of Science and Engineering (IGSSE) is sponsored by the Excellence Initiative of the German federal and state governments with more than 15 million Euros in funds for the period 2006-2017.*

*The IGSSE integrates Natural and Engineering Sciences through graduate and postgraduate education strongly rooted in TUM’s internationally renowned research environment. So far, IGSS’s research areas have included Computational Science & Engineering, Biomedical Engineering, Nanotechnology & Advanced Materials, as well as Energy, Geodynamics & Environment.*

#### 4.2.2 What

The TUM IGSSE website states [7]:

*A central aspect of the interaction between the Project Teams and creation of the IGSSE’s own identity has been the setting-up of the annual IGSSE Forum. During this three-day symposium, approximately 200 members of the IGSSE meet up with international guests in scientific workshops, lectures and ambitious training programs. The Forum takes place in the Monastery of Raitenhaslach, which has now come to be regarded as a hallmark of the Graduate School. Located in Burghausen in the south-east part of Bavaria, this former Cistercian monastery is gradually evolving as TUMs Off-Campus Study and Residence Center.*

*Since 2007 the IGSSE has hosted 6 Forums (2012). During the first part of each Forum (day 1 and 2), about 80 doctoral candidates gather for enabling skills courses*
designed according to the special needs and wishes of the IGSSE members (entrepreneurial skills, scientific paper writing, leadership in science, etc.). In the evenings, networking and social events are organised by the IGSSE Graduate Council. The second part (day 3) focused on the exchange of scientific ideas between larger clusters of Project Teams. This part is designed, organised and led by the doctoral candidates and Project Team Leaders themselves. To this, renowned international guests are invited and doctoral candidates may take the opportunity to present their research in a talk or a poster competition. The third part (day 4) is a large networking and celebration event with over 200 doctoral candidates and guests from both science and industry. Renowned keynote lecturers are invited to address a scientific topic that is of interest to a larger audience.

4.2.3 When
June 16-18, 2014.

4.2.4 Where
Bürgeralz, Burghausen.

4.2.5 Why
The IGSSE Forum was a great opportunity to make a connection with TUM as well as UT students. In fact, UT Austin was represented by more than 30 stu-
dents at the forum. It provided a platform for me to present my research in a poster session, and to collaboratively work with international TUM students in a workshop.

Figure 33: Bonnie Roberts in front of her research poster, TUM IGSSE Forum. Photo Credit: Kristen Cetin.

I was part of the Green Technology/Energy Systems workshop. Dr. Petra Liedl and Dr. Vincent Snyder (both professors of Architecture at The University of Texas at Austin) led the first part of the workshop, which consisted of lectures regarding sustainable design in building architecture. One highlight was Dr. Liedl’s informative presentation on climate-tool.com. From their website, ClimateTool is described [8]:

*Detailed climate analysis provides the basis for sustainable architecture. ClimateTool allows the analysis of the climate relevant aspects in planning, namely temperature, humidity, solar radiation, light and wind and the presentation of results in performance tables for any given location on earth. The analysis shows the challenges and potentials of each location worldwide as well as the relevance of the individual climate elements.*

*ClimateTool also allows any site to be allocated to a building specific climate zone*
and appropriate measures for a comfortable room climate to be planned. World maps using and combining the necessary parameters show differences in climate caused by geographical specifics like height or proximity to the sea. ClimateTool analyses are supplied with data from the global climate database Meteonorm.

In the second part, we were broken up into teams to address a particular topic. My group topic was comparing office buildings between Munich and Austin. Later, we presented our findings to the whole IGSSE forum. There were also guest speakers to the forum. My personal favorite was the research of Professor Dr. Dietmar Hutmacher. He has an FDA approved bone tissue engineering scaffold that has already helped over 400 patients heal better and faster. Not only is his research cutting-edge medical science, but he also demonstrated that academics can take their research and turn it into something “real”.

**Goal Status:** Met my expectations as an opportunity to learn and network. It was a hectic few days, with presentations, workshops, and poster sessions, but I met a lot of students and enjoyed the variety of research presented at the forum.
4.3 Meeting with Dr. Martin Mensinger at TUM

4.3.1 Who

Professor Martin Mensinger is the Chair of Metal Structures and a faculty member in the Civil, Geo and Environmental Engineering Department at TUM.

4.3.2 What

Dr. Mensinger’s research group studies steel, aluminum, and glass structures in the areas of fire and explosion resistance, sustainability, and economic efficiency.

4.3.3 When

June 25, 2014.

4.3.4 Where

Technical University of Munich (TUM), Munich.
4.3.5 Why

Dr. Mensinger was a very welcoming and kind professor who seemed genuinely happy to spend time discussing research and making a connection with The University of Texas. Of the many projects we discussed (as well as providing me with a booklet of their work), one I really enjoyed was the Sustainable Office Designer (SOD) program his student, Li Huang, helped write. It is an open-source tool that uses Google SketchUp as the user interface. It was inspirational, as SOD is similar to my ultimate research goals. The program is simple and easy to use, helping interested parties optimize building performance based on a number of parameters. It allows the user to make an informed decision, instead of going on intuition alone (which is all too frequently the case in building design and construction). I didn’t meet Li, but I met two other students of Dr. Mensinger. Peter Schaumann and Senta Pessel.

After our meeting, Dr. Mensinger invited me to attend a day-long seminar regarding fire design of steel structures. I was very appreciative, especially because there
was a fee to attend and he waved it for me. However, I had to politely decline because the seminar was entirely in German. This was one example of a language barrier hindrance that unfortunately prevented a great opportunity to learn more about research at TUM.

**Goal Status:** Mixed. Dr. Mensinger is doing some amazing work, and was truly interested in making a connection with UT. I gained some tangential knowledge for my research, but his work does not overlap very much with mine. However, I do know that Professor Engelhardt, in our Civil Engineering Department, will be delighted to learn about Dr. Mensinger’s work. They do very similar research and in fact, I was able to suggest a thesis from one of Dr. Engelhardt’s students that Dr. Mensinger would be quite interested in reading. I will be introducing Dr. Engelhardt and Dr. Mensinger via email soon.

### 4.4 TUM Fire Safety Laboratory

#### 4.4.1 Who

Dr. Horst Fark is the Chief Researcher at the laboratory. He is a faculty member of the Architecture Department of Building Climatology and Building Services at TUM. He is also a member of several German committees overseeing various aspects of building fire safety.

#### 4.4.2 What

From the TUM website [9]:

*Examining the fire-resistance performance of building components is the main purpose of the activities conducted at TU München’s Building Technology Research Laboratory. . . . Fire resistance tests for service installations constitute the bulk of the work. Experiments were launched in 1974. . . . The results of its development work and laboratory tests have been incorporated in numerous national and European standards and guidelines and are used for updating and amendments.*

*Today, the Research and Testing laboratory is recognized throughout Europe as*
a reputable institute with international customers from industry and the building sector. The leading manufacturers in the ventilation industry have developed their products to marketing maturity in conjunction with the laboratory and it is in this field that companies employ TUM as a hallmark of quality.

The laboratory’s sound experience is of great value in special analytical assignments and construction-accompanying consultancy when it comes to fire protection performance. The laboratory acts in an advisory capacity for spectacular building projects. . . . By way of an example of current construction-accompanying, structural fire-resistance measures, we would particularly like to mention Munich Airport’s Terminal 2, BMW World and the Olympiapark underground railway station in Munich.

4.4.3 When
June 26, 2014.

4.4.4 Where
TUM Fire Safety Laboratory, Dachau.

4.4.5 Why
I wanted the opportunity to see the fire test facilities at TUM. In comparison to the enormous and extensive facilities at SP in Sweden, the TUM test furnace is small. However, they stay busy year-round testing building assemblies and products for certification. In fact, TUM provides very little financial support to the facility, therefore, it must sustain itself by performing standards certifications for commercial entities. Dr. Fark lamented that they have little time and financial ability to support pure fire research at the university. However, we did talk in detail about his experience with these real-world products and the pros and cons of the current prescriptive method of rating fire safety of building parts and assemblies. There was a notable contrast between Dr. Fark’s take on the codes and standards method for fire safety vs. Dr. Mensinger’s preference for modeling. Dr. Fark explained that the German tradition of rule acceptance makes it difficult to move
away from the codes and standards method of fire ratings. Dr. Mensinger is meanwhile trying to change that, and growing the field of performance based structures.

I met Ernest Berghofer, Deputy Chief Researcher at the laboratory. He and Dr. Fark discussed issues with spray polyurethane foam (SPF) with me. Due to the desire to reduce energy consumption and a general desire from the population to adopt sustainable lifestyles, many homes have added facades of SPF. Ernest noted that they’ve had many fire issues with these facades, one such incident causing a neighborhood to burn due to the proximity of the original burning home to the others. Although the flammability of SPF is of great concern, he says that the cost is notably lower than other insulation, hence its popularity. In my research, I have not found that to be true. In fact, SPF is much more costly than other insulations. I’m investigating what the discrepancy is here.

Similar among the states in the US, there is no consensus among EU countries on standards for fire safety. Certainly, there are international codes that serve as blueprints for most countries, but each adopts their own variations to suit their traditions, needs, and financial tolerance.

**Goal Status:** Met my expectations. I enjoyed seeing the research facilities and discussing the current status of fire safety measures in Germany.

### 4.5 Sightseeing Highlights

![Figure 37: A peaceful pool of crystal-clear water along the Partnachklamm (Partnach Gorge) in Germany.](image-url)
Bavaria is a beautiful, and unique place. I enjoyed getting to know the students at TUM and exploring the region. Hiking in the Alps was definitely the most amazing sight of all. The 360° view of mountains towering over crystal-clear rivers of alpine water cannot be beaten.

Figure 38: Frauenkirche under renovation. It has become a symbol of the Bavarian capital city of Munich and is visible from nearly any location in the city, as there is a 99 m (325 ft) building height prohibition in the areas surrounding the church.

Figure 39: Stadtamhof district with a view of the Gothic Dom Cathedral in Regensburg, Germany. This medieval city is so well preserved that it is a UNESCO World Heritage Site.

In contrast to the shear serenity of the Alps, the presence of World War II still lingers in and around Munich. So many historic sites and buildings were bombed to rubble, but were quickly restored, though not to their original splendor. I went to the Dachau Concentration Camp Memorial, which displays its history of crematoriums and torture bunkers, making the horrors of that time all too real.
Figure 40: Entrance into Dachau Concentration Camp. The now infamous German phrase, *Arbeit macht frei*, inscribes the gate: *Work makes (you) free.*

Figure 41: The Renaissance Antiquarium (completed in 1571) of the Residenz in Munich is one of the few rooms of the royal palace that remained intact after the bombings of World War II.