

A Big Foot Treads Lightly The World's First "Green" Semiconductor Manufacturing Facility

The construction world has been abuzz with green homes, green condos and green cars aplenty this year, but little attention has been paid to some of the more esoteric projects whose impact per square foot can be enormous. Texas Instruments (TI) recently completed the first LEED certified semiconductor manufacturing facility (wafer fab) in the world.

Earlier this year, Mitchell Swann of MDC had the opportunity to interview Mr. Paul Westbrook, Sustainable Development Manager for TI's 300 mm LEED certified wafer fab in Richardson, TX. Mitchell had a chance to talk with Paul at length after having persuaded Paul into doing a presentation on TI's new wafer fab at the ASHRAE Winter Meeting in Dallas, TX. Paul's presentation was under the auspices of ASHRAE's Technical Committee TC 9.11 "Clean Spaces" of which Mitchell is a previous two-term chair of the Committee.

Some quick facts on Texas Instrument's Richardson Wafer Fab (RFAB):



The total complex covers 1.1 million square feet of built space with 220,000 square feet of clean room space (larger than 4 football fields). The cost to build the facility was approximately \$300 million, excluding process equipment fit-out costs, with 25% of those expenditures spent with minority-owned suppliers and contractors.

About Paul Westbrook:

Paul Westbrook is a LEED Accredited Professional and a Senior Member of the Technical Staff (SMTS) for International Facilities at Texas Instruments in Dallas, Texas. He received a B.S in Mechanical Engineering from Louisiana State University in 1982. Since joining TI in 1983, his positions have included Facilities Project Manager and Fab Facilities Manager. In 2002, Paul took on the role of Sustainable Development Manager for TI's facilities organization. Paul was the Sustainable Development Manager on TI's recently completed Richardson, TX Fab (RFAB) which is the first LEED registered Semiconductor Plant in the world.

INTERVIEW QUESTIONS

EMS: Tell us a bit about the semiconductor/microelectronics manufacturing process and its energy and environmental impacts.

PW: A large semiconductor manufacturing facility (we refer to them as a “fab”, which is short for fabrication) can use the same electricity as about 10,000 homes and up to 3 million gallons of water per day. There are tremendous opportunities for resource savings.

EMS: Would you say that TI’s decision to ‘go green’ on this project is a marked departure from the typical microelectronics manufacturing operation?

PW: Most of us in the semiconductor business have a variety of energy and water saving activities at our facilities. What was different about this recent project is that we bundled all those activities together and strengthened the focus. We held a 3 day design session with Amory Lovins and The Rocky Mountain Institute where we focused on building the most resource efficient facility possible. We registered with the US Green Building Council’s LEED program and made LEED Certification a top level project priority.

EMS: What prompted TI to look at a green solution to their facility needs?

PW: This is the culmination of many years of good environmental stewardship. We’ve had an energy conservation group since 1973 and our existing buildings were already recycling well over 80% of non-hazardous waste. This project pulled together all of our existing best practices, added some new ones, and integrated it all together. It was a whole system approach.

EMS: What were the key factors that drove your decision to push for LEED Certification for the project?

PW: We really struggled with our decision to register with LEED. We had already decided to incorporate many sustainable items into our project. LEED allowed us to have a common language to communicate the goals. If you say “let’s build sustainably” no one knows what that means exactly. With LEED, the targets are well defined and that allows everyone to work toward that goal and know what success looks like.

EMS: Can you describe some of the key ‘green features’ of the final project?

PW: This could be a lengthy answer. For the buildings, we did passive solar orientation, shade screens, light shelves, a reflective roof, efficient lighting (each fixture has a motion and daylight sensor), waterless urinals, low-VOC materials, high recycled content materials, and solar water heating. For the facilities systems, we did a split temperature chiller plant (40°F and 54°F), heat recovery on air compressors and chillers, a high pressure spray humidification system, low velocity air flows, premium efficiency motors, variable speed drives, a passively cooled central utility plant, and extensive process water recycling and reuse. For the site, we did native plant restoration, a 2.7 million gallon pond for runoff collection, a windmill powered pond aeration system, irrigation with 100% pond water, “dark-sky” friendly lighting, and covered bicycle parking with showers.

EMS: How did you go about getting ‘buy in’ from contractors, suppliers and other team members on the project?

PW: To get management buy-in, I toured them through my house. I designed a resource efficient, passive/active solar house back in 1996 (www.enerjazz.com/house). They were impressed with the engineering, but the low utility bills really made an impression. They asked if I thought sustainable design was scalable to the level of the Fab and when I told them it was, we were off and running.

'one off' project that just happened to be in the right place at the right time?

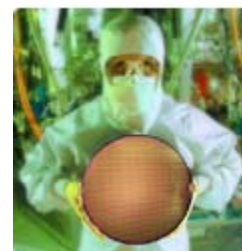
PW: We have committed to LEED certification for all new projects. We have two projects under construction in the Philippines that are registered now. We are in the midst of assessing LEED for existing buildings.

EMS: Do you feel that such initiatives can be employed in non-US plants where the economic factors may be weighted much differently? Might this be especially challenging for off-shore operations in 'developing economies?' How would you suggest TI make the business case in those locales?

PW: We are certainly finding challenges implementing LEED in the Philippines because no one there knows what LEED is. It will require much more education, but the desire is there. Sustainability is a global issue and not bounded by country borders. This affects us all and it's in all of our best interest to spread the good practices everywhere we can. LEED started in the US but it is being adopted or emulated in a number of other countries.

EMS: If there is a larger corporate initiative, do you believe that there is a 'bottom line' benefit and does this initiative extend beyond the 'environmental footprint' issues to larger corporate sustainability or governance issues?

PW: Businesses exist to make money. Eliminating waste and improving efficiency are very profitable ventures. Frankly, I don't know why more businesses haven't caught on. There are many metrics around people productivity, but resource productivity is becoming increasingly important. All businesses will eventually understand it – if they want to survive.



The design session with RMI really energized our TI engineering community. Our project manager, Terry Dalton, did a great job of putting LEED certification on our top level of project goals. Safety is always first, cost is usually second, and schedule is third. This time LEED certification was listed right there on the front page of our project goals. These goals are reviewed with our contractors, architects, engineers, and suppliers. There was some resistance to change, but what I found was that people really related to this goal of sustainability. It seemed to strike a chord with many, many people on the project. The more they learned, the more they wanted to be a part of the solution.

EMS: Is there any connection between the 'facility side' initiatives and 'green process chemistry' initiatives adopted by many chemical companies?

PW: We certainly control some of our own chemistry decisions in how we operate our facilities systems and we've made some strides there. We're also dealing with the output of manufacturing. We've had good efforts over the years to get involved in the early development and work toward green chemistries and I think the RFAB project has further boosted our efforts toward a complete systems solution in that regard.

EMS: Can you describe some of the financial or operational benefits that have resulted (if any) from TI's green initiatives?

PW: Our results were very good. We pulled together and expanded on our best practices to reduce water consumption by almost a million gallons per day (35% reduction). Our building energy model showed we were almost 40% better than code minimum design. The heat recovery allowed us to eliminate so many boilers that we cut our plant emissions of NOx by over 50%. This plant will have a multi-million dollar annual operating cost advantage over most other facilities.

EMS: Has TI incorporated green initiatives across the spectrum of their capital projects or was this a

EMS: What do you think is the future of sustainable design and green buildings for corporate capital programs and especially for 'high tech' businesses which can have such a deep environmental footprint?

PW: We are very active with ISMI, our semiconductor industry consortium, in working toward a supplement to LEED that focuses specifically on Fabs. I think we've reached a point where most people recognize that we need to do things differently and better than we have when it comes to our resource consumption. Most have at least moved into the exploration phase – they recognize the issues are looking for solutions.

Many worry about the initial cost, but we actually built RFAB for 30% LESS than our previous 300mm wafer Fab. We only added back a fraction of a percent of cost for the sustainable elements so I could claim that we built a green building for 30% less capital. We applied the same whole system design thinking to the capital cost side and ended up building a less expensive facility that also costs less to operate.

EMS: Lastly, are there any 'untapped opportunities' for enhanced sustainability in future TI projects?

PW: RFAB was a successful project, but it's by no means the best we can do. We've raised the bar, but now we think we can do even more. With each project we intend to improve. I probably can't predict what those improvements will be, but I can tell you that we have enough people committed to sustainability that we'll continue to surprise even ourselves. We'll look back and wonder why we ever did it any other way.