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# Team Las Vegas: Solar Decathlon 2013, technical proposal

University of Nevada, Las Vegas

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# **TEAM LAS VEGAS**

**SOLAR DECATHLON 2013**

TECHNICAL PROPOSAL  
NOVEMBER 10, 2011



A handwritten signature in black ink that reads "Ronald W. Smith". The signature is fluid and cursive, with a long horizontal stroke extending from the end.

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Ronald Smith, PhD  
Vice President for Research and Dean of Graduate College

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## 1 INTRODUCTION

Team Las Vegas is proposing an elegant, sustainable, and innovative home design that aims to be net zero energy as part of participation in the 2013 Solar Decathlon supported by the Department of Energy and the National Renewable Energy Laboratory (NREL). The home will be constructed and tested at the 2013 Solar Decathlon competition at a location to be determined by NREL. Imagine a home that captures energy instead of reflecting sunlight; one that filters rainwater and sequesters carbon in its vegetation and soils; one that actually gives back to the ecosystem in which it resides, and supports sustainability for all species. The design philosophy imagines a new type of home that could transform the housing market in Las Vegas. The house incorporates all of the high-tech opportunities (smart walls, smart ECS interfaces, solar thermal, PV, etc.) available, without focusing the design on these systems. The systems will support the project's conception, rather than being its driving force.

The conceptual design that Team Las Vegas has developed is the "Autonomy House," designed to operate independently from all traditional public utility services. It is a self-sufficient structure designed mainly as a recreational or vacation home, while also having the capability to function as a permanent, year-round residence in our arid desert environment. Environmental technologies and renewable energy combine to allow the users to live grid-free in a place of their choosing without having to give up any modern comforts. Careful consideration of accessibility and age-in-place considerations assist in creating a home that can be enjoyed during any stage of life.

Team Las Vegas consists of a collaboration between students and faculty from Architecture, Engineering, Business, and Communications. The two-year effort will be integrated into several education programs, including the Solar and Renewable Energy Minor and Renewable Energy Graduate Certificates (both supported by NV Energy), the David G. Howryla Design-Build Laboratory (supported by the named donor), the Mendenhall Innovation Center (supported by the named donor), and the Engineering Senior Design courses (supported by Fred and Harriet Cox). In addition, industry support is provided through the Architecture and Engineering Advisory Boards, and through existing partnerships with industry. The final outcome from the project will be a home that is used in the competition and eventually brought back to Las Vegas for continued use and testing. The final use of the home has not been determined; however, potential uses include a permanent office space for Green Chips in downtown Las Vegas or use at UNLV for educational and research purposes.



*UNLV Lied Library*



*School of Architecture*



*Science & Engineering Building*

## 2 TECHNICAL INNOVATION & DESIGN

### 2.1 Design Philosophy and Inspiration

We are constantly inspired by the desert – the intense sun, the relentless wind and the powerful landscape. Living in a place where the environment is harsh and the natural resources are scarce makes Team Las Vegas particularly aware of sustainable and conservational design measures. By learning from other residents of the Mojave Desert, such as the Paiute native American community, we can be part of the natural and dynamic cycle of the desert, be reciprocal in terms of what the environment provides, and most importantly, leave minimal impact on the Earth.

We formed our concept around three major considerations: 1) architecture: phenomenology and culture, 2) engineering: energy balance and technological innovations, and 3) ecology: conservation and ecosystems. Following these guidelines, our goal is to create a net-zero home that can be self-reliant in any climate including the harsh desert. This home will serve as a verdant refuge in the arid environment by generating energy through solar panels and harvesting rain water and grey water for use in the house as well as for recharging ground water supply. By incorporating passive design strategies, efficient active systems and appliances, we will be able to minimize the energy load required for the house and achieve energy balance. We also want to create memorable experiences through the architectural design of the home. It will be a home with all the modern comforts and amenities without overextending our energy budget, and it will have

the feeling of a custom home with a reduced price tag.

The Mojave Desert is a unique and fragile place. The power of its landscape is undeniable; the intense heat of the sun unforgettable. Our environment always challenges designers to think first and foremost about the environmental conditions. We are a group of designers and engineers that are constantly reminded of the climatic challenges and have practical experiences on solving these issues. A work of desert architecture must, however, also capture unique characteristics and provide refuge, while celebrating the unforgettable majesty of this place. Our design will celebrate the experiences of the desert landscape by offering new perspectives on the vistas that surround us.

## 2.2 Design Approach

Team Las Vegas will focus on design elements that are well adapted for the Mojave Desert climate, but will be able to adjust to other milder climates as well. The building must be oriented for optimum solar performance and the amount of glazing will be carefully controlled to minimize heat gains and losses. The use of screen walls as an exterior shading device can stop the solar radiation before it enters the building, thus lowering heat gain through the building envelope. Daylighting will be used primarily on south and north enclosures as it is most easily controlled in those locations. Clerestory windows will be placed high to provide optimal daylight factors for all corners of the house, minimizing the use of electric lights and reducing energy loads. Combining the use of operable windows and doors, natural cross ventilation will be optimized for cooling. Evaporative cooling will also be incorporated, as the predominant winds pass over the water features and into the house, effectively altering the temperature as well as the humidity to create more comfortable spaces.

Good architecture creates a sense of place and inspires memorable experiences. Thoughtful consideration of comfort, scale, light, and sensory experience distinguish a home from a simple shelter – these are the qualities people look for in a well-designed custom home. Through careful detailing and attention to craftsmanship, the Team is eager to create a green home that is a beautiful piece of architecture. By carefully considering sensory experiences – sound, texture, and smell, as well as visual perception – we will design a rich environment for any resident to enjoy. Phenomenological considerations like these are as relevant now as ever – perhaps more so, with society's preoccupation with the virtual environment; people need a release from the stresses of contemporary life in the haven that is our Solar Decathlon house.

Water is a precious, life-giving resource in desert. A little goes a long way, if properly used. Team Las Vegas' Solar Decathlon house will demonstrate water conservation strategies and underscore how essential these strategies are to the survival of our community. In addition, our design will use this water to provide microclimate and perceptual cooling through its judicious use as integral component of our landscape design. Our landscape design will use native plantings and efficient subsurface drip irrigation to reduce water usage and minimize evaporation. Our goal is to create a desert oasis that thrives solely on the water captured from the building, thus demonstrating a responsible desert lifestyle. A high albedo material will be used for surrounding landscaping and walkways in order to reduce the heat island effect, a growing concern in desert communities.

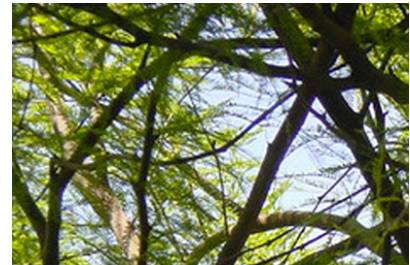
Team Las Vegas embraces a culture in which sustainable and renewable energy sources are the foundation for a diversified economy. This approach will illustrate the opportunities inherent in a constantly evolving civilization in order to suggest a progressive vision that responds to the unique social, economic, and environmental qualities of Nevada. A smaller, smarter, more subtle submission from Sin City will speak softly, but more sincerely, than any preconceived notion of what happens in Las Vegas. We live in the entertainment capital of the world, which is famous for providing a luxurious and grandiose lifestyle. We know instinctually that this is not a sustainable lifestyle, particularly given our desert environment. We strive to create a design that responds to our modern standards of living and comfort while utilizing sustainable and innovative approaches to achieve these goals.

## 2.3 Technological Design Approach

Team Las Vegas will design a house that incorporates all of the high-tech opportunities, including smart walls, digital environmental control interfaces, solar thermal collectors, and high efficiency photovoltaic panels. We aim to fully integrate these systems and technologies so that they will no longer be present in the resident's sensory foreground, but act as hidden supporting systems for the archi-



*Colors and textures of the Mojave*



*Light filters through a native mesquite tree*

tectural experience. This approach should help promote market acceptance because the consumer has a choice of purchasing a beautiful piece of architecture that is also energy efficient, instead of having to live with, for instance, awkwardly-installed solar panels that are poorly integrated into the building's design.

In addition to utilizing passive strategies for thermal comfort, the Team has identified various commercially available products to support their design. Since cooling is a major issue for our geographical location, the Team has done research in several cooling technologies. The team has been researching a new HVAC system called DOAS (dedicated outside air system), which conveys 100% outside air to each conditioned space via a constant-volume outside air unit (a total energy recovery ventilator). In addition to delivering ventilation air directly to each space, DOAS excels at humidity control (with an enthalpy wheel) and virtually eradicates microbial problems that contribute to sick-building syndrome. We are also investigating cooling grids made of capillary tube systems, which can be embedded in gypsum board or mounted on ceiling panels. This system provides an even surface temperature distribution. Due to the flexibility of the polypropylene tubes, cooling grids represent an excellent solution for both retrofit and new applications. We have also investigated TEX-COTE® Coolwall exterior wall paint finish, which can lower exterior wall surface temperatures by as much as 40 degrees. This exterior coating system uses the same heat reflective technology the military uses to reduce heat signatures produced by their vehicles. It is formulated to reflect solar heat by changing the invisible portion of the light spectrum, thereby helping to reflect heat without changing color. A study conducted by the U.S. Department of Energy's Oak Ridge National Laboratory showed that using this product can reduce a home's cooling costs by as much as 21.9%.

For heating in the winter, the team has identified a radiant floor system called Warmboard. Warmboard is a whole-home floor heating solution. By bringing the home's floor up to a mildly warm temperature (typically 75°-85°) one can experience silent, even, and comfortable warmth. Additionally, radiant heating will dramatically improve indoor air quality and lower the heating cost traditionally associated with inefficient HVAC systems. Warmboard responds faster and more accurately to changing heat loads, when compared to other radiant systems. This system responds quickly to fluctuating heating needs and will provide constant comfort.

We have done a series of investigation of photovoltaic elements for the house, including working closely with personnel of the UNLV Center for Energy Research. Our research strongly suggest using a product from SunPower Corporation. One of the reasons is that these are among the most efficient panels produced in the world, with efficiencies ranging from 19%-21%, allowing us to use fewer panels to meet our power requirement. Sunpower is an American company. Bombard Renewable Energy, one of our sponsors, is Sunpower's Las Vegas representative. So financially it will be desirable to do this. The units can be acquired either as panels or as building-integrated forms. The high efficiency crystalline solar PV panels under consideration are manufactured in an all black design, with each panel having a black back-sheet with the metal contacts between the cells located on the backside of the panels. Additionally, the panel frame is black which further integrates multiple panels into the architectural style of the home. Another option is to cover the roof with solar. These solar shingles take the place of conventional roofing materials and lay flat on the roof

## 2.4 Market Viability Concept

Our aspiration is to create a new housing prototype that will be attractive to residents of Las Vegas and the Southwest, while also being applicable to other climate regions in the country. Though the design targets the vacation home market, our offer of an off-the-grid, small family housing can also be appropriate for the senior and retiree market, young couples, or empty-nest families anywhere in the country. These are all emergent markets that are already transforming the social and economic landscape of the real estate housing market. Our design will offer these smaller family units a real chance to live sustainably in the environment. The house is designed to be a kit of parts and modules that can be easily transported and assembled in various sites, from the wilderness and mountain ranges of Nevada to the bustling city block in Las Vegas. Our design aims to provide the feeling of a custom home without the high cost by offering our expertise in digital fabrication technologies. This is a practical approach to manufacturing and mass production of our housing prototype.

In order to accomplish our goals and aspirations, Team Las Vegas will be using an integrated project delivery approach in the planning and design of our Solar Decathlon house. By utilizing a team of experts in which everyone is on a level playing field, all team members will be able to collaborate at the same time as the project progresses. Unlike traditional linear project delivery methods, our team will be incorporating the engineers' and consultants' opinions and suggestions throughout the development of the architecture. This approach will help the Team realize a truly integrated building design and, with the aid of BIM software, we will be able to produce a work of architecture that truly stands on its own and conveys the important messages to the public.

## 2.5 Learning from Past Competitions

Team Las Vegas has taken a small, dedicated team of students and faculty to Washington DC for the last two Solar Decathlon competi-



tions (2009 & 2011) to tour the Solar Decathlon houses, meet the teams, and observe first hand strategies, successes and issues. The team has since compiled information with the competition results and drawn some valuable conclusions about successful design strategies and performance issues that greatly effect category and overall results.

To present its findings in a group meeting, the travel team focused on a few key characteristics that stood out as significant.

- Craftsmanship was a prime factor in the overall impression of each house visited. The team found that the better crafted houses were among the top performers in some key areas (though this did not necessarily parallel overall performance).
- Circulation. Several of the houses had generous open central circulation that offered a luxury of space, ease of movement and generous views, but in some cases this plan compromised energy performance.
- Communications is a competition category that touched many critical aspects of the project and process. While visiting with competition team members, it became very clear that solid and consistent communication was a crucial factor in every step of the process. Team infrastructure, marketing devices, and concept communication all benefited from a well-defined and clear path of communication and open dialogue.

## 2.6 Internal Review Process for the Design-Build Studio

Architects today are better positioned to see the effects of social, economic, and environmental change than ever before. With the advent of computer modeling and animation, they are also able to develop new ways of thinking about how to conceive and deliver buildings of ever-greater complexity, responding to the challenges of speed, flexibility, and cost in ways that seemed unimaginable a generation ago. One of the unintended side-effects of the embracing of the 'virtual' has been the tendency among many students towards a lack of rigor in considering the actual materials from which their buildings are to be constructed. Yet, these are the 'notes' that, strung together, become the symphonic whole of any great architectural work.

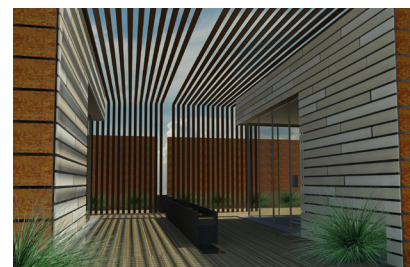
It is for precisely these reasons that the University of Nevada Las Vegas (UNLV) School of Architecture initiated its David G. Howryla Design-Build Studio. Many students who have participated in design-build programs across the country have cited them as critical formative experiences in their development as design professionals. This observation underscores the importance of careful consideration of the goals, methodologies, and opportunities that comprise the Design-Build Studio.

In the Design-Build studio, students formed groups to study the three finalists and winners from each Solar Decathlon in the past; each group also selected one additional noteworthy entry to discuss with the class. They focused on determining what was significant about the selected work, including determining why the finalists and winners were successful. Their research explored how the teams achieved these results in areas such as specific approaches, innovative systems, etc.

In the beginning of the studio, individual students were to propose a design concept, then a process of elimination was applied to narrow down the approach from twelve designs to six, then to three, and then down to the final design concept. During the process of elimination, a conscious decision was made not to describe the methodology at the beginning of the project, as it was important that this process not influence the initial explorations.

The two rounds of eliminations left the studio with three teams which spent the next two weeks developing designs that were presented to a jury of faculty and student members from the School of Architecture, the College of Engineering, and professional architects. All three teams had the opportunity to collaborate with the engineering students and faculty in recognizing and planning for areas in energy efficiency, constructability, cost estimation, and transportation consideration. In the final joint review session, the multidisciplinary jury ranked each team's proposal, and the highest scoring proposal was chosen to represent UNLV in the Solar Decathlon.

In practice, there were a few challenging moments, but ultimately, the three schemes that were presented were all credible, serious design proposals; the collaborative process did not 'water down' the ideas; in fact, by working together, the students were able to explore more ideas than would have been possible individually. Interestingly,



*Alternate concept: Living Desert House*



*Alternate concept: Desert Solar House*

the first elimination, where each student paired with one other student, was a more ‘seamless’ transition than the second; one team in particular experienced significant friction as their teams joined. However, this team managed to bridge their differences, and produced a well-developed scheme in a remarkably short time.

Once the final proposal was selected, the students were assigned research and development tasks in support of the design, including building skin, insulation, photovoltaic integration, glazing and sun control, interior finishes, logistics (moving house across state lines), HVAC, appliances, control systems interfaces, and many other engineering areas. The students who joined the winning team found that there was plenty of work to do; as a consequence, they discovered that there were numerous opportunities for them to demonstrate their design abilities.

## 2.7 Team Qualifications and Expertise

Team Las Vegas includes architects, engineers, interior designers, graphic designers, journalists, an economist, a biologist, and representatives of many other disciplines. This wide diversity of backgrounds provides Team Las Vegas with a unique opportunity to synthesize this wide-ranging expertise into a design that fully embraces its place in our desert landscape. Our team’s experience in meeting the challenge of designing for our desert environment is unrivaled, allowing us to explore design solutions that critique normative building systems and offer a new paradigm for desert building.

The architectural team has substantial experience in project design, management, construction administration, and design-build delivery methods. Professor Weber has 12+ years of professional industry experience at all levels of design and construction, as well as substantial graphic design, interior design, landscape/hardscape design, lighting and furniture design/fabrication expertise. In virtually every project, Professor Weber developed substantial experience working with fabricators, translating digital design to fabrications. He has also managed every project he has worked on from schematic design through construction administration. These experiences make him uniquely qualified to serve as Team Las Vegas’ Project Manager. Professor Fernandez has conducted extensive research on thermal comfort, energy efficiency, green design, passive and low-energy heating/cooling systems, and water harvesting, treatment and reuse systems. His expertise will be invaluable as the design is refined, ensuring the house is particularly well-adapted to the Mojave Desert.

The engineering team includes experts on a variety of interdisciplinary projects in renewable energy, solar energy applications, solar power generation from both thermal and photovoltaic approaches, as well as building applications of solar energy and zero energy building design. For instance, Professor Boehm is a national expert in projects that involve solar power generation from both thermal and photovoltaic approaches, as well as building applications of solar energy and zero energy building design. In addition, experts in structural, civil, materials, and construction engineering will contribute substantially to Team Las Vegas’ design process.

The communications, marketing and outreach team includes experts that understand the regional real estate market and how best to communicate the complexities associated with our Solar Decathlon home that promotes renewable energy and energy efficiency. The Director of the Lied Institute for Real Estate Studies, Professor Nasser Daneshavary has worked extensively on house prices in Southern Nevada, and his articles have appeared in top real estate and economic journals. Laurie Fruth (Director of UNLV TV) regularly works with students to communicate activities of UNLV programs.

## 3 FUNDRAISING & TEAM SUPPORT

### 3.1 Budget Planning

The gross area of the home is 730 square feet. The total estimated cost for design, planning, construction, transportation, deconstruction and hauling back to Las Vegas of the UNLV Solar Decathlon is estimated as \$993,720. The cost is divided into three phases; design and planning phase, construction and transportation phase, and deconstruction and hauling back phase. The estimated cost of the design and planning phase is \$45,000. A detail breakdown of these costs is given in Table 3.1.

*Table 3.1 Estimated Cost of Phase I (Design and Planning)*

No.	Cost Items	Estimated Cost
1	Construction Detail Drawings	\$5,000
2	3 D computer Building Information Modeling (BIM) & Physical Models	\$10,000
3	Construction Manual	\$5,000
4	Website Design	\$5,000
5	Communications and Marketing	\$25,000
6	Paid Student Labor	\$20,000
<b>Total</b>		<b>\$70,000</b>

After the design is completed the home will be constructed as two separate pieces in Las Vegas and transported to Washington D.C. The pieces will then be reinstalled in the DC with the help of paid student labor. The estimated cost of Phase II, Construction and Transportation is \$792,920. The cost breakdown is given in Table 3.2.



The constructed home in Washington DC will be broken down and will be transported back to Las Vegas. The total cost of deconstruction and hauling-back cost is estimated as \$155,800. The detailed estimated cost of deconstruction and hauling-back the home is given in Table 3.

### 3.2 Fundraising and Institutional Support

The University of Nevada, Las Vegas has long been supported in the area of renewable energy as evident by \$1,000,000 donated by NV Energy over the past three years for education programs. Team Las Vegas is confident that with the support of various UNLV and community partners it will be able to reach a donation level at which funding priorities will be met. Team Las Vegas will work on traditional and creative methods to procure the necessary equipment and supplies to produce a high caliber home. Team Las Vegas will also rely on their UNLV and community advisors to help with fundraising efforts (see attached letters from the UNLV President, Advisory Boards and other community partners).

The UNLV Foundation is an IRS Code 501(c)(3) nonprofit organization that seeks and manages gifts to the university. It was founded in November 1981 to coordinate all private giving for UNLV. The Foundation solicits, receives, and administers gifts and financial resources from private sources for the benefit of all programs of the university. Gifts to UNLV through the Foundation each year provide scholarships, research facilities, equipment, and other enhancements that improve the quality of higher education. Earnings from the UNLV Foundation endowment also provide a dependable, long-term source of income for the university. As a public nonprofit organization, the Foundation has members and no capital stock. The Foundation will offer a team approach to fundraising; the Senior Associate Vice President for Development (Nancy Strouse) has offered to have the development officers in the various Colleges of Fine Arts, Engineering, and Business assist with potential donors.

UNLV has various administrative and academic units on campus that have been supportive and will support the Team Las Vegas (see appendices for letter from President). The Division of Finance and Business will support all purchasing, facilities, planning, and construction. The Division for Research and Graduate Studies will support the effort; Associate Vice President for Interdisciplinary Research, Thomas Piechota, has already been involved in proposal development, and the Office of University Advancement will support fundraising as noted above and also the promotion of the event through the Public Affairs department.

UNLV is also financially supporting the effort through various units on campus totaling \$200,000. The specific commitments are outlined below:

- Vice President for Research and Dean of Graduate College (\$40,000 for Graduate Student support)
- Dean of Engineering (\$40,000 for Graduate Student support)
- Director of School of Architecture (\$60,000 for Graduate Student support and faculty support)
- Associate Vice President for Interdisciplinary Research (representing the Renewable Energy Education Programs) (\$60,000 for Graduate Student and Undergraduate support, and materials and supplies).

### 3.3 Industry Support

Team Las Vegas will rely heavily upon various companies that provide commercial services in the Las Vegas region. The team leadership has already identified three major areas of the project that will need a heavy presence; the three areas are architecture, engineering, and construction. Additionally, Team Las Vegas has also identified key companies that are suited to assist in the project and provide training to team officers

**Table 3.2 Estimated Cost of Phase II (Construction and Transportation)**

No.	Cost Items	Estimated cost
1	Site works	\$5,000
2	Masonry	\$500
3	Metal works	\$6,100
4	Millwork and casework	\$10,000
5	Roofing and waterproofing	\$52,505
6	Caulking	\$1,250
7	Doors and Windows	\$21,500
8	Finishes	
	Drywall and wood studs	\$41,788
	Acoustical Ceiling Grid & Tile	\$1,050
	Exterior Metal Stud, Framing & Plaster	\$35,850
	Fireproofing	\$2,500
	Hardwood Flooring	\$11,200
	Furnishings, Finishes, and Equipment	\$15,000
9	Misc. Specialties	\$1,750
10	Special Construction	\$17,500
11	HVAC, Plumbing, and Mechanical	\$62,000
12	Electrical	\$33,000
<b>Building Subtotal</b>		<b>\$318,493</b>
13	General Conditions	\$20,360
14	Travel Cost	\$89,000
15	Mobilization	\$112,000
16	Graduate Student and Student Worker	\$195,442
17	Contractor Contingency	\$15,000
18	Faculty Support	\$20,000
<b>Total</b>		<b>\$770,295</b>

**Table 3.3 Estimated Cost of Phase III (Deconstruction and Hauling-Back)**

No.	Cost Items	Estimated Cost
1	Deconstruction Cost	\$66,800
2	Hauling Back Cost	\$89,000
<b>Total</b>		<b>\$155,800</b>

and members to build, transport and operate their home safely. These companies include Lucchesi Galati Architects, NV Energy, Pulte Homes, Helix Electric, Gigacrete, and Bombard Electric. In addition, the Engineering and Architecture Advisory Boards and local engineering associations have shown their support for this effort (see letters of Support). Clearly, Team Las Vegas will have the support of the community to raise the anticipated amount of additional money needed to meet the goals of the project.

### 3.4 Facilities and Equipment

There are several research facilities that will serve as excellent resources for Team Las Vegas:

- The Center for Energy Research (CER, <http://www.cer.unlv.edu>) is a soft-money-funded operation that has performed a number of solar and renewable energy projects over the last 15 years. Included has been a project funded by the National Renewable Energy Laboratory (NREL) on the development of a zero energy house and its energy performance comparison to an adjacent code-built house. Both were monitored for five years. Currently the CER is the lead, in collaboration with Pulte Homes and NV Energy, on a large DOE-funded project on the development of a new housing tract (185 homes) that is designed to reduce the electrical energy peak demand by 65% compared to code built developments. CER also has a Solar Site that has two large high concentration (500X) PV systems, a number of solar and hybrid lighting systems, including a Sunlight Direct system, and a Façade Evaluation Facility. Lastly, CER has a wide variety of testing facilities related to PV and solar domestic water heating components and corresponding evaluation capabilities.
- The Natural Energies Advanced Technologies (NEAT) Laboratory (<http://www.unlv.edu/labs/neatl>) was established in the summer of 2004 from a donation by the H.R. and E.J. Hay Charitable Trust with the intent to evaluate passive and low energy strategies for daylighting, heating, cooling as well as on-site water harvesting, treatment, and reuse. To that end, the NEAT Laboratory's mission is to pursue environmentally and culturally responsible design through the use of appropriate technologies. NEAT has an outdoor test area where prototypes permit investigation of the performance of green roofs, roof ponds, and thermal insulation materials. The outdoor test area also has a complete outdoor weather station. The lab's indoor facilities include the main laboratory space, a small office and graduate student work stations. It is equipped with a Heliodon (sun simulator) with digital video-recording capabilities.

There are several fabricating facilities in the College of Engineering and the School of Architecture that will be utilized by Team Las Vegas:

- In the School of Architecture, the SimLab is a multimedia fabrication space equipped with a woodworking shop as well as cutting-edge digital fabrication equipment. The digital fabrication equipment includes two laser cutters, a Universal 25W laser and a Jamieson 100W. The Jamieson laser cutter has a 4'x8' cutting bed and is capable of doing full scale two-dimension cutting and etching on various materials. For three-dimensional sculpting and modeling, the lab has a CNC milling machine, a 3D printer, and a digitizing arm. The ShopBot PRS CNC milling machine is a three-axis milling machine, which can execute both two and three dimensional drawing file inputs. It also has a 4'x8' cutting bed and has been extensively utilized for architectural installation projects that are part of the curriculum. We are proud of our latest addition, the Dimension SST 1200es 3D printer. The Microscribe digitizing arm is a great tool to link traditional model making to computer aided design.
- Also in the School of Architecture the David G. Howryla Design-Build Lab strengthens the school's ability in real scale building construction. Primarily to reinforce the ability to fabricate metal works, the Design-Build Lab is equipped with a PlasmaCam CNC Plasma Cutter, a Flux-core MIG welder and various metal-working tools. The students are able to perform two-dimensional computer-aided cutting on the 4'x8' bed of the plasma cutter on metal. The SimLab and the Design-Build Lab are adjacent to each other; they both share high bay space and 4 roll-up doors that open out into a gravel building yard large enough for on-site construction. Depending on the final design, the majority of the fabrication can take place of School of Architecture premises. Also sharing the building yard are the Structures Lab and the Natural Energies Advanced Technologies Laboratory (NEAT Lab). The Structure Lab has the same high bay space, which can serve as a clean space for material or components storage.
- In the College of Engineering, there is a complex that consists of three rooms: a machine shop, a metals shop and a wood shop. The machine shop includes two milling machines, two lathes, a bench grinder, a wire wheel/deburring machine, and an assortment of small bench-top machines. The metals shop includes general use machines and equipment for supporting manufacturing and fabrication processes com-



**CNC milling machine**



**CER Solar Site**

monly found in manufacturing machine shops. The metals processing shop area includes a sixteen gauge finger brake, a twelve gauge power shear, a hand shear, two miller welding stations, a box corner notcher, a plasma cutter, two drill presses, two band saws, and a band saw blade welder. The wood preparation area has a ten inch radial arm saw, a twelve inch circular sander, and a six inch belt sander. The shops also house a five-axis HAAS CNC machine, a CNC turning center, and a rapid prototyping machine that have restricted-use access. There is also a large assortment of hand and power tools available for use in the shop or to be checked out to other labs.

- Contiguous to the College of Engineering shop is the Mendenhall Innovation Center, which couples entrepreneurship with design to enhance the student education experience. This fits in well with the Solar Decathlon for which innovation in design is needed and some of the new technologies have potential for commercialization. The Mendenhall Innovation Program is a resource available to Engineering Faculty and their Undergraduate Students for the purpose of enriching student experience in the commercialization of technology through exposure to independent “hands-on” activities. These activities are added to normal coursework to simulate the product conception, product design and product production processes required to successfully commercialize technical innovation. The laboratory space comprises 2,500 sq. ft. of space for general fabrication and project work, including an electronic testing and fabrication area, a computer-based design area, and space for undergraduate teams participating in national student competitions. Programs in the Center are underwritten through \$1 million gifts each from Dr. and Mrs. Robert Mendenhall and Mr. and Mrs. Fred Cox.
- The newest facility on the UNLV campus is the Science and Engineering Building. This is a state-of-the-art research and education facility that promotes an interdisciplinary environment with flexible laboratory space and integrated research areas. The machine shop is a 2,500 ft<sup>2</sup> facility staffed with a shop manager with 15 years of experience and can accommodate projects of significant size and diversity. Core equipment includes two four-ton cranes, a welding area, CNC milling machines, other standard mills, presses, cutters, and bending equipment, and rapid prototyping machining from 3-D CAD files.
- The last facility in the College of Engineering is the Perini Construction Engineering Laboratory that has 42 computers that are equipped with software related to construction engineering and management. The computers have scheduling software (Prima Vera, Sure Trak, and Microsoft Projects), estimating software (Heavy Bid, Quantity Take-off, Timber line), design software (AutoCad), and other Microsoft office software.

## 4 ORGANIZATION & PROJECT PLANNING

### 4.1 Team Las Vegas Organization

Team Las Vegas is proud to contribute to the diversity of the Solar Decathlon competition. Our team is composed of a diverse group of people. We are not only a combination of architecture and engineering students and faculty, but also a mix of skills, trades, and life experiences – our team includes an artist, nuclear engineer, anthropologist, set designer, furniture maker, biologist, journalist, construction superintendent, historian, interior designer and welder. We are each other’s teachers. We believe this diversity will contribute to a successful entry for Team Las Vegas. (See figure 4.1 for organizational structure)

### 4.2 Faculty and Student Team

#### Administrators

Tom Piechota	Associate VP Interdisciplinary Research Professor	Sustainability and Interdisciplinary Research Civil and Environmental Engineering
David Baird	Director, Professor	School of Architecture
Nancy Strouse	Senior Associate VP for Development	UNLV Foundation

#### Principle investigator

Eric Weber	Assistant Professor Director	Architecture David M. Howryla Design-Build Initiative & Building Technologies Laboratory
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#### Co-Project investigators

Alfredo Fernandez-Gonzalez	Associate Professor Director	Architecture Natural Energies Advanced Technologies Laboratory
Bob Boehm	Distinguished Professor Director	Mechanical Engineering Center for Energy Research
Alexander Paz	Assistant Professor	Civil Engineering

Pramen Shrestha	Assistant Professor	Construction Management
Nasser Daneshvary	Professor	Economics and Lied Institute for Real Estate Studies

### Participating faculty

Randall Stout	Associate Professor	Architecture
Deborah Oakley	Associate Professor	Architecture
Miriam Neet	Assistant Professor	Architecture
Samir Moujaes	Professor	Mechanical Engineering
Laurie Fruth	General Manager	UNLV TV, Journalism

### Student leaders

Alexia Hsin Chen	Graduate - Architecture
Noel Williams	Graduate - Architecture
	Adjunct Faculty - Interior Architecture
Christian Iusso	Graduate - Architecture
Nicholas Meyer	Graduate - Construction Management
Tim Albertson	Graduate - Environmental Studies
Jane Cretty	Undergraduate - Civil Engineering
Josh Bielinski	Graduate - Economics

### Participating students

Thom Slaughter	Undergraduate - Architecture
Heather Holstrom	Undergraduate - Architecture
Jacob Rivard	Undergraduate - Architecture
Zheng (Jinger) Zeng	Undergraduate - Mechanical Engineering
Kim Hammer	Graduate - Mechanical Engineering
Francisco Vargas	Undergraduate - Mechanical Engineering
Jim Rossi	Graduate - History
Rob Neilsen	Graduate - Public Administration

## 4.3 Conflict Resolution

Conflicts will arise during the design and construction of any project, and Team Las Vegas has a thorough understanding of the need for a clear and concise process that anticipates issues and provides clear resolution when necessary. The project's Design-Build project structure provides a delivery system where design and construction are contracted as a single entity that will design, engineer, procure and execute construction. Within this structure, Team Las Vegas will utilize decision matrices and the expertise of design-build professionals in the community to mediate issues and ensure issues are resolved in a timely and fair manner.

UNLV has identified three ways to combat any conflicts that may arise during the next two years.

- To reduce the number of conflicts, open dialogue and communication between all participants is crucial. Key to this is a successful and strong leadership team. The project manager and all five team leaders have shown strong communication, leadership and technical skills and will encourage discourse as a means to early and successful conflict resolution.

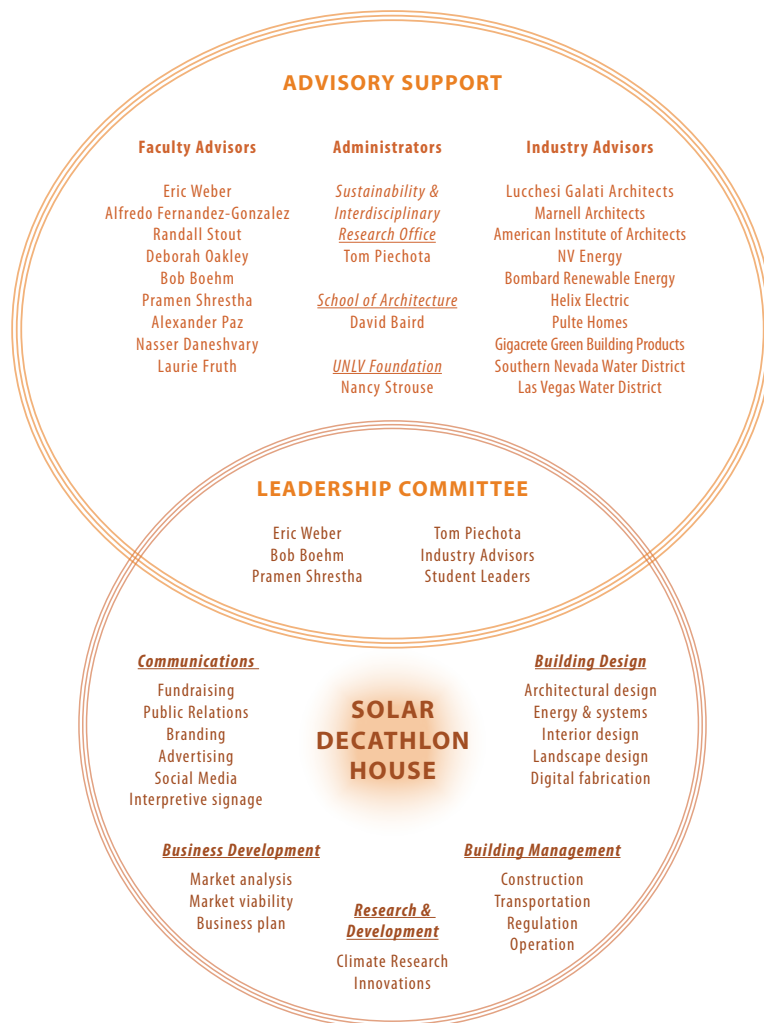


Fig. 4.1 Team Las Vegas Organizational Structure

- While first relying on strong leadership in all five teams to meet the demands of Design-Build schedules and the rigorous requirements of the Solar Decathlon Competition, Team Las Vegas will utilize the conceptual design proposal as a basis for directing decisions and driving resolutions.
- Finally, the advisory committee set up to consult for the project will act as an arbitration board when necessary, as would be done on traditional Design-Build projects. The UNLV Advisory Committee consists of representatives from UNLV School of Architecture, Howard R. Hughes College of Engineering, UNLV's Center for Energy Research, Las Vegas engineering and architecture firms.

#### 4.4 Project Organization and Timeline

Team Las Vegas has devised a project organization plan that includes the different phases of the competition. See table 4.1 for details.

Timeline	Task Name	Deliverables
Q1 12	J	Design & Planning Phase  · Schematic Design Review · Target 50% Completion for Website · Schematic Design Model/Manual  · Design Development Review · Target 100% Completion for Website · Design Development: BIM, Model & Manual · Computer Animated Walk-through · Construction Documentation Review
	F	
	M	
Q2 12	A	
	M	
	J	
Q3 12	J	
	A	
	S	
Q4 12	O	
	N	Construction Phase  · Scale Model · Health & Safety Plan · Construction Documentation : BIM, Model & Manual
	D	
Q1 13	J	
	F	Transporting & Commencing  · Project Summary · Public Exhibit Materials · Completion of Construction / Testing /Commissioning
	M	
Q2 13	A	
	M	Deconstruction Phase  · Assembly / Open House / Testing Transport Systems
Q3 13	J	
	A	
	S	Hauling back and deploying in Las Vegas  · Disassembly · Final Report
Q4 13	O	
	N	
	D	

*Table 4.1 Estimated Project Timeline*

#### 4.5 Decathlon House After the Competition

Team Las Vegas will be utilizing the home for research, education, and outreach purposes after the competition. Various options have been discussed and explored both on and off campus. There has been enthusiasm for the following options:

- UNLV campus location where Architecture and Engineering students would continue to monitor performance of the building and test new technologies. In addition, it would be used as a education facility for students in the Renewable Energy Education programs and for outreach to K-12 programs visiting the campus.
- Downtown Las Vegas location, where it would be used as an office facility for the Green Chips organization, a nonprofit public-private partnership in Southern Nevada that has a mission to encourage and facilitate environmental sustainability initiatives in the community. It has a long-term goal of making Southern Nevada a national leader in environmental sustainability and energy efficiency. The Board of Trustees includes senior executives from MGM Resorts International, Harrah's Entertainment, the City of Henderson, Vegas PBS, Southwest Gas Corporation, Clark County, the City of Las Vegas, the Las Vegas Convention and Visitors Authority, NV Energy, Laborers' International Union Local No. 872, and the City of North Las Vegas.



## 5 CONCEPTUAL DESIGN

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See attached conceptual design package.

## 6 CURRICULUM INTEGRATION

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### 6.1 Existing Programs

UNLV has established various undergraduate and graduate education programs that will provide students with knowledge to ensure project success.

The Solar and Renewable Energy Minor and Renewable Energy Graduate Certificate Programs were developed through generous donations by NV Energy of \$1,000,000 over the past three years. The Solar and Renewable Energy Minor has approximately 100 students enrolled. This interdisciplinary Minor provides students from a variety of backgrounds with the opportunity to explore this field. The minor degree program is available to all undergraduate students at UNLV through two tracks – one in engineering and science, and another in policy. In addition, various co-curricular activities are provided to prepare further students for careers in the solar and renewable energy fields. Similar in structure to the Minor, a new Graduate Certificate in Renewable Energy was recently approved for Spring 2011. The goal of this certificate program is to provide a specialized qualification for career professionals in the energy industry, professionals from other fields seeking entry into the clean energy field, or currently enrolled graduate students seeking an added specialization. There are various opportunities (e.g. undergraduate and graduate research assistantships, internships, student activities) for the Solar Decathlon to be integrated into the Minor and Graduate Certificate.

The School of Architecture offers a comprehensive education that includes undergraduate and graduate programs in architecture, as well as undergraduate programs in landscape architecture and interior architecture. Environmental control systems courses provide an opportunity to develop in-depth modeling of systems and passive design strategies. The capstone project for landscape architecture students will permit multiple students to focus on various aspects of the competition design, which may include drought tolerant landscape design, community gardens, grey water systems, or green roofs, while addressing the creation of a sense of place through the integration of the overall concept into the outdoor space. Collectively, studio and independent study courses support students in studying a wide range of topics, which can provide tremendous depth to the overall design and performance of Team Las Vegas' Solar Decathlon submission. UNLV School of Architecture is proud to offer, on site, fabrication, design-build, structures research, and sustainability research facilities.

Part of every College of Engineering student's academic experience, the senior design project stimulates engineering innovation and entrepreneurship. A capstone to the student's educational career, the senior design project encourages the student to use everything learned in the engineering program to create a practical, real world solution to an engineering challenge. Often, the senior design experience is a multidisciplinary one.

In recent years, the Senior Design Competition participants have focused on sustainability-related projects. UNLV's Howard R. Hughes College of Engineering has seen sustainable vertical farms, complete green communities for the United States and Iraq, electric car conversions and home metering systems. All these projects have helped the students develop a better understanding of sustainable issues and helped these young engineers understand the business side of their fields. For example, at last year's UNLV senior design competition, Ken Hines, a mechanical engineering senior, developed a real time energy net metering device that can be installed and operated immediately.

The College of Business and various programs in marketing, economics, finance, and accounting will contribute to the success of the team through curricular and co-activities. For instance, the Lied Institute for Real Estate Studies has advanced knowledge of the real estate industry and public policy of the region. This will be invaluable in determining the market viability of the house. In addition, the Center for Entrepreneurship is housed in the College of Business and interacts with units across campus to promote entrepreneurship in students. Most recently, students from UNLV won the 2011 Governor's Cup Competition for development of business plans. This student entrepreneurship will help make for a successful solar decathlon home.

The College of Urban Affairs and various programs in communications, journalism and media studies will contribute to the team's success. For instance, UNLV TV is housed in the College of Urban Affairs and has supported student and faculty education and research efforts. The Hank Greenspun School of Journalism and Media Studies has faculty and students that are on the leading edge of appropriate use of media technologies for communication to the public.

## 6.2 Integration into Courses

UNLV aims to integrate the Solar Decathlon into the course curriculum throughout all stages of the competition. A summary of all the relevant courses which may contribute to the Solar Decathlon team is provided in table 6.1 How the courses are incorporated to involve students both on and off the Decathlon Team is shown below, using the School of Architecture as an example. The Solar Decathlon experience will be integrated into the curriculum of these courses in a number of ways. Participatory exercises and design projects will be integrated into existing courses, while new electives will be added to the curriculum to focus students' creativity and facilitate bridging between interdisciplinary groups. Similarly, other disciplines will have opportunities to engage the project in many meaningful ways, from designing furniture for use in the house, to developing a holistic approach to the landscape design, to using the project as a critical component in the development of their own material/tectonic language.

With this in mind, there are numerous opportunities for design students to work, using their own expertise as a foundation, toward meeting the project's goals and their own discipline's requirements. Many required courses in the School of Architecture's curriculum already explore facets of the design and developmental processes necessary to completing a successful Solar Decathlon house. In several cases, the house design can be utilized directly to satisfy existing course requirements. This is particularly true in the case of the School's Integrated Building Systems, Construction Technologies, Building Structures, and Environmental Control Systems courses. In each of these courses, students are expected to develop carefully considered design solutions that meet the pedagogical objectives of the respective disciplines. With careful planning and communication between the design team and Building Technologies professors, these goals can be met by designing these critical systems for the Solar Decathlon House.

The following existing elective courses are currently scheduled for Spring 2012, and are of particular relevance to Team Las Vegas' Solar Decathlon entry:

**Table 6.1 Course Integration**

- **Furniture Design:** This course, offered through the Interior Design program, enables students to explore multifunctional furniture solutions for the Decathlon house. They will design multifunctional, customizable furniture pieces, and will collaborate with the Team to construct them in the School of Architecture's Sim Lab and/or Building Technologies Labs.

- **Meditations on Making:** This course is an exploration of the poetic potential of materials and tectonics as generators of architectural production and the cultural forces that inform this process. Materials and their detailing can and should be consistent with and reinforce the conceptual basis for architectural production. These possibilities are uncovered through a series of 'making' assignments, in which students create a series of 'constructed meditations' exploring means of thinking about

Courses	Solar Decathlon Components												
	Exterior Architectural	Interior Architectural	Landscape	Structural	Solar	Mechanical	Electrical	Materials	Construction	Cost & Financial	Market	Communication & Outreach	
AAE 495/795, Meditations in Making													
AAE 770, Research Methods in Environmental Design													
AAE 780, The Design Build Process													
AAI 680, Furniture Design													
ABS 521/522, Construction Technologies I & II													
ABS 531/532, Environmental Control Systems I & II													
ABS 541/542, Structures for Architects I & II													
ABS 632, Solar Energy Applications in Architecture													
ABS 741, Integrated Building Systems													
CEM 250, Construction Materials and Methods													
CEM 451/451L, Construction Estimating													
CEM 480, Sustainable Construction													
ECO 707, Environmental/Natural Resource Economics													
EE 495, Photovoltaic Devices and Systems													
EGG 150/450, Introduction to Solar Energy Utilization													
ENV 101, Introduction to Environmental Science													
ENV 206, Introduction to Climate Change													
ENV 407, Environment and Society													
ENV 420, Environmental Impact Analysis													
HIST 441/443, American Environmental History													
JOUR 202, Electronic Media Production I													
JOUR 261, Integrated Marketing Communications													
LAND 242, Irrigation													
LAND 258, Xeric Plant Materials													
LAND 443, Stormwater Management													
LAND 499, Sustainable Design for the 21st Century City													
ME 707, Radiation Heat Transfer													
ME 714, Computational Aspects of Solar Energy													
ME/EE/CE 497/498, Senior Capstone Design													
MKT 301, Marketing Management													
MKT 422, Integrated Marketing Communication													
NRES 411, Environmental Law													
SOC 407, Environment and Society													

how to bring an idea to its realization in architectural form. This course has been offered in the past, and has been particularly effective in helping students to develop a critical approach to considering materials and architectural detailing. These are essential skills in developing any compelling architectural work, and will be invaluable as Team Las Vegas begins design development.

If Team Las Vegas is selected, the College of Engineering, the School of Architecture, and other participating departments will offer additional elective courses tailored to meeting the needs of the Solar Decathlon Team. Examples of courses the School of Architecture is considering include Advanced Topics in Design – Digital Fabrication, Integrated Design Delivery, and Integrated Design Analysis. Digital fabrication coursework includes teaching students how to use digital fabrication tools to develop mockups and actual components to be utilized in Decathlon house. An integrated design delivery course would be the bridge between students of different majors, guided by multidisciplinary faculty members. Architecture, engineering, and construction students would be able to effectively coordinate their contributions to design; business, graphic design, and communications students, among others, would be able to provide their invaluable input at critical design stages. Integrated design analysis would offer students the opportunity to conduct quantitative analysis on the strategies and systems employed in the project. The work produced by this class would allow the Team to understand how their design decisions affect actual performance.

### 6.3 Institutional Support for Integration into Graduate Education

UNLV has supported the development of the Solar Decathlon proposal submission in 2009 and in 2011 through travel funds which allowed students to visit the competition, undergraduate student worker support, and graduate student support. This support will continue if UNLV is selected as one of the 20 teams. \$200,000 will be provided to the team in the form of graduate student assistantships and undergraduate researchers who will assist in the design and construction of the home. Two assistantships will support students from the College of Engineering (Mechanical Engineering and Civil and Environmental Engineering) and two from the School of Architecture. All of the assistantships will be for the two-year period of the project.

## 7 CONCLUSIONS

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Team Las Vegas is excited to have the cooperation and dedication of various UNLV departments participating in the Department of Energy's Solar Decathlon Competition. UNLV administration firmly believes in building a green and sustainable future and has acquired the assistance of many community partners in Southern Nevada's sustainability and renewable energy field. We have organized experienced and motivated faculty and student leaders into an interdisciplinary team. Team Las Vegas is dedicated to offering new design and construction approaches, such as integrated project delivery and digital fabrication capabilities, in order to further our goal of creating a net-zero home. Team Las Vegas has pursued a vigorous process to develop this proposal through researching past Solar Decathlon competitions, sending students and faculty to the 2009 and 2011 events, and organizing a Design-Build studio around the development of a conceptual design for the 2011 submission. Over the past semester, over 25 students and 13 faculty have participated in the development of the design and the proposal.

We believe that through exploration and practice, students can gain the most valuable learning experience in the field of sustainable design. The competition will be integrated into courses in a way that allows many UNLV students to gain hands-on design and construction experience before entering into professional practice. This process is most invaluable because the competition offers an opportunity to turn a school design project into a fully developed work of architecture. Team Las Vegas' Solar Decathlon house will be the laboratory for green design concepts that are suitable for the desert climate, which have been underrepresented well in the history of the Solar Decathlon competition. These design strategies, if proven efficient and practical in the extreme climatic context of the desert, may be easily adapted to work in other much milder climate zones in the country. When the house returns to Las Vegas, it will be a living laboratory for students, faculty, and the public to learn about energy efficient building technologies. This enhances the goals of UNLV becoming a leader in sustainable building design and promotes energy-efficient home design, which advances economic development in our community.

## 8 APPENDICES

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### 8.1 Team Member Biographies

- Administrators

**Dr. Thomas Piechota** is the Associate Vice President for Interdisciplinary Research and Professor in the Department of Civil and Environmental Engineering at the University of Nevada, Las Vegas (UNLV). Dr. Piechota received his B.S. in Civil Engineering in 1989 from Northern Arizona University, and his M.S. and Ph.D. in Civil and Environmental Engineering respectively in 1993 and 1997 from UCLA. In his current position, Dr. Piechota oversees interdisciplinary research and education initiatives, the development of government and industry partnerships, and the Urban Sustainability Initiative, which is a campus-wide effort supporting sustainability-related research, education, and outreach. Dr. Piechota is a Licensed Professional Engineer in the States of Nevada and California and serves on various committees with the American Society of Civil Engineers.

**David Baird** is the director of UNLV School of Architecture, which houses Nevada's premier accredited design programs in interior architecture, landscape architecture, and architecture. He is also the co-founder and president of +One Design and Construction – an award-winning firm known for socially responsible art and architecture. Baird studied architecture at the University of Illinois at Urbana-Champaign and received a Bachelor of Science in Architecture in 1987. He obtained his Master of Architecture degree in 1991 from University of Arizona. Since graduation, Baird has published over 30 academic papers, and his artwork has been exhibited in over 50 venues across the country, including seven museums and two international exhibits. Baird won five AIA design awards this year; one was a national AIA Small Projects Award for a modest home designed and built for a family displaced by Hurricane Katrina.

- Principal investigator

**Eric Weber** is an Assistant Professor of Architecture and director of David M. Howryla Design-Build Initiative & Building Technologies Laboratory. He currently teaches the fourth-year Design-Build Studio, and has previously taught third-year design studios, building technology courses, and seminars enabling students to explore conceptual/theoretical genesis for material selection and detailing and temporary installation design/fabrication. Weber is a Registered Architect in the State of Arizona. Many of the professional projects with which he has been associated have been published internationally and have won regional AIA honor awards, including the Nevada Museum of Art (Reno, NV); Hercules Public Library (Hercules, CA); AIA Arizona Citation Award, 2008, TAXI Mixed-Use (Denver, CO); AIA Arizona Merit Award, 2008, and Jarson Residence, Paradise Valley, AZ (completed 2009), published in *GA Project 103*, *GA Houses 116*, AIA Phoenix Metro Home of the Year, 2009.

- Co-Project investigators

**Dr. Robert F. Boehm** is Distinguished Professor of Engineering and director of the Center for Energy Research (CER). He is a co-principal investigator on a variety of interdisciplinary projects in renewable energy with a focus on solar energy applications, hydrogen topics, and energy conservation. Some projects involve solar power generation from both thermal and photovoltaic approaches, as well as building applications of solar energy and zero energy building design. He is also a PI on an innovative project for establishing a hydrogen filling station at the Las Vegas Valley Water District, where both standard and cutting edge methods for hydrogen production will be applied and vehicle conversions to hydrogen fuel are taking place. The Center for Energy Research handles external funding of over \$2M/year and employs nearly 50 students and others in accomplishing its mission.

**Alfredo Fernandez-Gonzalez** is an Associate Professor of Architecture and the director of the Natural Energies Advanced Technologies (NEAT) Laboratory at UNLV. His research areas include energy efficiency; green design; passive and low-energy heating/cooling systems; and water harvesting, treatment and reuse systems. He has been recognized with awards such as the U.S. Green Building Council-Nevada Chapter Leadership in Research Award, the Architecture Research Centers Consortium Best Architectural Research Paper of the Year Award, and an American Institute of Architects-Las Vegas Chapter Design Citation Award. Fernandez-Gonzalez received a Bachelor in Architecture degree in 1993 from Universidad La Salle in Mexico City and a Master in Architecture in 1999 from the University of Oregon.

**Pramen P. Shrestha**, PhD, PE, is an Assistant Professor of construction management in the Howard R. Hughes College of Engineering. He has ten years of supervisory experience in the construction of bridges and highways. He also has experience in residential building construction. He is a registered Professional Engineer and has supervised more than 200 workers in the construction of a diverse range of projects. He has hands-on experience on safety issues relating to falls from building construction sites and also high

retaining walls of highway projects. He has more than four years of instructional experience, teaching numerous classes related to construction management and safety since 2007. He has supervised more than 12 construction management graduate students for master theses and projects.

**Dr. Nasser Daneshvary** is a Professor of Economics, a Beam Research Fellow, and the director of the Lied Institute for Real Estate Studies in the College of Business at the University of Nevada, Las Vegas. His prior positions at UNLV include Vice Provost for Academic Resources, Associate Dean of the College of Business, director of the MBA Programs, and chair of the Economics Department. He has been studying house prices in Southern Nevada, and his articles have appeared in top real estate and economic journals such as *Real Estate Economics* and *Journal of Real Estate Finance and Economics*. Recently, he was appointed to the Editorial Review Board of the Realtor® University Research Center, National Association of REALTORS, a Washington think tank. He received his PhD in economics from the University of Tennessee Knoxville. He has taught undergraduate and graduate classes in international, urban and regional economics, econometrics, and in quantitative areas of business and economics.

**Randall Stout**, FAIA, is currently Associate Professor of Architecture at UNLV and he has served as lecturer and adjunct professor at prominent universities including UCLA, USC, University of Texas, University of Arkansas, and Cornell University. He holds architectural licenses in several US states and is a LEED accredited professional. He is the president and principal-in-charge of Los Angeles-based Randall Stout Architects, Inc. Stout's world-wide design experience encompasses museum, housing, civic, public safety, educational, commercial, institutional, industrial, recreational and residential facilities. Known for dynamic forms, state of the art technology and environmental sustainability, his work has garnered national and international attention, earning important awards and numerous publications.

**Deborah Oakley** is an Associate Professor of Architecture. She has education, practice and licensure in both civil and structural engineering as well architecture, and is freely conversant between two disciplines that have historic tensions between them. As an academic, she seeks to bridge this longstanding gap through her research, teaching and service, and has been teaching the principles of structural design to architecture students for fifteen years. She is a founding member and past president of the Building Technology Educators' Society, Inc., the only North American non-profit organization dedicated to the improvement of architectural technology education. She is currently writing a revised edition of *Structure in Architecture*, a seminal text on the subject originally authored by the celebrated Columbia University engineering and mathematics professor, Mario Salvadori.

**Dr. Alexander Paz** is a full-time Assistant Professor of Civil and Environmental Engineering at the University of Nevada, Las Vegas. He received his Ph.D. in Transportation and Infrastructure Systems from Purdue University in 2007. Dr. Paz is a Licensed Professional Engineer in the State of Nevada, and Dr. Paz has worked for projects sponsored by Purdue University, the National Aeronautics and Space Administration (NASA), the Federal Highway Administration, the California Department of Transportation, several local Metropolitan Planning Organizations in California, the Nevada Department of Traffic Safety, the Regional Transportation Commission of Southern Nevada, and the Nevada Department of Transportation. He has been P.I. or Co-P.I. on projects worth more than one million dollars. Dr. Paz' research and teaching are characterized by a multidisciplinary and systems perspective. His areas of interest include Urban Planning, Sustainable Infrastructure Systems, Transportation Economics, Transportation Networks, and Statistics and Econometric Methods.

**Laurie Fruth** is the general manager of UNLV TV. As a faculty member with the Hank Greenspun School of Journalism, she teaches classes in videotape editing and program development. She works with students and members of the campus community to produce original, innovative programming for two educational cable channels. She received an undergraduate degree in medical communication from The Ohio State University and a Master of Arts in Mass Communication from the University of Nevada, Las Vegas in 1983.

- Student Leaders

**Alexia Hsin Chen** is currently pursuing a Master of Architecture at UNLV. She received a Bachelor of Arts in Theatre with focus on scenography and technical theatre from University of Hawaii Manoa in 2007. Originally from Taiwan, she had received seven years of academic training in fine arts by the age of 15, which significantly influences her perspective in architectural design. She has two years of experience working as a student supervisor at the School of Architecture's SimLab, where her primary duties were to oversee and instruct students on the safety and the use of woodworking tools as well as digital fabrication equipment such as the laser cutter and CNC milling machine. In 2010 and 2011, she received AIA Las Vegas Chapter's YWS Award of Excellence for her academic achievement.

**Nicholas Meyer** is currently a graduate student in Construction Engineering Management at UNLV. With over five years of experi-



ence in the construction industry, he has been acknowledged for planning and construction expertise and familiarity with all aspects of project lineage. He received a Bachelor of Science in Architecture from The Catholic University of America, in Washington, DC, during which he developed an interest in green design. Through his continued studies and professional experience, he has been recognized for attention to detail, organization skills and team leadership. His goal is to become a leader and innovator in the construction industry, while excelling on cutting edge world-class projects.

**Noel Williams** is a graduate student in the School of Architecture and comes to the program as a Licensed Interior Designer with degrees in Interior Design and Art History, both from Louisiana State University. Having lived for years in the deep south, transitioning to the arid desert was a lesson in the preciousness of our natural resources that has led to a deep interest in and exploration of the conservation resources in the building industry and built environment. He will contribute additional experience in project management and administration, as well as production and contracting, which will be a valuable contribution to the Team.

**Timothy Albertson** is a doctoral candidate at the School of Environmental and Public Affairs, at UNLV. He holds a Bachelor of Science in Biology and a Master of Architecture, also from UNLV. This diverse background has been complemented by his completion of the Biomimicry Institute's Two-Year Certificate program through which he was deemed a Certified Biomimicry Professional. In 2010, he received both the ARCC King Student Medal for Excellence in Architectural and Environmental Design Research and the UNLV School of Architecture Graduate Design Excellence Award. Professionally, he has created Genius of Place reports for the Mojave Desert, which translate forms, functions and processes shared by flora and fauna into sustainable design strategies appropriate for the region.

**Christian Iusso** is a dedicated graduate student in the Master of Architecture program at UNLV with a focus in sustainability. He is also working to obtain a Graduate Certificate in Solar and Renewable energy by 2013. He is a well-travelled individual, who has experienced a number of different cultures and people around the world. His working experience is primarily in the hospitality industry and also completed a two-month architectural internship he completed in Buenos Aires, Argentina where his family lives.

**Joshua Bielinski** is currently pursuing a Master of Arts in Applied Economics at UNLV. His interest in environmental, social, and economic sustainability stems primarily from his undergraduate emphasis on solar and renewable energy policy. To this end, Joshua was the first student at UNLV to earn the LEED Green Associate credential and also served as President of the US Green Building Council Student Chapter. Later, as a sustainability intern at UNLV, he spearheaded the effort to organize, compile and publish the Sustainability Tracking & Assessment Rating System (STARS) report – for which the university earned a Silver Rating. Current disciplinary focal points include econometrics, urban/regional economic development, and the microeconomics of distributed solar generation.

**Robert Nielsen** currently manages the solar PV program for Bombard Renewable Energy that utilizes a third party ownership model within the State of Nevada. These rooftop solar projects take advantage of both Nevada's SolarGenerations rebate program combined with available Federal Tax Incentives. In 2011 this program will result in the installation of approximately three megawatts of distributed generation for churches, schools and other non-profits. Concurrently, Robert is also the point of contact for utility scale solar projects with regard to initial development issues and project financing. Building on previous experience in mortgage banking and finance, Robert is also pursuing a graduate degree at the University of Nevada, Las Vegas with an emphasis in Solar and Renewable Energy and Energy Policy. Robert was previously a member the Nevada State Office of Energy's Renewable Energy Task Force and has been appointed to the City of Henderson's Community Action Committee on sustainable issues.

## 8.2 Letters of Support

- Senator Harry Reid
- UNLV President Neal Smatresk
- UNLV (Research Office, College of Engineering, School of Architecture, Renewable Energy Programs)
- Council of Excellence, School of Architecture
- College of Engineering Advisory Board
- College of Fine Arts Advisory Board
- Lucchesi Galati Architects
- American Institute of Architects, Western Mountain Region
- Bombard Renewable Energy

## United States Senate

WASHINGTON, DC 20510-7012

November 9, 2011

National Renewable Energy Laboratory (NREL)  
Attention: Rebecca Dohrn, MS 1735  
1617 Cole Boulevard  
Golden, CO 80401-3305 USA

Dear Solar Decathlon committee:

I write today to congratulate the Department of Energy on the successful 2011 Solar Decathlon and to offer my support for the application submitted by the University of Nevada Las Vegas (UNLV) to participate in the 2013 solar decathlon.

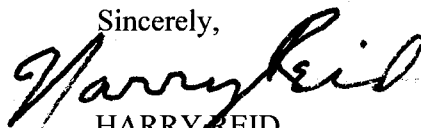
As you know, the Solar Decathlon is not only a competition; it is an event to educate people about the ingenuity of our students and the potential of clean energy while gathering data and valuable experience on building cleaner, more livable homes. The event also serves an important role, as noted by Secretary Chu during his remarks to the winners of the 2011 Solar Decathlon, in showing that our next generation of leaders can rise to the challenges presented by the nation's shared energy and climate problems.

I am confident that UNLV, which has worked diligently to incorporate clean energy into its research and curriculum in partnerships with my office and the Department of Energy, would be a strong addition to the 2013 Solar Decathlon. UNLV also has a variety of on-campus research centers that would support its application including the Center for Energy Research; the Natural Energies Advanced Technologies Laboratory; the Urban Sustainability Initiative; and the Brookings Mountain West Initiative. As you may know, UNLV has established undergraduate and graduate solar and renewable energy programs through its established partnerships with industry, government and academia.

Southern Nevada has some of the top homebuilders in the nation and they could be important partners in scaling up the technologies that UNLV envisions in its application. This could help to increase the impact of the Solar Decathlon by increasing the deployment of net-zero energy homes in the Southwest. UNLV and several high-profile private homebuilders in Las Vegas have already discussed ways that the University's entry home could be showcased or exhibited in the area to continue expanding the message and vision of the Solar Decathlon.

I appreciate your consideration of my support for UNLV's application and I look forward to supporting UNLV's team in the next Solar Decathlon. Please feel free to contact Ryan Mulvenon or Chris Miller of my staff at 202-224-3542 if you have any additional questions.

Sincerely,



HARRY REID  
Majority Leader

November 7, 2011

Dear Solar Decathlon Committee:

It is my pleasure to support the proposal by the University of Nevada, Las Vegas (UNLV) to participate as a 2013 Solar Decathlon Team. UNLV is committed to student success, and co-curricular activities like the Solar Decathlon are excellent opportunities for our students to gain additional skills while working in interdisciplinary teams. UNLV is also committed to sustainability and making Las Vegas known for accelerating the developing of solar and energy efficient building technologies. Our university is home to a variety of on-campus research centers, including the Center for Energy Research; the Urban Sustainability Initiative; the Natural Energies Advanced Technologies Laboratory; and the Brookings Mountain West Initiative. Southern Nevada has also demonstrated strong commercial interest in testing and deploying new solar technologies of all kinds.

UNLV is willing to commit resources to support our Decathlon team in four areas. First, we will actively look for opportunities to integrate aspects of the Decathlon into educational programs – most notably through our Renewable Energy Education Programs (Solar and Renewable Energy Minor and Renewable Energy Graduate Certificate) that are available to students from all disciplines – but also by having faculty use the Decathlon as a learning experience in various technical and non-technical courses in the School of Architecture, Howard R. Hughes College of Engineering, and Greenspun College of Urban Affairs. Second, the Office of University Advancement will support the students in areas of fundraising, marketing, communications, and public affairs. Third, the Division of Finance and Business will assist the team in various areas related to purchasing, facilities, and planning and construction. Fourth, the Division of Research and Graduate Studies will work with the students and faculty to ensure that relevant research from UNLV faculty is used in the competition. Dr. Thomas Piechota, Associate Vice President for Interdisciplinary Research, is already supporting the team members as they develop their proposal and will continue to assist in making this an interdisciplinary effort.

I believe this opportunity will showcase the abilities of our students and faculty in a variety of disciplines, while helping the Department of Energy advance the use of new technologies. Please contact me if you have any questions about the UNLV team.

Sincerely,



Neal Smatresk, Ph.D.  
UNLV President



November 8, 2011

Dear Solar Decathlon committee:

It is our pleasure to financial support the proposal by the University of Nevada, Las Vegas (UNLV) to participate in the 2013 Solar Decathlon Team. UNLV will support the Solar Decathlon Team through a financial commitment totaling \$200,000. The specific commitments are outlined below:

- Vice President for Research and Dean of Graduate College (\$40,000 for Graduate Student support)
- Dean of Engineering (\$40,000 for Graduate Student support)
- Director of School of Architecture (\$60,000 for Graduate Student support and faculty support)
- Associate Vice President for Interdisciplinary Research (representing the Renewable Energy Education Programs) (\$60,000 for Graduate Student and Undergraduate support, and materials and supplies).

We believe this opportunity will showcase the abilities of our students and faculty in the various disciplines, while helping the Department of Energy advance the use of new technologies. Please contact me if you have any questions.

Sincerely,

A handwritten signature in black ink, appearing to read "Ronald W. Smith", with a stylized flourish at the end.

Ronald Smith  
Vice President for Research and Dean of Graduate College

A handwritten signature in black ink, appearing to read "Rama Venkat", with a stylized flourish at the end.

Rama Venkat  
Dean, College of Engineering

A handwritten signature in black ink, appearing to read "David Baird", with a stylized flourish at the end.

David Baird  
Director, School of Architecture

A handwritten signature in black ink, appearing to read "Thomas Piechota", with a stylized flourish at the end.

Thomas Piechota  
Associate Vice President for Interdisciplinary Research

07 November 2011

National Renewable Energy Laboratory (NREL)  
1617 Cole Boulevard  
Golden, CO 80401-3305 USA

Attention: Rebecca Dohrn, MS 1735

Reference: Solar Decathlon 2013

Dear Solar Decathlon Committee:

The Council of Excellence for the UNLV School of Architecture is pleased to support the proposal for the University of Nevada, Las Vegas (UNLV) to participate in the 2013 Solar Decathlon. The Council of Excellence represents the architecture community and supports UNLV in various ways. The Solar Decathlon project is a great opportunity for us to support the students and help them succeed. We understand the need for our nation to rapidly improve the efficiency of buildings and to integrate solar technology into our homes. The Solar Decathlon is an excellent opportunity to accelerate these efforts and to enhance student educational programs related to renewable energy.

UNLV and the School of Architecture have shown leadership in advancing the renewable energy and sustainable building design. The most recent development of the David G. Howryla Design-Build Studio was timely in helping UNLV develop a conceptual design for the Solar Decathlon proposal. We look forward to seeing these efforts to continue to grow at UNLV. We will assist in their fundraising efforts, establishing community contacts, obtaining technical assistance, and promotion of the project with industry and the community.

This is an exciting opportunity for UNLV to show continued leadership in the area of energy efficient buildings. We also see the long-term value in these efforts in terms of economic diversification and workforce development to meet 21<sup>st</sup> century challenges.

Sincerely,



David G. Howryla, AIA  
School of Architecture, Council of Excellence

November 4, 2011

National Renewable Energy Laboratory (NREL)  
Attention: Rebecca Dohrn, MS 1735  
1617 Cole Boulevard  
Golden, CO 80401-3305 USA

Dear Solar Decathlon committee:

It is our pleasure for the Howard R. Hughes UNLV College of Engineering Advisory Board to enthusiastically support the proposal for University of Nevada, Las Vegas (UNLV) to participate in the 2013 Solar Decathlon. We understand the need for our nation to rapidly improve the efficiency of buildings and to integrate solar technology into our homes. The Solar Decathlon is an excellent opportunity to accelerate these efforts and to enhance student educational programs related to renewable energy.

UNLV has shown leadership in advancing the clean energy agenda for the nation. UNLV has a variety of on-campus research centers, including the Center for Energy Research; the Natural Energies Advanced Technologies Laboratory; the Urban Sustainability Initiative; and the Brookings Mountain West Initiative. UNLV is quickly growing the academic and research resources necessary to become a world-renowned center of excellence for solar energy innovation. For the past four years, UNLV has been part of National Clean Energy Summits and most recently the Global Solar Summit.

The College of Engineering Advisory Board has long supported UNLV programs and we are fully committed to ensuring that the UNLV Team be successful in their efforts. We will assist in their fundraising efforts, establishing community contacts, obtaining technical assistance, and promotion of the project with industry and the community.

This is an exciting opportunity for UNLV to show continued leadership in the area of energy efficient buildings. We also see the long-term value in these efforts in terms of economic diversification and workforce development to meet 21<sup>st</sup> century challenges.

Sincerely,



Frederick R. Stater  
Howard R. Hughes College of Engineering  
Advisory Board Chair





November 7, 2011

National Renewable Energy Laboratory (NREL)

Attention: Rebecca Dohm, MS 1735

1617 Cole Boulevard

Golden, CO 80401-3305 USA

Dear Solar Decathlon committee:

The Advisory Board for the UNLV College of Fine Arts is pleased to support the proposal for the University of Nevada, Las Vegas (UNLV) to participate in the 2013 Solar Decathlon. The Council of Excellence represents the architecture community and supports UNLV in various ways. The Solar Decathlon project is a great opportunity for us to support the students and help them succeed. We understand the need for our nation to rapidly improve the efficiency of buildings and to integrate solar technology into our homes. The Solar Decathlon is an excellent opportunity to accelerate these efforts and to enhance student educational programs related to renewable energy.

UNLV and the School of Architecture have shown leadership in advancing the renewable energy and sustainable building design. The most recent development of the David G. Howryla Design-Build Studio was timely in helping UNLV develop a conceptual design for the Solar Decathlon proposal. We look forward to seeing these efforts to continue to grow at UNLV. We will assist in their fundraising efforts, establishing community contacts, obtaining technical assistance, and promotion of the project with industry and the community.

This is an exciting opportunity for UNLV to show continued leadership in the area of energy efficient buildings. We also see the long-term value in these efforts in terms of economic diversification and workforce development to meet 21<sup>st</sup> century challenges.

Sincerely,

Jack A. Rappaport, Chair

College of Fine Arts, Advisory Council

1880 E. Warm Springs Road, Suite 100 Las Vegas, Nevada 89119

(702) 732-7332 (P) | (702) 732-4034 (F)

LUCCHESI | people  
GALATI | process  
place

November 7, 2011

Dear Solar Decathlon Committee:

Lucchesi Galati is pleased to offer this letter of support for the University of Nevada, Las Vegas (UNLV) participation in the 2012 Solar Decathlon. Lucchesi Galati is a cross-disciplinary consulting firm that brings together sociology, sustainable living and architecture to help create tangible, transformational experiences for our clients, their communities and the environment.

Our firm has long-term and extensive relationships within the Las Vegas Community and was integral to inception of the UNLV School of Architecture. In addition to providing employment to interns of the architecture program, we have established a funding methodology through the UNLV Foundation that supports graduate students from such disciplines as anthropology, biology and sociology interested in the integration of their respective field into the build environment. This opportunity has been integral to our firm adopting a business model that prioritizes living systems and human interactions.

To further our commitment to UNLV, we are willing to participate and assist the UNLV Solar Decathlon Team in several ways. First, we will: act in an advisory role as architects to support them in their design process and decision making towards exemplary sustainable architecture. We will assist the Team in the development and execution of an integral project delivery. We will offer assistance in design charrettes, and in the development of an interdisciplinary design process, with an emphasis on building sustainable and beyond. In addition, we will also actively participate in offering design critique, environmental feedback and construction methodology perspectives.

We are excited about this opportunity to support UNLV's Solar Decathlon Team in their goal to provide a high-level exchange of meaning, intention, and learning throughout this process, are equally excited as to what we can learn from the exuberance of the students. The UNLV Team's design philosophy is in alignment with our organizations position of environmental and socially conscious design that enhances the community.

Sincerely,  
LUCCHESI GALATI

Jeff D. Roberts, AIA  
Principal



Raymond J. Lucchesi, AIA

Craig S. Galati, AIA

John A. Haddad

Jeffrey D. Roberts, AIA





American Institute of Architects  
Western Mountain Region Council

November 2, 2011

National Renewable Energy Laboratory (NREL)  
Attn: Rebecca Dohrn, MS 1735  
1617 Cole Blvd  
Golden, Colorado 80401-3305

RE: 2013 Solar Decathlon-Team UNLV

Dear Evaluation Committee Members:

In my estimation there are few teams that possess the rare combination of intellectual and technical aptitude as Team UNLV. The University's learning laboratory is located in the heart of the best solar resource in our nation providing an extraordinary opportunity of design and technological expression as a matter of instructional practice for UNLV.

The State of Nevada has been in a leadership position in the advancement of the solar and renewable energy industries for decades, and UNLV has been at the forefront of these intellectual and technological efforts. As part of the programs at UNLV, the School of Architecture, the Department of Civil and Environmental Engineering, and the Urban Sustainability Initiative offer a unique blend of talent and expertise germane to the solar and green building industries. Having experienced the Solar Decathlon competition I truly appreciate that the most successful teams are ones of interdisciplinary talent possessing a collaborative rigor for achievement, the leadership of Team UNLV is just that!

I write this letter of support as a recognized leader in the solar and renewable energy industries of over thirty years and as a leader in the American Institute of Architects. As the Senior Regional Director of the AIA Western Mountain Region (6 states including NV, AZ, NW, CO, UT & WY) I believe the most ingenious solar design work is being done in our region, and UNLV is at the pinnacle of this work. I would also note there have been only two other schools chosen from our region to compete in the past Solar Decathlon.

Several resources available to Team UNLV include the most recent state of the art solar installations in the nation with Nevada second only to California in deployment and development of solar projects (SEIA). I can say without hesitation UNLV will be the consummate Decathlon team demonstrating exemplary leadership skills and design superiority.

It is for the many reasons cited that I enthusiastically support the selection of Team UNLV as a Solar Decathlon contestant; based on their exceptional leadership, intellectual body of work, and their significant contributions to the state of the industry.

Sincerely,

Richard Licata, FAIA  
Western Mountain Regional Director, The American Institute of Architects  
Professor of Architecture, Truckee Meadows Community College

AIA WMR  
Office of the Regional Director  
650 S. Rock Blvd, Suite 14  
Reno, NV 89502



L 702.492.0957 L 702.492.6090 • 6434 S. Arville Street • Las Vegas, NV 89119 • License #60327  
est. 1982

November 7, 2011

National Renewable Energy Laboratory (NREL)  
Attention: Rebecca Dohrn, MS 1735  
1617 Cole Boulevard  
Golden, CO 80401-3305 USA

Dear Solar Decathlon committee:

Bombard Renewable Energy is enthused to support the University of Nevada, Las Vegas (UNLV) to participate in the 2013 Solar Decathlon. This competition is a great way to highlight the need for the nation to rapidly improve the efficiency of buildings and to integrate solar technology into our homes. In addition, this provides excellent educational experiences to students in the areas of renewable energy.

UNLV and their renewable energy education programs are helping lead the way advancing the clean energy agenda for the nation. Their undergraduate and graduate programs in renewable energy are very popular and some of their students have worked with interns at Bombard. Our company is one of the nation's leading renewable energy contracting companies.

UNLV is also quickly growing the academic and research resources necessary to become a world-renowned center of excellence for solar energy innovation. For the past four years, UNLV has been part of National Clean Energy Summits and most recently the Global Solar Summit. This is an exciting opportunity for UNLV to show continued leadership in the area of energy efficient buildings. We also see the long-term value in these efforts in terms of economic diversification and workforce development to meet 21<sup>st</sup> century challenges. Our organization intends to support UNLV so they are successful in the Solar Decathlon competition.

Sincerely,

Chris Brooks  
Director  
Bombard Renewable Energy