

University of Cambridge

Solar Decathlon Europe 2010 Technical Proposal



The University of Cambridge is pleased to present this response to the Solar Decathlon Europe 2010 RFP

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INTRODUCTION

The University of Cambridge proposes to design and build a modular solar-powered home to meet all the requirements of the Solar Decathlon 2010 brief while simultaneously developing a home that is efficient and effective in the unique environmental, cultural and architectural climate of the United Kingdom. Our proposal is driven by a collaboration of professors and students who teach, research and learn together at the interface of architecture and engineering. We will draw on the many strengths of Cambridge University, including deep ties across the engineering, management and social and economic policy disciplines.

In 2009 the University celebrates its 800th anniversary. The Solar Decathlon will build on a very long tradition of scholarship and teaching that aims to positively influence the surrounding world. In the 1970s The Autarkic Housing Project in the Department of Architecture, Cambridge University was one of the first intensive, critical studies of the possibility of a sustainable house. A team of ten examined the potential of a family house that by relying on solar energy, wind power and biomass for the production of methane for cooking; by collecting and recycling rain water and by dealing with waste with a methane digester had no need to be connected to mains services. Thus, it could be constructed almost anywhere. All of the main lines of the project were to take on a growing importance in the 1990s because of global warming and the need to drastically limit the use of fossil fuels. But tragically, with the death of the founder, Alexander Pike, in 1979 the Project came to an end. Members of the team dispersed around the world where they were often instrumental in taking forward the same ideas (and ideals) of solar energy, wind energy and so forth into both mainstream projects and ongoing research.

Now with over half of the world's population living in urban areas, building sustainable, efficient housing becomes a concern. The UK is already seeking to address this issue via their national Code for Sustainable Homes and other programs instigated by the United Nations Agenda 21, issued in 1992. Knowing that 27% of energy is consumed already by existing housing, this number is expected to rise with population increases and the additional 200,000 homes that are projected to be built across the UK within the next 20 years. We are therefore in a position to take up the challenge of bringing together a variety of streams of research, including the sustainable built environment, natural ventilation, modular photovoltaic systems, and energy efficient design, to ensure new and existing structures do not compound the already limited strain on resources.

Through the Solar Decathlon the Cambridge University team aims to understand not only a more efficient building method, but to understand and capture the overall process so that sustainable building initiatives might be honed to a point of transferability across all disciplines and backgrounds. We look forward to the opportunity to participate in the Solar Decathlon Europe 2010 and continue the collaborations already developed in teaching and research toward sustainable solar-powered housing.

TEAM GOALS

Applied Education: Through the Solar Decathlon project, students and instructors from across disciplines will be able to create a core of shared knowledge that, when applied to a physical goal, benefit the greater educational community. Confronting the entirety of a real project, not one confined to the drawing board, will enable solving complex issues to their fullest extent. Long term intentions have this project being an integrated aspect of the larger curriculum for both Architecture and Architectural Engineering, regardless of the actual competition schedule, such that all levels benefit from this well-rounded experience.

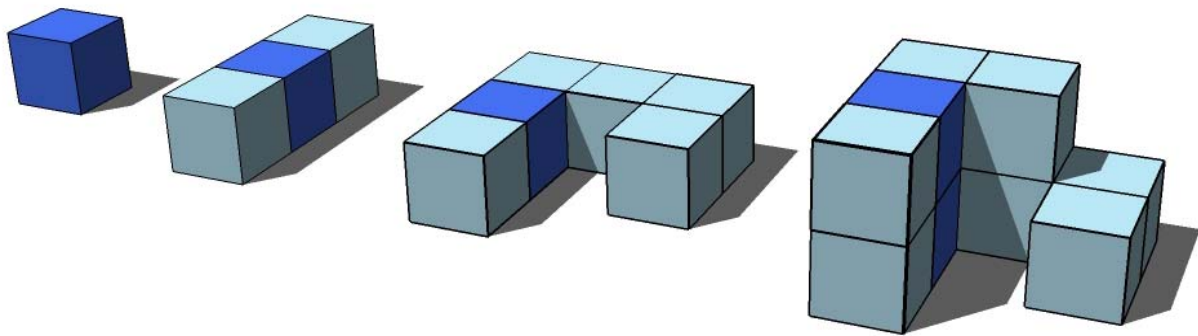
Community Outreach: To enable the participation of as many local entities as possible through contributions of time and resources and a distribution of relevant sustainable education through both the University and City bodies. This will be achieved through sustainability lectures that focus on issues related to the project and open-house programs that invite colleagues and neighbors to interact with the Team during different stages of the planning and building process. After two years of collaboration and commitment the Cambridge Team would benefit from being able to be seen as not only a proud subset of its participating departments, but also a recognizable member of the wider Cambridge Community.

TECHNICAL INNOVATION AND DESIGN

The IDEA Home

The Integrated Design for Engineered Architecture (IDEA) Home is a modular system that can adapt to changing needs and climates. It is prefabricated and offers changeable levels of finish and solar power production and consumption using a variety of “plug and place” wall, ceiling, and floor systems. It is transportable and can be assembled with simple tools, yet has a striking design that can reflect the owner’s taste.

The IDEA Home system is based on a 2.5m cubic module that allows for easy adaptation based on the residents’ daily lifestyle requirements. The most basic option for this system provides for one technical core module and five additional modules of living space. The technical core or service core essentially exists as the living center of the home, containing all mechanical, plumbing, and electrical connections. The additional modules are linked to this creating the livable spaces of the home, enabling easy installation and subsequent alterations to the home. To illustrate the variable nature of the module structure, the competition home will be expanded to include two technical core modules and ten open space modules. It is important to note that the technical core module does not arrive on site fully equipped as a



kitchen, bathroom, and mechanical room, but rather has all necessary connections available for any of these options. In this manner, one technical core module could be connected to a large kitchen, leaving the second module to house a bathroom and mechanical room. Any

entrances into the home or vertical circulation in larger permutations will also take place within this core.

Diagramed in four permutations, the technical module can be expanded with multiple living modules in any configuration, both horizontally and vertically. This will enable the installation of the IDEA Home within urban or suburban regions and minimize the amount of custom parts for easy transportability and sustainable construction. Since the placement of the modules is flexible, this will also allow for existing conditions (geography/climate/urban plan/orientation) and the resident's preferences. Based on current UK housing types, the IDEA Home can be adapted to fit in varying degrees of housing density:

- Density/Row (terrace) Housing – deep plan with sun space and narrow façade
- Single Family/Duplex (semi-detached) – long façade with green space
- Multiple story permutations (for Decathlon single story only, 16' height limit)

Within the structural system, the materiality of all surfaces is changeable and can be plugged into place dependent upon locality, economic levels, interior/exterior, solid/glazing, and time of year. The technical core module, being of a different nature from the space modules, will act as a visual cue for entrance to the home and materially act as a thermal mass and heat sink for the interior of the space.

The flexibility obtained by using modules means a family can expand their home by adding the needed modules and using those recycled by people who downsize their modular house, thereby minimizing the waste of materials and needed energy to heat the house.

Through mass production, the IDEA house will not only be flexible and sustainable but also affordable and readily available. Also, since the carbon footprint of the overall project and energy consumption of the finished home is of concern, the IDEA Home Team will set a benchmark carbon budget for the project which we will endeavor to maintain. This will play a key role in the discussion of materials procurement and assembly options and ensure that products are fully researched and chosen based on their embodied energy and architectural or engineering suitability.

One of the most important features of a modular system is the flexibility that comes with options. The IDEA Home design allows this concept to permeate the entire system, even when dealing with energy production. This modularity will feature in not only the method of energy production, but also in the system implementation. Research projects in Architecture and Engineering will address the development of modular, effective and well-designed systems for structure, envelope and living space.

Much like the structure of the home itself, the PV arrays will be integrated into the home using a set field module. This will allow for easy installation in Madrid, maintenance, and interchangeability with future research agendas when the home returns to Cambridge. Shading is a problem for any home dependent upon solar energy, and PhD researchers in Electrical Engineering are looking specifically at a modular system for PV energy production. This system will allow for a certain shading of PV cells without a detrimental effect on the whole system. In this way, there can be an assurance of optimal efficiency from the non-shaded cells and better overall energy production.

Other research in the University of Cambridge deals with novel photovoltaic cells, power conversion electronics for connecting solar cells to the distribution network and the power

system planning and stability implications of having distributed micro-generation within the distribution system. The particular emphasis on novel solar cells is to develop low energy payback time cells. The ongoing cutting-edge knowledge on novel solar cells will be integrated in the IDEA Home. Integration of PVs into the façade and roof of the IDEA home will be supported by projects and research in Structural and Electrical Engineering.

The computer monitoring system in the IDEA house will continuously assess the solar power available against the energy demands of the house. The load management system will adjust and balance the electricity loads in relation to the detailed observation of the varying uses and weather conditions. Student projects in Computer Science and Electrical Engineering will support the development of the IDEA Home smart backbone.

The IDEA Society will run lecture series on topics related to the Solar Decathlon process, both open to students and people from outside the university. The speakers will consist of a varied group including key business leaders and prominent Cambridge academics to provide an insight into the cutting edge of interdisciplinary research. The speakers will create a dynamic forum which provides opportunities for information exchange and meaningful networking among the participants.

The Departments of Architecture and Engineering have been neighbors in Cambridge for many years, and the Solar Decathlon will now create a much longed for bridge of collaboration between the two learning environments. This proximity to each other and to the project site will generate greater student interest in the project and enable an easier flow of knowledge across disciplines.

Full scale mock-ups and construction of prefabricated IDEA Home elements will be done within the Architecture model shop and Engineering research labs. Moving projects from one space to the other for manufacturing or storage will also be easily managed due to their close proximity. When larger construction mock-ups (Spring-Summer 2009) and final assembly of the home (Fall 2009 and Spring 2010) commence, the construction space will move to occupy part of the exterior parking lot between the two facilities. The construction in this space will take place only during non-term periods of the summer and will therefore not interfere with any parking requirements of the departments involved.

This close proximity will also make creating a construction site office unnecessary, facilitating easy access to all project materials and limiting distance between all project personnel. Students will have access to all amenities of both the Architectural and Engineering Department and be able to reach the site through standard Cambridge transport: the bicycle.

Target Audience

With 200,000 houses aiming to be built within the next 20 years, the quickly expanding metropolitan suburbs and urban communities of the UK/Ireland are in need of sustainable, affordable, readily available housing that can accommodate varying household sizes and economic levels. The IDEA Home design will accommodate fluctuating communities and adjust for household requirements. The target 'site' for the Cambridge IDEA Home will be determined through the system of integrated classes working on the Solar Decathlon during the Michaelmas Term this autumn. Students from every degree level and associated disciplines will be able to experiment with the parameters of the project and determine through design which location will provide the most intriguing challenge for the group to address with the competition home. This method of selection will enable the students to become fully committed to a project that they themselves helped to craft from its inception.

Transportation

Designed using an easily assembled, modular scheme, the IDEA Home will pack compactly for shipping to Madrid, Spain. From England, the IDEA Home will sail down to the coast of Spain where it will be driven overland to Madrid. This process will use normal methods of shipping which would be used for delivery of an IDEA Home to any potential home owner, demonstrating the transportability of the design. Although the Carbon Footprint of the IDEA Home is of considerable concern, it was determined that in order to fully showcase the potential of our strategy to the target audience, using materials with a low carbon footprint for the market area would be optimal. However, emphasis will be given to designing a light weight structure that will not only be useful in transportation overseas for the competition, but within the target market as well, reducing loads and fossil fuel needs. Our project Carbon Budget will quantify the embodied energy in various aspects of the project so that we can compare the effect of shipping the IDEA project to Madrid with also shipping it elsewhere in the UK.

Assembly and Safety

The IDEA Home will arrive at the Madrid Solar Decathlon site as it would to any prospective housing site, in a series of modular structural pieces and panel in-fills. Built from the ground up, and without the use of a crane, the pre-fitted members will join together easily, using only man power and readily available hand tools. We will design the house and its assembly within UK Building Regulations and Eurocodes. All members of the Cambridge IDEA Home team will be fully trained in Health and Safety and the proper operation of all necessary equipment.

And Next?

Following construction in Madrid, we will reassemble the IDEA Home on the West Cambridge Engineering campus of the University of Cambridge, where it will be in use and monitored for a minimum of 3 years as part of ongoing research into the longevity and realities of sustainable housing and building integrated PVs in the UK. A graduate student or Post-graduate researcher will live in the house and provide data on the building's suitability as a place to live in addition to its performance as an off-grid house. West Cambridge is an integrated research and living community.

FUND RAISING AND TEAM SUPPORT

Although the IDEA goal is to create affordable, ecological, flexible housing, the cost for the Solar Decathlon prototype will be substantial. The design, construction and iterative upgrading of the specially designed parts will be a major expense, and we will lack the benefit of the cost reduction from mass production, which is the inherent potential embodied within the IDEA Home. New solar and other novel sustainable technologies will be integrated in the house, and as the post-construction research is an important part of the project, the house will have to be adjustable for new technologies.

To bring the IDEA project from concept to construction, we expect to need £825,000 in funding and in-kind donations of materials and services over the course of 2 years. Costs for the project include the building cost, marketing, transportation of the house, travel expenses and other costs associated with the Solar Decathlon competition. We base our estimate (elaborated in the attached price/cost proposal form) on the experience of Dr. Choudhary and Ms. Denny, both of whom have previously participated in the US Solar Decathlon.

The Solar Decathlon 2010 exhibition in Madrid coincides with another big event: in 2009 the University of Cambridge celebrates its 800th anniversary. The Cambridge 800th Anniversary Campaign celebrates this remarkable history and seeks to raise £1 billion to help secure Cambridge's reputation as a top-research University. The IDEA team will start the search for funding here. This concurrence of events will maximize the visibility of our project throughout the media. The participation of the University of Cambridge in the Solar Decathlon will be widely advertised in the multiple 800th Anniversary festivities that are planned for 2009.

In addition to architectural teaching and research, faculty organizer Michael Ramage is a Business Fellow with The London Technology Network, which promotes innovative collaborations between universities and industry. They are interested in projects which bring research output into the real world –exactly what the Solar Decathlon aims to do. The London Technology Network also runs the London Innovation Relay Centre which aims to stimulate the exchange of technologies across Europe and want to assist London businesses in promoting their activities in the European market. We intend to help bring these connections to life through donations and in-kind support of Cambridge's Solar Decathlon entry.

Research Services Division (RSD) helps academics at the University of Cambridge to identify, secure and manage research funding from external organizations. They have long-lasting relationships with cutting-edge companies which makes them the ideal body to identify funding opportunities to foster the partnership between companies and academics for mutual benefit. They support the development of relationships between academics and industry, whether these are major multi-faceted collaborations with global companies or simply finding experts for specific one-off projects, like the Solar Decathlon.

For additional external and internal funding, our team will approach such organizations as The Prince of Wales Foundation for the Built Environment and the Cambridge University Active Community Fund. As an educational charity, the Prince's Foundation works to the betterment of the quality of life through teaching and practicing ecologically aware design. The Active Community Fund has distributed over £76,000 to local, national and international community projects over the past year which have educational or social objectives and provide valuable volunteering opportunities to staff and students.

The University of Cambridge has a great relationship with industrial partners helpful in the IDEA process like BP, which maintains the BP Institute adjacent to the Electrical Engineering Faculty, Ridgeons (Lumber products), Romag (Solar Glass). Our Team also has made strides in approaching professional firms such as Max Fordham LLP, ARUP, BuroHappold, Fosters, Infosys, and Ramboll WhitbyBird for offers of not only monetary support but asking for donations of time in terms of expertise throughout the design process. Also the smaller items in the house take a big portion of the budget, for this we count on our contact with companies like AEG and the large retailer John Lewis (Appliances) and Siemens (electrical gadgetry/appliances). Cambridge is the Silicon Valley of the United Kingdom, and probably Europe, and we expect the IDEA House to generate significant interest in vibrant venture capital community, led by technology investor Cambridge Angels.

The sharing of expertise and technology of these companies, as well as the donation of materials or financial support will be very valuable to us. Also the use of facilities will be greatly appreciated. Our sponsors can profit from the Cambridge University research and the implementation of their technologies in an international advertised project, including the important role of the post-construction research.

As we will design and build our home in Cambridge, we will have to transport the house to Madrid. To minimize both energy and transportation costs, we will transport our house in modules which fit compactly into one standard shipping container. For this shipping we are looking for funding and support from international shipping companies.

A new Cambridge University society, the IDEA Society, will be founded, similar to existing societies like ArcSoc and CUER. ArcSoc is the Cambridge Architectural Society; they represent the student body's interest to the department, run lecture series, life drawing and other architectural events. The CUER -Cambridge University Eco Racing- is a team brought together in January 2007 with the goal of creating a Solar Electric Vehicle to compete in the World Solar Challenge in 2009.

CURRICULUM INTEGRATION AND SPECIAL CONSIDERATIONS

The Solar Decathlon is a perfect fit for the University of Cambridge as it will build on the university's strengths in cross-disciplinary teaching and brings together various areas of research. Curricular integration will be in both teaching and research projects. A number of courses will take on the challenge of designing a small solar powered home, and individual research projects of undergraduate and graduate students will tackle specific aspects of solar home design and implementation.

The Department of Engineering is the largest department in Cambridge and one of the leading centers of engineering in the world, renowned for both its teaching and research. The Engineering department wants to address the world's most pressing challenges with science and technology, a perfect fit for the Solar Decathlon so we can embody the latest ideas in design, materials and sustainability. The Engineering Department consists of six divisions, which represent core strengths relevant to the Solar Decathlon Europe:

- Energy, fluid dynamics and turbo machinery
- Electrical engineering
- Mechanical engineering, materials and design
- Civil, structural and environmental engineering
- Manufacturing engineering
- Information engineering

The research centre of the Architectural Department – the Martin Centre – is the longest established architectural research centre in the UK with excellent progress in research regarding sustainable building design. The environmental performance of buildings lies at the heart of the research work covered by this team. Sustainable low-energy design strategies are developed incorporating natural ventilation, passive cooling, daylighting, sustainable construction and renewable energy technologies.

We will use Cambridge University's Solar Decathlon Europe project to pursue research and teaching in PV cells, energy efficient design, modular construction and architectural integration of sustainable technologies. Courses and research projects which will draw on and support the Solar Decathlon include:

Architectural Engineering: Energy Efficient Buildings
(4th year Engineers and 3rd year Architects/Michael Ramage, Allan McRobie and others)

A joint course between Architecture and Engineering in which student teams design low-energy buildings. The Solar Decathlon House will be the design project this year.

Solar-electronic power

(4th Year Engineers/Prof Gehan Amaratunga)

The aim of the course (running since 1998) is to introduce solar electronic power for terrestrial use within a total system context. It covers both the main solar cell types suitable for terrestrial power generation and the underlying physical mechanisms utilized in photovoltaic solar energy conversion and also examines the connection of solar cells to the power system.

Principles of environmental design in buildings

(1st and 2nd year Architects/Dr. Minna Sunikka and Prof Koen Steemers)

This course looks at the questions of the principles of environmental control and functional design, the practical applications of the principles of thermal response, of acoustics, and of lighting in buildings, micro-climate, planning and designing for user needs. The IDEA house could be a perfect case study.

Building Physics

(3rd and 4th year Engineers/Prof Randall Thomas and Dr. Mauro Overend)

The course takes a detailed look at technologies necessary for reducing energy demand in buildings.

Interdisciplinary design in the built environment (IDBE)

(Part-time Masters course)

IDBE draws together inquiring and enthusiastic individuals from all relevant disciplines encouraging them to explore pressing issues that cross the boundaries of conventional specialties. The program is divided in 7 weeks, each of them covering a different topic. During each week, lectures, workshops, seminars and collaborative project work is offered. The short design projects provide an opportunity for students, working in multi-disciplinary groups, to develop design ideas stimulated by material covered in lectures. The IDEA house could be the topic of one week.

MPhil in Environmental Design in Architecture

(Master degree/Prof Koen Steemers and others)

Course topics range from the impact of buildings on the global environment to the quality of indoor environments. The bioclimatic approach to environmental design is taught through architectural, engineering and scientific courses. There is a design studio which can be focused on the optimization of the IDEA house. Students also write a dissertation, which can incorporate a design project such as the IDEA house.

Architectural Design Studio

(Various Architecture Studio Critics)

At the University of Cambridge we aim to integrate our conceptual design studios with the technical requirements of real buildings. The Solar Decathlon house is an ideal project in which to introduce this to the students as a tangible project.

Principles of Construction

(1st and 2nd year Architects/Dr. Minna Sunikka and others)

The actual construction of the house on-site in Cambridge and then again in Madrid will be integrated with ongoing courses in building detailing and construction. We welcome the

opportunity whenever possible to make this hands-on; the Solar Decathlon project will be an exciting opportunity.

4th Year Projects

(4th year Engineers and Computer Scientists)

4th Year (final year) Engineering and Computer Science students design and conduct their own research projects. The Solar Decathlon project is a rich opportunity for 4th Year Projects in Electrical, Civil and Sustainable engineering and software and hardware for smart energy systems in homes.

3rd Year Dissertations

(3rd year Architects)

3rd Year (final year) Architecture students research and write a dissertation on a subject of their choice. Increasingly the focus in the Department is on sustainability in the built environment, so dissertations in this direction can be directly involved with the Solar Decathlon.

Research

Multiple PhDs are carried out in the sustainability field across the University. Integration and collaboration of the IDEA project with this ongoing research is planned. Post-occupancy research of the IDEA home will be part of the funding scheme for the Solar Decathlon and part of research projects.

ORGANIZATION AND PROJECT PLANNING

Organization

The Cambridge University Advisory Team includes:

Prof Gehan Amaratunga

Expert in modular solar energy systems. Research expertise in novel materials and device structures for low cost, high efficiency solar cells.

Dr Ruchi Choudhary

University Lecturer and specialist in Building Simulation with an emphasis on airflow and energy performance of buildings. Dr. Choudhary was a key Faculty member of the Georgia Institute of Technology Solar Decathlon team in 2007.

Dr Allan McRobie

University Lecturer, engineer and mathematician with particular interests in environmental risk, sustainable development and water, energy efficient cities, energy efficient buildings.

Dr Mauro Overend

University Lecturer and façade engineer integrating technology and architecture into current building envelope research.

Michael Ramage

University Lecturer in architectural engineering with a specialty in efficient structural design, embodied energy and construction systems.

Dr Andy Rice

Computer scientist working on the Computing for the Future of the Planet project, which considers the positive impact that Computer Science might have on global issues such as climate change, over-population, famine and desertification.

Prof Koen Steemers

Professor of Sustainable design with expertise in natural lighting and daylight-driven design.

Dr Minna Sunikka

University Lecturer on construction and expert in sustainable housing policy.

Prof Randall Thomas

Sustainable design engineer responsible for the building physics of numerous large-scale low energy buildings in the UK.

The Cambridge University Student body

Through course integration, collaborative workshops over five terms, and a lively new IDEA society, undergraduate and graduate students from all disciplines will be involved in conceptualizing, designing and constructing our sustainable, flexible and marketable IDEA house. The core IDEA team will have weekly meetings to guarantee a coherent team to push the project forward.

The Core IDEA Team will be comprised of Undergraduate students who will be present for the duration of the competition, MPhils focusing on the IDEA Home for their research, and PhD students either working on related research or in an extracurricular capacity. The team leaders will evolve from this interdisciplinary group. Our primary contact, Gillean Denny, participated in the 2007 Solar Decathlon as a student at Penn State University.

Timeline

September 30, 2008

Request for Proposal due

Planning:

Michaelmas term 2008 (October 7 – December 5, 2008):

- Planning and team make-up
- Business and fund raising plan
- Architectural Engineering course: Develop 15 parallel design projects
- October 16: recruitment of undergraduate and graduate architectural, engineering, management and other interested students by presentation in classes (see list integrated coursework)
- Society Fair: promoting of the IDEA Society and the Solar Decathlon on this extremely popular event at the start of term
- Foundation of IDEA society which will organize evening lectures for both students and people interested from outside the university on topics related to the Solar Decathlon Project
- Planning lectures and workshops by IDEA society – starting Lent Term 2009
- Design charrettes
- Develop networks through the London Technology Network, Cambridge Angels, and Cambridge University development office to secure cash and in-kind donations to support the project

Lent Term 2009 (January 13 – March 13, 2009)

- Project allocation (matching students with supervisors) for 4th years engineering students and 3rd year architectural students.
- Design
- Evening Lecture by IDEA Society – every 2 weeks
- IDEA Workshop on design and schematic energy analysis
- Team Website URL
- Ongoing fundraising efforts

January 16, 2009

Design Development Drawings and Project Manual

- Schematic Energy Analysis Report
- Team Web Site URL
- Preliminary Market Viability Report
- Business and Fund-Raising Plan

Easter Term 2009 (April 21 – June 12, 2009)

May 1, 2009

Architectural Model and A-V Media Presentation

- Updated Project Information for Workshop
- Team Web Site Linked to Solar Decathlon Site

Design

Summer 2009:

- Construction Documents and prototypes of building elements and integration with commercially available solar power products

September 11, 2009

Construction Drawings and Project Manual

- Stamped Structural Drawings and Calculations
- Project Summary #1

Michaelmas Term 2009 (October 6 – December 4, 2009)

- Construction Documents
- Society Fair: promoting of the IDEA Society and the Solar Decathlon on this extremely popular event at the start of term
- Evening lectures by IDEA Society – every 2 weeks
- IDEA Workshop on design integration
- Systems integration charrettes
- Course integration:
 - o Solar-electronic power
 - o Principles of environmental design in buildings
 - o Building Physics
 - o Architectural Engineering: Energy Efficient Buildings
 - o Interdisciplinary design in the built environment (IDBE)
 - o MPhil in Environmental Design in Architecture
 - o Architectural Design Studio
 - o Principles of Construction

- University of Cambridge 800th anniversary festivities
- January 2009: Solar Decathlon pre-Event Workshop

Construction

Lent term 2010 (January 18 – March 18, 2010)

- Evening lectures by IDEA Society – every 2 weeks
- IDEA Workshop on construction site safety
- Construction drawings

February 5, 2010

Updated Construction Drawings and Project Manual

- Stamped Final Market Viability Report
- Detailed Cost Estimate
- Comprehensive Energy Analysis Report
- Simulation Input Report
- Project Financial Summary
- Dinner Party Menu
- Project Summary #2

Easter Term 2010 (April 20 – June 11, 2010)

- Evening lectures by IDEA Society – every 2 weeks
- IDEA Workshop on construction topic
- Construction drawings
- House assembly

March 19, 2010

Site Operations Plan

- Safety Plan
- Fire Life-Safety Plan

Testing and Competition

May 27 – June 24, 2010

Solar Decathlon 2010 EVENT

- May 27- June 10, 2010: House assembly and inspections
- June 10, 2010: Finish work and commissioning
- June 10, 2010: Opening ceremonies
- June 11-20, 2010: The competition and public tours
- June 19, 2010: Closing ceremonies
- June 21-24, 2010: House disassembly

July 12, 2010

Construction Drawings and Specifications As Built

- Updated Detailed Cost Estimate
- Updated Simulation Input Report
- Updated Project Financial Summary
- Project Summary #3

CONCLUSIONS

Cambridge University's world-class reputation in teaching and research is well-placed to bring to bear on the interesting challenge of sustainable solar housing. Our IDEA Home combines modular construction and prefabricated components in a compelling solution that is driven by the ongoing expertise, research and teaching in sustainable architecture and building-integrated photo-voltaics. Our proposal offers the opportunity to draw a variety of research organizations within the University into one tangible and attainable project that will showcase and extend our current knowledge. The UK is an important market for and developer of solar products and sustainable development in the built environment. Participation by Cambridge University in the Solar Decathlon can showcase our expertise along side of that of our collegiate competitors from around Europe and the world.

The IDEA Home will develop collaborative links with industry and be engaged with a sponsorship program that will develop and demonstrate the marketable production of a solar-powered home for consumers in 2015. We very much look forward to competing in the Europe Solar Decathlon 2010.

APPENDICES

Resumes Advisory Team

Prof Gehan A.J. Amaratunga

Professor Amaratunga is the head of the Electronics, Power and Energy Conversion (EPEC) Research Group within the Electrical Engineering Division of the Cambridge University Engineering Department. His major research interests include nanoscale materials and device design for electronics and energy conversion, novel materials and device structures for low cost, high efficiency solar cells, power electronics for optimum grid connection of large photovoltaic electric generation systems and integrated and discrete semiconductor devices for power switching and control.

Dr Ruchi Choudhary

Ruchi Choudhary specializes in Building Simulation with an emphasis on airflow and energy performance of buildings. She received her PhD in Architecture from the University of Michigan in 2004, from where she also received her M.Sc. in 1998. Her dissertation, 'A Hierarchical Optimization Framework for Simulation-based Architectural Design', was awarded the ARCC King Medal for excellence in environmental design research. Before joining Cambridge, Ruchi has been teaching building technologies in the College of Architecture at Georgia Institute of Technology in Atlanta, USA. She has also taught in the Sustainable and Environmental Design Unit at the Architecture Association in London.

Dr Allan McRobie

Engineer and mathematician with particular interests in environmental risk, sustainable development and water, energy efficient cities, energy efficient buildings. His research is concerned with the statistical analysis of scientific data, especially when the degree of uncertainty is very high. This is particularly the case with climate change and risk analysis involved with that. Many of the models are incorrect in their assumptions. Issues concerned with Sustainable Development are also of interest to me, especially as related to water: there are two aspects, flood management and water supply such as represented by the Narmada River. Whether or not this should be dammed is a major ethical question, and here lies the real challenge for sustainable development. Education of engineers concerning these issues is of vital importance.

Dr Mauro Overend

Dr Mauro Overend has recently joined the Department of Engineering in Cambridge as a lecturer in Building Engineering Design and a Fellow of Christ's College. He is a chartered engineer and a corporate member of both the Institution of Structural Engineers and the Institution of Civil Engineers and has several years of industrial and academic experience in the fields of structural engineering and façade engineering. Mauro's research interest in façade engineering derives from his PhD on 'The Assessment of Structural Glass Assemblies' where he developed and validated a stochastic methodology for determining the strength of glass elements.

Mr Michael H. Ramage

Architectural designer with expertise in structural design and construction technology. Working as part of a team to set up a Centre for Building Engineering Physics at Cambridge. His work focuses on structural masonry, and on structural design and efficiency for architectural form. The environmental aspect of his work is in exploring new materials for old construction techniques, to replace concrete with less carbon dioxide-intensive materials and

minimize the use of steel, while continuing to deliver stunning and contemporary design to modern construction standards. It also focuses on valuing old technologies and old buildings for what we can learn from them about building for longevity, in Michael's mind one of the key aspects of a sustainable built environment.

Dr Andy Rice

Dr Rice works with Professor Andrew Hopper in the Computer Laboratory's Digital Technology Group. The group's work asks how computer science can help solve global sustainability problems and falls into four main areas. The first aims to help those building large complex models, such as those used in climate forecasting, to be sure that the models actually express their intent, that is their outputs are not affected by programming bugs. Computers use a lot of energy: both in running and the embodied energy in their manufacture. The second aspect of the group's research looks at ways of reducing these energy requirements, such as low power components and devices. The third is about sensing the state of the planet. Monitoring environmental conditions helps to detect changes, measure impacts and improve simulations. The group looks at ways of capturing data and making use of it, while making sure that the sensor network itself has a small impact. Finally, the group looks for ways that technology can offer ways of doing the things we want to do at lower environmental cost. One possibility might be a move from physical to digital products, such as from paper newspapers to online versions. Another might be telecommuting. The group emphasises that the digital alternative needs to be preferable in its own right as well as having a proven lower impact over its life cycle.

Prof Koen Steemers

An Architect whose research interests address the performance of building and urban form, and related issues of occupant comfort and behaviour leading to sustainable and low energy building design. Buildings account for 50% of the energy use in the UK, and cities are the focal point of energy demand. Energy design software has been developed to inform urban building for effective use of lighting, heating and ventilation. The environmental performance of cities has also been examined, leading to an understanding of the effect of urban design parameters such as density, compactness and orientation. Recent work includes design to allow for adaptation to climate change, as well as an analysis of occupant perception and behaviour, which will relate to planning strategies.

Dr Minna Marjaana Sunikka

Registered Architect with an interest in energy efficiency of buildings and policy making. She is interested in the energy performance of buildings, leading to questions such as whether it is better to renovate or demolish older buildings. She also has an interest in the policy instruments used by governments to implement appropriate actions. Her research includes the theory of architecture and how concepts related to environmentally friendly designs can be incorporated into the form of a building, not just into the infrastructure (such as heating and cooling systems).

Prof Randall Thomas

An engineer with a degree in architecture and with an interest in the interaction between the built and the natural environment. He is currently The Royal Academy of Engineering's Visiting Professor for Building Engineering Physics at the Department of Engineering. Randall Thomas is a practising engineer with an interest in sustainable urban design and the use of renewable energy sources, specialising in the linkages between architecture, biology and engineering. He brings the rigour of physics and engineering approaches to a study of both man-made and natural environments, and is the author of a number of books on the

subject of sustainable design. He is currently working principally on setting up a centre of excellence for building engineering physics in the Department of Engineering.

Resumes Student Team

Gillean Denny

After completing her MPhil in Environmental Design at Cambridge University, Gillean is currently working on her PhD in the same field. She has participated in the US Solar Decathlon 2007 as the Lead Architectural Designer for the Penn State University team, where their Morningstar Home placed 4th. Interested in sustainable building and community initiatives, she has participated in and lead several charity design-build projects including the Montana Strawbale Project (PSU and AIHI).

Fliss Davies

Felicity Davies, third year architecture student, part of ASF-Cam, we are currently trying to get some kind of outreach programme developed with school in which shelter building and other principle of Architecture are addressed.

Letters of Support

RIBA



Royal Institute
of British Architects

Michael H. Ramage
Cambridge University Solar Decathlon Europe Team
Department of Architecture
1 Scroope Terrace
Cambridge CB2 1PX

6 August 2008

Dear Michael

I am writing to express the support of the Royal Institute of British Architects for the Cambridge University Solar Decathlon Europe Team. The RIBA strives to support architectural education in the UK, raising standards and promoting excellence, and advancing our reputation overseas in pursuit of the same aim. The Cambridge University proposal to compete in the Solar Decathlon Europe addresses our mutual goal of encouraging students to apply their knowledge and creativity to pressing **challenges** in architecture for the 21st century.

The RIBA strongly supports your integration of architecture and sustainable metrics within the curriculum for the design, analysis and construction of a solar powered home for the Solar Decathlon Europe, and we wish you well in the competition.

Yours sincerely

Sunand Prasad
President

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INVESTOR IN PEOPLE

R J Mair FREng FRS
Professor of Geotechnical Engineering
Head of Civil and Environmental Engineering

Michael H Rummage
Department of Architecture
Cambridge University



19 September 2008


Dear Michael,

I am writing to express my support for the Cambridge University Solar Decathlon proposal you and your colleagues and students have prepared for the Solar Decathlon Europe 2010 Competition. Your programme for the Solar Decathlon is an initiative that fits into ongoing aims of Cambridge University. Elements of the solar house design and construction will fit in with the direction of our research and teaching in Engineering at Cambridge.

Good luck with the entry, and I look forward to the seeing the project develop with you and your colleagues and students in Architecture and Engineering.

I hope the Solar Decathlon Europe organising body is equally supportive of the proposal.

With best wishes



Professor Robert Mair

Department of Engineering
Trumpington Street
Cambridge CB2 1PZ

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E-mail: rjm50@cam.ac.uk



Professor Koen Steemers
Head of Department
Our Ref: KS 15 22.09.08

Michael H. Ramage
Department of Architecture
University of Cambridge

12 September 2008

Dear Michael

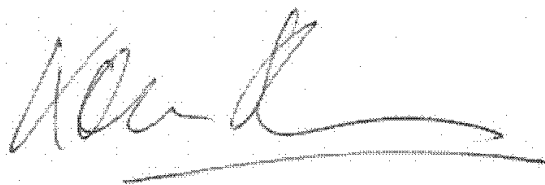
Solar Decathlon 2010

I'm writing to express my wholehearted support for the Cambridge University Solar Decathlon proposal you, your colleagues and students have prepared for the Solar Decathlon Europe 2010 Competition. Your programme for the Solar Decathlon is an initiative that fits into ongoing aims of Cambridge University and the Department of Architecture. We will support your efforts as best we can to assist with the success of this project.

Good luck with the entry, and I look forward to the seeing the project develop with you, your colleagues and students in both Departments of Architecture and Engineering.

I hope the Solar Decathlon Europe organising body is equally supportive of the proposal.

Kind regards,



Professor Koen Steemers

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