



SOLAR DECATHLON

A DESIGN COMPETITION FOR HOMES
POWERED BY THE SUN



HORIZON
Entertainment

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Solar Decathlon

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Civil & Mechanical

PV & Electrical

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Solar Decathlon – Brief Overview

International competition; Organized by the U.S. Department of Energy

First held in U.S.A in 2002; Held biennially since 2005

Accelerates research in the development of efficient houses and systems

Platform to try out a scientific project in real conditions

The procedures invented and applied to the solar house must be viable to industry production

20 teams are selected from across the world

First ever Indian team to be selected in the competition

A consortium of IIT Bombay and Rachana Sansad's Academy of Architecture

SDE 2014 to be held in **June-July 2014** in Versailles, France





















The house is to be designed for local conditions and has to be a high performance prototype for the competition



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Ordre de réception des dossiers / Order of receipt of proposals	Pays	Country	Ordre de réception des dossiers / Order of receipt of proposals	Pays	Country
1	Suisse / Switzerland		22	USA - Allemagne USA - Germany	
3	Espagne / Spain		25	Pays-Bas The Netherlands	
4	Japon / Japan		26	Allemagne / Germany	
7	France		30	Costa Rica	
10	Danemark / Denmark		32	France	
12	Inde / India		33	Italie / Italy	
14	Chili-France/Chile-France		36	Thaïlande / Thailand	
18	USA - France		39	Espagne / Spain	
19	Allemagne / Germany		40	Taiwan	
21	Roumanie / Romania		41	Mexique / Mexico	

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Competition Structure



Contest	Points
Architecture	120
Engineering & Construction	80
Energy Efficiency	80
Electrical Energy Balance	120
Comfort Conditions	120
House Functioning	120
Communication & Awareness	80
Urban Planning	120
Innovation	80
Sustainability	80
TOTAL	1000



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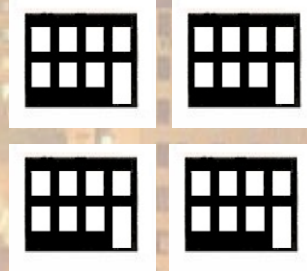
Market Research

Urban population: 340 million now 590 million in 2030



“Climbers & Seekers” – family income 2-5 lakhs per annum

Middle-class households: 22 million now 91 million in 2030



700-900 million sq. meters of commercial and residential space, each year

Direct impact on **77.7 million people**

Representing ~ **23% of urban population**

Team SHUNYA – Mission & Vision

Vision

To reach the utter best in design, structure and operation of energy-efficient and sustainable living habitats for the middle-income households of India

To solve the housing shortage problem through efficient design and quick construction at an affordable cost

Mission

Win SDE Europe and achieve vision by **developing innovations** in the following fields:

Architecture (use of multi-functional spaces)

Passive solar features

Building Energy Management Systems

Solar PV technology

A/C and refrigeration

Building materials

Simulations & Optimization

Building control systems



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Technical Systems Progress



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Team Composition



Technical scope of work divided 7 ways:

1. Architecture
2. Civil
3. Mechanical
4. PV + Electrical
5. Instrumentation & System Integration
6. Sustainability

Energy, Mechanical, Civil, Architecture,
Electrical, Environment, Climate Studies



100 people from disciplines and programs: Professors, Ph.D., M.Tech., M.Arch., B.Tech.



Architecture

Inspired by Vaastu Shastra

Integrating Indian culture into house design

Solar Passive Architecture for minimizing energy demand in house

Promoting confluence of traditional knowledge and modern technology

Specifically designed for hot and humid climate

Resisting heat gain and promoting heat loss through building orientation, roof design, materials, fenestrations, etc.

Integrating architecture and technology to design innovative systems



Civil & Mechanical

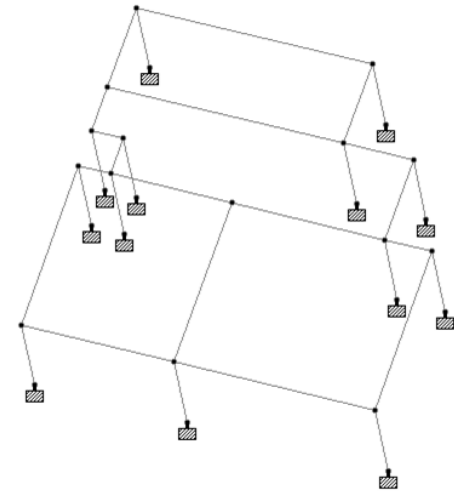
Lightweight, inexpensive, sustainable materials

Window: Double-glazed glass, PVC frames

Wall: Polycarbonate film, aluminium, OSB boards, glass wool

Roof: timber, bamboo, PUF, EPS

Structural options that allow freedom of house disassembly and assembly



HVAC:

solar thermal + vapor compression
Multi-hybrid system
Air heat recovery system

Solar Cooking

Refrigeration:

Solar refrigerator + plus water heater
Adsorption-based refrigeration

Solar Passive:

Radiant cooling; solar chimney

PV & Electrical

PV Technologies analysed:

HIT

CIS

Micro-Morph

Mono-C

Generation over time Vs. Efficiency comparison – Micro-Morph and CIS give better performance results

Load estimation Vs. Weather Data simulation – Average 13 kWh per day usage in competition week

Roof area required for PV estimated at ~ 50 sq. m.

Electrical

DC Vs. AC appliances

Home Electronics

Reduction in house functioning load by 5-6 kWh

Various technologies and energy conservation measures



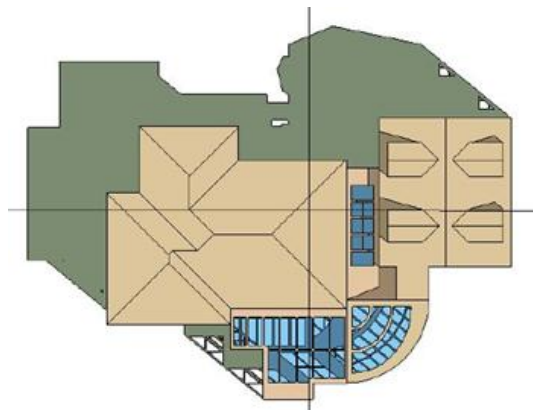
Instrumentation & System Integration

Energy Management System

Washing machine, Lighting,
Dishwasher, Computer,
HVAC, Security system,
Entertainment media, etc.

Building Information Modeling (BIM):
Autodesk; Revit

Building Simulation software:
EnergyPlus; IES

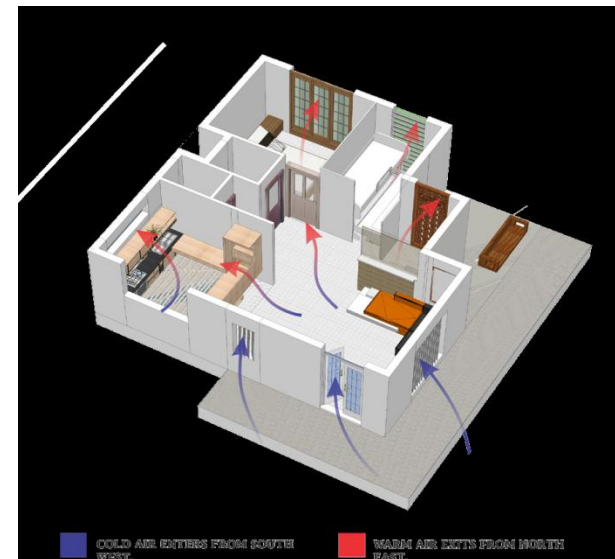


Innovations Potential

Universal Remote Control

Tablet/Phone-based device control app

Different Energy-use modes



Sustainability

In Materials:

Concrete has 25% greater CO₂ emissions than steel

Embodied energy analyses of stainless steel, recycled steel, glass, bamboo

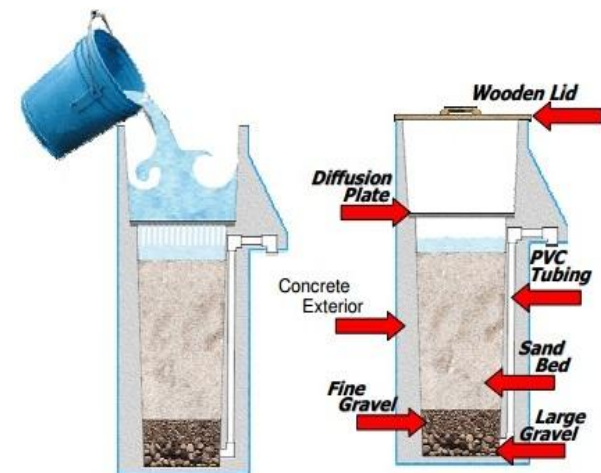


Waste Management Options:

Constructed Wetland; Reed Bed; Sand Filter (Natural systems)

Greywater Heat recovery through Spiral Heat Exchanger

Up to 50% savings in water use



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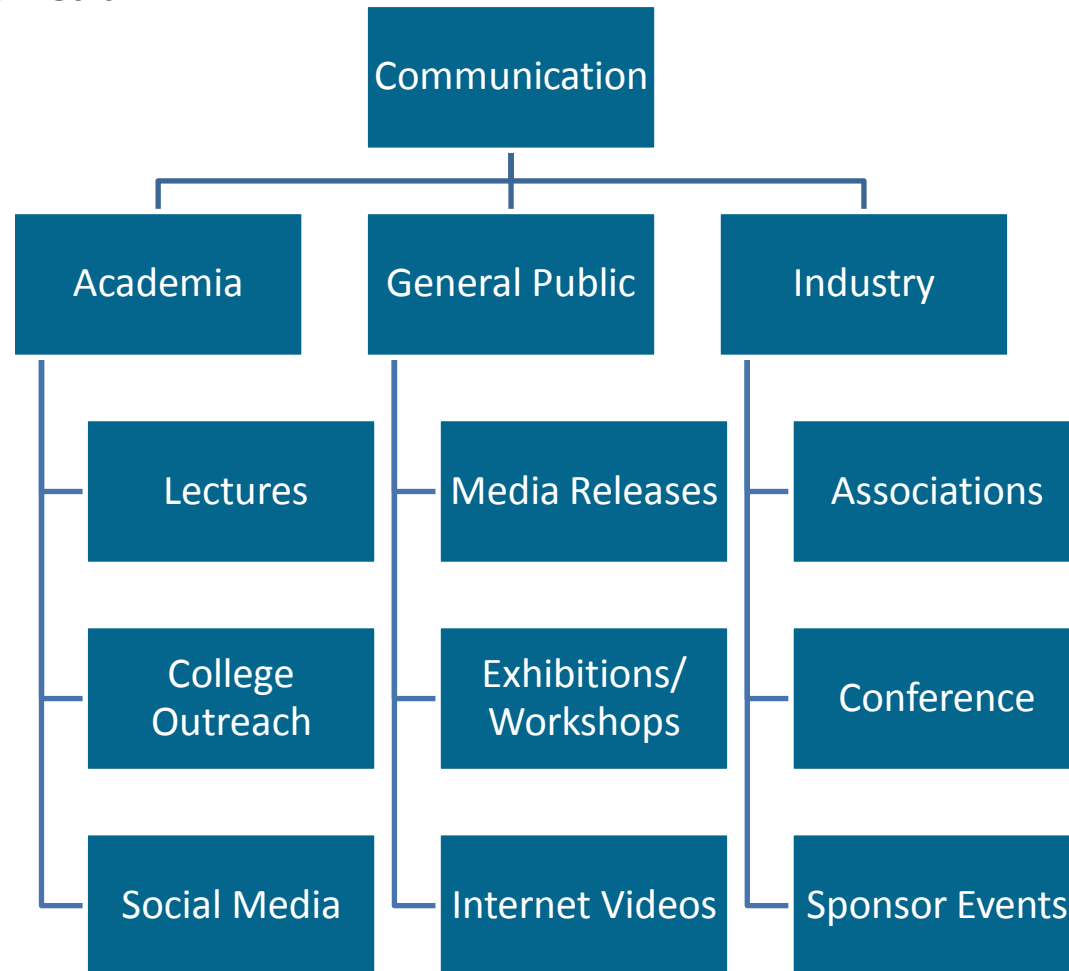
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Overview

The communication is being targeted at three distinct audiences and via different media



Media Plan

Press releases through print media - local and national newspapers, magazines

Online publicity through our own website, Facebook, Twitter, blogs, institute newsletter etc.

Extensive media coverage - **radio and TV**

Development and emphasis of well-defined and distinctly memorable **brand identity and personality**

Team SHUNYA Website Design

City students build a home for future, powered by Sun

MIHIKA BASU
MUMBAI, DECEMBER 21

INSPIRED by Dharavi community design, a group of IIT Bombay and Rachana Sansad students will design a single-storey home over the next 18 months in Mumbai under local conditions. The fully solar-powered home will be taken apart and re-built in France as part of 'Solar Decathlon 2014', a global competition that encourages students to build cost-effective, energy-efficient and attractive solar powered houses.

Twenty teams will participate in the third edition of Solar Decathlon, Europe, conducted by the US Department of Energy. This is the first time that an Indian team has been selected.

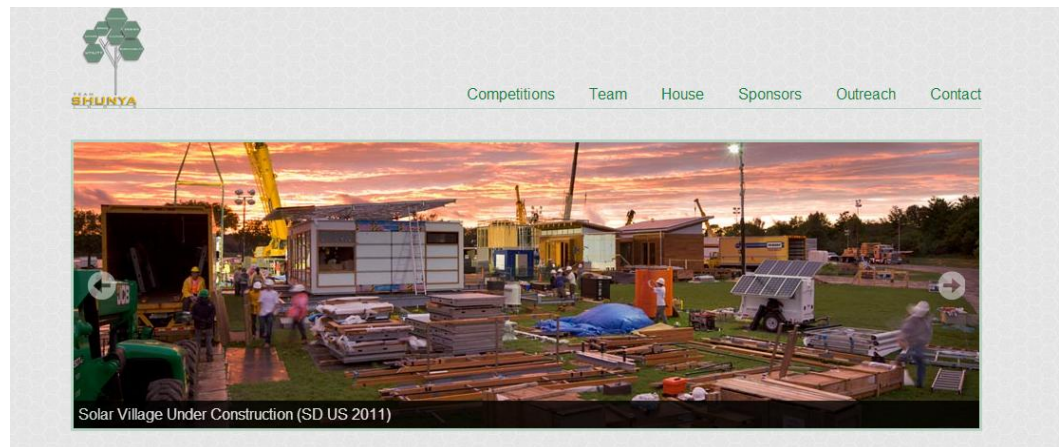
"Our house is a single-storey home designed for a working class family of four to six people. Our team will create

an affordable, sustainable, and quintessentially Indian home. According to a McKinsey report, the number of urban households in India will increase from 22 million today to 91 million in 2030. This growth rate can be sustained only if the new buildings are energy efficient. We aim to produce a sustainable, yet marketable, house for India," Vishnu Chandak, IIT Bombay student, said.

Chandak is part of team SHUNYA, which stands for Sustainable Habitat for an Urbanizing Nation by its Young Aspirants.

While exploring the possibilities of low cost housing, the team found inspiration in Dharavi's slums and adopted traits from it, both at the community- and individual home-level, to develop the basis of a sustainable township. They include super-compact houses, low-rise building clusters with

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Events and Outreach

Presentations to Alumni network of IIT Bombay in December 2012, including reaching out to distinguished alumnus Manohar Parrikar (current CM of Goa)

Workshop for students on sustainability and energy technology through **NMEICT, IIT Bombay with an outreach of 10,000 students** through 278 remote centers

Presentation of posters and brochures at conferences, exhibitions, seminars etc.



Series of lectures/ workshops for sustainable building technology on campus, with 2 lectures already conducted

Exhibitor at Techfest 2014 in an event visited by more than 50,000 college students



Techfest

7th-9th January 2011



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On-Venue Versailles

2 workshops in France

First on March 20-21st 2013

To take place as a part of a
Construction fair ECOBAT in France

Presentation by all teams in front of
construction industry

Special Interview session with media



2nd Workshop in November during
BATIMAT Fair

**Biggest Fair in Europe about
Construction Industry**

Over 200,000 people in attendance

Students; industry executives; investors;
entrepreneurs; government
representatives



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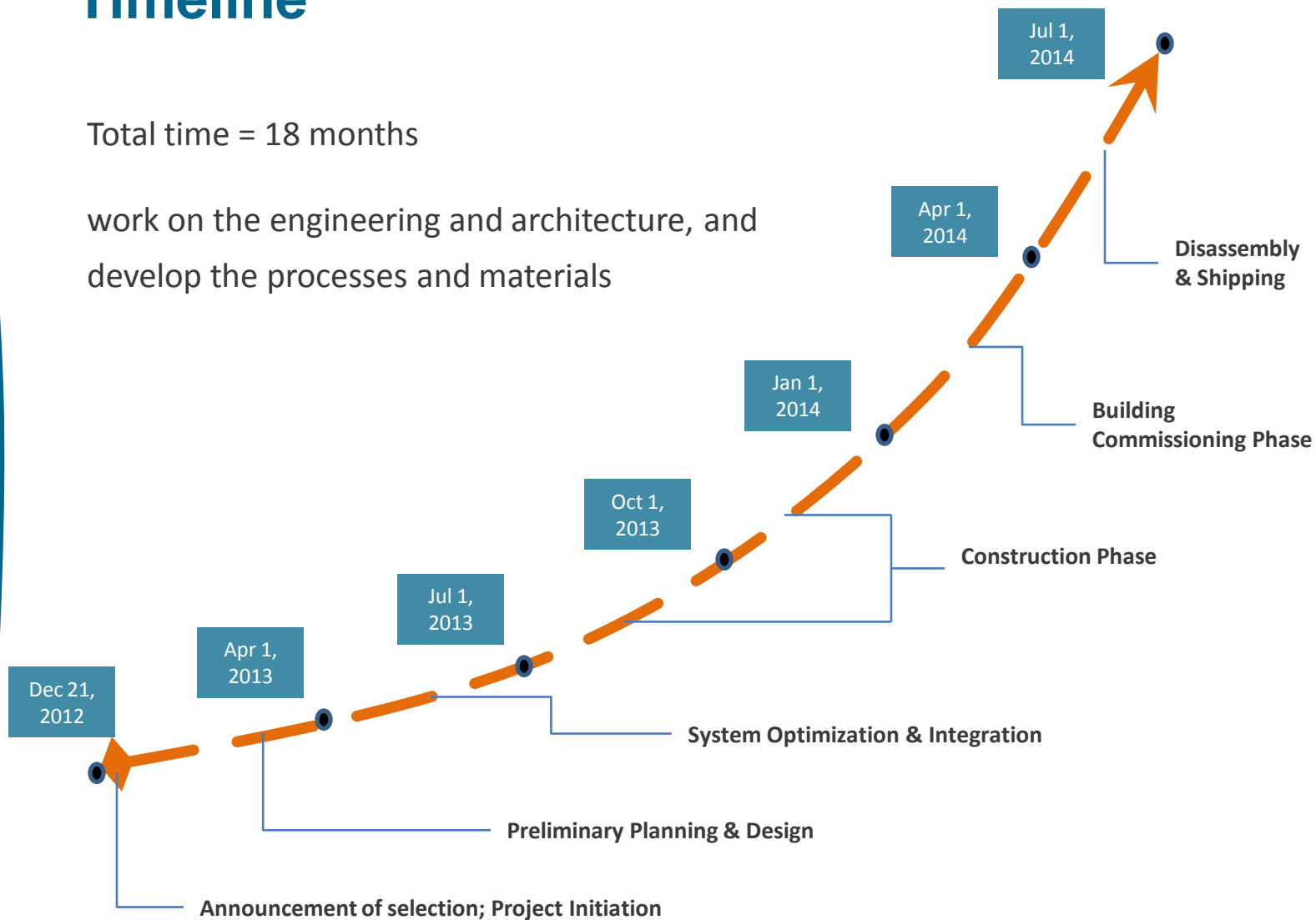


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Timeline

Total time = 18 months

work on the engineering and architecture, and develop the processes and materials



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Project Cost

Building construction	91 Lakhs
Raw Materials	6 Lakhs
Purchased items	73 Lakhs
Model and Communication	8 Lakhs
Liability Insurance	4 Lakhs
Labour and other services	78 Lakhs
Labourers and administrative	35 Lakhs
Consultants	18 Lakhs
Miscellaneous expenses	10 Lakhs
Accident and Medical Insurance	15 Lakhs
Transport, assembly and disassembly	110 Lakhs
Travel and lodging	61 Lakhs
Expenses	20 Lakhs
Assembly and Disassembly	14 Lakhs
Shipping Charges	13 Lakhs
Transport insurance	2 Lakhs
Total	2.79 crores



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Industrialized Cost Estimate

Construction Materials	Cost
Glass (Single Glazed and Double Glazed)	
SIP's and Interior Wall	14,00,000
Steel Frame	
Electrical Connections	
Lighting, Wiring, Cables and Earthing	2,00,000
Plumbing and Water Treatment	
Sanitary Fittings and Water Treatment Equipment	3,00,000
House Functioning Requirements	
BMS	5,00,000
Furniture	2,00,000
PV	8,00,000
Appliances	1,50,000
Total	36,00,000



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Sponsorship Avenues

Title Sponsor	50 lakhs
Associate Sponsor	30 lakhs
Platinum Sponsor	15 lakhs
Gold Sponsor	8 Lakhs
Silver Sponsor	5 lakhs
In-Kind Sponsor - Materials, Training, Equipment etc.	-- --



Motivation

First team ever from India to be selected

First time participation in a competition of this **scale and magnitude**

Aim to increase awareness about green buildings among students and academia

Catalyze **green building research** on campus

An opportunity to gain valuable **hands-on experience in technology development**

Tremendous **exposure** to the best of research in green buildings

The desire to make a change



THANK YOU!!

