

Solar Decathlon Design Challenge

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What is the Solar Decathlon?



The U.S. Department of Energy Solar Decathlon is a collegiate competition, comprising 10 contests, that challenges student teams to design and build highly efficient and innovative buildings powered by renewable energy.



Solar Decathlon Mission



Engage students with sustainable building science and engineering



Advance building science and engineering curriculum



Inspire the next generation of building workforce

10 Contest Categories



Energy
Performance

Engineering

Financial
Feasibility &
Affordability

Resilience

Architecture

Operations

Market
Potential

Comfort &
Environmental
Quality

Innovation

Presentation

Team must do well across all contest to win

Locations of Finalist Institutes



Why Participate?



- Develop critical career skills
- Learn from experts and peers
- Gain valuable insights from world-class thought leaders
- Showcase the future of high-performance building design
- Get hand-on experience and unique training for preparation to enter the clean energy workforce
- Be a part of multidisciplinary teams



What's UTC strength?

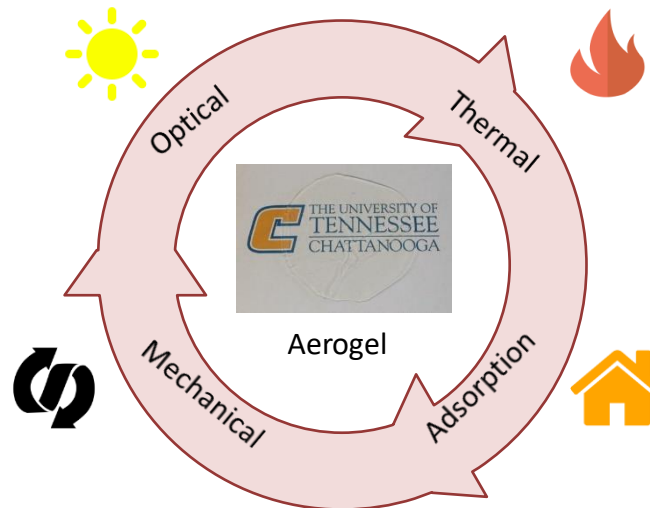


- Innovative building materials available, Aerogel with world best record optical and thermal properties ($< 0.027 \text{ W/mK}$, $> 96\%$ transmittance)
- Aerogel technology \rightarrow future windows + solar panel for heating and hot water + solar oven
- A totally new approach to building design, possible
- Interdisciplinary team: Engineering school, Business school, Interior design

Solar range and oven



Residential HVAC



Solar panel



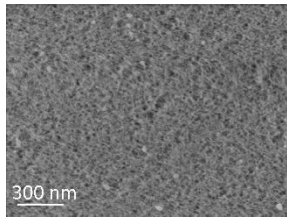
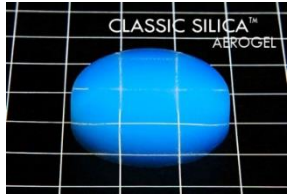
Efficient windows



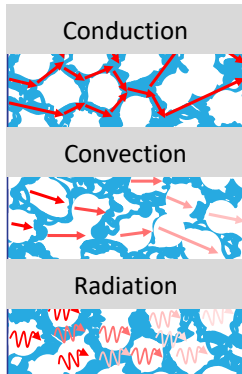
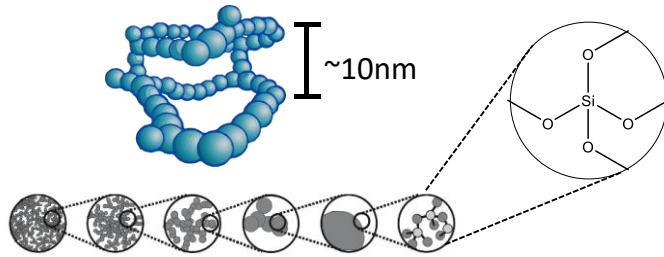
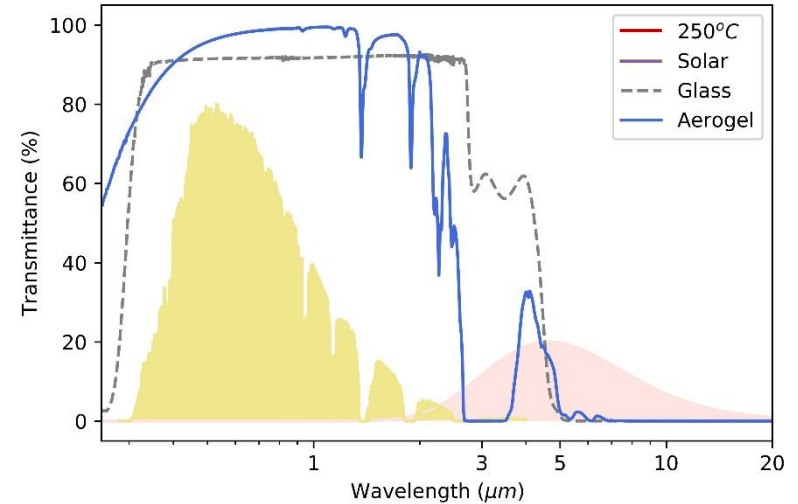
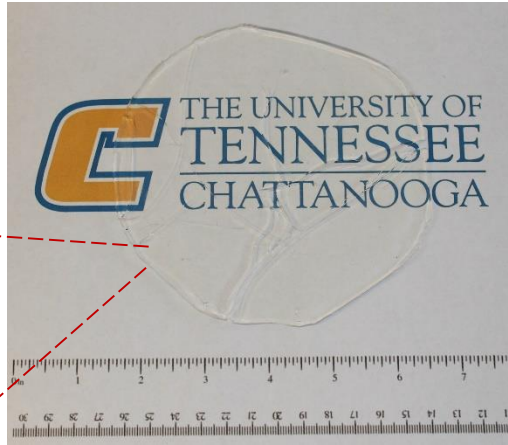
Aerogel = Air Glass = Solid Vacuum



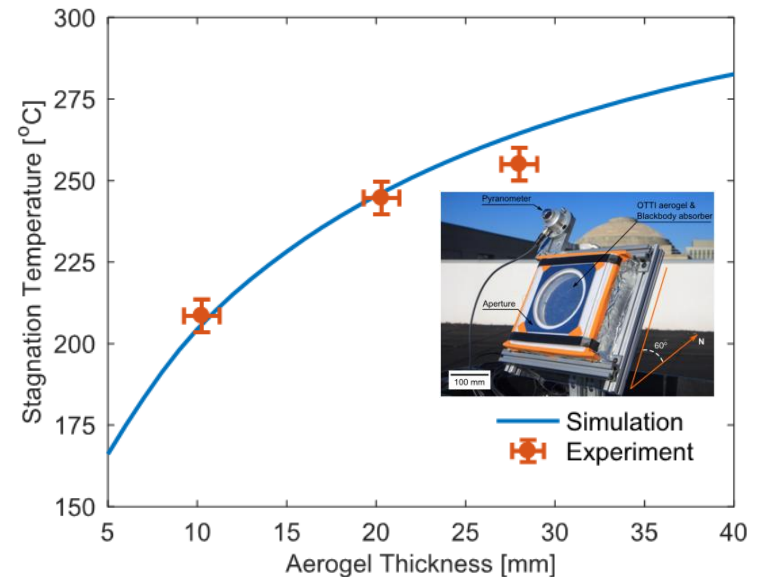
Commercial aerogel



UTC aerogel



- 96% transmittance
cf. 92% transmittance of glass
- 0.027 W/mK, thermal conductivity at 25 °C
cf. thermal conductivity of air \sim 0.03 W/mK



- Stagnation temperature of 250 $^{\circ}\text{C}$ with 1 Sun
- Highest temperature in ambient without vacuum

A Totally New Approach to Building Design



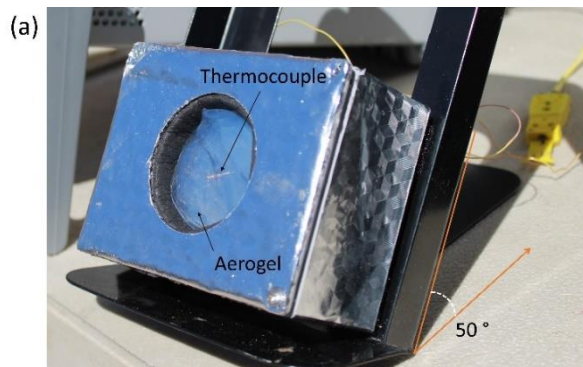
- Glass, Beautiful & Critical building material, but irreplaceable?
- We will look for practical, simple and beautiful energy efficient design



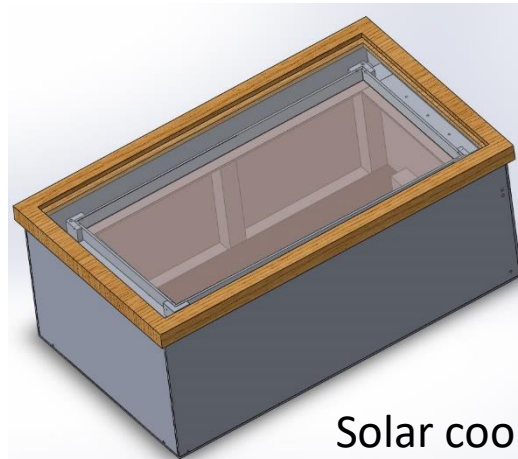
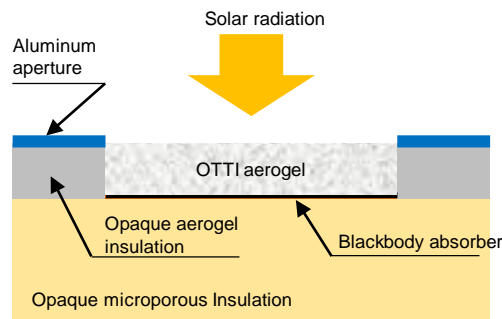
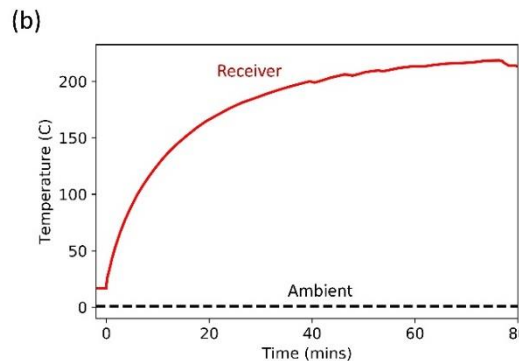
Our Capabilities and Demonstrations



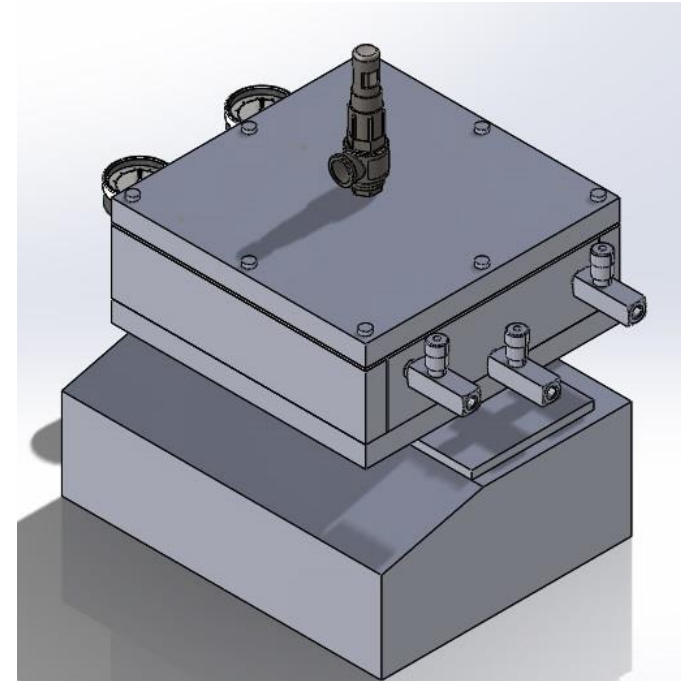
- Customized 10"x10" critical point dryer (bigger than commercialized one)
- Solar thermal receiver (demonstrated $>200^{\circ}\text{C}$)
- Solar cooker (design completed, in progress)



Solar receiver



Solar cooker



10"x10" CPD

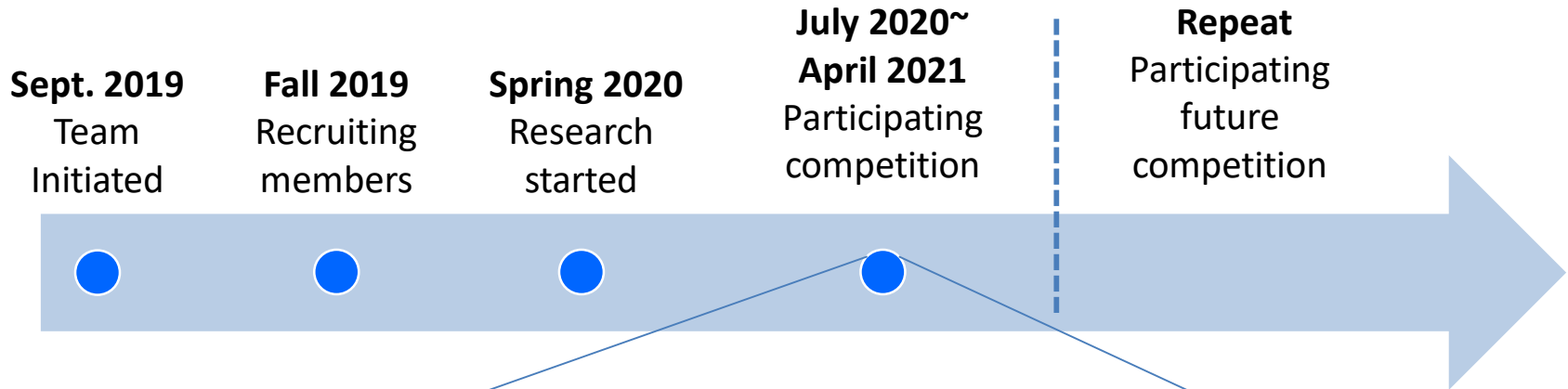
Expected Outcomes from UTC Solar Decathlon



- Participating in DOE's Solar Decathlon competition
- Patentable technology potentially attracting commercial interests
- Promoting Dr. Yang Solar energy related research (possible publications and external funding opportunities)
- Boosting inter-department research at UTC (Engineering + Business + Interior Design)
- Solar energy demonstration for various events (outreach, recruiting, etc)
- Many benefits for engineering students (career opportunity, hand-on experience, interdisciplinary research)



Timelines



Example schedule for 2020 competition

