
A Co-Design Approach to Creating Sustainable Communities

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E-Week: Engineering 4 Kids

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About Me

- Home: Letohatchee, AL
- Status: 4th yr. Ph.D. student in Mechanical Engineering
- Research Focus: Sustainability, Product Design, Expert Systems, Bayesian Models
- Co-founder of Community Assessment of Renewable Energy and Sustainability (CARES)
- Graduation: May 2011

Sustainability Technology

- Some technology solutions:
- Great concern about environmental impacts



Sustainability Technology: Adoption Rates

- Slow adoption by populous

- Common



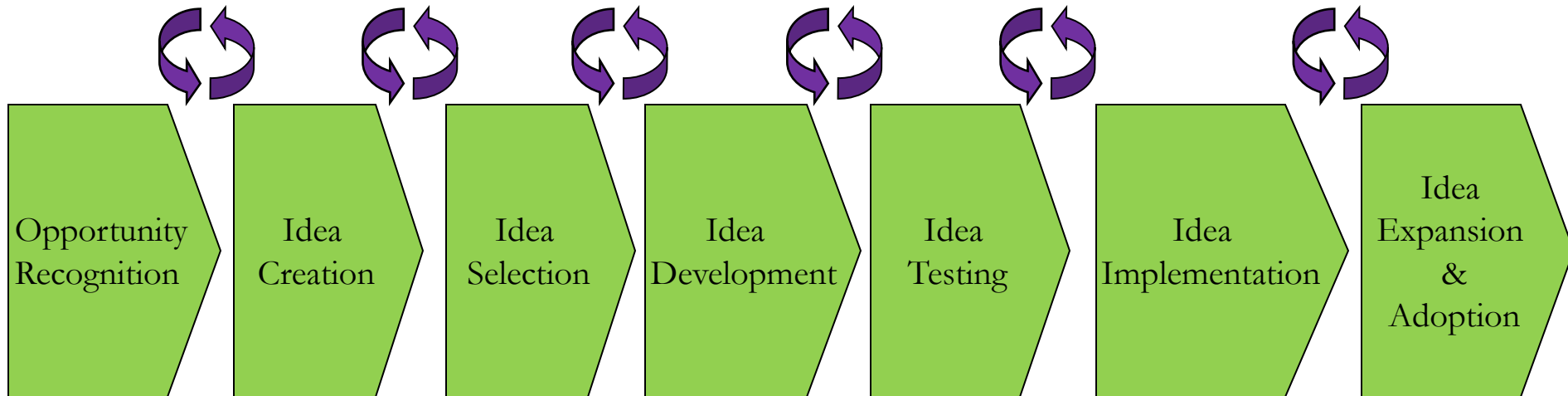
- ~ 90% of US residential sockets still contain incandescent bulbs (1)

- ~ 25% decline from 2007 peak sales level of CFLs (2)

• Source 1: US DOE, CFL Market Profile, March 2009

• Source 2: Richard Karney, Energy Star products manager, letter to C.F.L. industry stakeholders, 09/18/09

New Product Development (NPD) Process



Central Tenets: Technology Driven Design Methodology

- Technology Centered Design focus:

- I. Performance
- II. Reliability
- III. Manufacturability
- IV. Price Points
- V. Time to Market



Central Tenets: Human Centered Design Methodology

- Human Centered Design focus:
 - I. Better account for the end user needs
 - II. Inform design with end user needs
 - III. Maintain performance and reliability



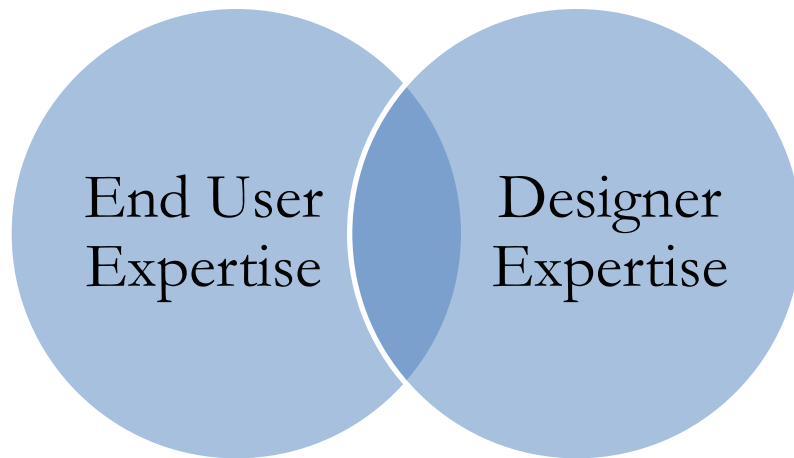
Central Tenets: Co-Design Methodology

- Co-Design focus:

I. End user is expert on needs

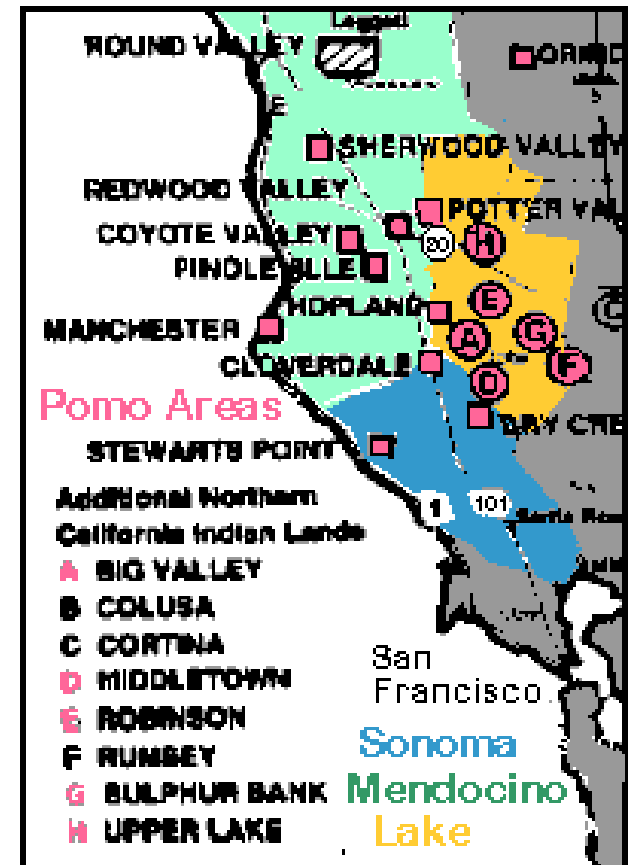
II. End users and designers both control idea creation

III. Idea creation is done in the usage environment



Pinoleville Pomo Nation Case Study

- The Pinoleville Pomo Nation is a Native American tribe located in Mendocino County



The Pinoleville Pomo Nation: Ukiah Parcel

- The PPN's land reserve consists of ~106 acres on two parcels



Initial Meeting: Concerns of the Pinoleville Pomo Nation

- Rising heating and cooling costs
- Drought conditions
- HUD-financed housing provides basic necessities
- No representation of the cultural and traditional values



Pinoleville Pomo Nation and UC Berkeley Partnership

- Engineering 10 is a freshmen engineering design class at UCB
- CARES enables consumers and stakeholders to make informed decisions about sustainability and renewable energy technologies
- Project goal: Assess the needs and design sustainable housing that could be integrated into the tribal community

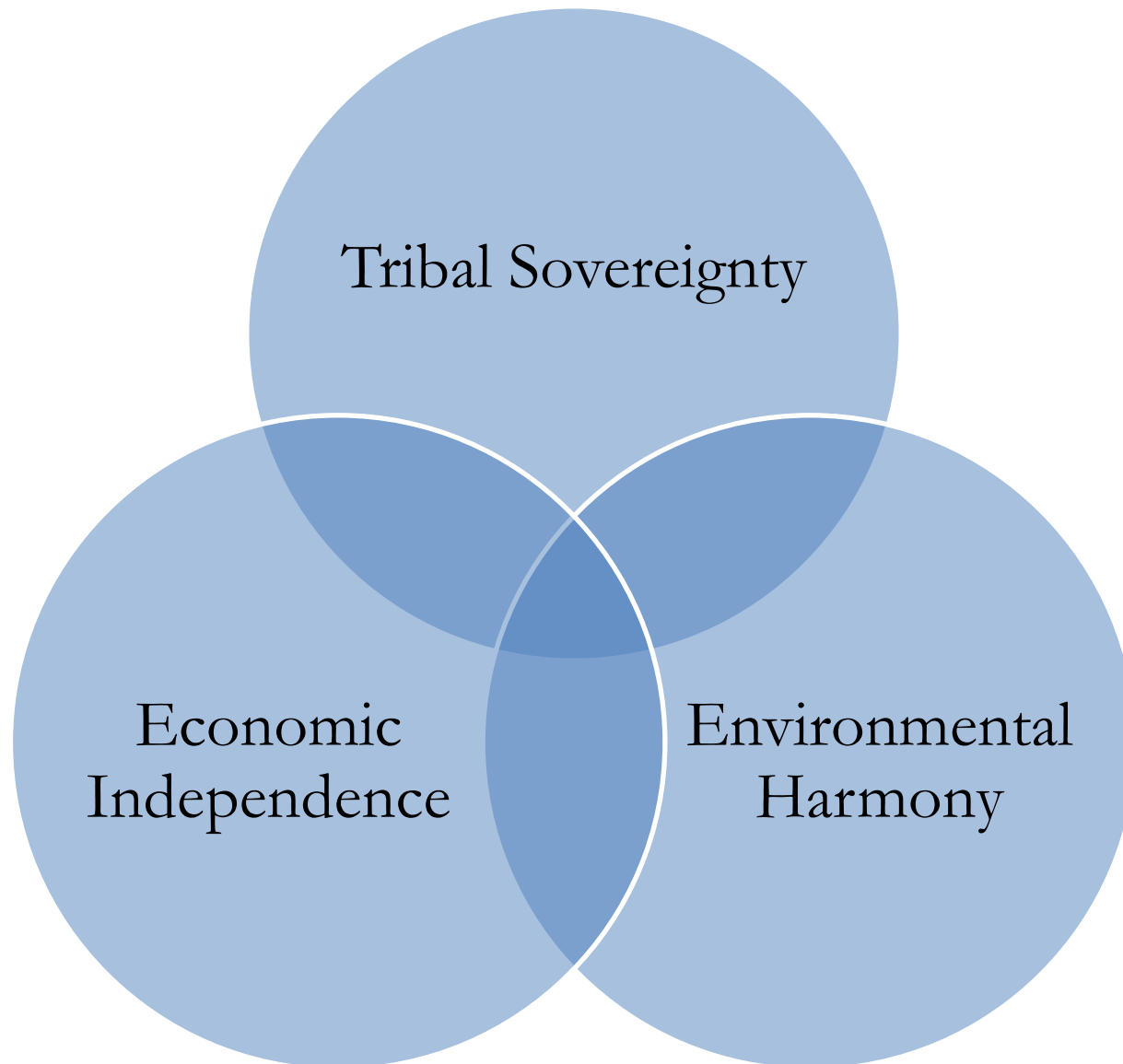


Codesign: Innovation Workshop 2008

- Workshop held to understand needs and brainstorm concepts with PPN.
- Good and Bad Technology Round Robin Session
- Split Group User Needs Assessment Session
 - Elders
 - Adults
 - Youth
- Brainstorming on Conceptual Designs Session



Innovation Workshop 2008: Framing Sustainability

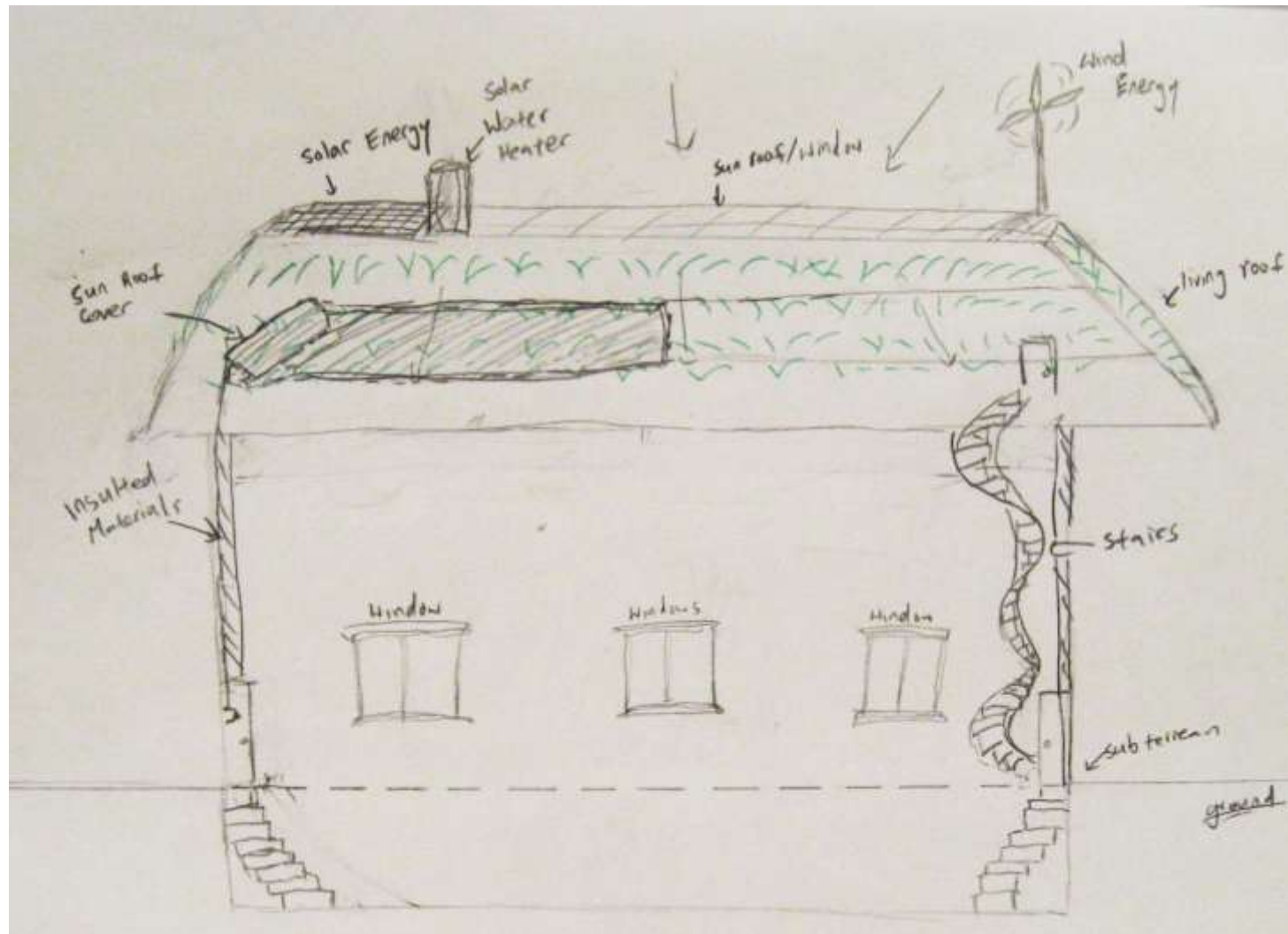


Innovation Workshop 2008: Top Needs and Metrics

- Learn and Use Traditional Techniques (Cultural Values)
 - Round Shape
 - Natural Materials
- Energy Conservation
- Water Conservation
- Privacy
- Exercise
- Storage
- Safety
- Comfort
- Lower Energy Costs
- Space



Innovation Workshop 2008: Co-designed Concepts



Conceptual Home Design 1 with Solar and Wind Power Generation

Innovation Workshop 2008: Co-designed Concepts



Conceptual Home Design 2 Wind Power Generation and Grey Water

Innovation Workshop 2008: Co-designed Concepts



Conceptual Home Design 3 with Grey Water, Wind, and Solar Power Generation

E10: Pomo-inspired Housing Prototype



Outcomes of Innovation Workshop 2008: PPN Quotations

One female resident, Deborah Smith stated :

- *Personally, I really enjoyed working with all of the UCB and CARES students over the one-year project. To see this project go from an original model all the way through to the completed prototype was amazing. The students worked very hard to create this project. They asked a lot of questions and seemed to take genuine interest in our needs, such as: our energy bills and gray water usage, and to keep this project as green as possible.*
- *We had several meetings with the UCB and CARES students and from these meetings they were able to accurately assess and meet our “green” ideas and traditional needs. Because, of this project, I have become very interested in sustainable environments and architecture. I look forward to working with CARES members Ryan and Tobias on future energy feasibility studies and other projects.*

Innovation Workshop 2008: Students' Quotations

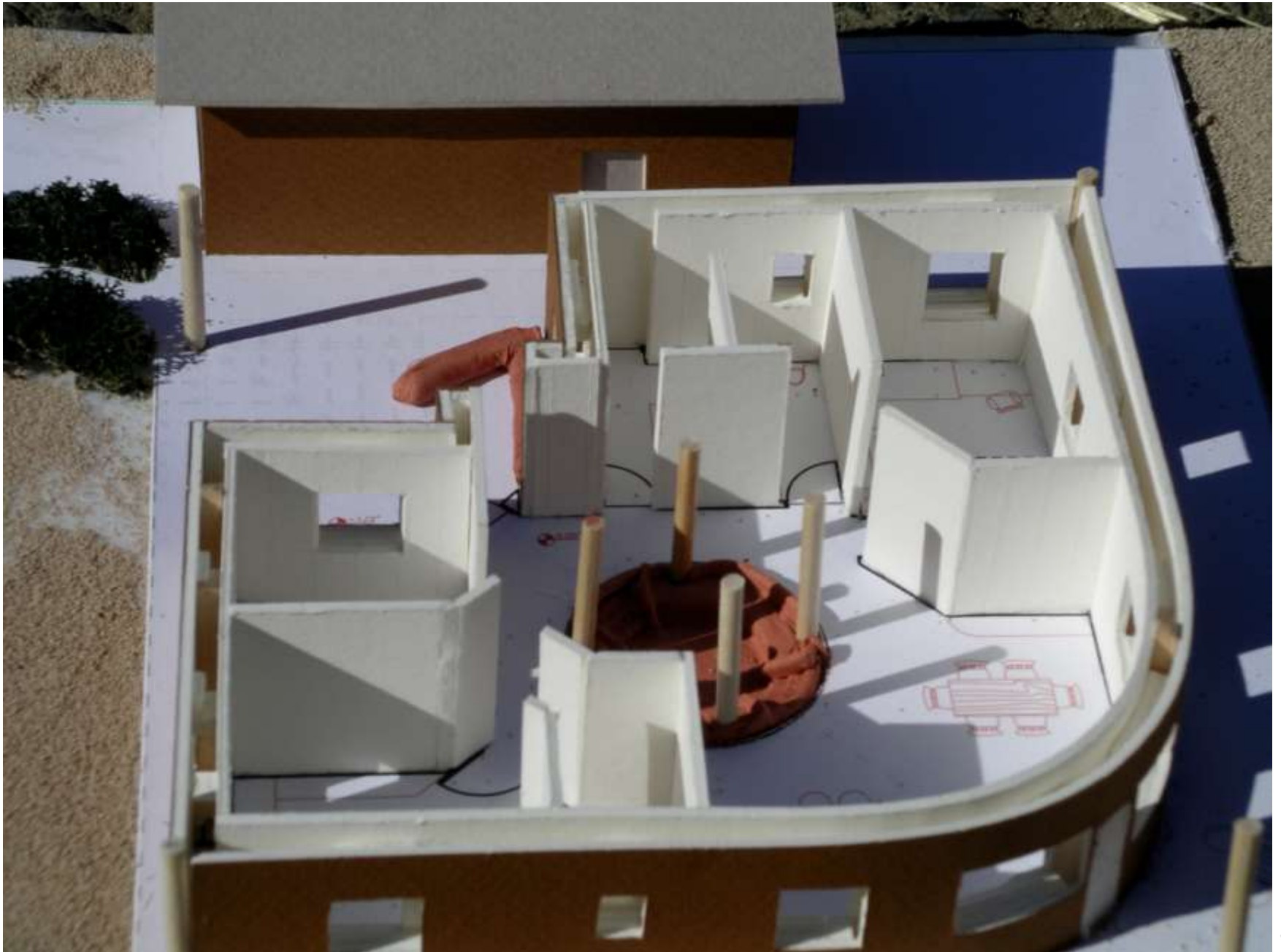
One male, Asian-American student wrote in his design journal:

- *Today was essentially the kick-off for our human-centered sustainable design project. To be honest, I'm rather excited about it. I was assigned to my first choice project - solar electricity generation for the Pinoleville Pomo Indian tribe. I've been interested in alternate forms of energy for a long time, and am eager to learn more about, not to mention have the chance to work on my first genuine engineering project.*
- *Today, we had our innovation workshop at the PPN reservation in Ukiah. Man-where to begin! Overall, I'd have to say the experience was a positive one. I mean yes, it was a bit of a hassle getting there and it was certainly a very long day, but I feel that the knowledge gained about the PPN people and their needs . . . It was a productive/ informative day, and I look forward to beginning the design process with my team mates.*

Final Housing Design: Innovation Workshop 2009



Final Housing Design I: Summer 2009



Draft Plan 'A' for PPN Sustainable Home

Plan not to scale

North is ↑







Outcomes of Partnership

- Empowered the PPN to make informed decisions about various renewable energy options
- E10 students were able to develop professional and communication skills
- Federal funding secured to build culturally inspired sustainable homes and buildings; Construction began in Summer 2009
- DOE funding secured to perform renewable energy feasibility studies: solar, micro-hydro, biomass, etc.

Final Thoughts: Lessons Learned

- There is no one standard for sustainability; merely frameworks
- Sustainability is personal; must be defined by the end user
- Key is to harness the local knowledge within end user group
- Youth have great intelligence and willingness to express views
- Co-design changes the power dynamics to utilize expertise of all
- Co-designing  Solutions  Willingness to Adopt

Acknowledgements

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Q/A?



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