Assessment and Prioritization of User Needs with Native American Nations for the Development of Renewable Energy Systems

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Qualifying Examination

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Date: 2010.12.07 13:55:08 -08'00'

December 6, 2010

Qualifying Exam Committee:
Dr. Sara Beckman (Business, Management of Technology**)**
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Dr. Alastair Iles (ESPM, Sustainability, Native American**)**

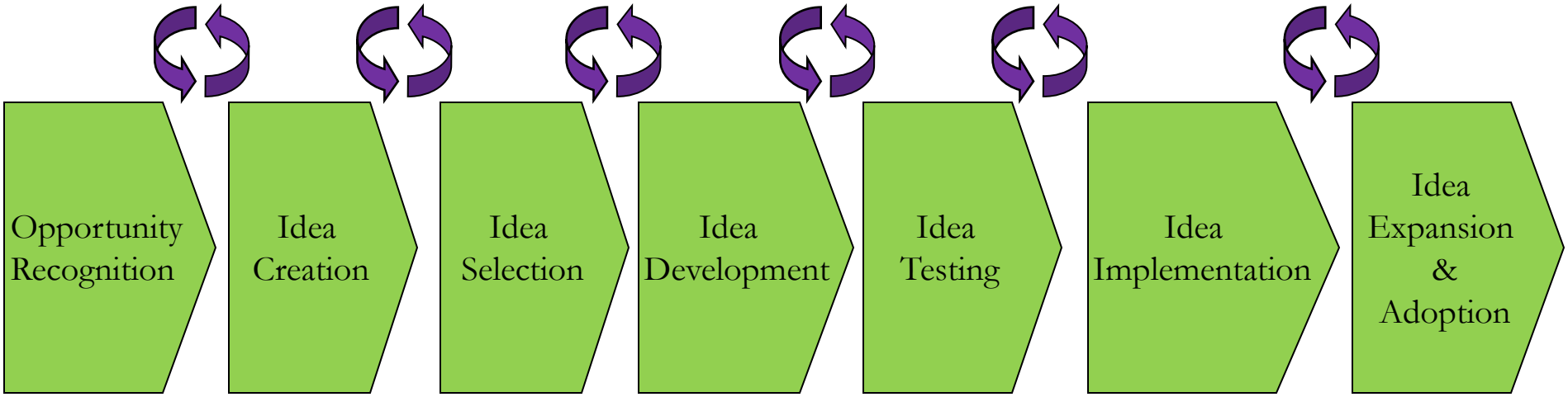
Agenda

- Background
- Motivation
- Research Questions
- Literature Review
- Methodology
- Work Done to Date
- Future Work
- Timeline
- Q/A?

Sustainability Technology

- Some technology solutions:
- Great concern about environmental impacts

Engineering Design Process (EDP) Process Overview



End Goal: Create a product and/or service that the end user will adopt and use

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

Conjecture: The methodology used to create the product results in a product is not designed to meet the needs of the end user

Research Questions Overview

- RQ A:
  - How effective is a codesign workshop in eliciting user needs from a target end user group such as a Native American nation?
- RQ B:
  - How do Native American nations define and frame sustainability?
- RQ C:
  - How effective are prioritization methodologies in establishing the relative importance of needs by target end user groups such as Native American nations?

Ph.D. Proposal Goals

A. Determine if Codesign Workshops are an effective approach for eliciting user needs and brainstorm concepts for Native American communities

B. Determine which prioritization methods are most effective

C. Describe how the codesign methodology worked in these applications (case studies)

D. Describe how one Native American community frames sustainability and if this framework is transportable to other Native American communities (case studies)

Research Questions: Native American Nation Locations

- Current Tribal Partners
- Potential Tribal Partners

Literature Review

A. Defining and Challenging Sustainability
   - "Sustainable Development: An Oxymoron Comes of Age" by Redclift, M. (2005)

B. Measuring Sustainability
   - "Bottom up and top down: Analysis of Participatory Processes for Sustainability Indicator Identification as a Pathway to Community Empowerment and Sustainable Environmental Management" by Fraser, E. et.al (2006)

C. Framing Sustainability in Native American Communities
   - "Hunters And Bureaucrats: Power, Knowledge, And Aboriginal-State Relations In The Southwest Yukon" by Nadasdy, P. (2003)

D. Processes for Generating Sustainability Plans
   - "Scenario workshops: A participatory approach to sustainable urban living?", by Street, P. (1997)

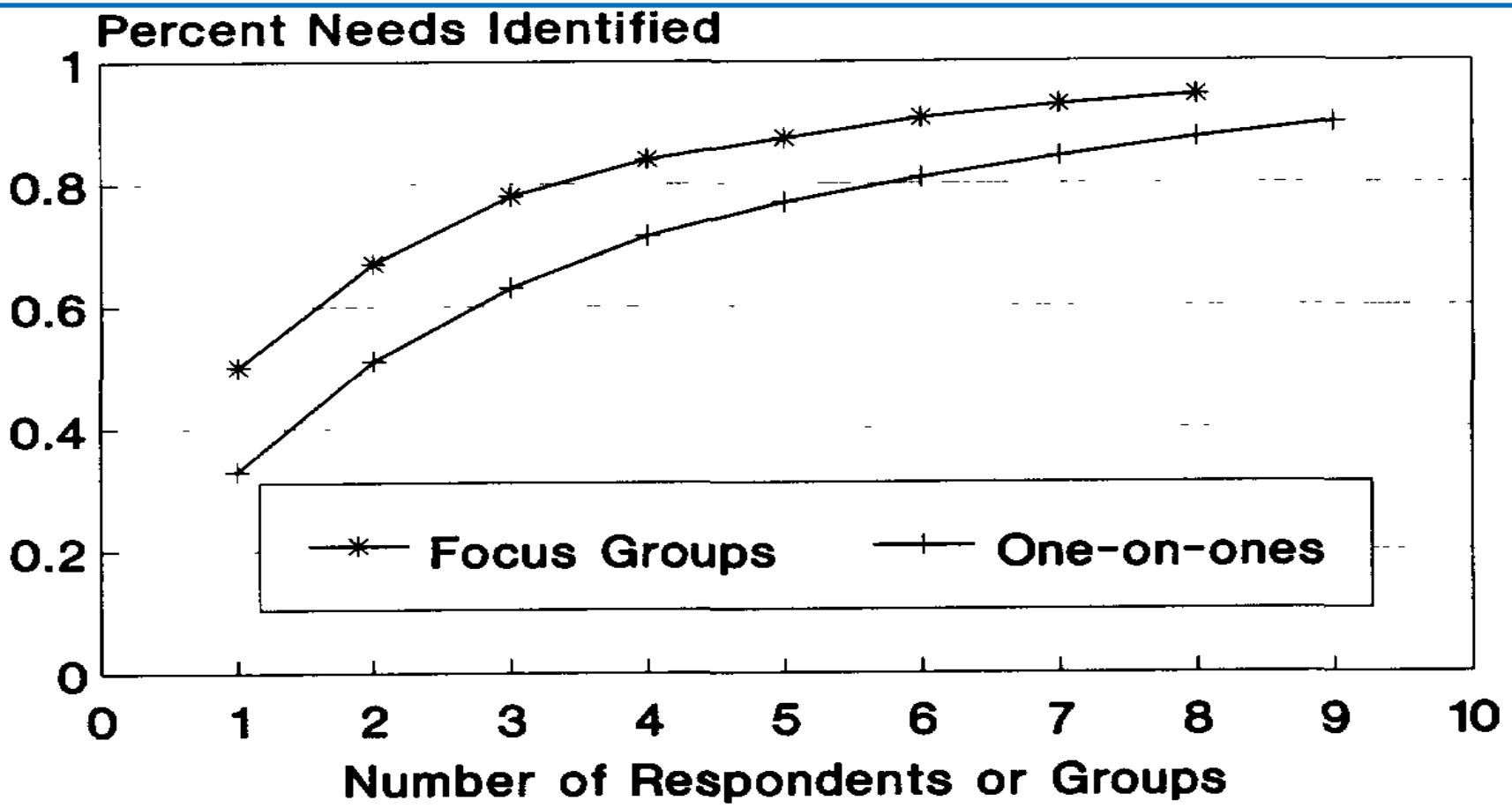
E. Eliciting Users Needs
   - "An Ethnographic Approach to Design" by Blomberg, J, et.al. (2008)

F. Needs Requirements, Hierarchies, and Prioritization
   - "The Voice of the Customer" by Griffin, A., Hauser, J.R., (1993)

Methods and Tools: RQ A

- RQ A: How effective is a codesign workshop in eliciting user needs from a target end user group such as a Native American nation?
  - Elicit end user needs codesign workshops and compile in case study
    - Metric: number of needs generate during innovation
  - Code and plot the number of unique user needs using Grounded Theory
    - Metric: number of duplicate needs
    - Metric: Percentage change in the number of needs generated from the codesign workshops
    - Metric: Qualitative comments about the the codesign workshops
- Grounded Theory
- Does not start with a theoretical framework or hypothesis about data
- Focus is on data collection first, data organization, then the creation of a theoretical framework from the organized data

Methods and Tools: RQ A: Griffin & Hauser's Eliciting Needs



- Main Findings
  - Found 230 needs; 2 one on one interviews (51%) are as effective as one focus group (50%)
  - No 'best' method; determined that both focus groups and interviews are valid

Methods and Tools: RQ B

- RQ B: How do Native American communities define and frame sustainability?
  - Conduct interviews with the tribal council and administration separately from the community
    - Metric: number of needs from the tribal council and administration
    - Metric: comparison of the needs to those of the community; Focus on duplication of needs if any
  - Conduct interviews and meetings with end user to define their concept of ‘sustainability’
    - Metric: Document analysis to look for frequency of words
    - Metric: Qualitative comments from interviews and participant observation
  - Embed the needs gathered in the framework established by the end user group
    - Metric: Qualitative comments from the end user about the appropriateness of how the needs were embedded

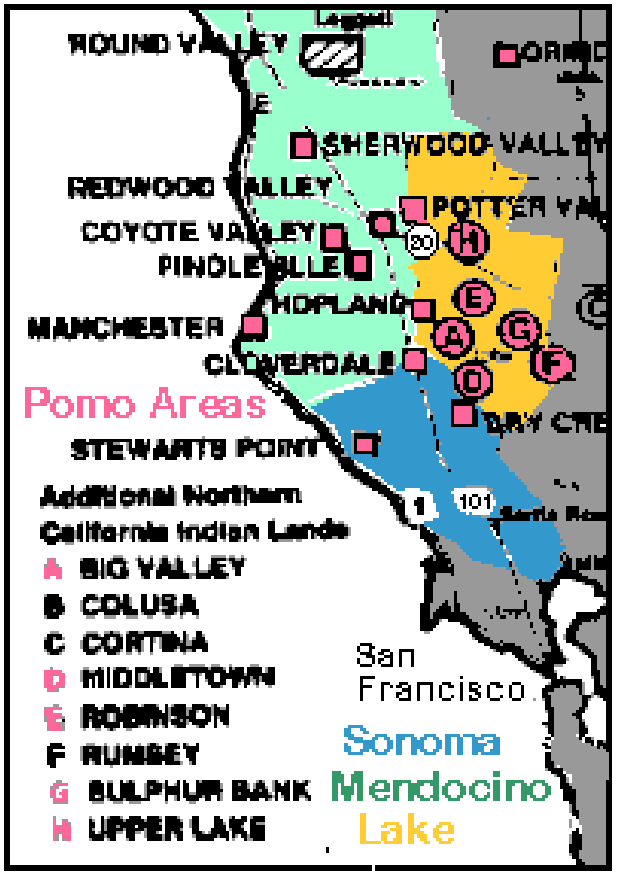
Methods and Tools: RQ C

- RQ C: How effective are prioritization methodologies in establishing the relative importance of needs by target end user groups such as Native American nations?
  - End user will establish the relative importance of the end user needs by directly ranking the needs
    - Metric: Comparison of the weights and/or order assigned to the user needs
    - Metric: Qualitative comments about end user comfort with using the above mentioned methods

- Prioritization Approaches
  - Analytic Hierarchy Process (AHP)
  - Direct Voting Methods
  - Conjoint Analysis

Pinoleville Pomo Nation Case Study

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



Background: Pinoleville Pomo Nation Case Study

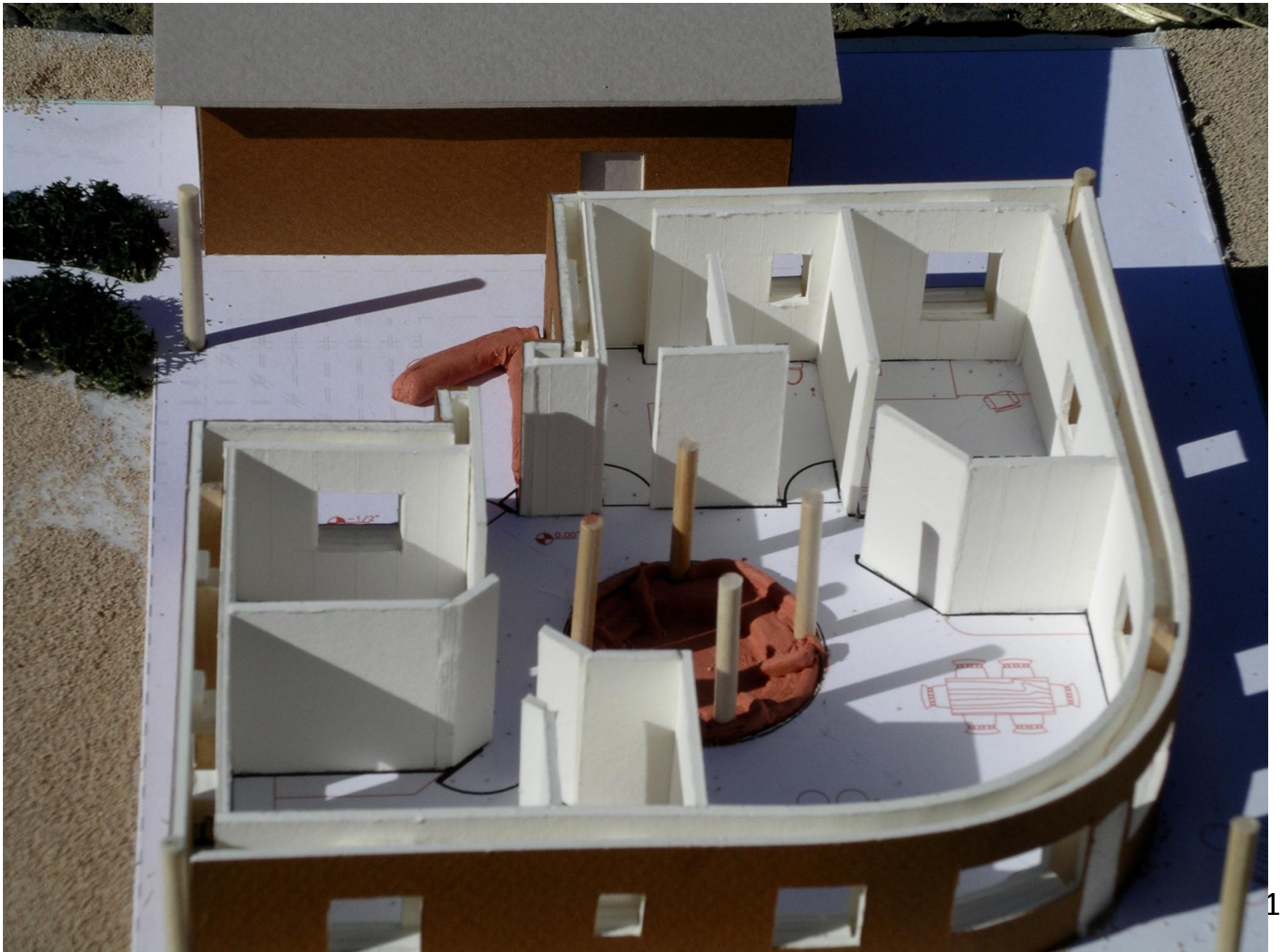
- Rising heating and cooling costs
- Drought conditions
- HUD-financed housing provides basic necessities
- No representation of the cultural and traditional values
- “designing houses that reflect Pomo culture and/or save energy and water”

Background: Pinoleville Pomo Nation Case Study

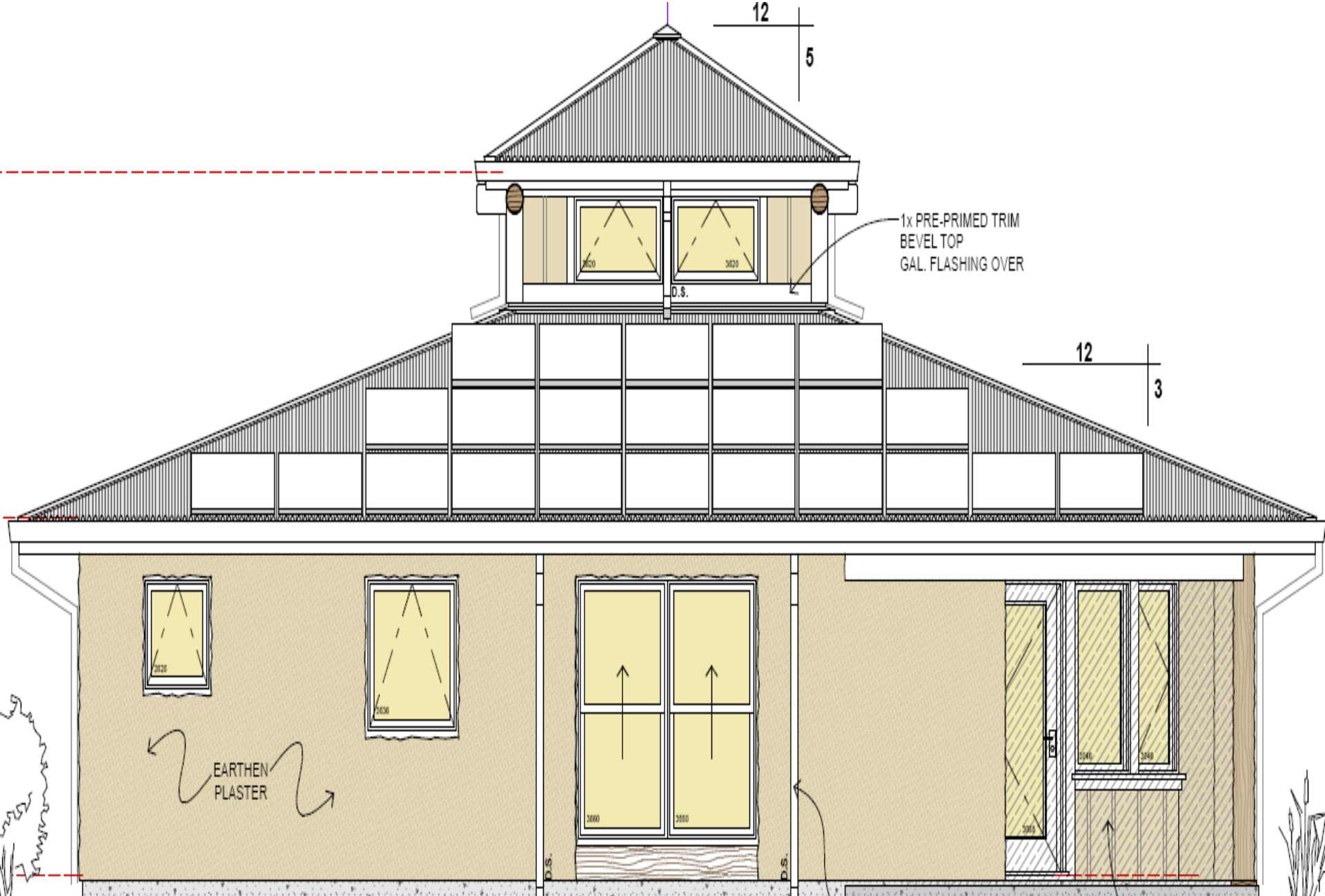
- March 2008: Pinoleville Pomo Nation (PPN) contacted American Indian Graduate Program
- March 2008: PPN and Community Assessment of Renewable Energy and Sustainability (CARES) agree to work on building designs
- May 2008: Pomo inspired home design created
- August 2009: HUD funding secured to build culturally inspired sustainable homes and buildings
- March 2010: DOE funding secured to perform renewable energy feasibility studies
  - Photovoltaic, wind, microhydro systems

Culturally Inspired, Sustainable Home, pt 1

Culturally Inspired, Sustainable Home, pt 2



Culturally Inspired, Sustainable Home, pt 3



Methodology: CoDesign Workshops with PPN

- Workshop held to understand needs and brainstorm concepts with PPN.

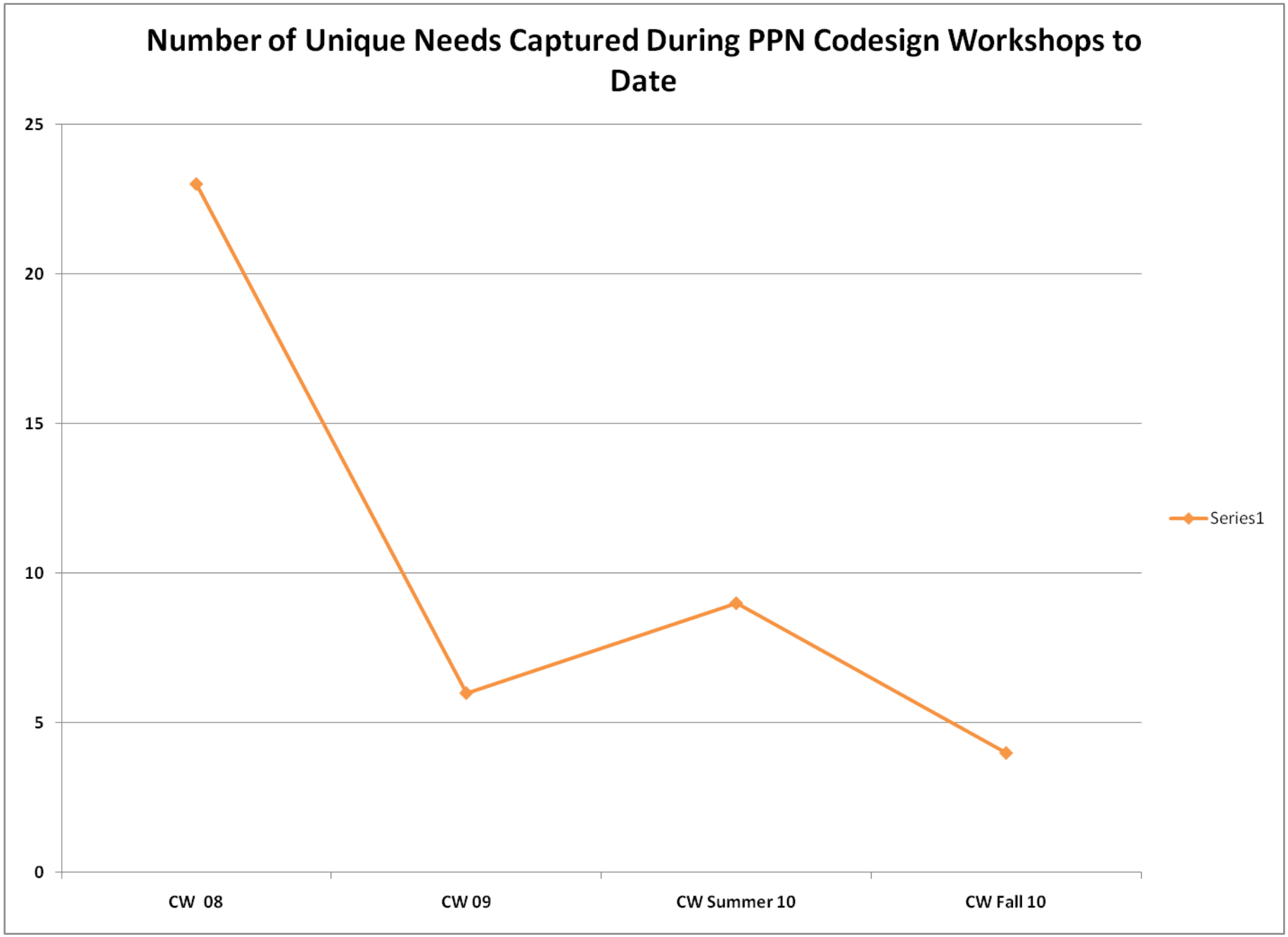
- Good and Bad Technology Round Robin Session
  - No titles; list personal reasons for participation
  - Improve comfort level about technology

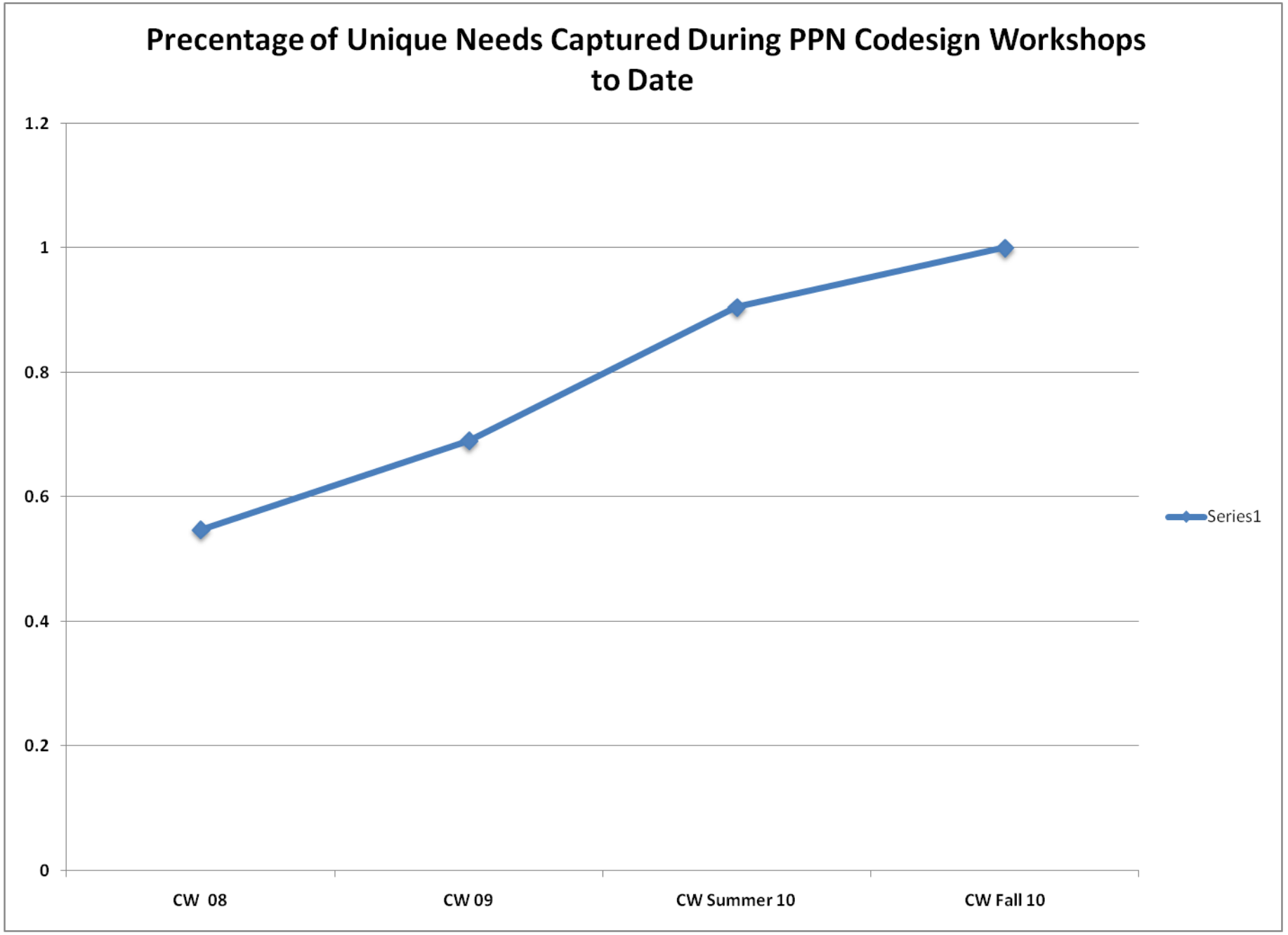
- Split Group User Needs Assessment & Prioritization Session
  - Elders
  - Adults
  - Youth

- Brainstorming on Conceptual Designs Session

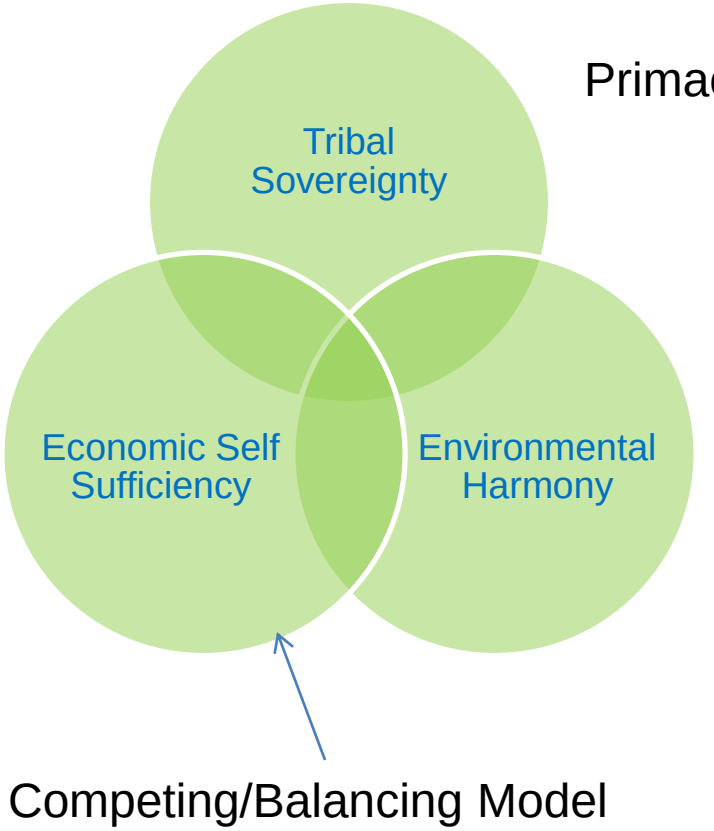
Multivoting of Expressed Needs

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


Number of Unique Needs Captured During PPN Codesign Workshops to Date
25
20
15
10
5
0
CW 08
CW 09
CW Summer 10
CW Fall 10
Series1

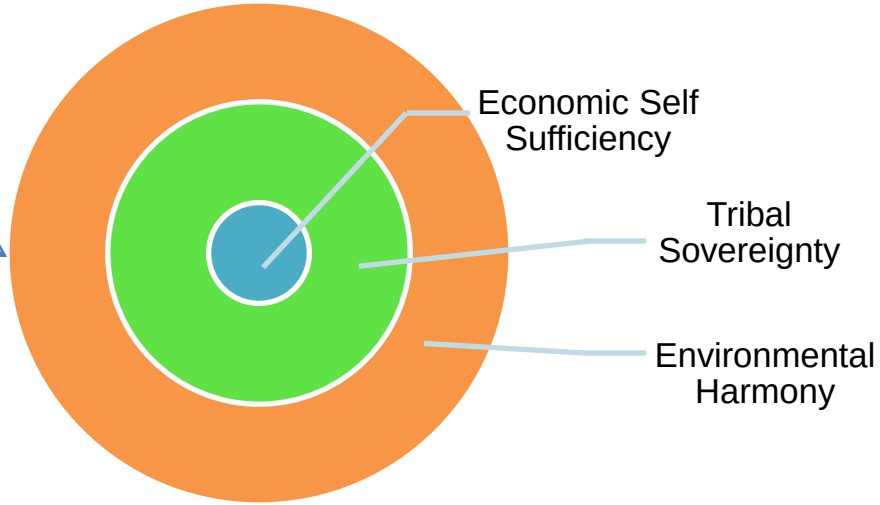

Precentage of Unique Needs Captured During PPN Codesign Workshops to Date
1.2
1
0.8
0.6
0.4
0.2
0
CW 08
CW 09
CW Summer 10
CW Fall 10
Series1

PPN Competing and Primacy Sustainability Frameworks

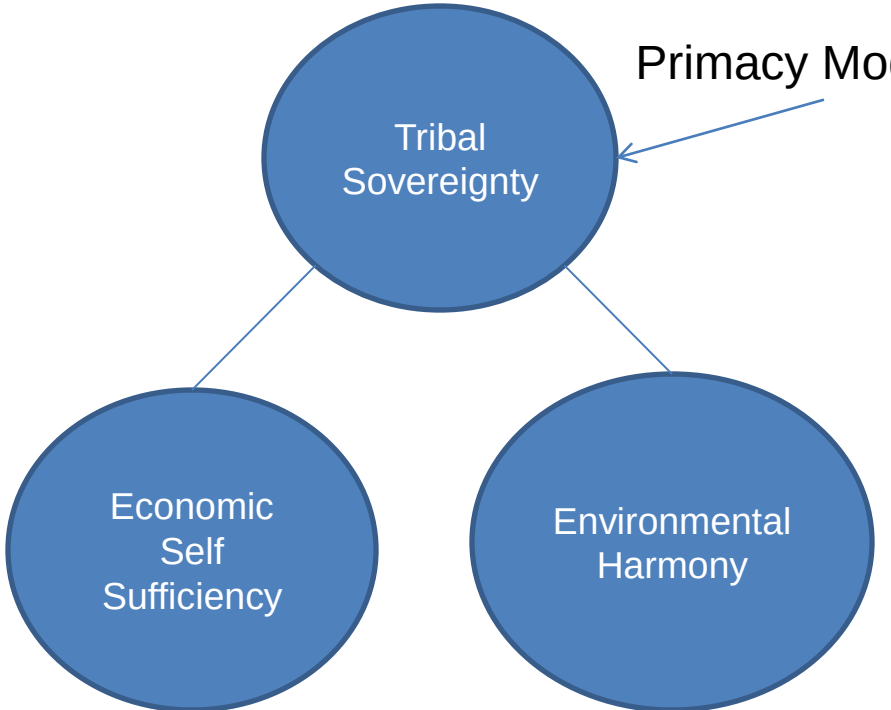


Competing/Balancing Model

Primacy Model I



Primacy Model II



Future Work and Timeline

- Conduct Codesign Workshop and code data
  - PPN (Dec 2010), Kashia (Jan 2011), Ione (Feb 2011), & Bridgeport (Feb 2011) [RQ A]

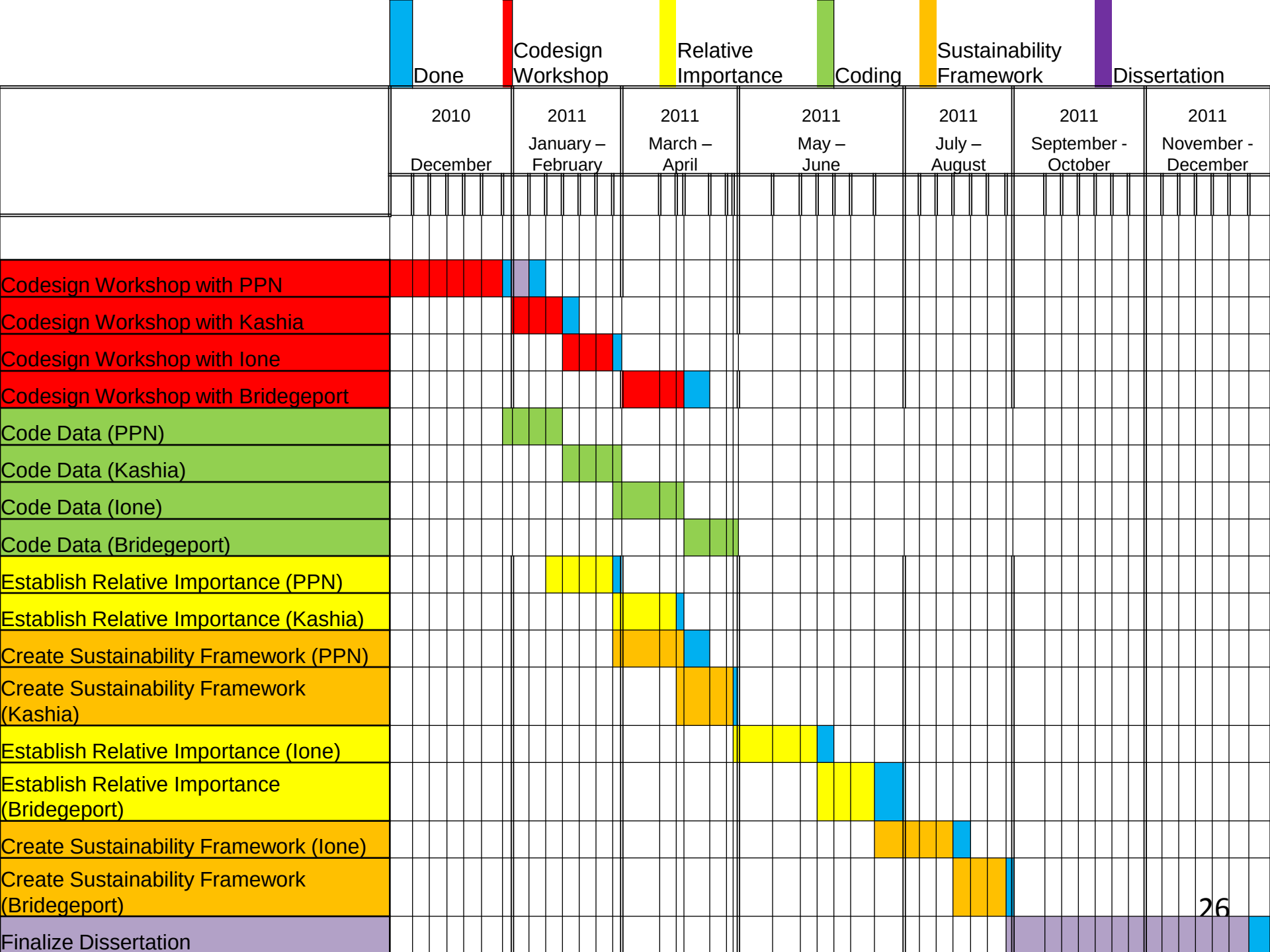
- Work with members of PPN and Kashia to establish relative importance of the expressed needs (Jan - March 2011) [RQ C]

- Establish and refine sustainability framework with PPN and Kashia (Late Feb –April 2011) [RQ B]

- Work with members of Ione & Bridgeport to establish relative importance of the expressed needs (Late April – June 2011) [RQ C]

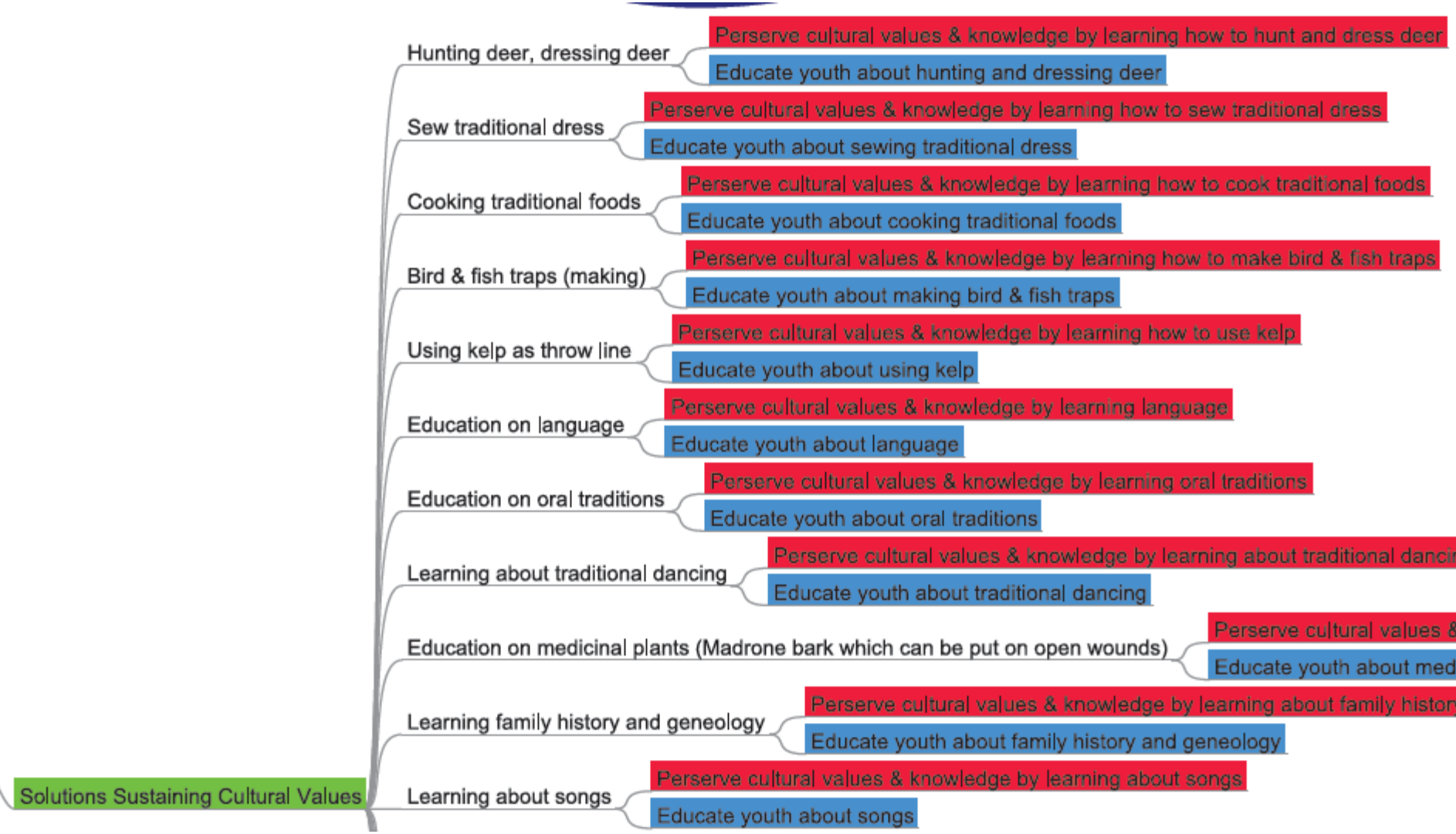
- Establish and refine sustainability framework with PPN and Kashia (Late June–August 2011) [RQ B]

- Finalize Dissertation (September – December 2011)


Done
Codesign Workshop
Relative Importance
Coding
Sustainability Framework
Dissertation
2010 December
2011 January – February
2011 March – April
2011 May – June
2011 July – August
2011 September - October
2011 November - December
Codesign Workshop with PPN
Codesign Workshop with Kashia
Codesign Workshop with Ione
Codesign Workshop with Bridegeport
Code Data (PPN)
Code Data (Kashia)
Code Data (Ione)
Code Data (Bridegeport)
Establish Relative Importance (PPN)
Establish Relative Importance (Kashia)
Create Sustainability Framework (PPN)
Create Sustainability Framework (Kashia)
Establish Relative Importance (Ione)
Establish Relative Importance (Bridegeport)
Create Sustainability Framework (Ione)
Create Sustainability Framework (Bridegeport)
Finalize Dissertation

Q/A?

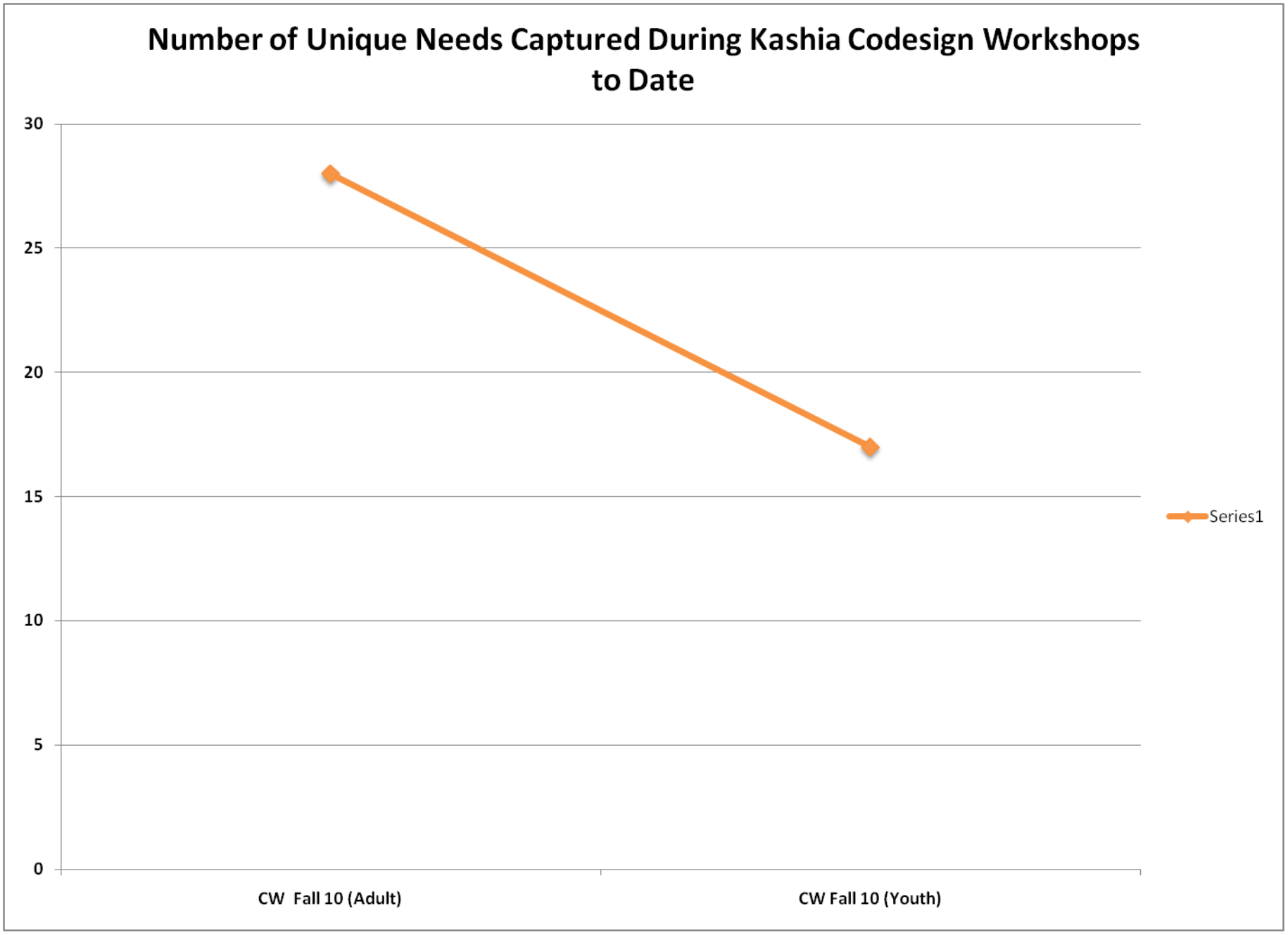
Backup

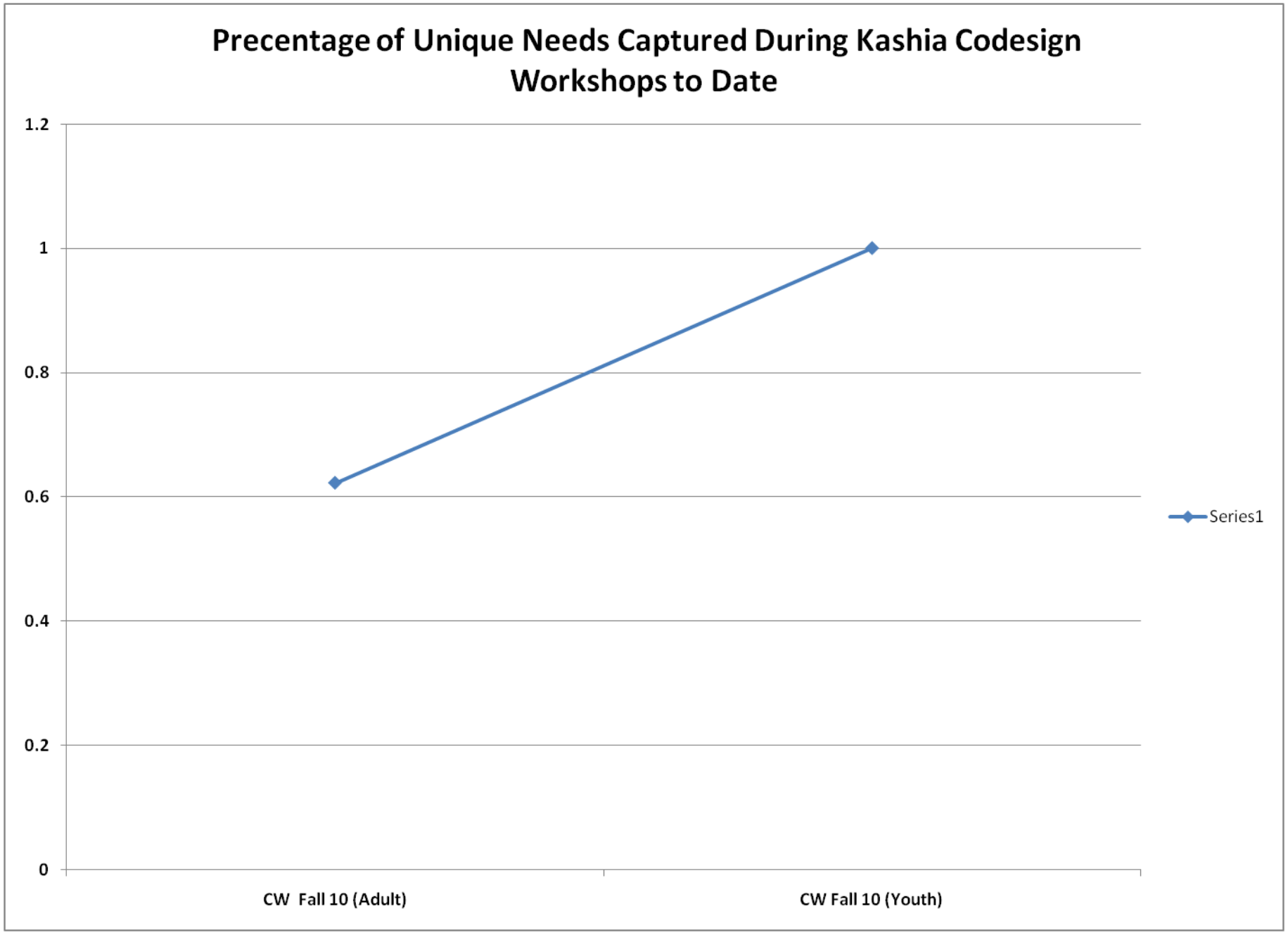

Solutions Sustaining Cultural Values
Hunting deer, dressing deer
Perserve cultural values & knowledge by learning how to hunt and dress deer
Educate youth about hunting and dressing deer
Sew traditional dress
Perserve cultural values & knowledge by learning how to sew traditional dress
Educate youth about sewing traditional dress
Cooking traditional foods
Perserve cultural values & knowledge by learning how to cook traditional foods
Educate youth about cooking traditional foods
Bird & fish traps (making)
Perserve cultural values & knowledge by learning how to make bird & fish traps
Educate youth about making bird & fish traps
Using kelp as throw line
Perserve cultural values & knowledge by learning how to use kelp
Educate youth about using kelp
Education on language
Perserve cultural values & knowledge by learning language
Educate youth about language
Education on oral traditions
Perserve cultural values & knowledge by learning oral traditions
Educate youth about oral traditions
Learning about traditional dancing
Perserve cultural values & knowledge by learning about traditional dancing
Educate youth about traditional dancing
Education on medicinal plants (Madrone bark which can be put on open wounds)
Perserve cultural values & kn
Educate youth about medicin
Learning family history and geneology
Perserve cultural values & knowledge by learning about family history a
Educate youth about family history and geneology
Learning about songs
Perserve cultural values & knowledge by learning about songs
Educate youth about songs


Adults Needs
Access to plants
Preserve cultural values & knowledge by accessing plants
Exercise tribal sovereignty by accessing plants
Substance abuse program (prevent drug and alcohol abuse)
Increase community safety by preventing drug and alcohol abuse
Improve community health by preventing drug and alcohol abuse
Safety from animals and cars
Increase community safety from animal and cars
Road Safety
Increase community safety
Increase transportation safety
Employment
Increase economic development
Transportation
Increase transportation options
Increase transportation reliability
Lack of guidance for the youth (They are being left out)
Increase youth community engagement
Increase youth mentorship
Organized Activities for the tribe (teaching about fish and abalone)
Educate tribal members by organizing activities about fish and abalone
Perserve cultural values & knowledge by organizing activities about fish and abalone
Access to beach ("Owners" stopping access) & (Money is need for licensing)
Preserve cultural values& knowledge by accessing beach
Exercise tribal sovereignty by accessing beach
Perserving traditions/culture/way of life
Perserve cultural values & knowledge
Access to medicinal plants
Preserve cultural values & knowledge by accessing to medicinal plants
Improve community health by accessing to medicinal plants
Exercise tribal sovereignty by accessing to medicinal plants
Access to seaweed
Preserve cultural values & knowledge by accessing seaweed
Exercise tribal sovereignty by accessing seaweed
Access to abalone
Preserve cultural values & knowledge by accessing abalone
Exercise tribal sovereignty by accessing abalone
Need for planning (to get access to beach)
Preserve cultural values & knowledge by planning for beach access
Exercise tribal sovereignty by planning for beach access
Preserve cultural values & knowledge by obtaining permits for fishing

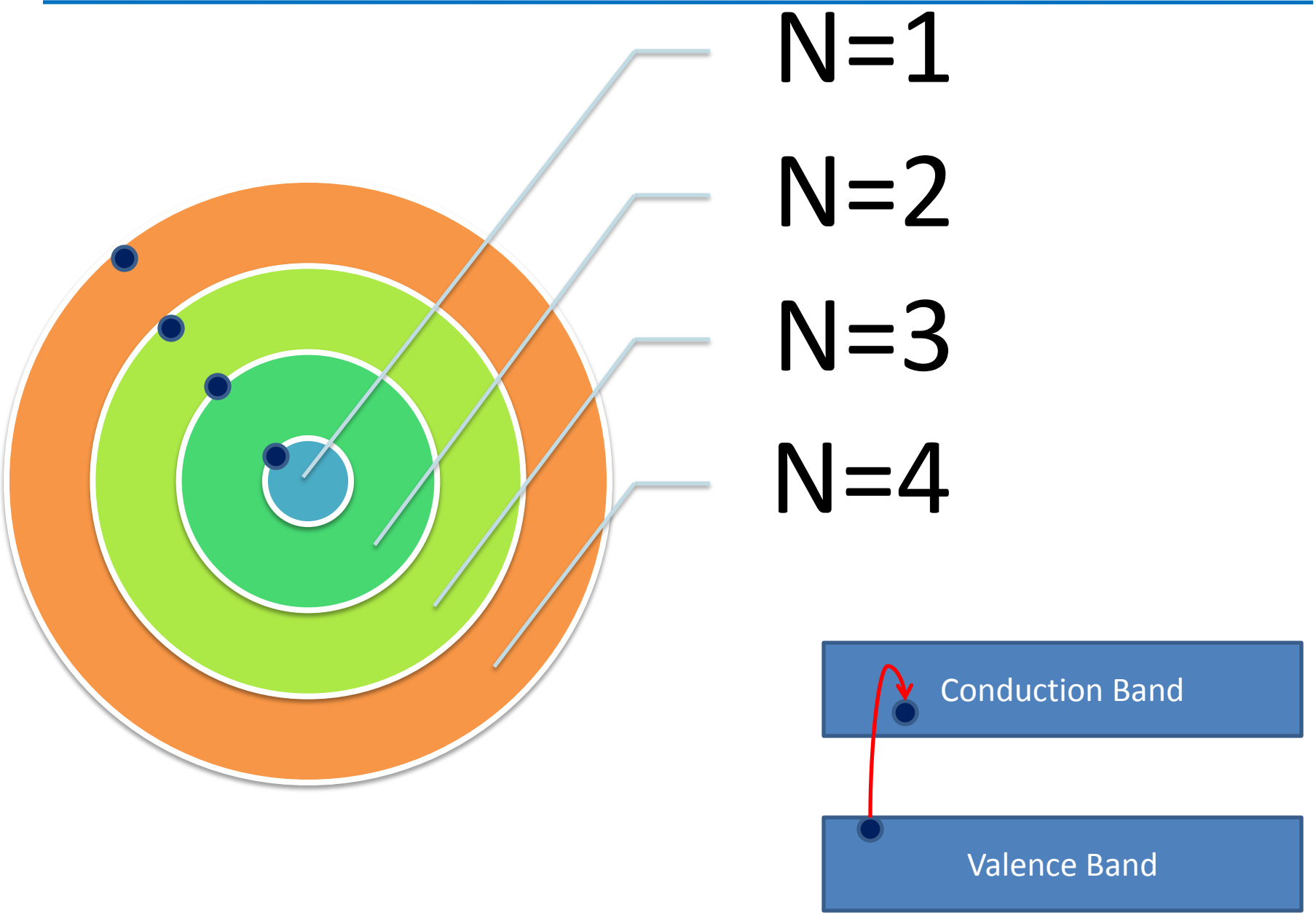
Kashia Band of Pomo Indians of the Stewarts Point Rancheria Case Study

- The Kashia Band of Pomo Indians of the Stewarts Point Rancheria is located in Mendocino and Sonoma County
- May 2010: Pinoleville Pomo Nation (PPN) connected Kashia Band of Pomo Indians with CARES
- June 2010: Innovation workshop held at Stewarts Points
- August 2010: Innovation Workshop held at UC Berkeley


Number of Unique Needs Captured During Kashia Codesign Workshops to Date
30
25
20
15
10
5
0
CW Fall 10 (Adult)
CW Fall 10 (Youth)
Series1


Precentage of Unique Needs Captured During Kashia Codesign Workshops to Date
1.2
1
0.8
0.6
0.4
0.2
0
CW Fall 10 (Adult)
CW Fall 10 (Youth)
Series1

Bohr's Model of the Atom and Band Gap



$$P_{inrad} = \int_0^\infty \partial P / \partial f \, df$$

$$\partial P / \partial f = A \frac{f^3}{e^{hf/kT} - 1}, blackbody$$

$$P_{inrad} = A \left(\frac{kT}{h} \right)^4 \int_0^\infty \frac{x^3}{e^x - 1} dx$$

$$P_L = \phi_g W_g$$

$$W_g = hf_g$$

$$P_L = hf_g \phi_g = f_g \int_{f_g}^\infty \frac{1}{f} \frac{\partial P}{\partial f} df$$

$$\eta \equiv P_L / P_{inrad}$$

$$\eta = 1780 \frac{V_g}{T} \int_{\frac{qV_g}{kT}}^\infty \frac{x^2}{e^{x-1}} dx$$

Planck's constant (h) = 6.62x10-34 (Js)

Boltzmann's constant (k) = 1.38 x 10-23 (J/K)

Electron charge (q) = 1.60x10-19 (C)

Frequency (f)

Temperature (T)

- Displacement= $Px^2 (3L-x)/ 6EI$
- $M = P(L-x)$
- $e = Lf/Li$

alpha = Lf -Li/Li(Tf-Ti)

= deltaL/Li(DeltaT)