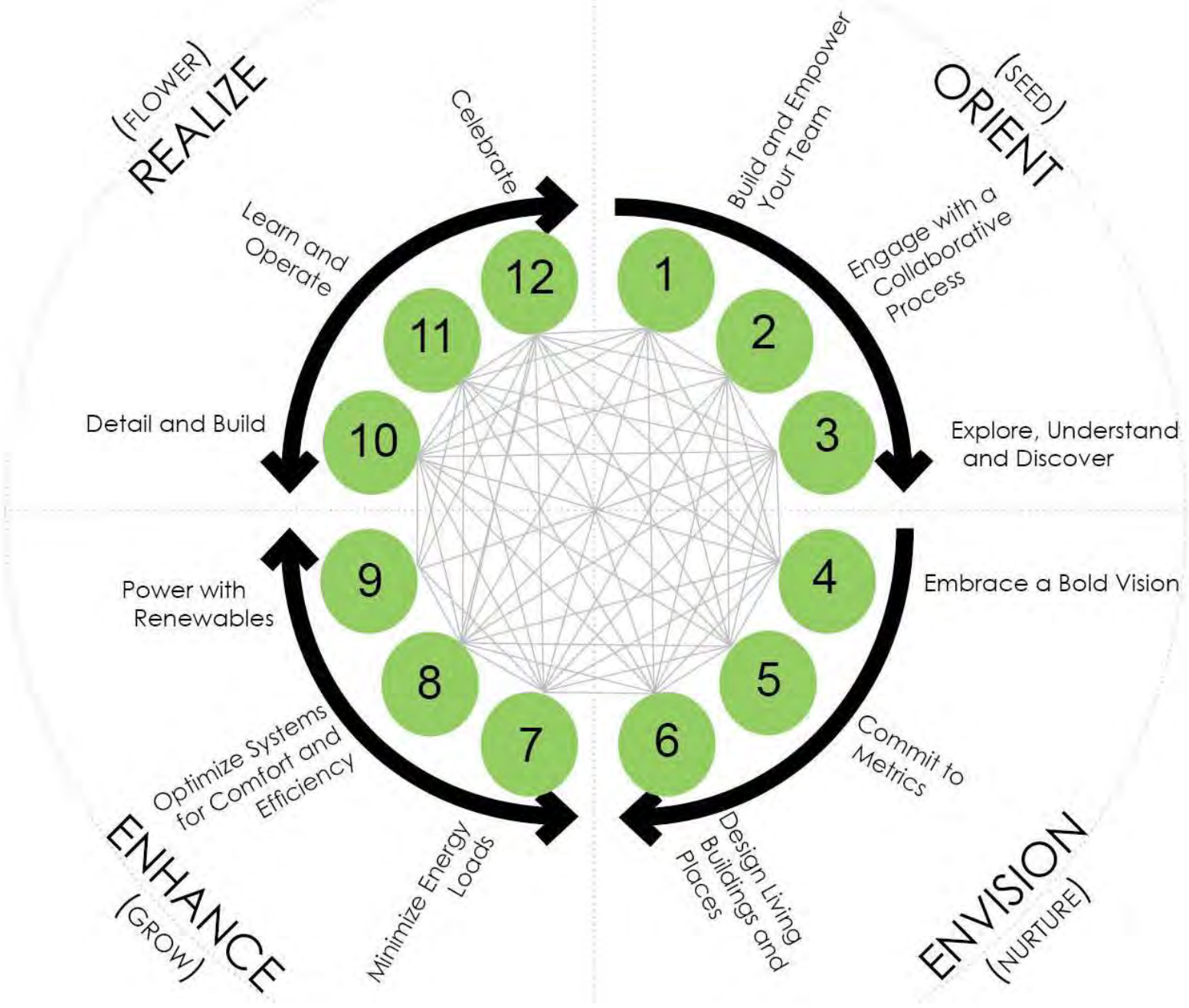
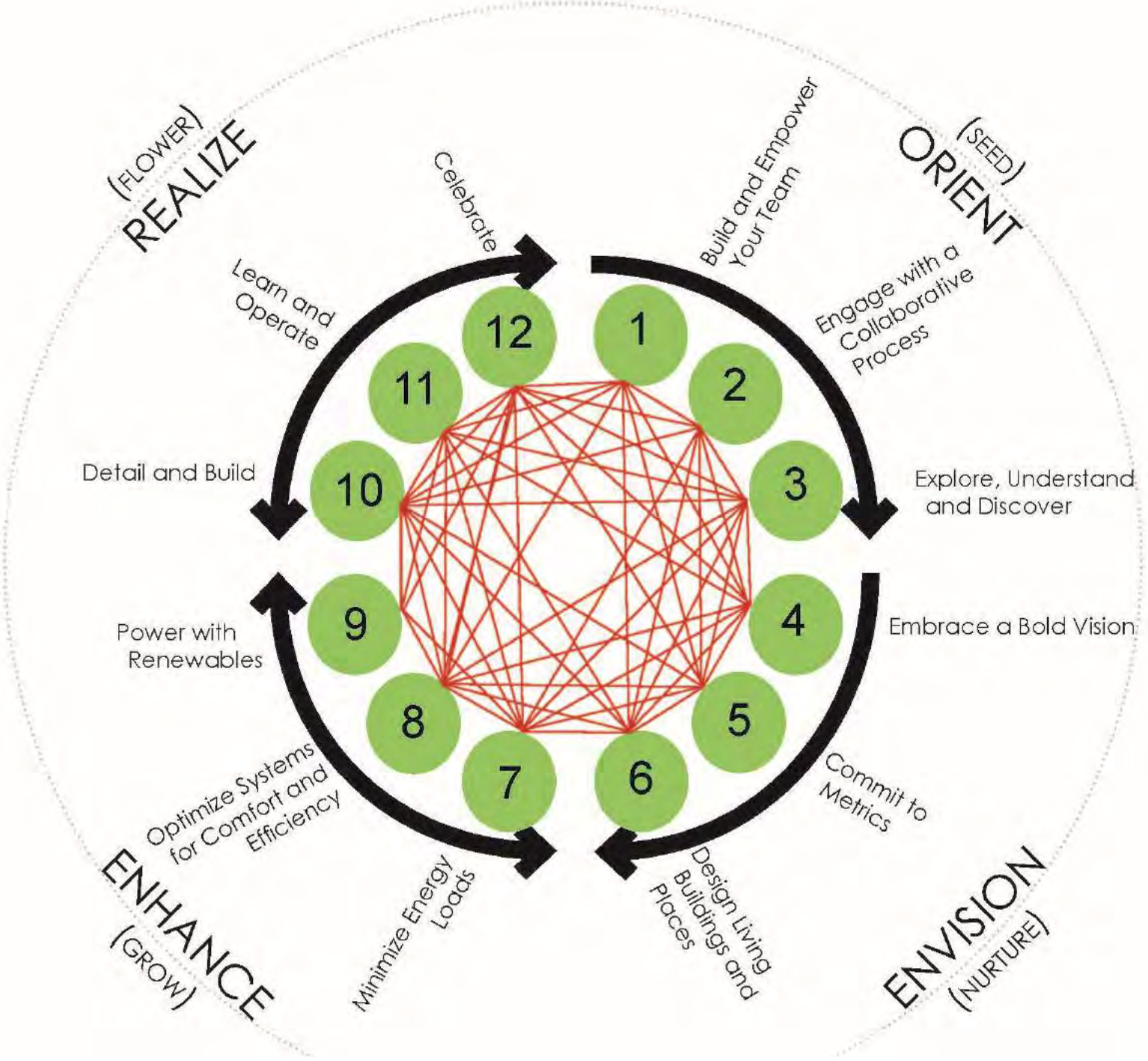
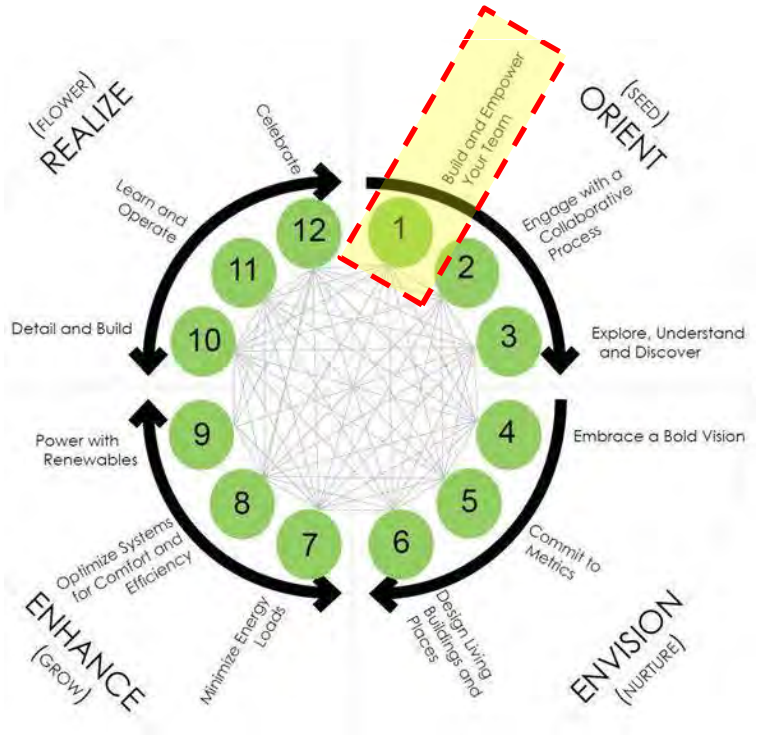
12 Practices for Achieving Net Zero



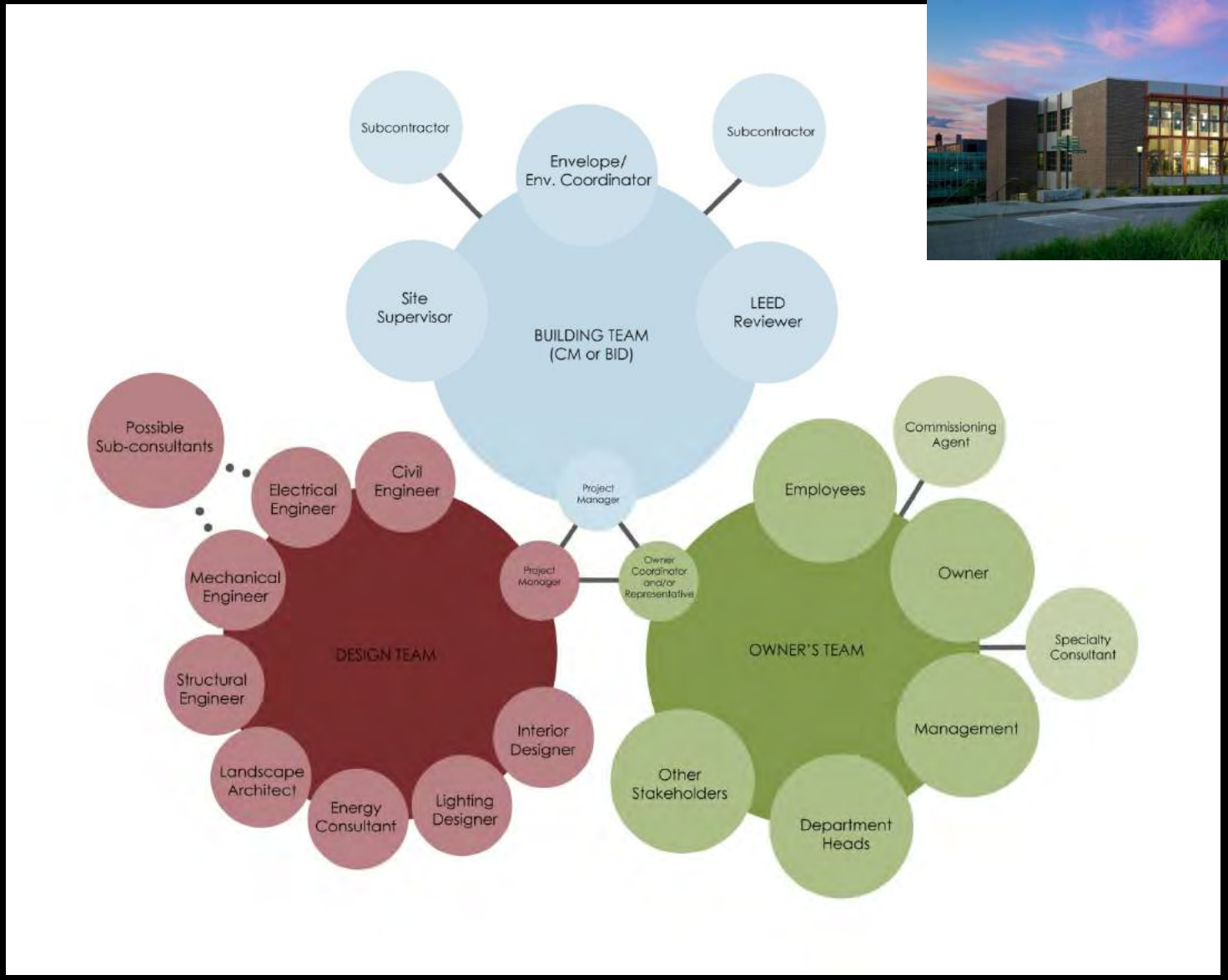

(SEED)
ORIENT
Build and Empower Your Team
Engage with a Collaborative Process
Explore, Understand and Discover
Embrace a Bold Vision
Commit to Metrics
(NURTURE)
ENVISION
Design Living Buildings and Places
Minimize Energy Loads
(GROW)
ENHANCE
Optimize Systems for Comfort and Efficiency
Power with Renewables
Detail and Build
Learn and Operate
Celebrate
(FLOWER)
REALIZE
1
2
3
4
5
6
7
8
9
10
11
12

ORIENT

- Step 1-Build and Empower Your Team
    1. Creating the Right Team
    2. Challenge and Align your Team
    3. Dialogue for Success

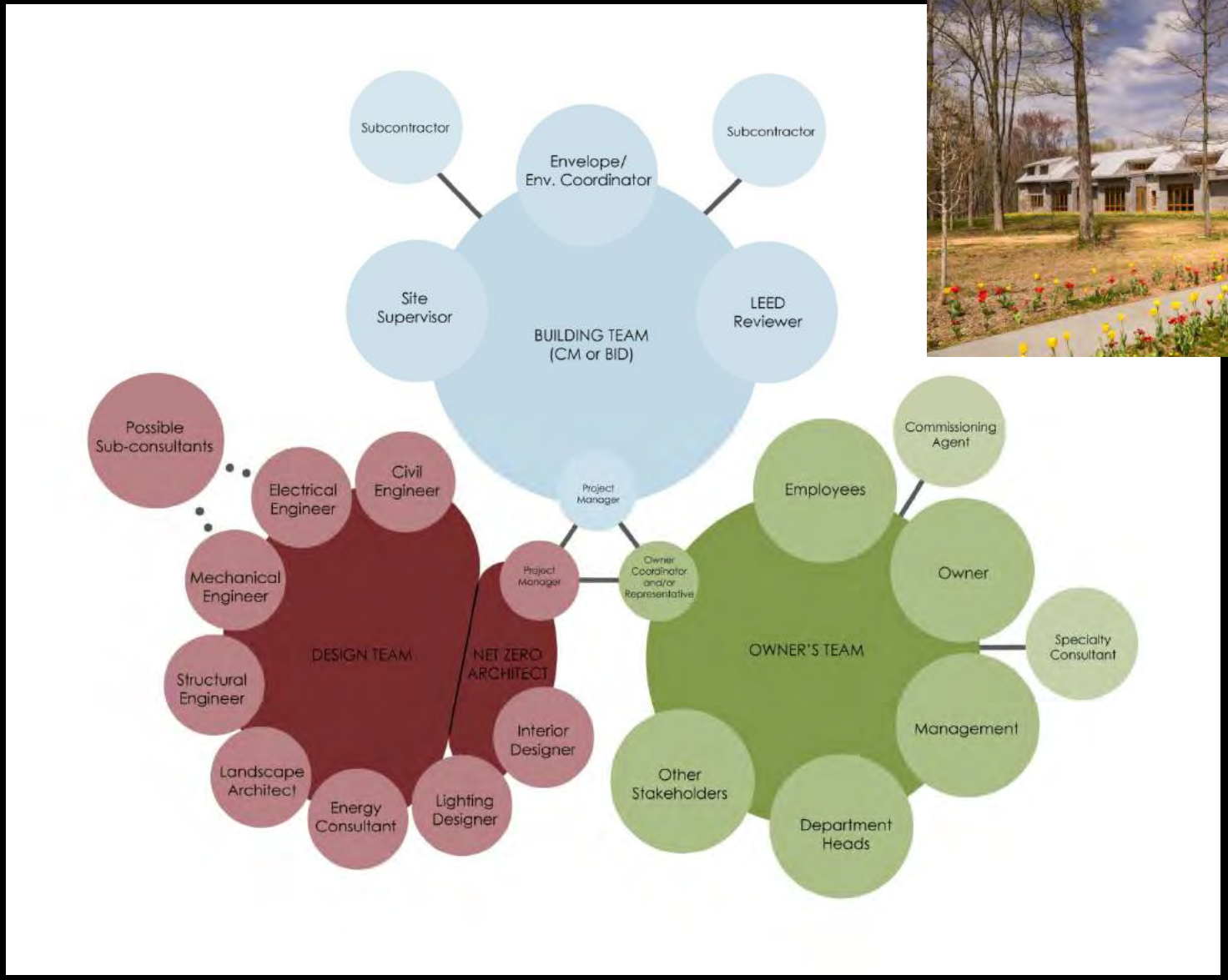


Typical Net Zero Design / Consultant Team



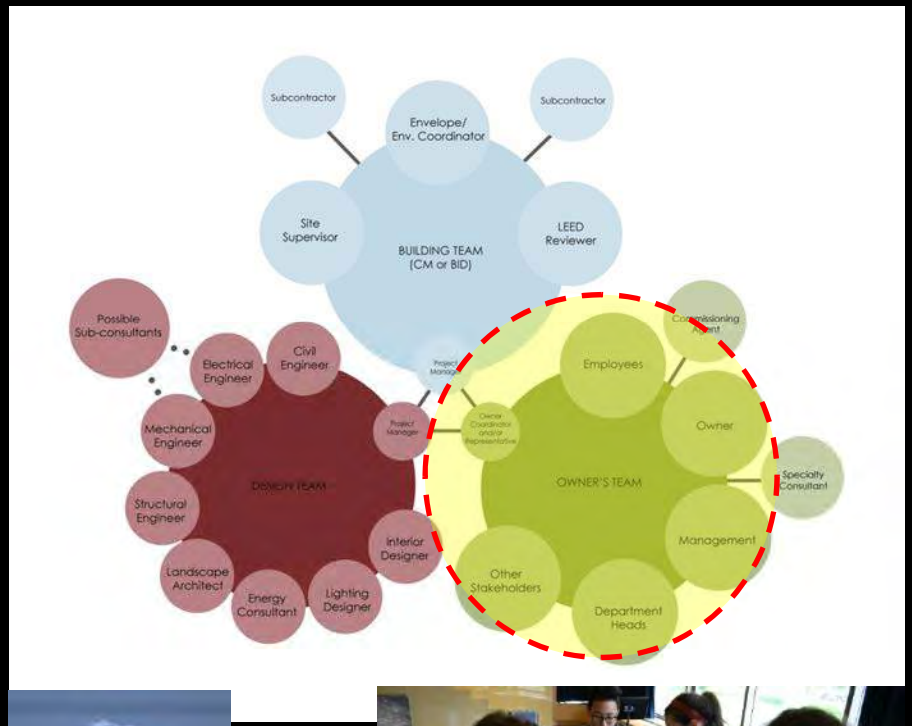
Joint Venture Net Zero Design Team

Design Team With Net Zero Architect Consultant



Step 1-Build and Empower Your Team

Assemble the Right Client Team




Head of School


Assistant Head of School / CFO


Director of Development


Staff


Plant Manager

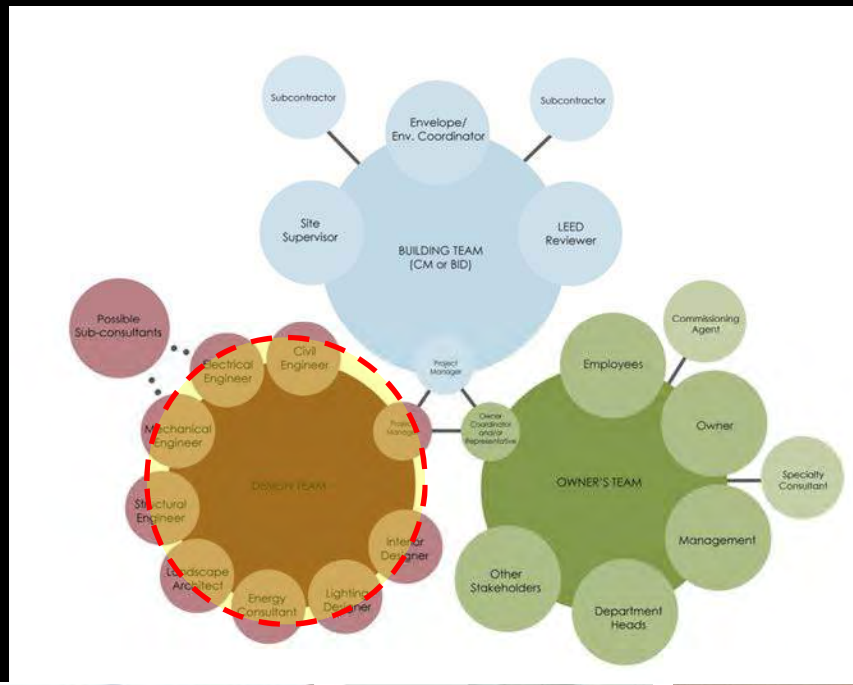

Students

Board of Directors

Step 1-Build and Empower Your Team

Creating the Right Design Team

- Experience
- Core Mission
- Market Segment



Bill Maclay
Founding Principal

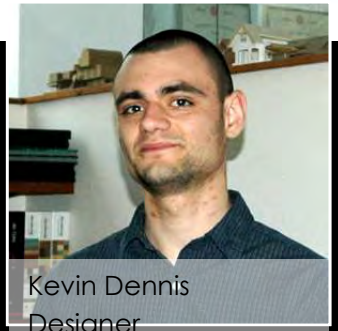
Eileen Hee
Studio Director

Bill Gallup
Senior Associate

Megan Nedzinski
Sr. Project Manager

Tom Bodell
Technical Director

Laura Bailey
Research Director



Kevin Dennis
Designer

Marc Young
Designer, Project Manager

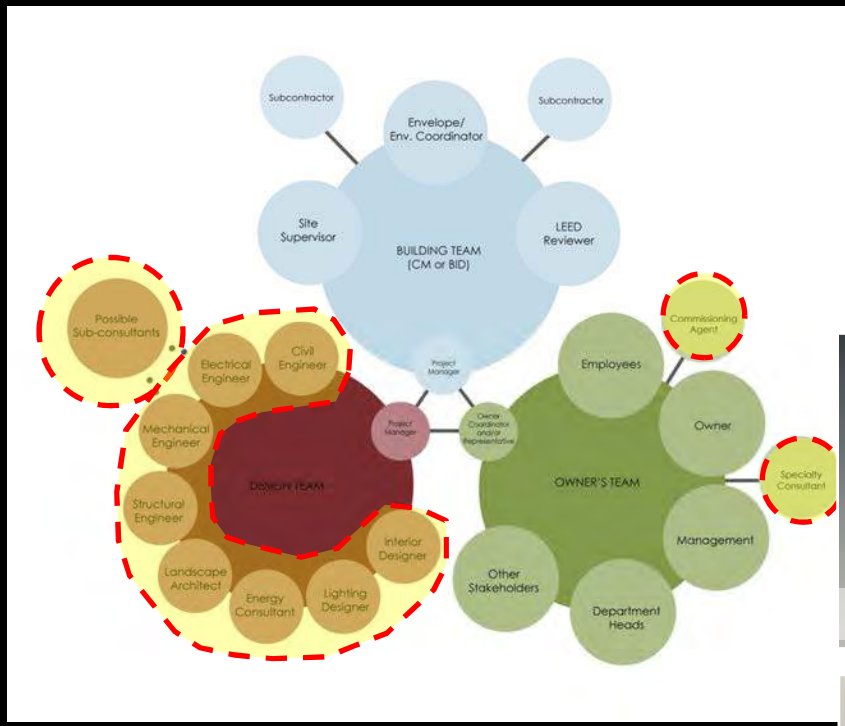
Chris Cook
Designer, Project Manager

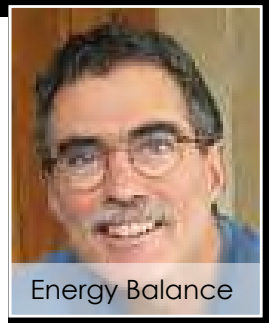
Patricia Lorraine
Office Manager

Step 1-Build and Empower Your Team

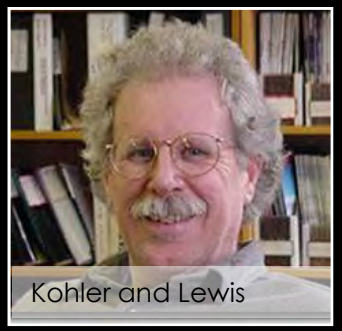
Selecting the Right Consultant Team

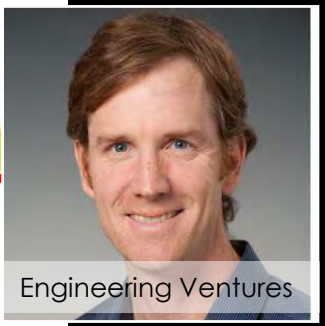
- New vs. Repeat Team
- Team Experience

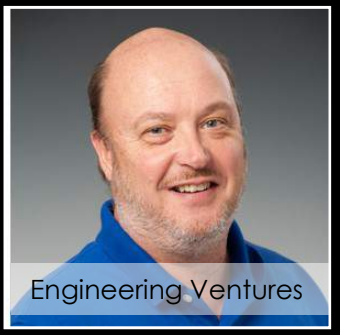



Energy Balance


LN Consulting


Kohler and Lewis


Engineering Ventures


Engineering Ventures


Landscape Design


DEW

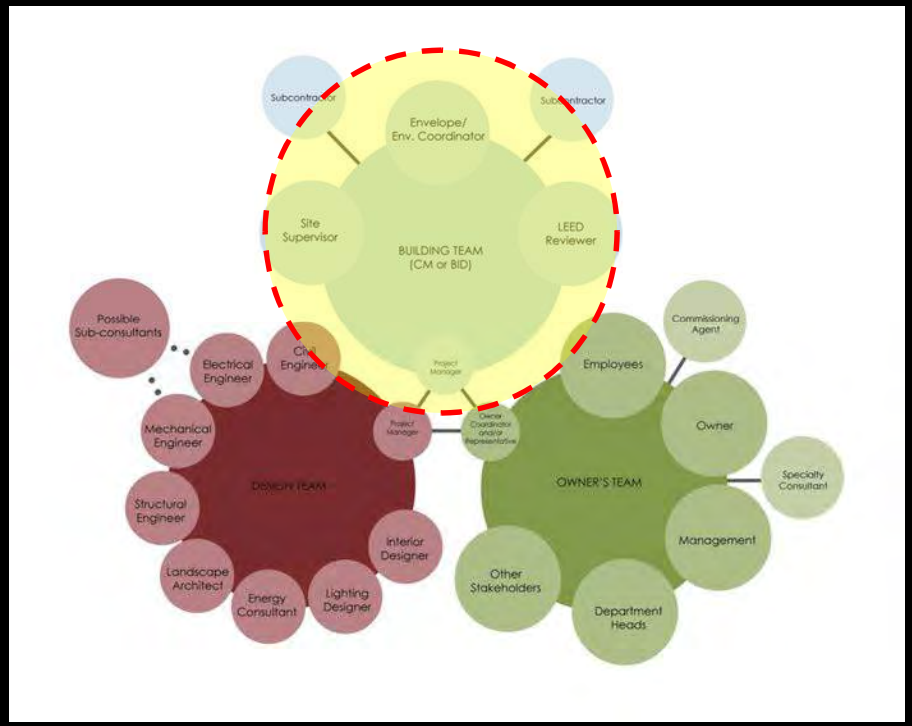

Erickson Consulting


AFS

Step 1-Build and Empower Your Team

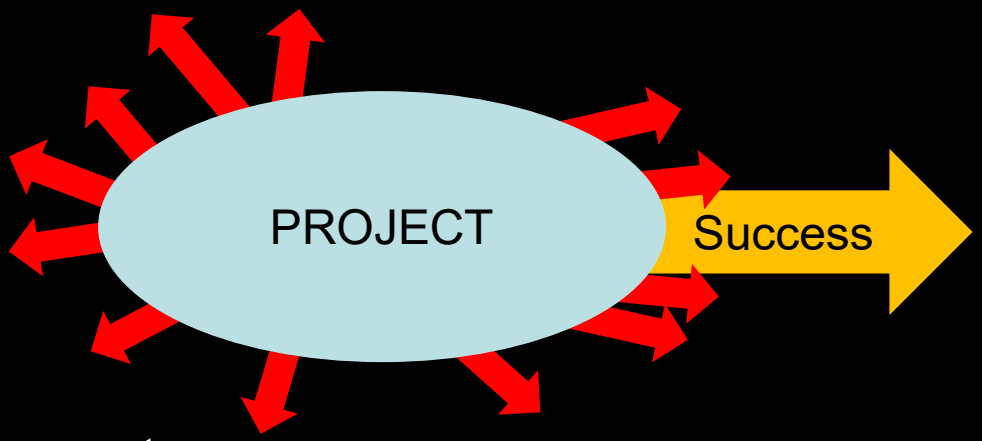
Selecting the Right Construction Team

- CM vs. Bid Process
- New vs. Repeat Team

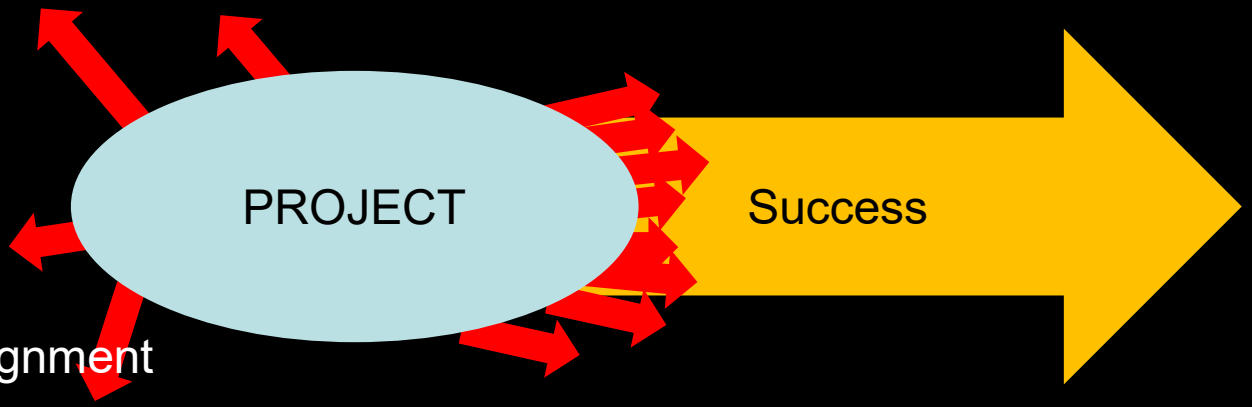


Step 1-Build and Empower Your Team

Challenge & Align your Team
Dialogue for Success



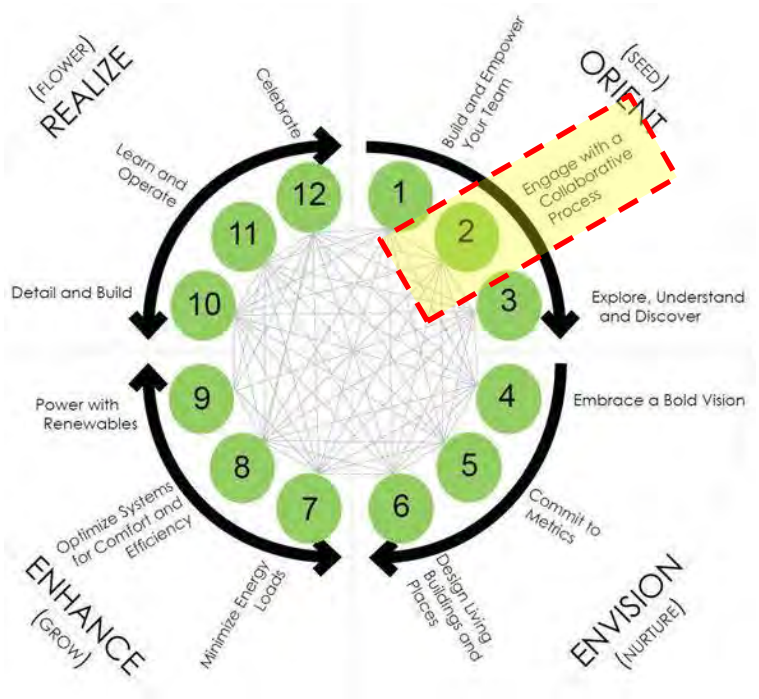
Poor Alignment



Good Alignment

ORIENT

- Step 2 – Engage with a Collaborative Process
    1. Engage all stakeholders
    2. Connect with purpose, cares, and concerns
    3. Collaboration, integration and teamwork

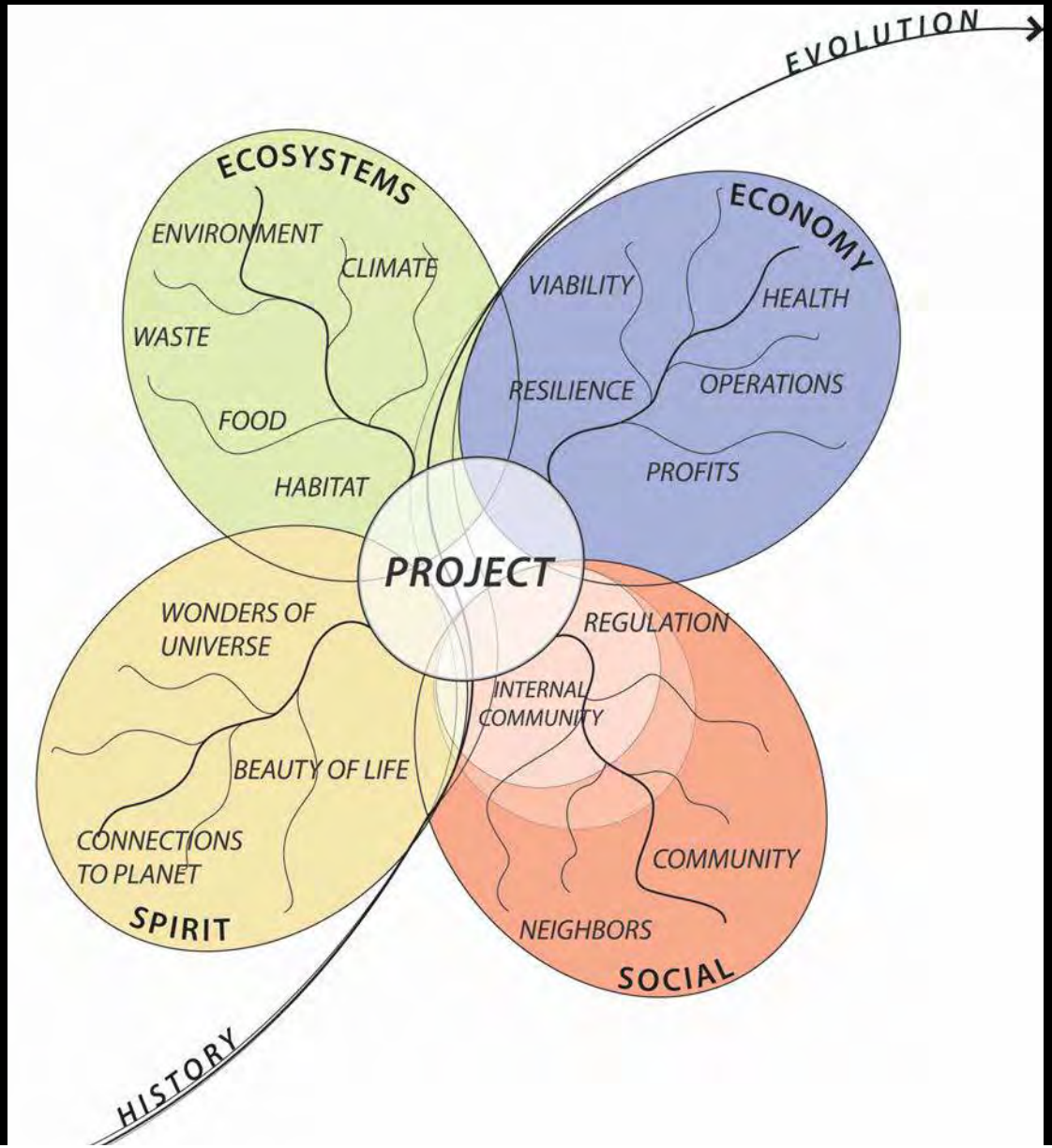


Step 2 – Engage with a Collaborative Process

Engage all stakeholders

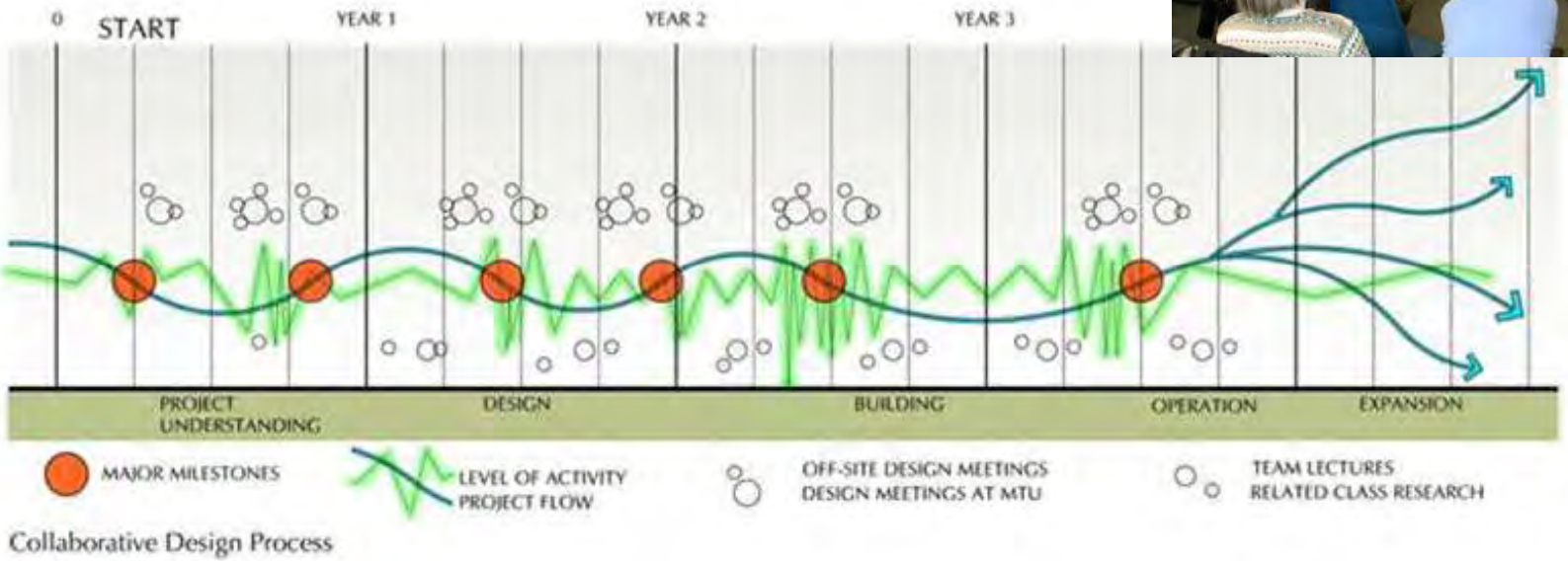
Step 2 – Engage with a Collaborative Process

Connect with purpose, cares, and concerns

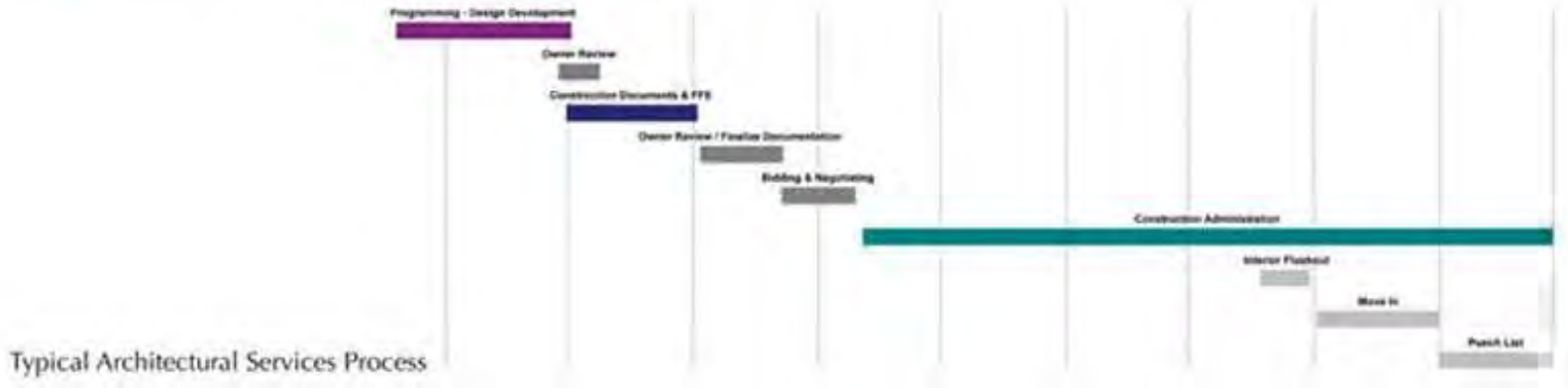


Step 2 – Engage with a Collaborative Process

Collaboration, Flow & Teamwork



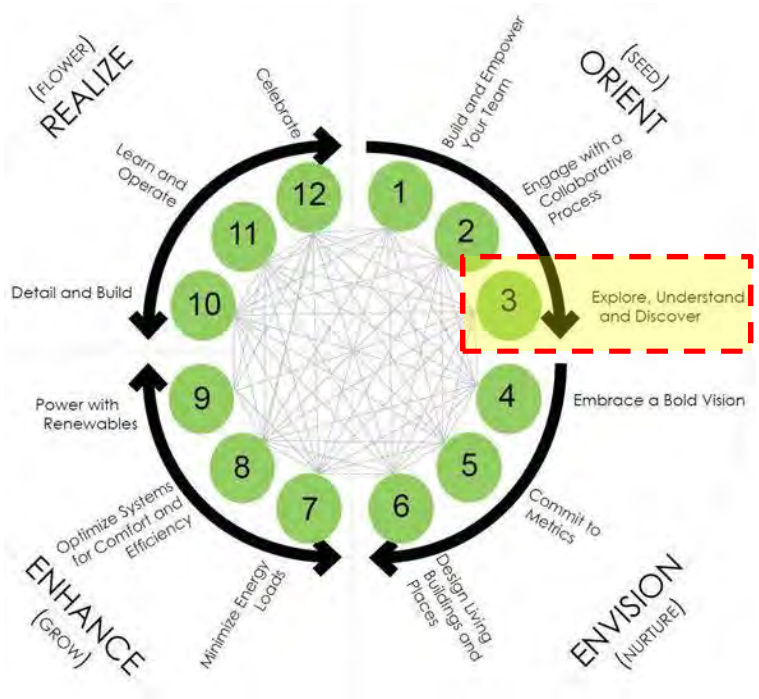
Collaborative Design Process



Typical Architectural Services Process

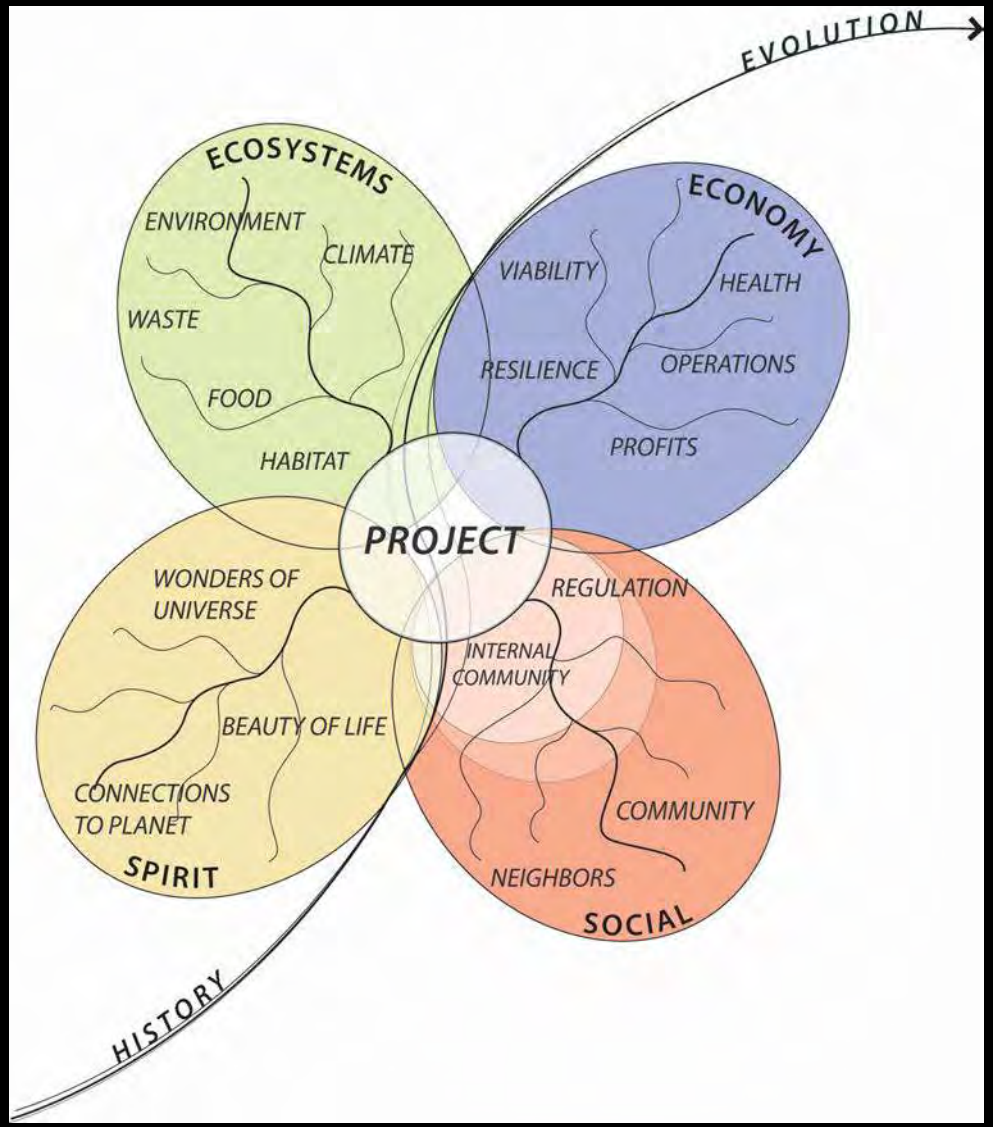
ORIENT

- Step 3- Explore, Understand, and Discover
    1. Living in Worlds / World Views
    2. The Emergence and Evolution of World and Project



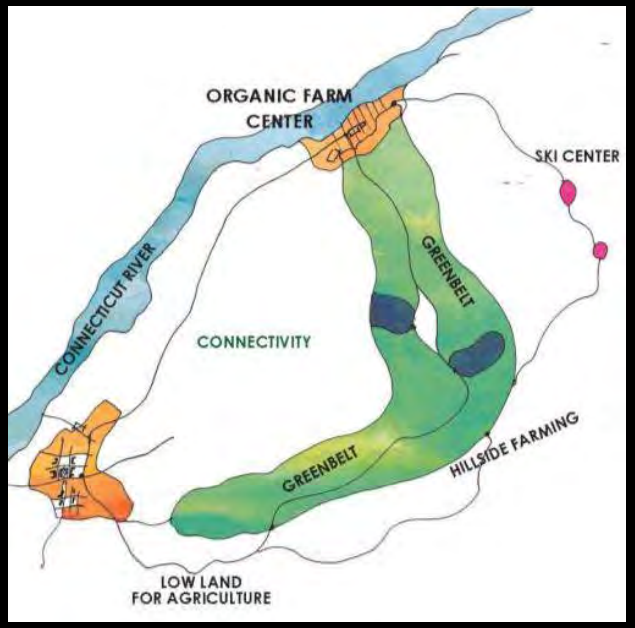
Step 3- Explore, Understand, and Discover

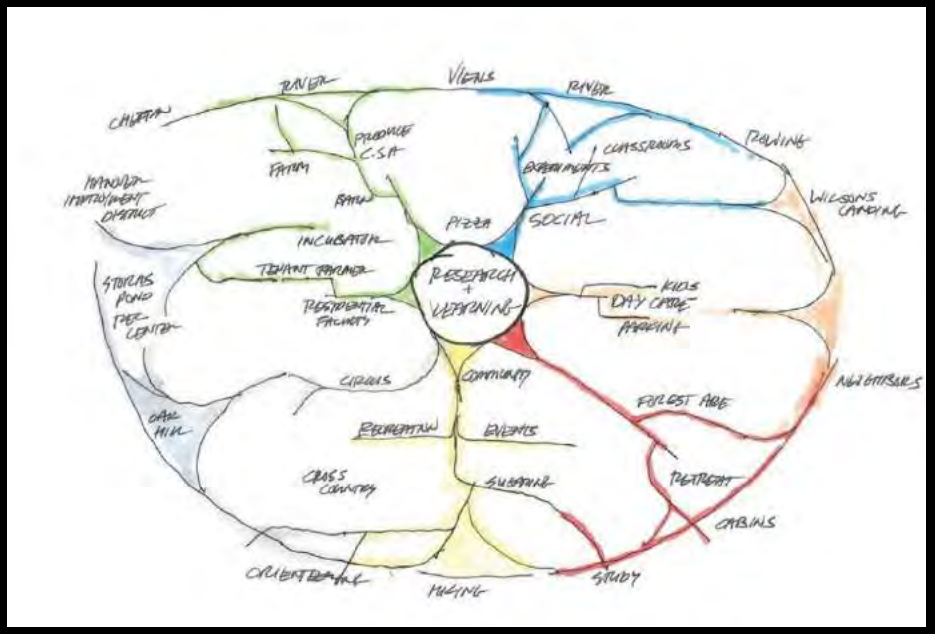
Living in Worlds / World Views

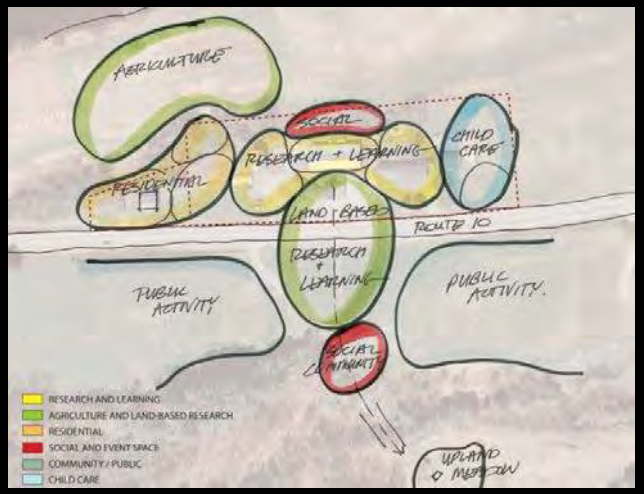


Step 3- Explore, Understand, and Discover

The Emergence and Evolution of World and Project

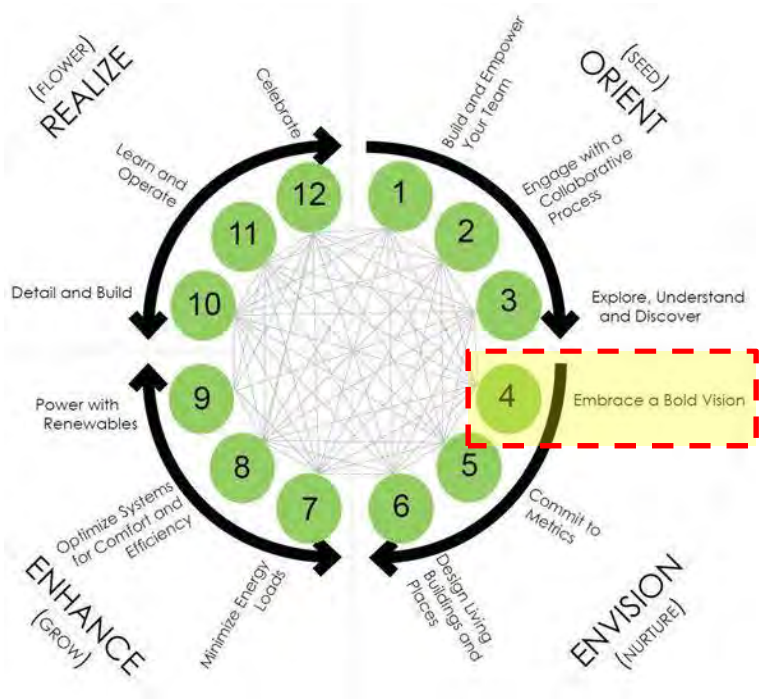






ENVISION

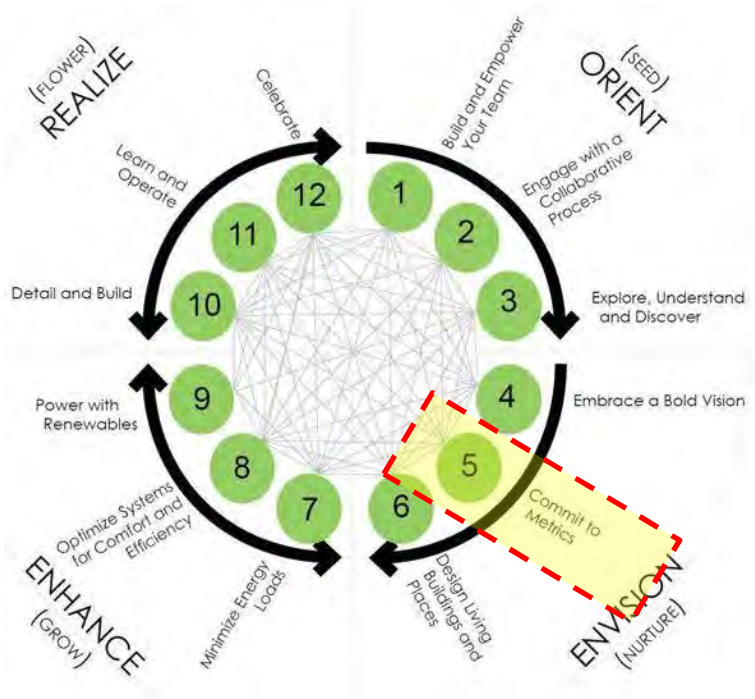
- Step 4- Embrace a Bold Vision
    1. Opening the Quest with Wonder
    2. Imagine Scenarios
    3. Creating a Vision that Lasts



ENVISION

- Step 5 – Commit to Metrics
  - **Purpose/Organizational Mission**
  - **Environmental Goals**
    - **Objectives / Metrics**
  - **Space Programming**

Documented in Owner's Project Requirements (OPR)



Step 5 – Commit to Metrics

Purpose, Goals, Objectives / Metrics

Define the environmental "goals" for the building

- *Who: Green Champion, architect, consultants with Owner(s)*
- *When: Pre-Schematic*

Step 5 – Commit to Metrics

Purpose, Goals, Objectives / Metrics

Define the environmental "goals" for the building

- Organization's Mission
- Overall Environmental Goals for Project
- Specific Environmental Goals

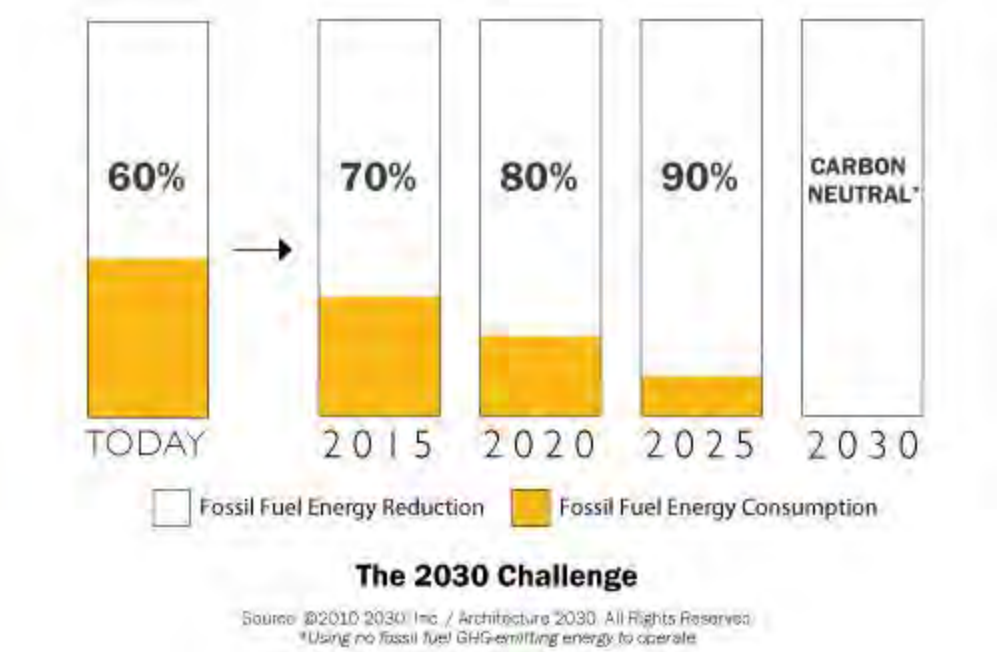
- Examples, See handouts
  - *Shelburne Farms Goals*
  - *HMC Building Environmental Goals*
  - *Shelburne Farms Ecogoals#4*

Step 5 – Commit to Metrics

Purpose, Goals, Objectives / Metrics

Translate goals into "objectives" or "metrics"

- ***When you walk into the building, how do you know if you met a goal?***
- *Who: Green Champion on design team, architect, others on design team with Owner*
- *When: pre-Schen*



Clear metrics: Why Bother?

Guidance for design team during

- Visioning
- Designing
- Value engineering

Step 5 – Commit to Metrics

Purpose, Goals, Objectives / Metrics

Translate goals into "objectives" or "metrics"

- ***How do you know you met a goal when you walk into the building?***

- Goal: Daylight all regularly occupied spaces
  - Metric: Daylight sufficient and comfortable in all workspaces without electric light on a clear day
  - minimum 30 fc on work surfaces; max 120 fc

Step 5 – Commit to Metrics

Purpose, Goals, Objectives / Metrics

Translate goals into "objectives" or "metrics"

- How do you know you met a goal when you walk into the building?
- *Moving into geek world!*
- *Net Zero goal is a numerical goal – This is a numbers game!*
- *ACTIVATE YOUR INNER GEEK! Or go find one!*
- ***Or train one!***

Step 5 – Commit to Metrics

Purpose, Goals, Objectives / Metrics

Low "Energy Usage Index"

or

EUI

What's an EUI??

- Energy Use per Unit Area per year
  - kBtu/sq.ft.-yr
  - kWh/sq.m.-yr
- From all energy sources for the building

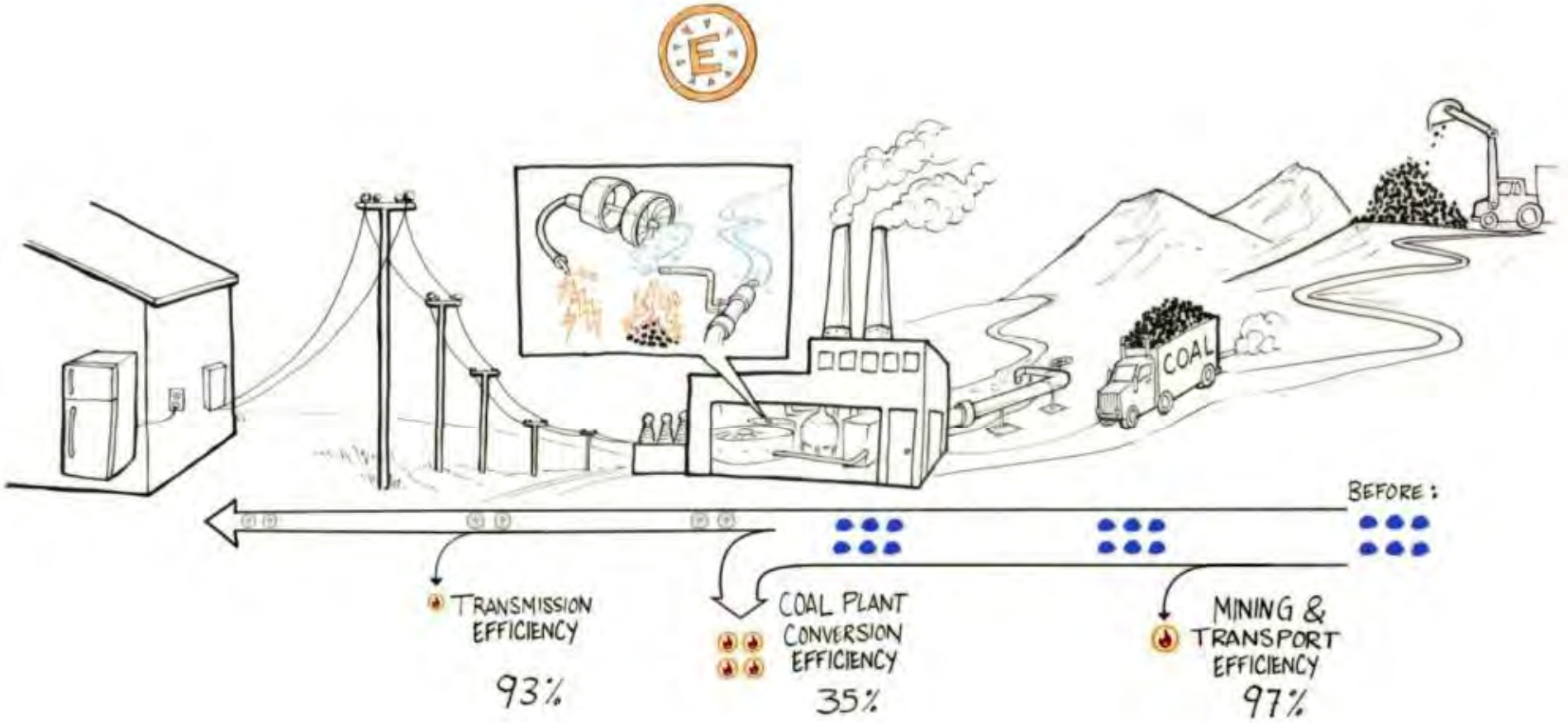
What's an EUI??

$$\frac{100{,}000{,}000 \text{ Btu/year}}{3{,}000 \text{ sq.ft.}} = \sim 33{,}333 \text{ Btu/sq.ft. - yr}$$

$$= 33 \text{ kBtu/sq.ft. -yr}$$

$$= \sim 100 \text{ kWH/sq.m-yr}$$

SPECIFY IF THIS IS "SITE" OR "SOURCE" ENERGY



32%
Site

100%
Source

EUI Metrics Calculators

- For monthly all electric home
  - *Electric heat normalization worksheet 170302.xlsx*
- For monthly data – all fuels
  - *Energy Statistics and EUI for Buildings for monthly data 170302.xlsx*
- For annual data – all fuels
  - *EUI calculator with **annual** data170302.xlsx*

Open this one:

- *Electric heat normalization worksheet 170302.xlsx*

Delia's House 8/28/2015

Electric Use total*

Month	kWh
Feb 2014	1,420
Mar	1,790
Apr	500
May	300
Jun	300
Jul	375
Aug	375
Sep	350
Oct	430
Nov	1,200
Dec	1,480
*Jan 2015***	*1,700*
Total	10,220

***est. from part month*

1144	heated sq.ft.

EUI - normalized

90	kWh/sq.m-yr
28	**kBtu/sq.ft-yr**

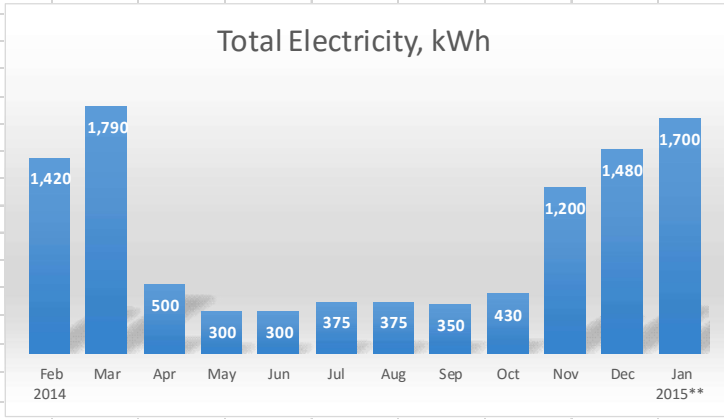
* from electric utility data

May, June and Sep baseline -- no air conidtining

317	avg kWh/month, non-heating non-cooling months
	select which baseline months to average

Annual heat only use

6,103	kWh for heating (Annual total - 13* summer baseline)
7,700	Normal degree days (65 base)
2.4	Btu/sq.ft-dday -- *NOT NORMALIZED*
8,651	Degree days from period of usage
	from wunderground.com
2.1	**Btu/sq.ft-dday -- *NORMALIZED***
112%	(ddays of study period)/(ddays normal)
5,432	Normalized heating usage, kWh/yr



Delia's House

	2014/15	normalized
Annual heat bill	$916	$810
Annual total energy bill***	$1,533	$1,400

Cost of electricity $ 0.15 per kWh

*** Not inlcuding monthly meter charge

For average weather data

Go to http://www.nrcc.cornell.edu/ccd/nrmhdd.html and find the closes w

For weather data for period you have data for

Got to wunderground.com. Use same weather station as you used for nc

then "history" Enter the frist day of your data period in the date and click

Next, under the date, click "custom" and enter the first and last

Scroll down a bit to see annual degree days

Now open this one

- *EUI calculator with **annual** data150821.xls*

Energy Usage Index -- EUI -- Calculator — *Insert data only in yellow cells* — 02/21/15

Project name

Provide minimum 12 months, preferably 24

Building conditioned sq.ft.: 2100

	Electricity	Natural Gas	Propane	Oil	Other Fuel
Total units/year	3,875	-	268	-	2.0
MMBtu/unit	0.003413	0.100	0.091	0.138	22
MMBtu/yr	13	0	24	0	44

Total: 82 MMBtu/yr

39 **kBtu/sq.ft.-yr**

note: not normalized for heating degree days

	Electricity	Natural Gas	Propane	Oil	Other Fuel
Number of months*	12	12	12	12	12

*this is number of months of usage covered by the fuel use

fuel type: wood — e.g., wood pellets, wood chips, cordwood, coal, etc., solar electric

units: cord — e.g., tons, cords

Meter read date	kWh	Meter read date	ccf or therm	delivery date	gallons	delivery date	gallons	delivery date	No. of units
01/01/15	350								2
02/01/15	350				100				
03/01/15	325				58				
04/01/15	300								
05/01/15	300								
06/01/15	300								
07/01/15	300								
08/01/15	300								
09/01/15	300								
10/01/15	325								
11/01/15	350				110				
12/01/15	375								

FUEL COST TABLE

Fuel (Abrrev.)	Unit	$/Unit	MMBtu/ Unit	$/MMBtu
Electricity	kWh	$0.15	0.003413	$43.99
Kerosene	Gal	$3.50	0.137	$25.62
Natural Gas	ccf	$2.00	0.100	$20.00
Oil	Gal	$3.00	0.138	$21.43
Propane	Gal	$3.00	0.091	$32.09
Wood**	Cord	$220	22	$10.89
pellets	ton	$229	16	$14.31
wood chips*	ton	$61	9.0	$6.72

* green wood chips

** dry hardwood

Open this one:

*EUI calculator with **annual** data150821.xlsx*

EUI Calculator EUI = Energy Usage Index

1 How big is the building?

Total fully conditioned sq.ft. 5,000

Andy Shapiro:
Don't include unconditioned spaces or partially conditioned spaces such as unoccupied basements

2 How much fuel does the building use?

Fuel	Unit	Used per year	MMBtu/ Unit	MMBtu/yr Use
Electricity	kWh	12,100	0.00341	41
Kerosene	Gal	100	0.137	14
Natural Gas	ccf	100	0.100	10
Oil	Gal	100	0.136	14
Propane	Gal	100	0.094	9
Cord Wood	Cord	1.0	20	20
Wood pellets	ton	10	16	160
wood chips	ton	5.0	9.0	45
TOTAL MMBtu Used per year				313

In this section enter one year of energy usage

Andy Shapiro:
example assumes 10 MMBtu for domestic hot water

3 Normalize heating usage for coldness of period of usage data

Fuel used for space heating only, MMBtu/yr		262
Normal Degree Days for your location		7,478
	starting date for fuel use data	1/1/2014
	ending date for fuel use data	12/31/2014

Add up all fuels used for heating. If some used for both

Go to http://www.nrcc.cornell.edu/ccd/nrmhdd.html and

Step 5 – Commit to Metrics

Purpose, Goals, Objectives / Metrics

c. **Example goal and metrics (Shelburne Farms)**

A building that connects to the outdoors and adapts to the seasons: Natural light, multiple access points to the outdoors, patios and landscaping will allow full use of both indoor and outdoor spaces for gathering, eating, learning activities and reflection. The building will support activity that expands (is outdoor oriented) in the summer and contracts (is hearth/fire oriented) in the winter.

- *Objective/Metric: Daylighting will be used in all spaces.*
- *Objective/Metric: All spaces will have a view out of a window.*
- *Objective/Metric: Outdoor learning spaces will have appropriate weather protection and furniture for productive use in all seasons*

Step 5 – Commit to Metrics

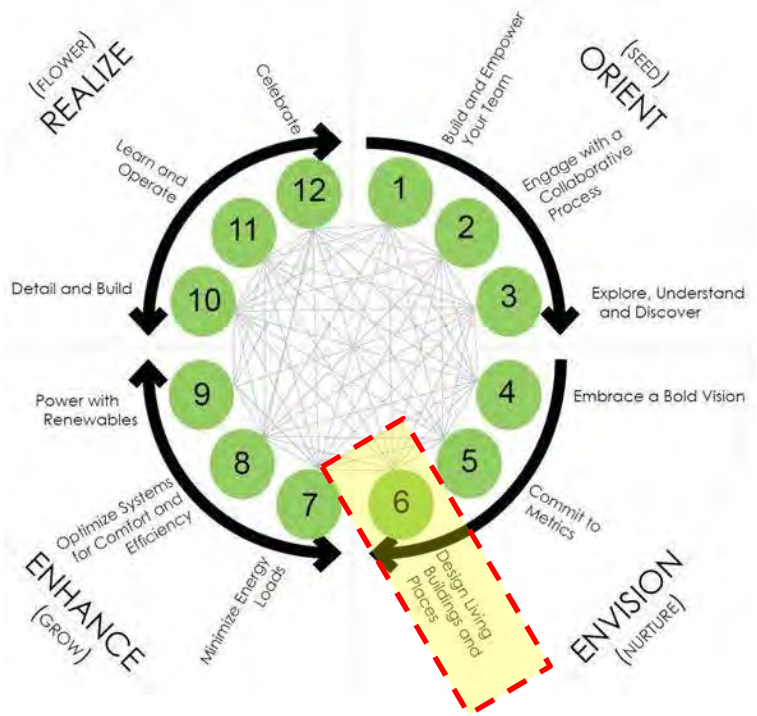
Purpose, Goals, Objectives / Metrics

Example

- Goal: Air tight building
  - *Metric: tested air leakage no more than 0.05 cfm@50 Pa air leakage per square foot of above grade shell area (0.05 cfm50/sq.ft. shell)*
- Goal: An energy efficient building
  - *Metric: 20 kBtu/sq.ft. year total energy actual usage (site energy) from all sources*
- Goal: Net Zero building
  - *Metric: Site energy consumption is at least 100% offset by on-site energy production*

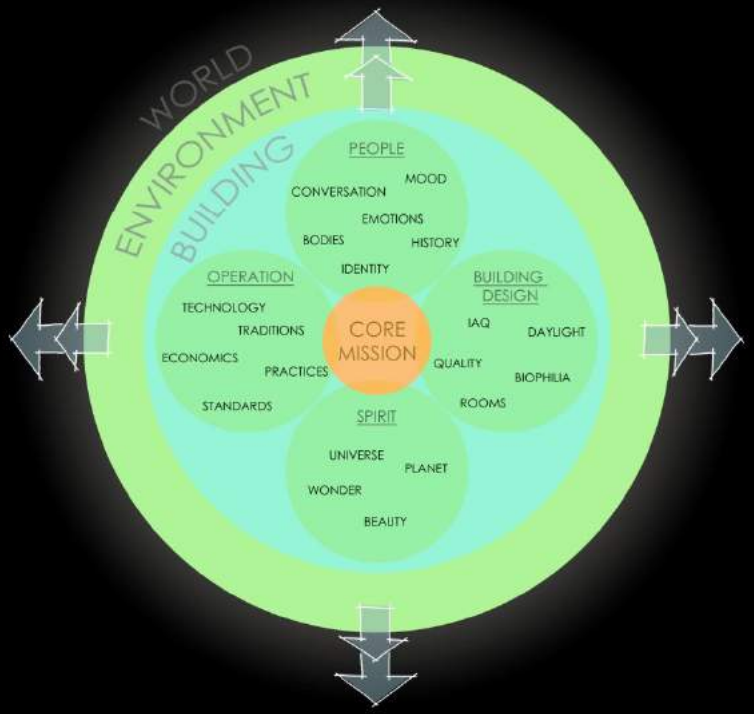
ENVISION

- Step 6 -Design Living Buildings and Places
    1. Organizational Ecology
    2. Living Systems, Design and Building Formats
    3. Health for Occupants and Environment



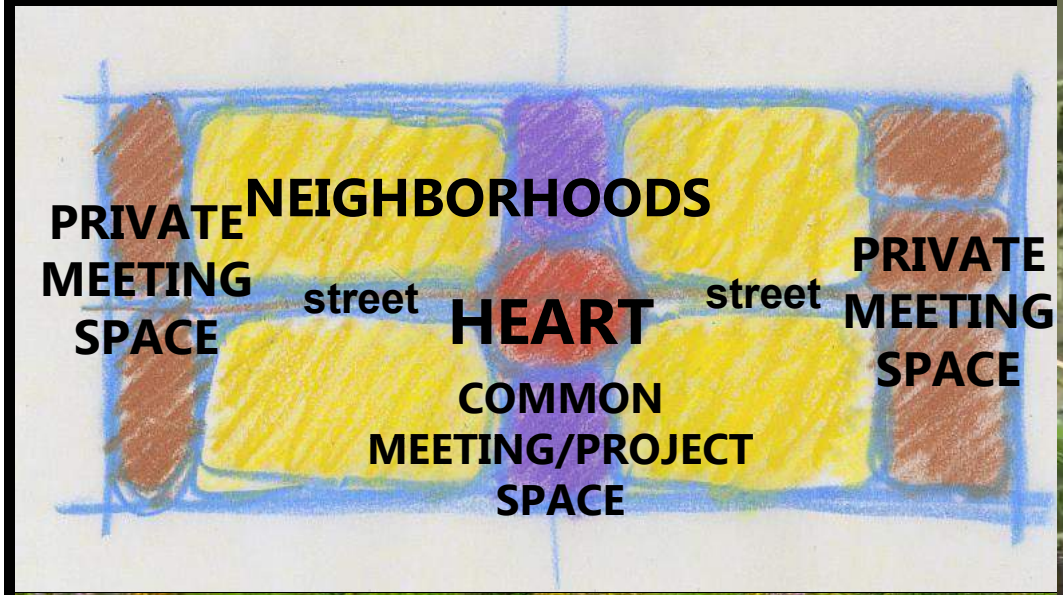
Step 6 -Design Living Buildings and Places

Organizational Ecology



Step 6 -Design Living Buildings and Places

Living Systems, Design and Building Formats



Step 6 -Design Living Buildings and Places

Connect Building to Site