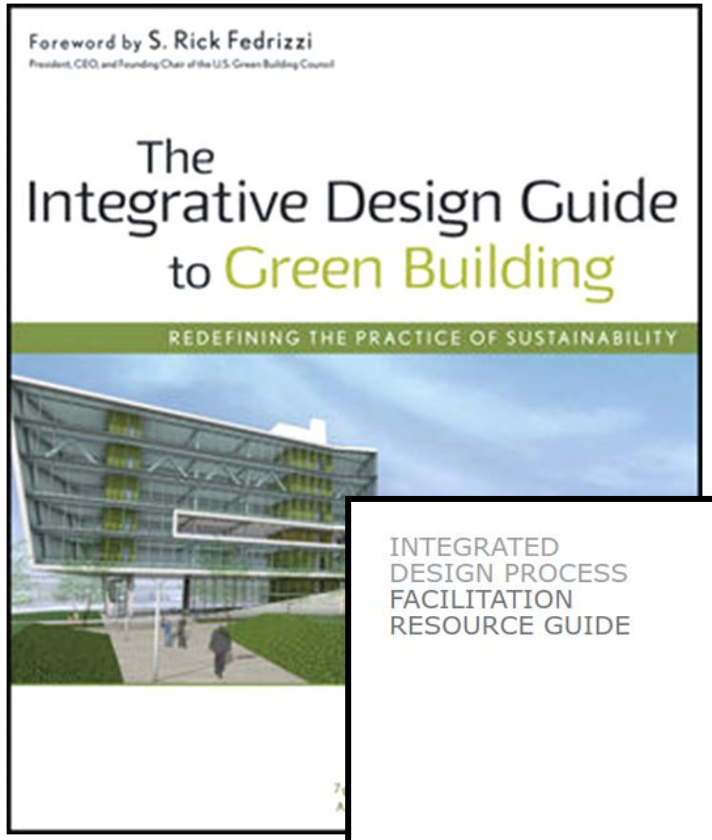
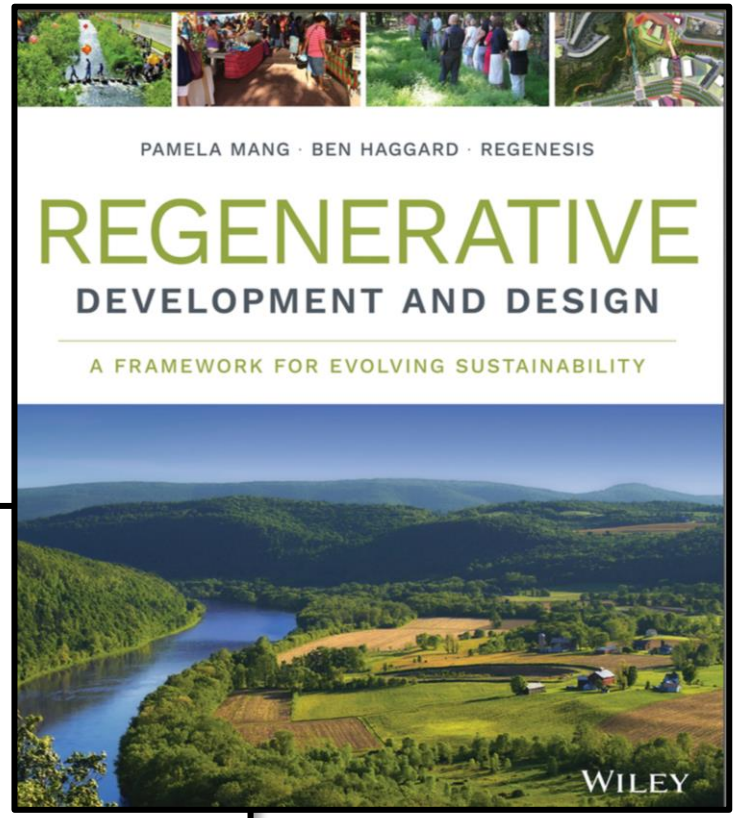
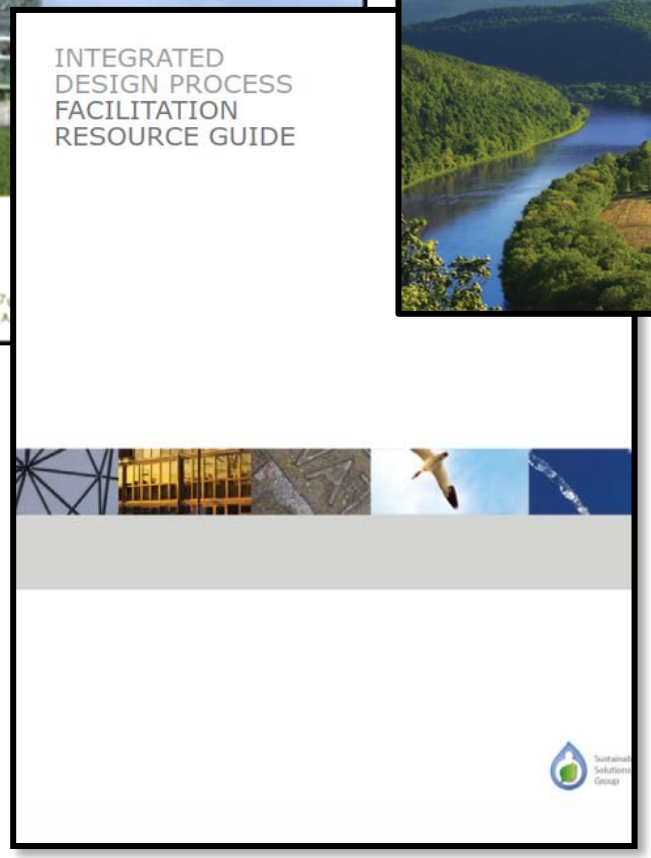
Conceptual Design Phase

جلسه هشتم– مبانی طراحی محیطی، نظریه و روش‌ها

اردیبهشت ماه ۱۳۹۸







Variation in IDP Phases

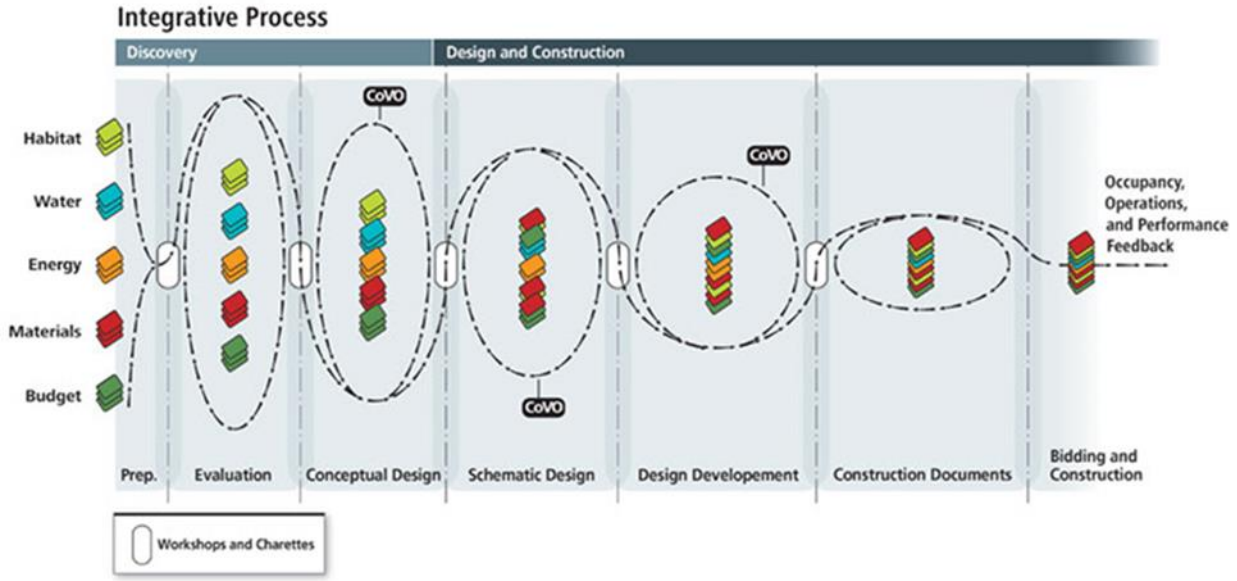


Figure 4: IDP Design Process

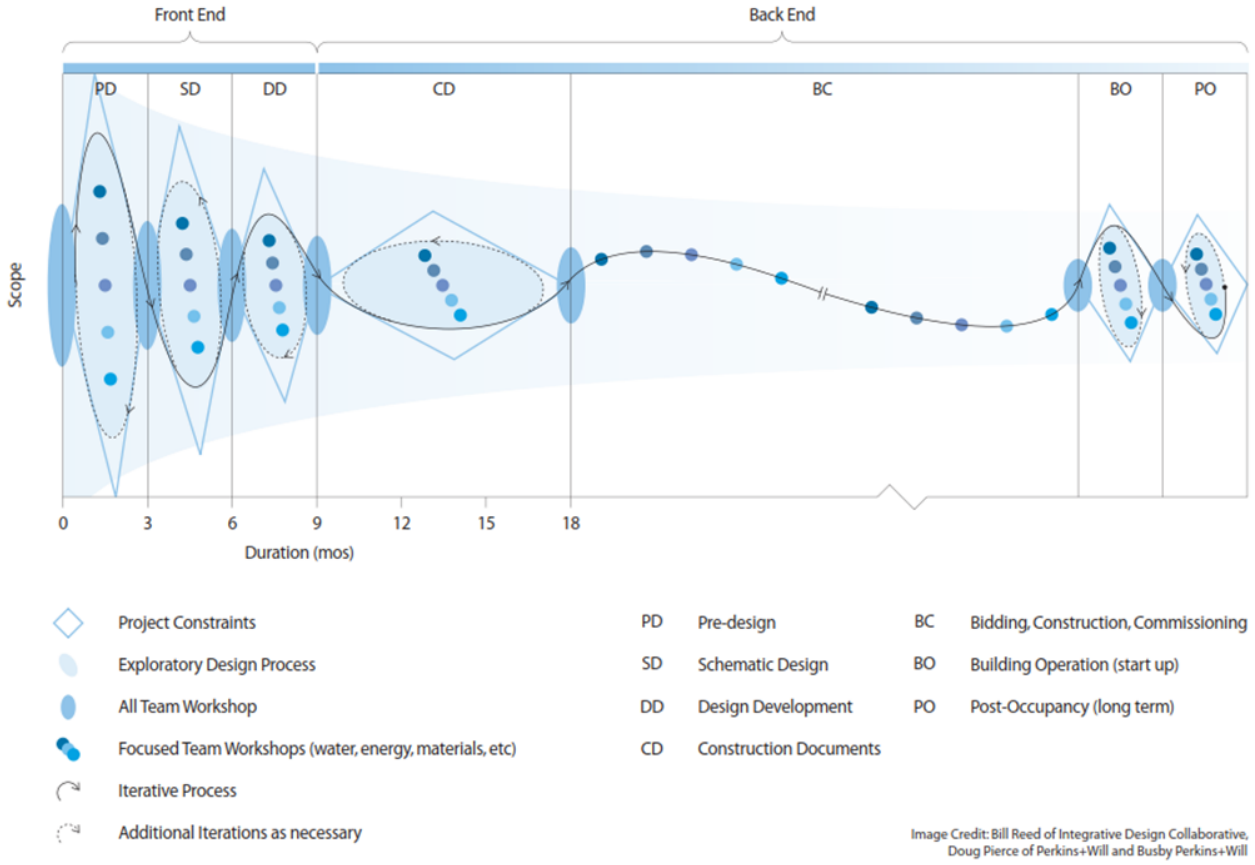


Image Credit: Bill Reed of Integrative Design Collaborative, Doug Pierce of Perkins+Will and Busby Perkins+Will

Introduction

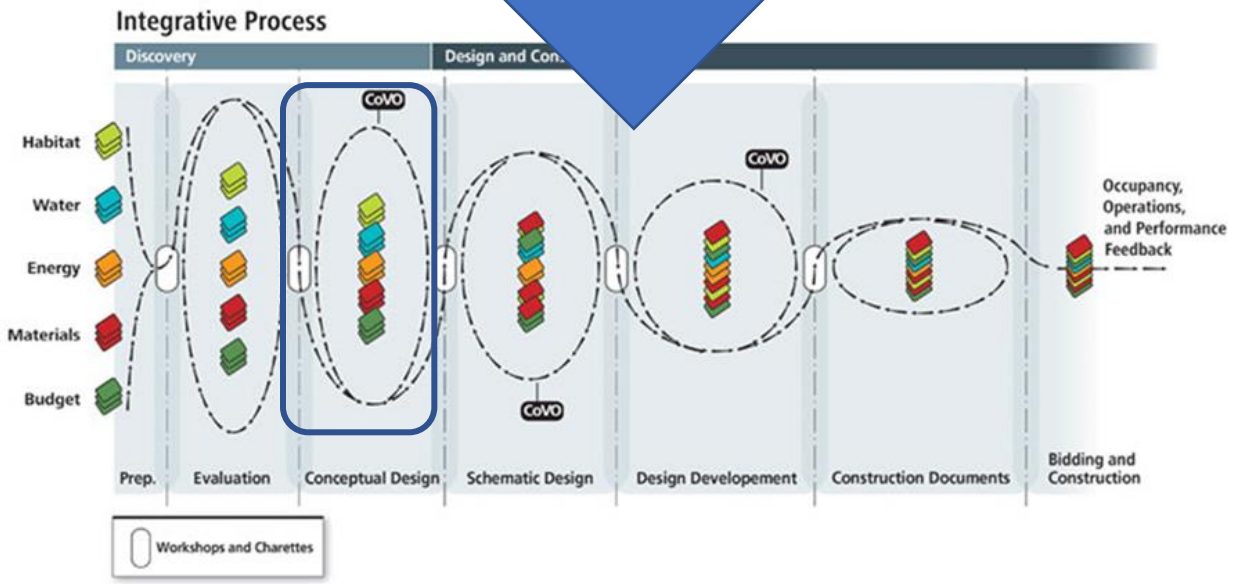
- Conceptual Design Charrette
- Third Research & Analysis Phase: Testing Conceptual design Ideas

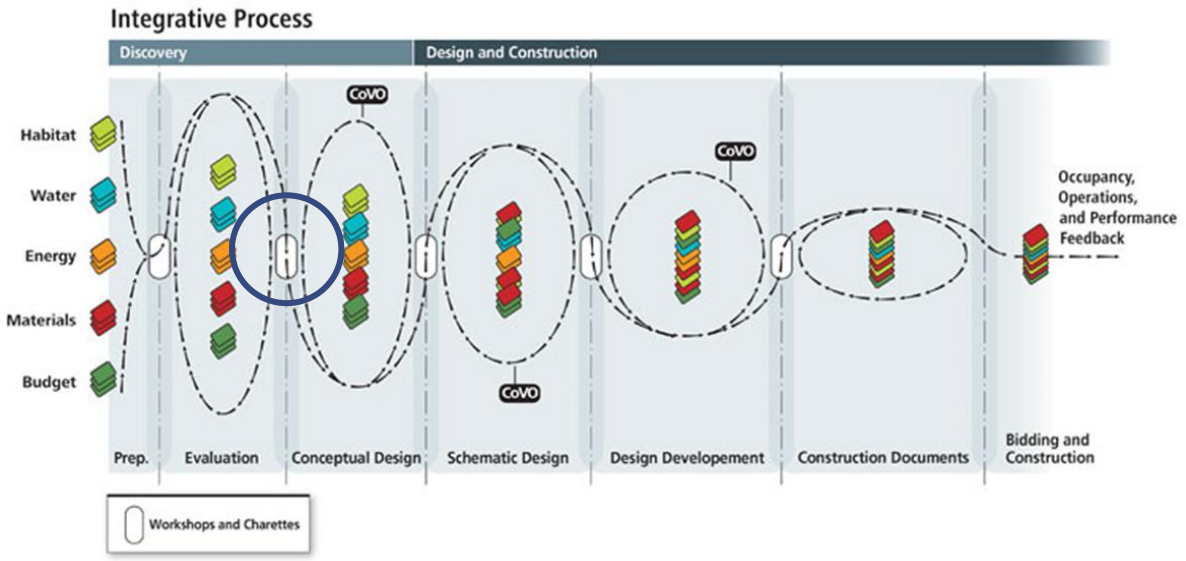
MENTAL MODEL
Client, design, and building teams' mind-set, attitude, and will

PROCESS
Integrated, all parties engaged-system optimization through iterative analysis

TOOLS
Metrics, benchmarks, modeling programs-analytical methods for materials and costing

PRODUCTS/ TECHNOLOGIES
Things and stuff, technologies and techniques





Conceptual Design Workshop

Stage A.4

Workshop No. 2: Conceptual Design Exploration

A.4.1 Workshop No. 2: Activities

- Assess the findings from Stage A.3 (Research and Analysis) of the four key subsystems:
  - Habitat
  - Water
  - Energy
  - Materials
- Generate conceptual site and building design concepts from:
  - Touchstones and Principles
  - Site forces
  - Community and watershed living-system patterns
  - Functional program
  - Breakout group working sessions
- Confirm alignment with Touchstones, Principles, Metrics, Benchmarks, and Performance Targets
- Review integrative cost-bundling studies in progress
- Review and adjust the Process Road Map
- Provide time for reflection and feedback from client and team members
- Commissioning: Review Owner's Project Requirements (OPR)

A.4.2 Principles and Measurement

- Document adjustments to Performance Targets to reflect input from Workshop No. 2
- Commissioning: Adjust OPR to reflect input from Workshop No. 2

A.4.3 Cost Analysis

- Update any required integrative cost-bundling templates to reflect input from Workshop No. 2

A.4.4 Schedule and Next Steps

- Update Integrative Process Road Map to reflect input from Workshop No. 2
- Distribute Workshop No. 2 Report

Generate Conceptual Design Concepts from:

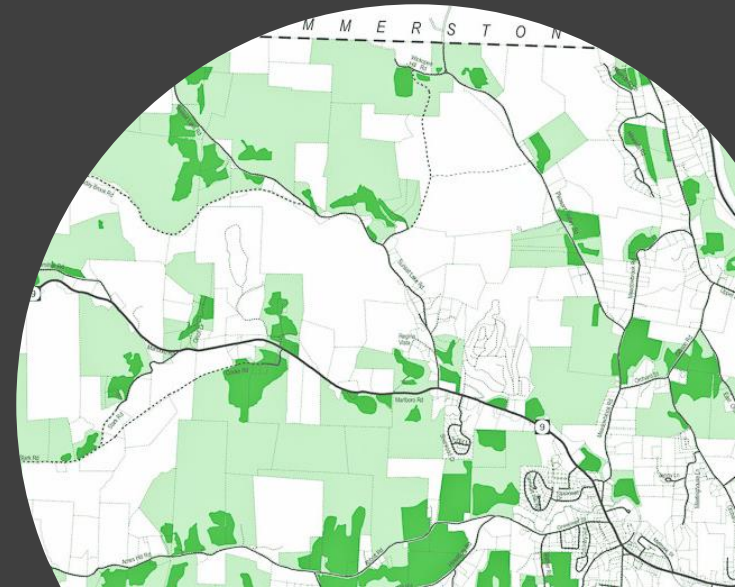
- Touchstones and Principles
- Site forces
- Community and watershed living system patterns
- Functional program
- Breakout group working sessions

Site Forces

- Solar orientation
- Prevailing winds
- Pedestrian and/or vehicular circulation,
- Public transportation access
- Utilities access
- Topography
- Stormwater flows
- Views
- Noise sources
- Neighborhood connections

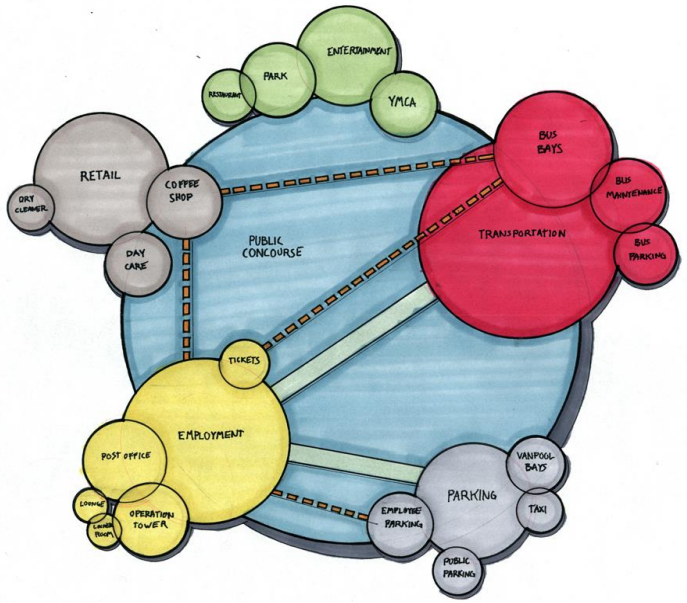
Community and watershed Living-system patterns

- Have a team member (e.g. system ecologist, permaculturist, biologist, …) present to the team an assessment of site and neighborhood interrelationships.
- Try to understand the essence of the place:
  - What gives it vitality?
  - Viability?
  - What is the source of its potential to evolve?
  - Elicit from people what they love about where they live.

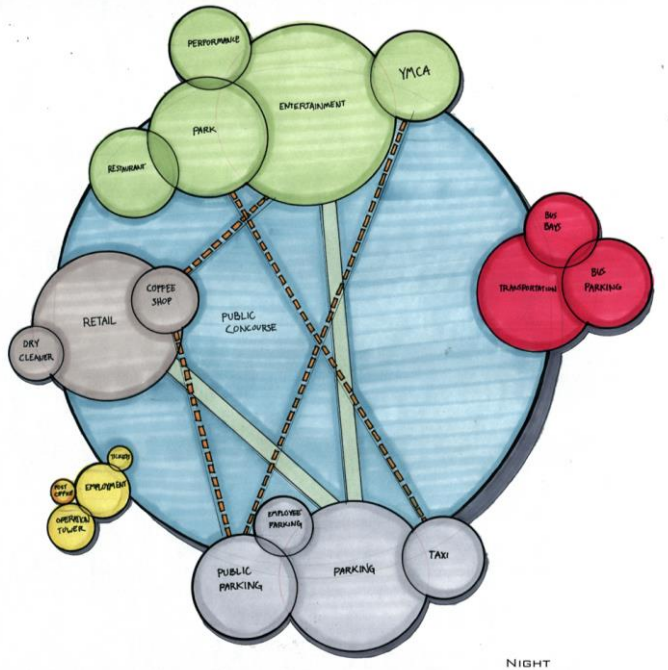


Functional Program

- The research and discoveries often inform and generate adjustments to aspects of the project's functional program.
- e.g. similar occupancy schedules for several programmed spaces may suggest groupings of functions into adjacent or consolidated mechanical zones to improve the efficiency of both distribution components and operations.
- A group exercise that focuses on any potential adjustments to the functional program can be useful.
- The exercise can help clarify the functional "unknowns" or to refine the entire program.
- Defining the functional program collectively, can benefit all project team members in terms of reaching a deeper understanding of the project's purpose.



MORNING



NIGHT

Breakout Group Working Sessions

What you need:

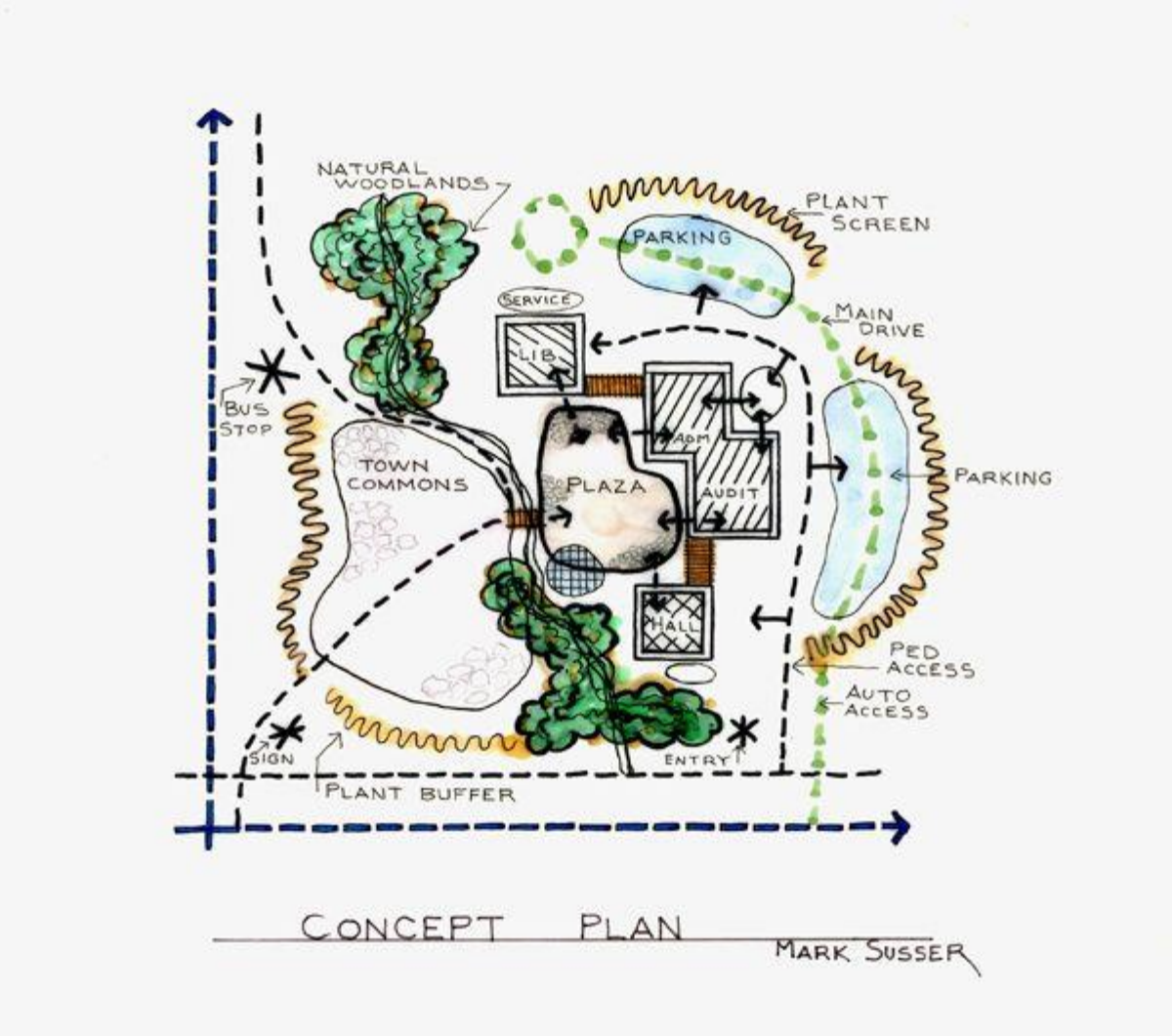
- Tracing paper, markers, colored pencils,….
- Project’s touchstones
- Principles and performance targets
- Information from the site forces exercise, and functional program review

Issues to consider:

- Site connections to the neighborhood
- Contextual remedies
- Functional and program components (in large chunks)
- Strategies aimed at achieving sustainability targets
- Parking, transportation, and service locations and solutions
- Image and character

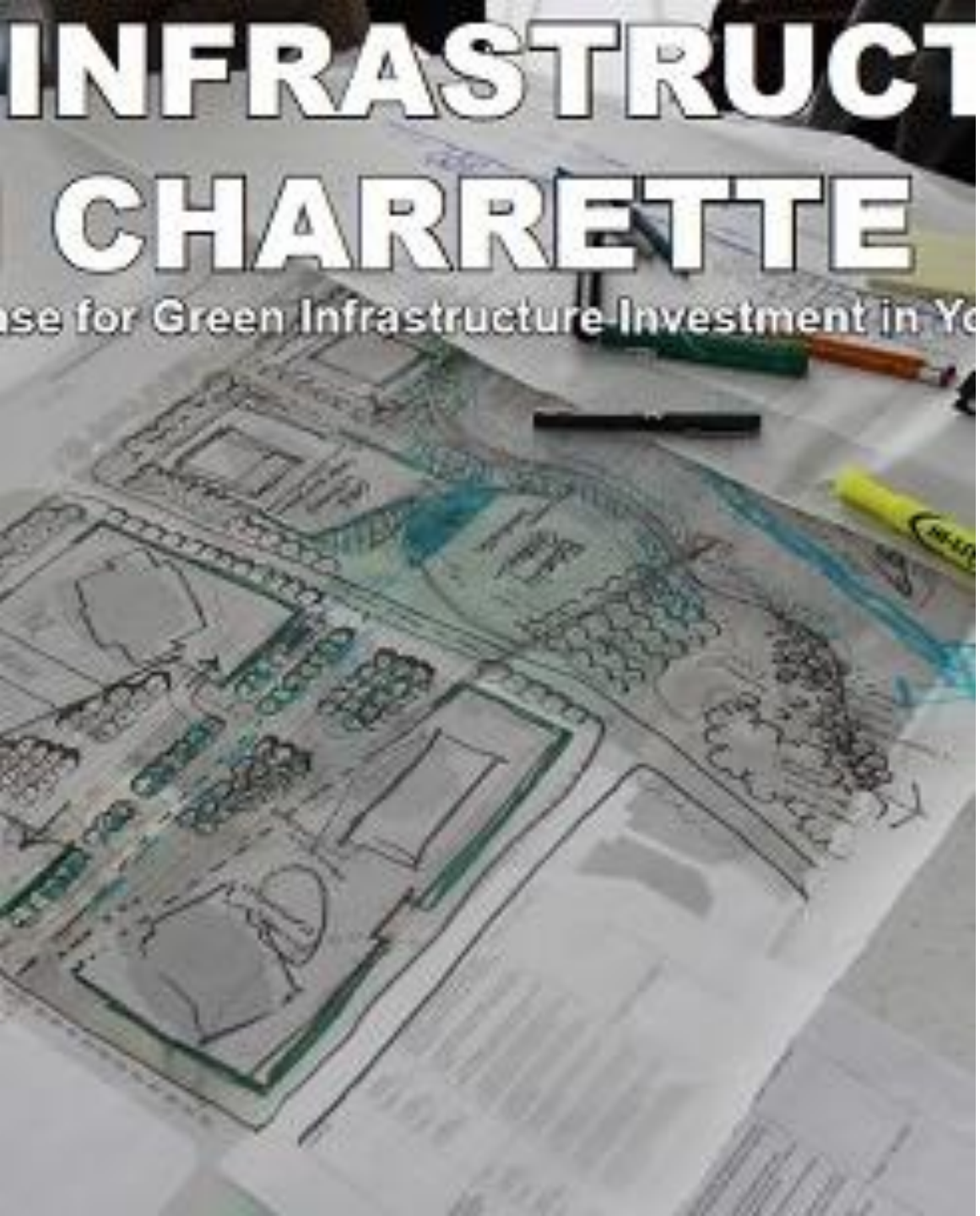
Breakout Group Presentations

- The outcome should be a single consolidated sketch from each small group for presentation to the large group.
- This site plan sketch should clearly depict the overarching design idea and identify all key strategies, proposed site solutions, and chunks of program elements.
- Solicit reflections from the larger group.
- “green hat”/ “red hat” exercise.
- How the “want-to-keep” concepts can best work together to create more whole solutions.
- Second round of breakout groups can be followed.



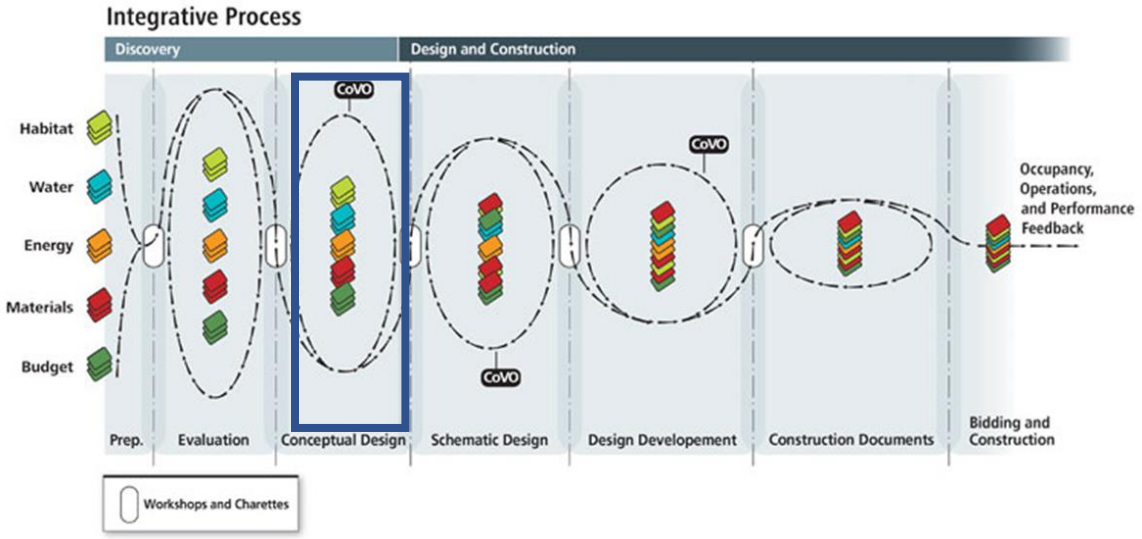
Other Workshop Activities

- Confirm alignment with Touchstone, Principles, Metrics, Benchmarks, and Performance Targets.
- Review/adjust integrative cost-bundling studies in progress.
- Provide time for reflection and feedback from client and team members.
- Commissioning: Review/adjust Owner's Project Requirements (OPR)
- Update integrative Process Road Map to reflect input from Workshop No. 2.



Distribute Workshop No. 2 Report

- Meeting agenda
- Lists of attendees
- Photos of activities
- Site forces exercise sketch
- Images of all conceptual sketches
- Meeting notes recording additional findings, results, reflections, “what to keep”, etc.
- Touchstones, Principles, Metrics, Benchmarks, Performance Targets- Including updated LEED checklist, if applicable
- Updated integrative cost-bundling template
- Process Road Map spreadsheet of schedule and tasks
- Next steps



Stage A.5

Research and Analysis: Testing Conceptual Design Ideas

A.5.1 Research and Analysis Activities: Explorations within individual disciplines and smaller related groups

- Test Conceptual Design schemes from Workshop No. 2 within the realities of the program and guiding principles relative to the four key subsystems:
  - Habitat
  - Water
  - Energy
  - Materials
- Coalesce findings and bring analysis to a reasonable conclusion before beginning the Schematic Design phase

A.5.2 Principles and Measurement

- Confirm and solidify Metrics, Benchmarks, and Performance Targets
- Commissioning: Develop Basis of Design (BOD)

A.5.3 Cost Analysis

- Put a price tag on every strategy and subsystem, then aggregate them into integrated cost bundles

A.5.4 Schedule and Next Steps

- Update Integrative Process Road Map in preparation for Workshop No. 3
- Prepare Agenda for Workshop No. 3

Research & Analysis: Testing Conceptual Design Ideas

Test Conceptual Design Schemes within the realities of the program and guiding principles relative to the four key subsystems

- More detailed analysis of the four key subsystems to test the feasibility of the ideas
- Includes small cross-disciplinary group sessions
- Informed by using various **tools**

Habitat (biotic systems other than human)

- Look for multiple ways to use a unit of water to support life before it leaves the site:
  - Irrigation
  - Habitat for constructed wetlands
  - Vegetated roof(s)
  - Groundwater recharge
  - On-site pond
  - Rain gardens and bioswales
- Investigate planting materials appropriate to the microclimates that may result from the design of the building itself.
- Look for opportunities for restoring plant habitat in conjunction with integrating stormwater management opportunities.

Habitat (Biotic systems other than human)- Tools (examples)

- Floristic Quality Assessment

-Coefficients of conservatism (C value) range from 0 to 10 and represent an estimated probability that a plant is likely to occur in a landscape relatively unaltered from what is believed to be a pre-settlement condition.

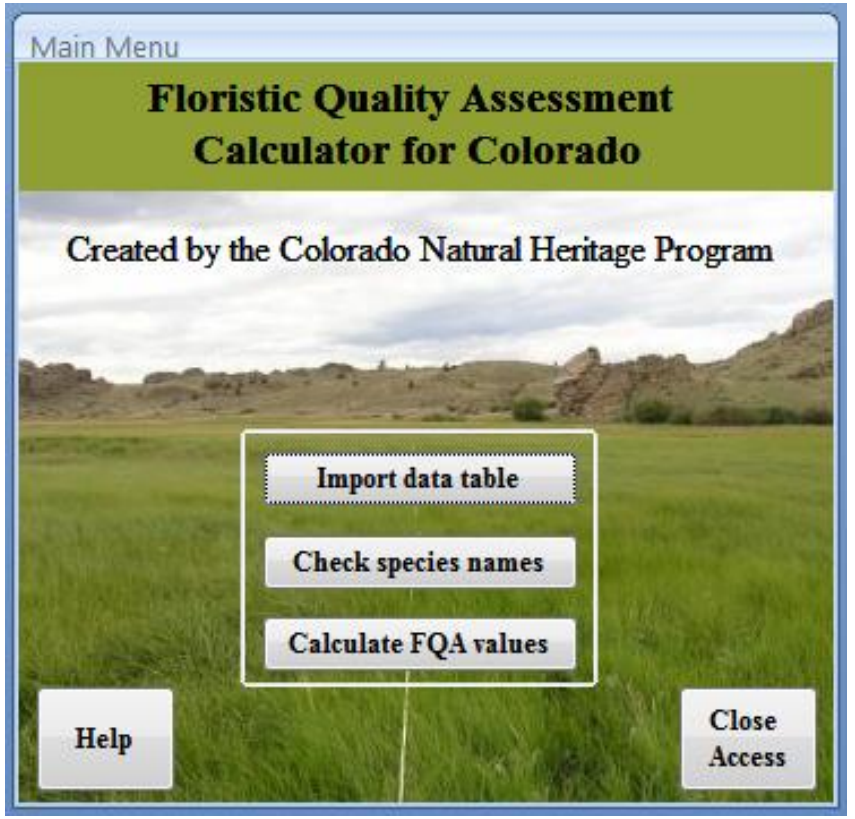
-Floristic Quality Index (FQI): $\bar{C}\sqrt{n}$

n: total number of species

- Observation of living systems

-data or facts alone, do not reveal patterns

- Consolidated Inventories of soil, plant species, animal habitat, microclimates, and evolutionary interaction of people in the project's place over time.

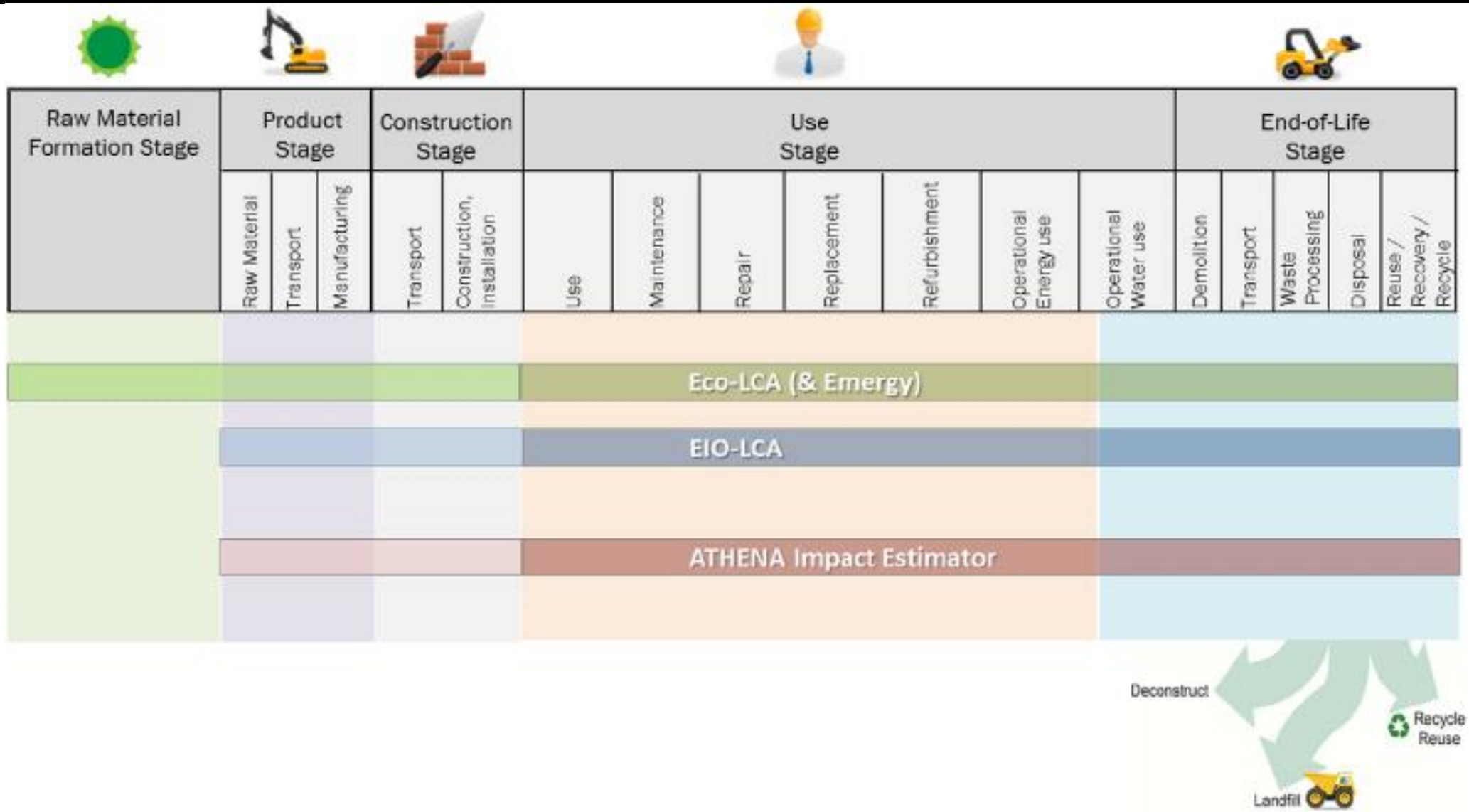


Habitat (Human)

Example of issues to be tested and examined in more detail:

- Indoor air quality
- Ventilation
- Thermal comfort
- Lighting
- Acoustics
- Odor
- Vistas and views
- Inter-relationships between the project and the community
- Toxicants in materials (extraction, production, use, and disposal)

Habitat (Human)- Tools (Examples)- Toxicants



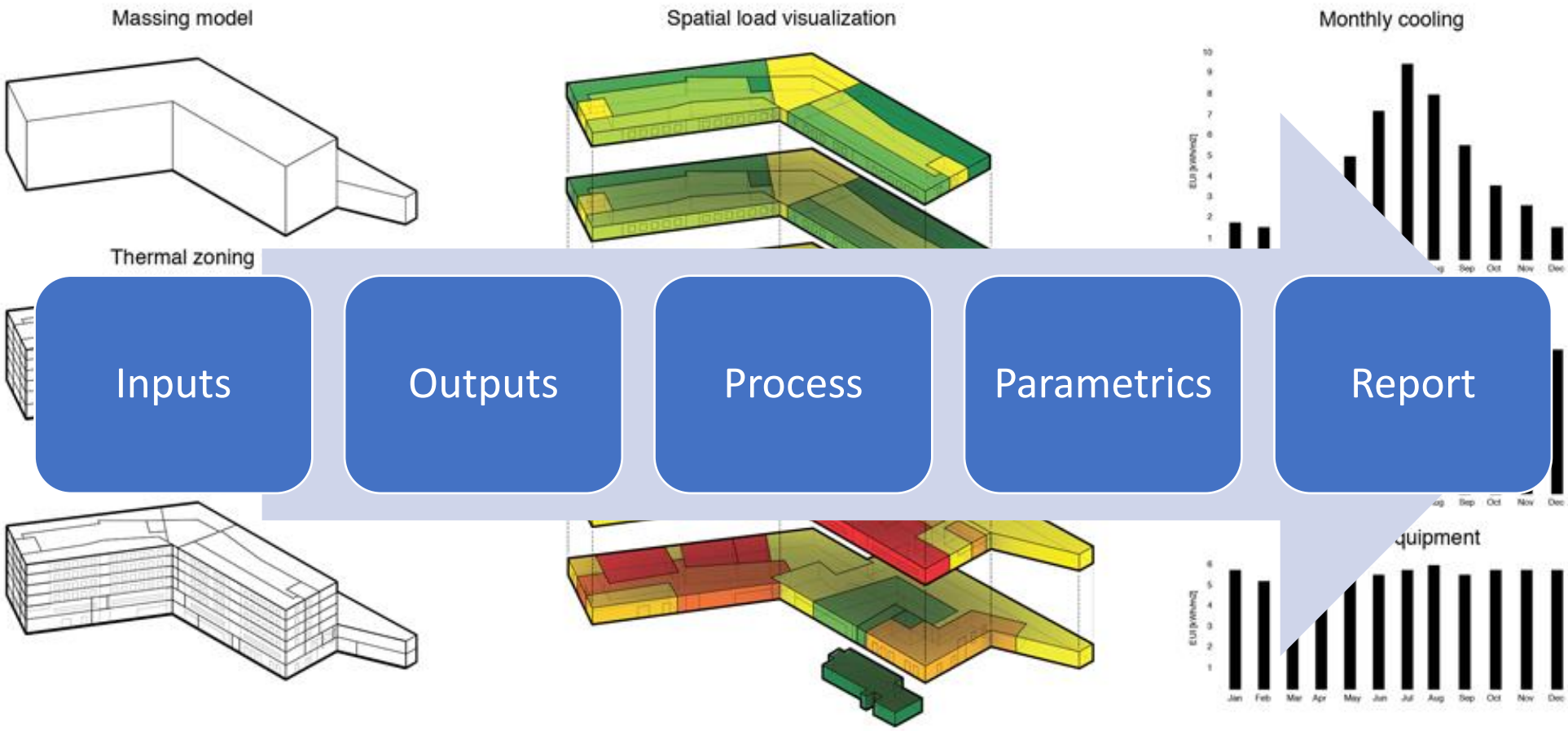
Energy

- Modeling runs to evaluate the effectiveness of individual strategies.
- Determine an appropriate baseline for comparison.
- Reduce, Reduce, Reduce!
- Prioritize Energy-efficiency measures (EEMs)
- HVAC system options should be evaluated after all loads have been reduced via the most promising combination of EEMs.

Energy-Tools

- Energy-10
- E-Quest
- VisualDOE
- HAP
- TRACE
- EnergyPlus (BLAST+DOE-2)
- TRaNsient Systems Simulation (TRANSYS)

Energy Simulation Tools

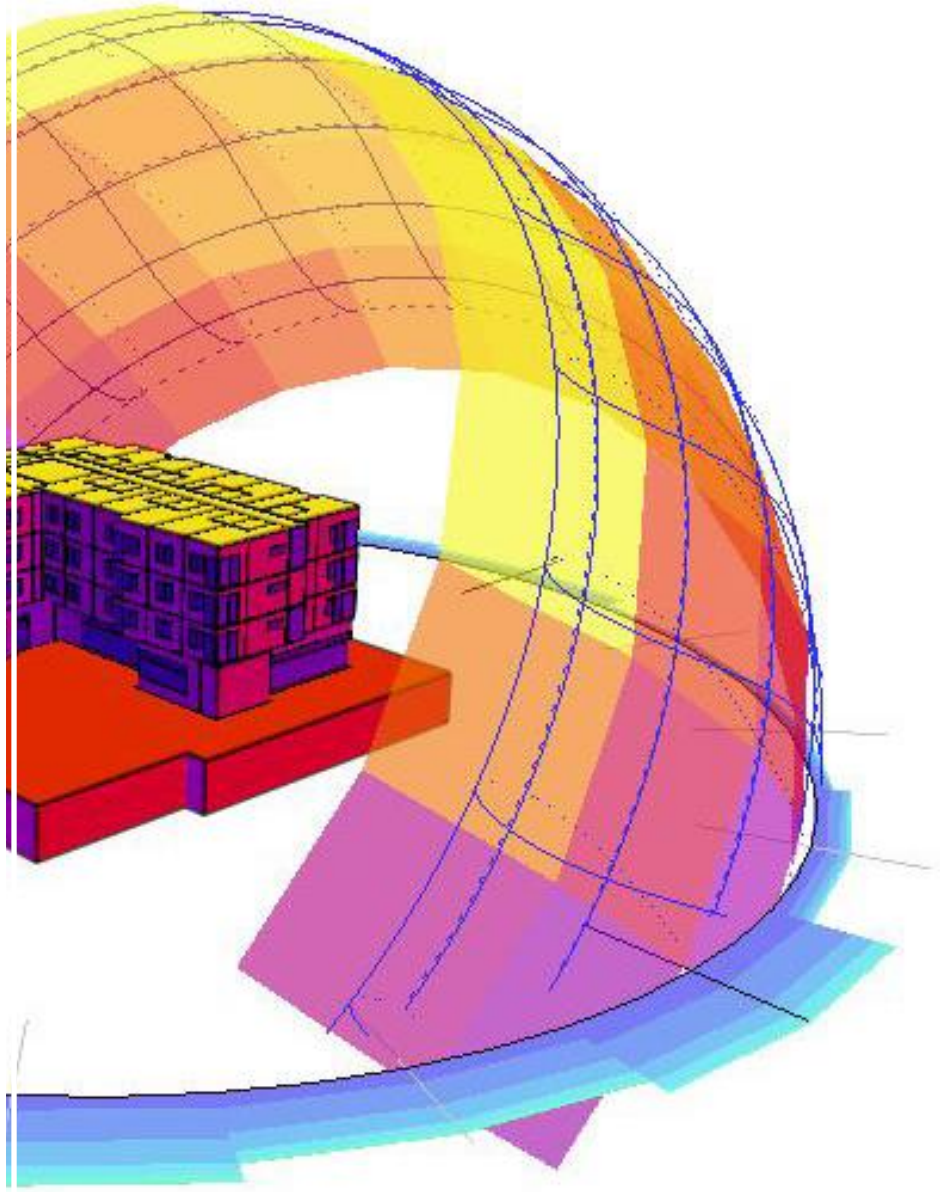


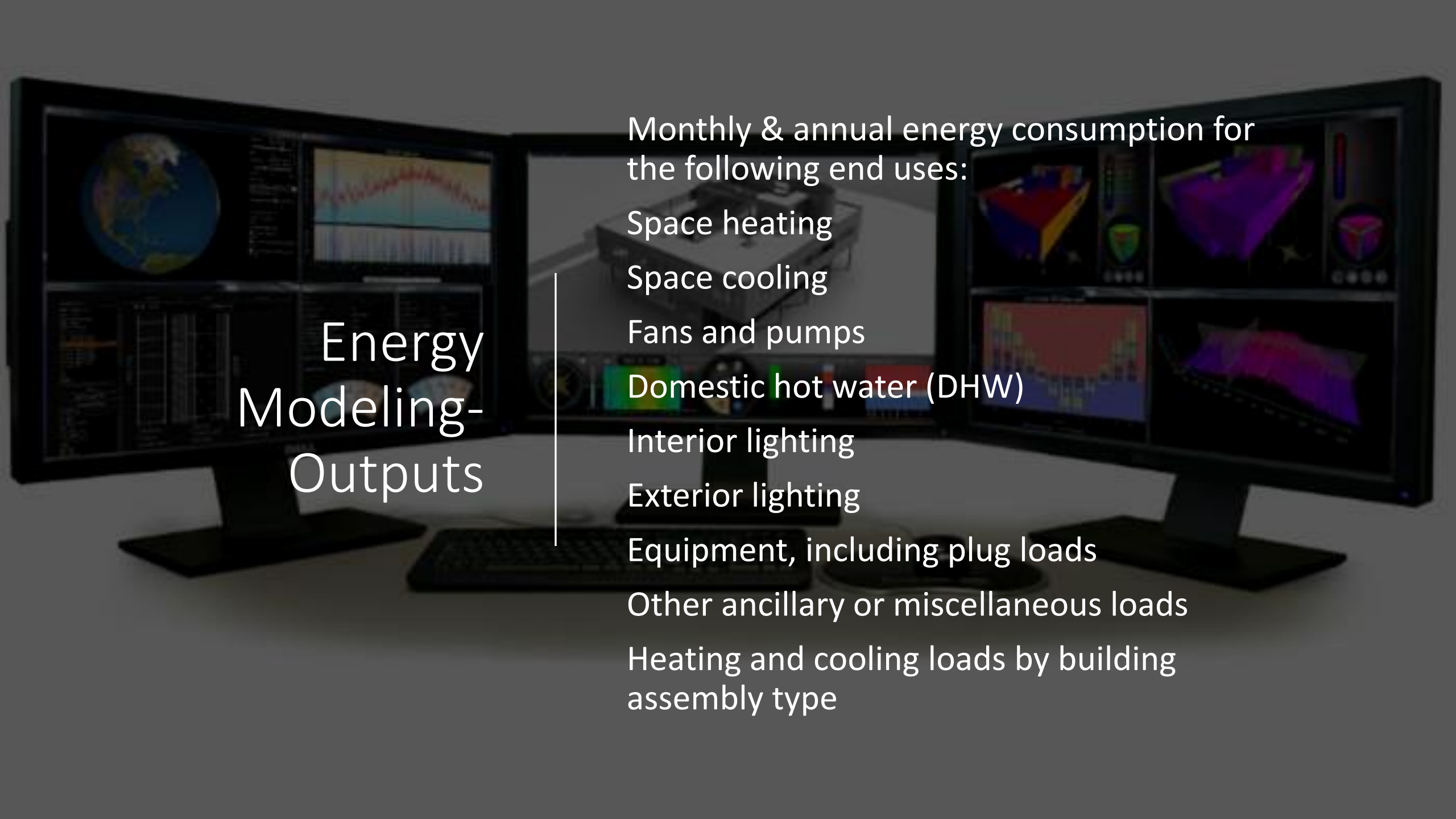
Archsim Energy Modeling for Grasshopper © Timur Dogan

Image credits: Aiko Nakano, Denise Rivas, Manos Saratsis, Julia Sokol

Energy Modeling- Inputs

- Envelope data (U value and thermal mass inputs)
- Areas of floor, wall, roof, and glazing, etc, by zone and orientation.
- U-value, Tvis, and SHGC for glazing
- Internal gains such as people and equipment
- Lighting loads and schedules
- Weather data such as insolation, Heating degree days, cooling degree days, wind rose charts
- Seasonal design temperatures
- Indoor conditions- occupied and unoccupied temperature set points
- Utility rates
- Ventilation quantities and schedules
- Ventilation equipment recovery efficiency
- Infiltration assumption
- Distribution equipment types and efficiencies, including fans and pumps, economizer settings, ….
- HVAC equipment type, efficiencies, and details regarding settings.





Energy Modeling-Outputs

Monthly & annual energy consumption for the following end uses:

- Space heating
- Space cooling
- Fans and pumps
- Domestic hot water (DHW)
- Interior lighting
- Exterior lighting
- Equipment, including plug loads
- Other ancillary or miscellaneous loads
- Heating and cooling loads by building assembly type

Energy Modeling Process

Review the outputs to see how they compare with experience and data from actual buildings of similar occupancy (such as energy use data in Target finder).

We want to convince ourselves fist the model is realistic and then we want to be able to design parametric runs to look at variations.

Metrics Comparison for Your Property & Your Target

Metric	Baseline (May 2011)	Current (May 2013)	Target*	Median Property*
ENERGY STAR score (1-100)	72	67	75	50
Source EUI (kBtu/ft²)	210.7	225.4	204.1	276
Site EUI (kBtu/ft²)	119.6	139.7	126.5	171.1
Source Energy Use (kBtu)	24073025.7	25750203.4	23315771.7	31529412
Site Energy Use (kBtu)	13657396.1	15954800.9	14450980.5	19545950.7
Energy Cost ($)	0	0	0	0
Total GHG Emissions (MtCO2e)	1439.5	1583.4	1433.78738412	1939.7964222

* To compute the metrics at the target and median levels of performance, we will use the fuel mix associated with your property's current energy use.

Energy modeling Parametrics- Report

Ferguson Elementary
eQuest v3.6 Modeling Results Summary
Building Energy Enduse Summary for Individual Energy Efficiency Measures (EEMs)

Individual EEM Design Runs	Base Building ASHRAE 90.1-2004 Appendix G w/ modified HVAC	EEM-1 R20 Roof	EEM-2 R30 Roof	EEM-3 Triple Pane Windows	EEM-4 Reduced Lighting LPD=0.75 W/sqft	EEM-5 LPD=0.75 w/ Daylight On/Off Controls	EEM-6 Increased Wall Insulation to overall Rt=18.5	EEM 7 Slab on Grade Edge Insulation	EEM 8 Elim Bridge & South Stair Glazing
Estimated Operating Costs									
Electric	$70,611	$70,472	$69,838	$72,361	$61,214	$58,646	$70,959	$71,583	$68,914
Gas	$68,210	$67,155	$65,771	$55,850	$71,150	$71,620	$63,631	$46,499	$65,424
Total	$138,821	$137,627	$135,609	$128,211	$132,364	$130,266	$134,590	$118,082	$134,338
Cost/SqFt	$1.56	$1.55	$1.52	$1.44	$1.49	$1.46	$1.51	$1.33	$1.51
Consumption									
Site (kBtu / SqFt / Yr)	91.4	90.6	89.1	80.9	90.6	90.2	87.5	71.2	87.8
Building Electric Use (kWh)									
Total	726,722	730,864	725,871	754,987	634,267	610,662	734,861	730,443	701,324
Building Gas Use (Therms)									
Total	56,587	55,704	54,547	46,290	59,033	59,424	52,772	38,497	54,265
EEM Economics									
EEM Savings	NA	$1,194	$3,212	$10,610	$6,457	$8,555	$4,231	$20,739	$4,483

EEM Descriptions

EEM 1 - ASHRAE Baseline but with R20 roof insulation

EEM 2 - ASHRAE Baseline but with R30 roof insulation

EEM 3 - ASHRAE Baseline but with Triple pane windows, Pella Designer Series LowE IG w/ argon w/ 3rd LowE pane, U=0.16, SHGC=0.37, Vt=0.61

EEM 4 - ASHRAE Baseline but with reduced lighting power density (LPD) to 0.75 W/sqft

EEM-5 - ASHRAE Baseline but with reduced lighting power density (LPD) to 0.75 W/sqft and Daylighting On/Off controls for 1/3 of lights in perimeter spaces

EEM-6 - ASHRAE Baseline but with Wall insulation increased such that the overwall wall R=18.5

EEM-7 - ASHRAE Baseline but with R10 24" vertical and horizontal edge insulation added to slab on grade

EEM-8 - ASHRAE Baseline but eliminating all of the bridge windows and 75% of the windows in the South Stairwell.

Figure 5-49 These sample parametric energy modeling runs analyzed individual energy-efficiency measures (EEMs) to evaluate energy savings relative to a baseline (see also Figure 5-50). *Image courtesy of Sheila Sagerer.*

Energy modeling Report- Cumulative effects of combination of chosen EEMs on energy savings

Ferguson Elementary
eQuest v3.6 Modeling Results Summary
Building Energy Enduse Summary for Energy Efficiency Measure (EEM) Combinations

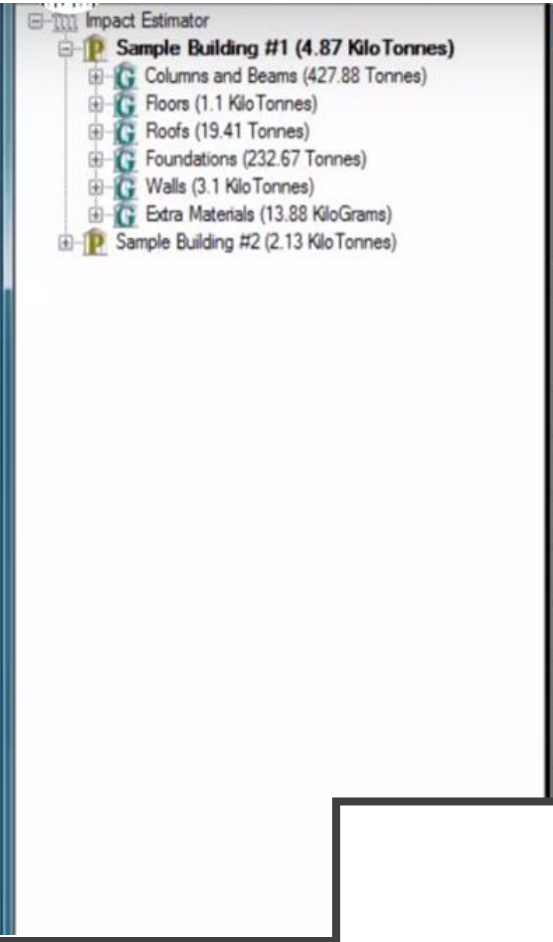
Combined EEM Design Runs	Base Building ASHRAE 90.1-2004 Appendix G w/ modified HVAC	EEM Combo 1 EEM 2, 3, 5, 6, 7, 8 w/ modified HVAC	EEM Combo 2 EEM 2, 3, 5, 6, 7, 8 w/ groundsource heatpumps & Heat recovery on ded OA
Estimated Operating Costs			
Electric	$70,611	$55,864	$64,652
Gas	$68,210	$27,188	$1,280
Total	**$138,821**	**$83,052**	**$65,932**
Cost/SqFt	**$1.56**	**$0.93**	**$0.74**
Building Energy Use (MBtus)			
Site (kBtu / SqFt / Yr)	91.4	46.5	26.7
Building Electric Use (kWh)			
Total	**726,722**	**555,385**	**671,554**
Building Gas Use (Therms)			
Total	**56,587**	**22,409**	**836**
EEM Economics			
EEM Savings	NA	$55,769	$72,889

EEM Descriptions

Baseline building uses ASHRAE design as described on "Baseline Input Summary" tables.

EEM Combo 1 - ASHRAE building with chiller & boiler HVAC system, applying EEMs 2, 3, 5, 6, 7, & 8: R30 Roof, Pella Designer Series Triple Pane Windows U=0.16, SHGC=0.37, VLt=0.61, LPD reduced to 0.75 W/sqft, Daylight On/Off Controls for 1/3 of lights in perimeter spaces, wall insulation to overall Rt=18.5, R10 24" vertical and horizontal edge insulation, and eliminating all windows in bridge connector and 75% of windows in South Stairwell

EEM Combo 2 - ASHRAE Baseline but with GSHPs and heat recovery on dedicated OA units and applying EEMs 2, 3, 5, 6, 7, & 8: R30 Roof, Pella Designer Series Triple Pane Windows U=0.16, SHGC=0.37, VLt=0.61, LPD reduced to 0.75 W/sqft, Daylight On/Off Controls for 1/3 of lights in perimeter spaces, wall insulation to overall Rt=18.5, R10 24" vertical and horizontal edge insulation, and eliminating all windows in bridge connector and 75% of windows in South Stairwell



1 of 1 100% Find | Next

Summary Measure Table By Life Cycle Stages

Project Sample Building #1

Summary Measures	Manufacturing			Construction			Maintenance			End - Of - Life			Operating Energy	
	Material	Transportation	**Total**	Material	Transportation	**Total**	Material	Transportation	**Total**	Material	Transportation	**Total**	Annual	**Total**
Fossil Fuel Consumption (MJ)	3.33e+07	1.53e+06	**3.48e+07**	1.56e+06	1.80e+06	**3.36e+06**	8.93e+06	6.20e+05	**9.55e+06**	1.92e+06	6.73e+05	**2.59e+06**	6.04e+06	**5.98e+**
Global Warming Potential (kg CO2 eq)	3.32e+06	8.80e+04	**3.41e+06**	1.07e+05	1.30e+05	**2.37e+05**	9.96e+05	4.57e+04	**1.04e+06**	1.29e+05	5.18e+04	**1.81e+05**	3.52e+05	**3.48e+**
Acidification Potential (moles of H+ eq)	1.36e+06	3.58e+04	**1.40e+06**	5.12e+04	4.20e+04	**9.33e+04**	7.28e+05	1.46e+04	**7.43e+05**	6.93e+03	1.59e+04	**2.28e+04**	1.43e+05	**1.41e+**
HH Criteria (kg PM10 eq)	2.33e+04	4.69e+01	**2.34e+04**	4.24e+01	5.46e+01	**9.70e+01**	2.25e+04	1.90e+01	**2.25e+04**	9.29e+01	2.06e+01	**1.14e+02**	5.00e+02	**4.95e+**
Eutrophication Potential (kg N eq)	1.75e+03	3.91e+01	**1.79e+03**	4.96e+01	4.57e+01	**9.53e+01**	2.52e+02	1.59e+01	**2.68e+02**	6.95e+00	1.50e+01	**2.20e+01**	1.86e+01	**1.84e+**
Ozone Depletion Potential (kg CFC-11 eq)	1.52e-02	3.59e-06	**1.52e-02**	7.55e-07	5.20e-06	**5.96e-06**	4.41e-03	1.82e-06	**4.41e-03**	5.64e-06	2.06e-06	**7.70e-06**	2.97e-07	**2.94e-**
Smog Potential (kg O3 eq)	3.24e+05	1.98e+04	**3.44e+05**	2.78e+04	2.25e+04	**5.03e+04**	1.02e+05	7.81e+03	**1.10e+05**	6.74e+02	8.44e+03	**9.12e+03**	1.81e+03	**1.79e+**

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Materials-Tools (example)

Athena Impact Estimator for Buildings

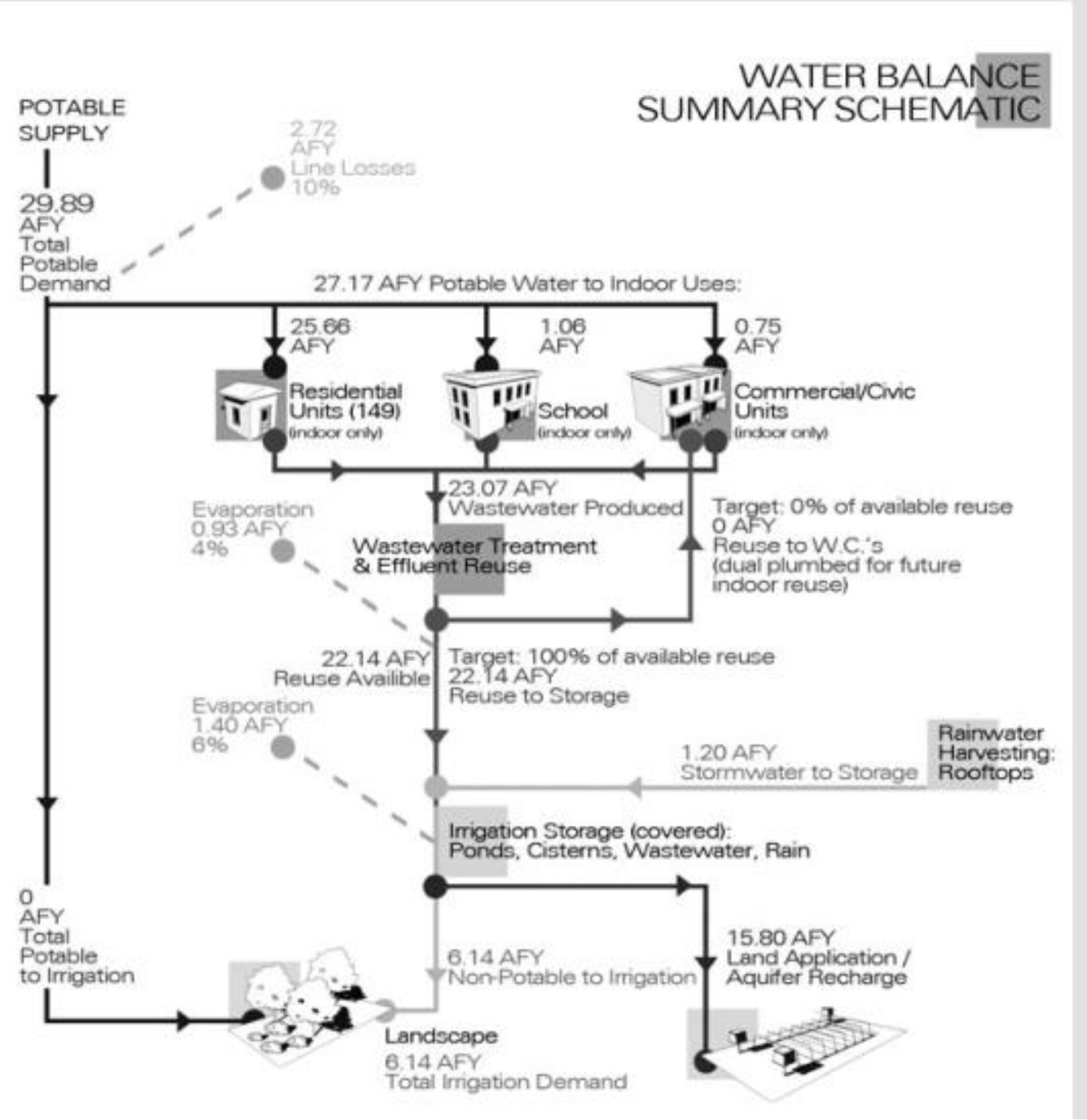
Athena Pavement LCA

Athena EcoCalculator for Commercial Assemblies

Athena EcoCalculator for Residential Assemblies

Water- Tools (example)

Water-balancing diagrams



Commissioning: Develop Basis of Design (BOD)

- ASHRAE defines the BOD as “a document that records the major thought processes and assumptions behind design decisions made to meet the owner’s project requirements (OPR).”

Sample Basis of Design Outline

The following sample BOD outline, when tailored to the specifics of a project, provides a framework for documenting the technical design parameters and quantified performance objectives.

1. Primary design assumptions
- a. Space use based on OPR
- b. Redundancy level
- c. Diversity issues
- d. Climatic conditions
- e. Space zoning
- f. Occupancy types and schedules
- g. Special requirements for indoor environmental conditions

2. Standards
- a. General building codes, guidelines, regulations
- b. LEED related additional requirements (i.e., energy-use reduction, water-use reduction, etc.)
- c. Industry-related requirements (i.e., hospital, information technology (IT), manufacturing standards)

3. Narrative descriptions and performance requirements (chronological descriptions of the main systems as they evolve over the phases of project design and construction)
- a. Architectural systems
- b. HVAC systems
- c. Building automation systems
- d. Lighting systems
- e. Water systems
- f. Power systems (normal/emergency, special metering)
- g. Communications systems
- h. Information technology systems
- i. Security and life-safety systems

Sample BOD Table

TABLE 3 Sample lighting and electrical design criteria.

ITEM	DESIGN CRITERIA
Interior Lighting	• **Controls.** The entire facility shall be on a timed lighting control system with photocells. Lighting shall also be controlled manually by local switches that have motion-controlled occupancy sensors. • **Lighting fixtures** in offices, cubicles, conference rooms, break rooms, utility rooms, the lunchroom, and the data center shall be recessed, high-efficiency linear fluorescents with energy-saving, low-mercury lamps. Lobby lighting shall use metal-halide lamps, LED (light-emitting diode) downlights, and LED accent lights. Restrooms shall have LED downlights. • **Exit signage and emergency lighting** shall be equipped with a 90-minute emergency battery pack. Exit signs shall use LED illumination. • **Light levels setpoints** (in foot-candles) shall be 40 fc; except in the data center and mechanical, electrical, and storage rooms, which shall be 30 fc. • **Lighting heat gain.** The heat gain from lighting fixtures shall be obtained from the lighting power density factors defined in the latest version of ANSI/ASHRAE/IES Standard 90.1, and shall be based on the actual lighting installed in the building.
Exterior Lighting	• **Lighting elements/power density.** All exterior lighting shall employ LED lamps, and shall be designed to use less than at least 25% of the allowable lighting-power density based upon the latest version of ANSI/ASHRAE/IES Standard 90.1. • **Zones of illumination.** All site lighting shall have minimal trespass over the property line. All exterior lighting shall comply with LZ3 zone requirements as defined by the latest version of IESNA RP-33L. • **Fixtures** shall be either pole- or wall-mounted, with angled shade to reduce light pollution. Total lumens above 90 degrees from nadir shall be less than 5%.
Electrical Requirements	• **Design codes.** The electrical design shall comply with the Minnesota Building Code, all applicable local codes, and the requirements of the latest version of NFPA 70. • **Building utilization voltage** shall be 277/480 volt, 3-phase, 4-wire. The calculated service size shall be 1,250 amperes. • **Grounding** shall be in accordance with the latest version of NFPA 70, article 250. Raceway systems shall be concealed, except in mechanical and utility areas.

Questions to Consider for writing the Reflections:

ESTABLISH INITIAL BENCHMARKS, AND PERFORMANCE TARGETS FOR ANY OF THE FOUR KEY SUBSYSTEMS IN YOUR STUDIO PROJECT.

WHAT IS THE ESSENCE OF PLACE IN GAZORKHAN? TRY TO DESCRIBE IT IN ONE WORD!