

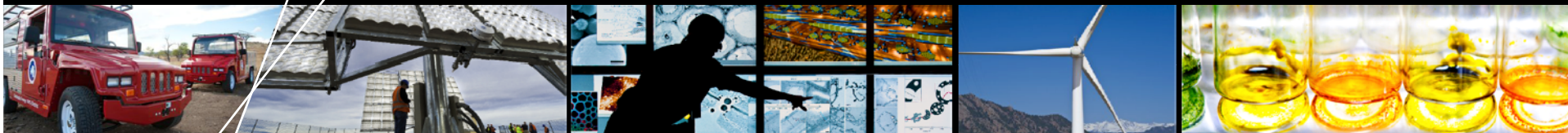


U.S. DEPARTMENT OF
ENERGY | Energy Efficiency &
Renewable Energy



RNL

Integrated Design



NASA Net Zero Workshop

Tom Hootman, AIA, LEED AP

RNL, Director of Sustainability

June 6, 2012

Integrated Design



Integrated Design



Integrated Design



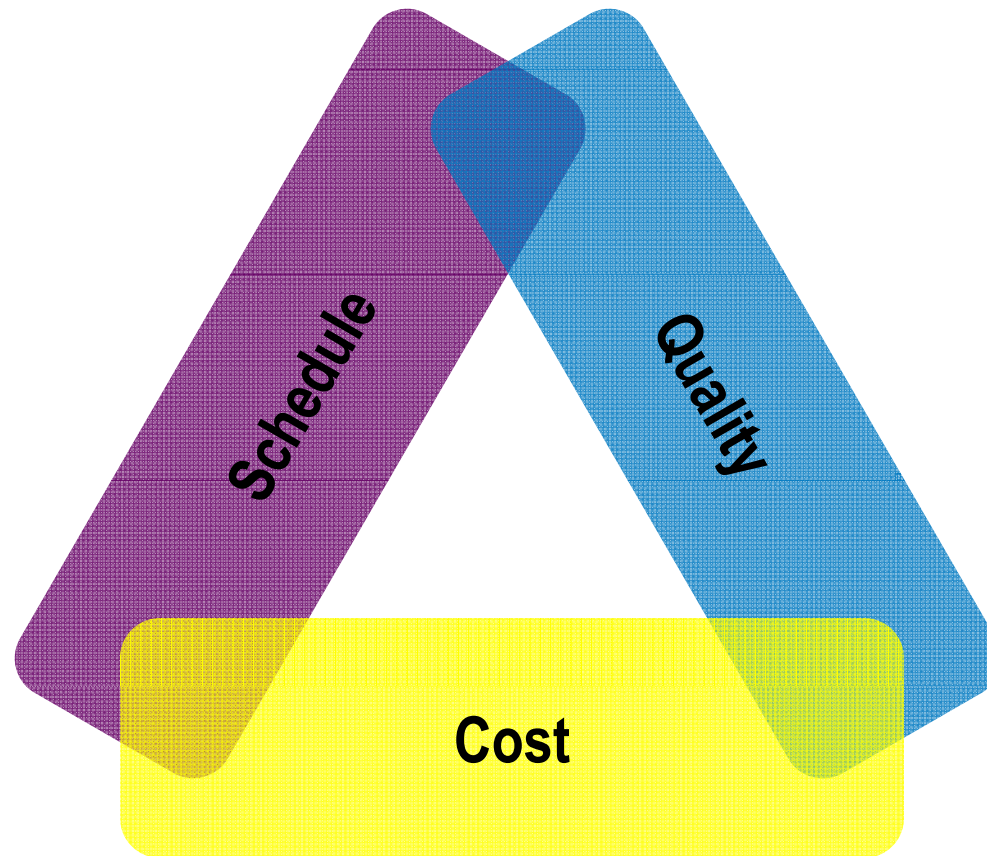
Integrated Delivery



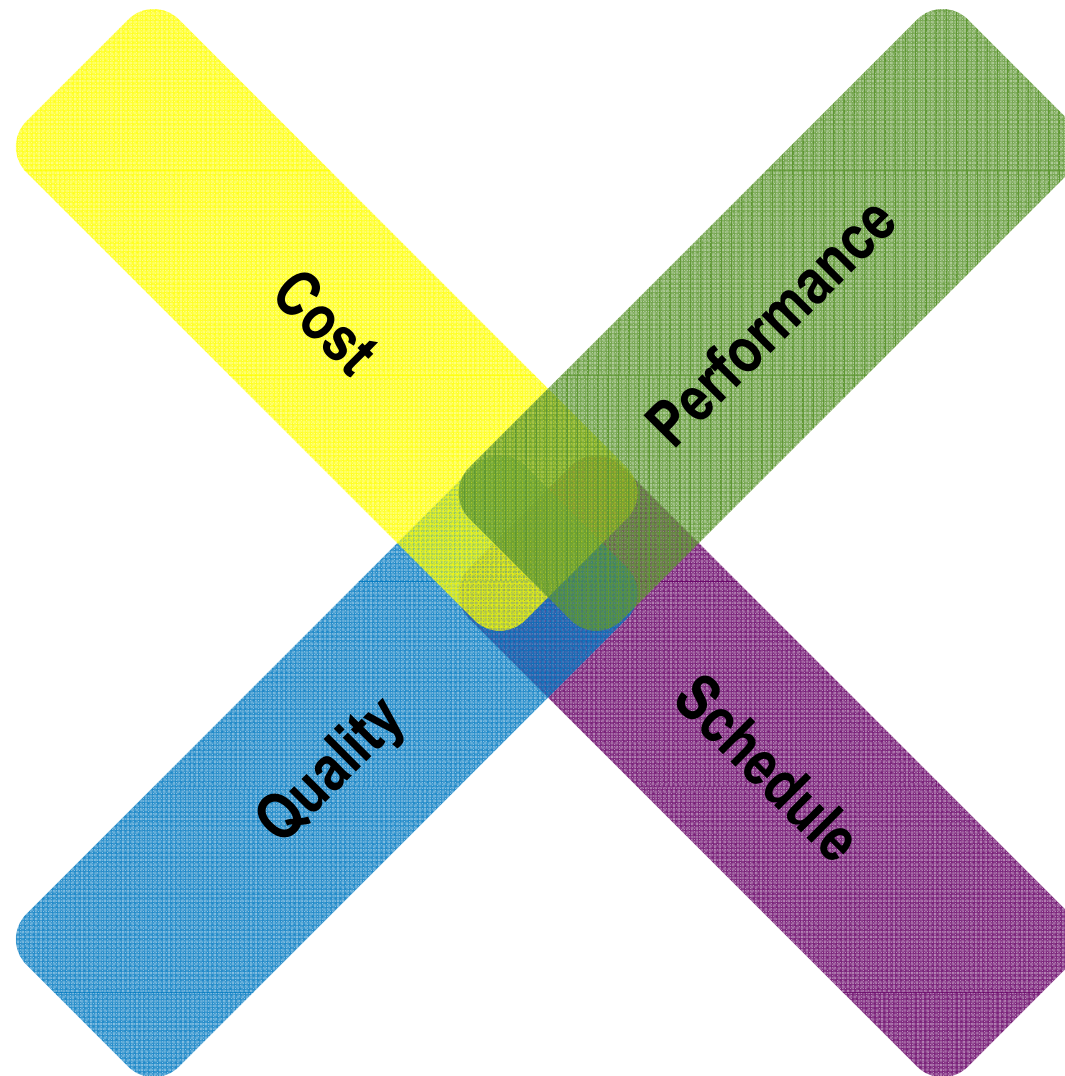
PERFORMANCE RISK



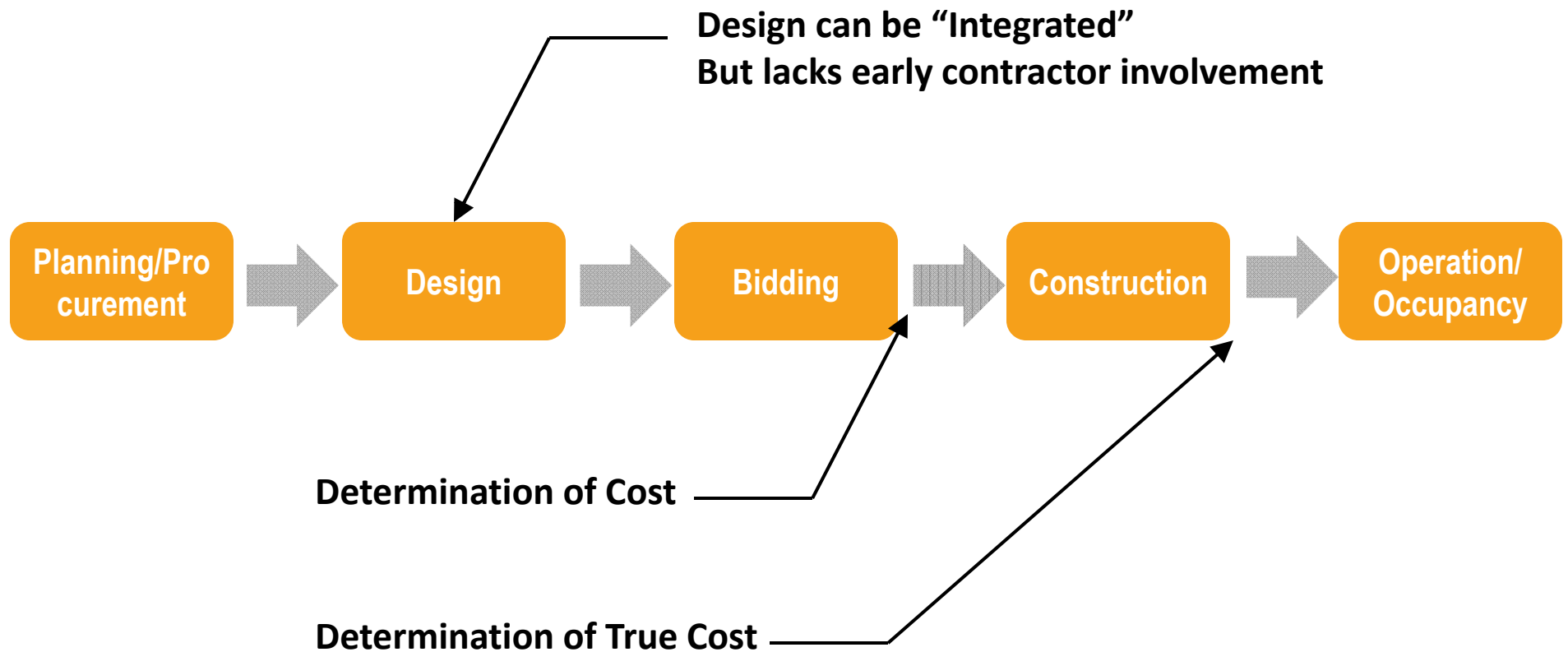
Conventional Delivery



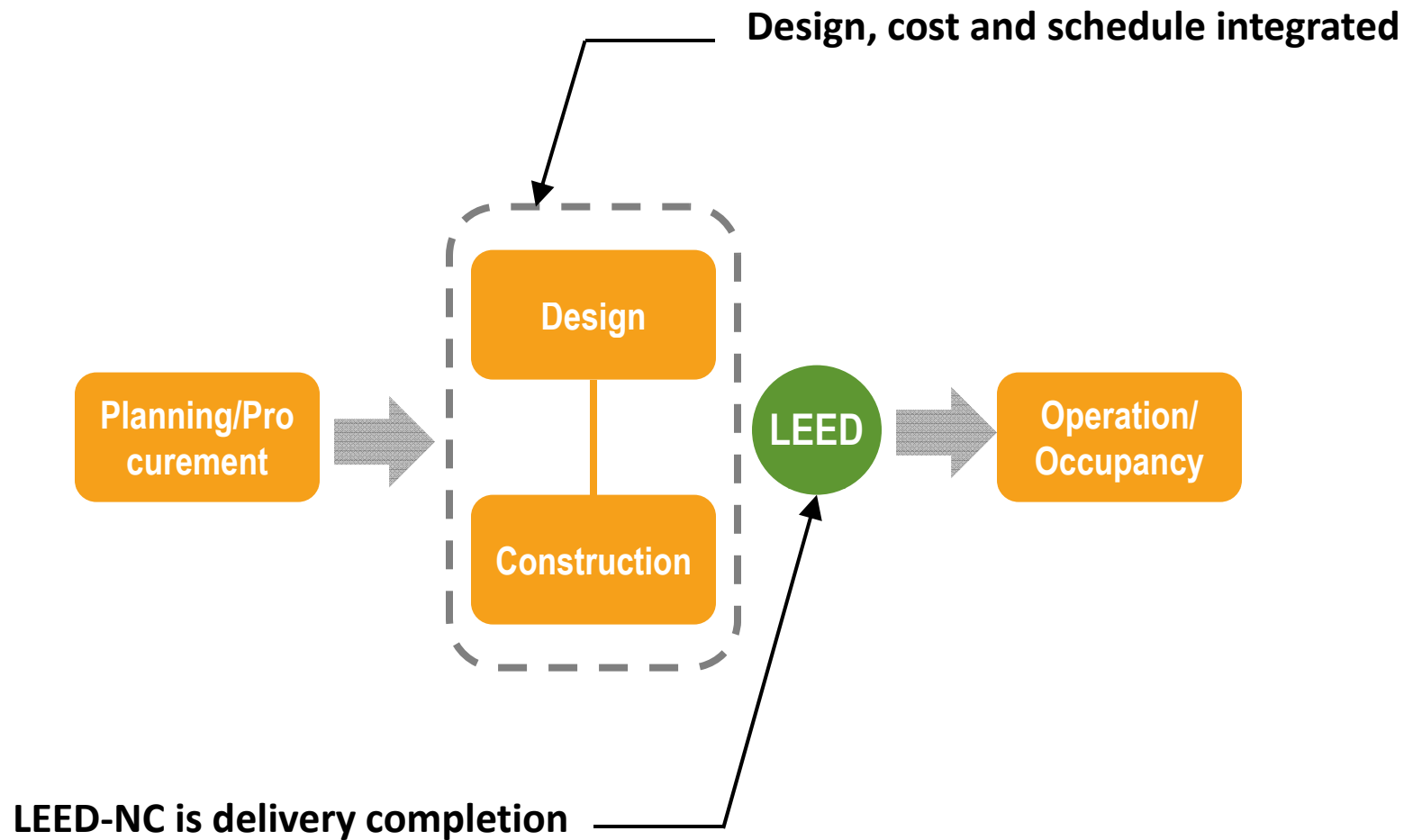
Integrated Delivery



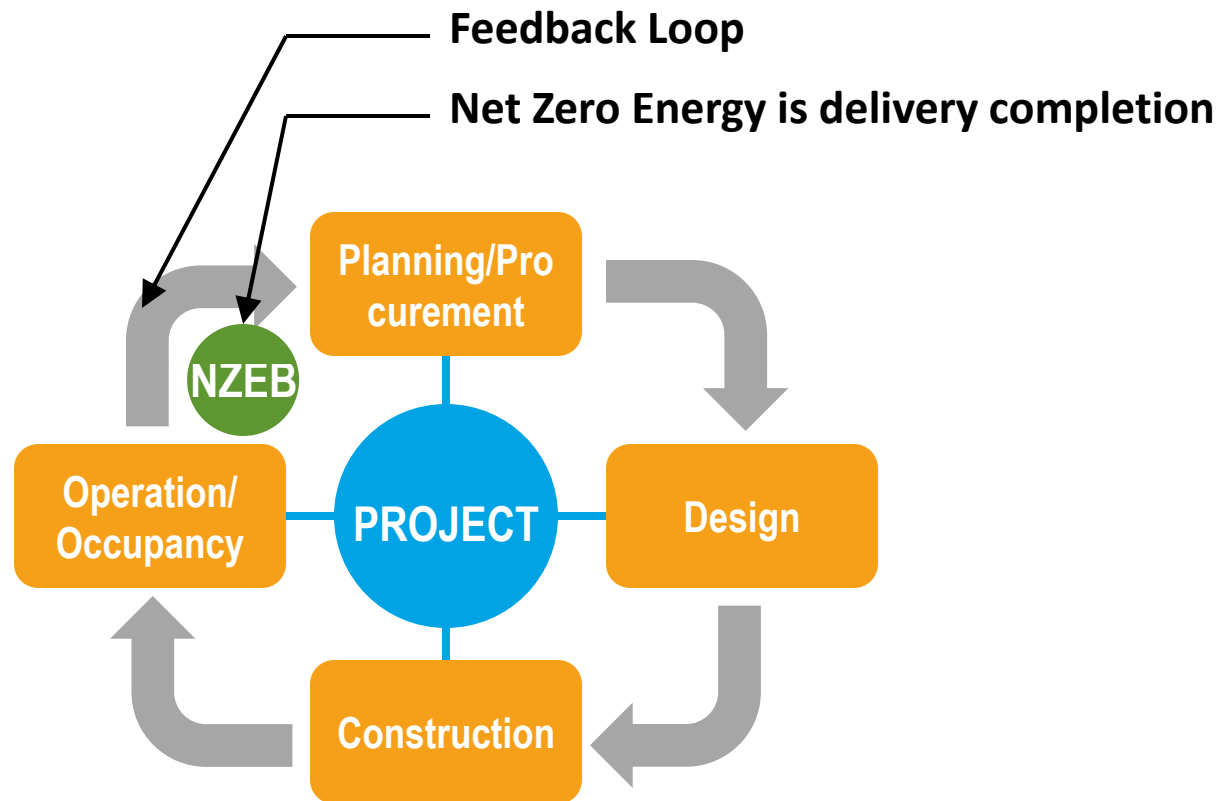
Conventional Delivery



Integrated “LEED” Delivery



Integrated Delivery / Project Centered



Integrated Delivery

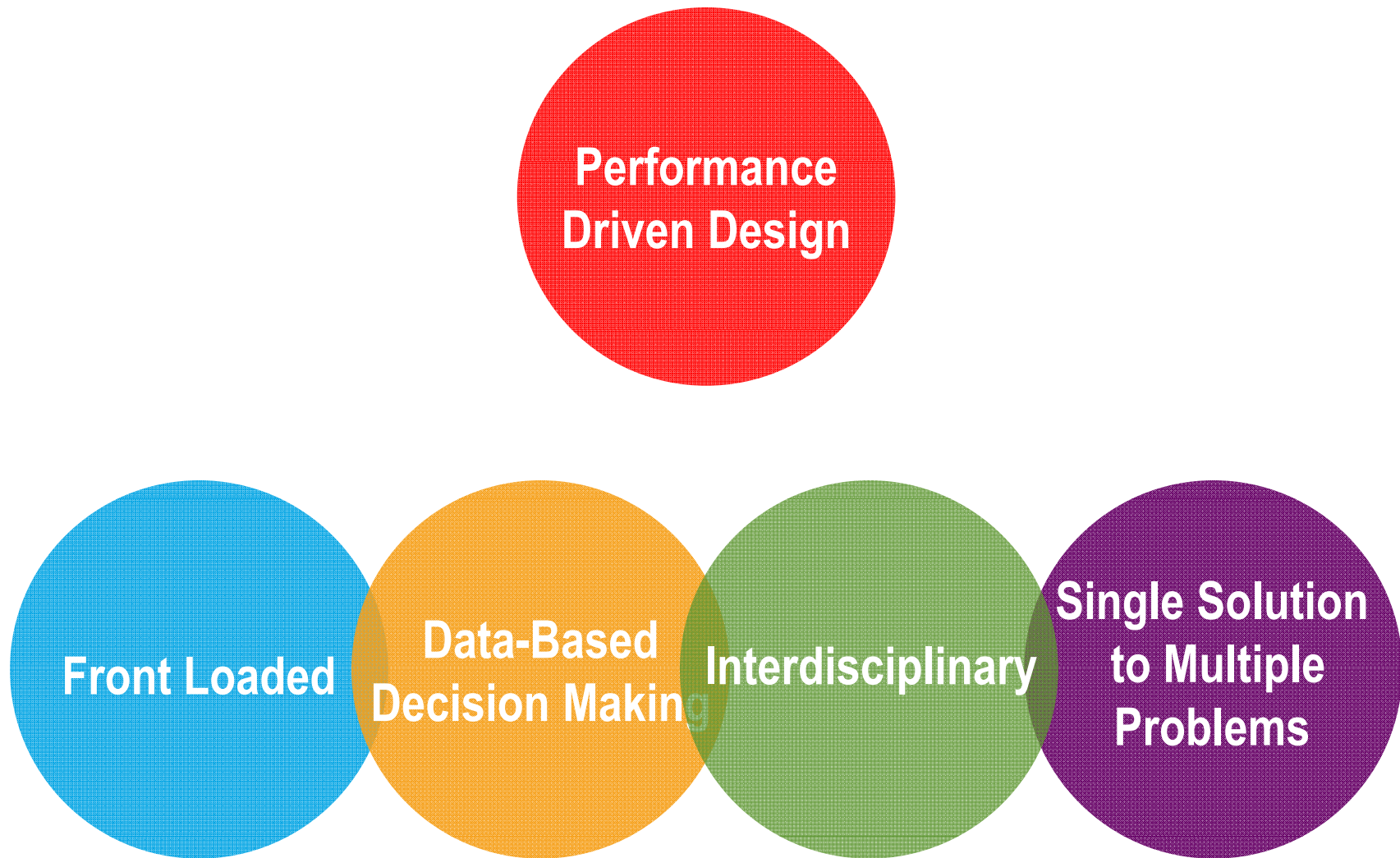


Integrated Design

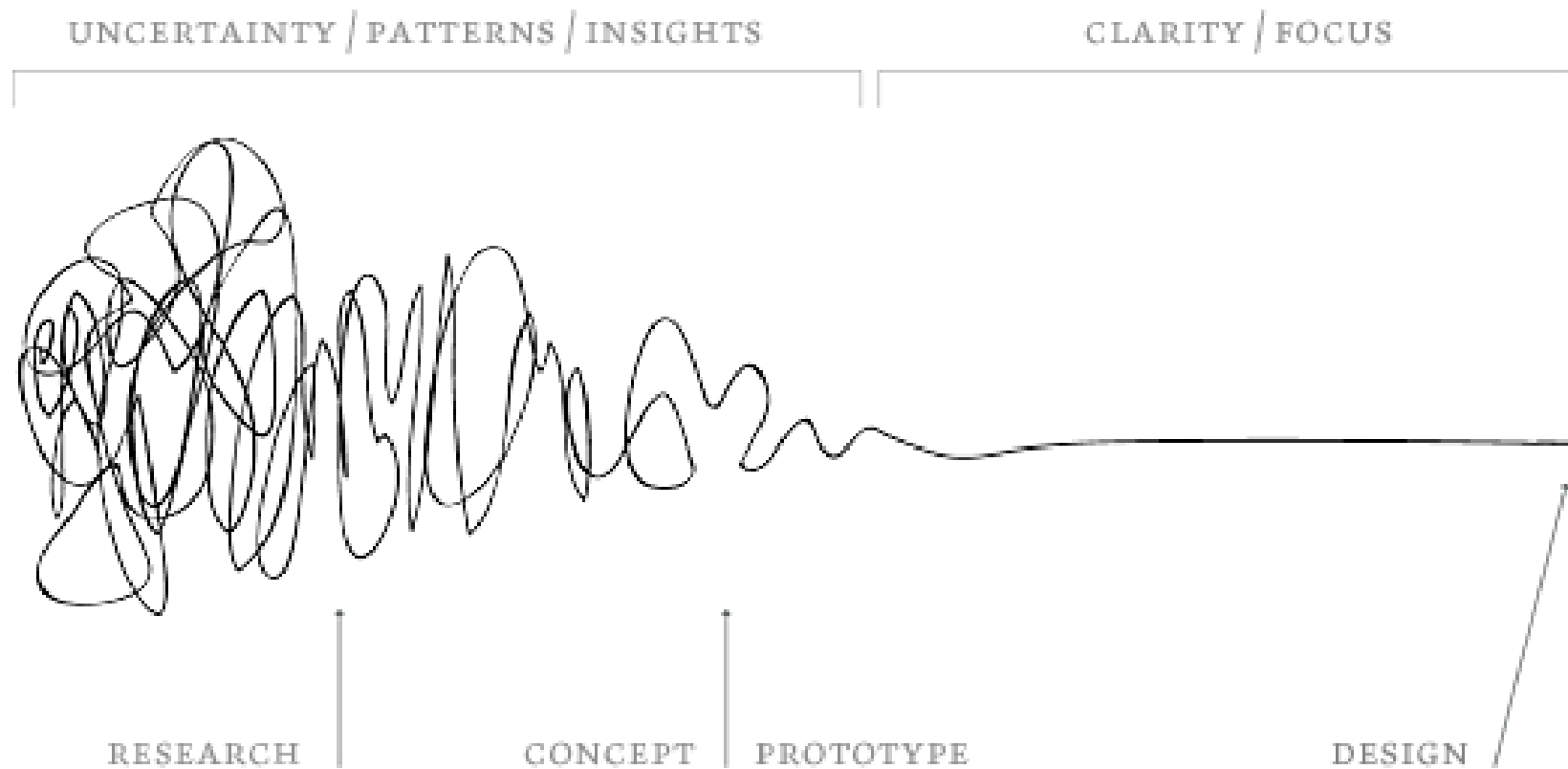


**Performance
Driven Design**

Integrated Design



Integrated Design

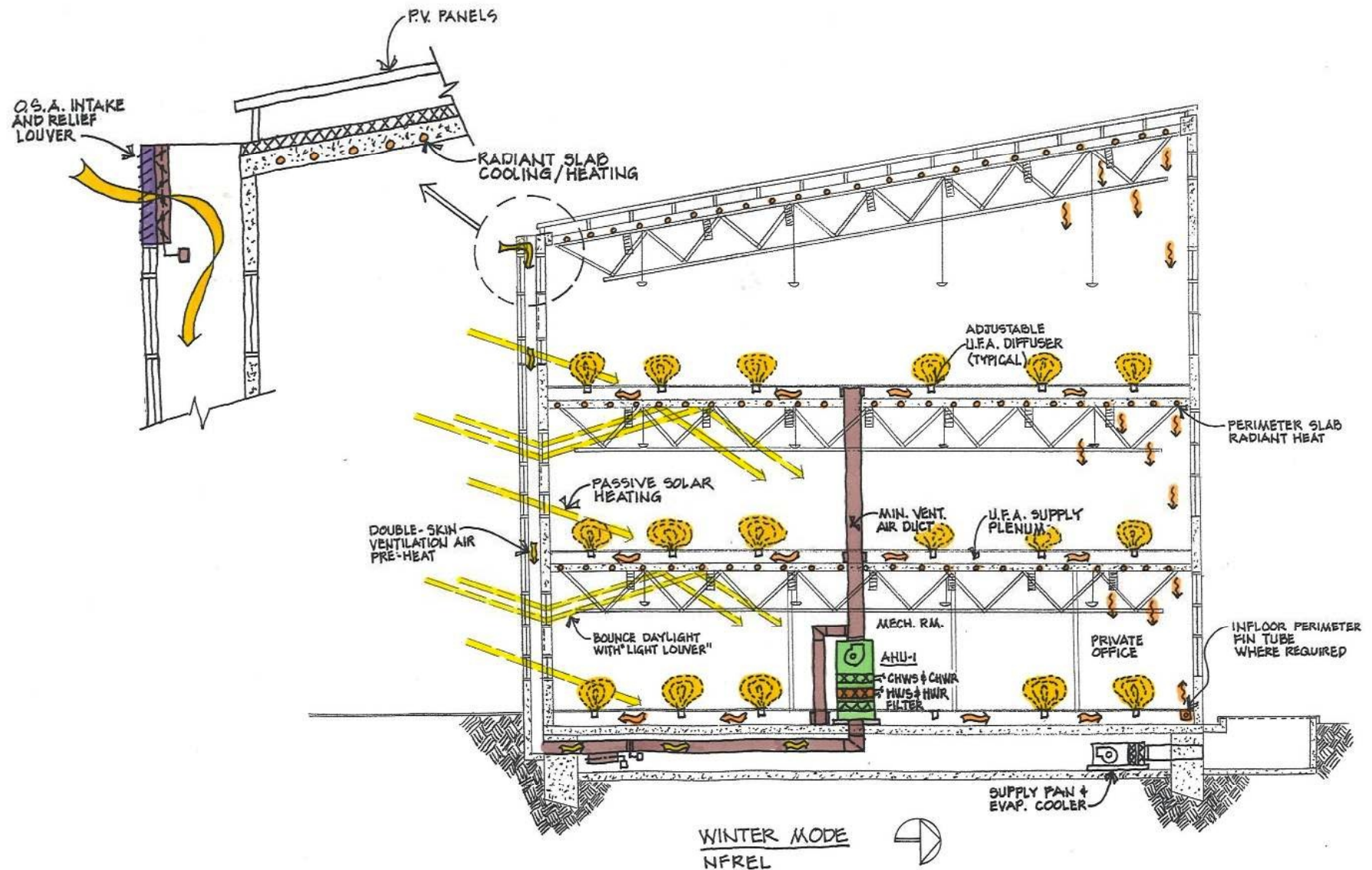


Source: “Squiggle” by Damien Newman / Central Office of Design

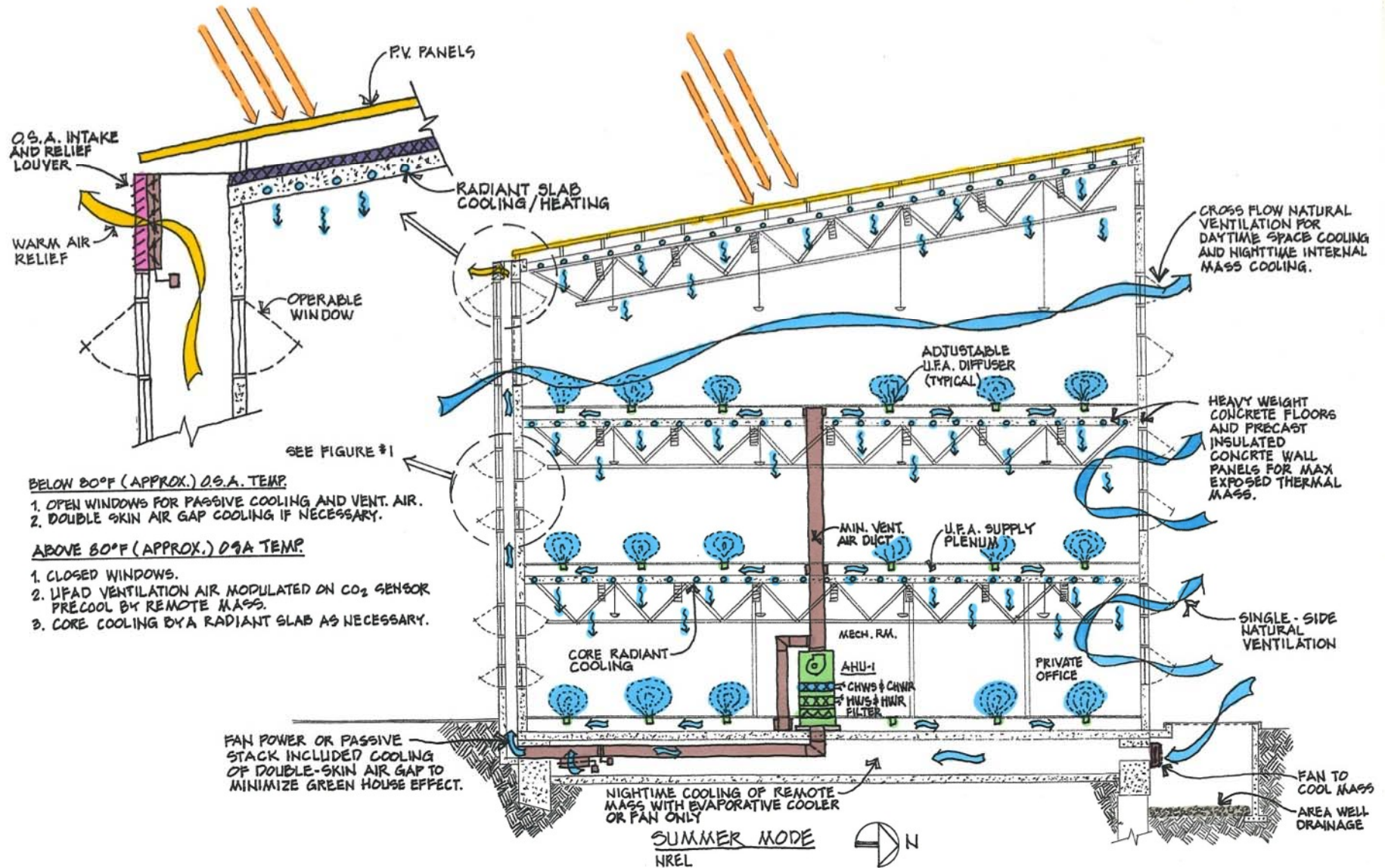
Concept Design = DNA



Concept Design = DNA: Winter Mode Section



Concept Design = DNA: Summer Mode Section



Concept Design = DNA: Competition Rendering



Concept Design = DNA: Design Rendering



Concept Design = DNA: Final Building

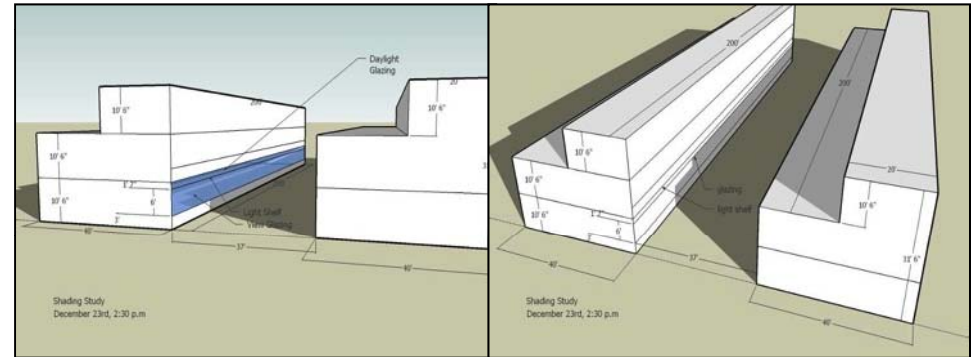


Front Loaded: Eco-Charrette

- **Multi-day charrette to kick-off competition**
- **Included all disciplines in design-build team**
- **Focus on net zero energy goal**
- **Determined NZEB and LEED Platinum strategies**
- **Developed building section first**
- **Began early building simulations**
- **Explored relationship of site, program, plan, roof and section for NZEB strategies**

Data-Based Decision Making: Analysis

- Shading Studies
- Daylighting
- Natural Ventilation
- Thermal Comfort
- Building/Wall Sections
- Window/Wall Ratios
- Roof/Floor Ratios
- Energy Use
- PV Energy Generation



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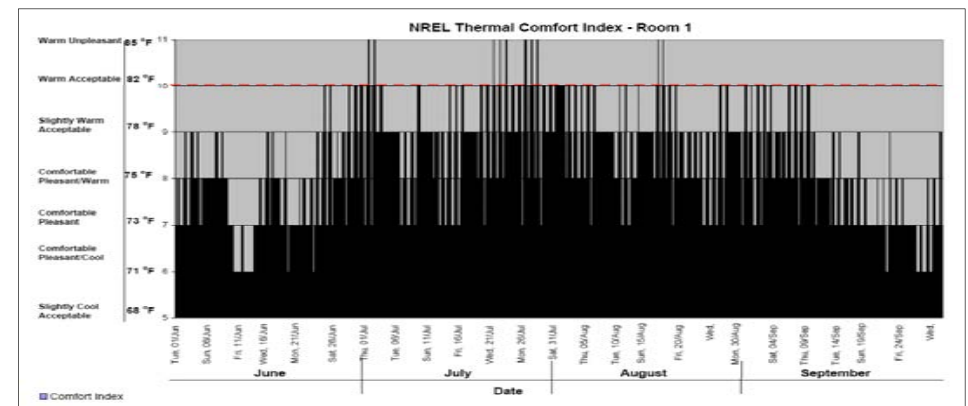
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BDL RUN 6

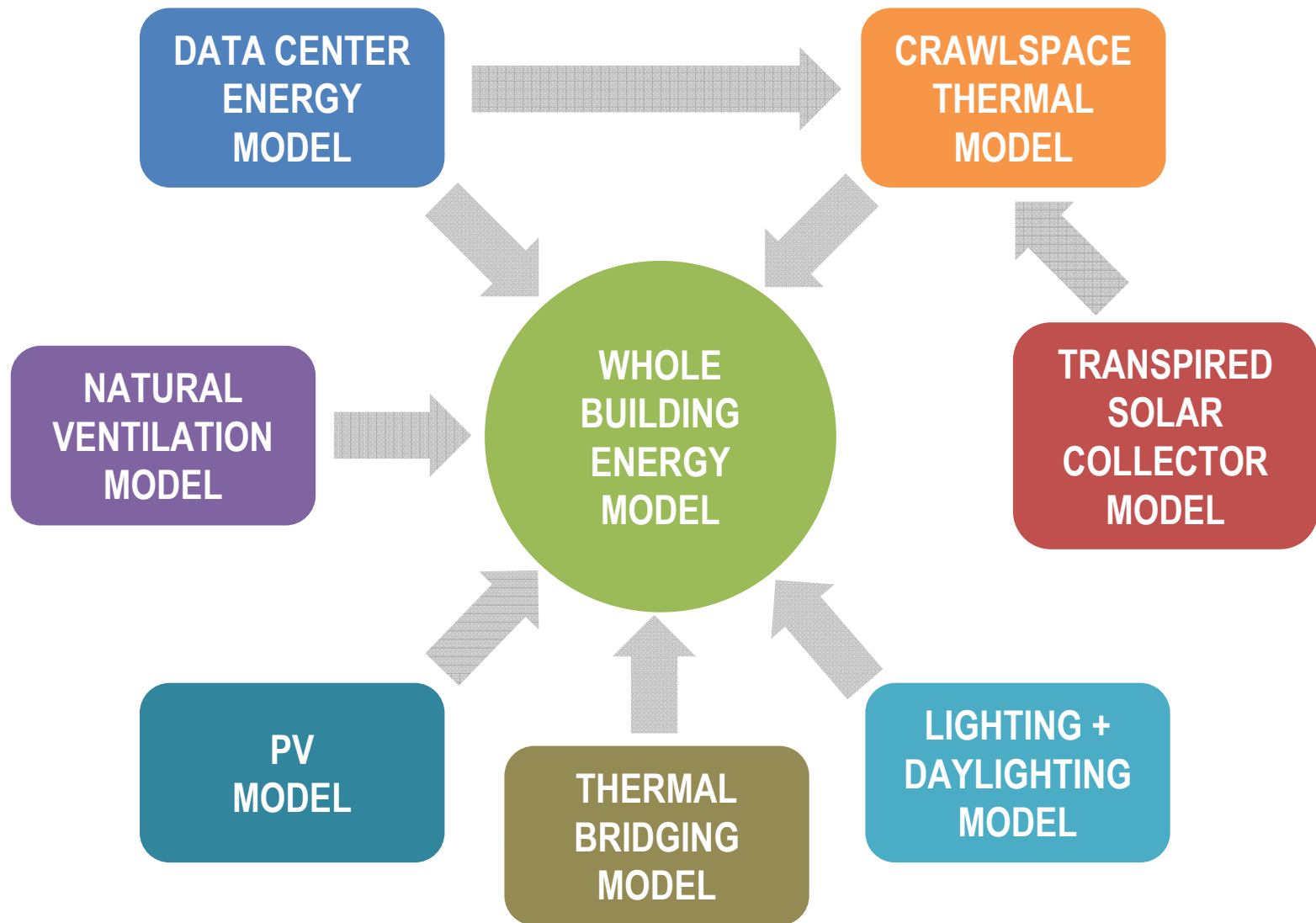
REPORT- BEPS Building Energy Performance

WEATHER FILE- DENVER, CO

	LIGHTS	TASK LIGHTS	MISC EQUIP	SPACE HEATING	SPACE COOLING	HEAT REJECT	PUMPS & AUX	VENT FANS	REFRIG DISPLAY	HT PUMP SUPPLEM	DOMEST HOT WTR	EXT USAGE	TOTAL
EM1 ELECTRICITY MBTU	77.3	31.5	207.0	1.4	59.6	0.0	35.6	13.9	0.0	0.0	0.0	21.8	528.0
FM1 NATURAL-GAS MBTU	0.0	0.0	0.0	467.2	0.0	0.0	0.0	0.0	0.0	0.0	42.7	0.0	509.9
	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
MBTU	77.3	31.5	287.0	468.6	59.6	0.0	35.6	13.9	0.0	0.0	42.7	21.8	1037.8
TOTAL SITE ENERGY				1037.84 MBTU	26.9 KBTU/SQFT-YR GROSS-AREA				26.9 KBTU/SQFT-YR NET-AREA				
TOTAL SOURCE ENERGY				2099.78 MBTU	52.3 KBTU/SQFT-YR GROSS-AREA				52.3 KBTU/SQFT-YR NET-AREA				
PERCENT OF HOURS ANY SYSTEM ZONE OUTSIDE OF THROTTLING RANGE = 0.1													
PERCENT OF HOURS ANY PLANT LOAD NOT SATISFIED = 0.0													
NOTE: ENERGY IS APPORTIONED HOURLY TO ALL END-USE CATEGORIES.													



Data-Based Decision Making: Energy Modeling



Data-Based Decision Making: Energy Modeling

COMPETITION/CONCEPT

DESIGN

CONSTRUCTION

OPERATIONS

CHARRETTE MODEL

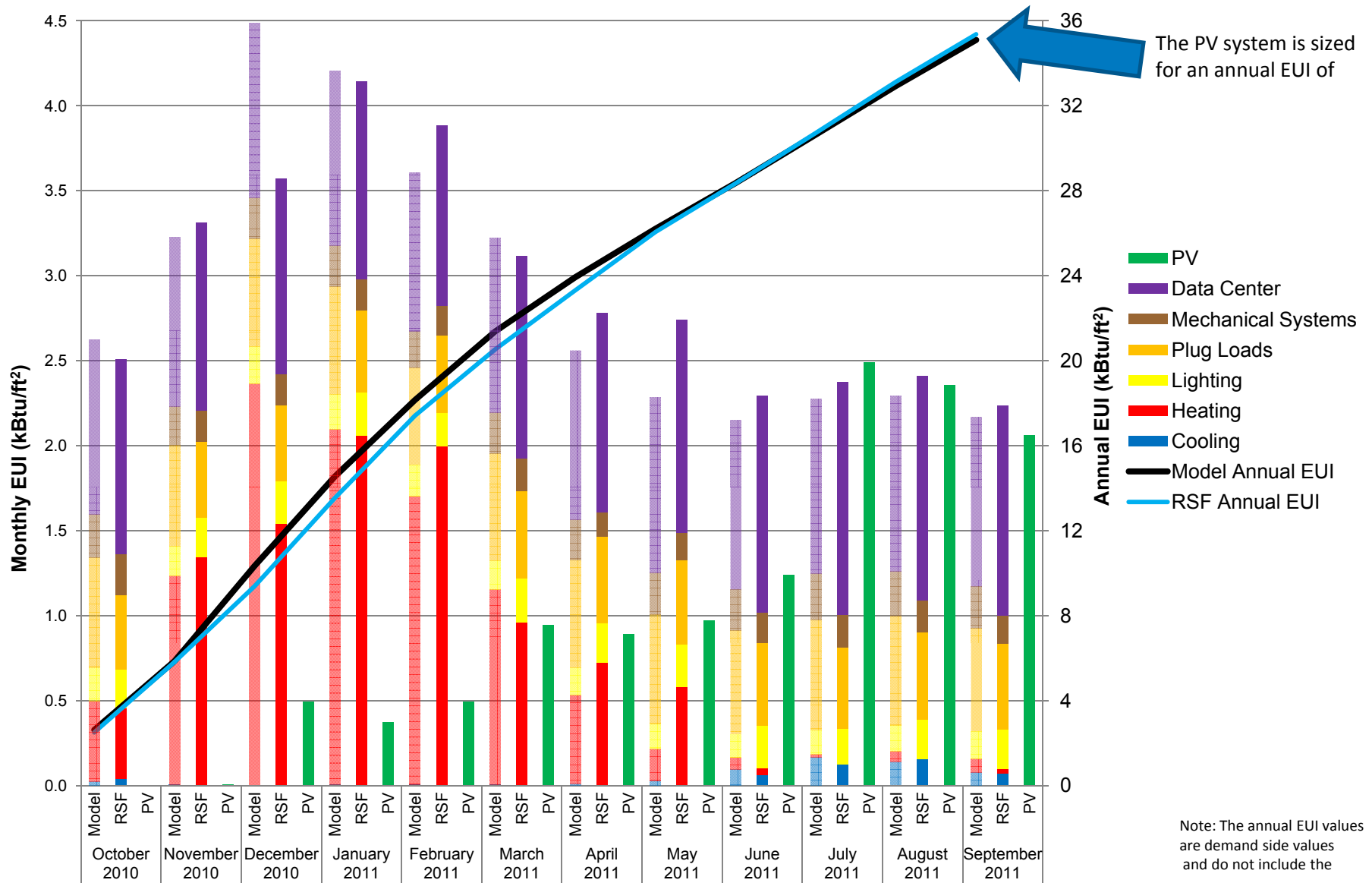
AS-DESIGNED MODEL

LEED MODEL + BASELINE

AS-BUILT MODEL

OPERATIONS MODEL

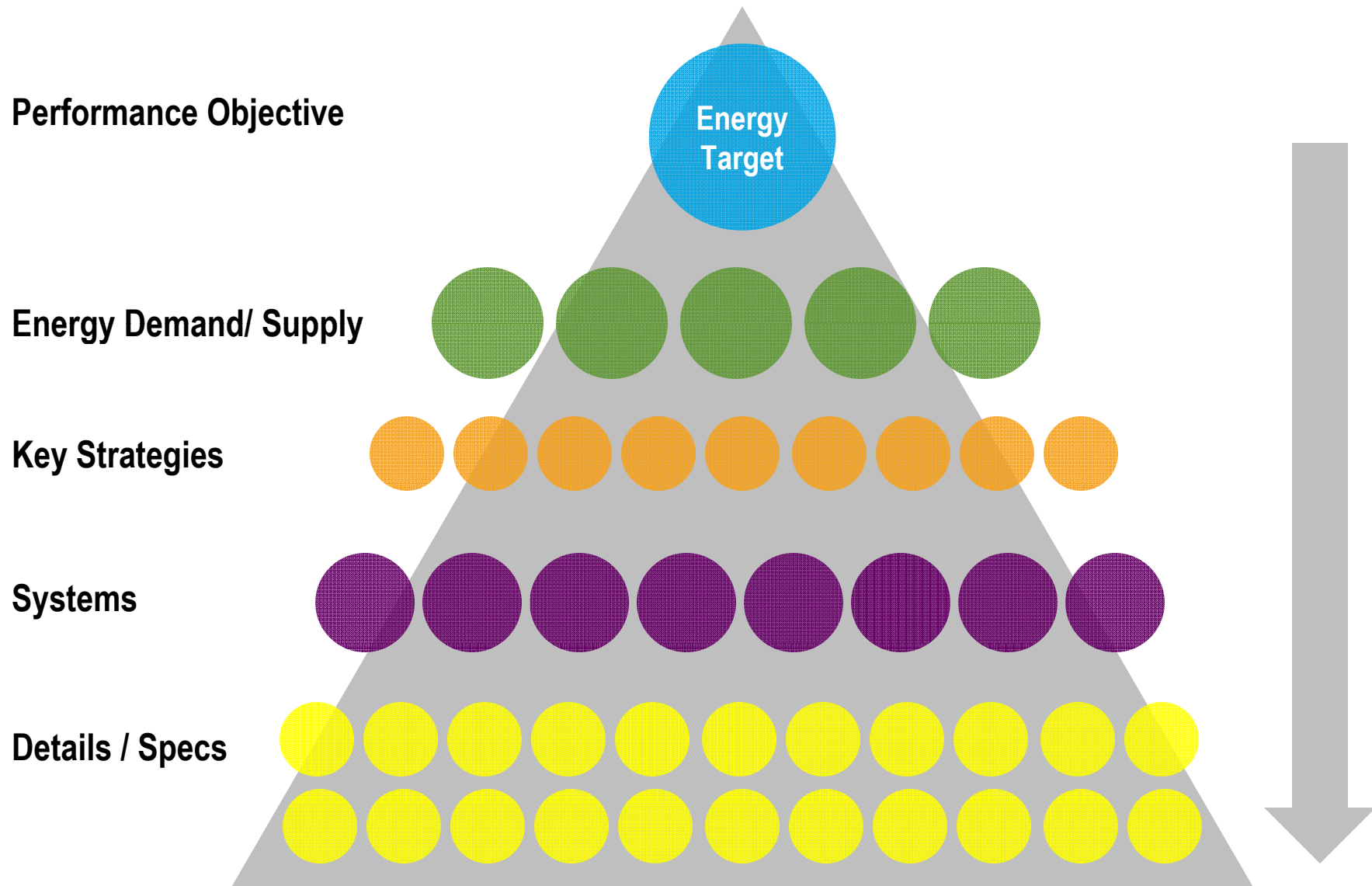
Integrated Delivery: Real Performance



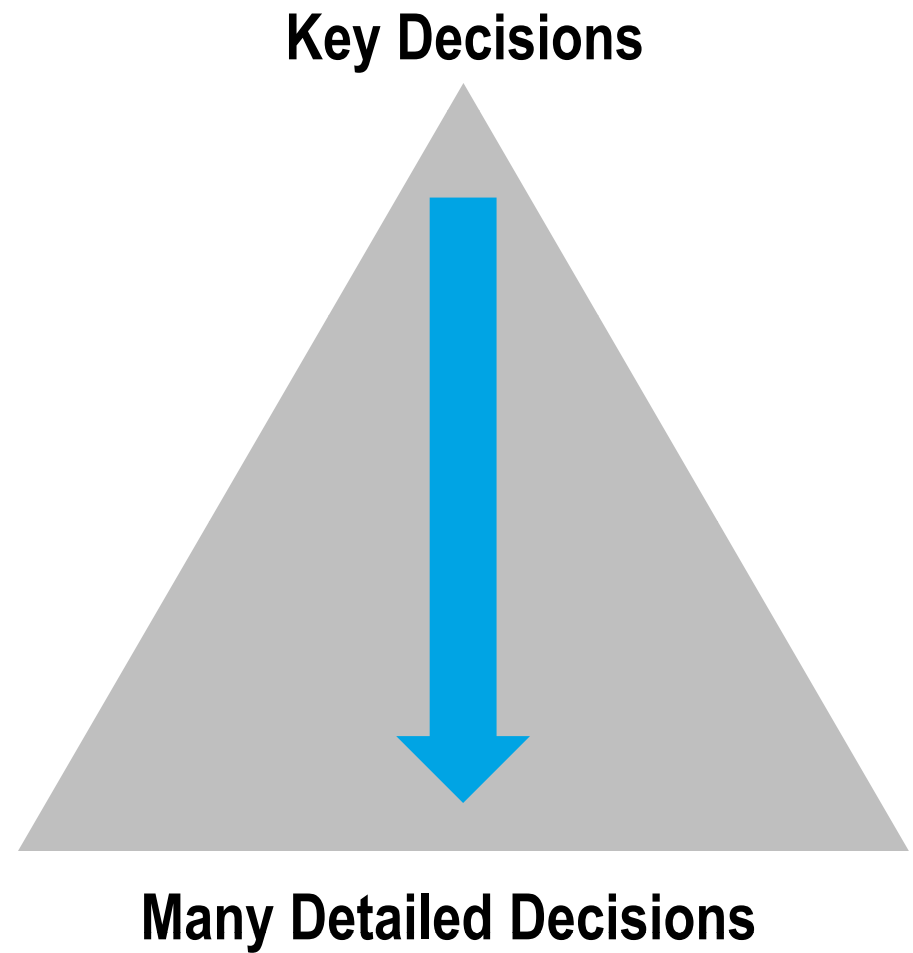
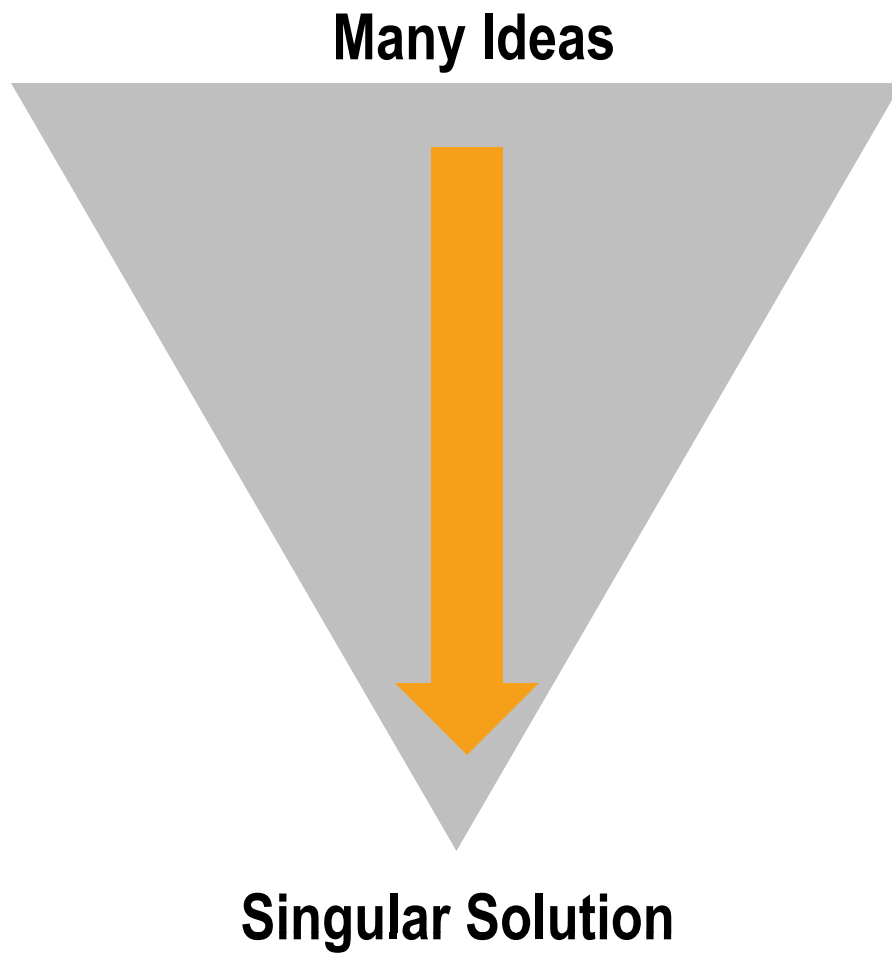
Data-Based Decision Making: Energy Target



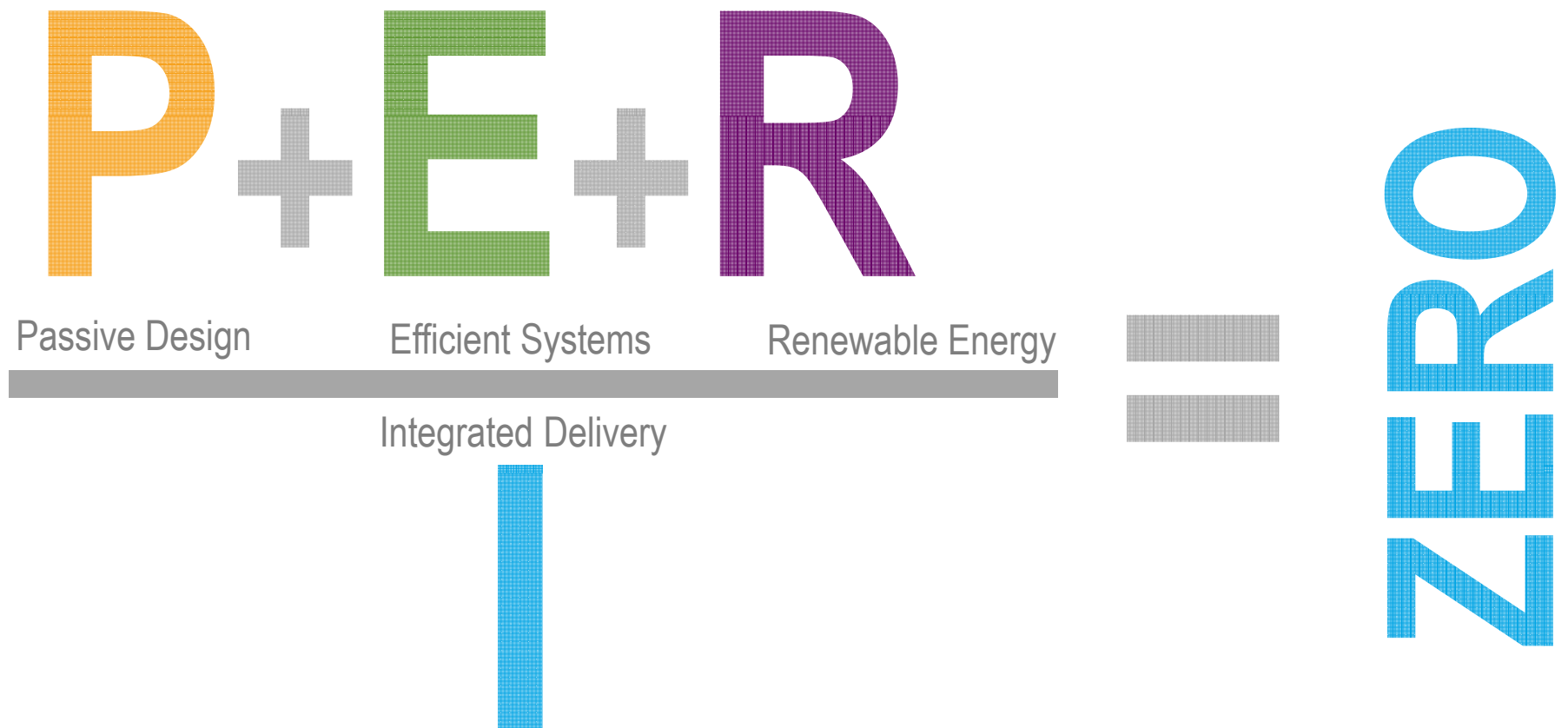
Integrated Design: Decision Making



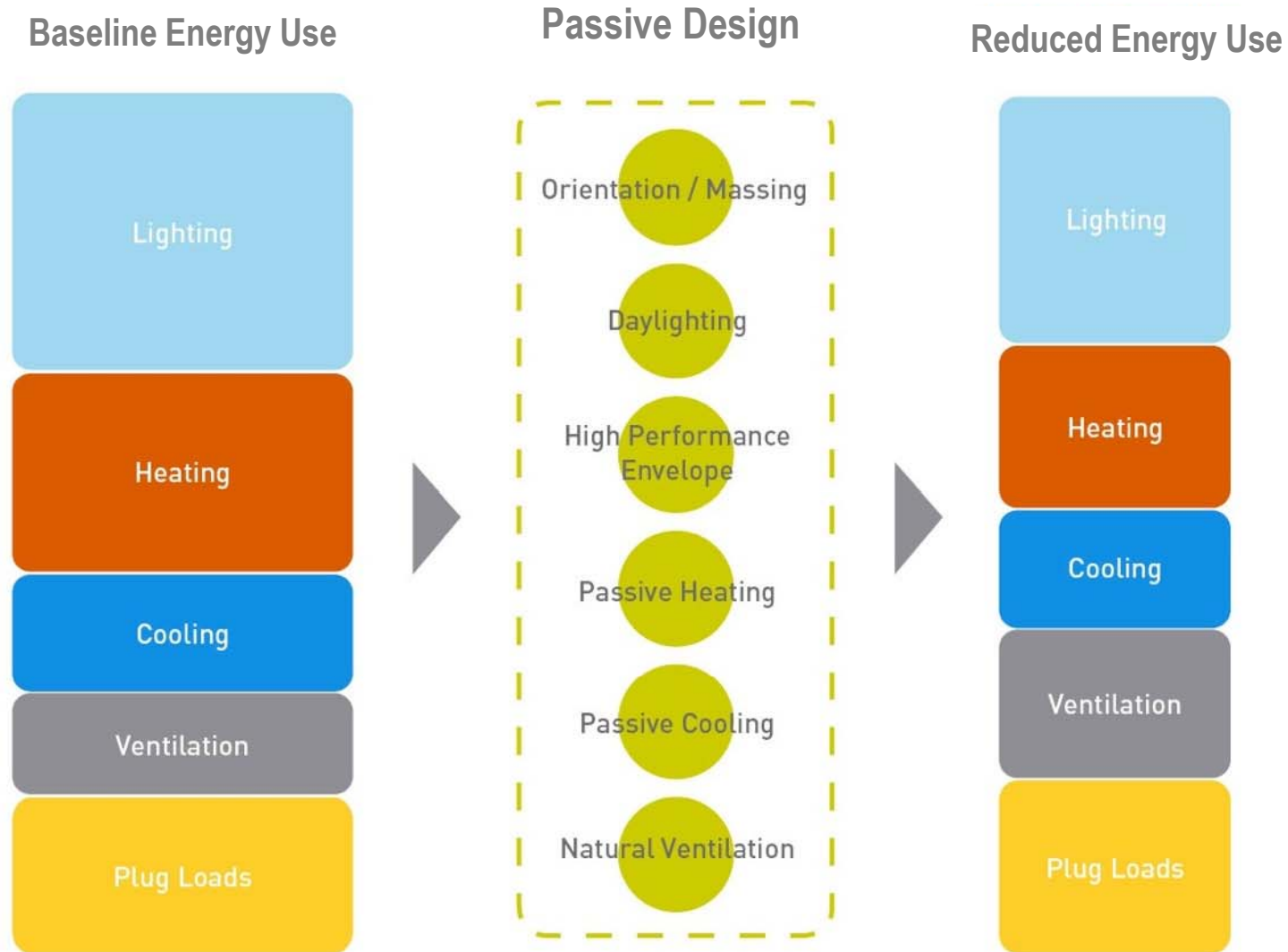
Integrated Design: Decision Making



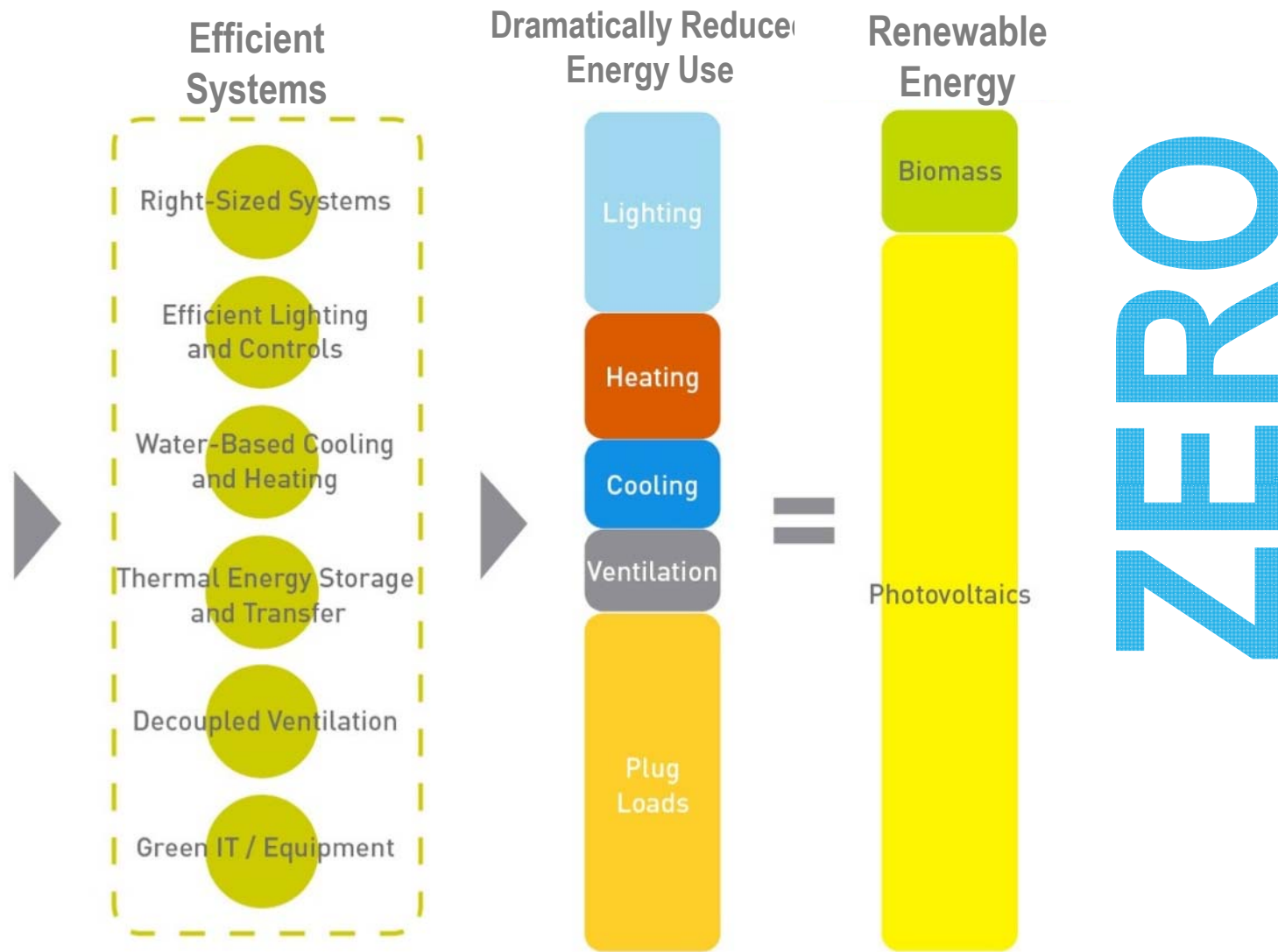
Integrated Design: Pathway to Net Zero Energy



Integrated Design: Pathway to Net Zero Energy



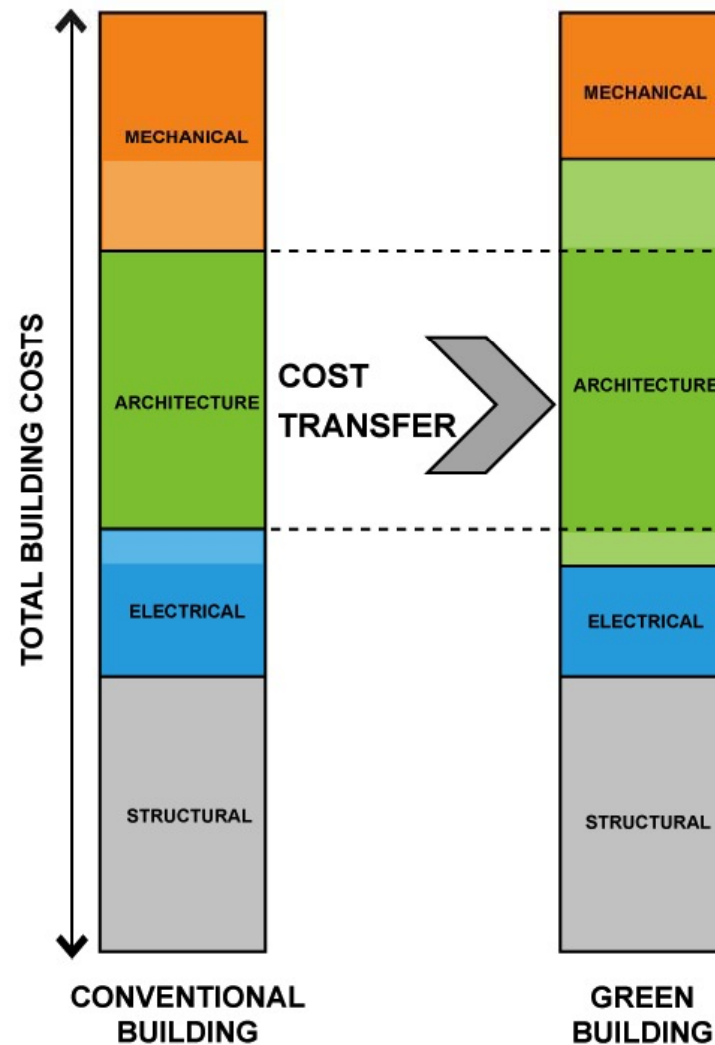
Integrated Design: Pathway to Net Zero Energy



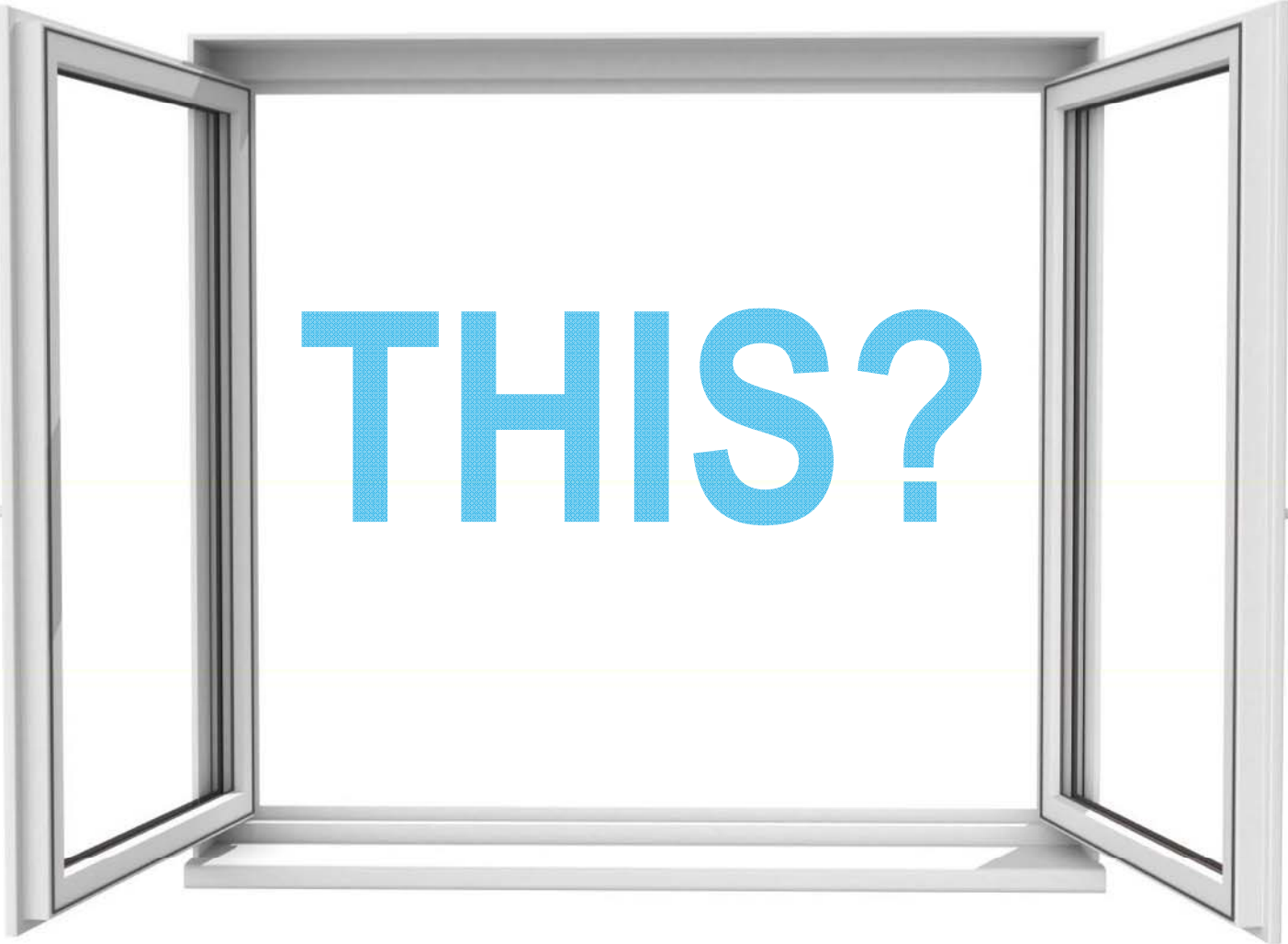
Design for Simple Operations



Valuing Passive Design



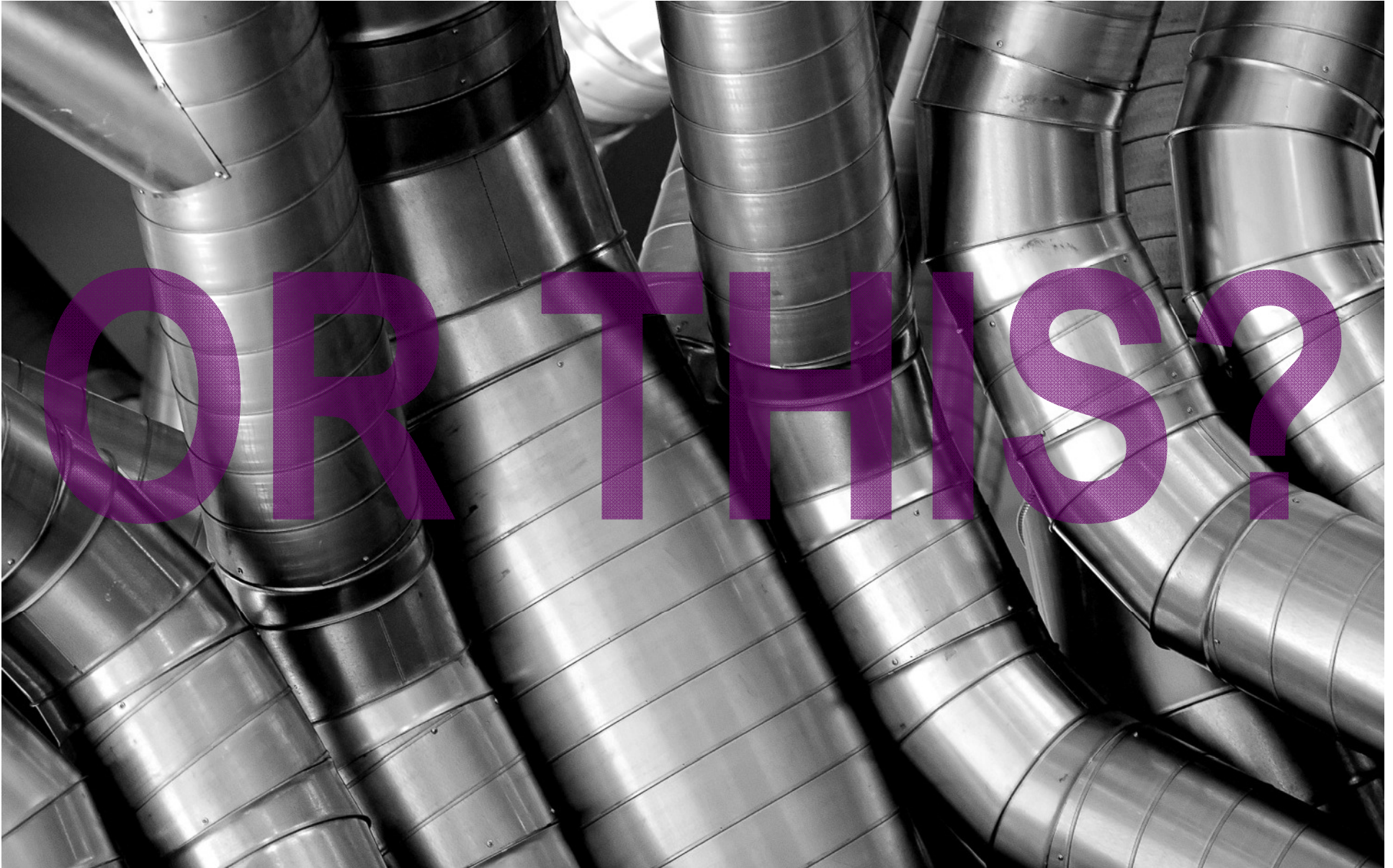
Design for Simple Operations



THIS?

A 3D rendering of a white-framed window with two sashes open, revealing a bright white background. The word "THIS?" is written in large, bold, blue capital letters in the center of the window opening. The window has a simple design with visible handles on the sashes.

Design for Simple Operations



Design for Simple Operations



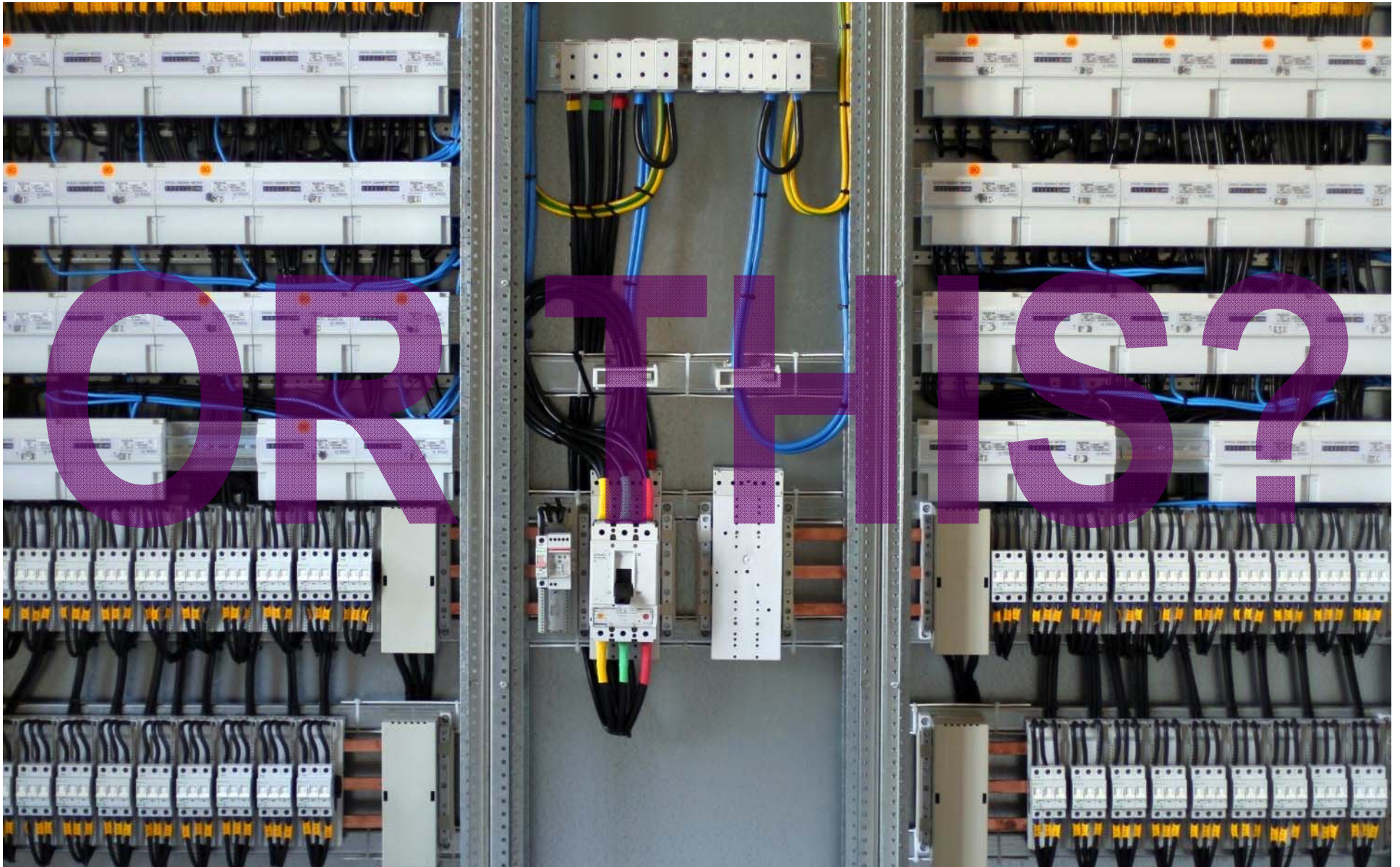
Design for Simple Operations



Design for Simple Operations



Design for Simple Operations



Interdisciplinary Design

Acoustics

Structural

Interior Design

Mechanical

Architecture

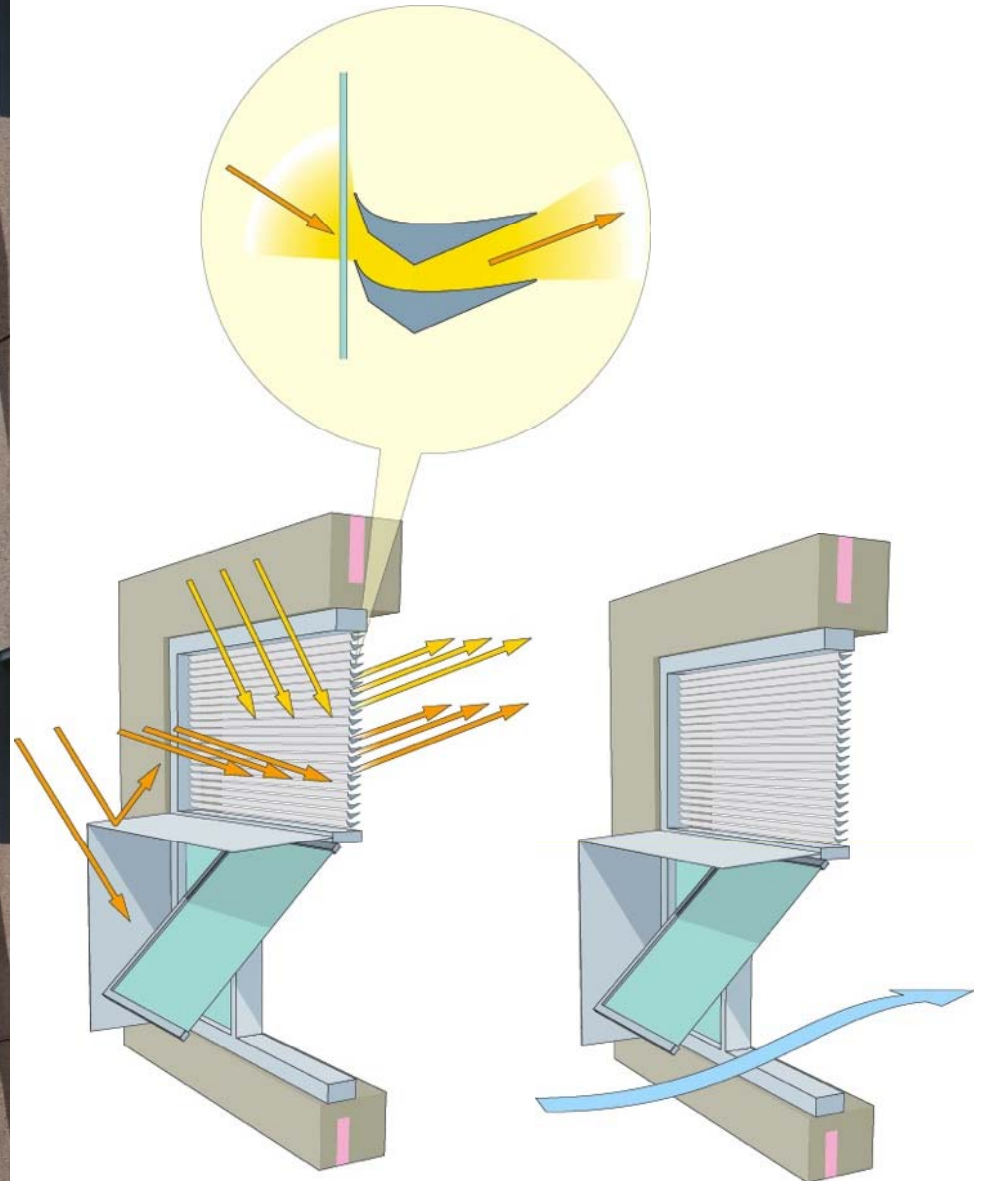
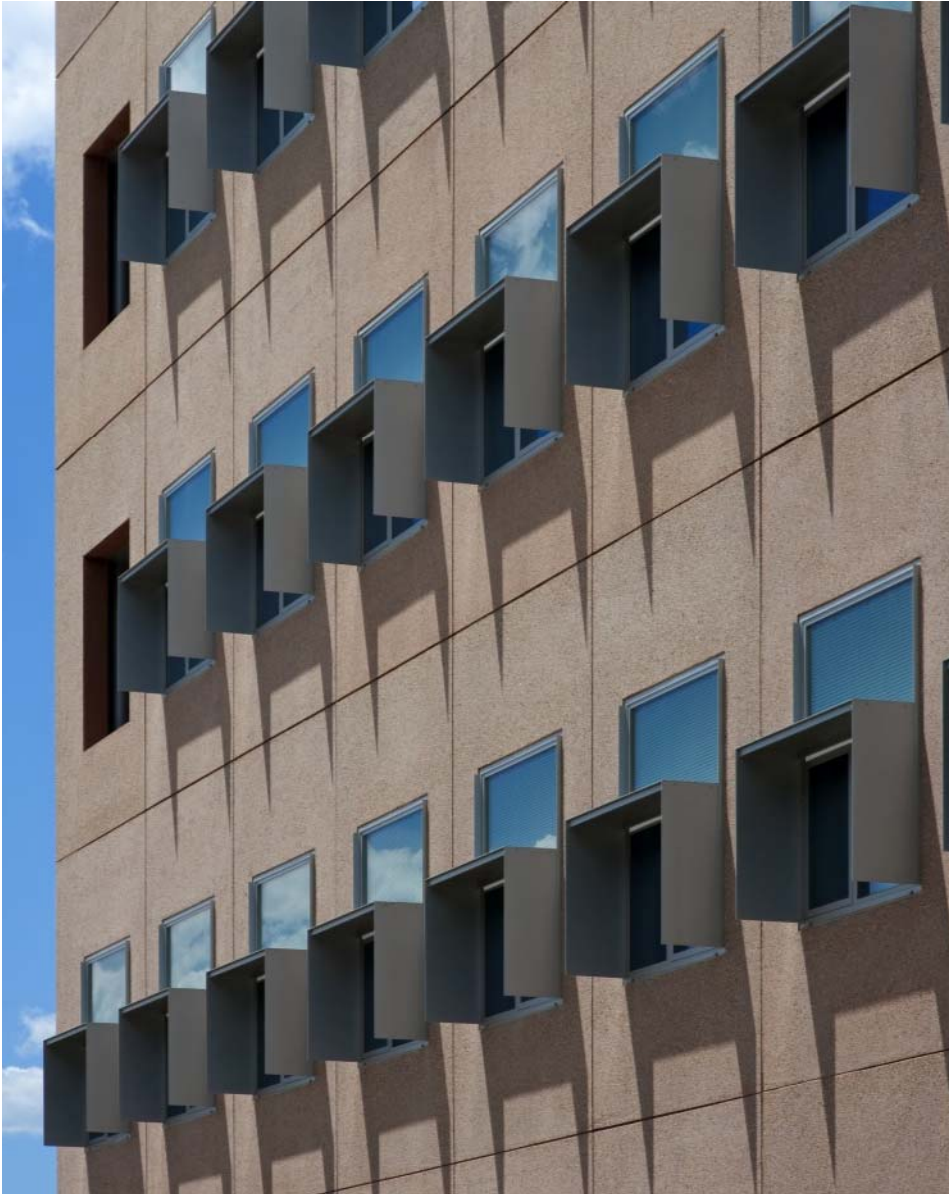
Multiple Problems – One Solution



Multiple Problems – One Solution



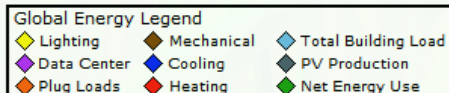
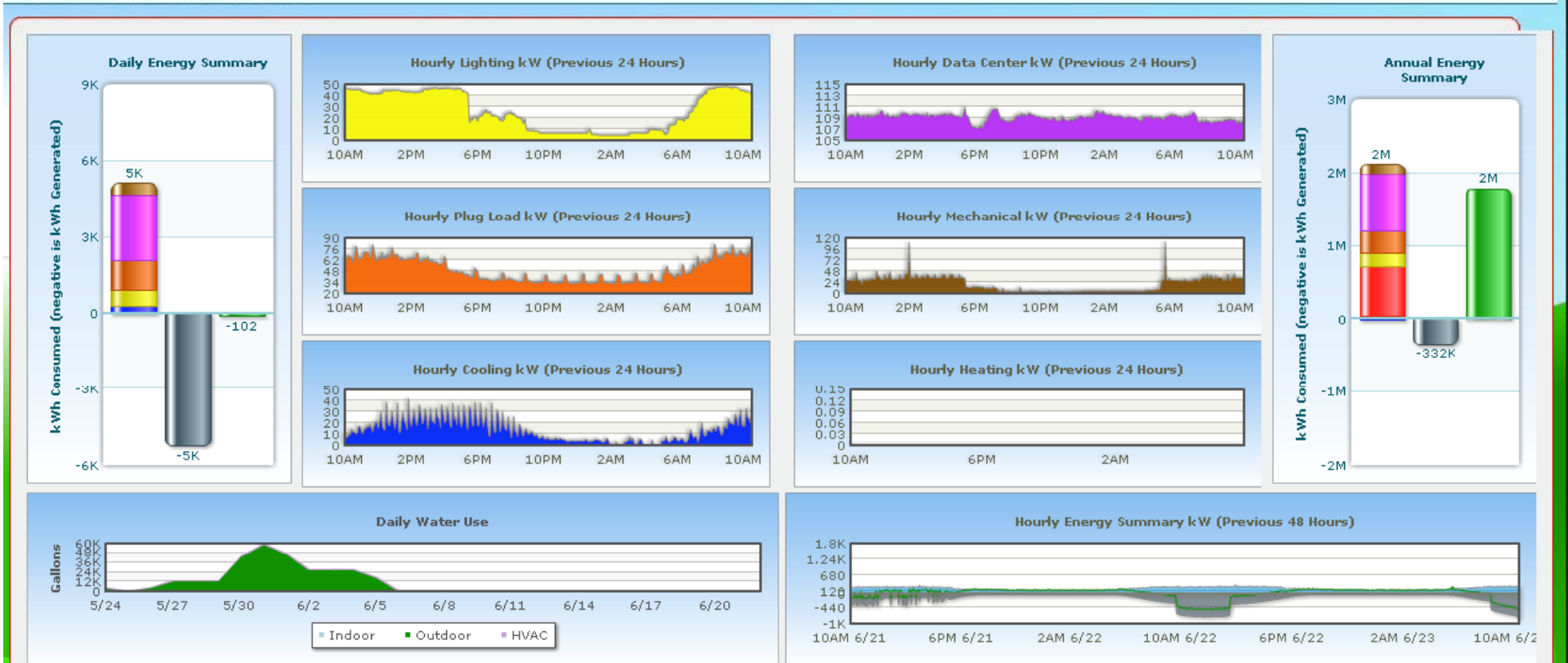
Multiple Problems – One Solution



First Day of Net Zero – June 23, 2011



RSF Energy Monitoring



Outside Temperature: 78.3 °F
Outside Relative Humidity: 25.9 %RH

Wind Speed: 2.4 mph
Wind Direction: SE