

# ESTUARY

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## Architecture at Zero

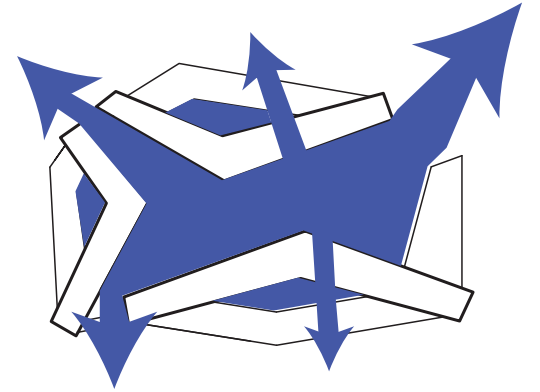
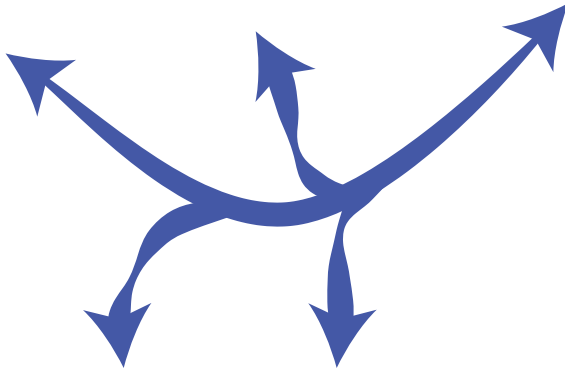
Technical Submission

• 2015 •

# Task 1e // Project Narrative

Inspired by the predevelopment ecology of the Mission Bay estuarine marshes, ESTUARY comprises **three residential structures that are shaped and organized by the flow of people and systems**. These prismatic building masses envelop a central terraced community courtyard that connects the residents and also the energy and water systems below. A porous site plan allows entry and access to major campus greenway and transit connections, and invites the larger community to circulate through the courtyard spaces. Each faceted residential tower is arranged to offset individual unit views and optimize daylight harvesting and natural cooling, with residential units connected through internal atrium ventilation stack spaces.

**ESTUARY weaves together timeless passive strategies and high performance building envelope and renewable energy strategies**, including a district heating loop that combines energy collected from the earth, sun and compost and methane sources on and below the site. Most importantly, **ESTUARY also seeks to inspire user engagement and responsibility**, through a celebration of human actions that drive down energy demand, including inviting external stairways, expressed passive clothes drying, occupancy energy budgets and shared community kitchen spaces. **Collectively, these and other strategies encourage stewardship, social engagement and a community commitment to a zero net energy balance**. ESTUARY is an icon of change, and a powerful new framework for human experience.

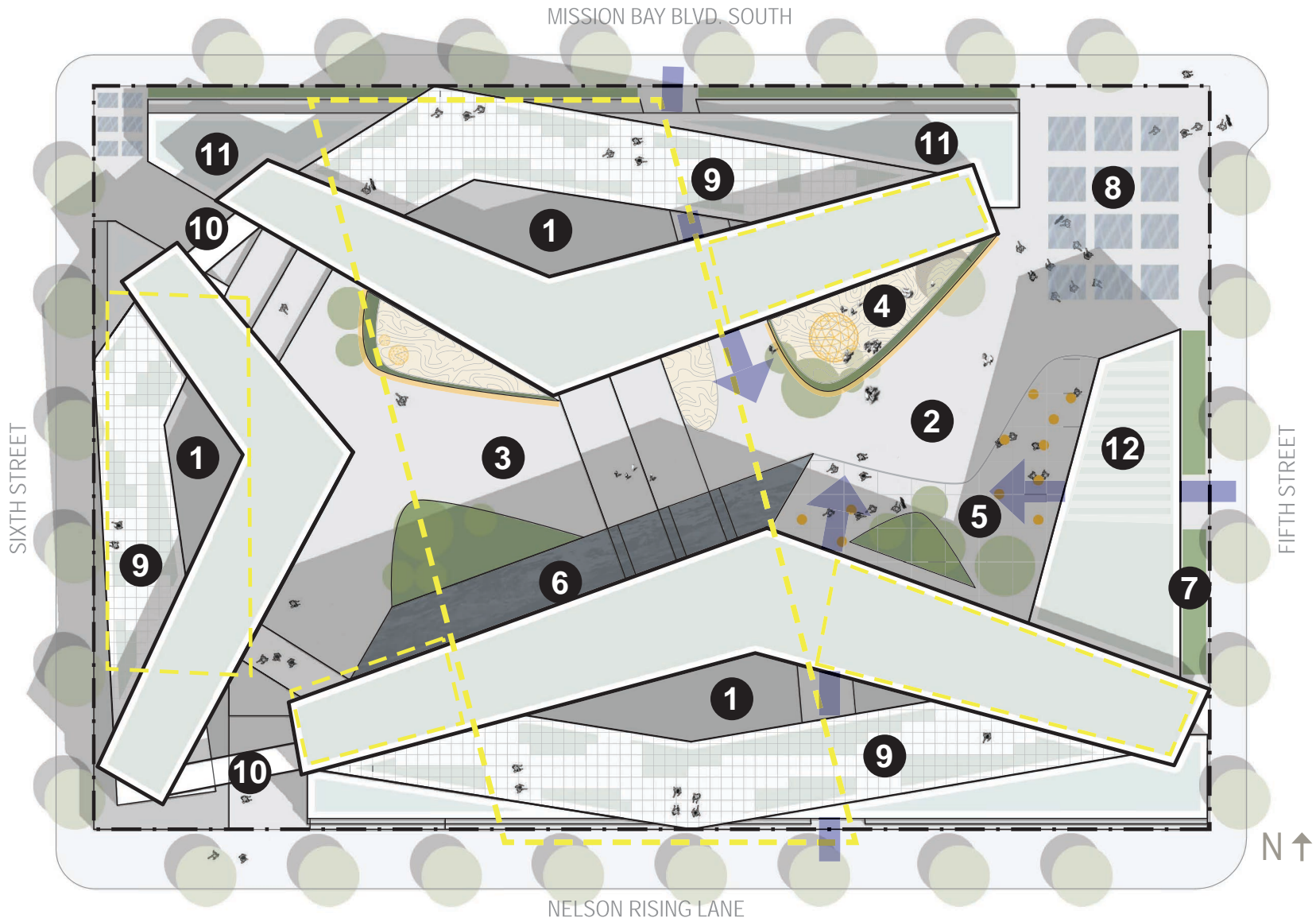


# Task 1a // Annotated Site Plan

The site planning for ESTUARY **engages the urban surroundings** with lower podium elements that hold the edges of the street grid with permeable access points that are strategically located at key access portals for transit, greenway and campus connections. **Above the podium the building masses shift their forms, responding to timeless principles of passive design.** The prismatic residential building masses offset to take advantage of opportunities for natural ventilation, frame residential views and to create a dynamic interior courtyard space that connects the community and creates protected space for residents and the childcare center at the northwest corner of the site. The interior court is terraced, and steps up over the core building mechanical and energy systems, and the visible living machine which provides a legible example of the projects commitment to innovation and high performance. Each residential tower is faceted and flared to create a central atrium space for circulation, stairs, and natural ventilation through the units. These spaces also allow the height of each tower to split and step in accordance with zoning massing setback requirements for the site.

- 1. CENTRAL ATRIUM
- 2. LOWER COURTYARD
- 3. UPPER COURTYARD
- 4. CHILDCARE
- 5. OUTDOOR CAFE
- 6. LIVING MACHINE
- 7. STREETScape LIVING MACHING
- 8. SOLAR PLAZA
- 9. GREEN ROOF TERRACES
- 10. BRIDGES
- 11. BLUE ROOFS
- 12. ROOFTOP AGRICULTURE
- SOLAR CANOPY (64,105 SF TOTAL)

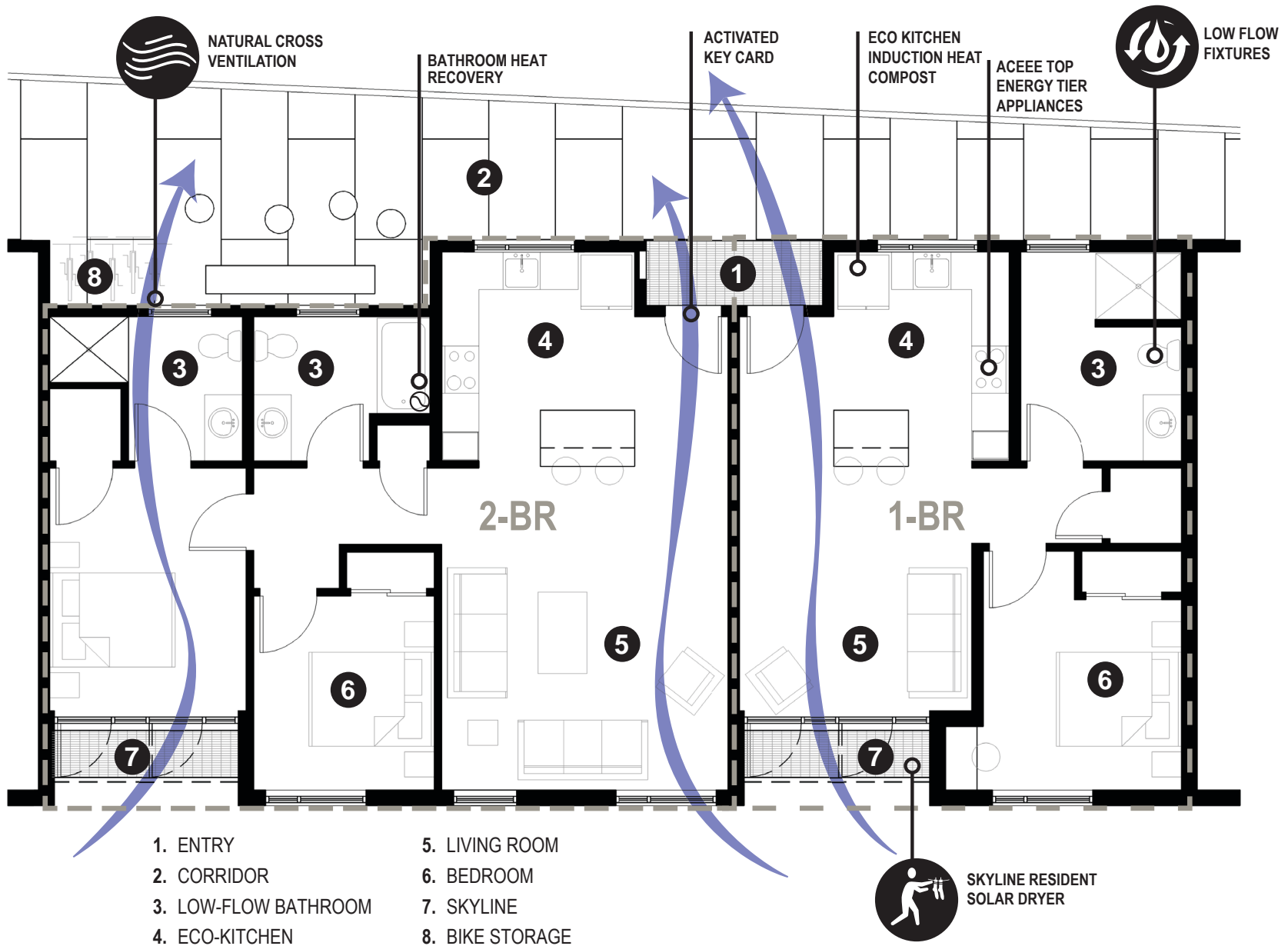
# Task 1a // Annotated Site Plan



# Task 1b // Representative Floor Plan of a 1 Bedroom Unit

**Resident comfort and function is at the core of the ESTUARY design.** The range of unit types are intermixed to create a cohesive community that blends generational and demographic range of users. Units are accessed via open air atrium spaces within each building, which offer circulation areas that accommodate informal “porch” seating as well as covered bicycle storage and overlook areas that are open to the sky and PV canopy above. The unit planning expresses functional logic and optimized use of space and flow, with **abundant access to natural ventilation, daylight and views, and through ventilation to the atrium spaces** from the building exterior. Unit design features zero VOC finishes, robust acoustic separations, LED lighting, and energy efficient appliances to reduce energy demand. In an effort to drive down plug loads, each unit features a card-activated occupant power switch upon entry that limits ghost loading on circuits, and also dryers are not provided. A 40% Energy Savings over typical residential equipment loads is possible through the activated key card system. All clothes drying occurs via “skyline” exterior clothes drying spaces in the building facade that allow vertical passive stack air movement. **These expressed elements reduce energy, and activate the facade through human interaction, weaving a 21st century building with timeless cultural and social sustainability practices.**

# Task 1b // Representative Floor Plan of a 1 Bedroom Unit



# Task 1c // Illustrative Section

**ESTUARY creates layers of space organized in response to the height limitations of the site zoning & context, & also to take advantage of timeless principles of passive design.** The ground level podium engages the urban grid, while above building masses are sculpted & inflected to create a range of spaces and to offset resident views. Flexing & opening, the building masses above the podium form central prisms, creating space for community courtyards and atria. **In addition to providing spaces for social & community engagement, these prisms also allow for natural ventilation and cooling opportunities.** Energy from sun, ground loops and methane is collected and distributed via the centralized sub-grade district energy systems.



# Task 1c // Illustrative Section



# Task 1d // Perspective Drawing

**The central court is a mixing chamber for all residents to share and access spaces for gathering and respite.** Punctuated by administrative spaces, daycare and other common amenity program areas, the courtyard provides a comfortable center of gravity for the ESTUARY community. Terracing steps & ramps ascend to the upper courtyard, providing a natural gravity flow for the living machine to operate & to also provide cover to the centralized mechanical systems that link & power each of the 3 residential buildings from below the court. The facade cladding of the buildings is interrupted with sculptural penetrations for natural light, and the “skyline” notches that celebrate the cultural practice of air drying clothes, a strategy that further reduces plug loads for the project and creates a dynamic visual texture on the buildings. Overhead the solar PV canopy creates a dramatic feature, providing dappled shade to the courtyard spaces.



# Task 2a // Window-to-Wall Ratio

## North

Step 1: Total area of light transmitting glazing surfaces on north façade: 28,010 sf

Step 2: Total area of north façade: 73,490 sf

Window-to-wall ratio of north façade =  $\frac{\text{number from step 1}}{\text{number from step 2}} = \underline{0.381}$

## East

Step 1: Total area of light transmitting glazing surfaces on east façade: 13,592 sf

Step 2: Total area of east façade: 35,158 sf

Window-to-wall ratio of east façade =  $\frac{\text{number from step 1}}{\text{number from step 2}} = \underline{0.387}$

## South

Step 1: Total area of light transmitting glazing surfaces on south façade: 30,895 sf

Step 2: Total area of south façade: 80,617 sf

Window-to-wall ratio of south façade =  $\frac{\text{number from step 1}}{\text{number from step 2}} = \underline{0.383}$

## West

Step 1: Total area of light transmitting glazing surfaces on west façade: 13,284 sf

Step 2: Total area of west façade: 36,405 sf

Window-to-wall ratio of west façade =  $\frac{\text{number from step 1}}{\text{number from step 2}} = \underline{0.365}$

## Total Building Window-to-Wall Ratio

Step 1: Façade area<sub>total</sub> = step one<sub>north</sub> + step one<sub>east</sub> + step one<sub>south</sub> + step one<sub>west</sub> = 225,670 sf

Step 2: Light transmitting glazing<sub>total</sub> = step two<sub>north</sub> + step two<sub>east</sub> + step two<sub>south</sub> + step two<sub>west</sub> = 85,781 sf

Total window-to-wall ratio =  $\frac{\text{number from step 1}}{\text{number from step 2}} = \underline{0.380}$

## Task 2b // Window Openings & Shading

**ESTUARY** responds to differential solar orientation through a variety of **layered strategies**. The building facades & massing feature articulated window depths, vertical shading fins at east & west orientations, recessed “skyline” clothes drying spaces & an overhanging PV canopy that provides dappled shade to the central courtyard and adjacent atria spaces. The high performance glazing & building envelope are designed to optimize thermal comfort and energy performance, and the concrete structure provides significant thermal mass and free cooling to interior spaces.

### Type of window & glass:

East facing U-factor: **0.34** ; SHGC: **0.24** ; Visible Transmittance: **0.48**

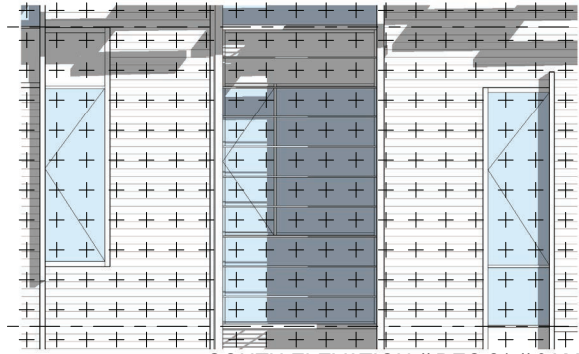
South facing U-factor: **0.34** ; SHGC: **0.24** ; Visible Transmittance: **0.48**

West facing U-factor: **0.34** ; SHGC: **0.24** ; Visible Transmittance: **0.48**

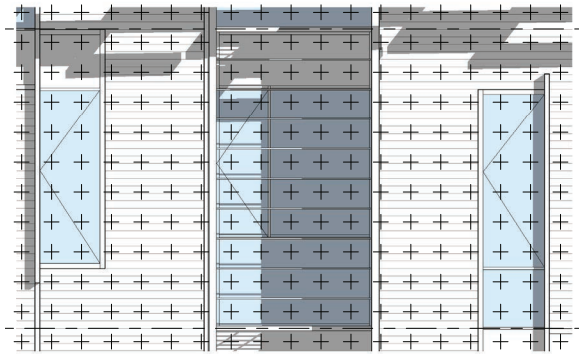
North facing U-factor: **0.34** ; SHGC: **0.24** ; Visible Transmittance: **0.34**

# Task 2b // Shadow Study at South and West Elevations

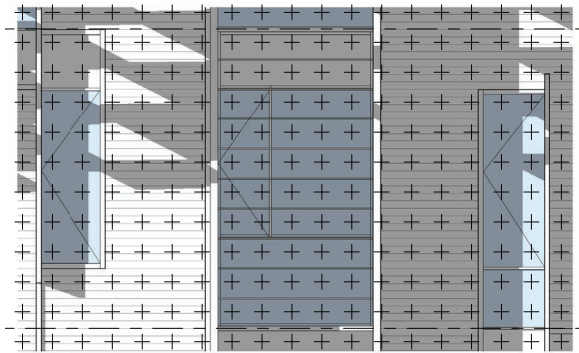
SOUTH ELEVATION // WINTER SOLSTICE



SOUTH ELEVATION // DEC 21 // 9AM

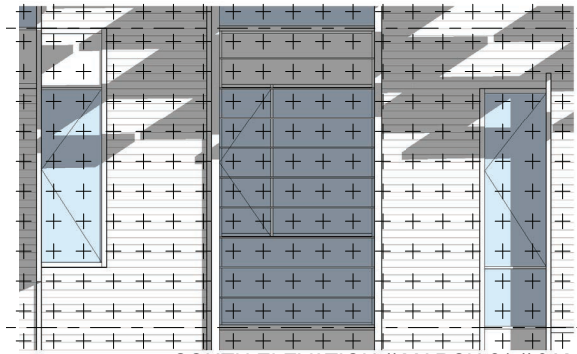


SOUTH ELEVATION // DEC 21 // NOON

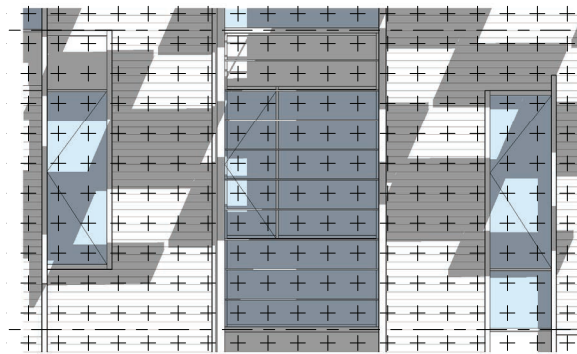


SOUTH ELEVATION // DEC 21 // 3PM

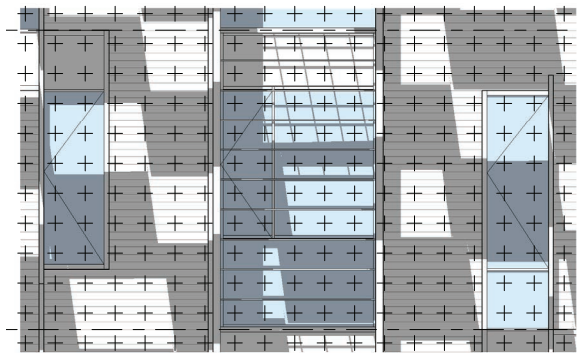
SOUTH ELEVATION // SPRING/FALL EQUINOX



SOUTH ELEVATION // MARCH 21 // 8AM

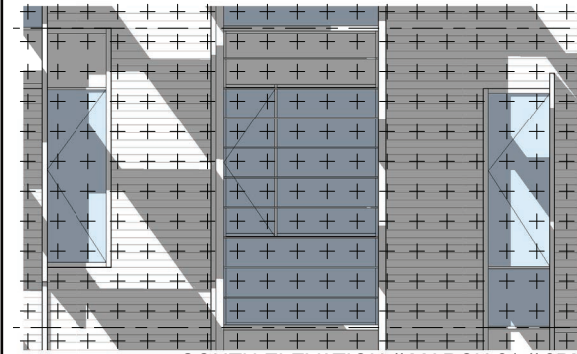


SOUTH ELEVATION // MARCH 21 // 10AM

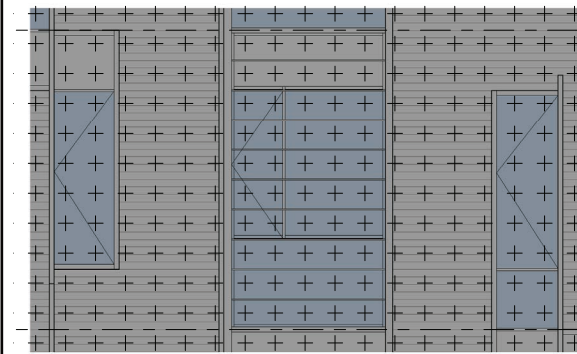


SOUTH ELEVATION // MARCH 21 // NOON

SOUTH ELEVATION // SPRING/FALL EQUINOX



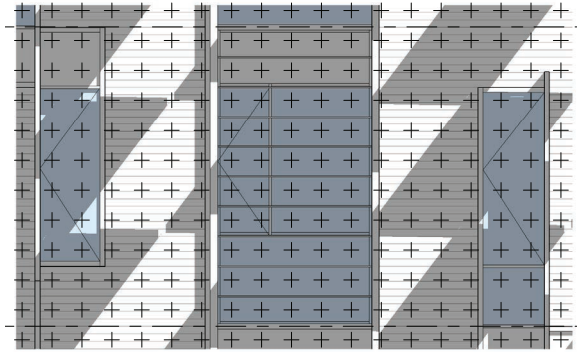
SOUTH ELEVATION // MARCH 21 // 2PM



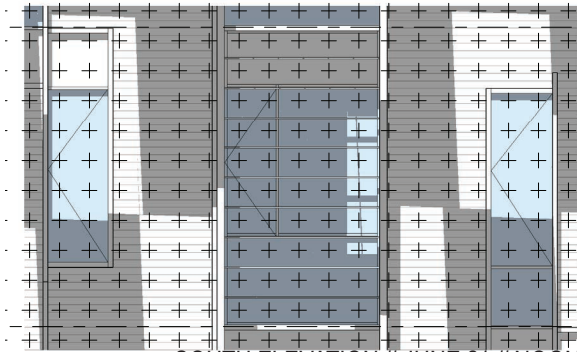
SOUTH ELEVATION // MARCH 21 // 4PM

# Task 2b // Shadow Study at South and West Elevations

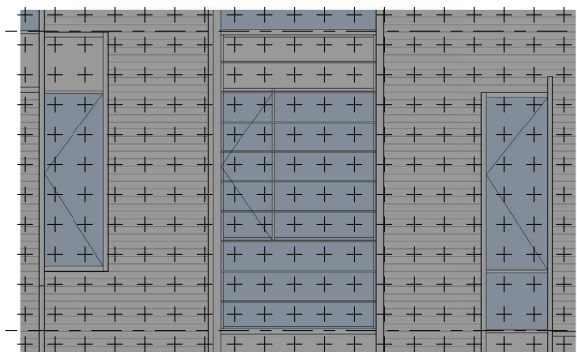
**SOUTH ELEVATION // SUMMER SOLSTICE**



SOUTH ELEVATION // JUNE 21 // 9PM

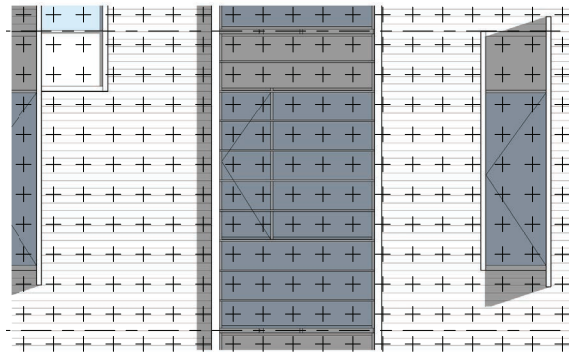


SOUTH ELEVATION // JUNE 21 // NOON

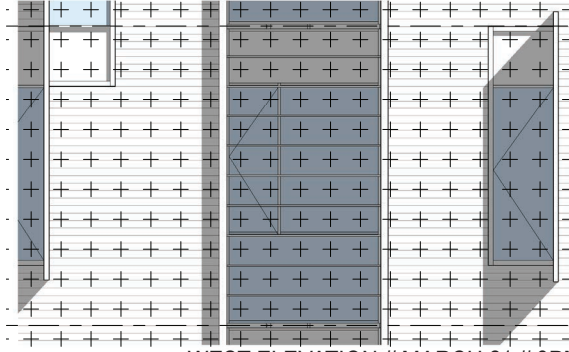


SOUTH ELEVATION // JUNE 21 // 3PM

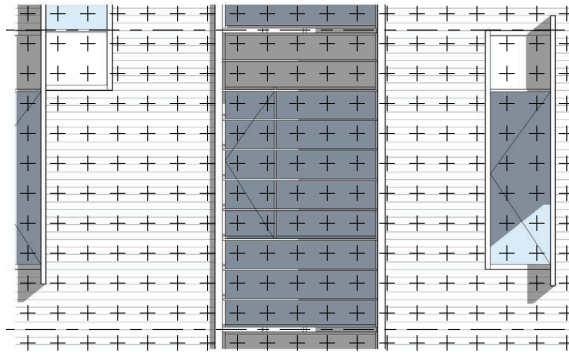
**WEST ELEVATION // WINTER SOLSTICE & SPRING/  
FALL EQUINOX**



WEST ELEVATION // DEC 21 // 3PM

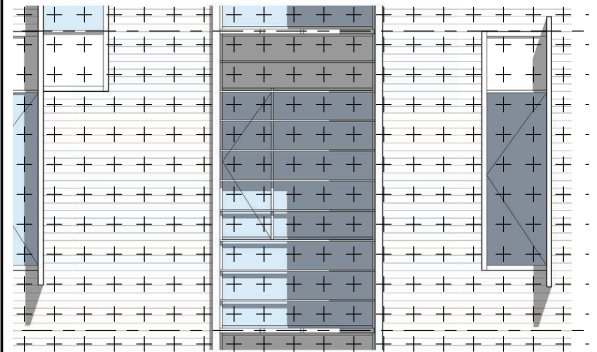


WEST ELEVATION // MARCH 21 // 3PM

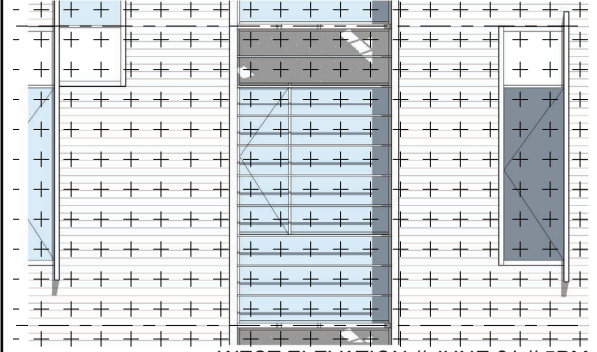


WEST ELEVATION // MARCH 21 // 4PM

**WEST ELEVATION // SUMMER SOLSTICE**



WEST ELEVATION // JUNE 21 // 3PM



WEST ELEVATION // JUNE 21 // 5PM

## Task 2c // Building Enclosure Details

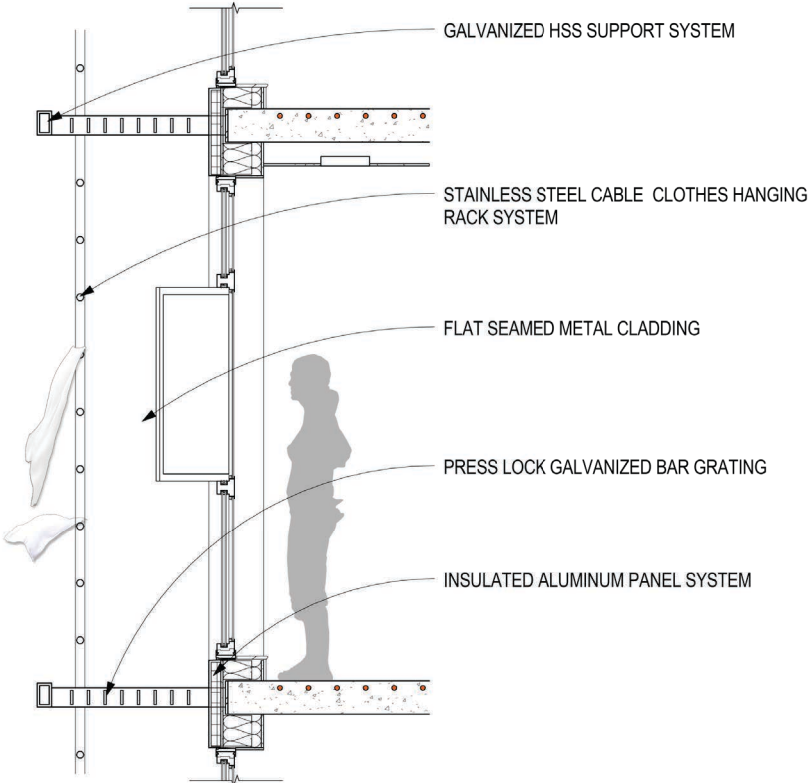


**ESTUARY** features a high performance building envelope that couples optimized orientation of primary building masses with smart detailing & durable cladding materials. Primary cladding elements include terra cotta, fiber cement & insulated aluminum panel systems, and concrete. All of these exterior cladding elements are layered over exterior poly-isocyanurate insulation, a weather resistant barrier, sheathing & a staggered stud wall system with offset interior & exterior studs to eliminate thermal bridging in the wall cavity. **Controlling thermal bridging in the exterior stud design, slab edge conditions & window systems is an area of special attention in the building detailing to provide the best interior thermal comfort for residents.** The roof is comprised of a cool TPO roof membrane system over rigid insulation. The following minimum R-values are used for the purposes of energy modeling:

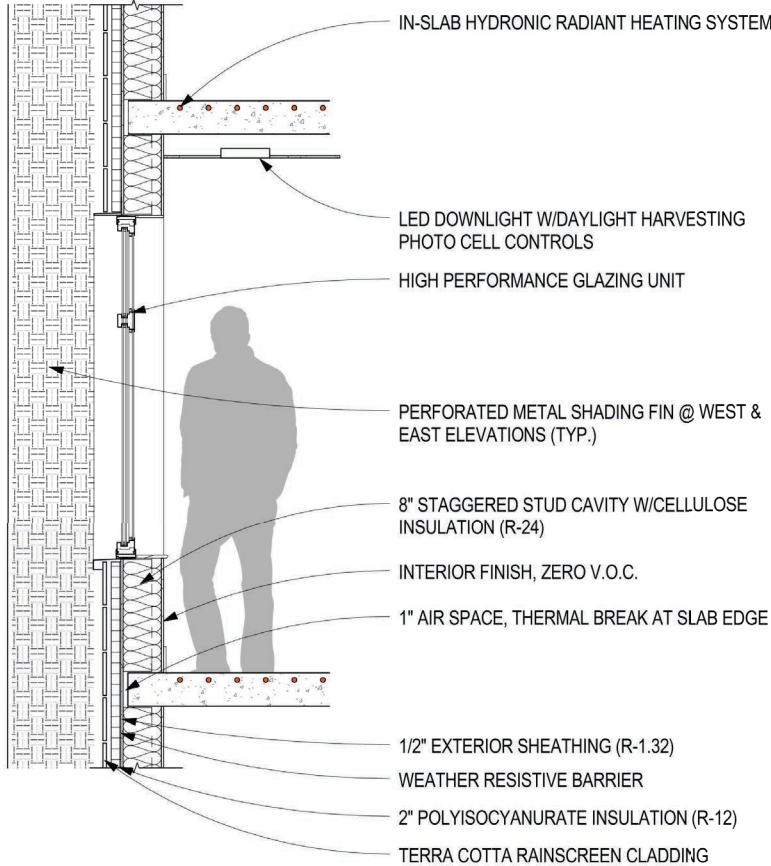
- Walls: R-23
- Roofs: R-40
- Infiltration Control: 1.0 ACH at 50 Pascals



# Task 2c // Building Enclosure Details



SECTION A



SECTION B

# Task 2d // End Use Breakdown

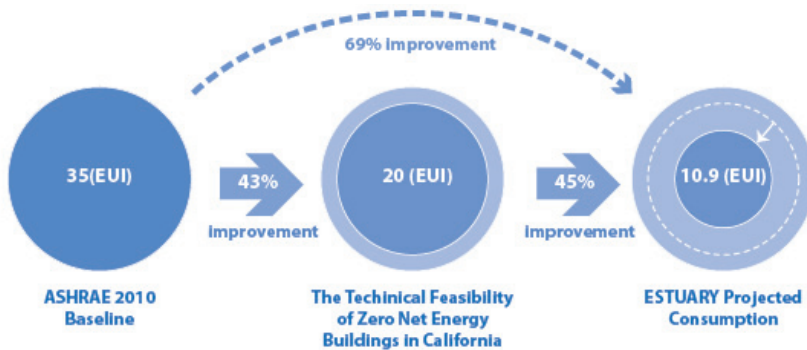
	Design Load*		Calculated Energy Use (Btu/sf/year)
End Uses			
HVAC	-----		2.37
Lighting	0.18	W/sf	1.85
Appliances and Plug Loads	0.65	W/sf	4.14
Domestic Hot Water	6.2	gall/per/day	1.79
<b>TOTAL</b>	-----		<b>10.15</b>
Renewable Production	-----	-----	10.87
Net EUI	-----	-----	0.72

## BUILDING BREAKDOWNS

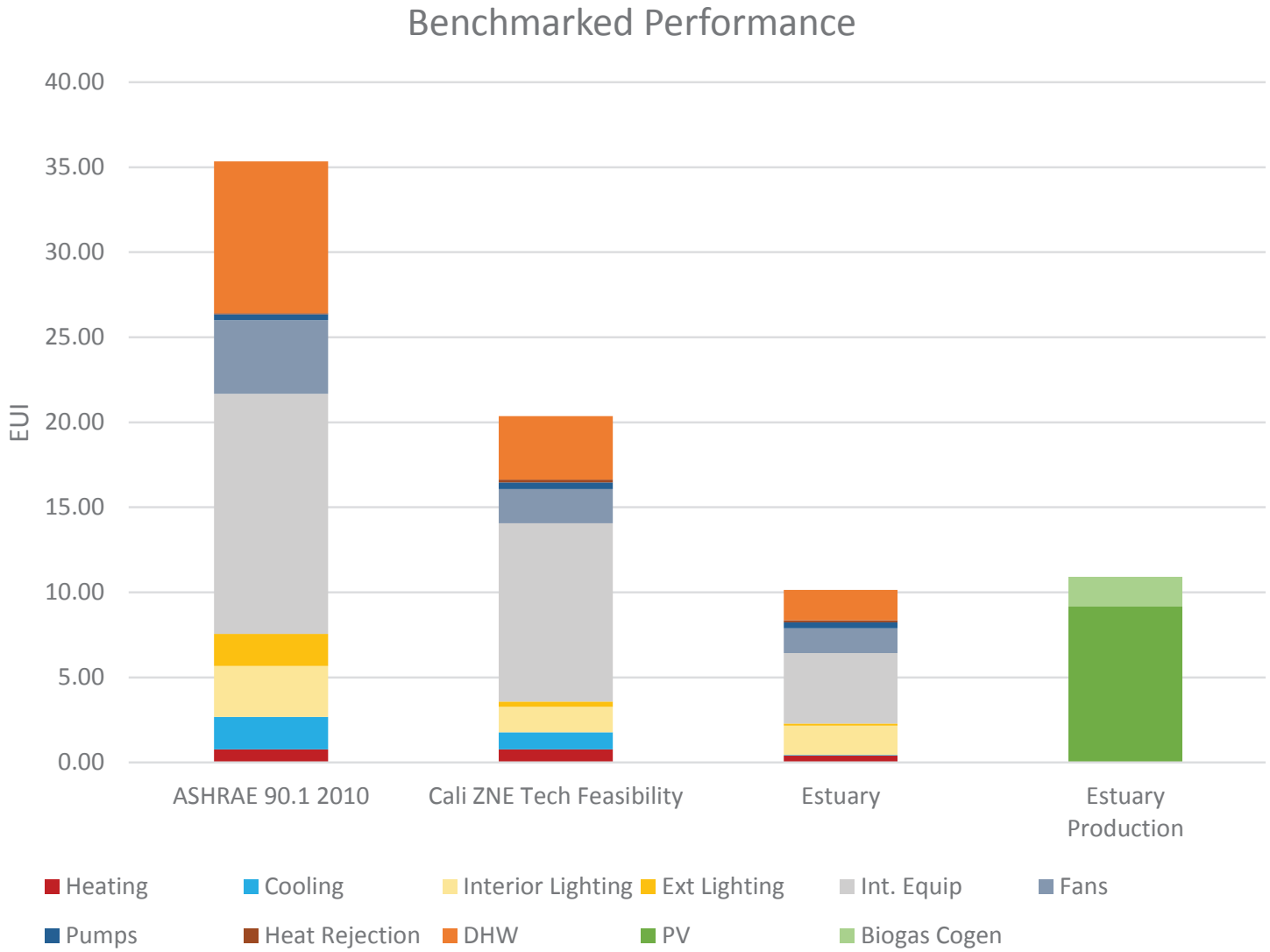
	Building A	Building B	Building C	Total Site
Heating	0.43	0.35	0.42	0.40
Cooling	0.06	0.00	0.03	0.03
Interior Lighting	1.95	1.34	1.82	1.74
Ext Lighting	0.13	0.07	0.12	0.11
Int. Equip	4.98	3.46	4.12	4.14
Fans	1.42	1.39	1.55	1.45
Pumps	0.40	0.28	0.36	0.35
Heat Rejection	0.18	0.10	0.12	0.13
DHW	1.73	1.73	1.91	1.79
<b>Total</b>	<b>11.27</b>	<b>8.72</b>	<b>10.45</b>	<b>10.15</b>

Benchmarked to baselines

	ASHRAE 90.1 2010	Cali ZNE Tech Feasibility	Estuary	Estuary Production
Heating	0.77	0.77	0.40	
Cooling	1.91	1.00	0.03	
Interior Lighting	2.99	1.50	1.74	
Ext Lighting	1.89	0.30	0.11	
Int. Equip	14.11	10.50	4.14	
Fans	4.33	2.00	1.45	
Pumps	0.36	0.40	0.35	
Heat Rejection	0.06	0.15	0.13	
DHW	8.92	3.75	1.79	
PV				9.18
Biogas Cogen				1.70
<b>Total</b>	<b>35.35</b>	<b>20.37</b>	<b>10.15</b>	



# Task 2d // End Use Breakdown

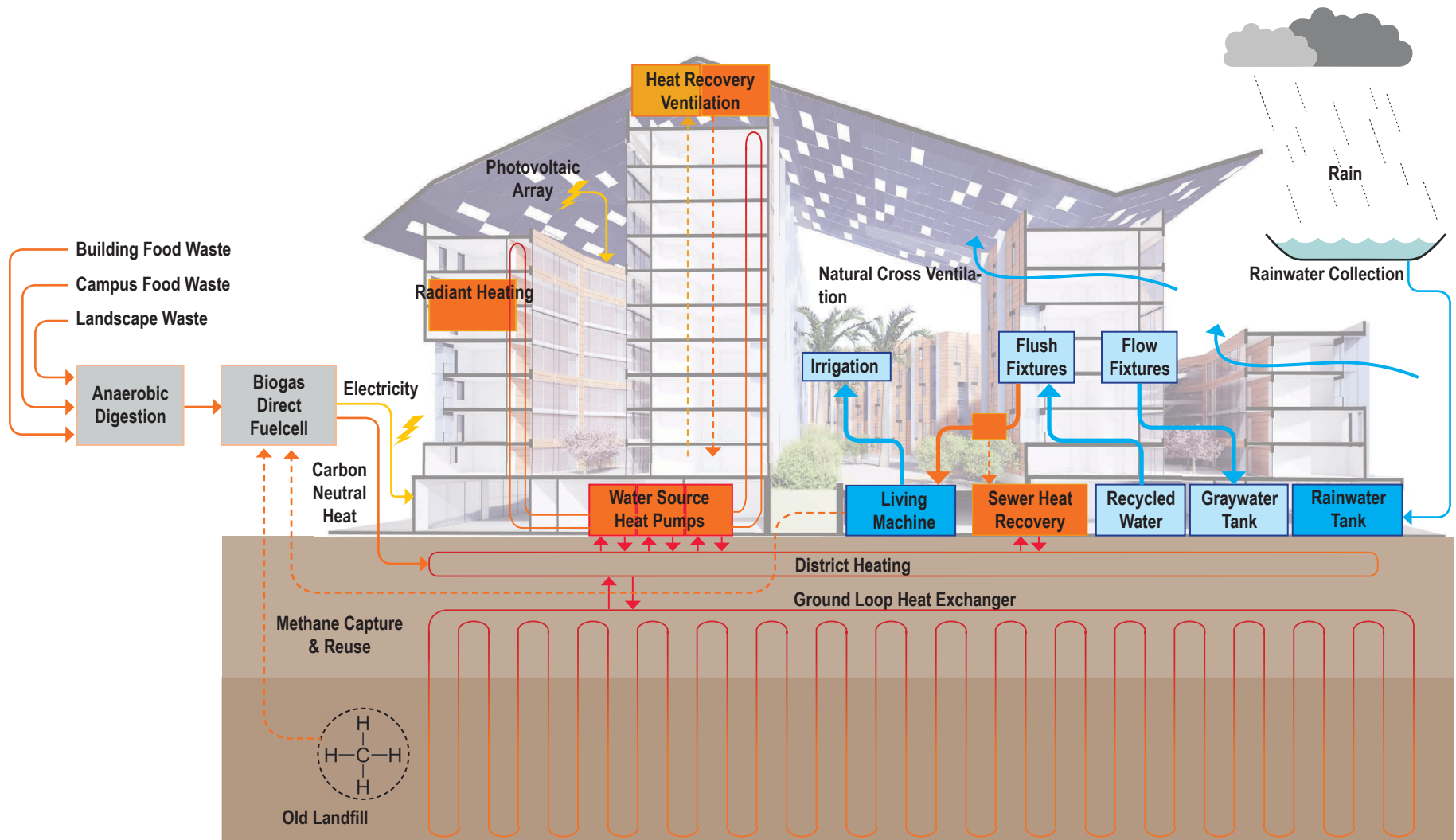


# Task 2e // Whole Building Heating and Cooling System

**District heating, ventilation and water ecosystems enable, on a dense mixed-use site such as at ESTUARY, the entire site to be optimized to allow for energy sharing between buildings and usage types.** The core of this is the district heating loop that ties the buildings together with the groundloop, sewer heat recovery and biogas direct fuelcell plant. The biogas plant makes use of the compost from the building and can take landscape and food waste from other buildings on campus to turn current waste streams into energy sources. The compost is broken down in an anaerobic digester before being sent through the biogas direct fuelcell. Since the project is on top of an old landfill methane can also be tapped from the ground to use as a fuel source in the biogas plant. The site has watersource heatpumps for all of the heating needs in the various program types.

The site captures rainwater and graywater for reuse in flushing fixtures. It also captures heat from the blackwater before processing it within a living machine to create recycled water for irrigation. **By reusing all the water sources on-site the project greatly reduces its impacts on the drought in California. It also reduces the true energy usage of the building as municipal water sources in California have high embodied energy.**

# Task 2e // Whole Building Heating and Cooling System



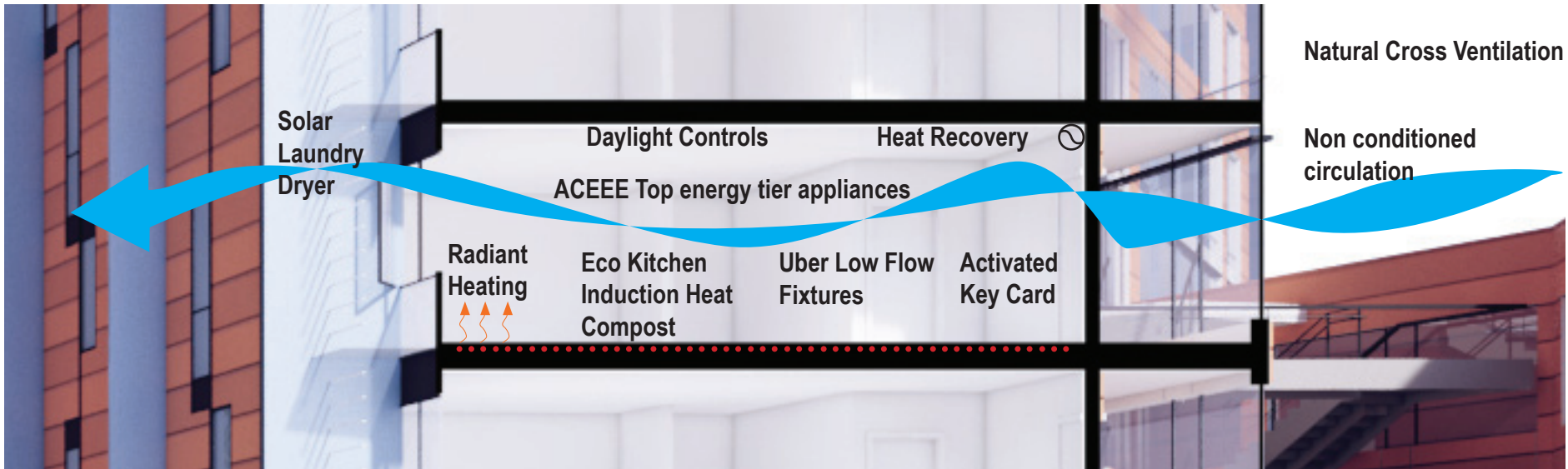
# Task 2f // Residential Unit Systems

## **Residential Units**

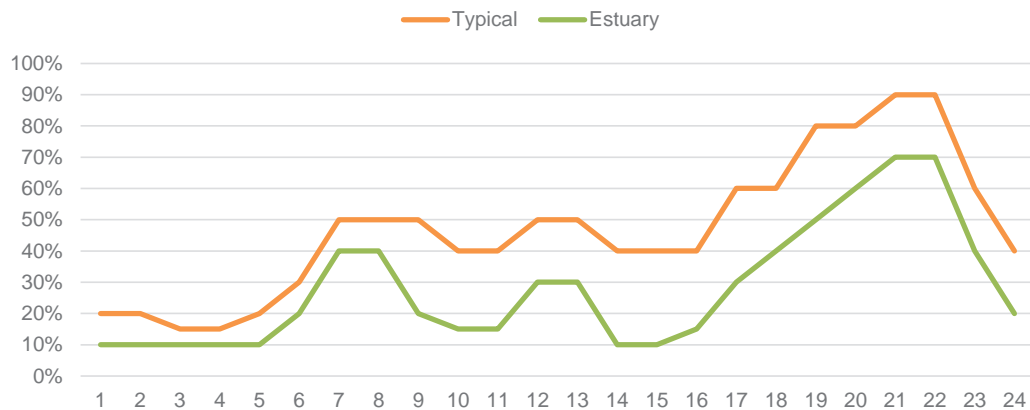
The units respond to the mild climate of San Francisco by optimizing daylight and natural ventilation performance through a narrow floor plate and operable windows. Each unit has an activated key card that must be engaged to have power to anything but the refrigerator. **When not activated everything else is off in the rooms other than the heating from the radiant floor, providing a 40% savings on residential equipment loads.**

Hot water is provided from the district heating system making use of heat pumps for both the radiant floor and the domestic hot water. The majority of the domestic hot water needs are met with sewer heat recovery from solid waste from the building. Each unit has ultra low flow fixtures with showers at 1 GPM. The units also each have a solar laundry dryer taking a European approach to drying clothes.

# Task 2f // Residential Unit Systems



Typical Equipment Profile

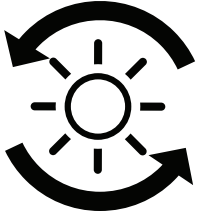


**40% Energy Savings possible through the use of the activated key card system.** Residents are also able to engage with & be aware of their own energy usage through the community incentive program where the lowest energy units each month win prizes & rent reductions.

Typical Apartment Plug Load Profile

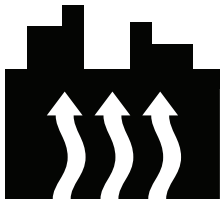
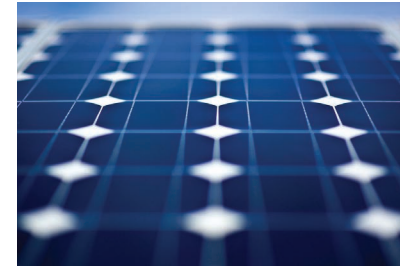
Estuary Apartment Plug Load Profile

# Task 2g // Renewable Energy



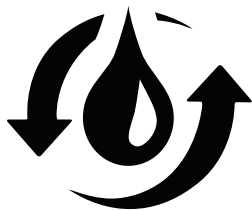
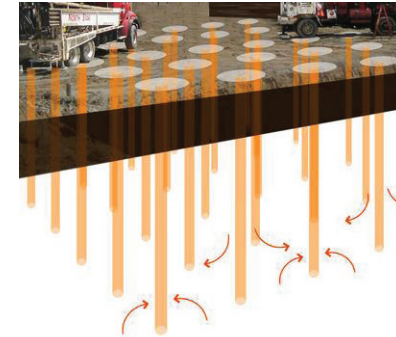
## SOLAR PHOTOVOLTAIC SYSTEMS

- A total PV array of 950 kW, using highly efficient SunPower panels
- Total area of PV: 64,105 square feet
- Annual Production: 4,311,905 kBtu/yr



## FUEL CELL SYSTEMS

- The fuel cell is a 50 kW biogas direct fuel cell that makes use of waste food streams from the building & surrounding campus, methane from the landfill below the site & methane produced by the living machine. The compost will be processed in an anaerobic digester that creates biogas to be processed in the fuel cell
- Annual Production: 800,000 kBtu/yr



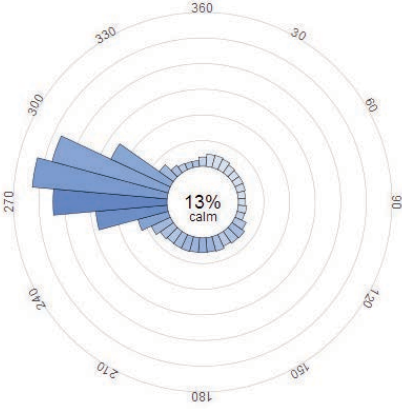
## WORKING TOWARDS NET ZERO WATER

- The site captures rainwater and graywater for reuse in flushing fixtures. It also captures heat from the blackwater before processing it within a living machine to create recycled water for irrigation.
- The true energy usage of the building is greatly reduced by reusing all water resources on site, as municipal water sources in California have high embodied energy.

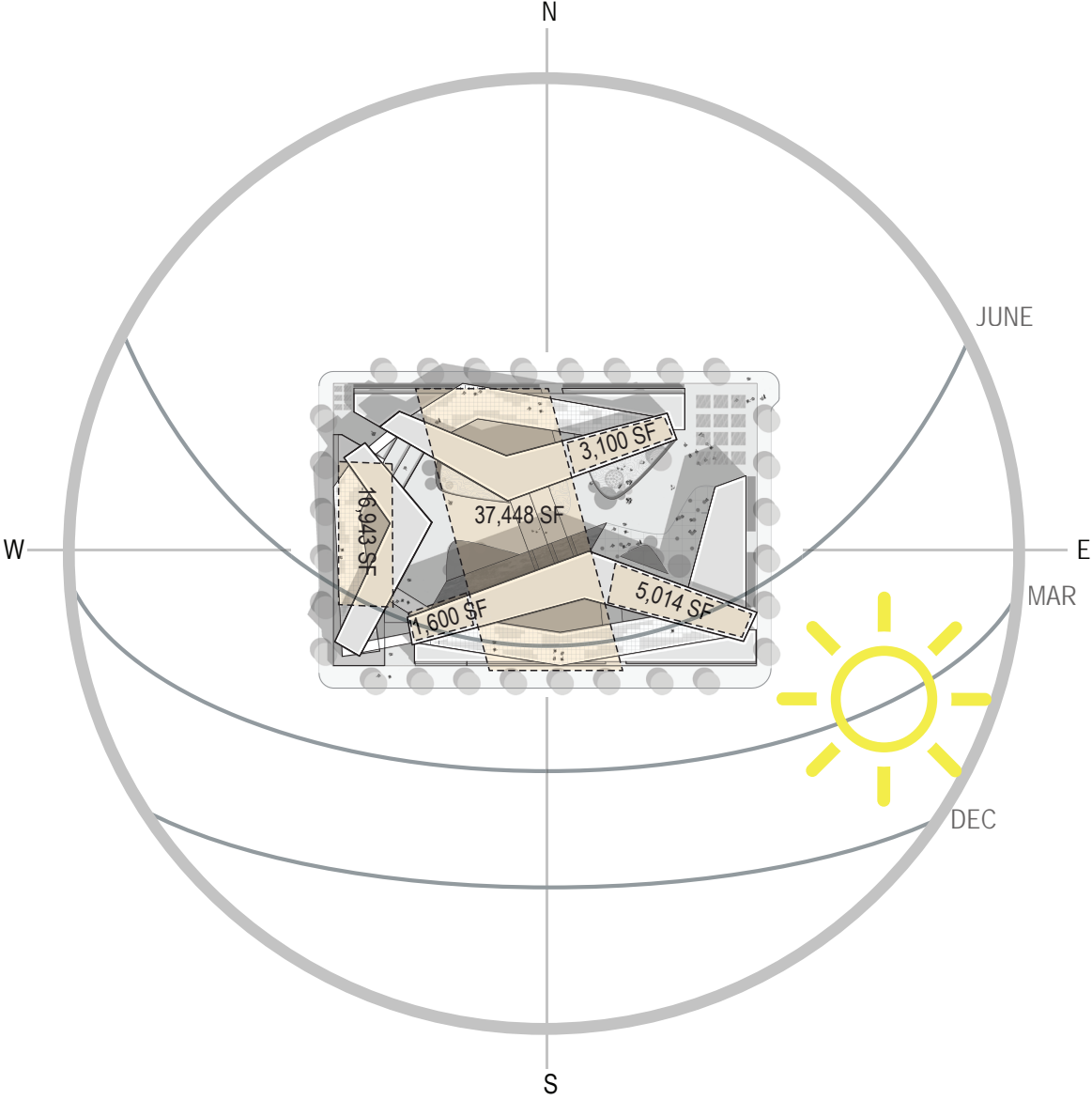




# Task 2g // Renewable Energy



Site Wind Diagram



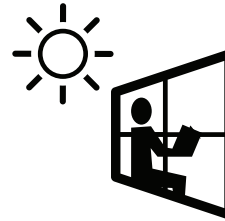
# Task 2h // Occupant Behavior

**ESTUARY's performance depends on positive engagement with its residents.** The project inspires stewardship and action through the design of spaces that encourage and reward reduced energy and resource use. These strategies not only drive down the EUI of the building, but they also promote community and interdependency with the social fabric of the project. Pat, one of ESTUARY's newest residents, helps to illustrate the layers of user experience & behavior that contribute to the performance of the project.



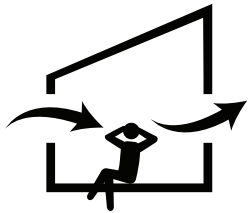
## MEET PAT

Pat is one of Estuary's newest residents.



## DAYLIGHT + VIEWS

Pat loves all of the natural light that comes into his apartment. He is able to read for hours without having to turn the lights on.



## NATURAL COOLING

Pat feels good all year round in his Estuary apartment due to the supreme passive ventilation. No need for AC or heating here!



## SKYLINE CLOTHES DRYING

Drying laundry is a breeze with the clothes-line laundry chutes in his building. As Pat always says "there's nothing better than sun-dried sheets!"



## SHARED COMMUNITY KITCHENS

Some of Pat's newest and best friends are those he met in the communal kitchen on his floor.



## ACTIVE STAIR CULTURE

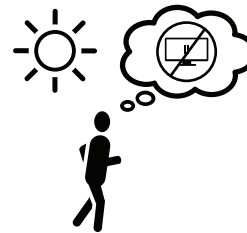
Why take the elevator when Pat can get a healthy workout taking the stairs to his 4th floor apartment!? The stairs also happen to be the most convenient way to get home.

# Task 2h // Occupant Behavior



## ENERGY BUDGET + RENT INCENTIVES

Pat jumps for joy when he learns that his rent is reduced this month since he was in the top percentage of low energy residents in Estuary. Go Pat!



## OPEN SPACE LINKAGES

With all of the great outdoor spaces in Estuary, Pat spends little time inside and hardly misses watching TV and playing video games.



## LIVING MACHING + WATER REUSE

Pat is fascinated by the living machine and appreciates his new awareness of water conservation and resources.



## ROOFTOP AGRICULTURE

Pat can grow his own food on the rooftop agricultural garden. All vegetables are organic and irrigated with recycled water.

## (Conclusion // Overall Performance Narrative)

**ESTUARY** is a project that addresses the challenges of **Architecture at Zero 2015** through a multitude of **aligned strategies that include pasive building performance strategies, advanced building envelope design, on-site renewable energy collection & enhanced user behavior**. The design uses timeless ideas and marries them to cutting edge technology & systems to create a community of residents that is part of the solution. The building aesthetics are both informed and activated by this participation, and the building becomes an icon of a new kind of lifestyle, one of **participation & interconnection**.

**Ultimately, the project meets the challenge of Getting to Zero**, but relies on all these layers of thinking and acting to achieve this goal. Importantly this project is not only about performance. It is inspired and crafted to honor its place - not only as a part of the new & evolving UCSF Mission Bay Campus, but as design that is informed by the predevelopment ecology of this region and place. The flow of water through the estuarine marshes evoked in this design call to mind a sense of movement and discover that the architecture aspires to re-create in the user experience. **This is a place that honors not only its place, but the people who live here and invites them to fully be a part of the successes.**

