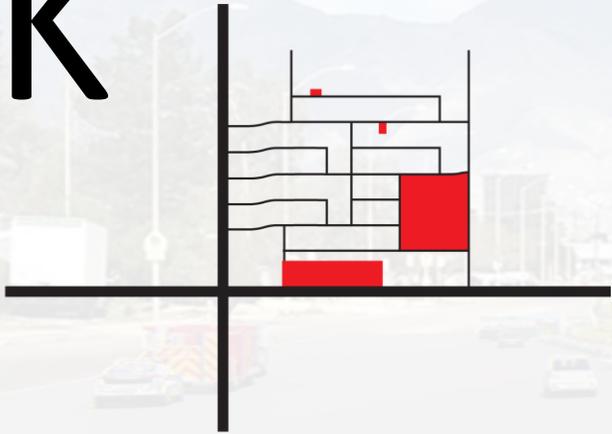


SUNBLOC

Mixed Use Multifamily | The Loop



Solar Decathlon

U.S. Department of Energy
Solar Decathlon 2020 Design Challenge

University of Arizona



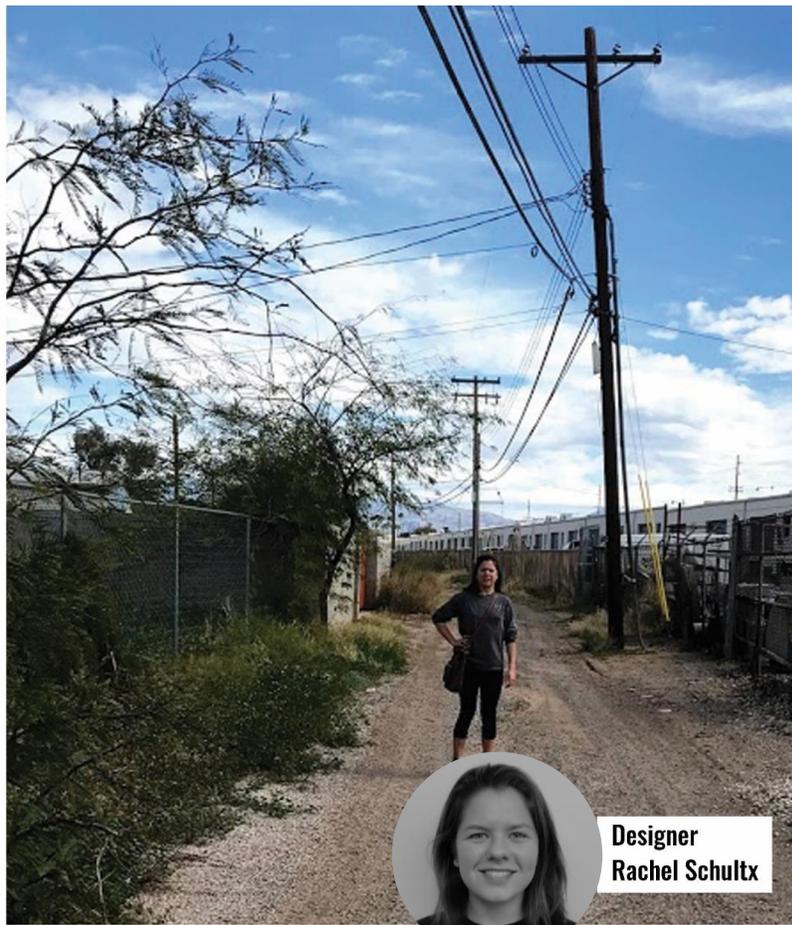
College of Architecture, Planning
& Landscape Architecture



INTRO | Our Team



Team Lead
Elizabeth Franzen



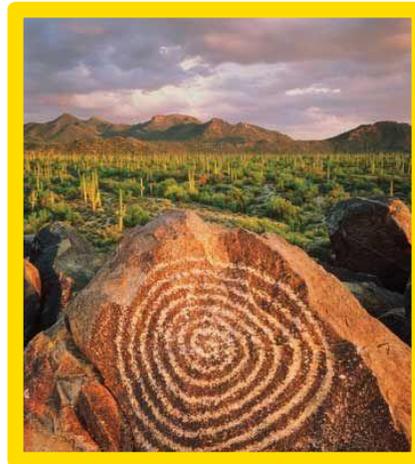
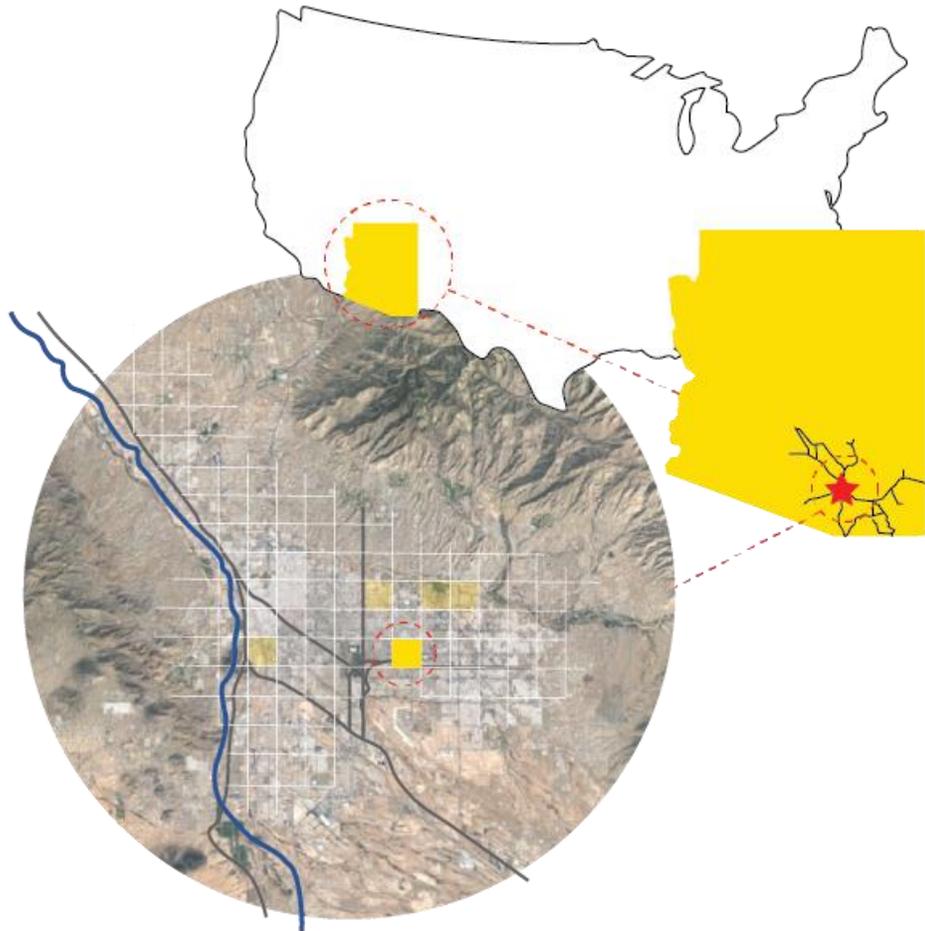
Designer
Rachel Schultx



Designer
Hao Wang



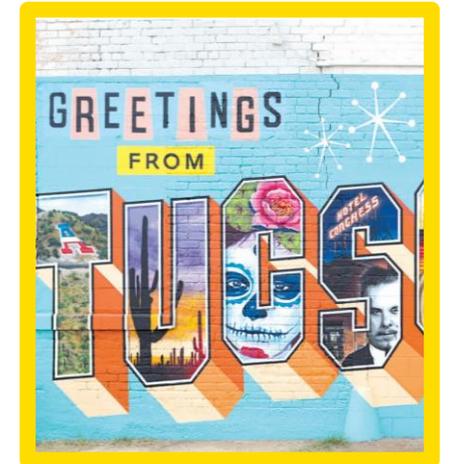
INTRO | Our Home



SONORAN DESERT



CULTURE



ART

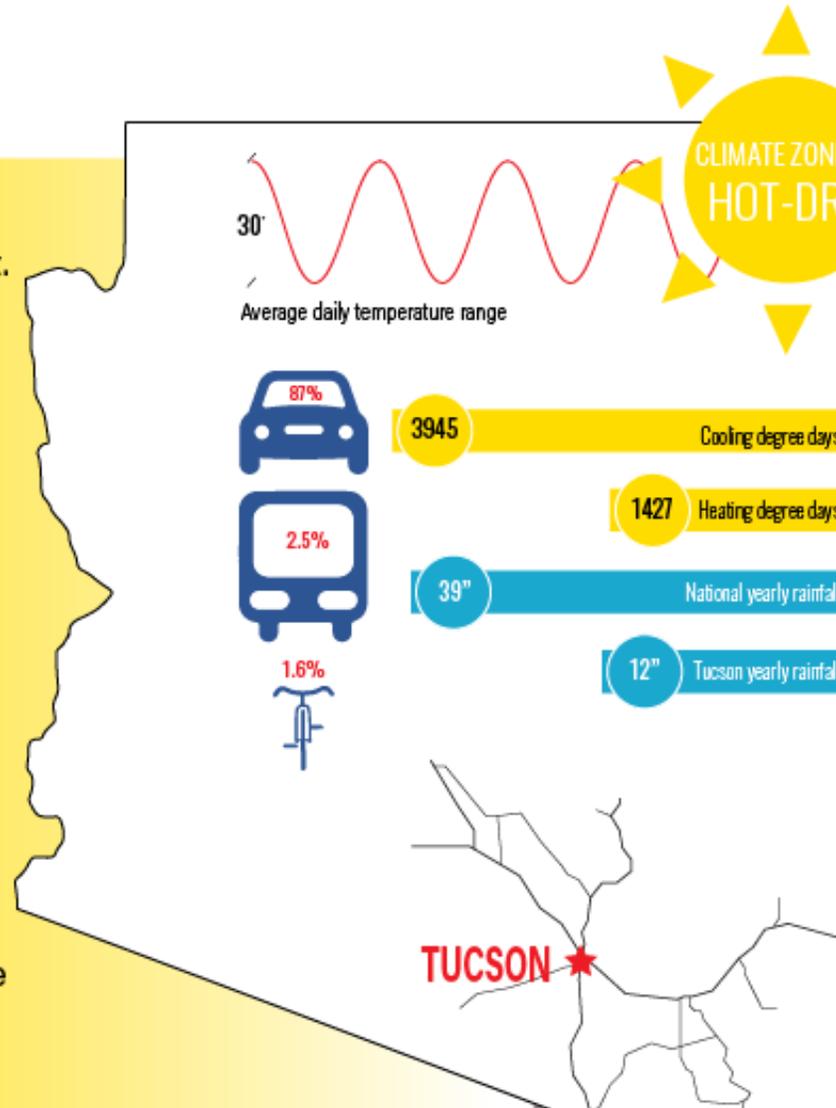


INTRO | Our Home

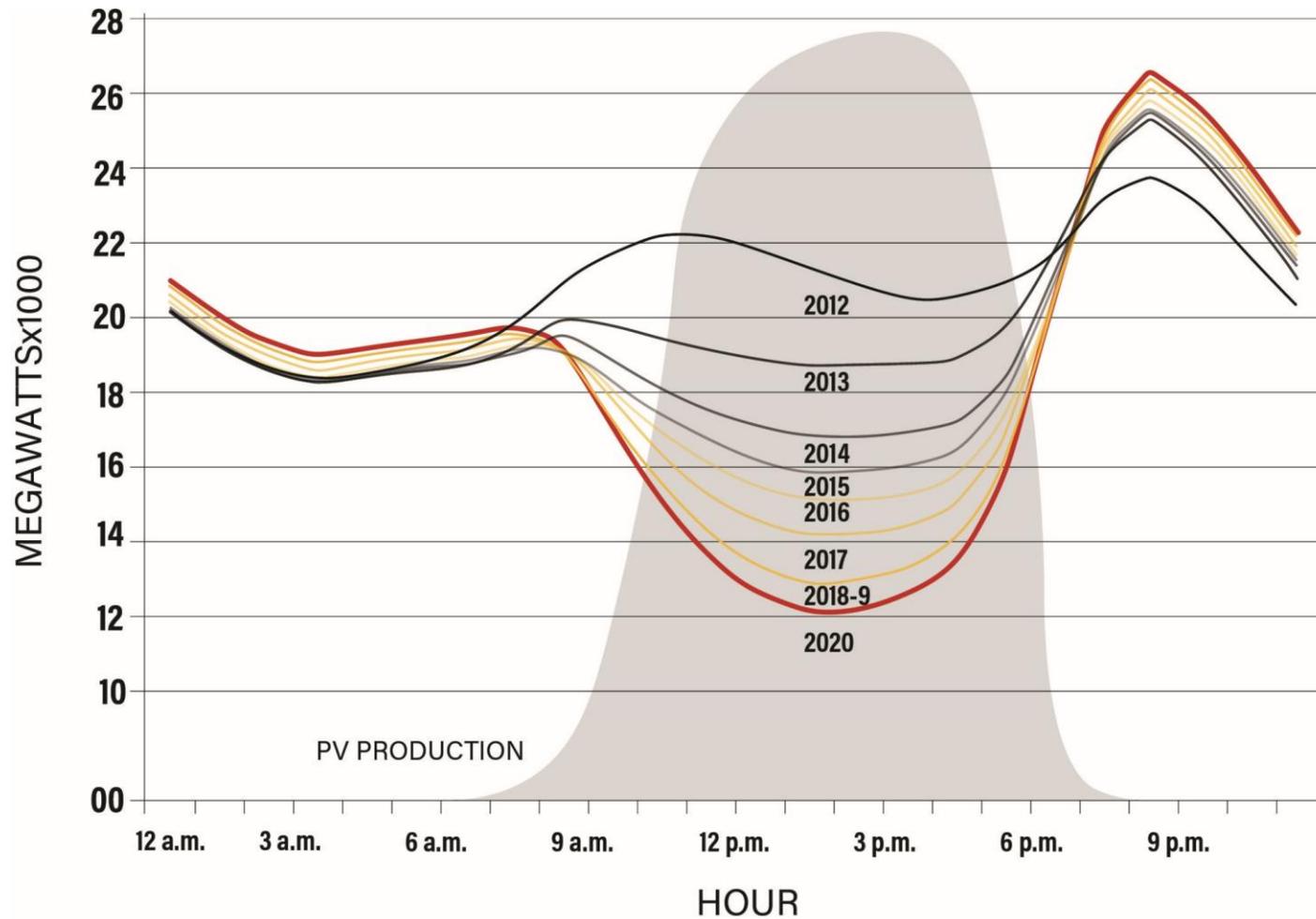
Tucson provides ideal conditions for a zero energy built environment.

- Existing buildings are easy to retrofit to sustainable building standards
- Gridded roads are a microgrid opportunity
- High waste heat production from cooling loads in large buildings
- AZ has highest total daily solar resource out of the entire United States
- High solar radiation and minimal cloud cover means efficient pv panels

A single kW of PV panels can produce 1,760 kWh/year, 25% more than the same panel in New York City.



INTRO | Grid Stress



INTRO | Sunblock

THE LOOP



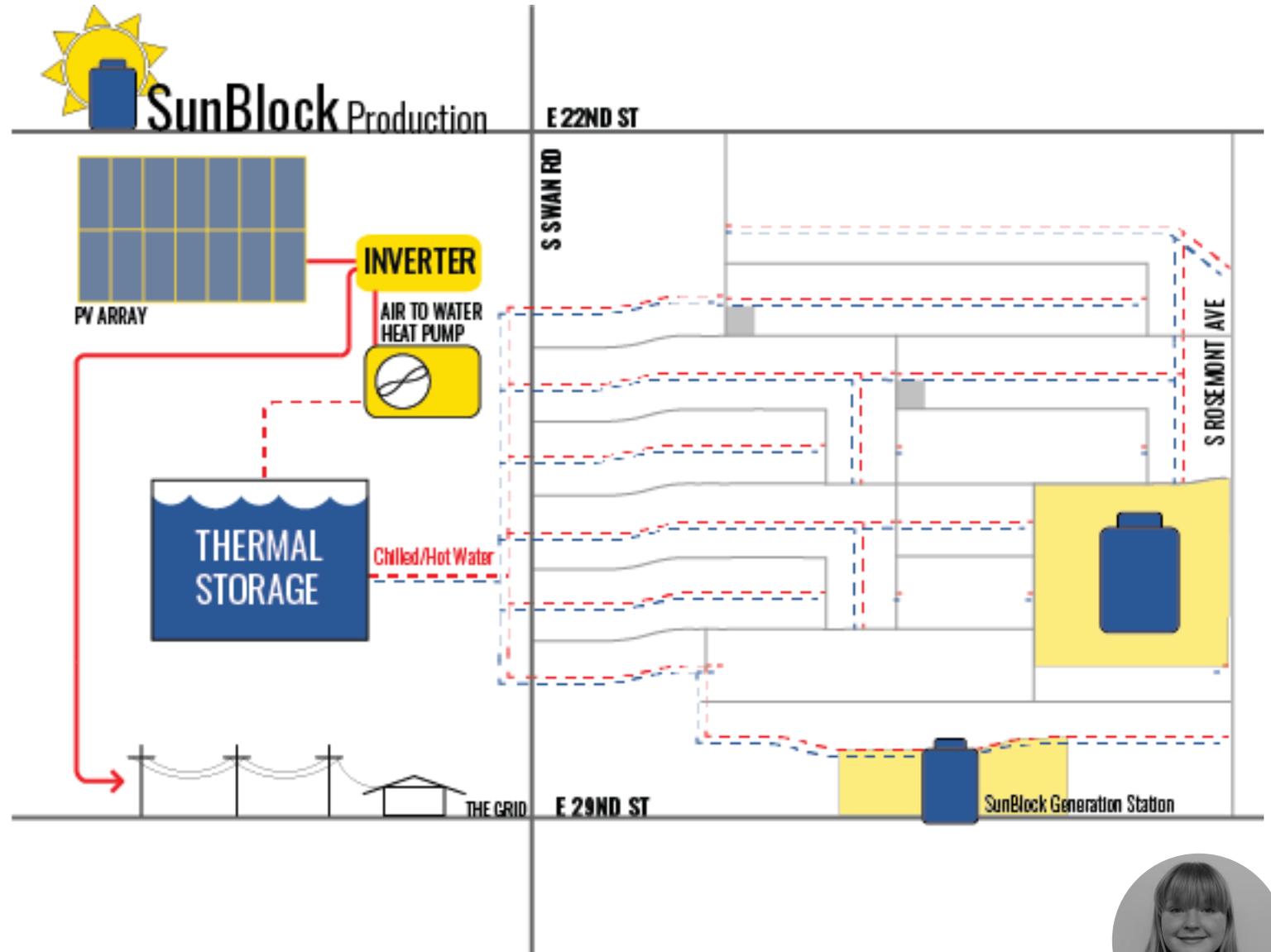
MYERS GANOUNG



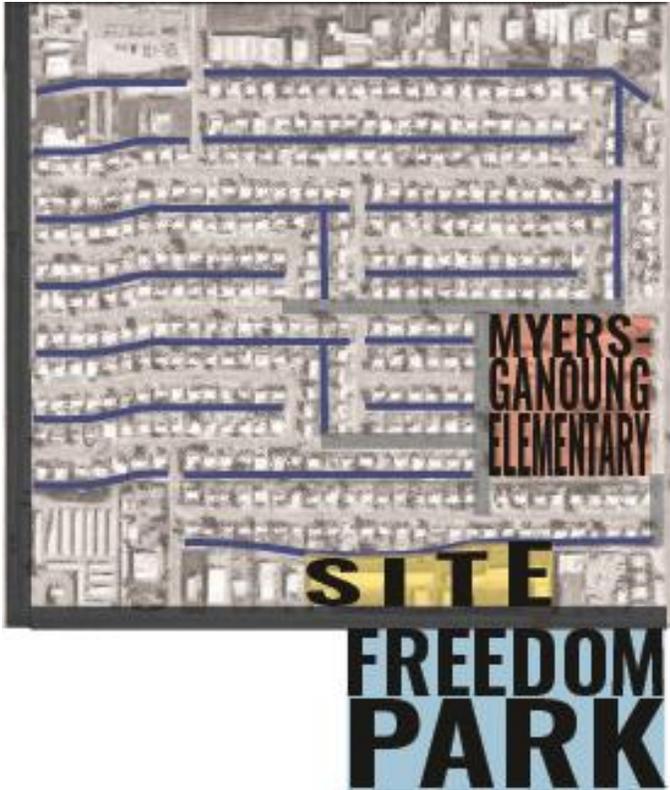
BARRIO 2.0



CASA DONANTE



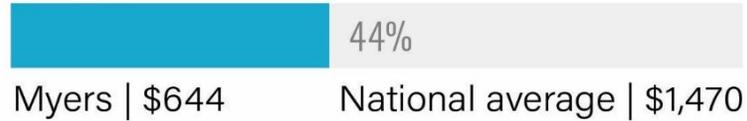
INTRO | Myers



RENTED 64%

OWNED 36%

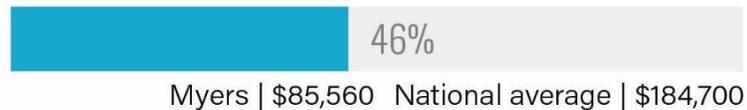
Median rent



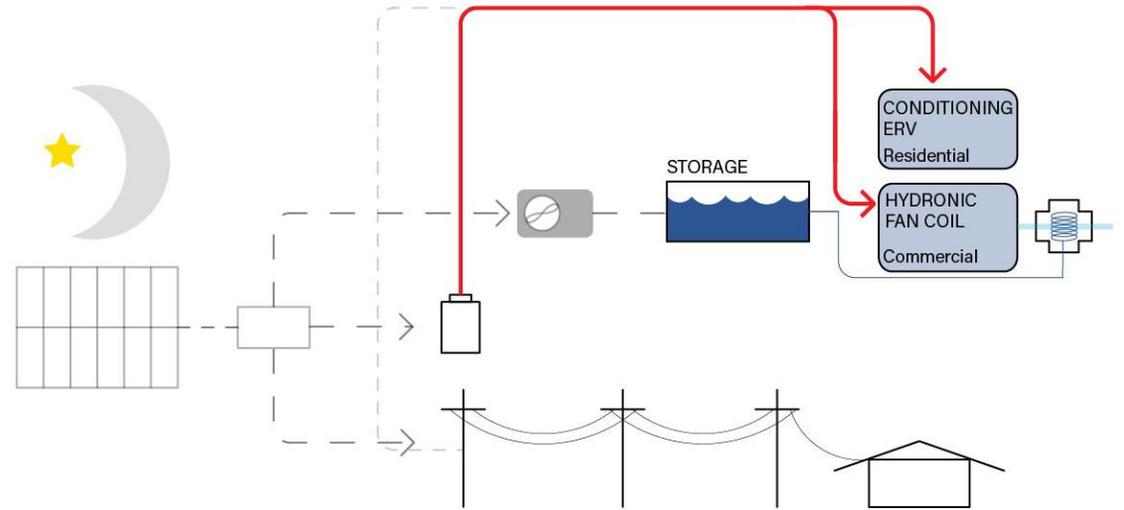
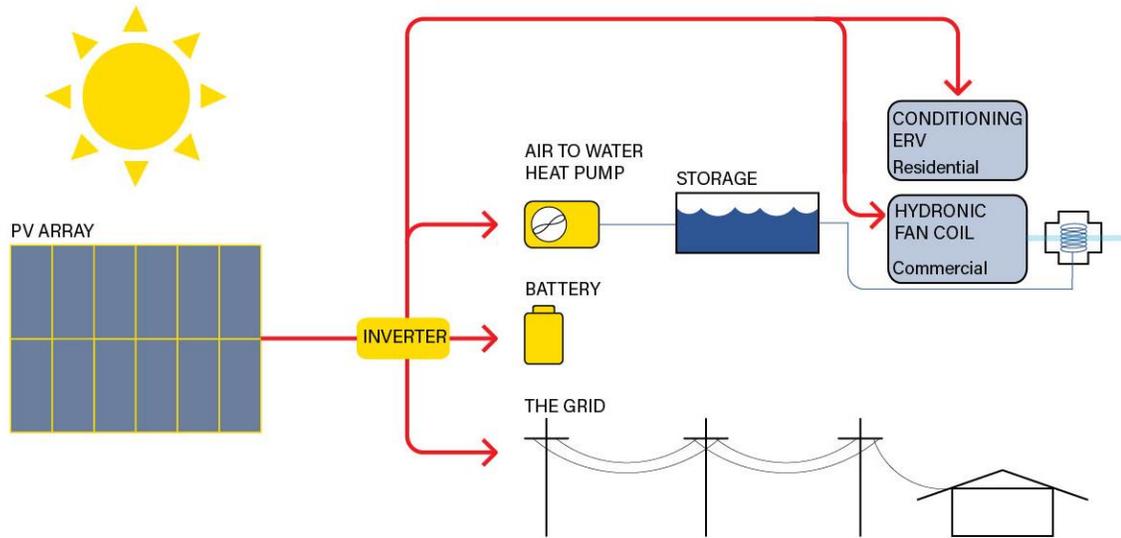
Household income

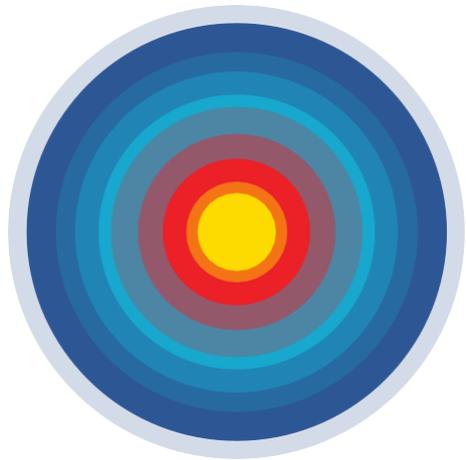


Home value



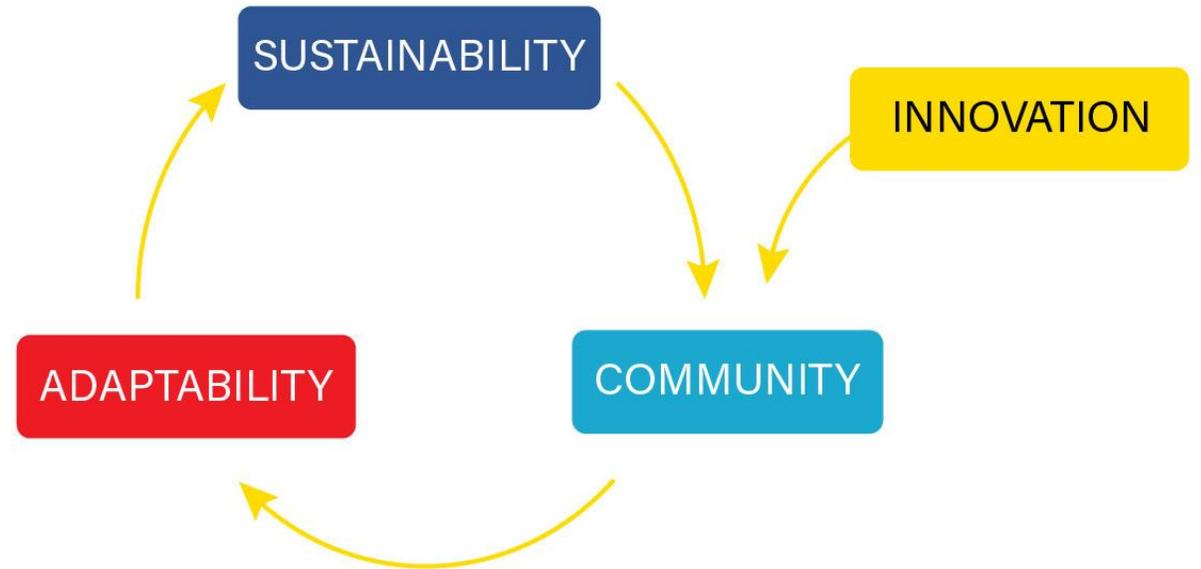
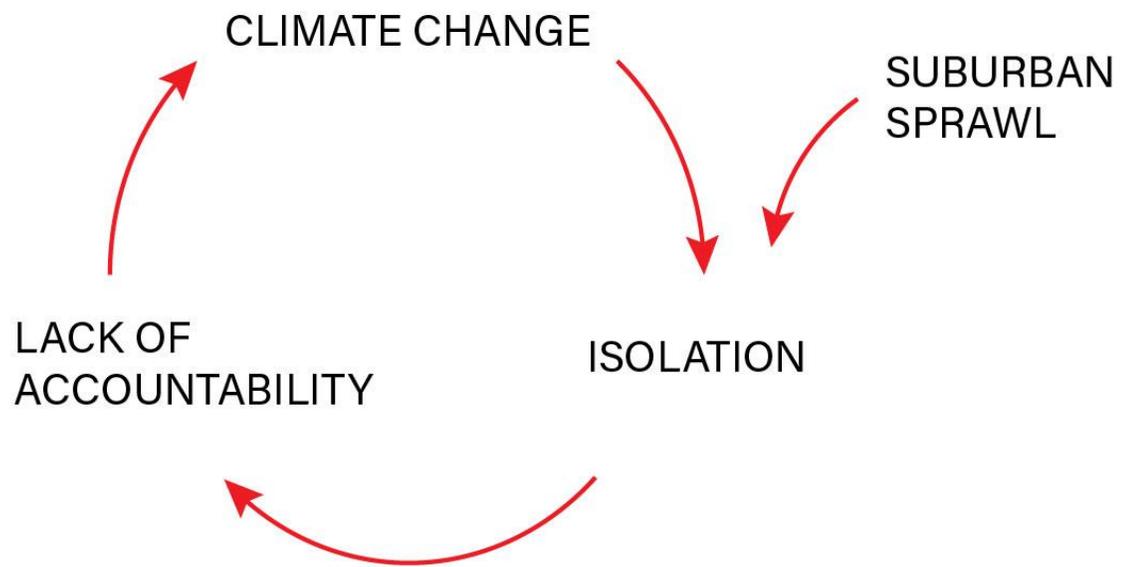
INTRO | Sunblock

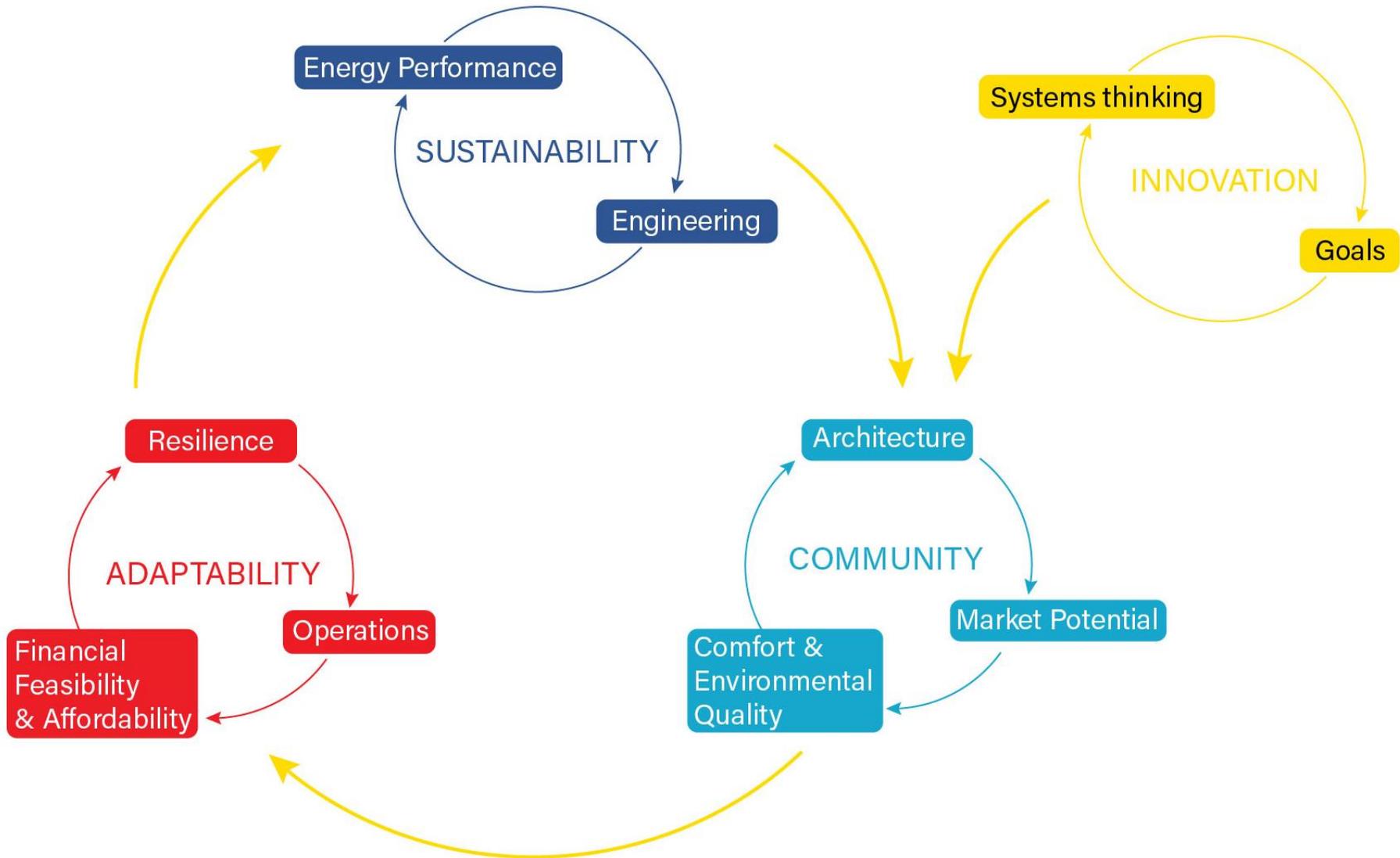




SUNBLOCK | Suburban Growth Template







Systems thinking

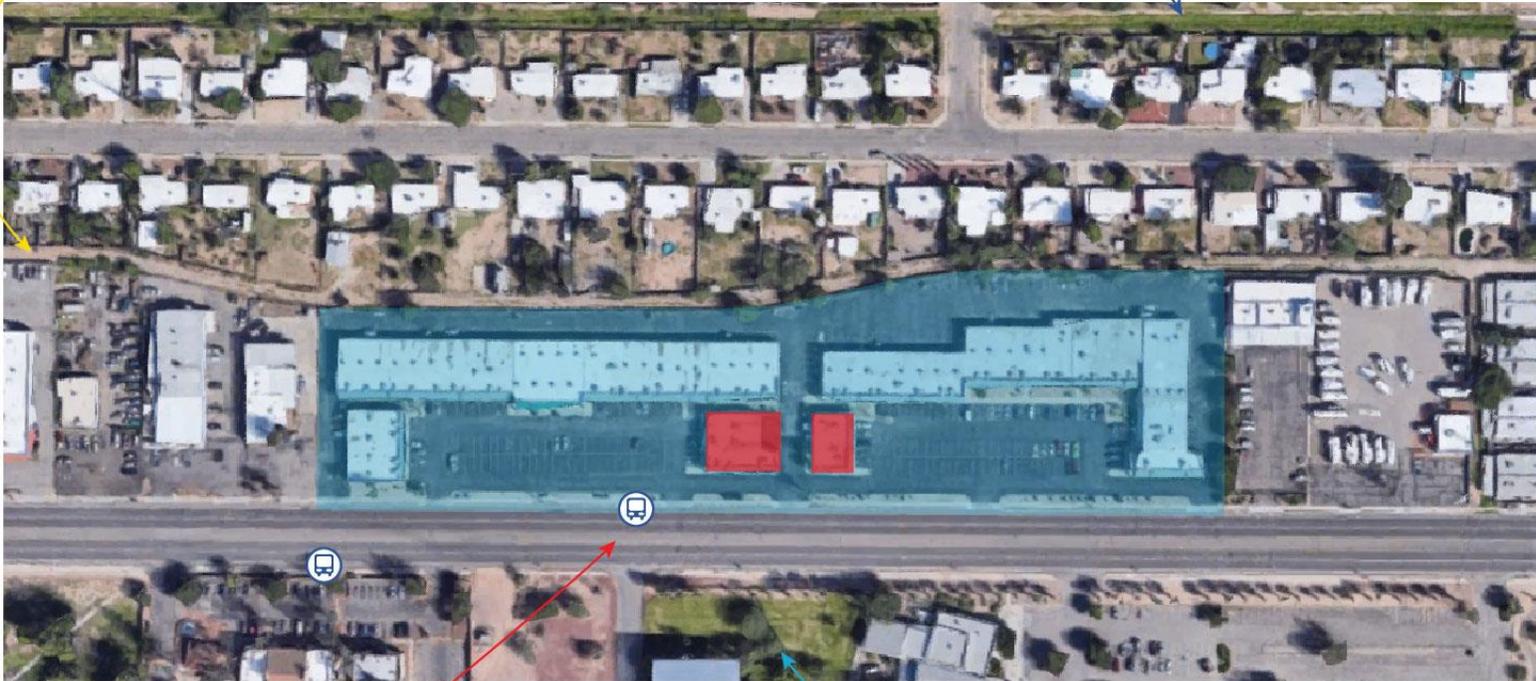
INNOVATION

Goals

The team selected a site that best reflects the problems that Tucson faces and the symptoms of suburban sprawl, a vacant strip mall.

UTILITY EASEMENT

SUNBLOCK ELEMENTARY
MYERS-GANOUNG



EXISTING BUS STOP
BUS 17 : STOPS EVERY 30 MIN

FREEDOM PARK

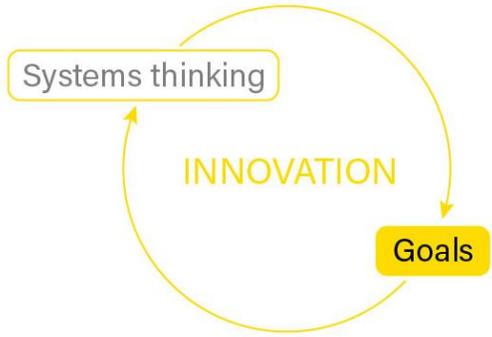


UTILITY EASEMENT

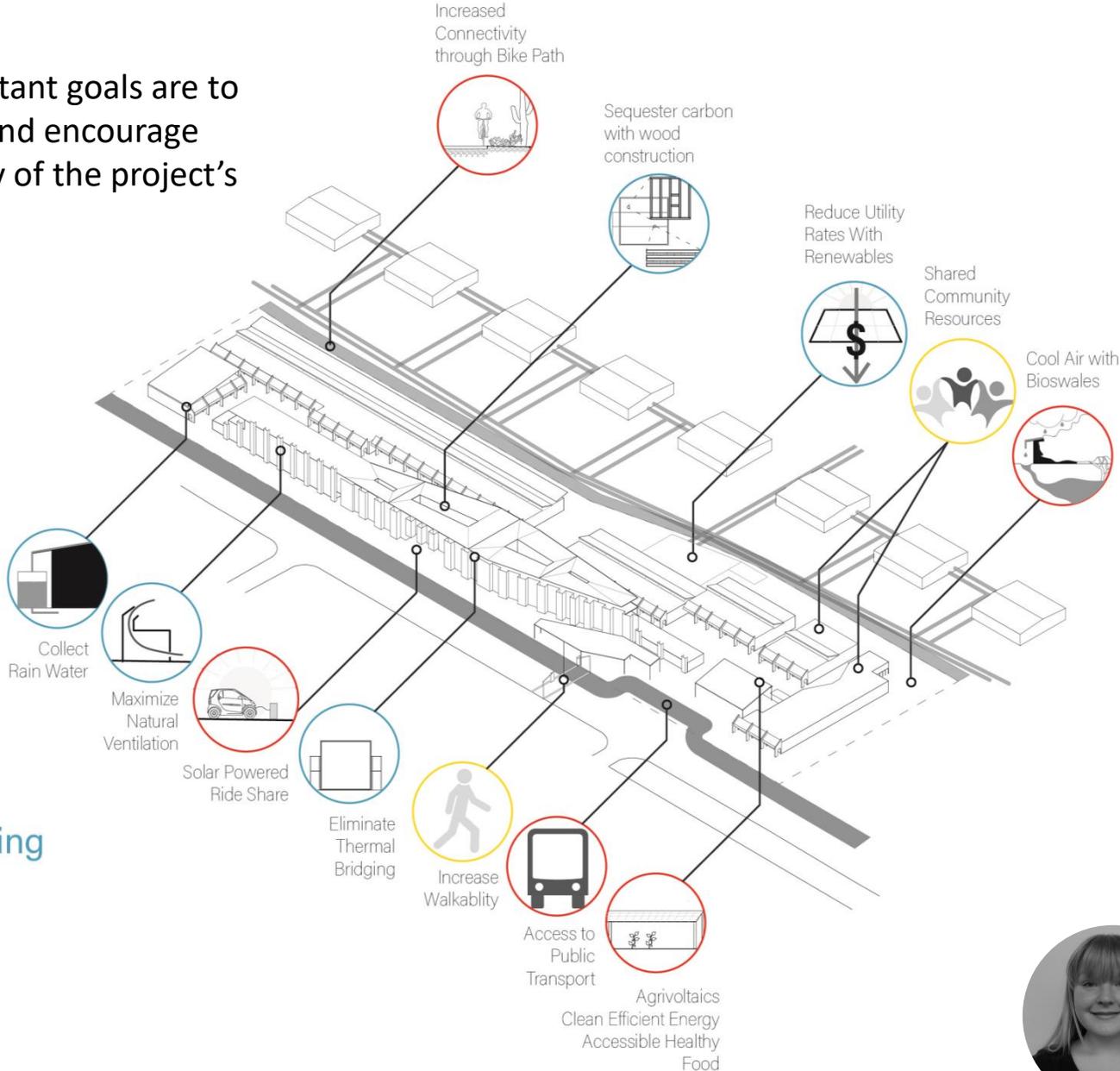


EXISTING BUS STOP





The Loop's two most important goals are to empower the community and encourage sustainable living, but many of the project's features achieve both.

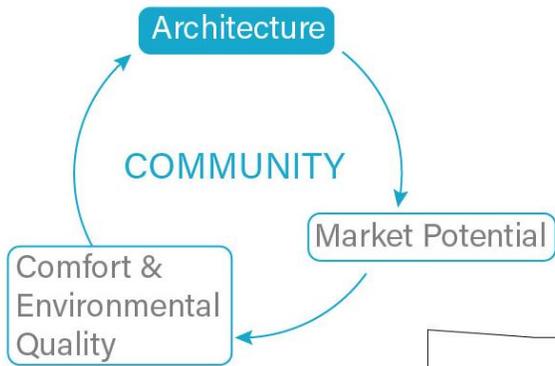


Empower the community

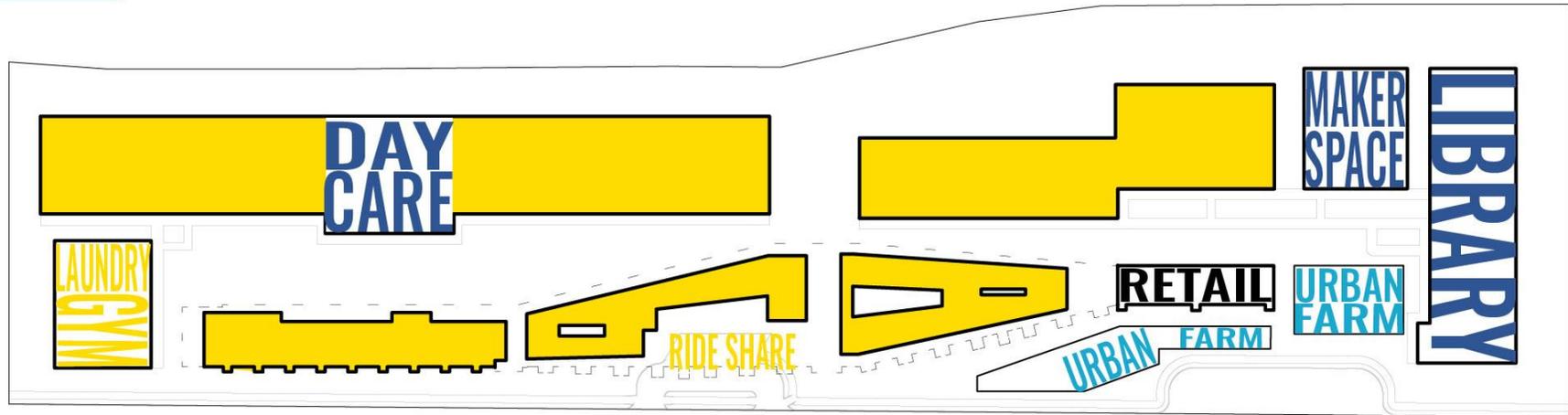
Encourage sustainable living

Both





The Loop is made up of a retrofit building that contains units and public resources, as well as a new building with units and retail space. Public spaces feature open floorplans for a flexible program.



■ **RESIDENTIAL** Area: 127,162 sf

■ **PUBLIC RESOURCES** Area: 23,150 sf

■ **RETAIL** Area: 2,730 sf

■ **URBAN FARM** Area: 6,893 sf

New Build: 57 units

28 Studio: 415 sf

12 1 BD: 450 sf

7 2 BD: 550 sf

20 3 BD: 800 sf

AREA: 93,240 sf

Retrofit: 32 unit

32 2 BD: 1060 sf

AREA: 33,920 sf

Resources

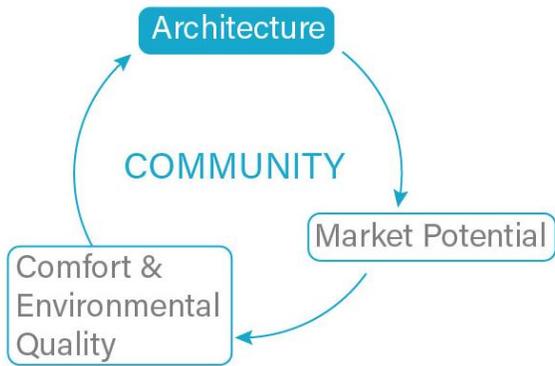
Library : 11,300 sf

Office space : 5,450 sf

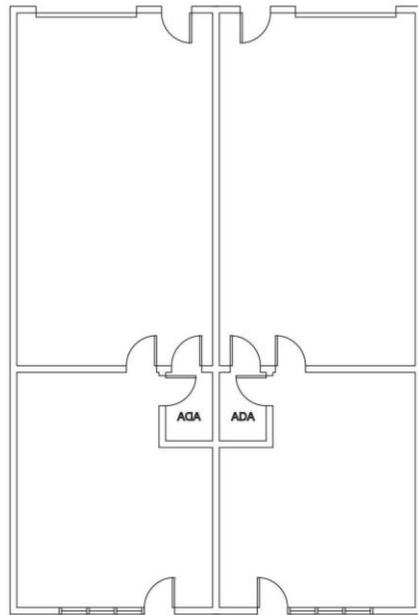
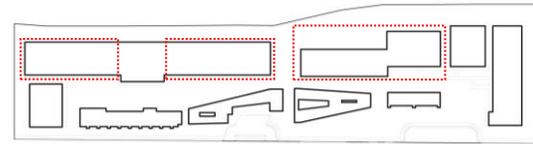
Daycare: 6,400 sf

AREA: 23,150 sf

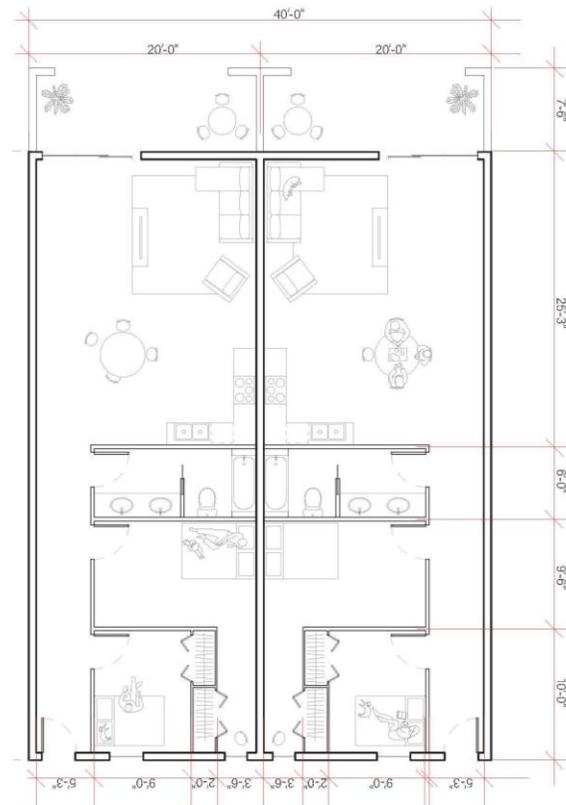




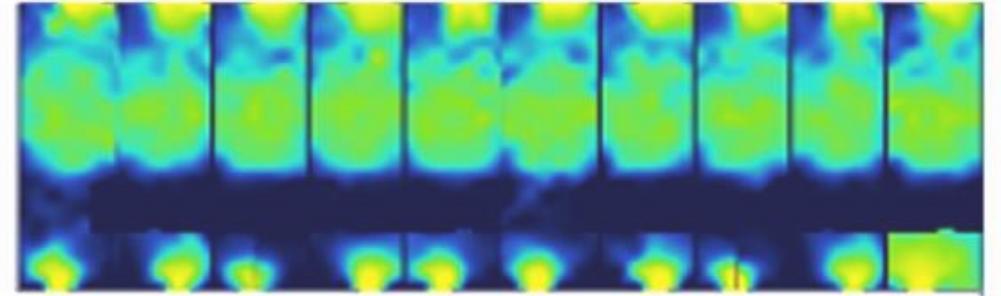
The Retrofit residential units turn existing storefront spaces into 1000 square foot, two-bedroom units with patios and a skylight.

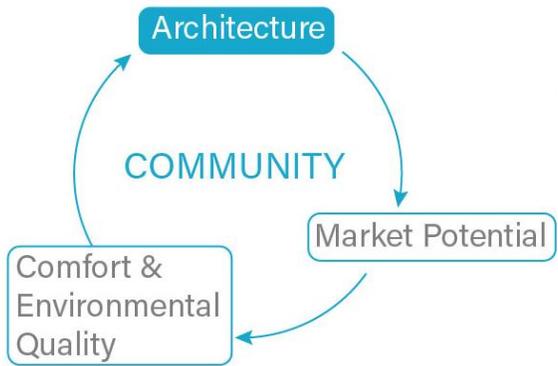


BEFORE

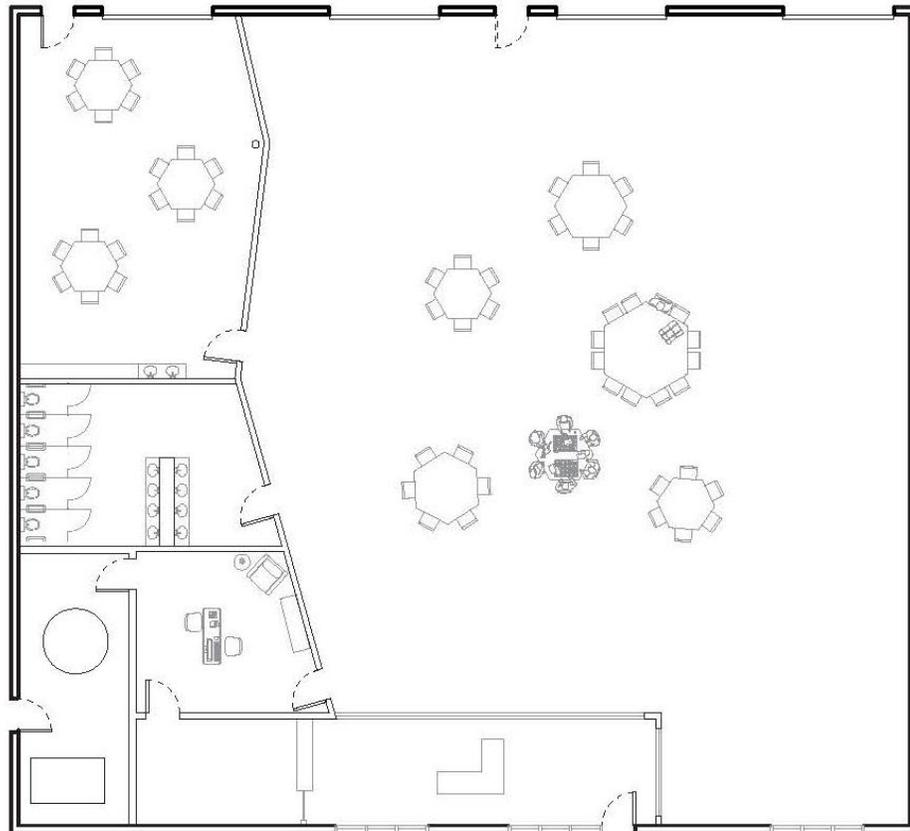
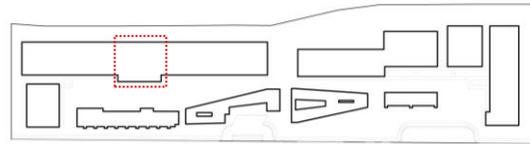


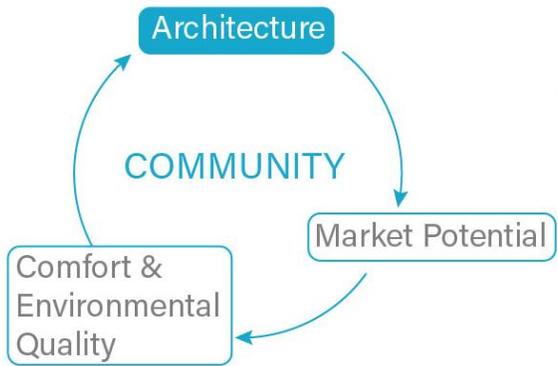
AFTER



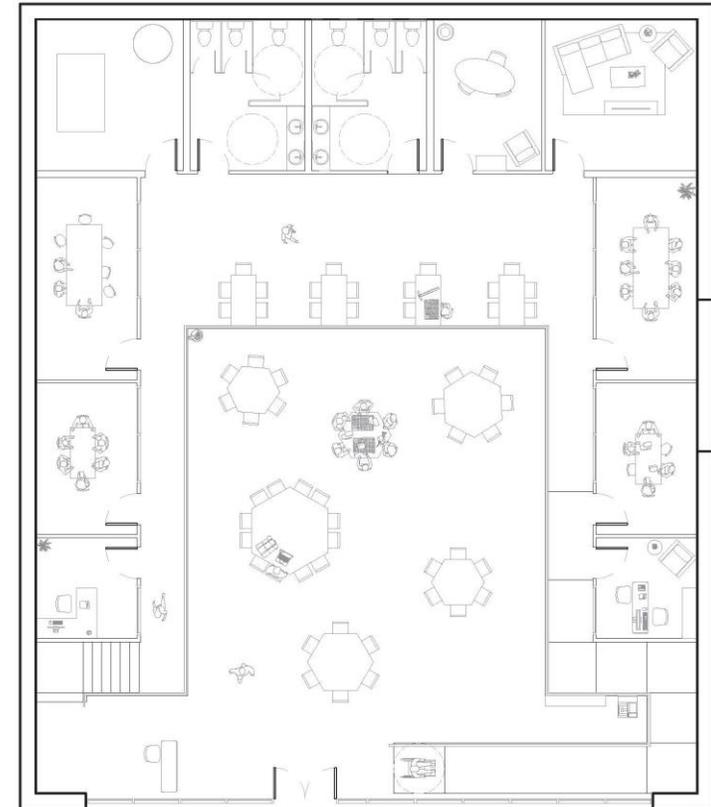
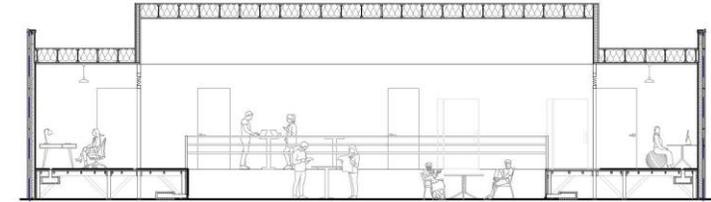
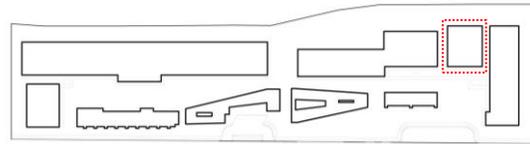


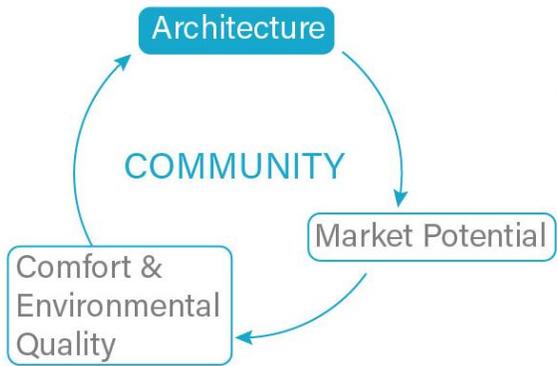
A daycare is an important resource for low-income and single-parent families, as well as an employment opportunity for residents.



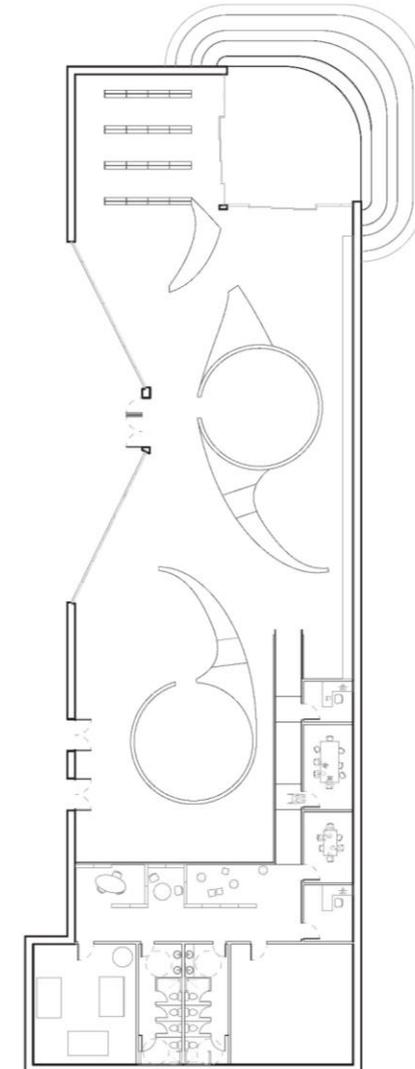
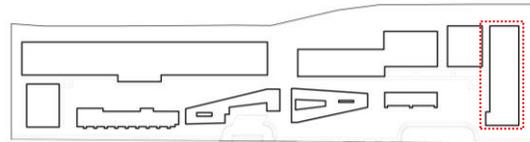


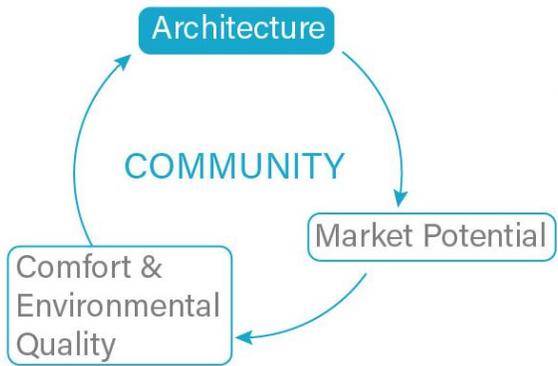
A commercial maker-space provides rentable offices and an open center for large groups or flexible desk space.



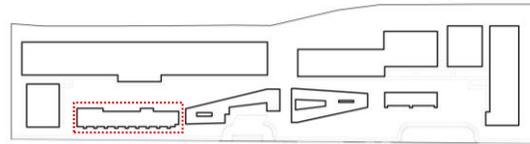


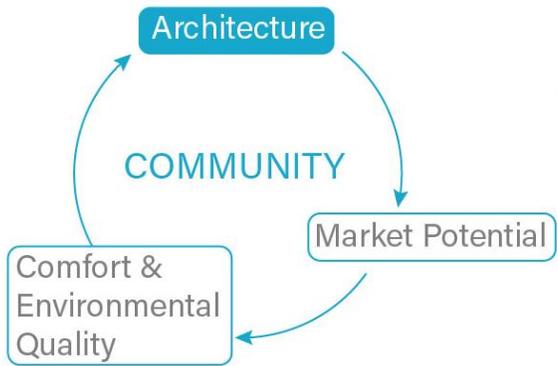
A public library provides for The Loop with tech and literary resources, an open floorplan, and an outdoor amphitheater for events.



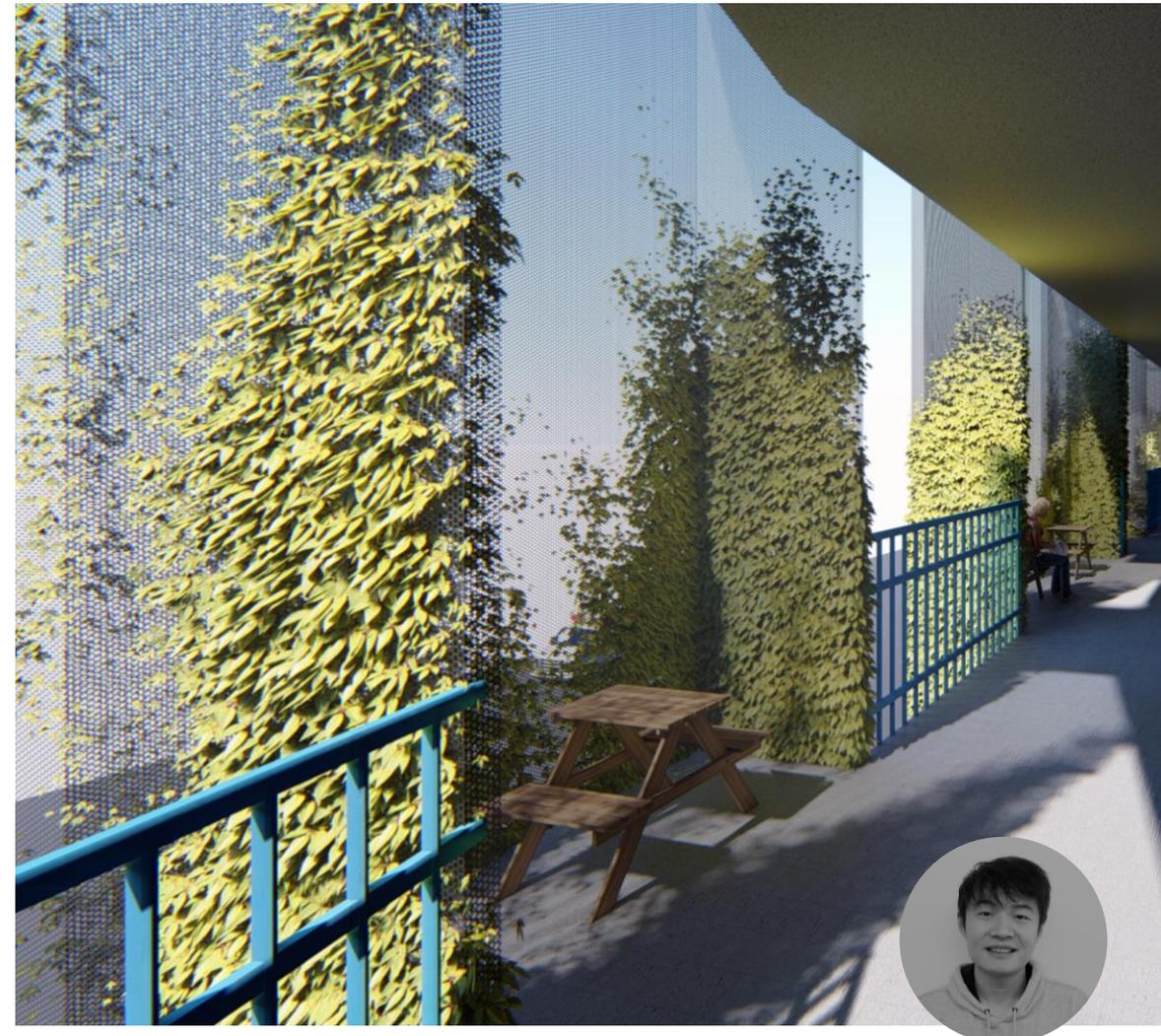
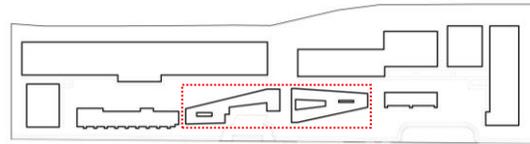


The New Building shows off its passive cooling methods with metal-clad solar chimneys against a stucco façade.





To the west, the visual language of the solar chimneys continue on the New Building as shady, screened-off patio spaces with vines.





Thanks to our rent pricing, The Loop can focus on three often overlooked demographics that make up Tucson and the Myers community.

TUCSON

MYERS



Tucson is my home, I have a job but I can no longer afford the rising price of rent. I wish I could be more involved in my community.



I am retired and living off of social security. I would like to live somewhere with community values and friendly neighbors.

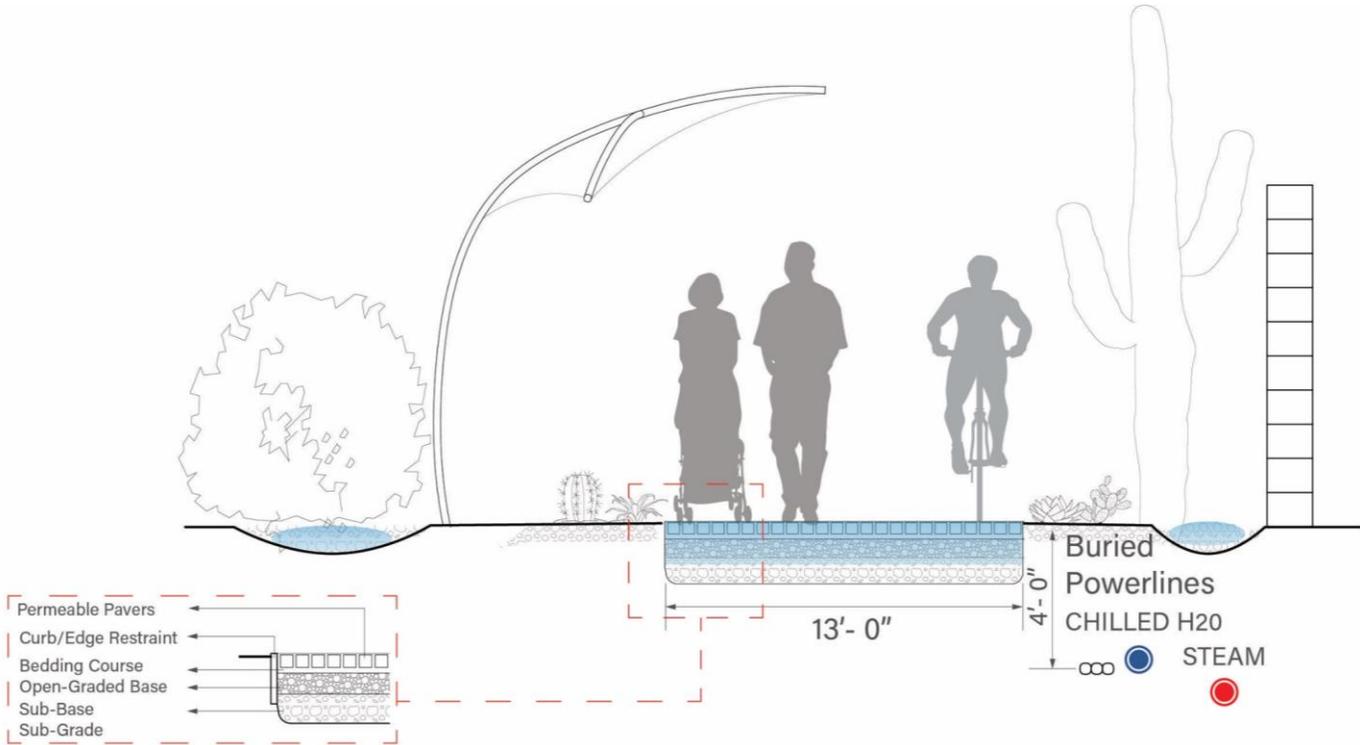
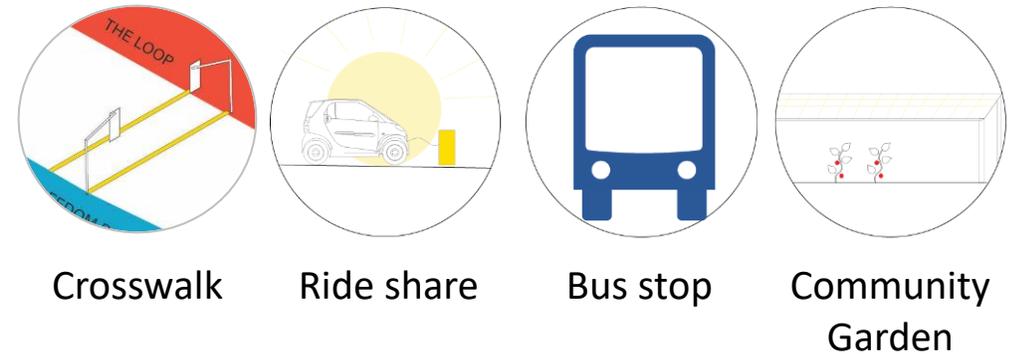


I am a single parent working full time. I am looking to live somewhere that is safe and close to a good school.





The Loop responds to needs within its community by adding important resources to a car-dependent, isolated site.



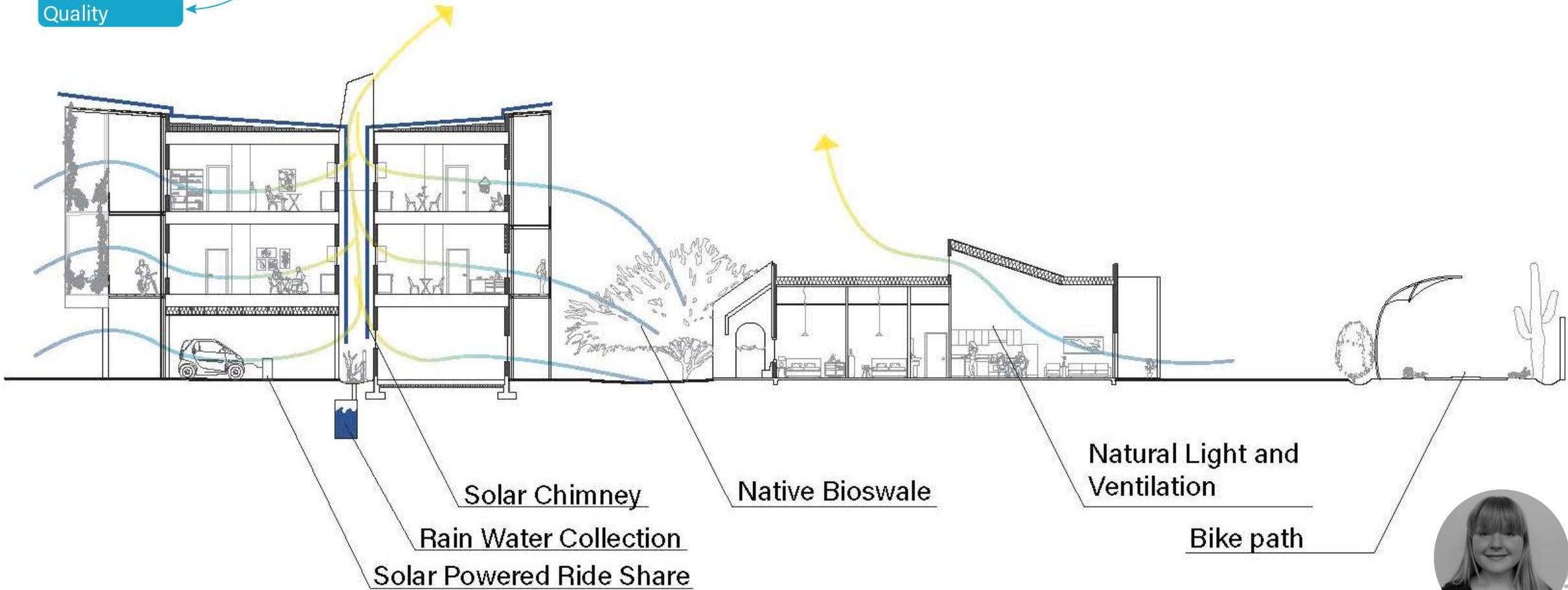
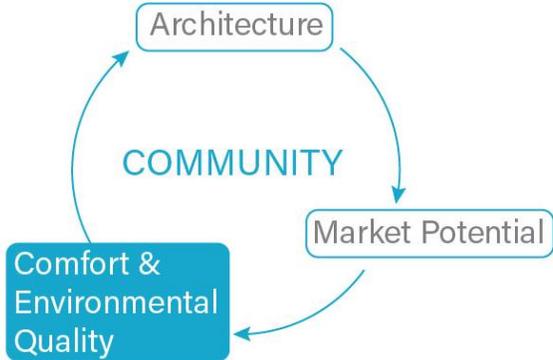
Easement adaptation

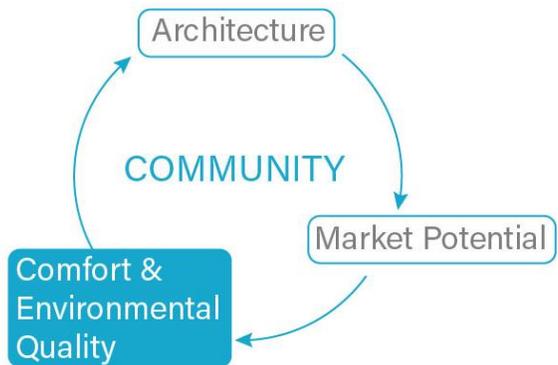
Walk Score 46	Car-Dependent Most errands require a car.
Transit Score 38	Some Transit A few nearby public transportation options.
Bike Score 68	Bikeable Some bike infrastructure.

Existing easement

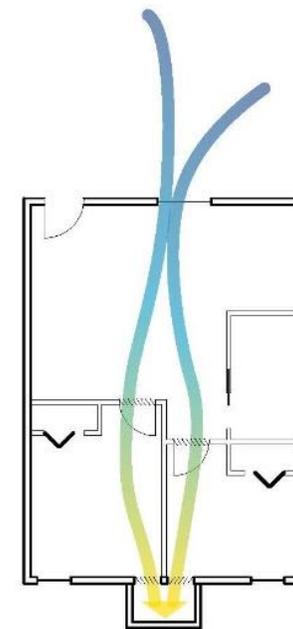
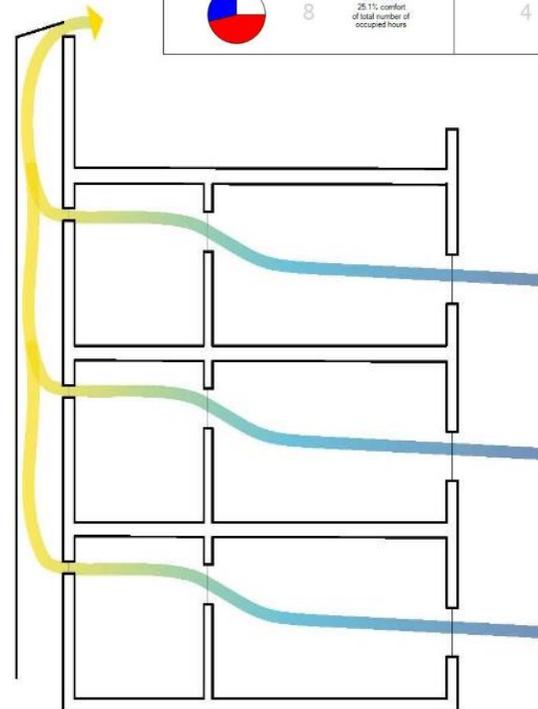
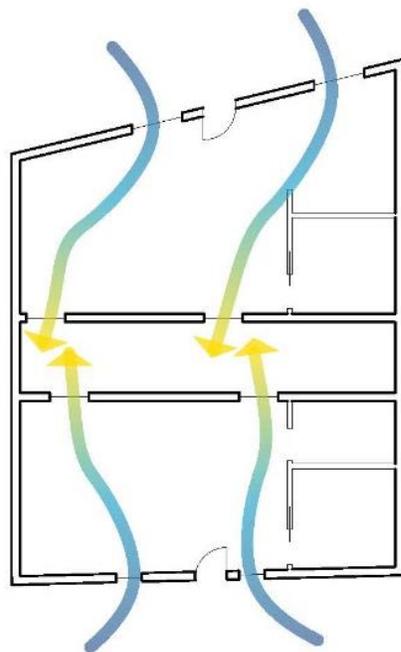
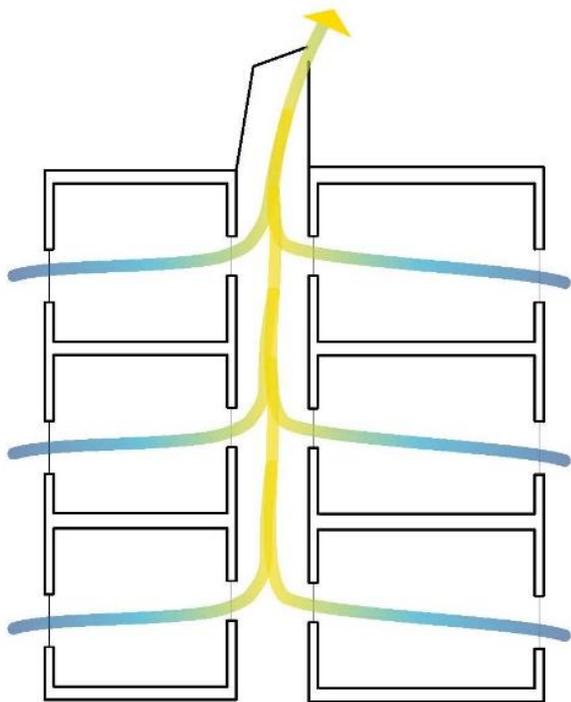


The landscape and buildings work together to create natural ventilation throughout the site.



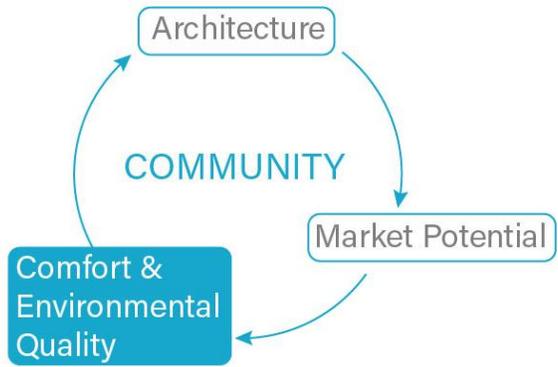


Two different kinds of solar chimney ventilate each residential unit, keeping The Loop comfortable indoors for up to 30% of the year.

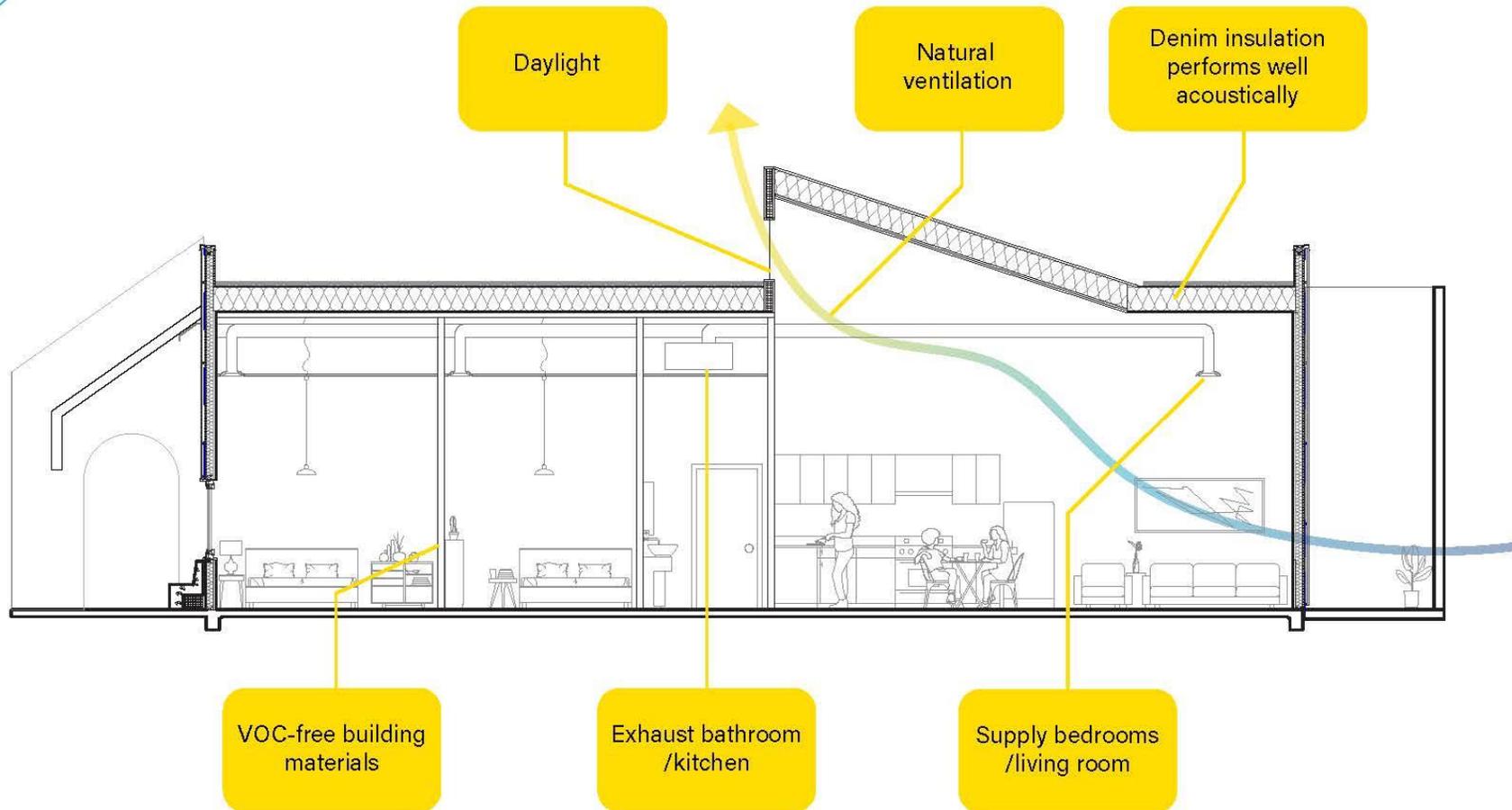


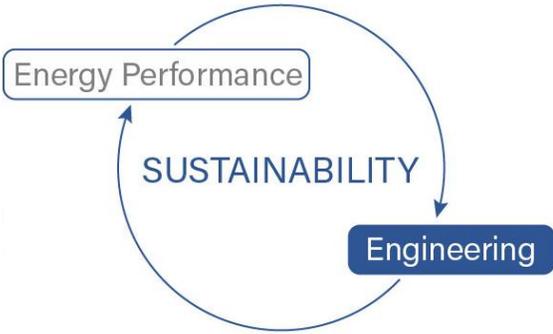
		7		
	10	45.4% hot 29.1% cold 25.5% comfort of total number of occupied hours	6	
	9	45.3% hot 28.8% cold 25.9% comfort of total number of occupied hours	5	
	8	46.3% hot 28.7% cold 25.1% comfort of total number of occupied hours	4	
				1
				3
				2
				4
				5
				6
				7



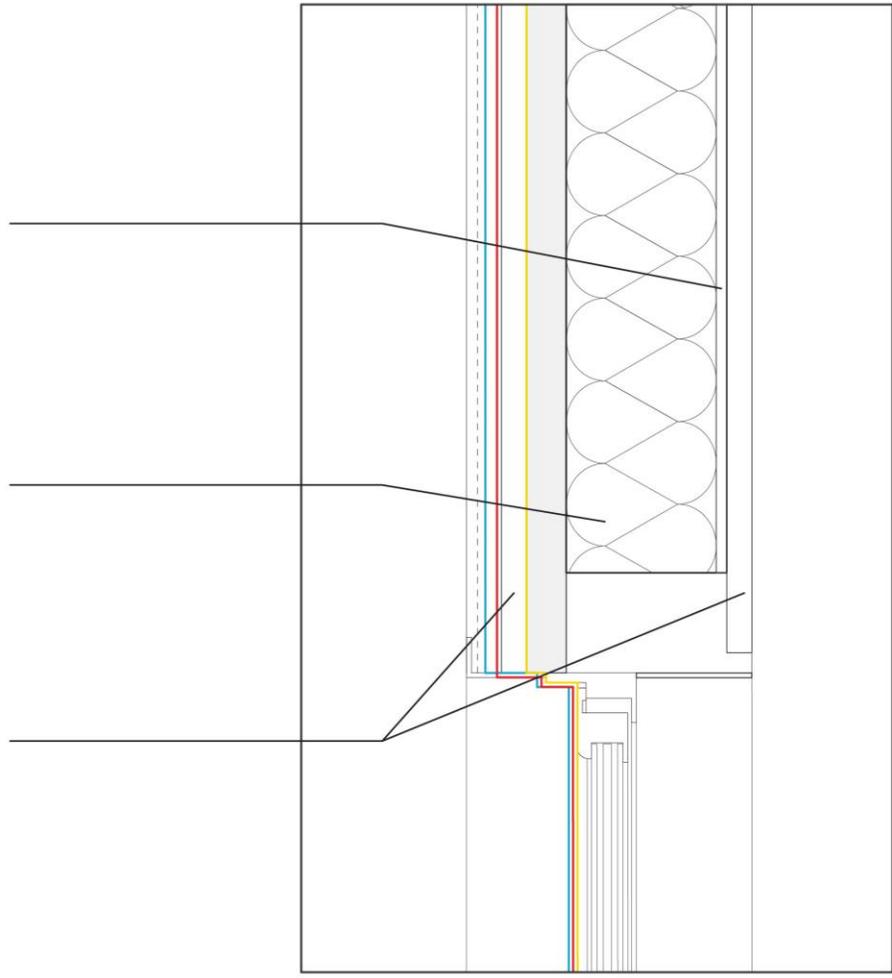
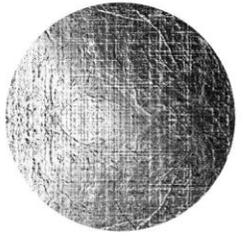


Within each unit natural building materials, ventilation, daylight, air quality, and acoustics all go into a comfortable environment.





The Loop's wall assembly is successful thanks to three special building materials.



— WATER — THERMAL — AIR/VAPOR

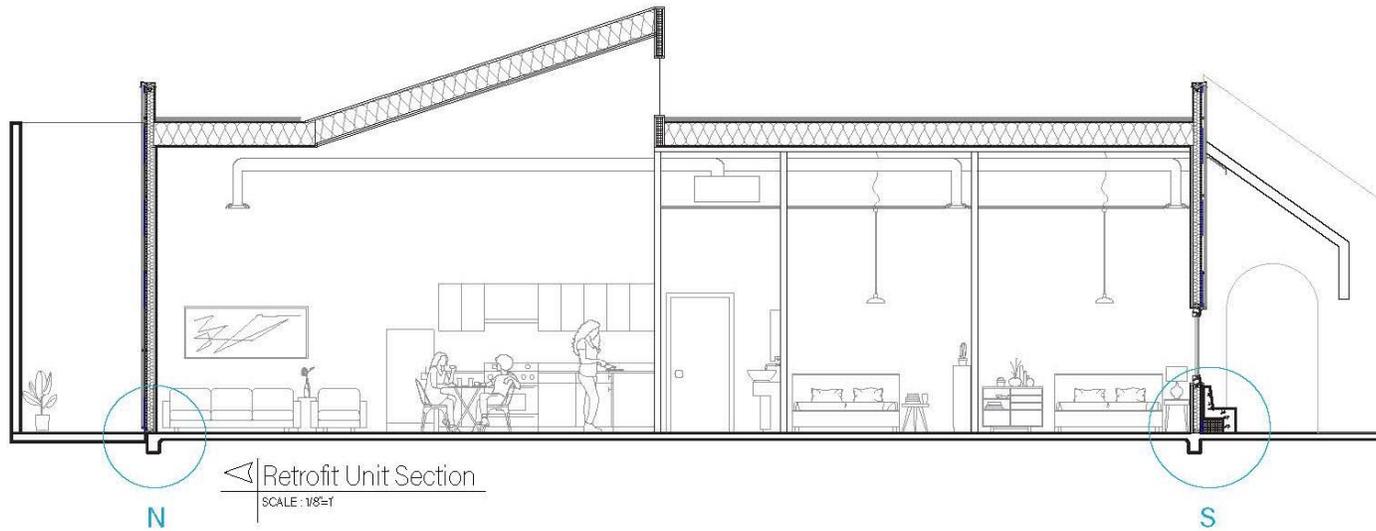


Energy Performance

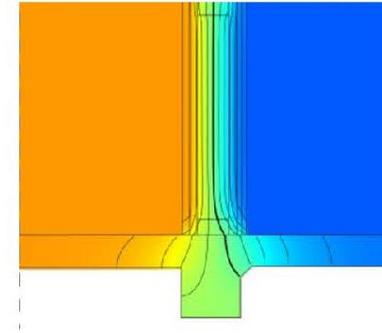
SUSTAINABILITY

Engineering

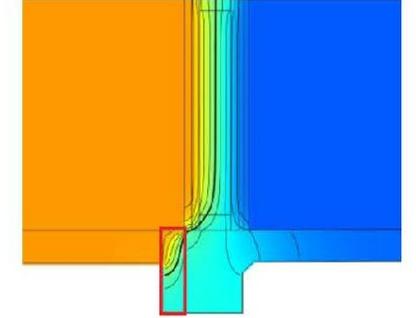
Properly placed insulation ensures that there are no thermal bridges in the retrofit building from an exposed slab.



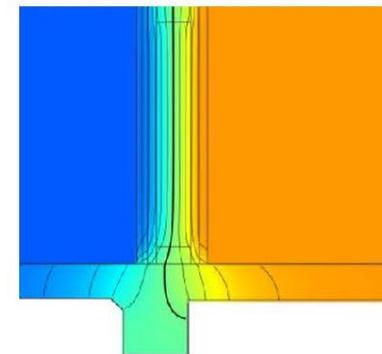
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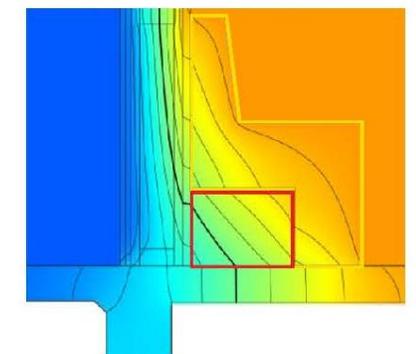
After



Before



After

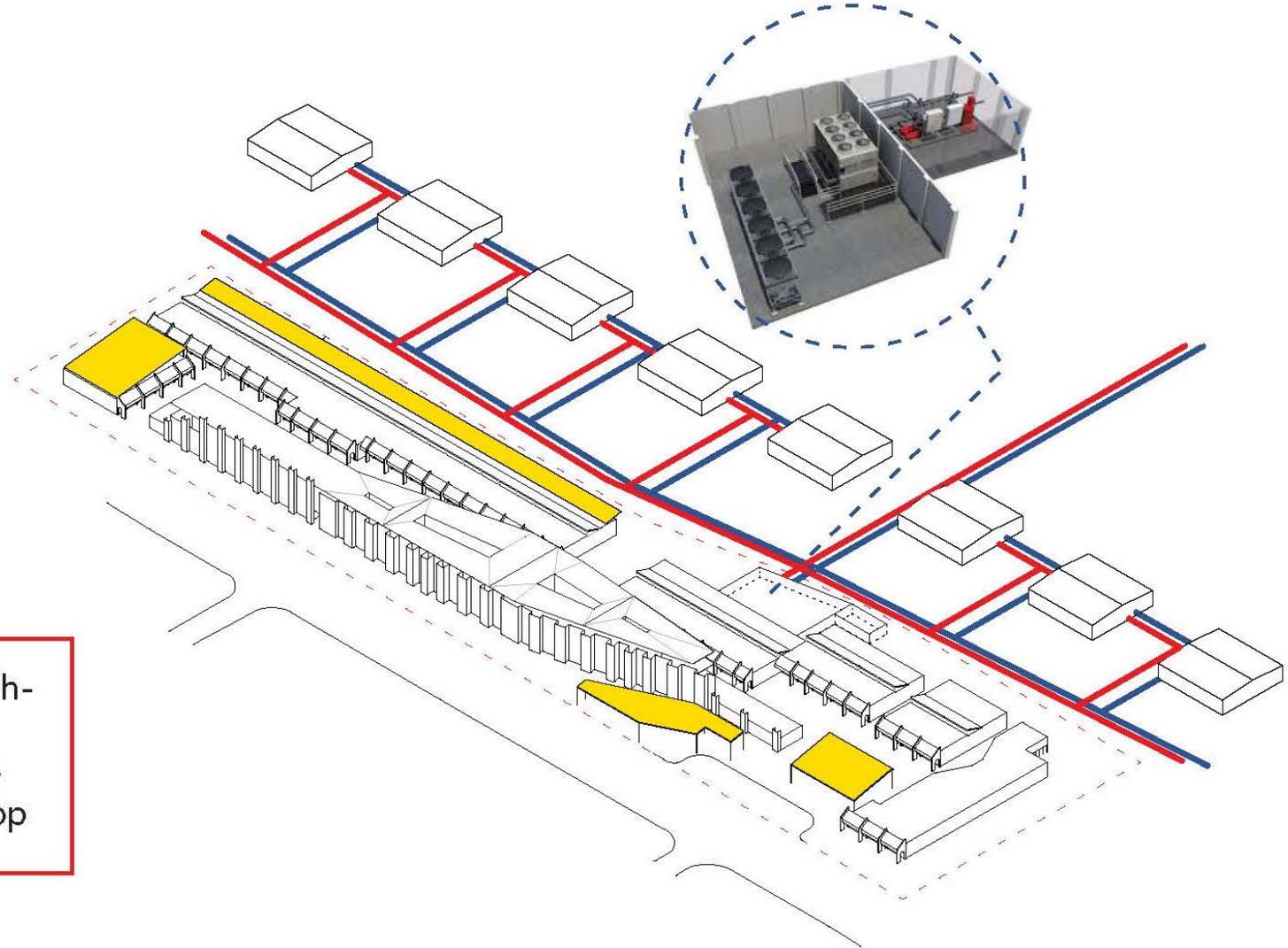


Energy Performance

SUSTAINABILITY

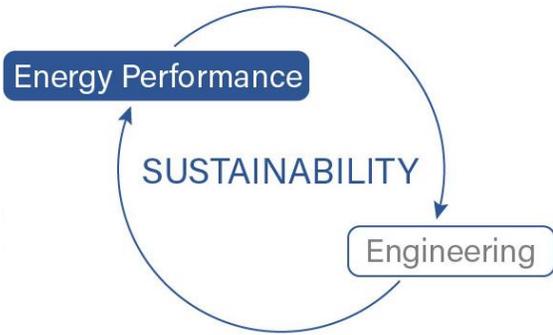
Engineering

With a 454,750 kWh/year pv array, The Loop generates enough energy to cool the entire Myers neighborhood.



The Myers neighborhood 100% Cooled by Sun-Block's The Loop





DYNAMIC RESULTS

Heat gain/loss through components [kBtu]

Nr.	Component group	Gain	Loss
1	Outer walls	32334	27462
2	Roof	92	73
3	Flat roof	60020	31076
4	Floor over outer air	803	2788
5	Floor on ground	24783	63299
6	Windows	185268	62715

Case 1/Zone 1: Main results

Setting	Value		
Heating period [d]	92		
Cooling period [d]	43.6		
Heating demand [kBtu]	227343.2		
Cooling demand [kBtu]	99608.5		
Humidification demand [lb]	0		
Dehumidification demand [lb]	0		
Min/Max/Mean values			
Setting	Min	Max	Mean
Inner temperature [°F]	68	93.9	75.7
Inner relative humidity [%]	6.9	65.6	30.2
Heating load [Btu/hr]	0	252275.6	25952.4
Cooling load [Btu/hr]	-793465.3	0	-11370.6
Humidification [lb/hr]	0	0	0
Dehumidification [lb/hr]	0	0	0

ZONE 1 : Residential



Zone 2: Main results

Setting	Value		
Heating period [d]	25.2		
Cooling period [d]	56.8		
Heating demand [kBtu]	12983.5		
Cooling demand [kBtu]	75276.2		
Humidification demand [lb]	0		
Dehumidification demand [lb]	0		
Min/Max/Mean values			
Setting	Min	Max	Mean
Inner temperature [°F]	68	94.2	77.4
Inner relative humidity [%]	16.3	61.8	37.7
Heating load [Btu/hr]	0	56394.3	1479.6
Cooling load [Btu/hr]	-130863.1	0	-8593.2
Humidification [lb/hr]	0	0	0
Dehumidification [lb/hr]	0	0	0

ZONE 2 : Commercial

STATIC RESULTS

Heating load

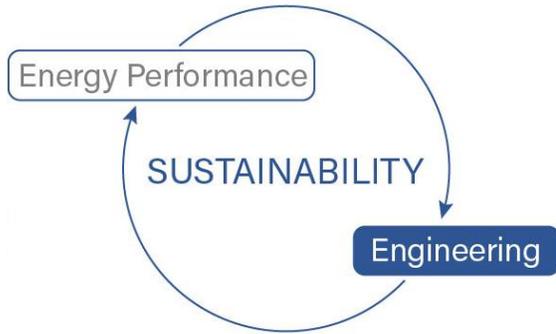
specific: 2.71 Btu/hr ft²
 target: 4.4 Btu/hr ft²
 total: 252,288.5 Btu/hr



Cooling load

specific: 3.62 Btu/hr ft²
 target: 7.3 Btu/hr ft²
 total: 337,734.61 Btu/hr





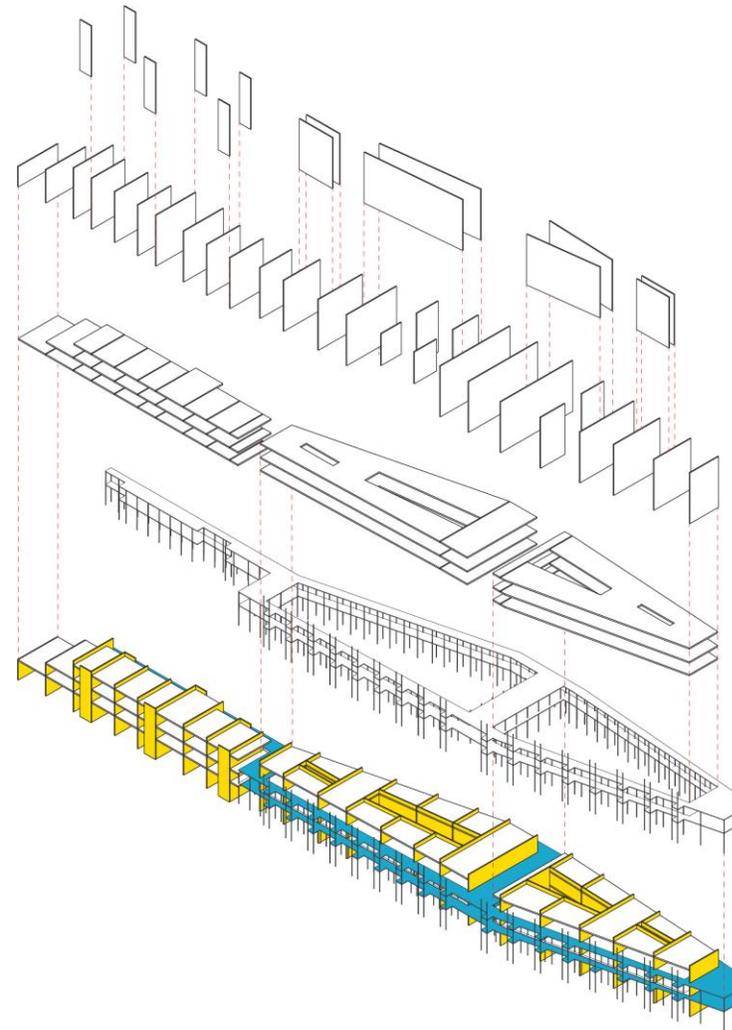
A predominantly CLT panel structure ensures a simplified construction process and small carbon footprint. Exterior walkways are a steel superstructure to avoid thermal bridging.

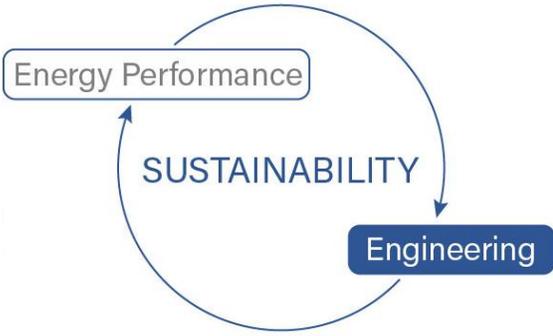
Perpendicular CLT panels
Add lateral support and turn light wells into structural cores

Vertical CLT Panels
Serve as structural parti walls between units

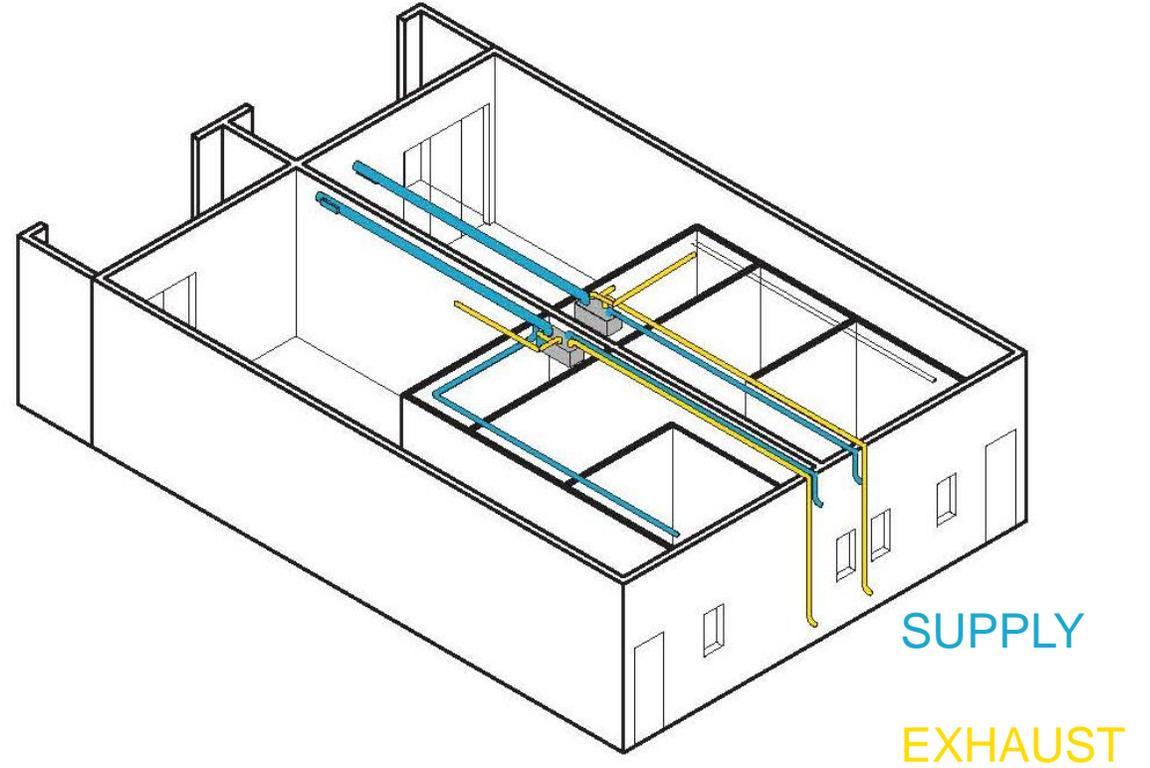
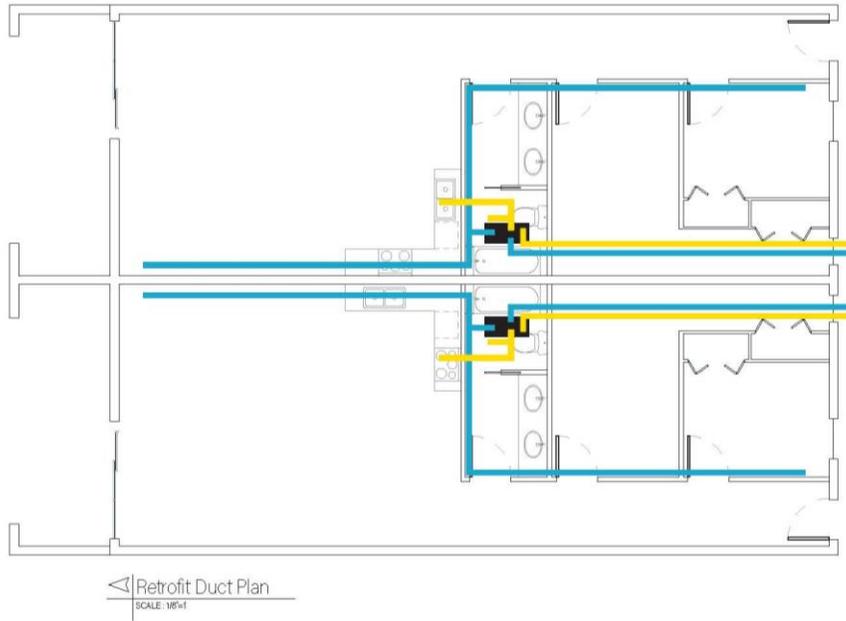
Horizontal CLT Panels
Serve as structural floor members, no beams required

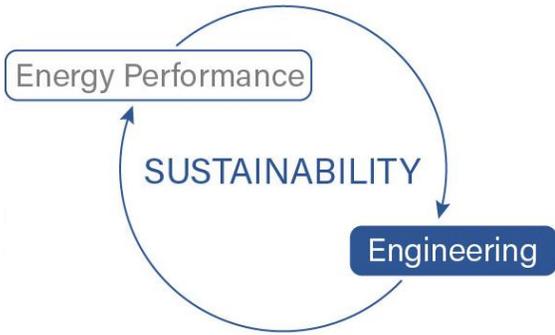
Steel Superstructure
Ensures minimal thermal bridging from exterior walkways



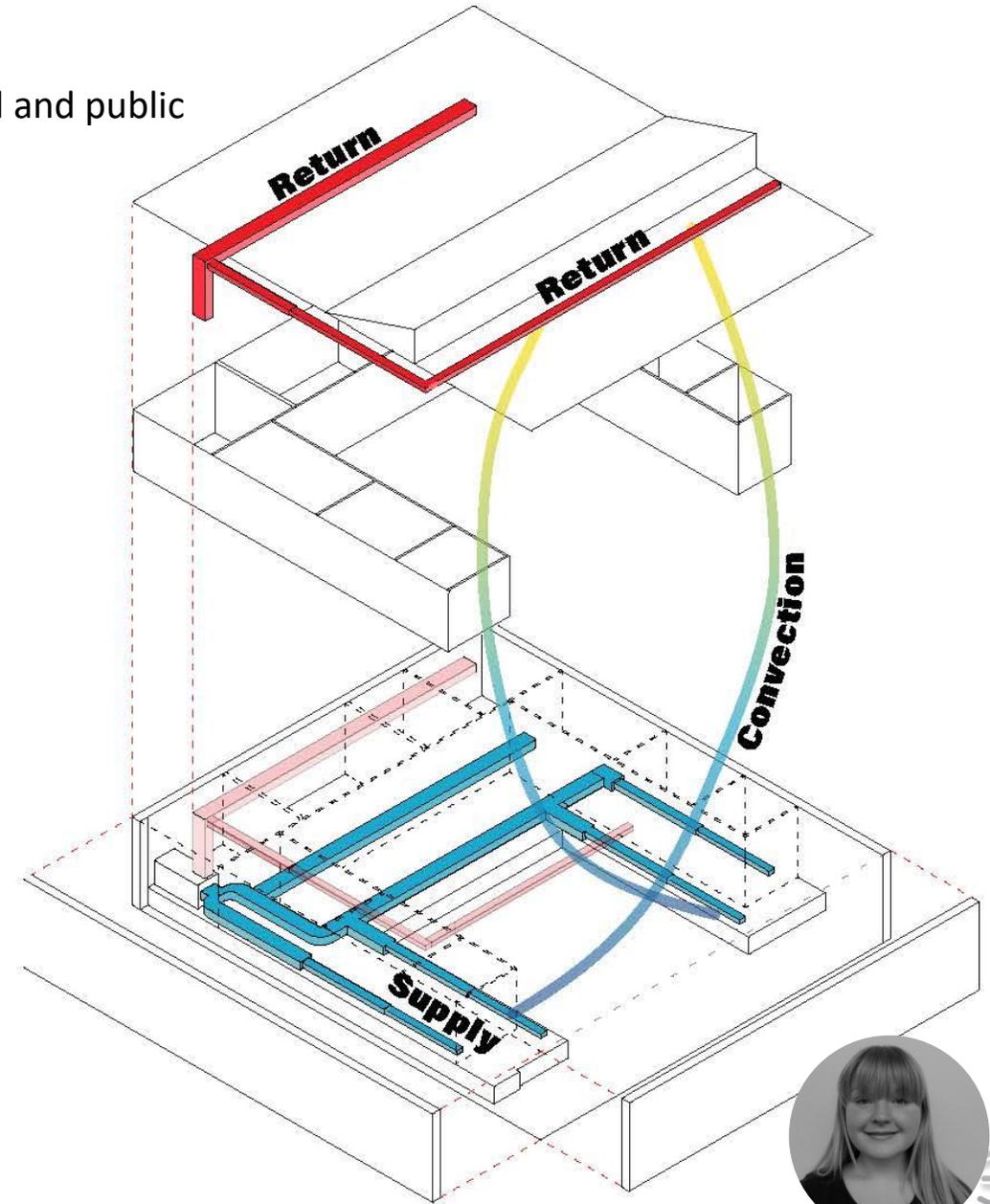
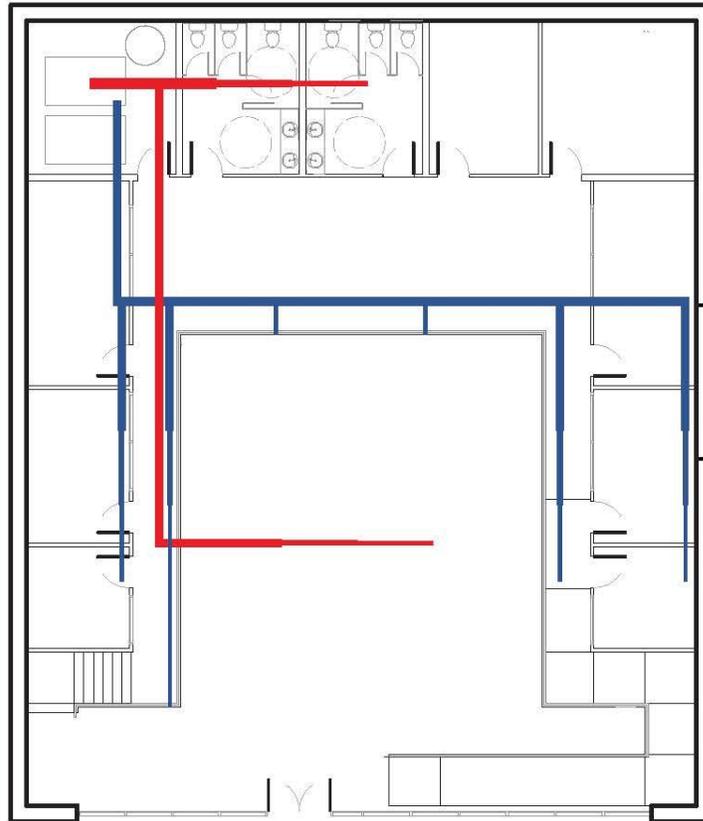


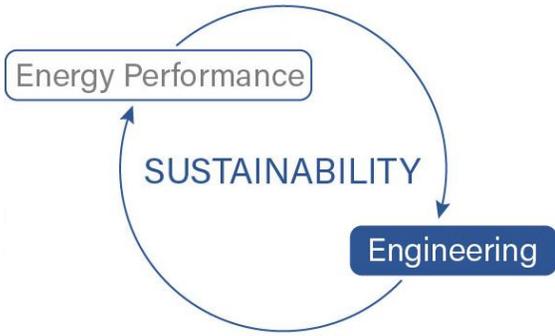
Balanced ventilation is an important part of unit design and duct planning.



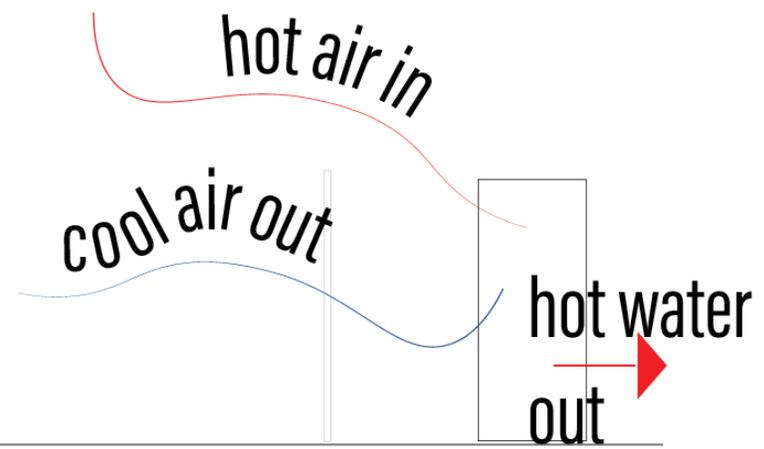
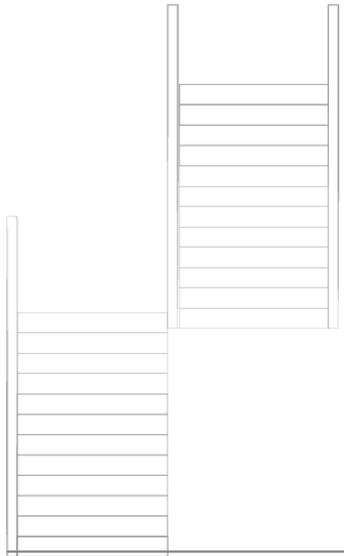


Balanced ventilation is achieved in commercial and public spaces through creative strategies.





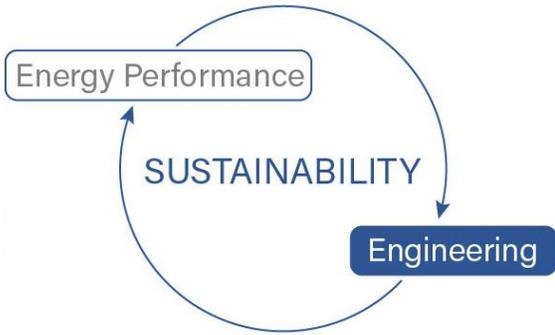
Heat Pumps are placed in exterior circulation corridors to take advantage of the cool air produced as a byproduct.



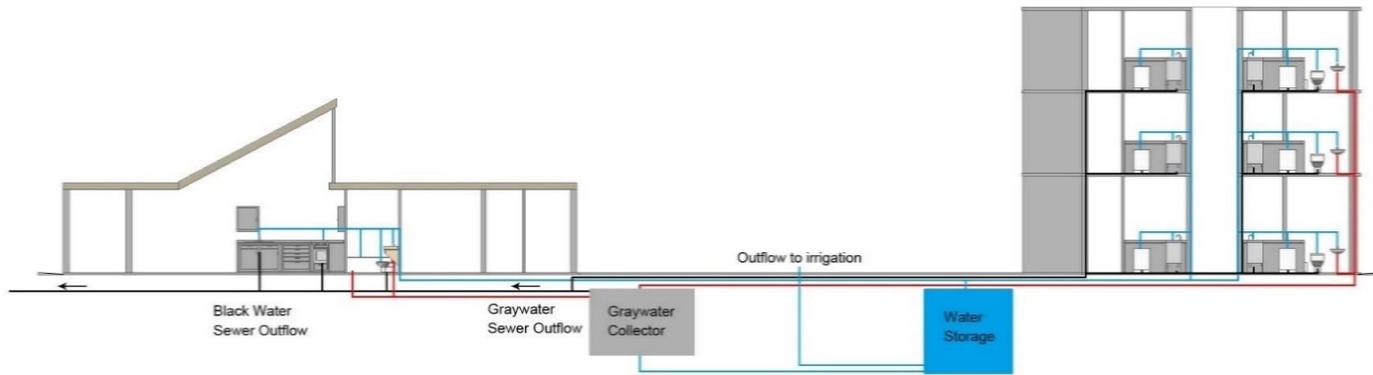
- 2nd Floor services first and second
- Circulation Pump
- Check Valve
- Water Heater
- ⋯ Branch from loop to fixture
- Circulation Loop

Cooling Extior Circulation through Heat Pump DWH





Gray water reduces SunBlocks potable water usage

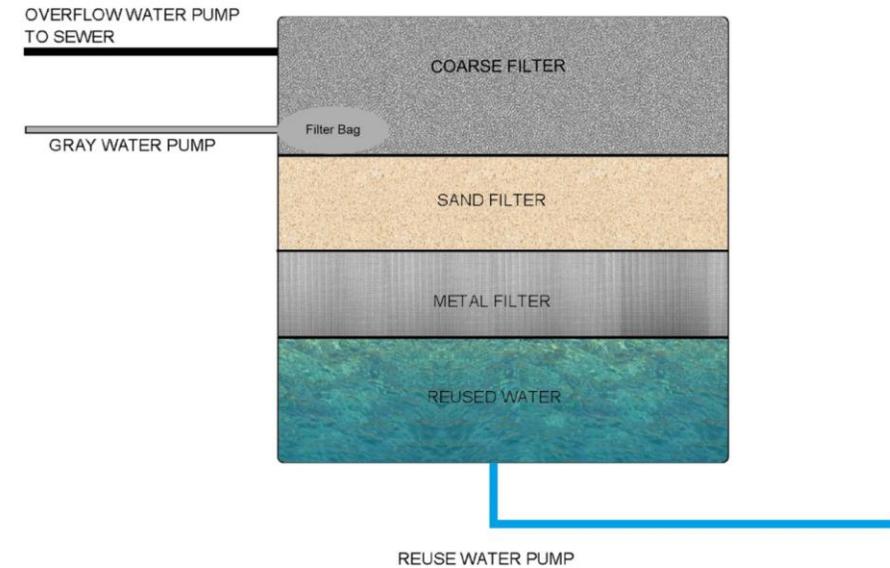


Grey water: clothes washers, bathtubs, showers bathroom sinks

Black water: Kitchen sink, dishwasher, toilet

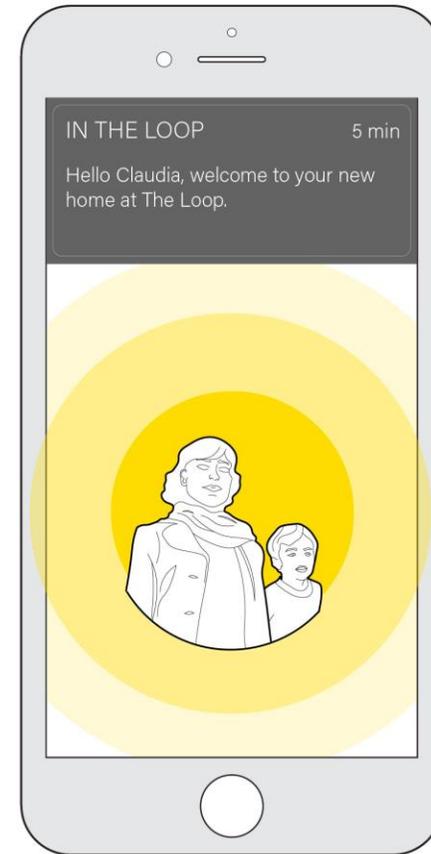
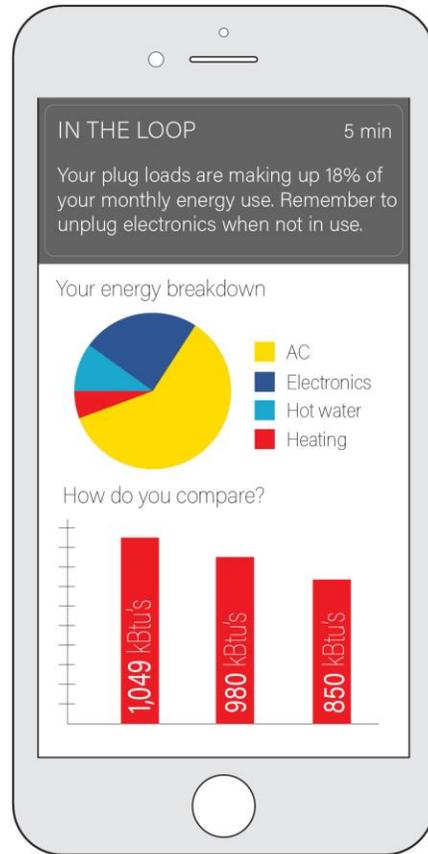
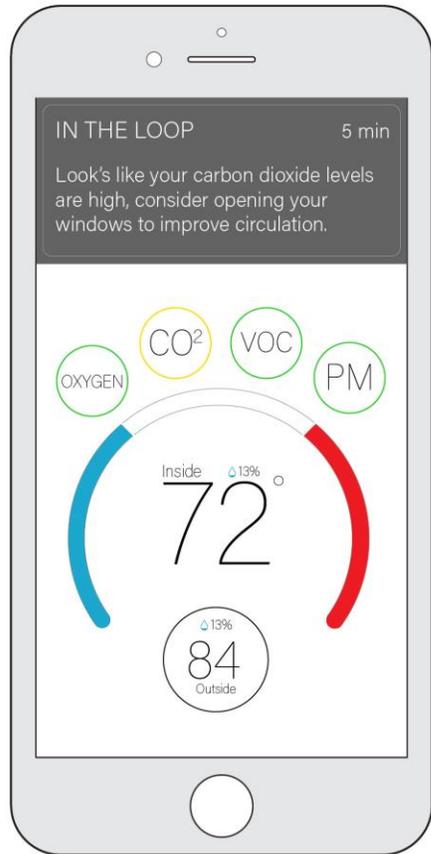
— Blackwater Pipe — Water Pipe — Graywater Pipe

GRAY WATER COLLECTOR



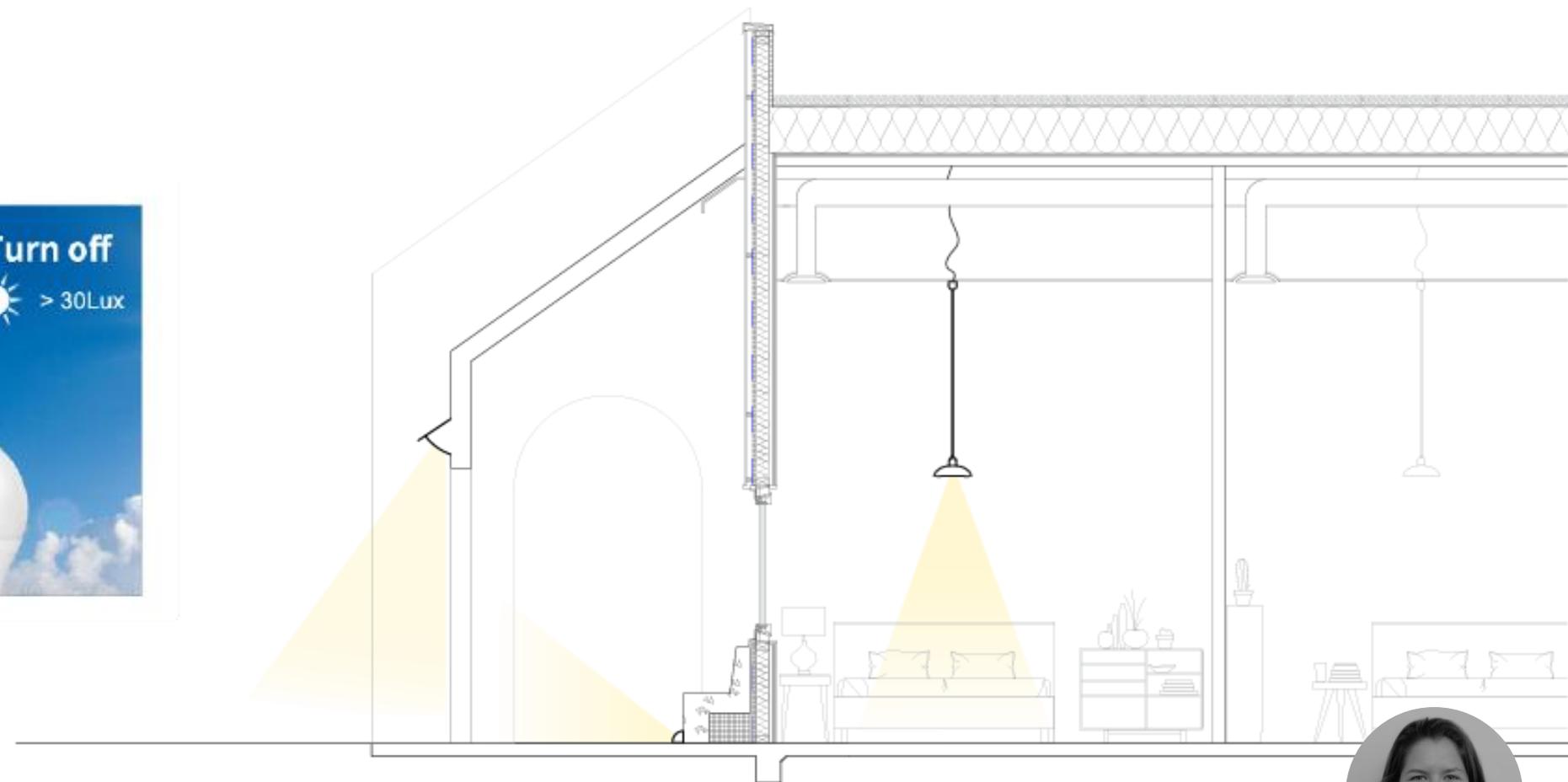


Our “In The Loop” app empowers residents by keeping them connected and informed



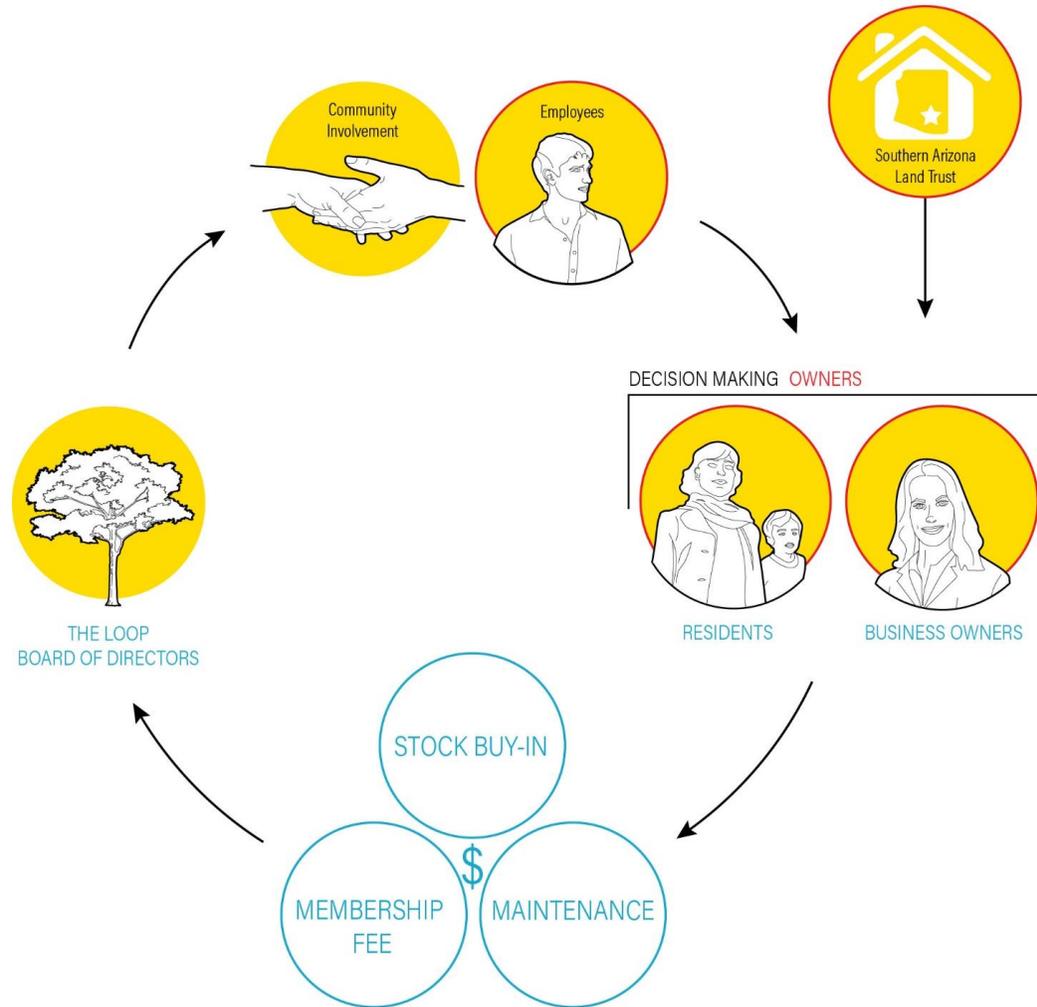


Even lighting in The Loop adapts to its environment. Lumination sensors turn off indoor lights when the sun is out, and outdoor lights only activate by motion.



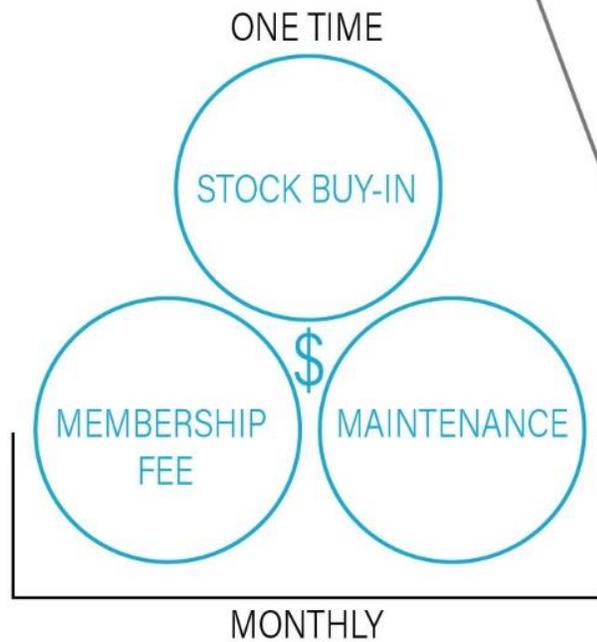


The Loop is a limited equity co-op owned by its shareholders, which gives renters a unique opportunity to own private property and have a voice in their community.



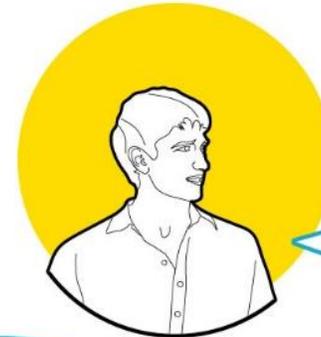


Rent is a sliding scale based on Tucson's average median income (AMI), with a rent reduction program for low-income residents. Thanks to Sunblock, the price of utilities has been reduced.



MARKET RATE

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AFFORDABLE HOUSING

I live with my wife and son and make \$23,000 a year, or 40% of Tucson's AMI. Thanks to my community, my rent for a two bedroom unit is \$800 a month.

Tucson

\$125 Electricity
\$75 Gas

\$200 Monthly

The Loop

\$100 Electricity
\$0 Gas

\$100 Monthly

SunBlock at The Loop

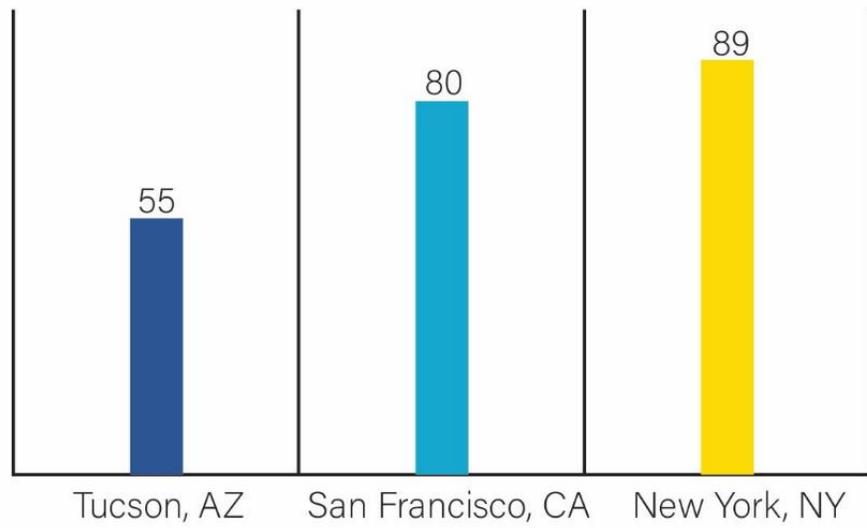
Subscription model:
AC, Heat, Hot Water
&
Twice-annual systems services





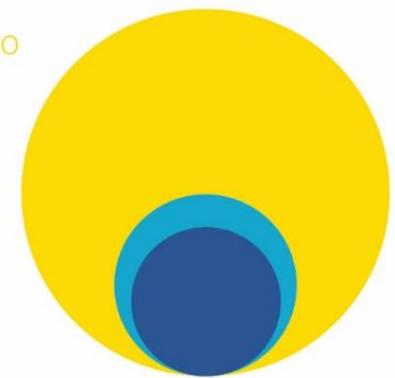
Low cost of construction helps make income-based rent pricing possible. Construction is 65% cheaper in Tucson than San Francisco.

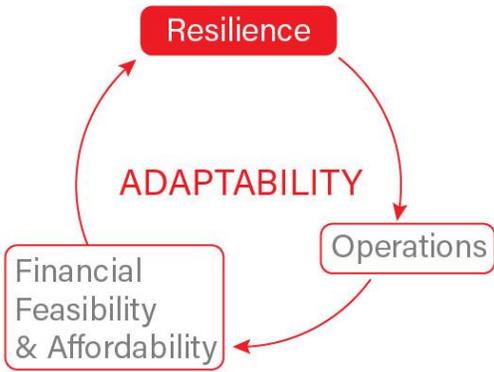
Building Material Cost Index 2020



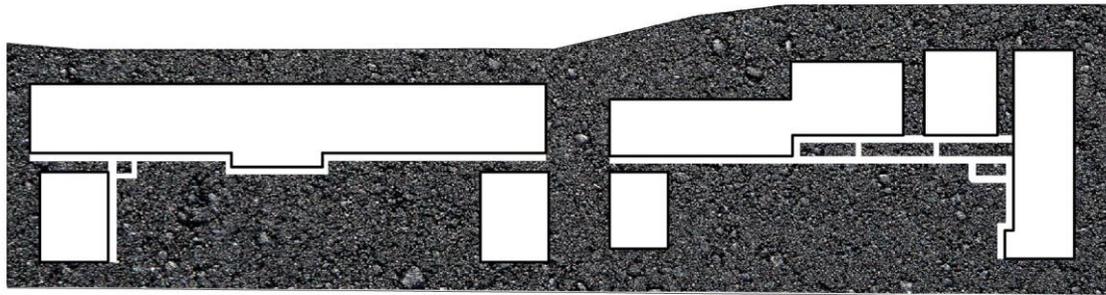
Average Multifamily Construction Cost per ftsq

San Francisco
\$449 ftsq
Arizona
\$182 ftsq
Tucson
\$147 ftsq

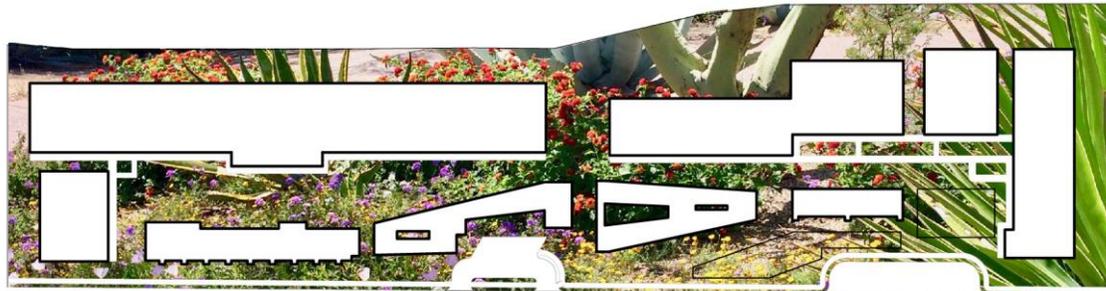




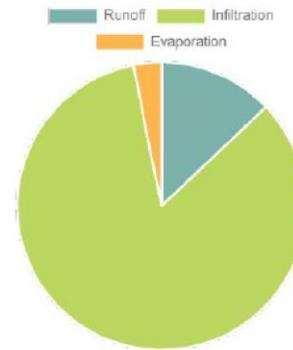
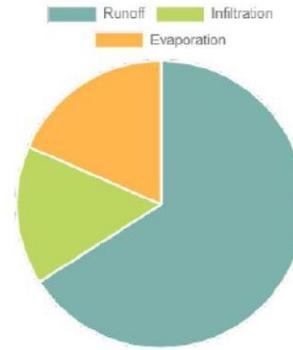
Thanks to xeriscaping with native plants, no extra water is required and rainwater runoff that caused dangerous flooding is now 80% soil infiltration.



BEFORE Asphalt parking lot

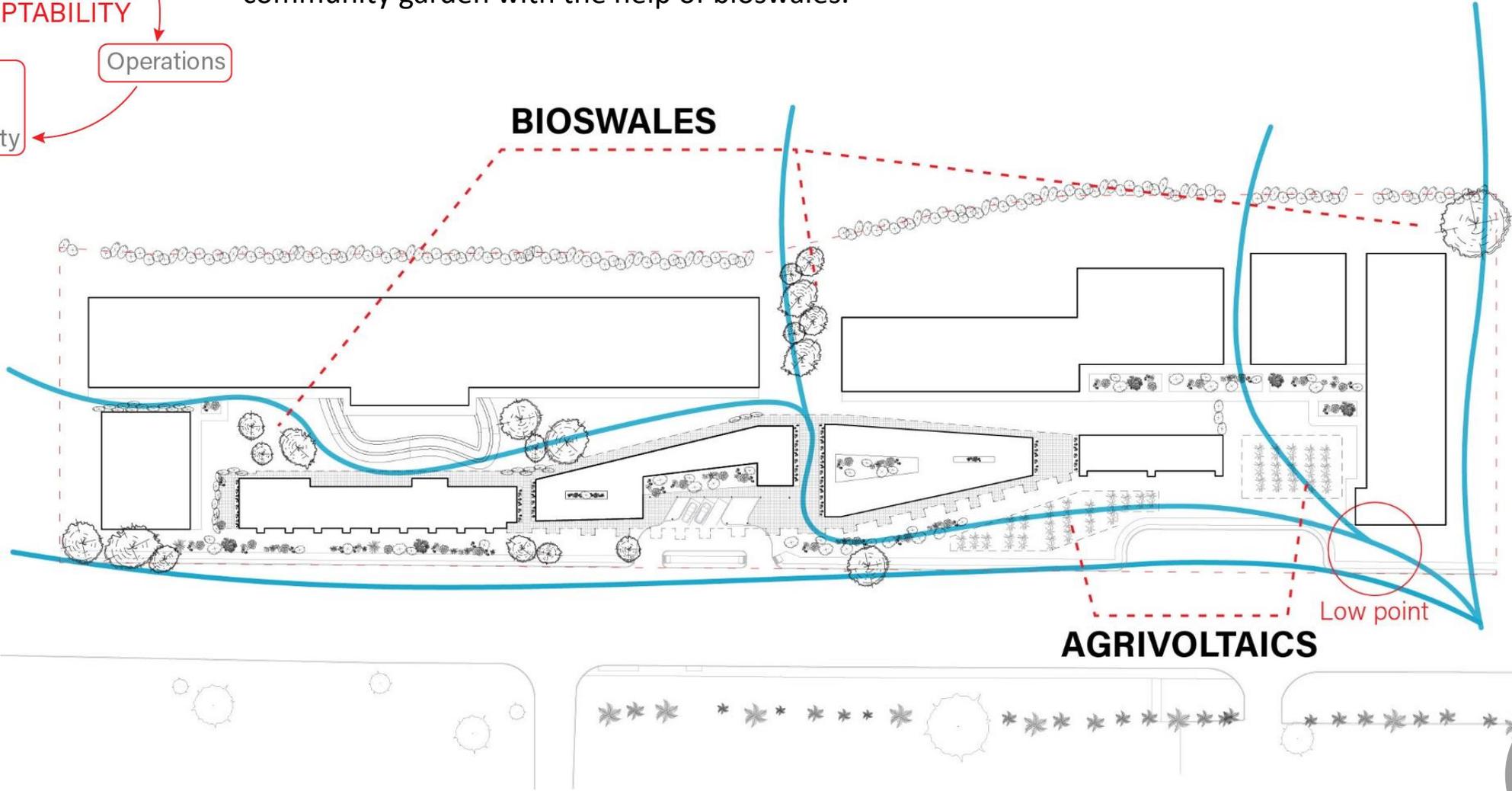


AFTER Desert xeriscaping



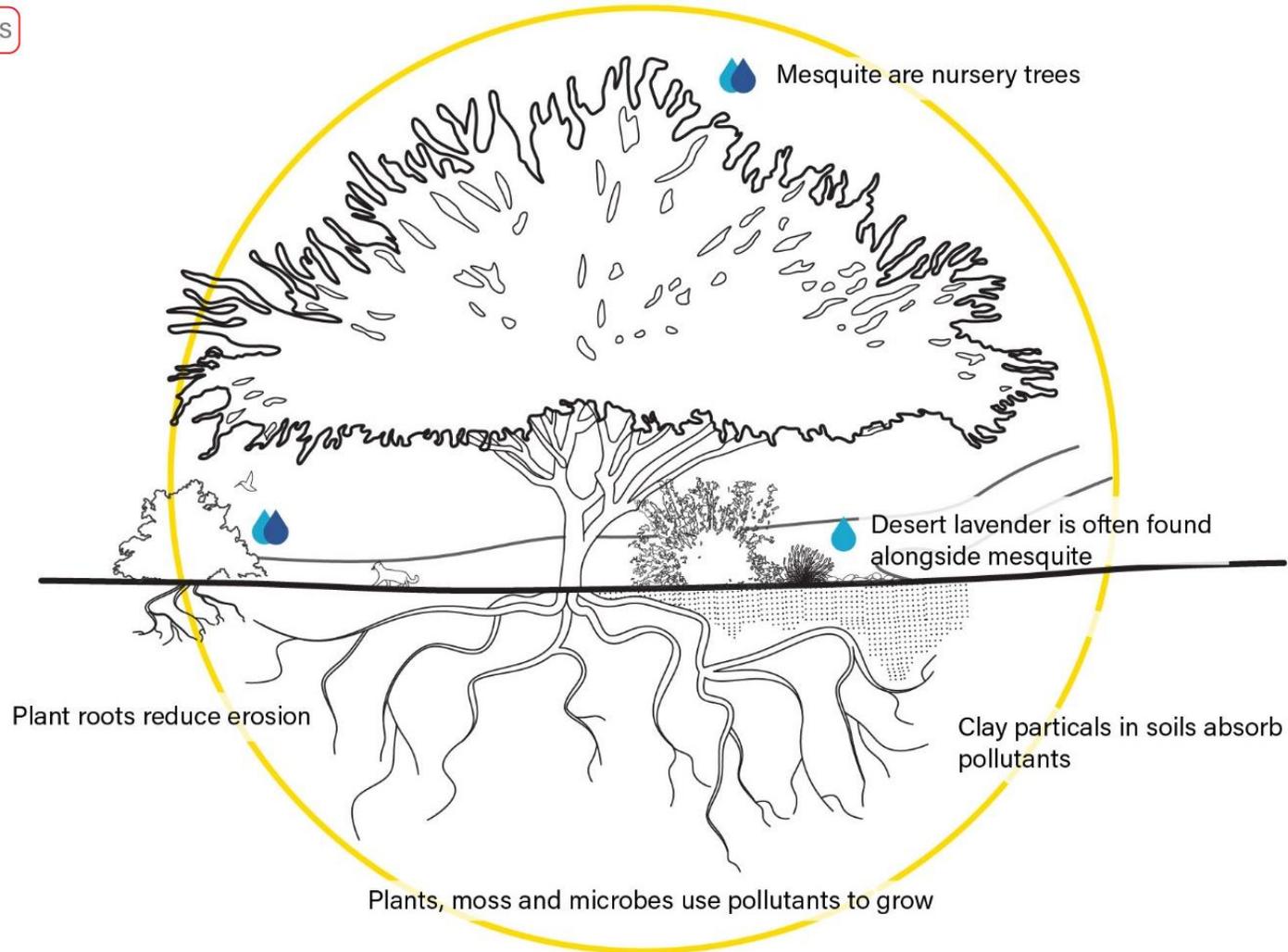


The site is designed to direct rainwater through all landscaping as well as the agrivoltaic community garden with the help of bioswales.



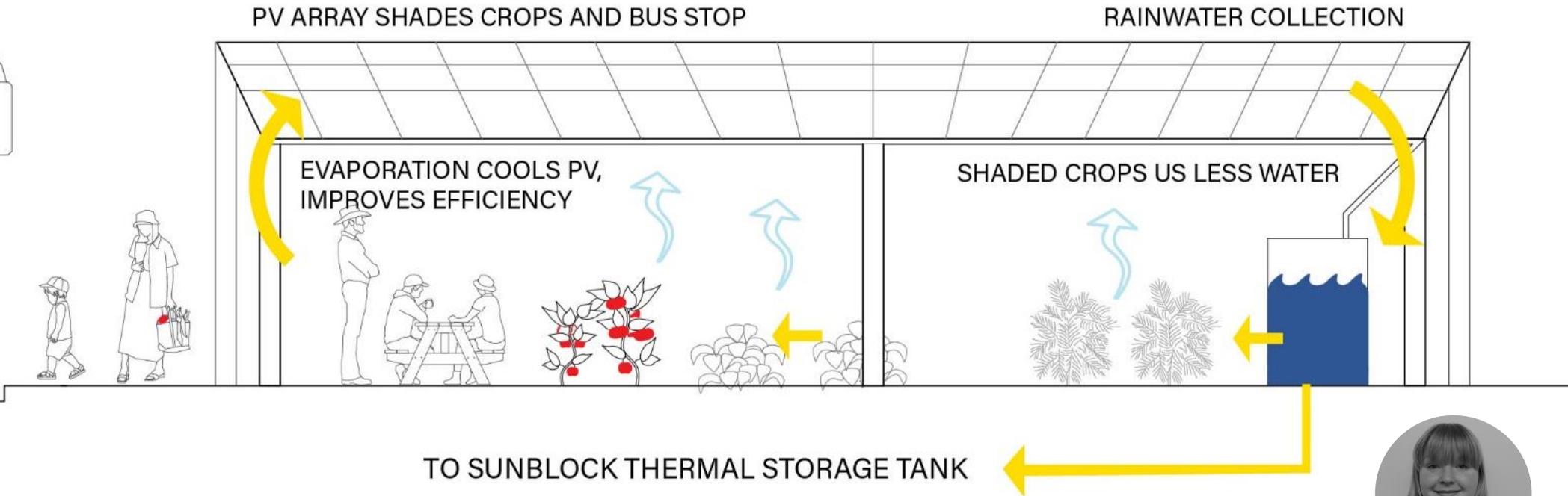
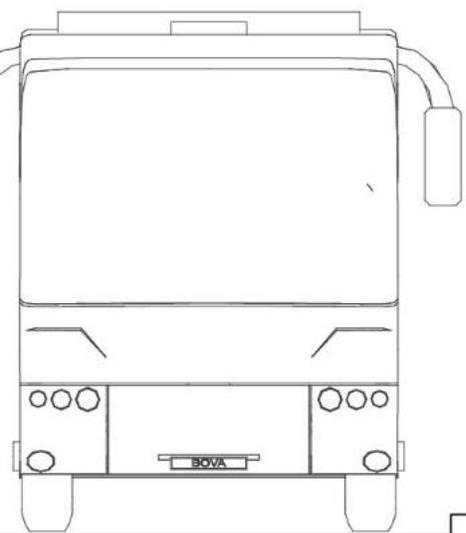


Bioswales take advantage of the natural relationship between plants to create a comfortable, self-sustaining environment.



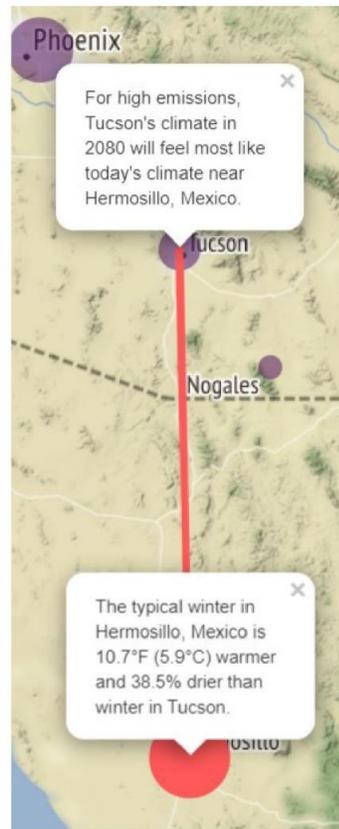


Agrivoltaics create a relationship between a shady community garden and a pv array that is cooled by evaporation.

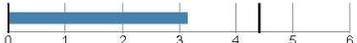
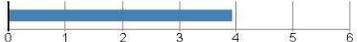




By simulating a climate affected by global warming projections, WUFI proves that The Loop will meet Passive House 2018 + requirements even in the year 2080.



<https://fitzlab.shinyapps.io/cityapp/>

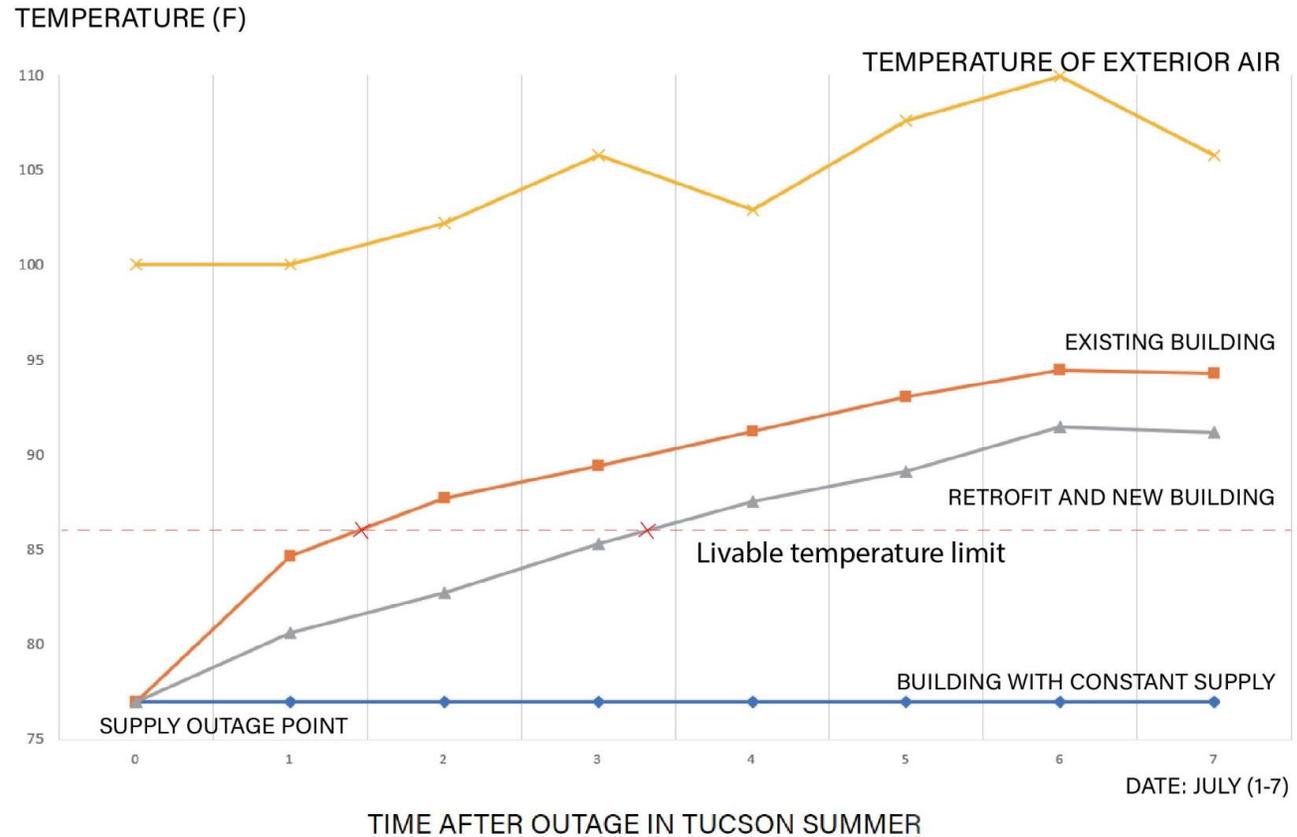
PASSIVEHOUSE REQUIREMENTS			
Certificate criteria:	PHIUS+ 2018		
Heating demand			
specific:	2.51 kBtu/ft ² yr		✓
target:	2.7 kBtu/ft ² yr		
total:	230,740.84 kBtu/yr		
Cooling demand			
sensible:	9.85 kBtu/ft ² yr		✓
latent:	0.01 kBtu/ft ² yr		
specific:	9.86 kBtu/ft ² yr		
target:	25.6 kBtu/ft ² yr		
total:	904,465.76 kBtu/yr		
Heating load			
specific:	3.15 Btu/hr ft ²		✓
target:	4.4 Btu/hr ft ²		
total:	289,457.1 Btu/hr		
Cooling load			
specific:	3.92 Btu/hr ft ²		✓
target:	7.3 Btu/hr ft ²		
total:	360,024.46 Btu/hr		





In the event of a power outage, The Loop will remain survivable for almost three days, while the original building lasted less than one day.

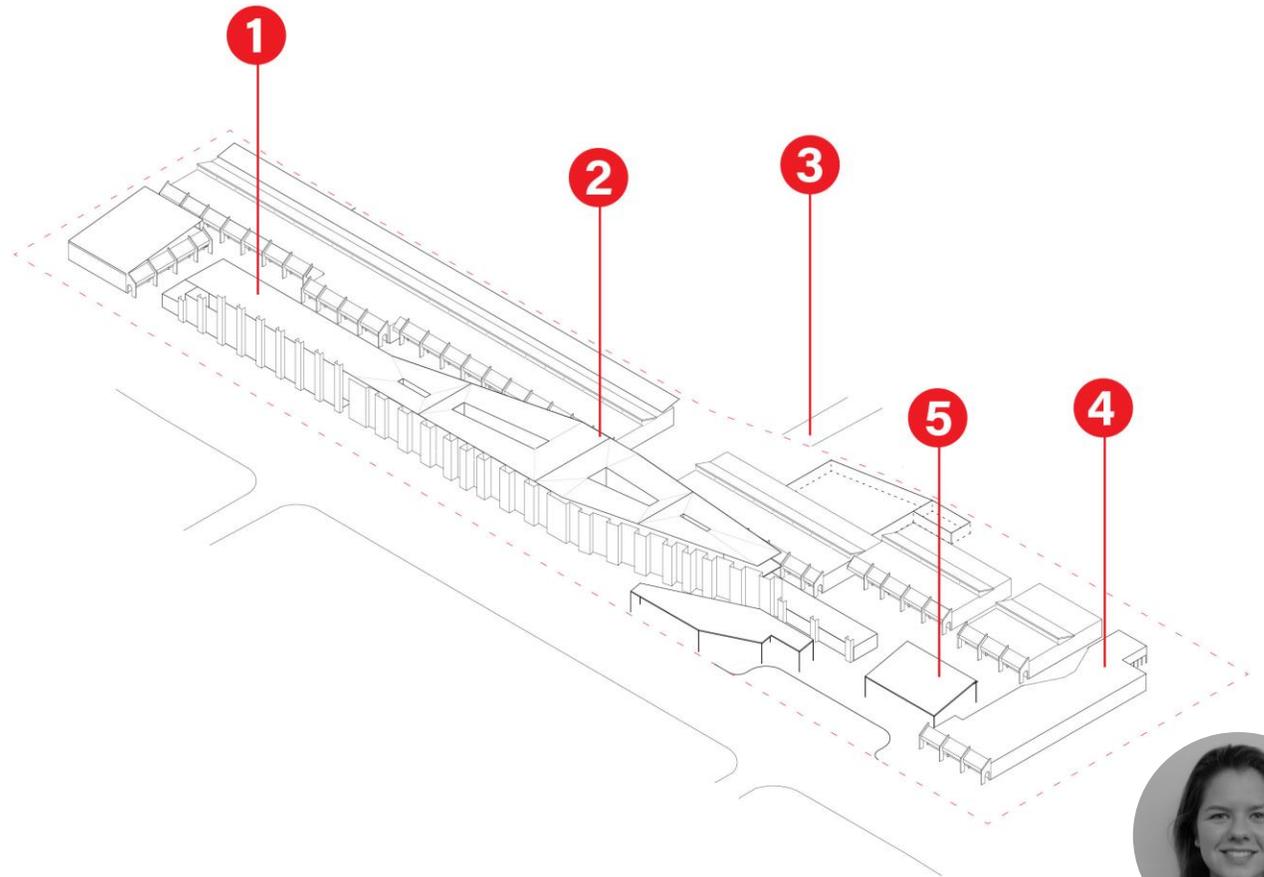
POWER OUTAGE DISASTER EVENT





The Loop is an interconnected community that can respond efficiently to a global virus pandemic.

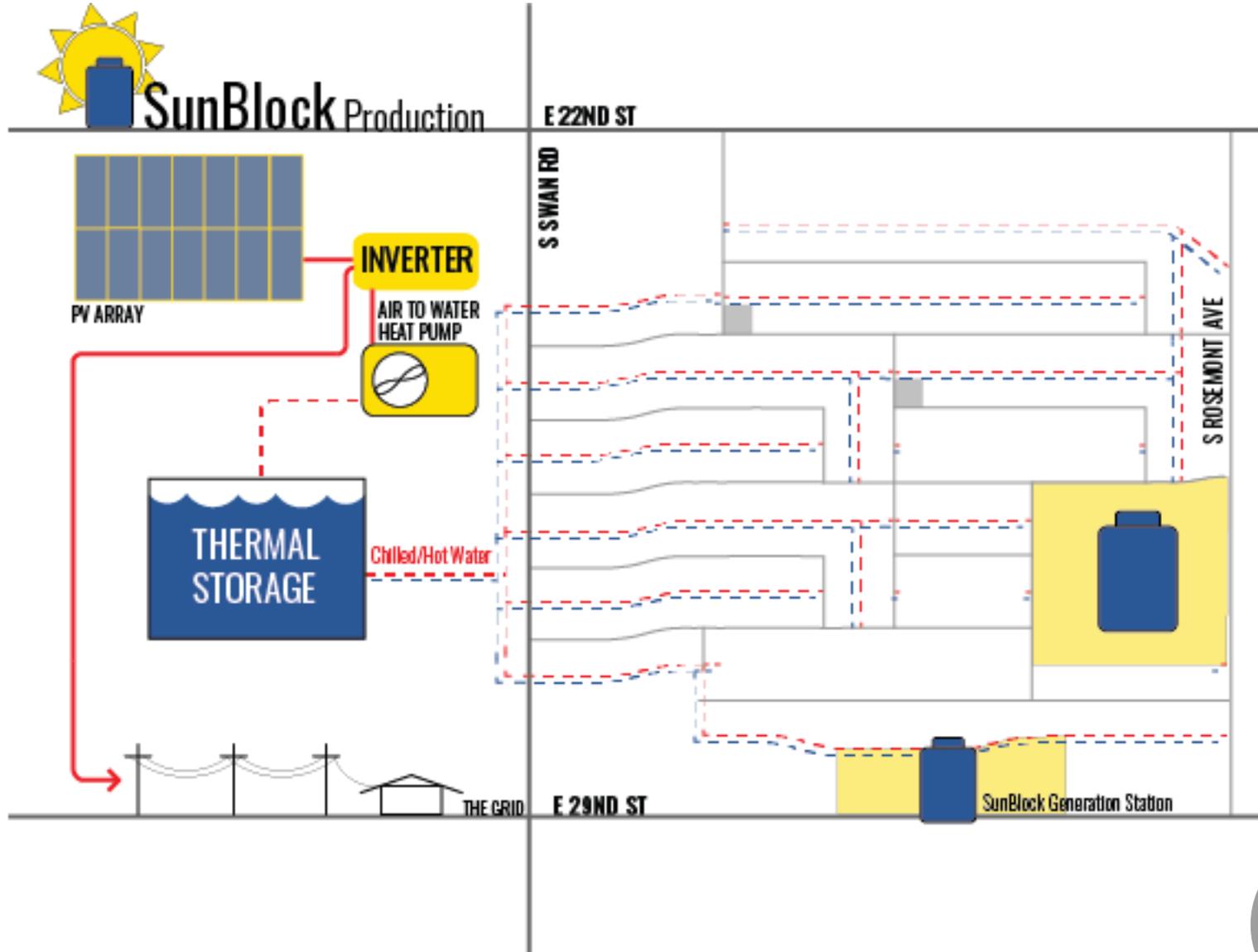
- 1 Each unit has its own ERV and airtight layer
- 2 All circulation is outside, no shared corridors
- 3 Bike routes safely connect residents to grocery stores
- 4 Public resources on site
- 5 Community garden in case of limited food supply

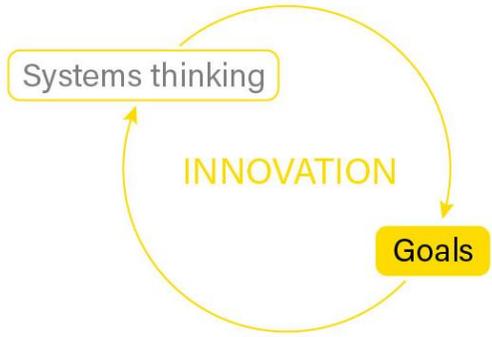


Energy Performance

SUSTAINABILITY

Engineering

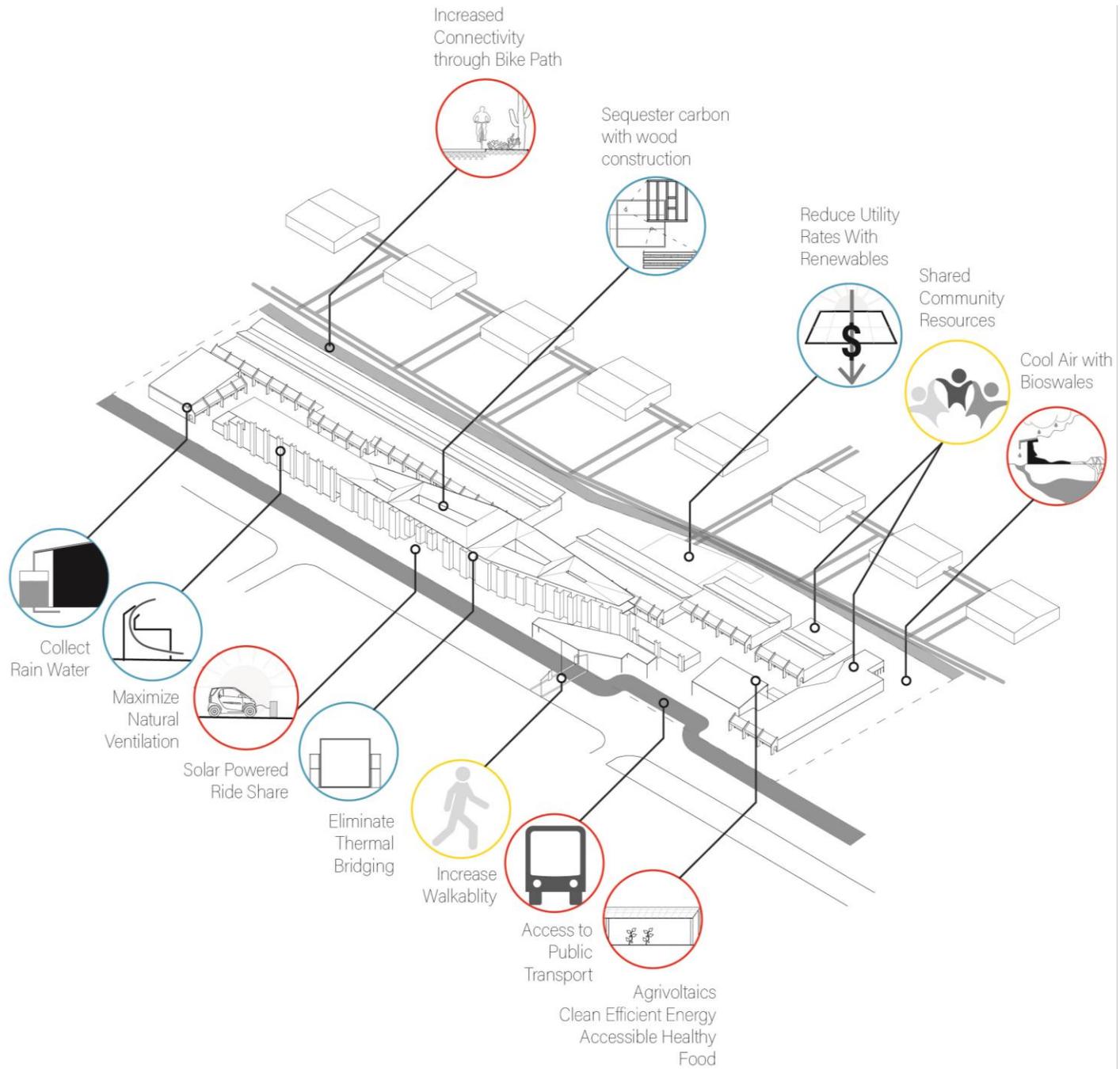


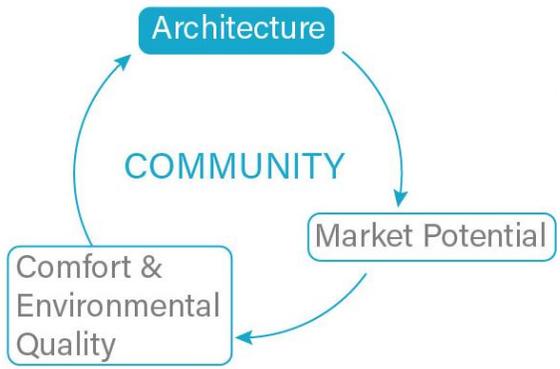


Empower the community

Encourage sustainable living

Both







TUCSON



Tucson is my home, I have a job but I can no longer afford the rising price of rent. I wish I could be more involved in my community.

MYERS

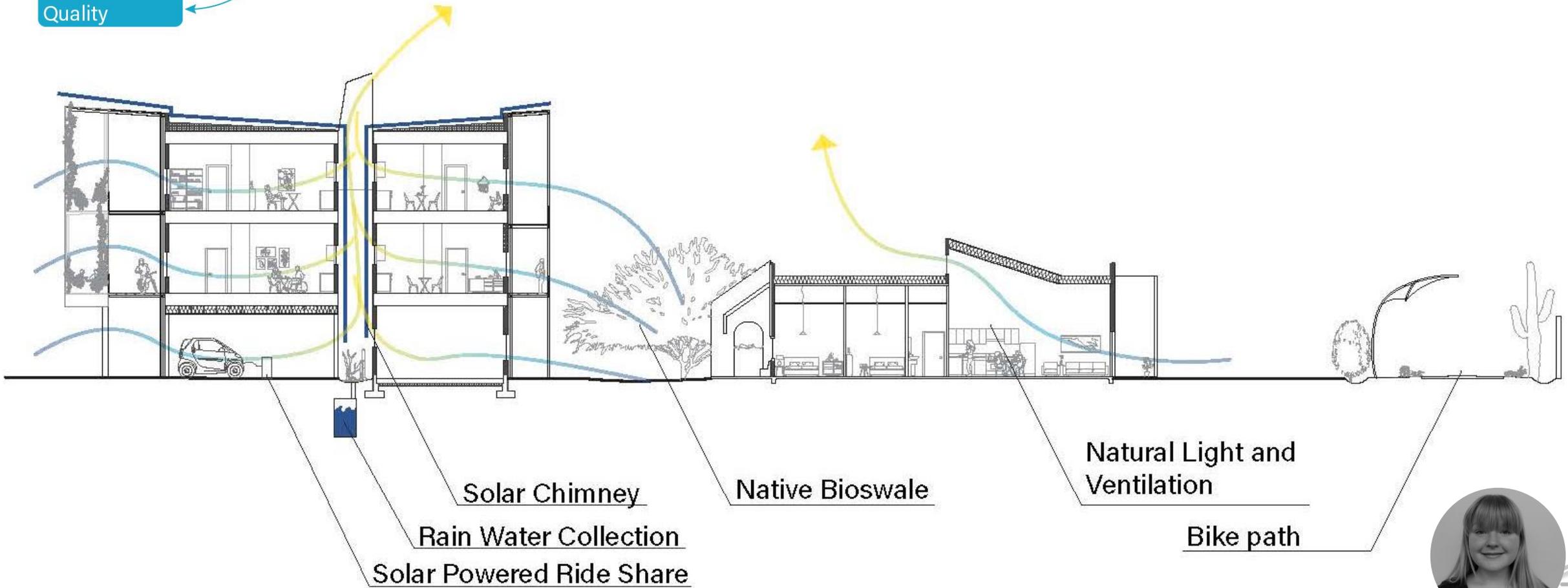
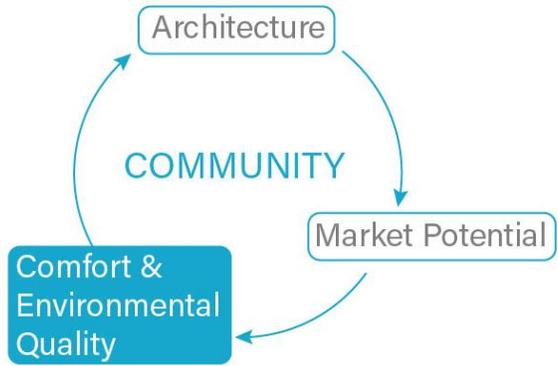


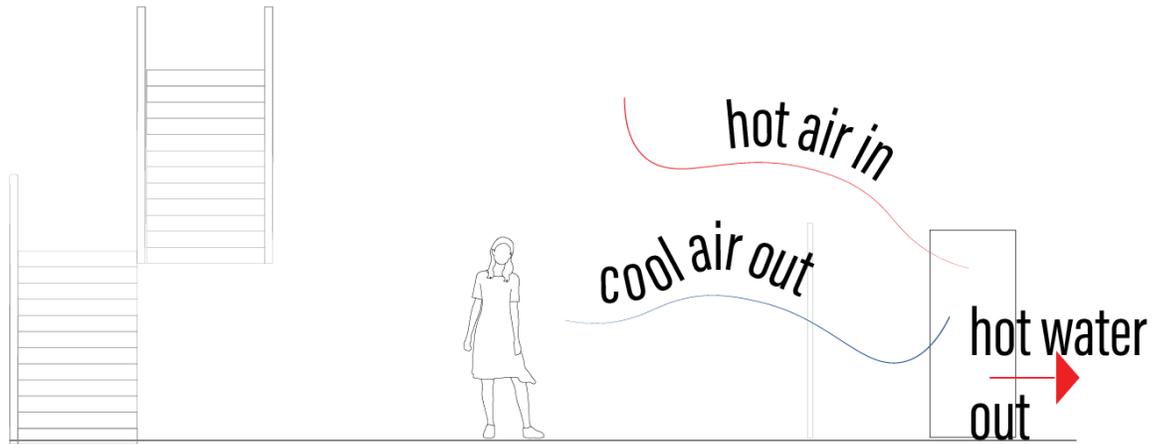
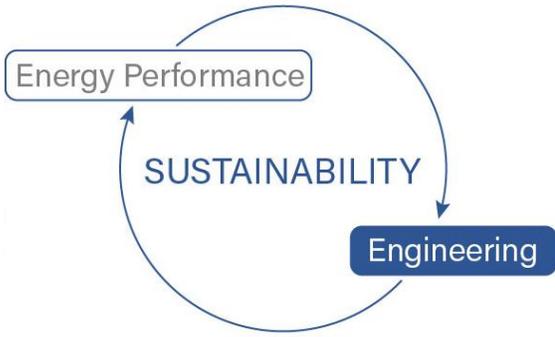
I am retired and living off of social security. I would like to live somewhere with community values and friendly neighbors.



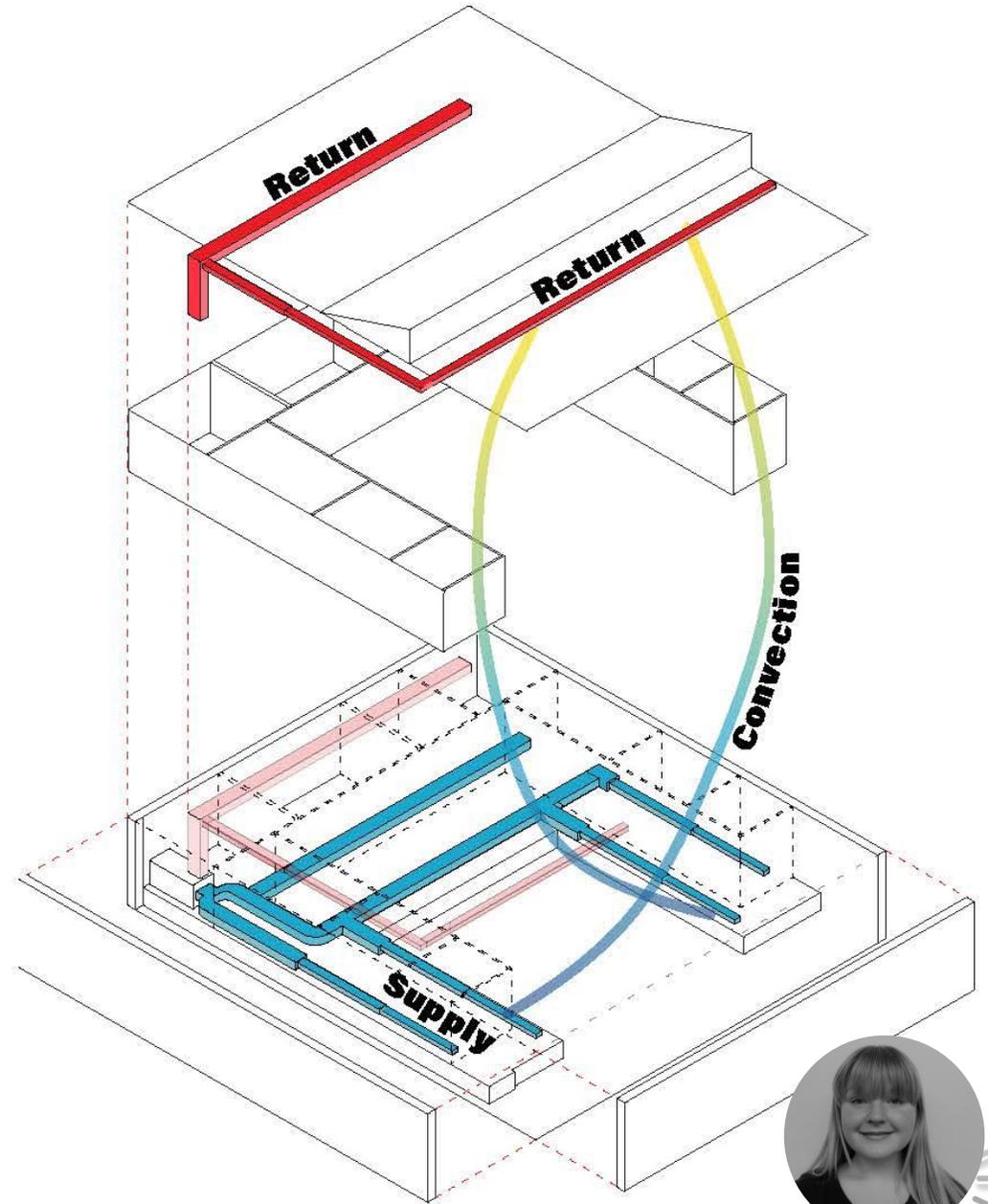
I am a single parent working full time. I am looking to live somewhere that is safe and close to a good school.

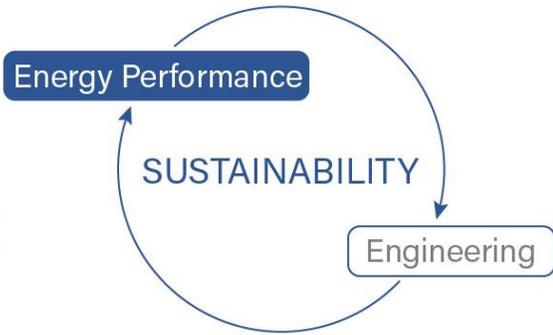






Cooling Extior Circulation through Heat Pump DWH





DYNAMIC RESULTS

Heat gain/loss through components [kBtu]

Nr.	Component group	Gain	Loss
1	Outer walls	32334	27462
2	Roof	92	73
3	Flat roof	60020	31076
4	Floor over outer air	803	2788
5	Floor on ground	24783	63299
6	Windows	185268	62715

Case 1/Zone 1: Main results

Setting	Value		
Heating period [d]	92		
Cooling period [d]	43.6		
Heating demand [kBtu]	227343.2		
Cooling demand [kBtu]	99608.5		
Humidification demand [lb]	0		
Dehumidification demand [lb]	0		
Min/Max/Mean values			
Setting	Min	Max	Mean
Inner temperature [°F]	68	93.9	75.7
Inner relative humidity [%]	6.9	65.6	30.2
Heating load [Btu/hr]	0	252275.6	25952.4
Cooling load [Btu/hr]	-793465.3	0	-11370.8
Humidification [lb/hr]	0	0	0
Dehumidification [lb/hr]	0	0	0

ZONE 1 : Residential



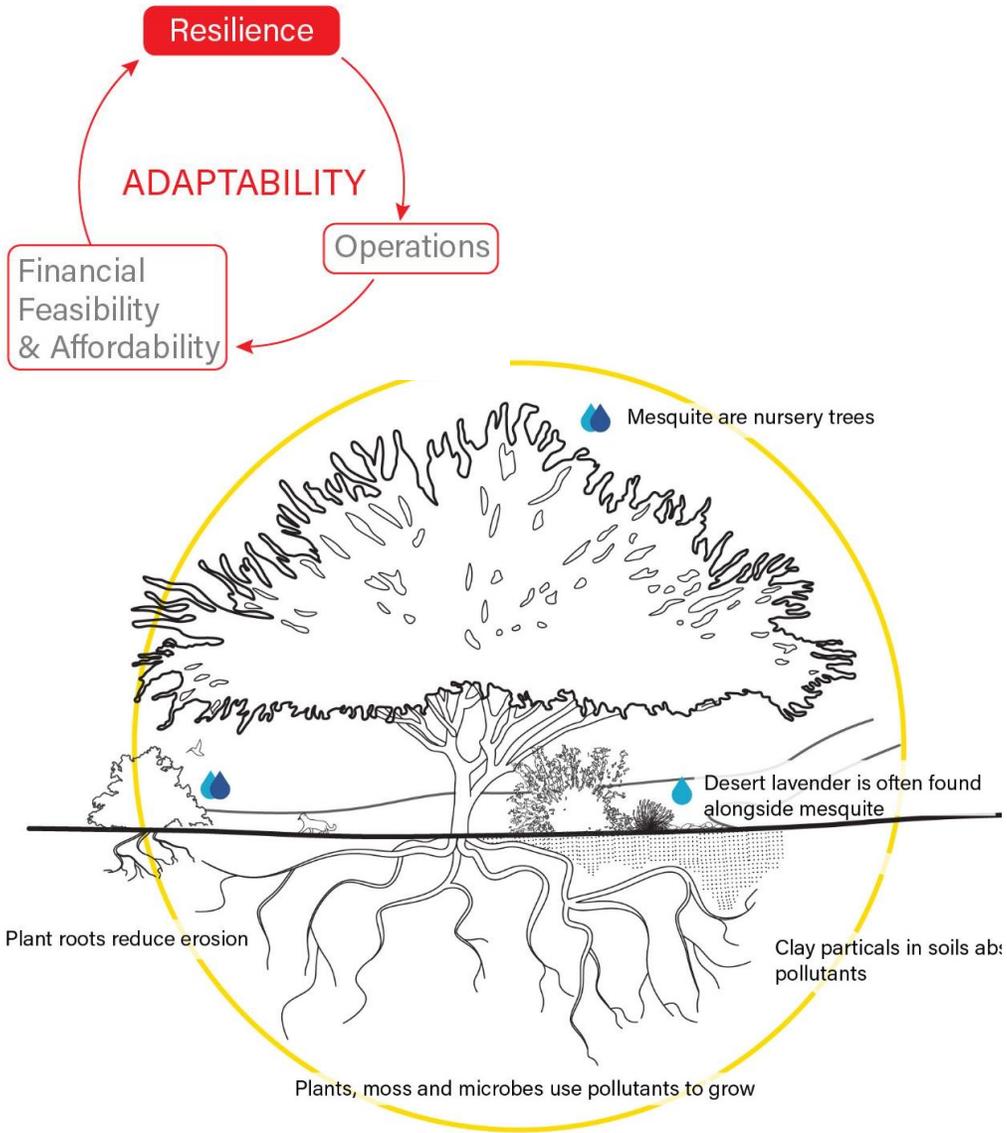
Zone 2: Main results

Setting	Value		
Heating period [d]	25.2		
Cooling period [d]	56.8		
Heating demand [kBtu]	12963.5		
Cooling demand [kBtu]	75276.2		
Humidification demand [lb]	0		
Dehumidification demand [lb]	0		
Min/Max/Mean values			
Setting	Min	Max	Mean
Inner temperature [°F]	68	94.2	77.4
Inner relative humidity [%]	16.3	61.8	37.7
Heating load [Btu/hr]	0	56394.3	1479.8
Cooling load [Btu/hr]	-130863.1	0	-8593.2
Humidification [lb/hr]	0	0	0
Dehumidification [lb/hr]	0	0	0

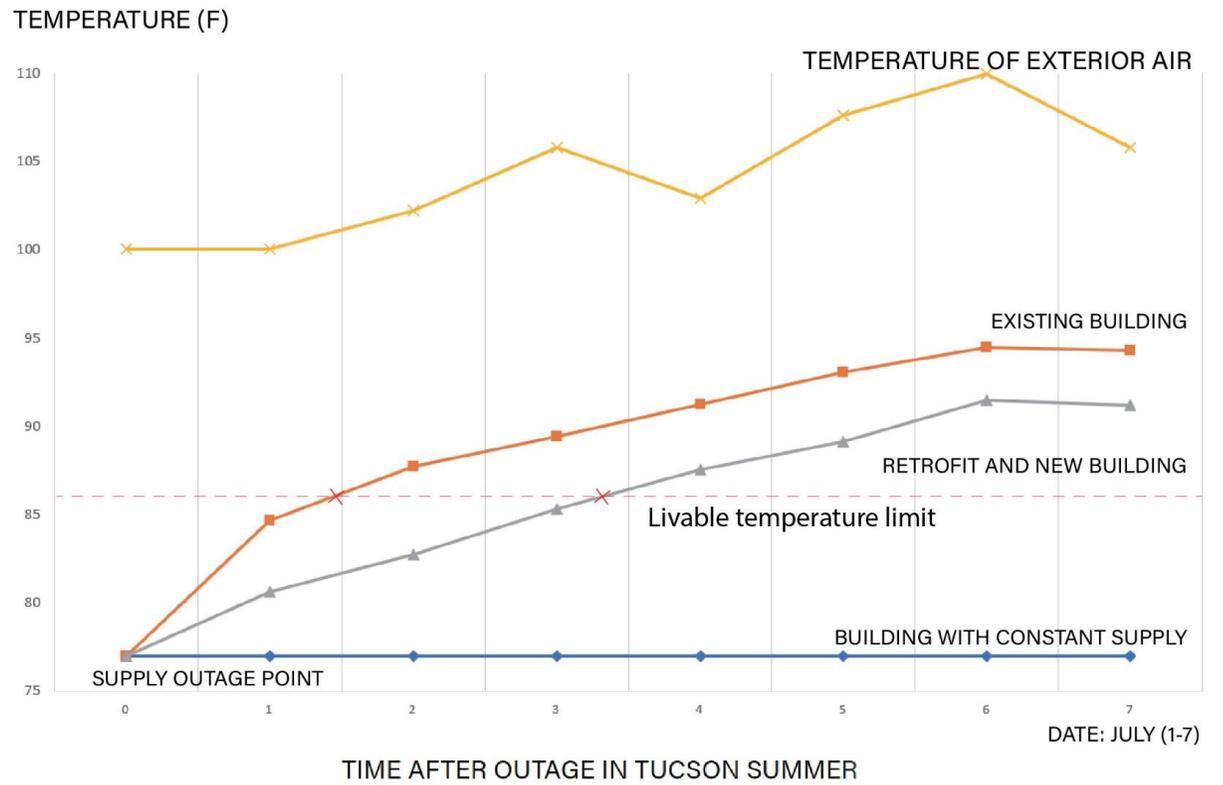
ZONE 2 : Commercial

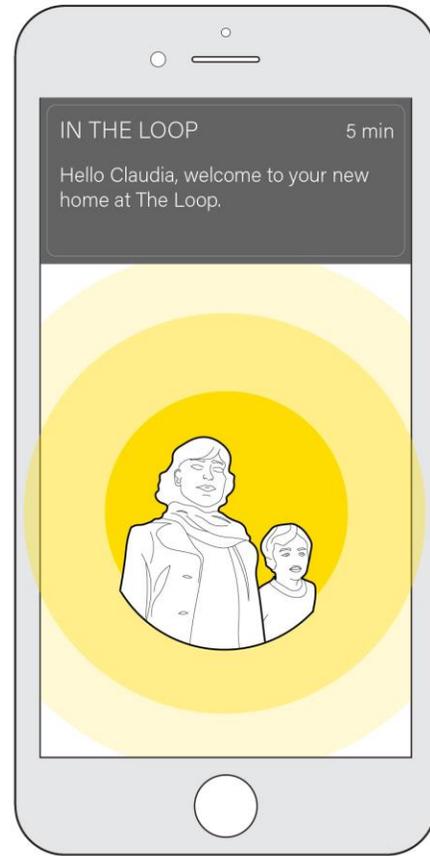
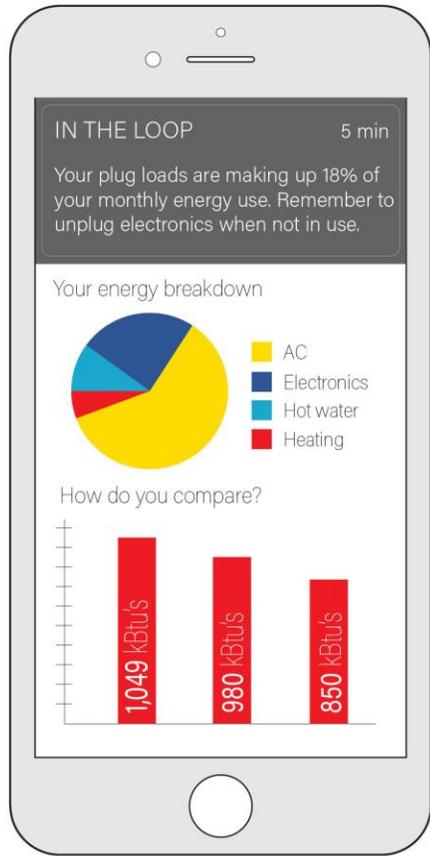
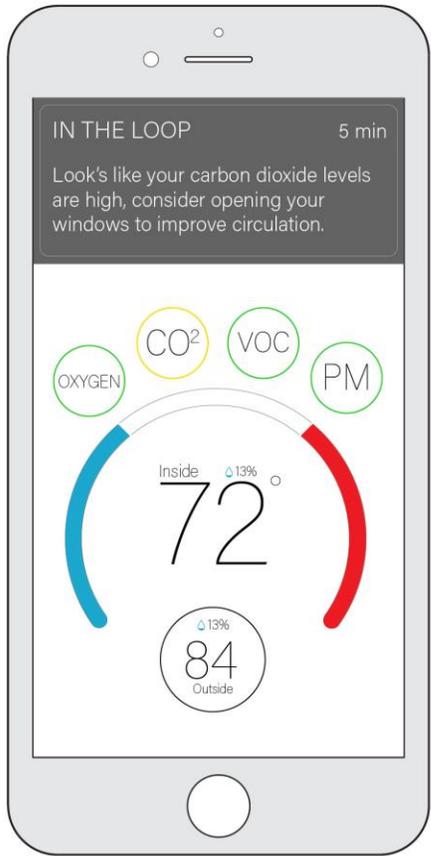
The Myers neighborhood 100% Cooled by Sun-Block's The Loop

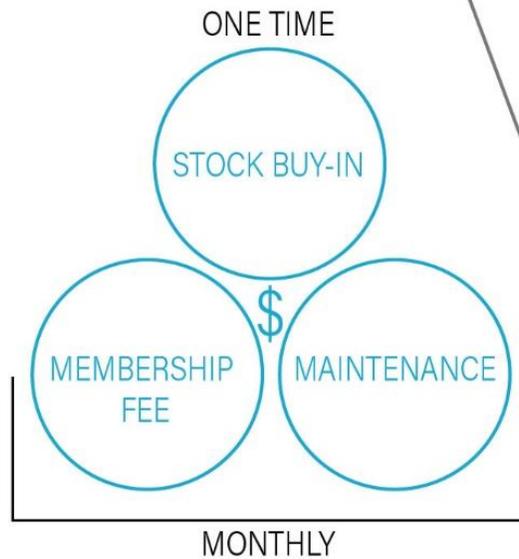




POWER OUTAGE DISASTER EVENT







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Tucson

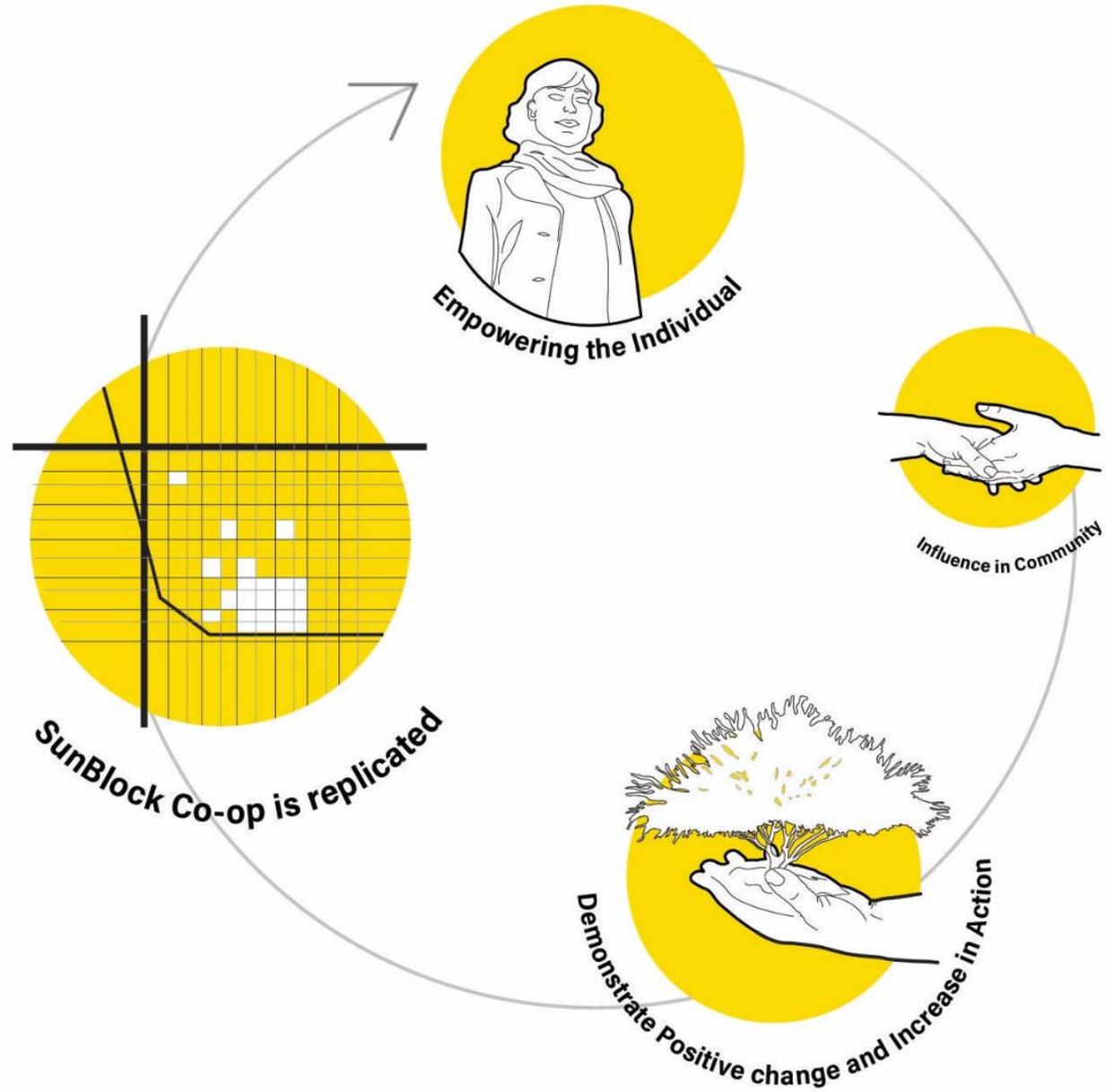
\$125 Electricity
\$75 Gas
\$200 Monthly

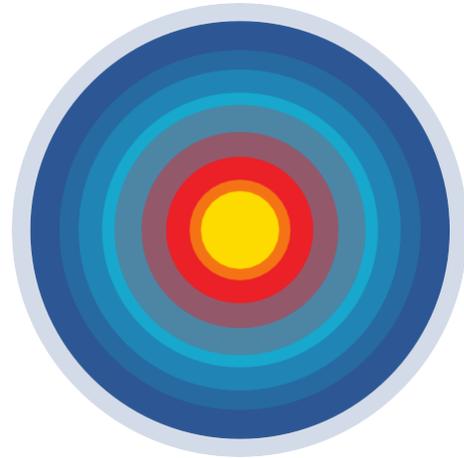
The Loop

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SunBlock at The Loop
Subscription model:
AC, Heat, Hot Water &
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SUNBLOCK | Thank You

