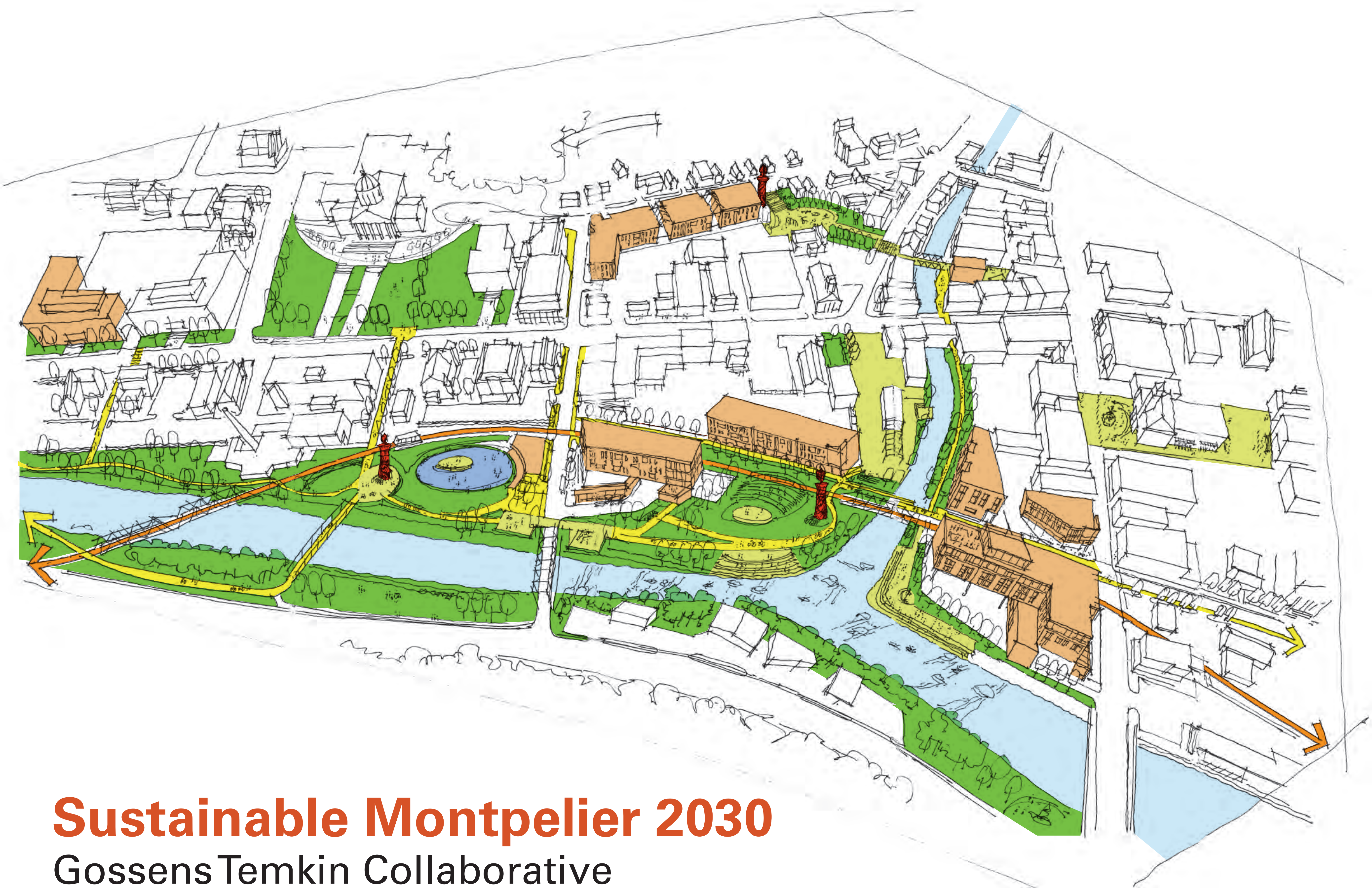
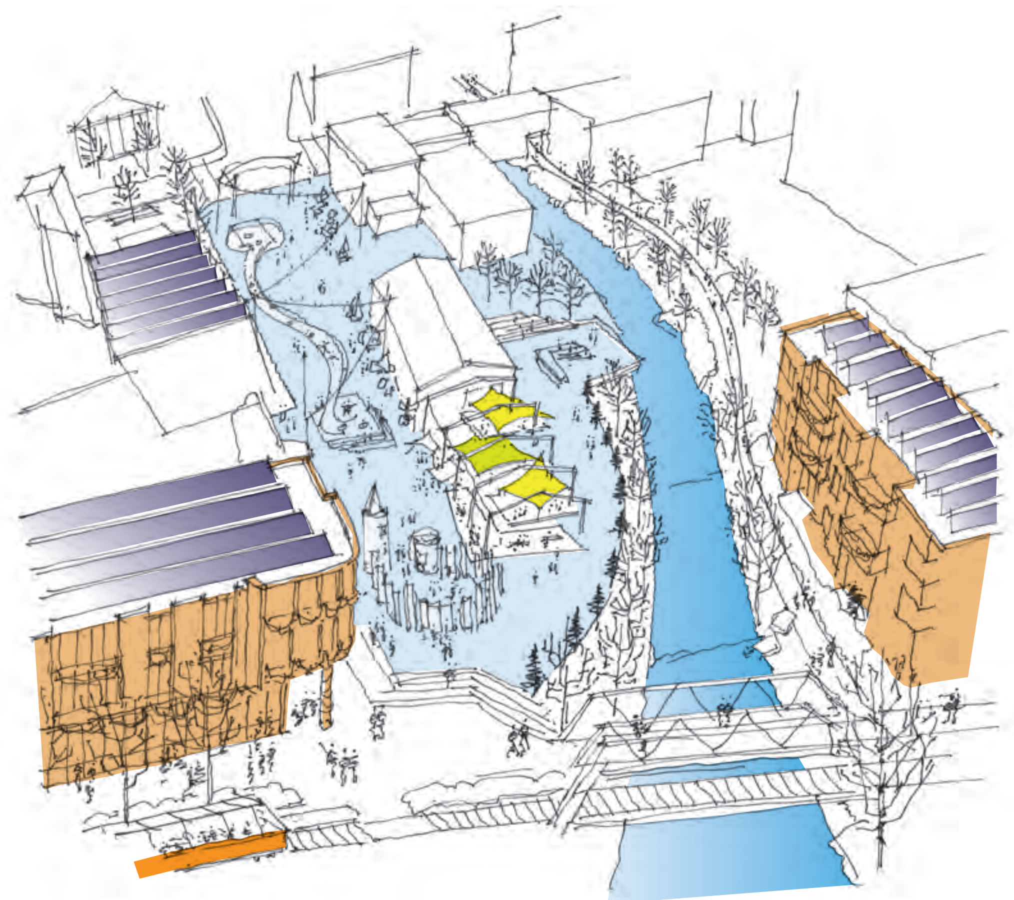
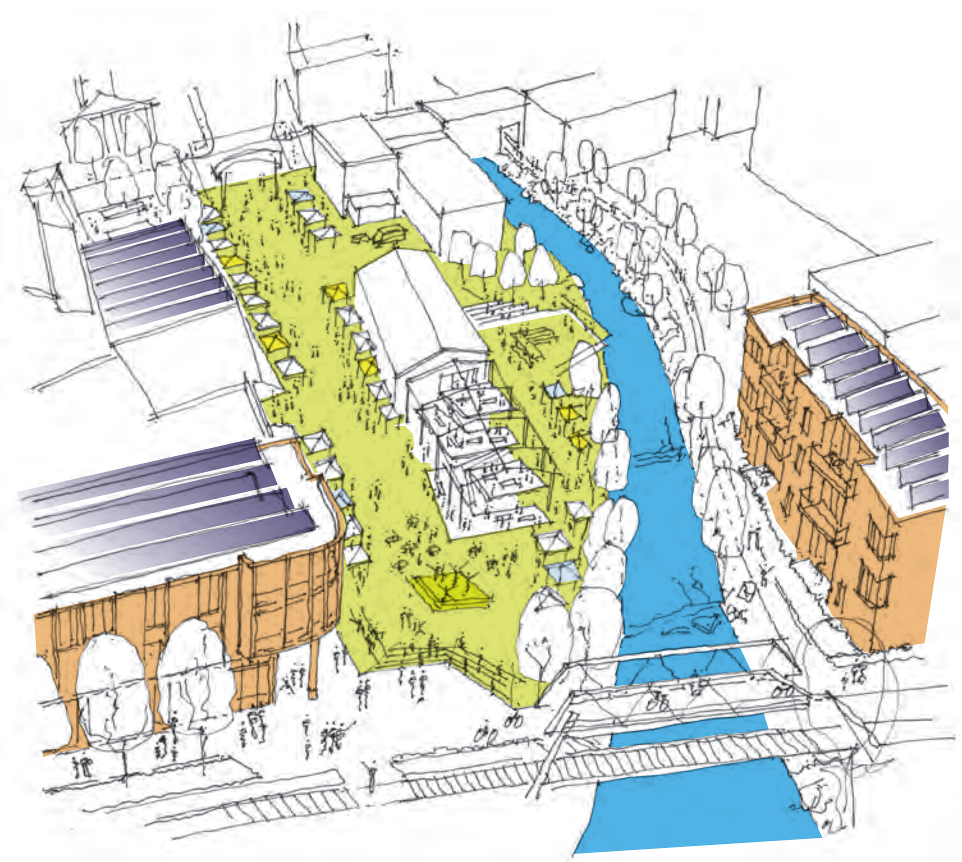


Sustainable Montpelier 2030

GossensTemkin Collaborative

team 80242





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Introduction

In organizing a strategy for Net Zero Montpelier we asked how can our underlying design approach enhance existing opportunities, uncover hidden assets, expand and enrich public space, and make energy efficiency a catalyst for specific and targeted density, allowing for growth while also opening better living experience for all?

This design strategy takes cues from Leo Hollis: there is already strength and vitality in the community and city fabric.

> *"Rather than imposing a bold new vision on the city, the plans should reinforce the existing city qualities: as a dense environment, the city should become more dense, and the city should become a place that people would want to come to."*
>
> -- Leo Hollis

Achieving net zero in a comprehensive community response requires both environmental and social responsibilities. Net zero is basically about numbers and projections, but a true response needs to stir the imagination as well. Our design also is done in a manner that is realizable and scalable. Making it happen is critical and all aspects of this proposal are grounded in reality and backed up with data. Making it happen is also an effort of the entire community: it cannot just be left up to the State or private developers. The proposed design affords opportunities for all members of our community to participate in a meaningful manner.

All aspects of the proposed plan are done in a manner that reinforces and builds upon Montpelier's existing scale and atmosphere. Great care has been taken to "right size" all of the proposed solutions: we want Montpelier to remain the unique and individual community that it is.

There are four primary strategies in the design: engaging with the rivers, consolidating parking, recapturing and making new public space, and knitting spaces and paths together to improve circulation and accessibility. New public spaces like the riverfront amphitheater, Confluence Park, and summer fountain/winter ice rink provide new places to gather, circulate, and play. The Market Plaza builds on the vitality of the weekly farmers market, new circulation paths allow faster and more dynamic dialog between people and places.

Environmental Sustainability

The environmental energy strategy addresses existing structures, as well as strong guidelines for new buildings. The plan calls for aggressive weatherization of existing downtown buildings, the application of photovoltaics (PV) to all roofs with appropriate exposures, and an expansion of the Biomass District Energy System (BDES) to add co-generation (i.e. electricity generation as well as heat).

The area of the city core is compact enough to accommodate significantly more pedestrian and bicycle circulation once accommodated effectively. The plan shows new paths, improved connectors and bridges to make paths that are fun, scenic, and efficient.

The addition of a People Mover makes it easier for more people to park at the edges of town and take this quick at-grade system, on the existing rails, into and out of the city core.

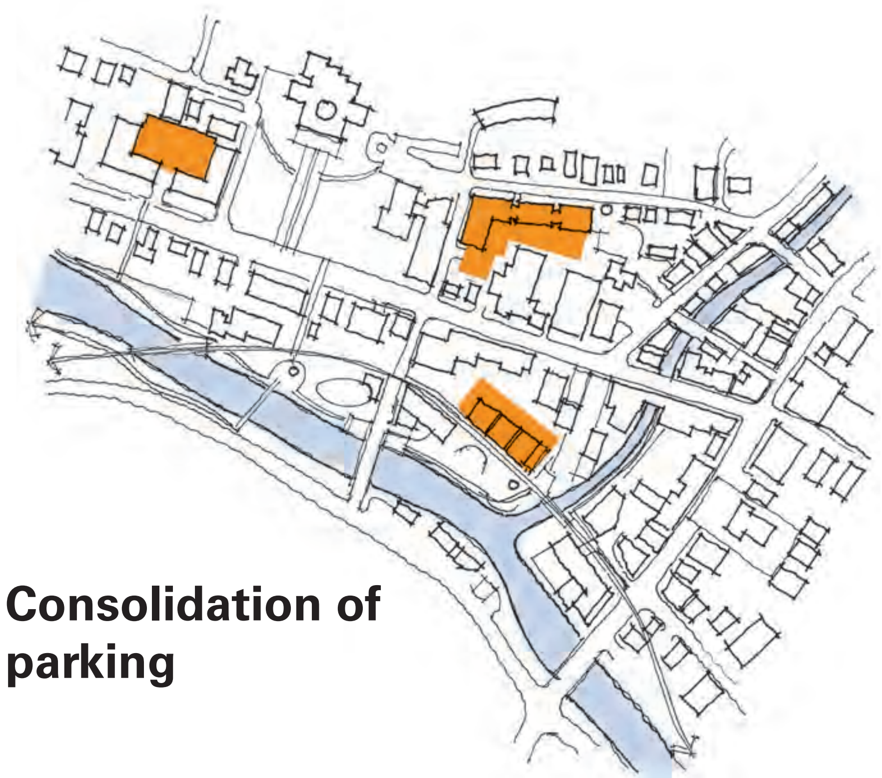
Social Sustainability

By reclaiming space currently dedicated to surface parking we create new opportunities for public space. The city recaptures the river edges through a new park and amphitheater by the multi-modal hub, Confluence Park where the rivers come together, and a new recreation center with fountain/skating area. Langdon Street becomes pedestrian only west of Onion River Sports and connects to a new children's play area below Court Street.

The typical location of the summer farmers market is re-envisioned as a year-round market in the old garage building, with outdoor seating, market stalls, indoor market space, and a local food-processing hub.

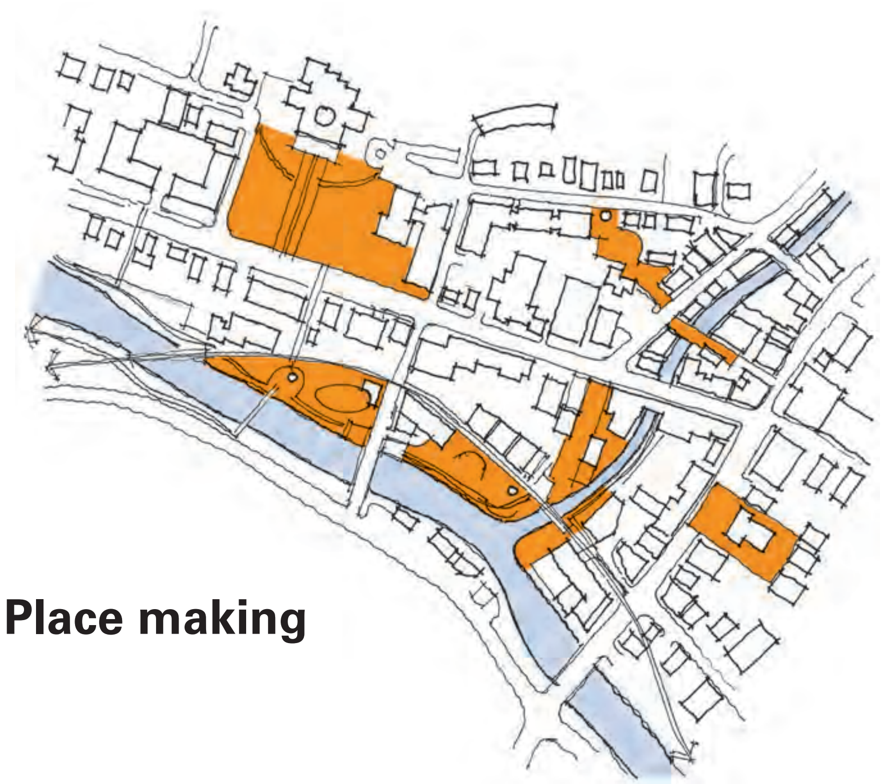
Durability and Resilience

With consideration of the flood plain, most new structures will have parking at grade and finished floors above, so they are protected from floods during extreme weather conditions. Parking is consolidated primarily into three high-density parking structures. By consolidating parking we reduce the amount of impervious paving thereby improving the impacts of runoff and storm water management.



Consolidation of parking

Engaging with the rivers



Place making

Knitting places together

Four Strategies

Consolidation - Place making - Engaging - Knitting

Consolidation of parking

Court Street (State of Vermont & private)
Potential Parking = 340 spaces
Potential Building, 3 levels = 46,500 sf

133 State Street (State of Vermont)
Potential Parking = 160 spaces
Potential Building, 5 levels = 120,000 sf

Capital Plaza site (private)
Potential Parking = 90 spaces
Potential Building = 63,000 sf

Place making

Space within the city is enhanced and recaptured for public use, performance, market space, and play.

Engaging with the rivers

By recapturing land for public use community activities can engage the river edges.

Knitting places together

New paths, primarily for pedestrians, bicycles, and the People Mover provide easier connections between functions in the city core.

Housing in proposed buildings = 350 new units

Shaw's site = 4 x 19,000 sf	140 units
North Branch site = 4 x 6,400 sf	28 units
Capital Plaza site = 3 x 21,000 sf	120 units
One Taylor Street site = 3 x 13,000 sf	45 units
Langdon Street site = 3 x 4,000 sf	17 units

Other downtown sites = 220 new units

Accessory Dwelling Units (ADU's) = 100 new units

There are 480 existing large (≥ 2500 square feet) homes within a 15 minute walk of downtown. If 20% of these added Accessory Dwelling Units that would provide 100 new housing with minimal impact on the existing infrastructure or energy use profile of the City. And, this provides an additional income stream for homeowners.

Infill sites = 115 new units

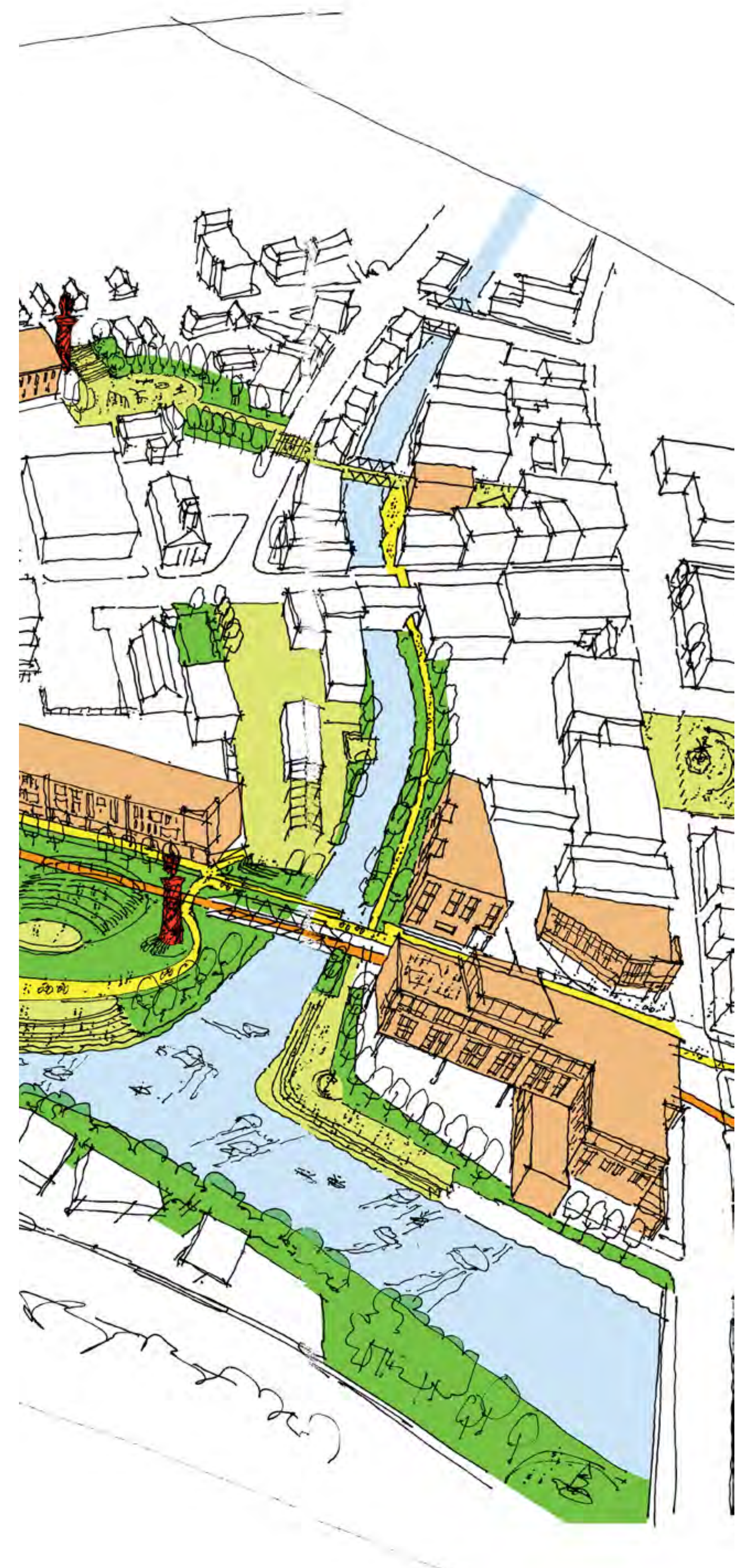
Within a 15 minute walk of downtown there are infill development sites enough to accommodate 115 units of housing while keeping the existing neighborhood scale and character.

Barre Street Enterprise Zone = 200 new units

A neighborhood in Sabin's Pasture = 140 new units

A new neighborhood can be developed in Sabine Pasture, as multi-unit dwellings, to accommodate 140 new units of housing while still preserving a significant portion of the landscape for public use, tillable land for food production and green houses.

1,125 new homes developable within a 15 minute walk of downtown



How to add more housing

Increasing population without disrupting the urban fabric

Desire: Create 1,000 additional housing units downtown.

Reality: If we desire to maintain our existing City character, large-block housing structures will not work. Large housing developments are also dependent on significant private development in an economically difficult environment.

Solution: We propose a nuanced and diverse approach to housing creation. Our design includes appropriately scaled new construction downtown including small-scale downtown infill development, one and two family infill development in our beautiful neighborhoods and a program of accessory dwelling units (ADU's) in existing larger-than-needed homes. This approach allows for development at many scales for larger and small development firms as well as individual property owners. Introducing the income from ADU's will also help with maintaining affordability for private homeowners.

Surface parking *removed*

Behind state buildings along State Street	-125 spaces
Large river front state lot	-170 spaces
Heney lot	-70 spaces
French Block/Jacobs lot	-50 spaces
City Hall lot	-24 space
Post Office lot	-32 spaces
County Court lot	-22 spaces
	493 spaces removed

Parking spaces *added*

Court Street garage	+340 new spaces
133 State Street garage	+160 new spaces
Capital Plaza garage	+90 new spaces
	590 spaces created

Net effect: 6.6 acres less paving

290,000 sf of paving removed = **6.6 acres less**

97 new parking spaces added to downtown

360 new parking spaces downtown protected from snowfall in the winter and heat during the summer

How to provide enough parking while reducing paving

Desire: Downtown parking can be greatly reduced by introducing better mass transit, alternative transportation and density.

Reality: While the above strategies will make our community much less auto dependent, as the state capital Montpelier is a destination city and without a significant regional and statewide adoption of public transportation parking will remain necessary for many people in the local and regional community.

Solution: Our design reduces existing pavement by 6.6 acres yet provides an additional 100± parking spaces through the use of strategically placed parking structures beneath and adjacent to proposed new buildings. This solution also has the benefit of raising the buildings above the FEMA flood elevations while using the sloped topography to maintain grade-level street frontage.

Summary of energy loads and sources

Total new load required	**4,300,000**	**kWh/yr**
Net Zero ready new building load	4,200,000	kWh/yr
Trolley annual load	84,000	kWh/yr
Cogeneration from the District Energy plant		
Cogeneration output	1,350,000	kWh/yr
Photovoltaic generation		
Rooftop capacity: 1,010 kWp, like:	1,161,500	kWh/yr
Ground mount PV array: 1,600 kWp, like:	1,840,000	kWh/yr

Area needed for ground mount PV = 9 acres

1,840,000 kWh/yr
generated by a new ground mount PV array (43% of load)

1,110,000 kWh/yr
generated by new rooftop PV arrays (26% of load)

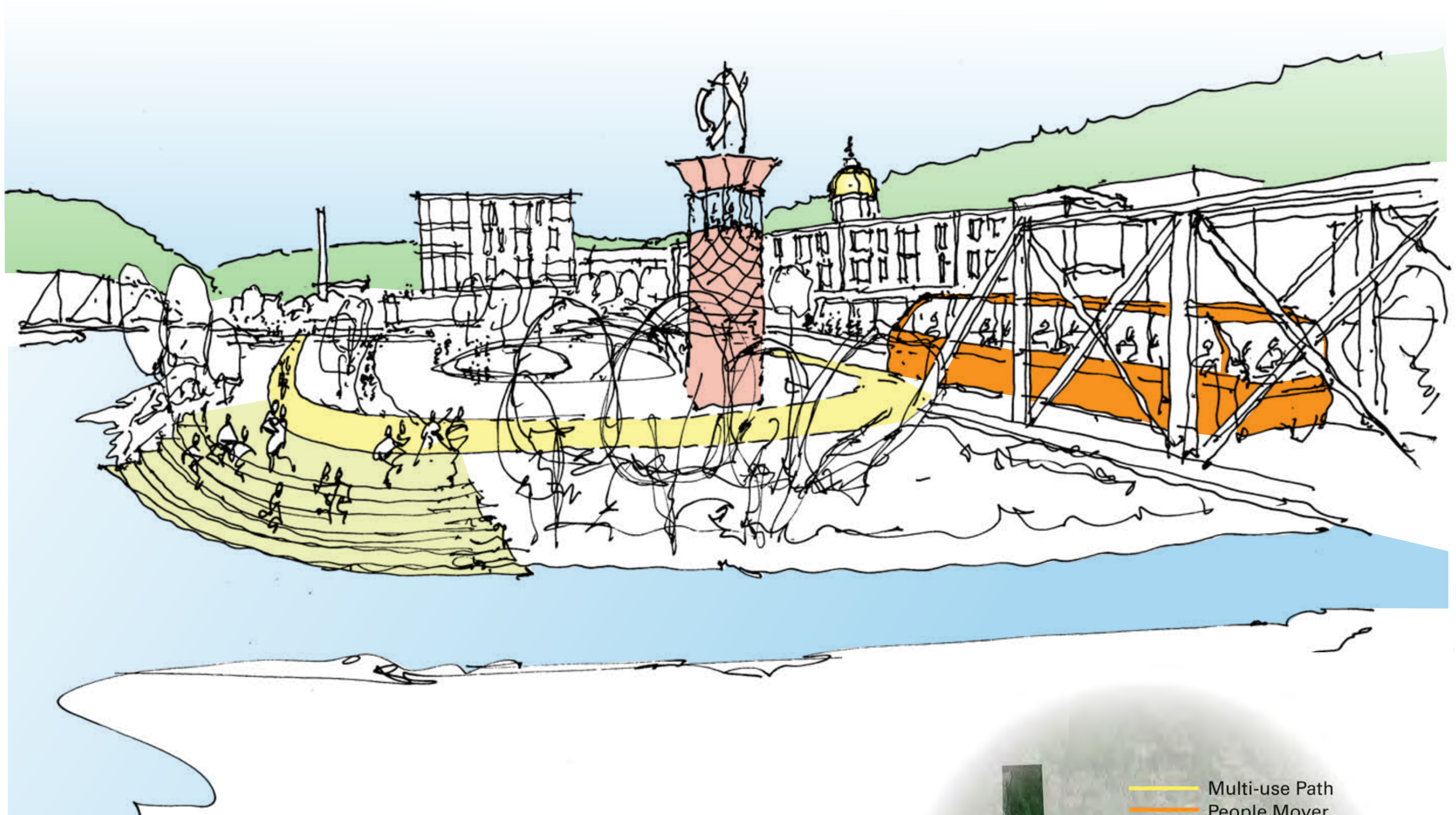
1,350,000 kWh/yr
generated by converting the existing District Energy plant to cogeneration (31% of load)

How to generate enough new energy

Desire: Rooftop photovoltaic arrays (PV) will be sufficient to meet the energy load to accomplish net zero.

Reality: Even if all downtown buildings are renovated and constructed to net zero ready specifications, the available roof areas will not be sufficient to accommodate needed PV panels. This is especially true when considering the historic nature of the existing building fabric and the fact that new construction should be fitting to the current city aesthetic. Our calculations indicate that rooftop PV on new structures will provide 1,010kWp, less than 30% of the anticipated electrical load.

Solution: Our design includes appropriately designed PV on both new and existing buildings. The remaining PV would be ground mounted: our data indicates that to achieve net zero (including the energy required for the proposed people mover) an additional 1,600 kWp of PV is required. This will requires 9 acres of land. The City stump Dump has a perfect site available accommodating 8.3 acres. An additional .7 acres will be needed and we feel can easily be found within the City limits.

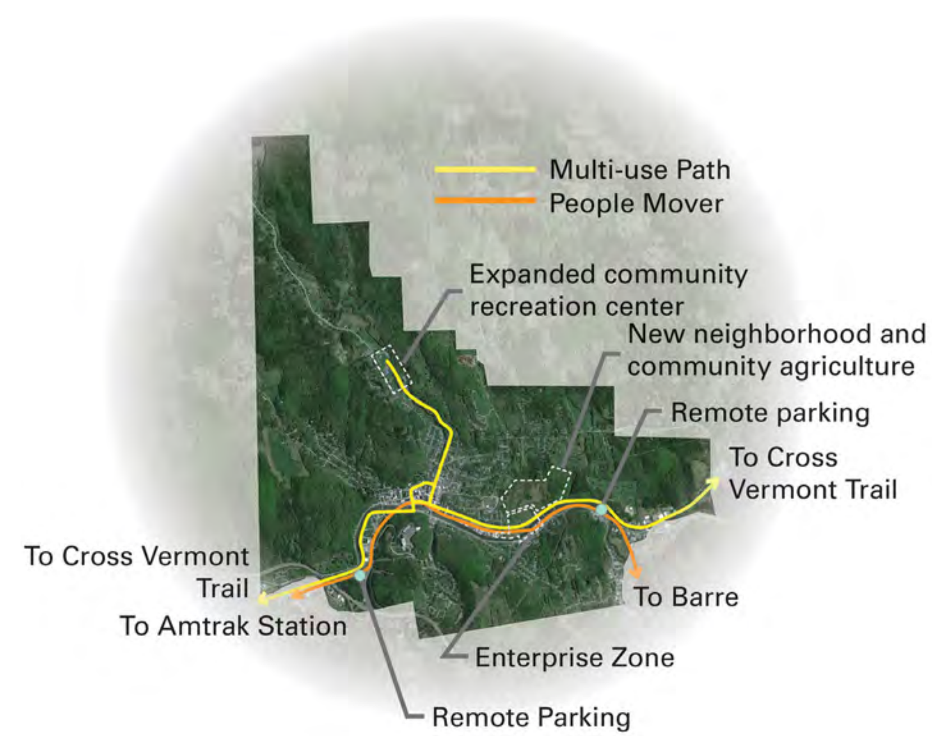


How to move people in and out of downtown

Desire: Introduce significant alternative mass transit modes.

Reality: The scale of Montpelier makes it difficult to introduce some potential solutions and many proposed modes are in conflict with a net zero goal.

Solution: We propose a people mover electric trolley connecting remote parking areas at the Rt. 2 roundabout and Amtrak station. We propose two trolleys operating in 15-minute intervals for 16 hours per day. The electrical demand per year will be 84,000 kWh (or .54 acres of PV). The potential ridership and reduced parking needed downtown are in balance with this scheme. Our design rules out other large-scale mass transportation ideas, including a tram to the National Life Complex. Assuming a tram will run 8 hours per day, the electrical demand per year would be 220,000 kWh (or 1.4 acres of land). An electric bus to National Life running 12 hours per day at 15-minute intervals will need 33,000 kWh (or .2 acres of land.) *Obviously, the electric bus is a far more efficient solution.*

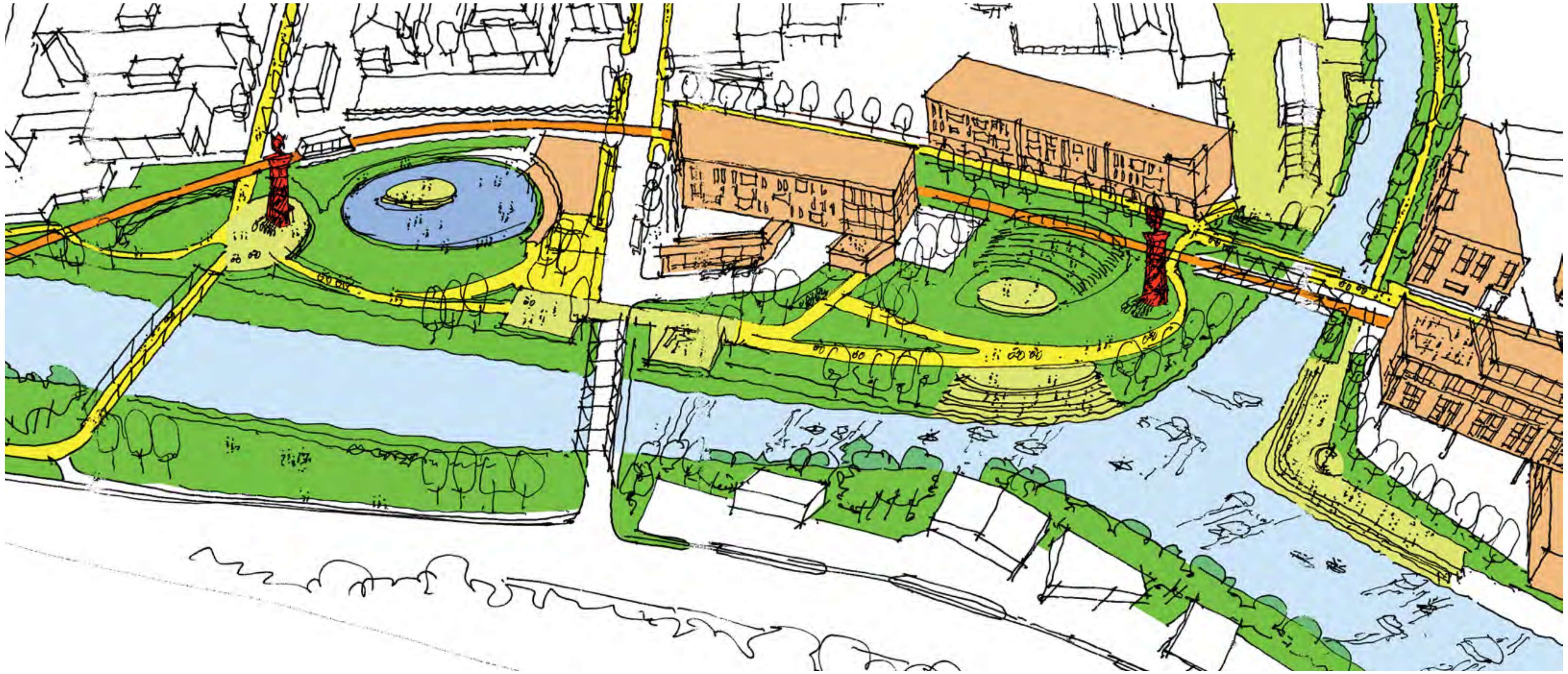


How to make vibrant public space

A true net zero City should encourage not only environmental sustainability but social and economic sustainability. Our plan creates significant public spaces of various scales throughout the downtown. Most of these places open up new entrepreneurial opportunities. A vibrant community is a place where people want to linger, interact, recreate, shop, live and take care of business. All of our proposed public spaces are designed to encourage and enable these activities and in a manner that is cohesive but also diverse. Great care is taken to provide meaningful linkages to each public space as well as links to the surrounding neighborhoods, Hubbard Park and the Capital Complex. We placed an emphasis on re-introducing the rivers to the downtown and rediscovering many hidden gems in our existing community. Our places are about our people.

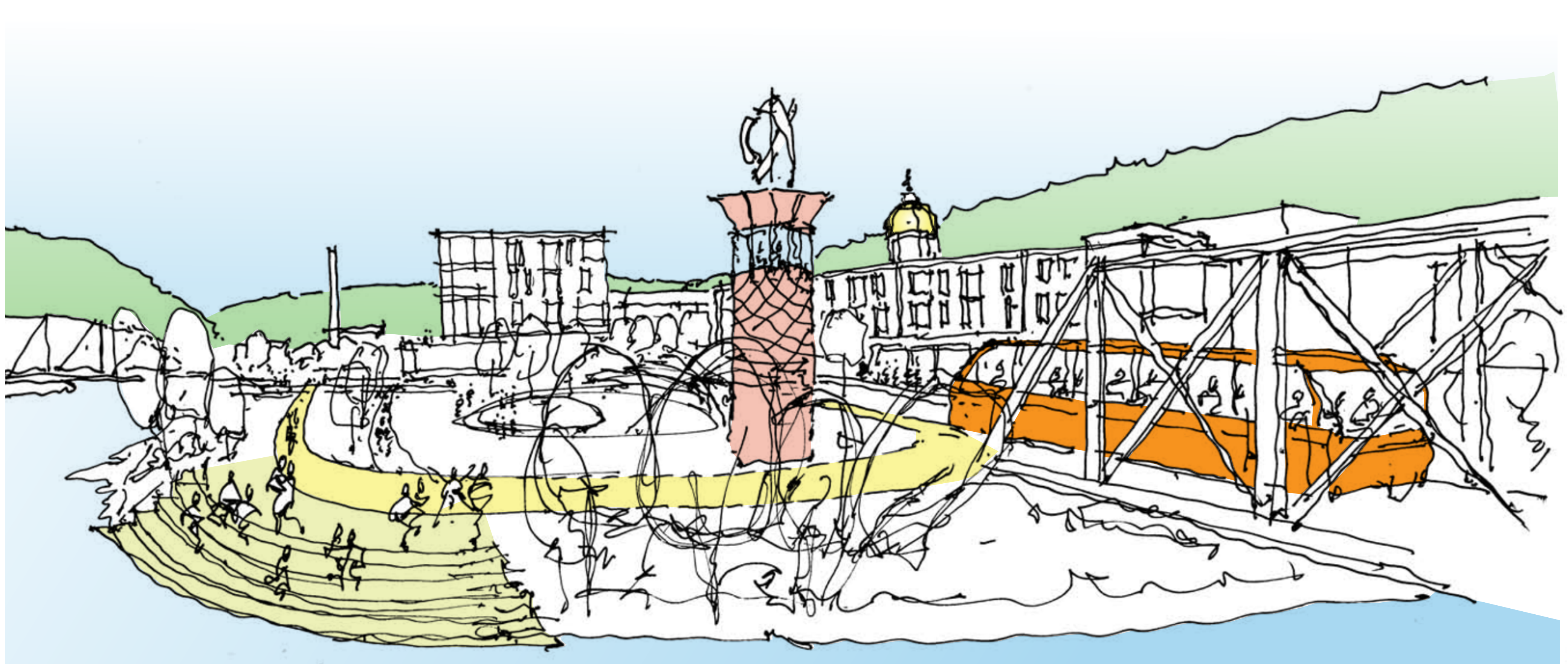
How to protect and enhance our rivers

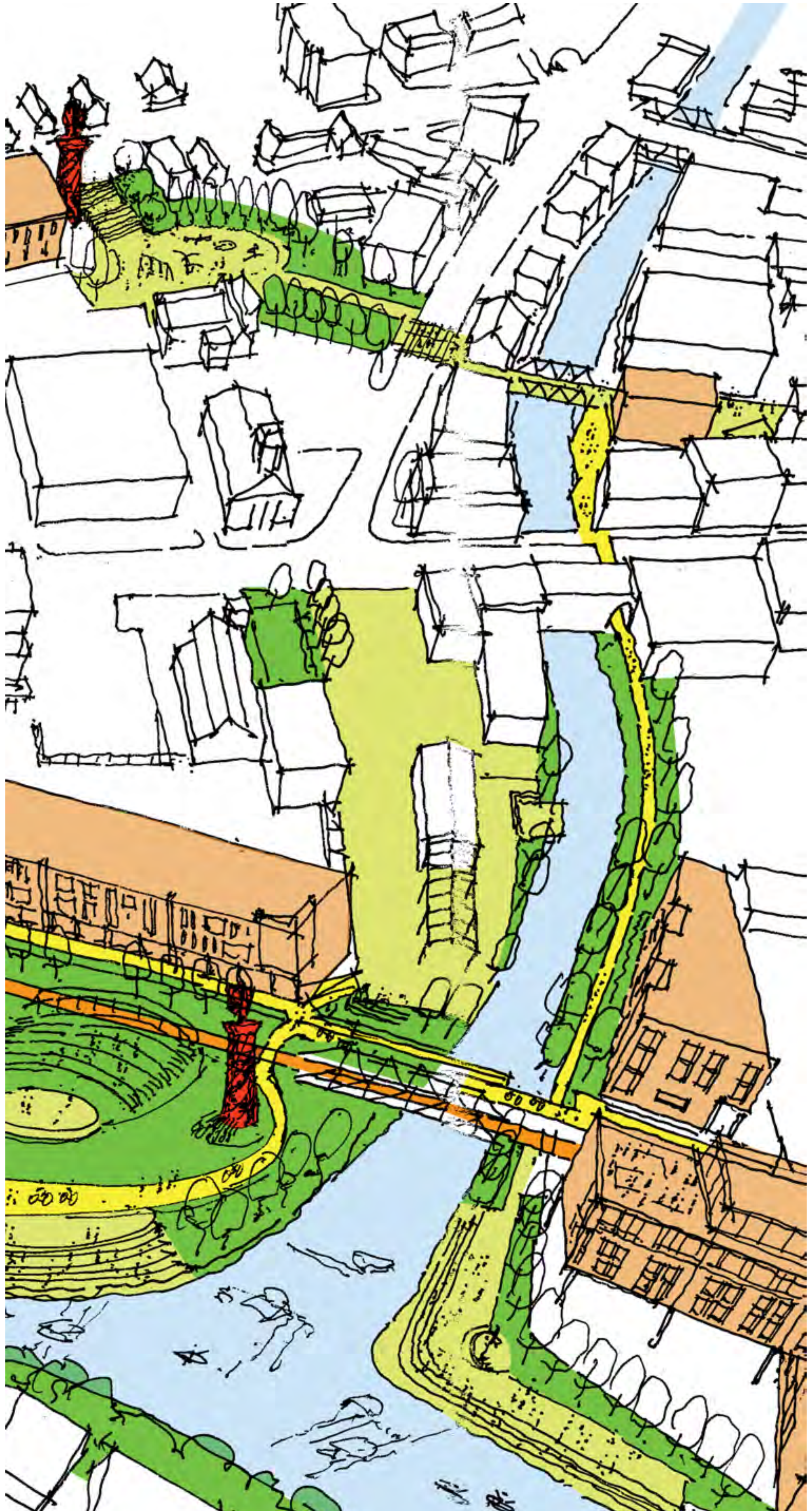
Historically the riverfronts have not been treated kindly. We are not unique in this abuse, but can now take a leadership role in making corrections. Our riverfront is primarily paved, has armored banks, unnecessary dams and little biological diversity. We propose over 2,600 linear feet (a little over 3 acres) of river edge riparian buffer creation. These riparian buffers not only restore bio-diversity, they also provide storm water run-off mitigation, naturalized green space, greater flood resiliency and overall environmental sustainability. The buffers are also visually beautiful and compliment the public places along the rivers.



How to reengage the rivers

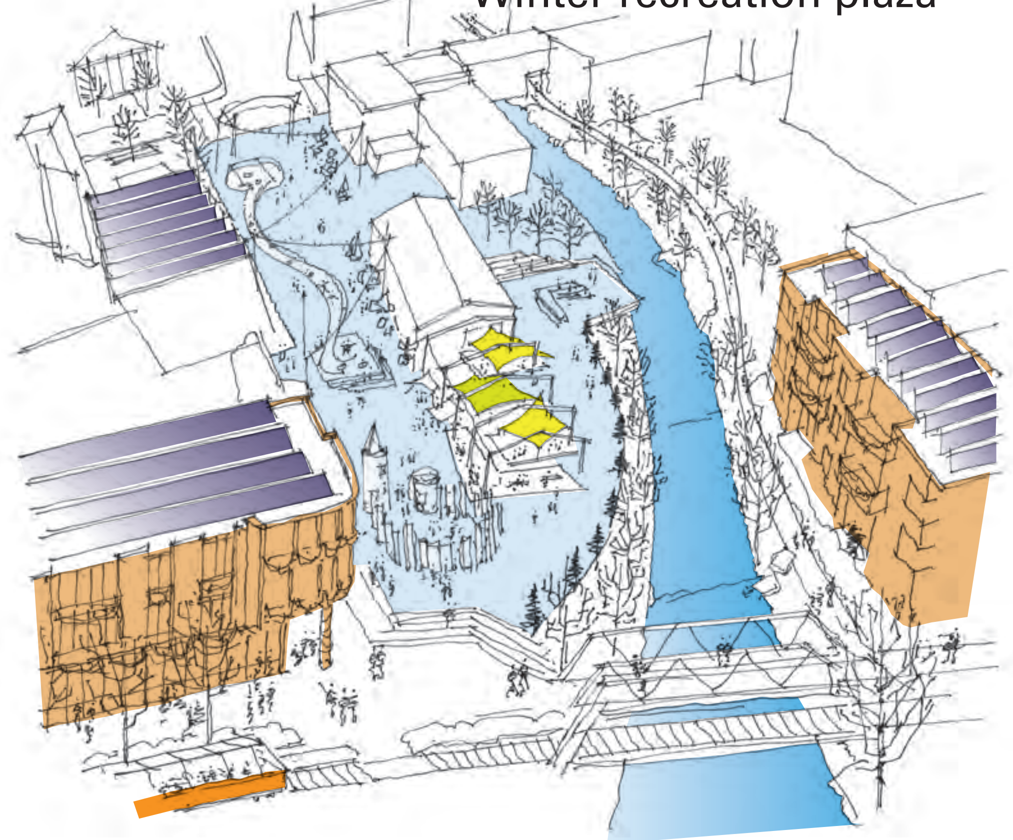
Embracing our riverfronts has been a long-standing goal for our community. Much of our existing riverfront is paved and the river edges inaccessible. Our proposed design reduces paved areas, mostly along the river, by well over 6 acres. The design along both rivers offers a balance of public place making and naturalization. We not only use the riverfront for place making in specific locations, but also as a river edge route of linking pathways throughout the downtown and Capital Complex. Our riverfronts will no longer be the back of downtown. We recognize that Montpelier is a four-season City, our riverfront re-design provides for social interaction, recreation and economic opportunity throughout the year. It will be an exciting place for all ages, residents and visitors alike.





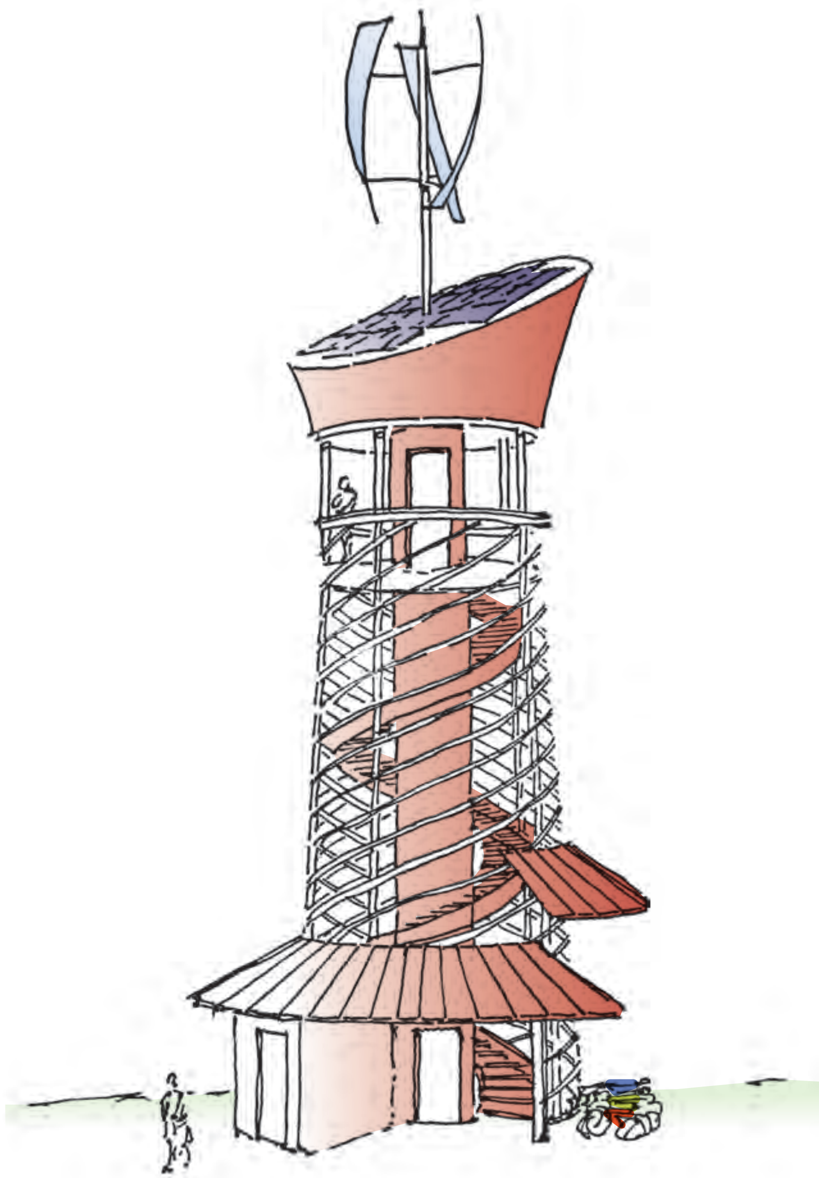
Summer outdoor market

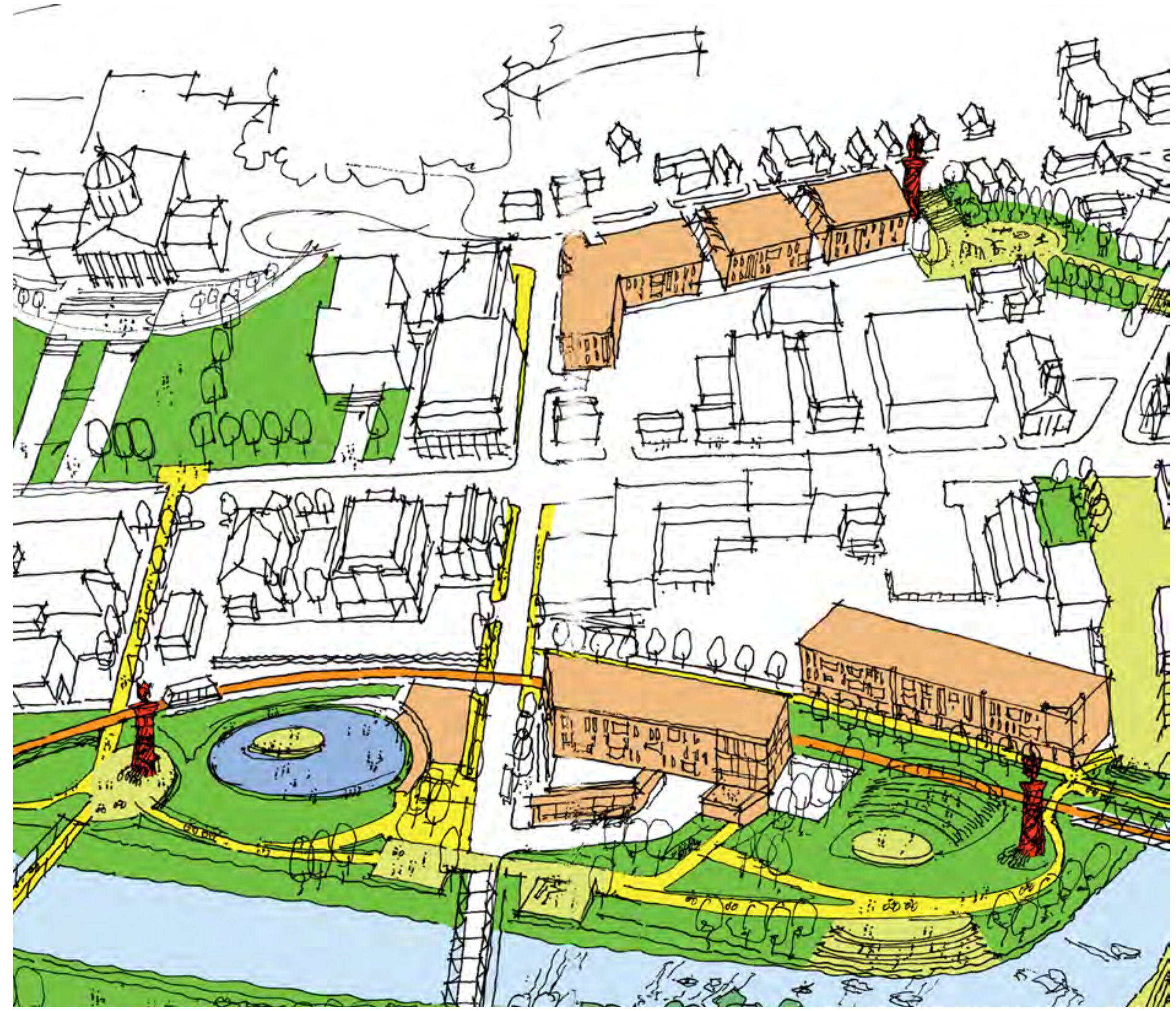
Winter recreation plaza



A Four Season City

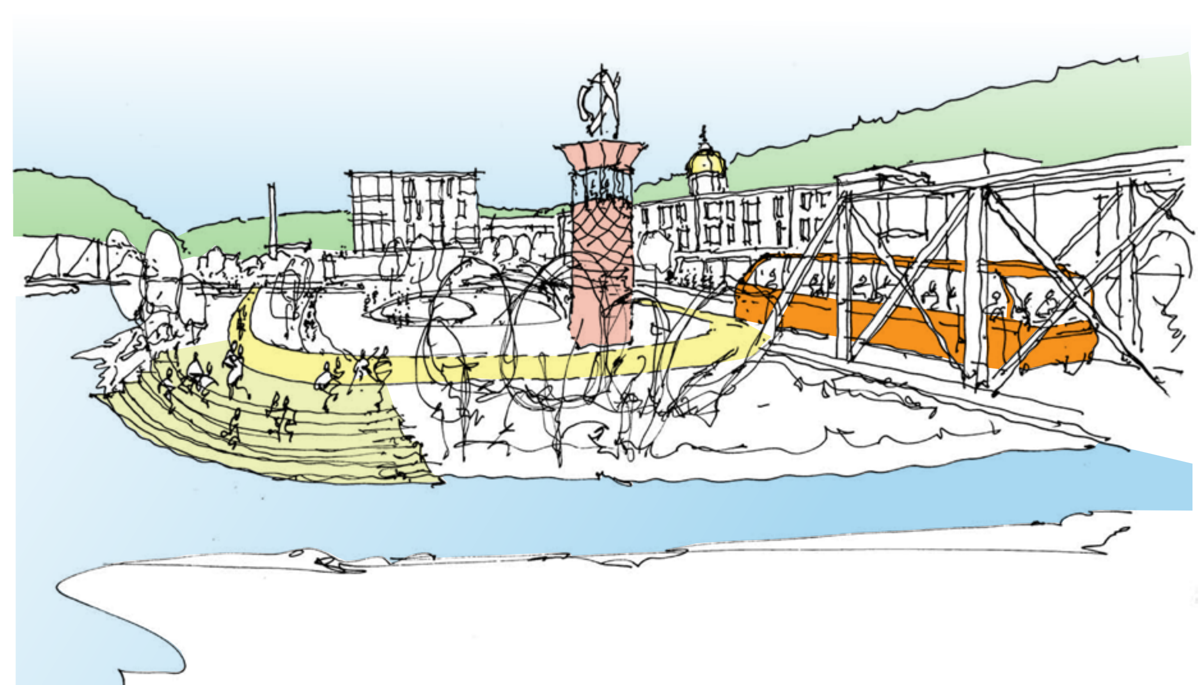
We live in a diverse climate and embrace the four seasons. Unfortunately many Cities do not take advantage of the seasons, especially winter. All of our public spaces and energy modeling take into account seasonal changes in a manner that brings out the best in each. The proposed public spaces are located in areas that take advantage of views, sun orientation, prevailing wind patterns and seasonal attributes. Our Market Place and Riverfront Park especially are designed to embrace winter and encourage out of doors interaction, recreational activities for all ages as well as providing business opportunities. The Market Place plaza transitions from a full scale outdoor market in the spring, summer and fall to a winter recreation plaza including a sloped sledding run, ice sculpture gallery, snow structure and canopied ice bar/café. The indoor portion of the market will function year round.





Three hub towers

A net zero city should be proud and show it. We propose 3 Hub Towers as symbols of this accomplishment. In true net zero fashion, nothing is done gratuitously. Our Hub Towers provide public toilets, bicycle parking, bicycle repair stations, electric charging stations, drinking fountains and fully accessible observation platforms. Each tower will include PV awnings and a small sculptural wind turbine. The towers are located in significant public place intersections and in a manner that is a visual reminder of our community commitment. *They are a blend of the beautiful and practical, the essence of net zero!*



Appendix: Data

Data Used to Generate Energy Usage Estimates
Net Zero Montpelier
1/6/17

Values used in analysis	EUI, kBtu/sq.ft.-yr		
	CBECS	**Net Zero Ready**	
Housing	**80**	**22**	
Lodging	**88**	**20**	**no restaurant**
Office	**73**	**25**	
Food Store	**192**	**110**	**some food prep**
Retail	**65**	**25**	**non-food**

Data below was used to develop the values used in the analysis

waterfront Housing	45000 sq.ft.			
40 apts				
Total energy consumption	kWh	kWH/sq.m-yr	kWh/sq.ft.-y	Btu/sq.ft.yr
Total gas kWh/yr	308,966	74	7	23,433
Electricity kWh/yr	202,000	48	4	15,321
Total kWh/yr	510,966	122	11	**38,754**
Heat, therms/yr		7,905		
Domestic Hot Water, therms/yr		2,640		
Total therms/yr		10,545		
Electricity Use				
Electricity, apt's only kWh/yr		96,000		
Electriciy, house meter		106,000		
Total kWh/yr		202,000		
Avg monthly tenant electric bill	$	19		
Cost of house meter/apt	$	32		
kwh/sq.ft.-yr		5		
House meter breakdown				
common lights		43,000		
ventilation fans		30,000		
cooling vent air		7,000		
heating pumps		9,000		
elevator		9,000		
fire pump		611		
controls and other		8,000		
Total		106,611		

Actual use summary	use	$		unit	EUI
					39
gas	10,545	$	12,794	therm	kBtu/sq.ft.-yr
electricity total	202,611	$	24,894	kWh	
apt electricity	96,000	$	9,341	kWh	
house electricity	106,611	$	15,553	kWh	

Office EUI's	kBtu/sq.ft.-yr
M'bury S. Village	33
NRG Systems	20
Bennington Courthouse	26

Waterfront if Net Zero Ready with heat pumps
kBtu/sq.ft.-yr

7.6	heat
5.9	DHW
15	electricity
29	TOTAL

40 units

if heat were 30% less

5.3	more insulation, Temp Eff Hx recovery
2.9	with 50% solar hot water
13.7	with 30% less lighting, no heating pumps
22	TOTAL

Brattleboro Food Coop			
		23,570	sq. ft. co-op food store
		11,420	sq. ft. co-op offices and kitchen commissaries
		34,990	total sq.ft.
estimated breakout		6,852	office only sq.ft.
Office	**Store**		
36,000	964,000	1,000,000	kWh/year
500	7,500	*8,000*	*propane guess*
25	**117**	**98**	**Total EUI**

CBECS Data 2012				130% nat gas NE/US*
Elec kWhsq/ft	Gas cf/sf	EUI ** calculated	EUI	Gas, NE adjusted cf/sf
15.3	43.8	88	100	57
16	26.8	73	75	35
45	61	192	210	79
15	21.5	65	65	28

** New England gas usage is 30% above average, but I expect with VT commercial energy code, usage would be lower, so I'll use the national average to calculate EUI for code buildings in Montpelier. Elec reduced 15% for Effiency Vermont effect

CBECS = Commercial Building Energy Consumption Survey
http://www.eia.gov/consumption/commercial/
* NE usage of gas averages 30% more than national average

Appendix: Data

Net Zero Montpelier
New Building Enery Consumption

1/6/17

Building	Usage Type	# Levels	Sq.ft./level	Energy Usage Index EUI, kBtu/sq.ft.-yr [5] 2015 Code	Net Zero Ready	kWh/yr Energy Usage [4] 2015 Code	Net Zero Ready [2]	PV kWp Required [1]	Roof area Available	kWp PV that fits on roof [3]	# Housing units	Notes
Shaw's site	grocery	1	24,000	192	110	1,300,000	800,000	700	22,000	190		
Shaw's site	Housing	4	19,000	80	22	1,800,000	500,000	400			88	
M&M Site	Retail	1	5,500	65	25	100,000	40,000	-	5,000	40		
M&M Site	Office	2	5,500	73	25	200,000	100,000	100				
North Branch Site	Housing	4	6,400	80	22	600,000	200,000	200	5,500	50	28	
Bashara Site	Retail/Commerc	1	20,000	65	25	400,000	100,000	100	20,000	180		
Bashara Site	Housing	3	20,000	80	22	1,400,000	400,000	300			75	
One Taylor Site	Transit center	1	4,000	98	38	100,000	40,000	-	12,000	110		
One Taylor Site	Housing	3	13,000	80	22	900,000	300,000	300			45	
Taylor/Court Site	Conf. Center	1	11,500	88	20	300,000	100,000	100	10,000	90		
Taylor/Court Site	Hotel	4	11,500	88	20	1,200,000	300,000	300			80	rooms, no commercial kitchen
Court St Site	Office	3	15,500	73	25	1,000,000	300,000	300	15,000	130		
Elm St. Site	Retail	1	4,000	65	25	100,000	30,000	-	3,500	30		
Elm St. Site	Housing	3	4,000	80	22	300,000	100,000	100			12	
130 State St Site	Office	5	24,000	73	25	2,600,000	900,000	800	22,000	190		(State Office expansion)
Total			505,100			12,300,000	4,210,000	3,700	115,000	1,010	328	

83	28
Avg EUI, kBtu/sq.ft.-yr	

20	Acres required for non-roof PV
28	Acres required if All PV on ground*

** does not include reduction for CoGeneration*

[1] kWH per year per peak Watt installed of PV: 1.15
[2] Buildings insulated to .05 cfm50/sq.ft. air leakage, R-30 foundation, R-40 walls, R-60 roofs, R-5 windows
LED lighting with occupancy and daylight control, highest effiency energy recovery ventilation, air source heat pumps for heating and cooling
Solar hot water for lodging and residential with electric backup or electric heat pump backup
[3] PV with ballasted racks at low angle on roofs, allowing 20% of available area for fire access and solar hot water, and 25% of space for aisles between low slope rows
[4] for code buildings, some energy would be fossil fuel -- in this tally all energy is expressed in kWh, whether electricity or fossil fuel
[5] Based on experience with Net Zero Ready buildings, and from Commercial Building Energy Consumption Survey, http://www.eia.gov/consumption/commercial/reports/2012/energyusage/
Adjusted for Colder climate, Vermont Energy Code and Efficiency VT reduction in electricity usage due to demand side management programs

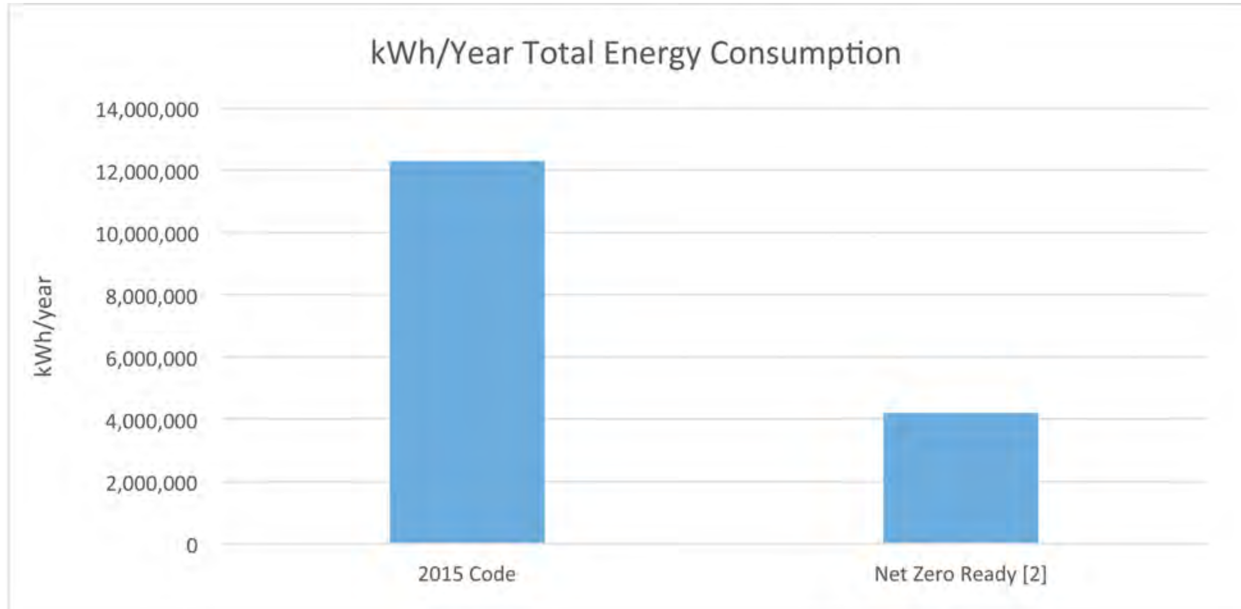
Values Used in Analysis

	EUI, kBtu/sq.ft.-yr CBECS	Net Zero Ready	
Housing	80	22	
Lodging	88	20	no restaurant
Office	73	25	
Food Store	192	110	some food prep
Retail	65	25	non-food

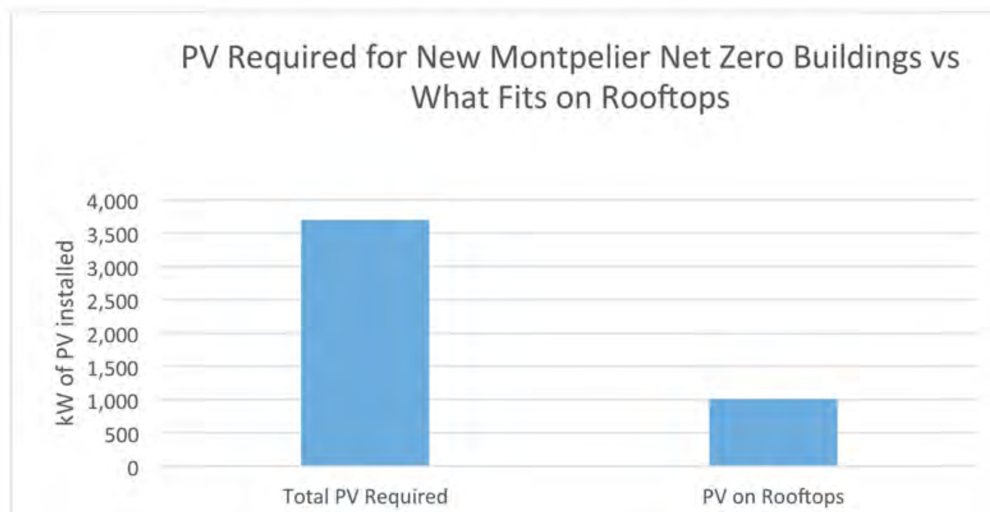
CBECS = Commercial Building Energy Consumption Survey
http://www.eia.gov/consumption/commercial/

Appendix: Data

kWh/yr Energy Usage	
2015 Code	Net Zero Ready [2]
12,300,000	4,210,000



Total PV Required	PV on Rooftops
3,700	1,010



Area Required for Ground Mounted PV Arrays 1/6/17

Candian solar PV panel -- typical commodity panel

78	Height inches
39	width inces
21.1	sq.ft. area
310	Wp
14.7	Wp/sq.ft
11.0	Wp/sq.ft with 25% aisle space

For ground mount
aisle width =2 x panel height

4.4	Wp/sq.ft land
0.23	sq.ft/Wp
227	sq.ft required per kWp
227,151	sq.ft required per MWp
5.21	acres/MWp

Used this>>> **5.5 acres per MW-AC (from NREL)**
7.5 total acres including all area within fence
http://www.nrel.gov/docs/fy13osti/56290.pdf
Lower value used due to tighter sites in VT compared to national average

Team 80242 Gossens Temkin Collaborative

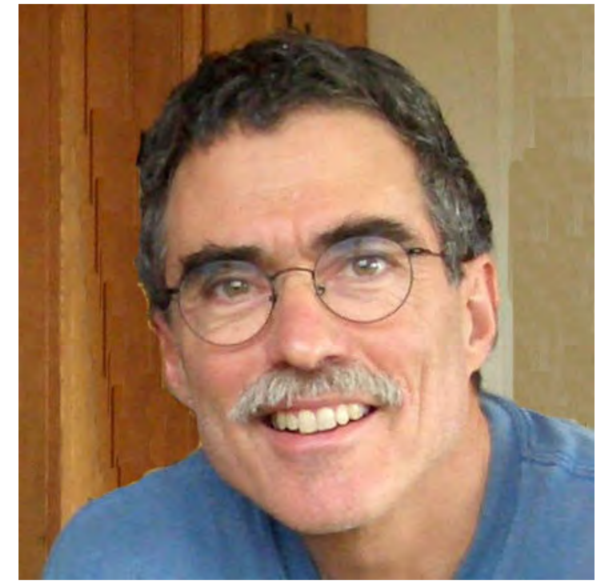
Gregg Gossens, AIA

Gregg Gossens is a founding partner of gbA and an adjunct professor at Norwich University. gbA is a design studio style firm with an emphasis on sustainable design in community settings. The firm has been awarded over fifty state, regional, and national design awards. Gregg is a past president of the Vermont Chapter of the American Institute of Architects and is currently on the Board of Directors of Montpelier Alive. Gregg was Project Lead on the Montpelier Capital District Master Plan, and the Montpelier District Energy Biomass Plant, and he is currently working on the One Taylor Multi-Model Transit Center/Housing project. He earned a Bachelors of Architecture and Urban Planning from the University of Wisconsin – Milwaukee (1978) and a Masters of Architecture from the University of Minnesota (1980).

Aron Temkin, AIA

Aron Temkin began practicing in Pittsburgh, Pennsylvania, in 1992, working with several award-winning firms, including L.P. Perfido Associates (now Perfido Weiskopf Wagstaff + Goettel) and Urban Design Associates. He is a dean and a Professor of Architecture at Norwich University with a specialization in digital design. He is a past-president of the Association for Computer Aided Design in Architecture (ACADIA), and he has served on the boards of the Architectural Research Centers Consortium (ARCC), AIA Florida, and AIA Vermont. He is currently on the Steering Committee of Vermont Public Radio's Community Forum.

Along with his university responsibilities, Aron has worked as a sole practitioner since 2000. In practice, his work has included low-income housing, corporate headquarters, elderly housing, urban design, park design, and graphic design. His professional and scholarly work has been exhibited and published regionally, nationally, and internationally.



Andrew M. Shapiro

Andrew Shapiro is president and sole proprietor of Energy Balance, Incorporated, which provides high performance building design consulting services to a wide variety of clients, including owners, architects, engineers and builders, and many others. Andrew recently worked on the Coastal Maine Botanical Gardens Borsage Education Center, which received the NESEA 2013 Net Zero Award and was certified LEED Platinum. He was also involved in the Montpelier Senior Center and Housing, which involved rehabbing a structural brick school building. Additionally, Andrew has been a part of the work on multiple other projects that have been LEED certified, including NRG Systems manufacturing and office facilities (LEED Gold) in Hinesburg, VT, and Putney Field House (LEED Platinum), as well as several micro-load/"net zero" houses in Vermont and White Pine Co-Housing, a six-unit village where he now lives. Andrew is also the Energy Engineer for the Vermont Energy Education Program, where he works to train teachers and students.

David Burke

David Burke is a Master of Architecture candidate at Norwich University and a resident of Montpelier, Vermont. He is currently working on a thesis project investigating the ways in which sound and architecture influence each other and how the relationship between the two can improve the environments we live in. His background includes carpentry and field research for a climate change model project on the Big Island of Hawaii.