June 18, 2019
via e-mail

Mr. Michael Capuano, Chair
Somerville Planning Board
City Hall
93 Highland Avenue
Somerville, MA 02143

Reference: **D2.1 – 10 Prospect Street**
Resiliency Questionnaire Supplement

D2.1 | PATHWAY TO NET ZERO EMISSIONS

The City has been engaged in a multi-year planning process to achieve carbon neutrality by 2050. Steps taken to date include the development of the City's first Greenhouse Gas Inventory (2016), the Carbon Neutral Pathways Assessment (2017), and the Somerville Climate Change Vulnerability Assessment (2017). The planning steps most recently culminated in Somerville Climate Forward (SCF – 2018), Somerville's first comprehensive climate change plan. The plan represents a set of implementable actions that will reduce Somerville's contribution to GHG emissions while increasing city resiliency to unavoidable impacts of climate change. Somerville's buildings, mobility, environment, community, and leadership are identified as distinct categories that will drive 13 identified action areas, all of which maintain relationship to the D2 Projects.
Buildings, both new and existing will play a significant role in achieving the City's carbon neutrality goal. Consensus around compliance objectives for Somerville Climate Forward are still being explored but are described as potentially including:

- High energy efficiency design, such as achieving Passive House or other recognized building certification programs;
- Electrification of building systems, including heating, hot water and cooling;
- On site and/or off-side renewable energy development; and
- Purchase of verifiable carbon offsets.

Although compliance objectives have not yet been defined, this report provides US2's approach to addressing each of the potential target areas of energy efficient design, electrification, on and offsite renewable energy, and green power purchasing. These achievements through buildings are further supported by mobility and public realm enhancement actions described in summary below that position the project as a resilient model. (These are expanded on in further detail elsewhere in the Design and Site Plan Review application and the applicant's Final Environmental Impact Report EEA# 15889.)

- Mobility Actions: reduce vehicle trips, incentivize green and electric vehicles, encourage bicycle use, and increase MBTA ridership

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- Public Realm Enhancements: increase walkability, expand tree canopy, combat the urban heat island, implement green infrastructure, etc.

Somerville Climate Forward also identifies the role of the City to incentivize and facilitate Net-Zero buildings. While not yet enacted, identified development incentives of relaxed building height, increased density, reduced off-street parking requirements, reduced fees and expedited permitting may be considered to further guide and incentivize future development projects. Since there are not any specific incentives in place to support these objectives for D2, US2 has not assumed the availability of any City incentives in the analysis that follows.

1) An update to the Energy Use and GHG emissions modeling from the DEIR incorporating any changes to the building design that have been made since the modeling was initially completed.

The energy model that was submitted in the DEIR continues to be the most current energy model of the proposal. The model, described as 'Model Group 1' in the DEIR analysis represents this speculative commercial development in which end users are yet unknown. As such, best assumptions around future tenant mix were used, with 10 Prospect Street being modeled with a 60/40 lab-office use mix. Provided regional market growth in the life-science sector, US2 believes that this is an appropriate assumption to ensure Somerville is able to participate in the area's commercial growth. Providing opportunities for life-science users results in unique energy demands for the project, which in turn drive base system design.

Building D2.1's exterior envelope is designed to meet specific energy consumption reduction targets while providing the flexibility to deliver an interior environment attractive to life science tenants intended to occupy the building. The façade types favoring the west and north facing portions of the building will offer more glazing, while the façade types applied to the south and the east façades will integrate more opacity to mitigate solar heat gain effects and to provide for areas of greater insulation. The blended window-to-wall ratio (WWR) had been initially designed to be 46% and was modeled as such as part of the Expanded Environmental Notification Form. Between the EENF and the filing of the DEIR, in an effort to improve the envelope's overall performance, the WWR was lowered to 39%. An updated model was prepared for the DEIR to reflect this improvement and is attached here as Table 1.

At the areas of higher transparency, the façade is anticipated to be comprised of an aluminum curtainwall system with one-inch insulated glazing units (IGU) for both vision and spandrel conditions. The glass will include a low-e coating and have argon gas in the air space between the glass lites. For the vision glass, a U value equaling 0.388 has been assumed while the spandrel glass conditions are anticipated to achieve a U value of 0.189. For both of these conditions, the assumed U values include the performance value of the curtainwall system. At the façade types that contain more opacity, the walls are intended to be a rain screen system, comprised of a finish material, air space and thermally broken clips, mineral wool insulation and sheathing. In board of the sheathing will contain metal studs, additional insulation and gypsum wall board. The total wall assembly for the opaque portions of the façade targets an overall R value achievement of 21.

Should the façade design continue to evolve, the team will be mindful to balance the WWR and performance values of the proposed systems with the need to provide adequate natural light as desired by the life science and office tenants intended to occupy the building. As designed, the building as proposed achieves code standards and does not introduce the trade-offs that would necessarily require more of its mechanical systems.

Proposed Mechanical Systems

The proposed mechanical systems include high efficiency central heating and cooling plants with water-cooled electric chillers, condensing gas-fired hot water boilers, and distribution pumps with VFDs. The lab portions of the building are served by a "once-through" variable air volume (VAV) supply and exhaust air system with energy recovery loop. The air handling unit and lab exhaust fans are VFD-driven. Single duct VAV boxes with hot water reheat coils serve all lab spaces. The office and retail areas are served by four-pipe fan coil units, with ventilation air provided from the central lab air handlers. Domestic water heating is accomplished via electric storage units for all spaces.

Alternative Systems

Three alternatives were studied for comparison. Alternative 1 studied an improved roof R-value, from the proposed R-31 to R-40. Even for this building with a large roof area, the R-40 roof had no impact on energy use or GHG emissions. For this reason, an improved roof has not been incorporated into the proposed design.

Alternative 2 improved the opaque wall performance from the proposed R-21 to R-32. This resulted in a GHG improvement of 0.5% over the proposed case. While improved wall performance will continue to be evaluated as design progresses, the energy impact of increased insulation does offer enough benefit to justify the added cost.
An alternate mechanical system for the office space is modeled as Alternate #3. It includes active chilled beams in lieu of fan coil units. This mechanical alternative resulted in slightly improved GHG reduction levels, 1.4% over the proposed case. While a viable alternative for Office uses, this alternative is not suited to lab uses as the relative humidity needed to support the lab program could result in condensation issues within the space. As such, the alternative will be referenced for future office uses. Please refer to **Table 1** for Model Group 1's energy use results, along with a comparison against the code baseline and the aforementioned alternatives.

Table 1 Energy Use and GHG Emissions, Model Group 1, Lab/office Building D2.1

Lab/Office Building D2.1						
Modeled Conditioned space	198,314	sf				
Design Conditioned space	198,314	sf				
Factor	1.0					
		Baseline	**Proposed**	**Alternative 1 Improved R40 Roof**	**Alternative 2 Improved R32 Wall**	**Alternative 3 Proposed Env. Chilled Beams**
DIRECT (NATURAL GAS)		MMBtu/yr	MMBtu/yr	MMBtu/yr	MMBtu/yr	MMBtu/yr
Space Heating		25,741	12,768	12,698	12,465	12,134
Domestic Hot Water		0	0	0	0	0
Misc. Equipment		999	999	999	999	999
	subtotal	26,740	13,767	13,698	13,464	13,134
INDIRECT (ELECTRICITY)		MWh/yr	MWh/yr	MWh/yr	MWh/yr	MWh/yr
Space Cooling		524	514	513	514	506
Space Heating		0	15	15	15	14
Domestic Hot Water		290	239	239	239	239
Fans Interior		2,503	3,298	3,298	3,287	3,252
Pumps		362	503	503	503	505
Heat Rejection		19	68	68	68	65
Internal Lighting		631	467	467	467	467
Misc. Equipment		2,275	2,275	2,275	2,275	2,275
	subtotal	6,605	7,379	7,379	7,368	7,323
ENERGY USE INDEX	PNNL reference[4]	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr	kBtu/sf/yr
	73.3	248.5	196.4	196.0	194.7	192.2
(compared to baseline)			**-21%**	**-21%**	**-22%**	**-23%**
GHG EMISSIONS		tons/yr	tons/yr	tons/yr	tons/yr	tons/yr
Direct	Gas-burning	1,564	805	801	788	768
Indirect	Electricity	2,345	2,620	2,619	2,616	2,600
	Total	3,909	3,425	3,421	3,403	3,368
	Diff, tpy		**-484**	**-488**	**-505**	**-541**
Diff, % (compared to baseline)			**-12.4%**	**-12.5%**	**-12.9%**	**-13.8%**
CO_2 Emission Factors:						
Electricity [2]	710	lb/MWh				
Natural Gas [3]	117	lb/MMBtu				

[2] 2016 ISO New England Electric Generator Air Emissions Report

[3] EIA Fuel Emissions Factors, Weighted National Average (1029 Btu/scf)

[4] Pacific Northwest National Laboratory study, Massachusetts Zone 5A, ASHRAE 90.1-2013, Large Office

2) A description of the building's envelope performance as compared to code, including a comparison of designed window area with code specified window area.

The building's envelope performance as compared to code is summarized below.

Measure	Baseline		Proposed	
	R Equivalent	U Value	R Equivalent	U Value
Roof	31.3	0.032	31.3	0.032
Framed & Insulated Wall	18.2	0.055	21.3	0.047
Percent wall	*61%*		*51%*	
Spandrel			5.3	0.189
Percent Spandrel			*10%*	
Window	2.4	0.420	2.6	0.388
Percent Window	*39%*		*39%*	
Aggregate Vertical Assembly	5.1	0.197	5.1	0.194

3) A technical description of how the building will transition to net zero emissions, including how and when systems can be transitioned in the future to carbon-free alternatives (provide timeline including 2030, 2040, and 2050 targets). Description must include whether any remaining emissions will be offset with on-site or off-site renewables and at what quantity.

- The building's HVAC system is a combination of single pass air systems to serve laboratory ventilation needs as well as 4 pipe fan coils to serve office areas and supplemental cooling for laboratory spaces. The laboratory air system will be provided with exhaust heat recovery for energy savings. The building heating is provided by five (5) 4000 MBH natural gas fired condensing boilers. Service water heating for emergency tempered water systems is provided by two (2) 199 CFH natural gas fired water heaters.
- The project will be investigating the implementation of a hybrid boiler plant that converts to electric boilers for heating over a period of time. This will allow the cost of operation of the building to benefit from advances in technology and optimization of the power grid for renewable source energy.
- Initially the boilers will be gas fired, however this will not provide a barrier to implementation of alternative future systems. Over time, a replacement strategy from

gas fired to electric boilers could be implemented with the intention of having the primary source for heating to be electric. To protect building occupants, the use of gas fired systems could be reduced to fulfilling an emergency backup role should heat recovery systems fail.

- System replacement could begin in 2040 where two of the five 4000 MBH boilers would be expected to be replaced. Each 4000 MBH boiler would be replaced with two (2) 520 KW electric boilers. Space will be allocated in the penthouse to support this replacement. Power feeds to the penthouse will be designed now to support this future transition. Beyond replacement of two boilers, additional space is planned in the penthouse to support transition of a third, with the fourth and fifth boilers to remain gas fired to provide system redundancy and the ability to provide heating during an interruption in power service.
- Incoming electric service will be coordinated with Eversource to support the incremental increase associated with supporting the future electric boilers.
- Although future system efficiencies are unknown, US2 would look to renewable energy sources to offset any remaining emissions. At the present time, on-site renewable energy generation is challenged by the nature of the D2.1 site. Limited regional wind productivity, a heavily contaminated site imposing restraint on geothermal opportunities, and a limited site area to deliver roof-top photovoltaic production suggest renewables are best pursued off-site. As such, the project is making a commitment to procure 100% of D2.1's energy needs from a qualified green power source for a period of 10 years. This third-party provider will be certified by the Green-E Certification program to ensure the highest level of quality and consumer assurance through the chain of custody. The 10-year time period will allow the assessment of changing market dynamics around renewables and inform the best path towards continued emissions reductions and/or offsets over the long term.

4) Evaluation of energy usage and GHG emissions of Passive House building envelope, compared with Code envelope. Passive House will generally be the most effective way to reduce environmental and climate impacts across the site. Refer to DOER comments on the DEIR for guidance and comparable Passive House Projects.

DOER comments to the DEIR were referenced for guidance in the development of the Final Environmental Impact Report for EEA# 15889. In response to this guidance, a thorough Passive House analysis was performed by a certified Passive House Consultant to inform the decision-making process. In advance of this report and at the suggestion of the DOER, US2 undertook considerable due diligence to ensure any assumptions were consistent with those of experts in the field who were familiar with both the opportunities and obstacles associated with what was described by the co-Founder of Passive House Institute US, Katrin Klingenberg, as "an engineering feat." US2 attended conference (PHMass, NAIOP), and engaged owners (Affordable Housing Developers), engineers, and consultants (Building Evolution Corporation, BR+A) to understand the engineering and pre-design challenges associated with Passive House. Subsequently, US2 heard firsthand of the complexities of implementation and the importance of team experience from Commodore Builders, the general contractor of Boston's first certified multi-family project and a residence hall at Wheaton College. Lastly, together with the Union Square Neighborhood Council, US2 also met with ICON Architecture, the architect and team member with Commodore Builders of the Distillery Project.

This due diligence with subject thought leaders was instrumental in understanding the technical nature of Passive House, its associated hurdles and constraints, in parallel with the opportunities for innovation and the benefits it could provide. In concert with DOER comments, the scope of this Passive House Analysis focused on residential buildings as Lab buildings are not well suited for Passive House as the energy use intensity of labs are well above Passive House standards. More specifically, while the surface area to volume ratio of D2.1's massing offers promise, its Lab/Office use type challenges potential Passive House achievement in several ways:

- Where a well-insulated and draft-stopped building envelop is an energy-use advantage for any building, with Lab buildings, energy use for equipment is the principle challenge in that its function can defeat the benefits of a tight envelope.
- Lab buildings require significantly greater numbers of air changes, hot and cold- water generation for lab equipment use, and in general, defeat the benefit of the high-performance envelope by exhausting unwanted equipment-use air and water from the building. In essence, the active resource use that a laboratory demands overwhelms the energy economizing effort that a Passive House envelope is able to deliver.

(It should be noted that the DOER did not provide comparable office or Lab Passive House project.) This obstacle did not preclude the design team from studying opportunities to include Passive House principles throughout the building.

- Elements of Passive House design were studied and modeled in detail as described in response to question 1 above, and were balanced against market expectations for daylight and system performance to inform the building envelope.
- As it relates to the enclosure specifically, as described above, Building D2.1 was modeled with a better-than-code R-40 roof. The results of this envelope improvement were negligible. Additionally, D2.1 was modeled with a better-than-code R-32 wall. Again, the results of this envelope improvement were negligible. This negligible improvement in performance is a product of the building use type specifically. In a laboratory setting, 90% of all energy demands are driven by the required ventilation needs of the space; as a consequence, envelope improvements have little effect on improving GHG emissions.
- Although not overcoming the system needs, several key principles of Passive House design have been incorporated to help improve building envelope performance. D2.1 has proposed a building envelope that exceeds prescriptive code levels, with an over-all aggregate vertical assembly of R=5.1. Larger expanses of glazing have been located on the building on the North / Northwest facades to limit the amount of sun exposure. As each building elevation responds to different exposures, the selection of glass and its inherent solar heat gain coefficient properties can be fine-tuned to limit the amount of heat gain in the building. The majority of the building elevations are composed of

"punched" openings with vertical accent fins adjacent to the glass. Further, the building will be designed for the air tightness that will deliver on the efficiencies gained through the improved wall makeup. When assembled, envelope commissioning will ensure the building is constructed as designed. The building will also be detailed to avoid external thermal bridging that would exacerbate heat loss.

5) Feasibility analysis of full electrification (fully electrifying space and water heating). Evaluate energy usage and GHG emissions of aggressive electrification design to compare with current design. Must include cost analysis, including operational cost. Include estimate of Alternative Energy Credit value.

- As a Lab building, D2.1 presents obstacles to large scale electrification. US2 has consulted with numerous systems engineers in the market to understand the feasibility of implementation, of large scale VRF systems specifically. It is readily understood that product type and project scale factor considerably in feasibility which has resulted in a scarcity of large-scale, project precedents in the market. Similarly, the New England climate presents real challenges for VRF systems to support 100% outside air. VRF efficiencies in tempering heat unfortunately do not correlate with like successes in handling the 0 degree or 98% saturated outside air extremes our climate can present.
- Provided these limitations and parallel demands for significant coolant needs of large buildings such as this one, application of VRF systems could be implemented as a supplemental cooling source. This alternative for partial-electrification could be in lieu of fan coils for example. In this mode, the benefit of providing for both heating and cooling is lost – compromising the efficiency for which the product is known. The end result necessitates more system infrastructure within the building, further expanding costs and system complexity in operations and ongoing maintenance.
- Given the impracticality of implementation, it is difficult to compare this alternative against the current design.

6) An analysis of the size and cost of on-site and off-site renewable energy generation that would be required to offset the emissions of the building as currently designed.

- Offsetting building emissions through on-site renewable energy generation is challenged by the nature of the D2.1 site. Limited regional wind productivity, a heavily contaminated site imposing restraint on geothermal opportunities, and a limited site area to deliver roof-top photovoltaic production suggest renewables are best pursued off-site.
- Further challenging the implementation of an onsite array is the extensive building equipment requisite of lab uses within the building. In plan, the rooftop equipment is located as far south and east as possible in order to limit heights against the zoning-defined 'Pedestrian Streets' of Somerville Avenue and Prospect Street. This effort serves to minimize the 'street presence' of these systems while minimizing shadows cast onto

Union Square Plaza. A bi-product of this deference to the public realm is that the little remaining roof top area for PVs lies north of the mechanical levels, which at elevations above the potential array would hide them from adequate sun.

- Beyond D2.1's rooftop potential, should an array be provided at an off-site location, it is estimated that it would need to be sized at approximately 476,000 SF. The productivity of this area would offset the 7,379 MWh of energy demand from the building. These results, as estimated through the *National Renewable Energy Laboratory* have been attached for reference.
- Estimating the cost of such an array is difficult absent both a determined location that permits a study of its solar productivity and the location's land cost. Excluding the cost of land and assuming the found location reflects similar productivity levels to that of the Union Square area, US2's FEIR detail provided in consultation with a third-party provider estimated a project cost of $2.23 per KWh of electricity production. Applied to the production target of 7,379 MWh results in an estimated cost of $16.4 million. The summary table of the area's PV Productivity Analysis it attached for reference. Please see Appendix E6 of the FEIR for supporting detail.
- Although on-site renewables at this scale are not feasible, US2 has committed to procure 100% of D2.1's energy needs from a qualified resource for green power, carbon offsets or renewable energy certificates for a period of 10 years. This third-party provider will be certified by the Green-E Certification program to ensure the highest level of quality and consumer assurance through the chain of custody.

7) Description of incentives, rebates, grants provided by utilities, government organizations, and other organizations being pursued to maximize building efficiency and to reduce emissions. Description must include any incentives that were considered but are not being pursued, including reasoning for each decision.

- The proponent has met with Eversource representatives to discuss available MassSave incentives. MassSave incentives are awarded on a "whole-building" basis, where the proposed design is compared to a MassSave baseline. The MassSave baseline is typically calculated by an approved MassSave modeler. The MassSave baseline will be more stringent than the code-compliant baseline utilized in State permitting. However, the code-compliant baseline can be used to approximate incentives. As indicated in the DEIR, the proposed lab building uses less gas but more electricity than the base case. Therefore, approximately $240,000 in MassSave gas incentives would be available. Please see **Table 2** on the following page for calculation of this incentive.
- State Alternative Energy Credits (AECs) are not applicable to this building, as Heat Pumps are not appropriate for a lab space use.
- Similarly, MassCEC credits for heat pumps have been phased out and are no longer available.

Table 2 Estimated MassSave Incentives

		Baseline	DEIR Proposed
DIRECT (NATURAL GAS)		MMBtu/yr	MMBtu/yr
Space Heating		25,741	12,768
Domestic Hot Water		0	0
Misc. Equipment		999	999
	subtotal	26,740	13,767
	Dif from Baseline		-12,973
INDIRECT (ELECTRICITY)		MWh/yr	MWh/yr
Space Cooling		524	514
Space Heating		0	15
Domestic Hot Water		290	239
Fans Interior		2,503	3,298
Pumps		362	503
Heat Rejection		19	68
Internal Lighting		631	467
Misc. Equipment		2,275	2,275
	subtotal	6,605	7,379
	Dif from Baseline		+774
MassSave Incentives	Gas		$239,995
	Electric		n/a
	Total		**$239,995**
Incentive Rate			
Electricity [2]	$0.35	per kWh	
Natural Gas [3]	$1.85	per Therm	

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Caution: Photovoltaic system performance predictions calculated by PVWatts® include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by PVWatts® inputs. For example, PV modules with better performance are not differentiated within PVWatts® from lesser performing modules. Both NREL and private companies provide more sophisticated PV modeling tools (such as the System Advisor Model at https://sam.nrel.gov) that allow for more precise and complex modeling of PV systems.

The expected range is based on 30 years of actual weather data at the given location and is intended to provide an indication of the variation you might see. For more information, please refer to this NREL report: The Error Report.

The energy output range is based on analysis of 30 years of historical weather data for nearby , and is intended to provide an indication of the possible interannual variability in generation for a Fixed (open rack) PV system at this location.

RESULTS

7,379,783 kWh/Year*

System output may range from 7,083,116 to 7,648,407 kWh per year near this location.

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)	Value ($)
January	3.10	458,437	68,353
February	3.96	516,726	77,044
March	4.71	655,817	97,782
April	5.51	714,195	106,487
May	5.61	736,705	109,843
June	6.09	756,818	112,842
July	6.50	820,973	122,407
August	5.96	754,896	112,555
September	5.27	660,249	98,443
October	3.89	527,371	78,631
November	2.94	401,178	59,816
December	2.60	376,417	56,124
Annual	**4.68**	**7,379,782**	**$ 1,100,327**

Location and Station Identification

Requested Location	Sommerville. ma
Weather Data Source	Lat, Lon: 42.37, -71.1 1.3 mi
Latitude	42.37° N
Longitude	71.1° W

PV System Specifications *(Residential)*

DC System Size	5720 kW
Module Type	Standard
Array Type	Fixed (open rack)
Array Tilt	20°
Array Azimuth	180°
System Losses	14.08%
Inverter Efficiency	96%
DC to AC Size Ratio	1.2

Economics

Average Retail Electricity Rate	0.149 $/kWh

Performance Metrics

Capacity Factor	14.7%

Rooftop Solar Summary

	PV PRODUCTIVITY ANALYSIS[1]							FEIR COMMITMENT		
Lot	Potential Roof Area (SF)	Studied Roof Area (SF)	Potential kW DC	Potential kWh	Cost per Watt ($)	Project Cost ($)	Simple Payback	PV Set Aside (SF)	Potential Additional Set-Aside (SF)[2]	Note
1.1	6,849	6,849	79.2	89,296	2.68	212,000	8 yrs	6,700		*shading from 1.2 am and pm, from 2.1 in winter*
1.2	17,237	17,237	185.6	198,134	2.25	418,000	7 yrs		16,600	*good exposure*
2.1	-		-		-	-				*planned as lab, no available roof area*
2.2	14,066	10,626	115.4	119,203	2.41	278,000	8 yrs	10,200		*shading from 2.3, mid am to mid pm*
2.3	-		-		-	-				*mechanicals at tower roof, no available roof area*
3.1	15,352	15,352	185.6	198,134	2.25	418,000	7 yrs		14,800	*solar on south east and west, shading from 3.2*
3.2	7,946		-	-	-	-				*too much shading with limited array areas*
3.3	18,332	18,332	214.1	237,191	2.25	482,000	6 yrs		17,700	*shading from 3.2 in PM*
4.1	2,962	2,962	33.9	38,684	3.49	118,000	11 yrs	2,800		*shaded by 2.3, small area with extensive payback*
4.2	-	-	-	-	-	-				*no solar, too small*
4.3	9,897	7,112	93.6	113,537	2.61	244,000	7 yrs	6,800		*good exposure and productivity*
5.2	2,862	2,084	26.5	29,302	3.76	100,000	9 yrs	2,000		*small with shading from 1.1 and 1.2, highest cost/watt*
5.3	3,986		-		-	-				*unproductive, significant shading from 1.1 and 1.2*
6.1	4,487		-		-	-				*limited available area per zoning heigh sensitivities*
6.2	4,393		-		-	-				*limited available area per zoning heigh sensitivities*
7.1	6,680	4,317	60.8	68,123	2.86	174,000	8 yrs	4,100		*shading from 7.2 in am*
7.2	9,237	7,738	95.2	114,497	2.60	248,000	7 yrs	7,400		*good exposure and productivity*
Total	**124,286**	**92,609**	**1,090**	**1,206,101**		**2,692,000**		**40,000**	**49,100**	
kWh/SF				*13.02*						

Avg. Paybacl	8 yrs	
Maximum Potential Set Aside (SF)	**89,100**	*sum of PV Set-aside and Potential Additional Set-Aside*
Imputed Productivity (kWh)	1,160,401	*Maximum Potential Set Aside * 13.02kWh*
Imputed Cost	2,589,999	

[1]Analysis by solect energy provided on following pages

[2]Additional PV set-aside available in event buildings are delivered as office buildings. If lab, limited productive roof area would remain available.