Climate Neutral Campus Energy Alternatives Report

Appendix A: Quadruple Bottom Line (QBL) Ratings Results

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Executive Summary

This appendix contains a record of the results of an exercise completed by members of SLCAG. During this exercise, members were provided some preliminary financial and technical information regarding the alternatives under consideration within the CNCEAR and asked to provide a Quadruple-Bottom-Line assessment of each. The results of that exercise are summarized in the CNCEAR report. The purpose of this Appendix is to provide additional information regarding the ratings so that SLCAG members and others who were not able to participate can understand the context of that exercise. This Appendix also provides some additional information that may be relevant to subsequent SLCAG recommendations or actions. For example, it contains information regarding the standard deviation (SD) of specific sampled responses and an averaged SD for each Alternative considered. This information may be useful in gauging the uniformity of opinions regarding each alternative and the potential difficulty in obtaining broad consensus of these qualitative QBL ratings.

Summary of the Process

Ideally, a group QBL rating session would involve one or more sessions with all participants in the same room, whereby each member could receive and study baseline information about each alternative, ask questions, voice opinions and add individual expertise and concerns, hear opposing or supplementary opinions and expertise, and finally go through a multi-step "voting" process. Unfortunately, due to many factors (the large number of alternatives and combinations of alternatives under consideration, the complexity of many of these concepts, the limited time available to Senior Staff, the difficulty in getting all SLCAG members who desired input into a common meeting room for an extended rating exercise, the deadlines imposed on the project, etc.) a more streamlined process was necessary.

The following is a brief description of the process that was used and resulted in the ratings provided in the CNCEAR:

- SLCAG members were provided with a Draft copy of the CNCEAR, which provided background information on the technologies and financial and other analyses completed as of that date (August 1, 2016).
- SLCAG members were provided with a "QBL rating packet" that provided a description of each alternative under consideration, a summary of some key metrics for each alternate, and a narrative which included some factors that staff believed may be worth considering in the rating (August 3, 2016). Generally, this information packet represented a very concise extraction from the draft CNCEAR rather than "new" information.
- The packet also included a summary of the QBL criteria (from the CNCEAR report) and "worksheets" for members to provide their own independent ratings for each. SLCAG members were asked to provide independent ratings by August 8, 2016 (to allow staff time for collating and recording) and to attend a session to review these ratings on August 9, 2016.
- Nine members were able to provide ratings in advance of that meeting. FE staff collated those ratings and used standard Excel spreadsheet tools to provide average ratings and standard

deviations (to suggest the degree of uniformity of the group in each case). FE staff also recorded all of the comments entered onto the worksheets.

- FE staff presented the preliminary results (QBL ratings, standard deviations, and comments) to SLCAG members who were able to attend in person or by web conference on August 9, 2016. At that meeting, members were also provided with new rating sheets which recorded their prior rankings and showed the group average for each ranking (72 in all; 18 alternatives x 4 rankings each to capture all four QBL factors). The worksheets also provided a space to provide a "final" ranking should members wish to change their ranking based on the discussions at the meeting.
- SLCAG members discussed the ratings, the comments, and shared additional opinions and comments in the meeting on August 9th. Some members also updated some of their rankings in response to new information or opinions presented by the group. FE also provided an opportunity for SLCAG members to provide updated rankings by email in advance of the final CNCEAR deadline (August 12th).

The "final" rankings as provided by SLCAG are included in this Appendix and summarized in the CNCEAR. These include only SLCAG rankings; FE staff involved in the facilitation process did not contribute their rankings to the final numbers.

Results of the Process

The table (2 pages) that follow summarizes the ranking results based on the nine SLCAG members who provided data. Data that is highlighted indicate those responses that had a Standard Deviation of at least 1.0, which staff considered relatively significant considering that the rating system (1 to 5) had a maximum span of only 4. Alternatives with these highlighted rankings might therefore be considered as those for which there is not strong consensus regarding the benefits or impacts in that specific rating area. It should be noted that this range of opinions is not unusual, especially considering the broad background and areas of interest and expertise represented by the SLCAG. It also suggests the even broader set of viewpoints that might be expected in an even broader community group. Nonetheless, considering the QBL rankings does help suggest which Alternatives might be more suitable for further discussion or action.

Table A-1: SLCAG Ratings Results (page one of two)

	Rating (1-5) (1= Lowest; 5=Most Favorable)				
Alternate	*Supports Cornell Mission (Purpose)*	*Supports Cornell Finances (Prosperity)*	*Supports Community Goals (People)*	*Supports Environmental Needs (Planet)*	Overall SD aver
Business as usual (BAU)					
Average	2	3.5	1.67	1.5	
Standard Deviation	1.10	1.64	0.82	0.55	1.03
Business as usual with offsets					
Average	3	1.5	2	2	
Standard Deviation	0.63	0.84	0.89	0.89	0.81
Earth Source Heat (ESH)					
Average	4.38	3.00	3.50	4.25	
Standard Deviation	0.74	1.41	1.07	0.71	0.98
B/ESH					
Average	4.78	2.33	3.33	4.33	
Standard Deviation	0.44	1.41	0.87	1.00	0.93
Biomass Combustion (BC)					
Average	3.38	3.13	2.13	2.38	
Standard Deviation	1.06	0.99	0.83	0.92	0.95
Biomass Gasification (BG)					
Average	4.11	3.33	2.22	2.56	
Standard Deviation	1.17	0.87	0.83	0.73	0.90
Air Source Heat Pumps (ASHP)					
Average	2.63	2.25	3.13	2.75	
Standard Deviation	0.74	0.46	0.64	0.46	0.58
Ground Source Heat Pumps (GSHP)					
Average	2.89	2.33	3.22	3.67	
Standard Deviation	0.93	0.71	0.83	0.87	0.83
Small Modular Nuclear Reactor (SMR)					
Average	1.67	2.22	1.78	2.89	
Standard Deviation	1.00	0.97	0.97	1.05	1.00

Table A-1: SLCAG Ratings Results (page two of two)

	Rating (1-5) (1= Lowest; 5=Most Favorable)				
Alternate	*Supports Cornell Mission (Purpose)*	*Supports Cornell Finances (Prosperity)*	*Supports Community Goals (People)*	*Supports Environmental Needs (Planet)*	Overall SD aver
Wind Power					
Average	3.89	3.11	3.11	5.00	
Standard Deviation	0.78	1.05	0.78	0.00	0.65
PV Solar Power					
Average	3.13	3.38	4.00	5.00	
Standard Deviation	1.13	1.06	0.76	0.00	0.74
Hydroelectric Power					
Average	2.78	1.88	3.00	4.56	
Standard Deviation	1.09	0.99	1.00	0.73	0.95
WWS - Electric for Entire Campus					
Average	3.67	2.56	3.89	5.00	
Standard Deviation	0.87	1.33	0.78	0.00	0.75
Aggressive ECI					
Average	3.56	4.22	4.22	4.33	
Standard Deviation	0.73	0.83	0.83	0.71	0.78
Increased Recomissioning					
Average	3.11	4.22	3.44	4.00	
Standard Deviation	0.78	0.67	0.73	0.71	0.72
Aggressive Green Design					
Average	3.56	3.11	3.56	4.44	
Standard Deviation	0.73	0.60	1.13	0.53	0.75
Electric Charging Stations					
Average	1.63	2.25	3.88	4.13	
Standard Deviation	1.06	0.71	0.64	0.64	0.76
B/ESH w/ WWS					
Average	4.67	2.78	3.22	4.56	
Standard Deviation	0.71	1.20	0.83	0.73	0.87
ASHP w/ WWS					
Average	3.11	1.44	3.33	3.89	
Standard Deviation	0.60	0.73	0.71	0.93	0.74
GSHP w/ WWS					
Average	3.67	2.33	3.56	4.22	
Standard Deviation	0.87	0.87	0.88	0.67	0.82