DOE/NREL's Research Support Facility Energy Goals and Net-Zero Energy Calculations

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October 25th, 2010

The first phase of DOE/NREL's new Research Support Facility, which opened June 2010, includes contractual commitments to deliver a Leadership in Energy Efficiency and Design (LEED) Platinum Rating, a demand side energy use intensity of 35 kBtu/ft^2 and 50% energy savings, and net-zero energy status. The second phase of RSF (RSFII), combined with the RSF parking lots and parking garages, is currently in design development phases and planned for completion in early 2012. Each of these projects incorporate contractual demand side energy use requirements, as shown in Table 1. Based on the contractual energy use requirements of each project, the RSF net zero energy goals will be met for the full RSF complex, which includes RSFI, RSFII, the RSF Visitor parking lot, and the RSF Staff Parking Garage. The RSF complex is identified below in Figure 1.

Until recently, large-scale, cost-effective NZEBs were thought to lie decades in the future. The early examples of net-zero energy buildings (NZEBs) have shown that achieving net-zero energy is technically possible, but have not necessarily focused on cost-effective, large-scale, replicable NZEBs. To address the growing energy use in the commercial building sector, an influential community of industry leaders and researchers has committed to pushing the boundaries of building performance to develop NZEBs. DOE was authorized by Congress in the Energy Independence and Security Act of 2007 to develop the Net-Zero Energy Commercial Building Initiative to support the goal of net-zero energy for all new commercial buildings by 2030. Building design professional societies also recognize the vision of NZEBs. For example:

- The ASHRAE Vision 2020 report [2] sets out requirements for developing the tools by 2020 to enable commercially viable NZEBs by 2030. ASHRAE's recent conference on NZEBs featured more than 25 posters [3] of NZEBs, some of which operate close to or at net zero. Others are in various stages of design or construction.
- The AIA 2030 Challenge [4] calls for incrementally reducing energy use, starting with a 50% reduction over existing buildings and increasing savings up to 2030, when new buildings will be carbon neutral. Some architecture firms are voluntarily committing to adopt energy-saving design targets and to implement steps toward carbon neutrality.

Policymakers also are embracing NZEBs as a key strategy for meeting energy and carbon goals. On October 5, 2009, President Obama signed an Executive Order that sets sustainability goals for federal agencies. The Order requires that all new federal facilities that enter the planning process by 2020 be designed as NZEBs [5]. The California Public Utilities Commission has an energy action plan to achieve net-zero energy for all new California residential construction by 2020 and for all new commercial construction by 2030. NZEB goals also were recently announced by the European Parliament in a March

2009 press release [6]. All European Union Member States are to ensure that all newly constructed buildings produce as much energy as they consume on site no later than December 31, 2018.

To reach a net zero energy position in a cost effective manner on a firm fixed price, all cost effective energy efficiency strategies had to be fully integrated into the design of the RSF. This includes maximizing daylighting, radiant heating and cooling with dedicated outdoor air systems, and integrating energy efficiency into the architecture of the building. To meet the energy goals at a $\$259/ft^2$ construction cost budget, unessary architectual elements were minimized. This inlcudes optimizing expensive glazing areas, minimizing complex curved surfaces, and simplifing the envelope construction process through prefabricated modular precast concrete wall panels. All energy efficiency and LEED attibutes had to be designed into the project with no additional budget.

Once all cost effective energy efficiency strategies are incorpated, PV funded through a power purchase agreement (PPA) combined with ARRA funded PV will offset all energy used by the RSF complex. Based on published net-ZEB definitions, the RSF complex (RSFI, RSFII, and RSF Parking) is expected to reach a net-zero energy position (Site NZEB:B) with PV located within the RSF Complex. The RSFI PPA PV system will be operational Fall of 2010, and all of the Sunpower ARRA funded PV systems have been purchased. The additional PV will be installed as RSF2, the visitor parking lot, and parking garage projects are completed (Winter 2011 -Spring 2012).

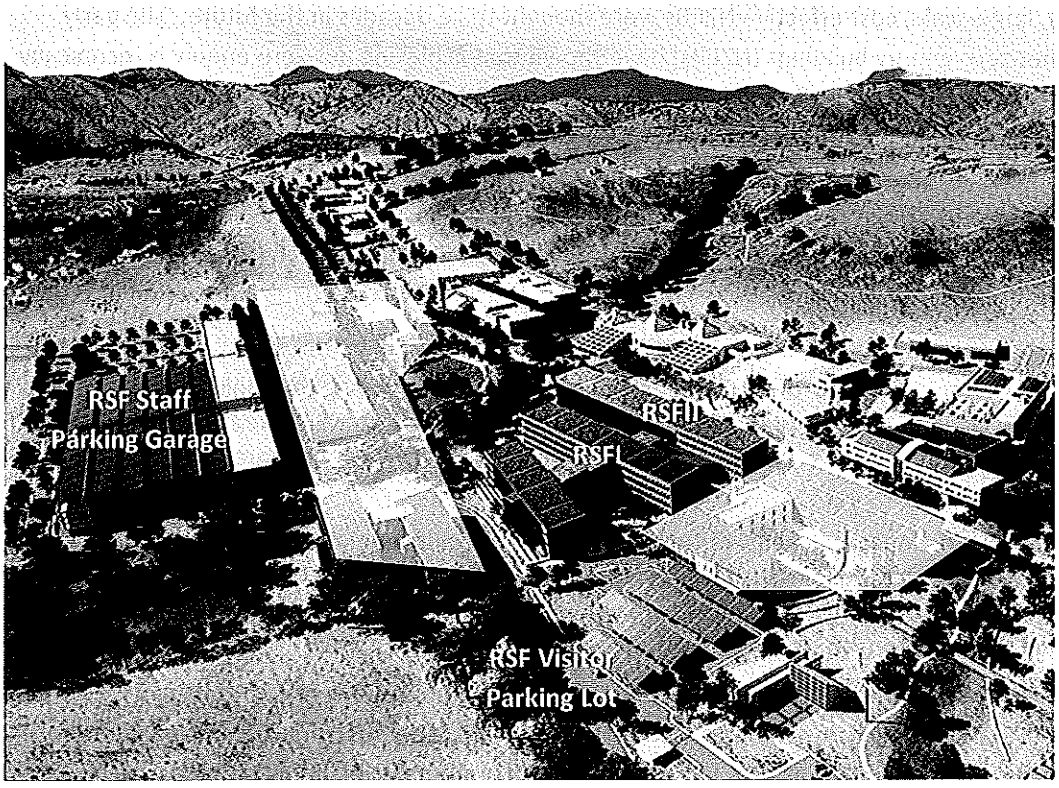

Figure 1. NREL Campus Rendering showing RSF Complex, including RSFI, RSFII, RSF Parking Garage and RSF Visitor Parking Lot. Note unfunded buildings identified in the master plan are grayed out.

Table 1. RSF Complex Energy Use and PV Production

RSF Complex	Building Area (ft^2)	Contractual Building Energy Use Requirements			PV System Size (kW)	PV Power Factor	PV Energy Generation (kWh)
		kBtu/ft^2/yr	kWh/ft^2/yr	kWh/yr			
RSFI	220,000	35.1	10.3	2,263,095	450	1,411	634,950
RSFII	136,640	25.5	7.3	1,021,340	442	1,317	582,114
RSF Staff Parking Garage				95,000	1,094	1,317	1,440,798
RSF Visitor's Parking				5,000	552	1,317	726,984
Totals				**3,375,229**	**2,538**		**3,384,846**

References

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