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Simulation and Field Evaluation Support for ESTCP Dynamic Windows

Cooperative Research and Development Final Report

CRADA Number: CRD-12-492

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Cooperative Research and Development Final Report

In accordance with Requirements set forth in Article XI.A(3) of the CRADA document, this document is the final CRADA report, including a list of Subject Inventions, to be forwarded to the Office of Science and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

Parties to the Agreement: Soladigm, Inc.

CRADA Number: CRD-12-492

CRADA Title: Simulation and Field Evaluation Support for ESTCP Dynamic Windows

Joint Work Statement Funding Table Showing DOE Commitment:

Estimated Costs	NREL Shared Resources
Year 1	$ 252,331.00
Year 2	$ 97,328.00
TOTALS	$ 349,659.00

Abstract of CRADA Work:

We will leverage new building performance and daylighting simulation tools to characterize the performance of a new electrochromic (EC) glazing as well as perform a field evaluation of the same product installed in a DoD facility. The in situ data will be used to validate and calibrate the simulation model, which will then be used to extrapolate the performance of the product across all US climate zones. The property as part of this agreement will be installed at MCAS Miramar, California.

Summary of Research Results:

The results of an annual energy simulation using the "combined rule" (planned control algorithm for commercial product) show that the View electrochromic glass resulted in a small increase in heating energy due to times when the building is in heating mode and the increased solar gain is beneficial. However, the EC glass also resulted in a decrease in cooling and fan energy that overcame the small heating energy increase, resulting in an annual whole-building energy savings of about 0.4% and an annual HVAC savings of approximately 0.6%.

The combined rule was also simulated in DOE Climate Zone 2A (representative city Houston, Texas) and 5A (representative city Chicago, Illinois). The simulations were performed using EnergyPlus, EMS controllers for the windows, and TMY2 weather input data. The results showed that the EC glass resulted in a small increase in heating energy due to times when the building is in heating mode and the increased solar gain is beneficial. However, the EC glass also resulted in a decrease in cooling and fan energy that overcame the small heating energy increase, resulting in an annual whole-building energy savings of about 8.4% and an annual HVAC savings of 18.6%.

From the occupant perspective, the View Dynamic Glass retrofit on the in situ test facility was a neutral to positive change. The primary advantage proved to be increased satisfaction with access to views. The

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primary disadvantage is general comfort with the darker tint. The latter issue was addressed through improved control algorithms in the second phase of the retrofit (May-September 2014).

The baseline/closeout survey and ongoing survey results support the following conclusions:

- Overall comfort with respect to interior lighting and thermal conditions was not significantly different before and after the retrofit.
- Satisfaction with views improved during the dynamic glass demonstration.
- The improved control algorithm that responds to exterior solar condition and interior sun penetration depth proved superior to timer-based control in terms of occupant reports of glare and overall satisfaction, but the glare simulations indicate some possible areas for improvement in the predictive control.
- Emphasis of occupant issue reporting shifted from a desire for increased views and decreased brightness in the baseline scenario to a focus on the following two issues in the post-retrofit scenario:
    - Lack of operable window control
    - Decreased brightness to the point of "gloominess".
- Recommendations for future View Dynamic Glass installations include:
    - Seek retrofit opportunities where operable windows are not already in place and where the occupants are currently not benefitting from a view due to closed blinds
    - Do not rely on dynamic glass to completely mitigate glare; pair with interior furniture layouts or other means to block midafternoon view of the sun
    - Focus on afternoon glare issues on the west façade when setting up and adjusting control system
    - Consider using view glass in only some areas in open and closed offices, maintaining some clear glass under shaded areas to prevent the gloomy appearance when all dynamic windows are tinted.

Subject Inventions Listing:

none

Report Date:

January 13, 2015

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