such a program. The CE+ team was frequently forced to simplify the way variables were defined (e.g. by defining characteristics on an annual basis rather than hourly) as well as the way interactive effects between variables were captured, in order to manage the level of effort required for preliminary analysis. Implementing a more sophisticated approach would have introduced challenges around both defining variable profiles and analyzing their effect on project outcomes.

The prototypical analysis methodology developed by the CE+ team parallels over a decade of work by the building simulation community to incorporate uncertainty and sensitivity analysis into energy modeling platforms. EnergyPlus is now capable of performing uncertainty analysis through OpenStudio (NREL 2016). However, this progress remains bounded by many of the other shortcomings detailed in this paper, chiefly the absence of non-energy considerations and an inability to perform preliminary analysis at the speed and level of detail required by the market. Future phases of the CE+ initiative will attempt to bridge this gap by working to diffuse the "optimize measures, not buildings" analysis approach into popular energy modeling platforms. This will necessarily include the development of more nuanced variables and variable profiles, similar to the Building Component Library already available in OpenStudio.

Using disclosure programs and measured data to inform future models

The CE+ initiative is committed to catalyzing the broad-scale adoption of economically-viable ECMs worldwide. Because variable profiles vary across different locations and building types, and because many variable profiles will fluctuate significantly over time (e.g. existing lighting efficacy will steadily decrease as LEDs penetrate the market), this long-term goal would traditionally entail a truly prodigious industry-wide analysis effort without a defined end date. However, two key trends stand to make our work easier:

- The recent increase in the adoption of mandatory energy use disclosure programs is presenting analysts with more real-world data than ever before. Over 20 U.S. cities have now mandated such a program (Gulbinas 2016).

- The advent of EM&V 2.0 can provide the detailed real-time data necessary to "offer new opportunities for understanding and engaging customers… [and] help shorten evaluation timelines". The recent passage of AB 802 in

California implies a reliance on EM&V 2.0 technologies[6] (Oster 2015), and the adoption of these technologies is expected to continue to grow in the near future (Rogers et al. 2015).

Assuming that this influx of measured data is made sufficiently detailed, accurate, and available, future iterations of the CE+ methodology will no longer need to depend upon theoretical models, academic research, and industry outreach to develop variable profiles. Instead, Bayesian updating can be harnessed to develop profiles using real data from real buildings with well-understood properties, and to make those variable profiles as dynamic as the buildings they correspond to.

CONCLUSION

RMI's CE+ initiative presents an alternative methodology for evaluating energy efficiency projects focused on increasing the adoption rate of easily-customized, broadly-applicable, high-return ECMs in the commercial market. Measures are selected and analyzed in depth before project initiation. By optimizing measures and comparing them against a large portfolio of buildings, rather than optimizing the buildings themselves, the CE+ approach provides decision makers with a compelling argument to retrofit their building without access to a complete data set.

Propagating this methodology, and the "foot in the door" mentality it represents, within the energy efficiency industry has the potential to drastically increase project initiation rates and diminish the existing investor bias against energy efficiency projects. However, future iterations of the CE+ framework must be developed hand-in-hand with the building simulation community and EM&V 2.0 practitioners in order to ensure that analysis inputs are sufficiently nuanced and that they continue to accurately reflect an ever-evolving building stock. Only by combining these efforts can we ensure an offering capable of transforming the built environment.

ACKNOWLEDGEMENTS

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