



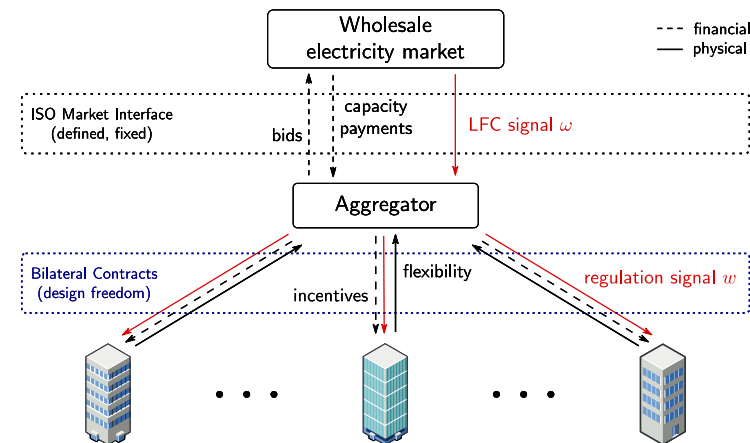
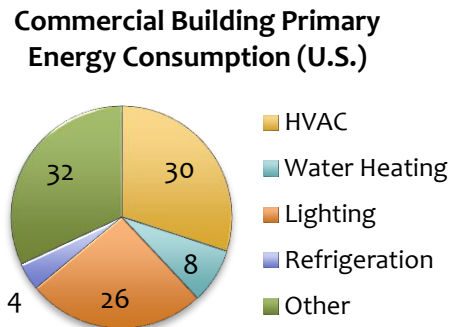
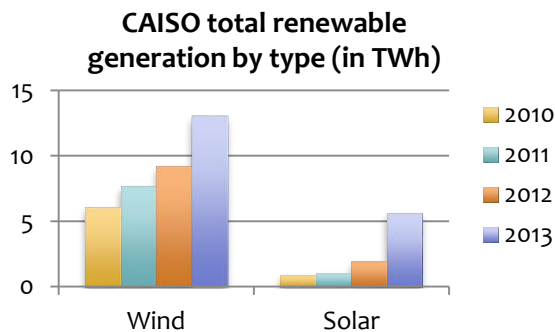
# Frequency Regulation by Aggregations of Buildings

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# Background & Motivation

- \* Renewable energy sources increase supply uncertainty
- \* Consumption flexibility in buildings can be pooled by an aggregator to provide Ancillary Services (AS) to the grid
- \* Incentives are necessary for buildings to participate



- \* **Contribution:** Fuse robust scheduling, chance constrained programming and optimal contract design problem

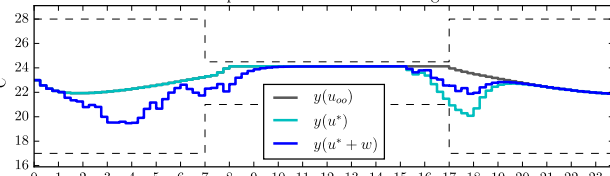
# Results & Current Work

- \* Contract design as a bilevel optimization problem:

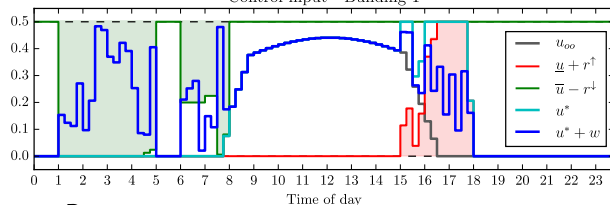
Building	Aggregator
<p><b>Minimize (energy cost – reward) subject to</b></p> <ul style="list-style-type: none"> <li>• building thermal dynamics</li> <li>• actuator constraints</li> <li>• comfort constraints</li> </ul>	<p><b>Maximize (market revenue – rewards) subject to</b></p> <ul style="list-style-type: none"> <li>• buildings' optimal behavior</li> <li>• individual rationality constraints</li> </ul>

- \* Formulation as a Mixed Integer program (LP for first-best contract)
- \* Ongoing: Implementation on Sutardja Dai Hall

Temperature evolution - Building 1



Control input - Building 1



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Allocation of regulation capacities between buildings

