Characterizing Energy Flexibility as a Dynamic Function for Buildings and Districts

Rune Grønborg Junker

- Why do we need Energy Flexibility?
- How to characterize and label it?

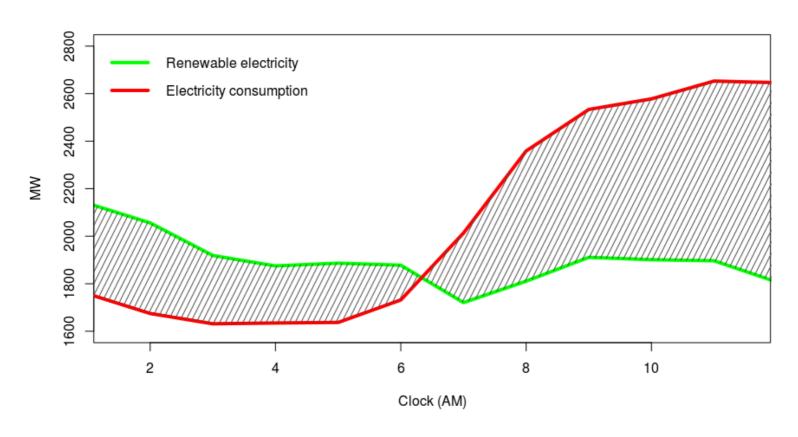








Why Energy Flexibility?



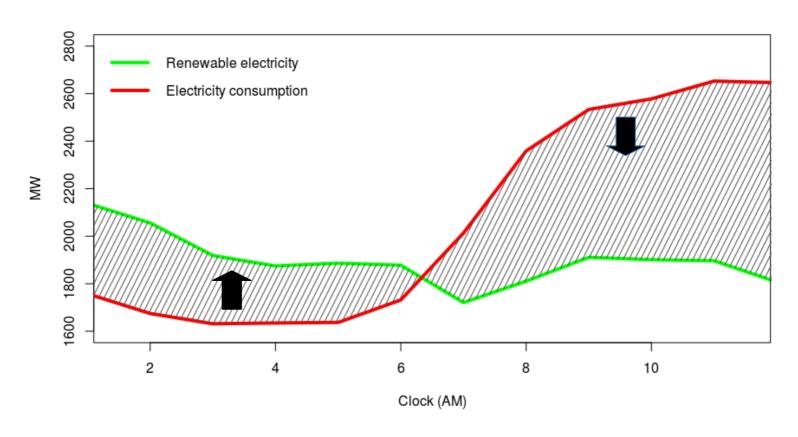








Why Energy Flexibility?



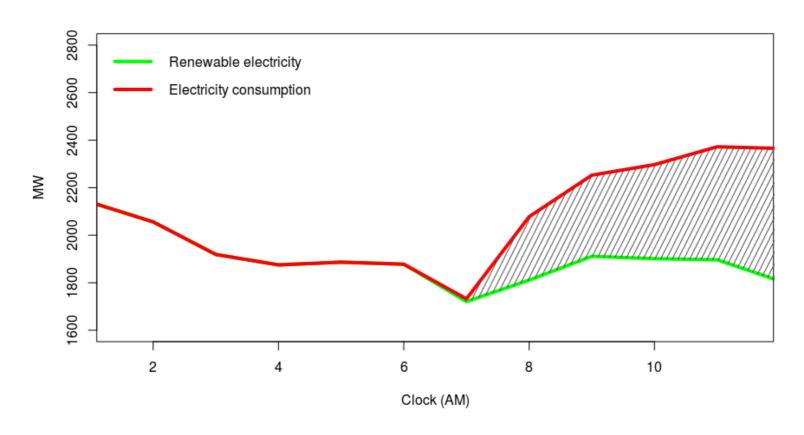








Why Energy Flexibility?

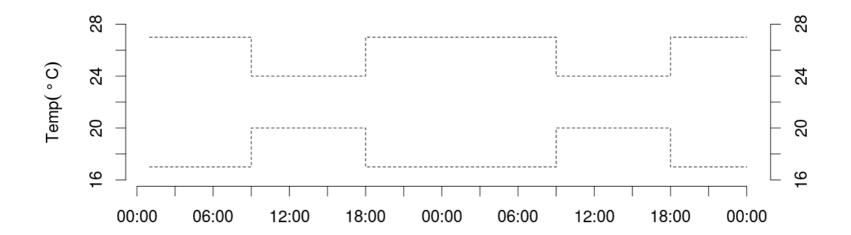










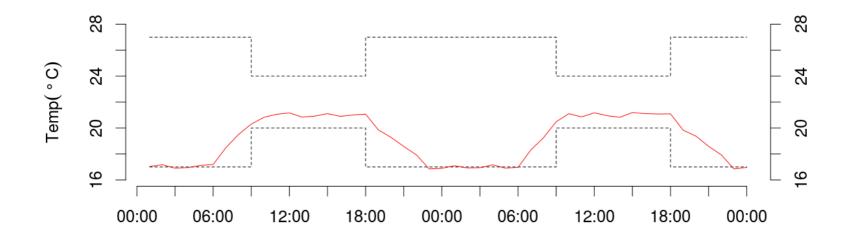










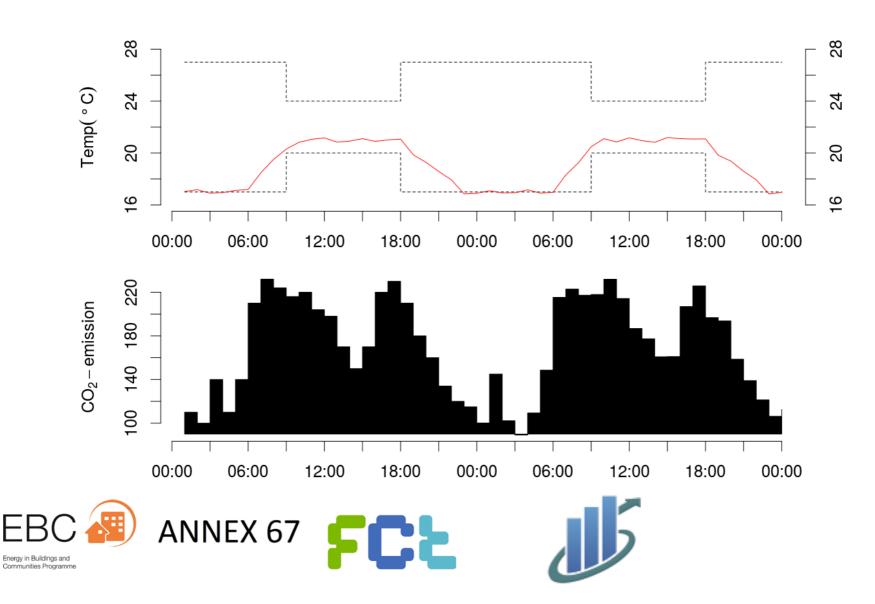


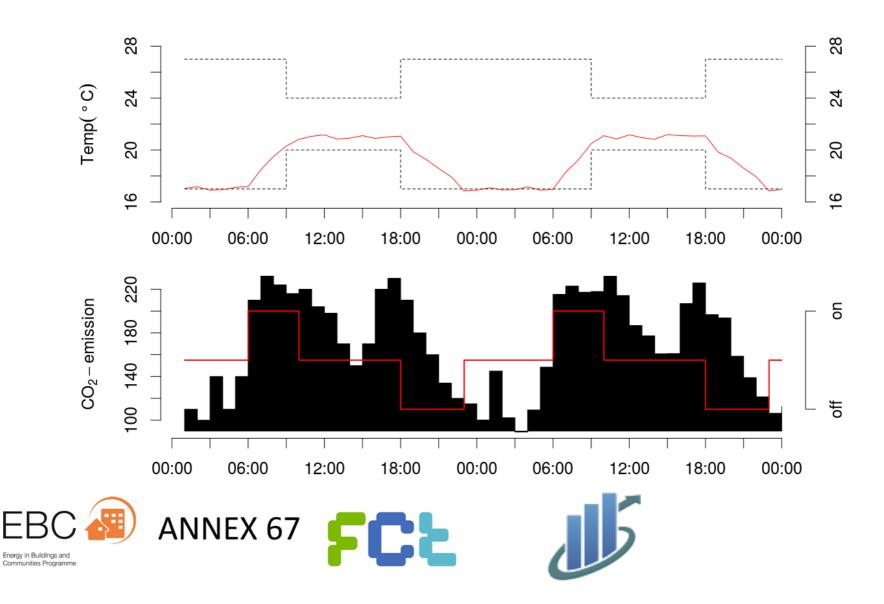


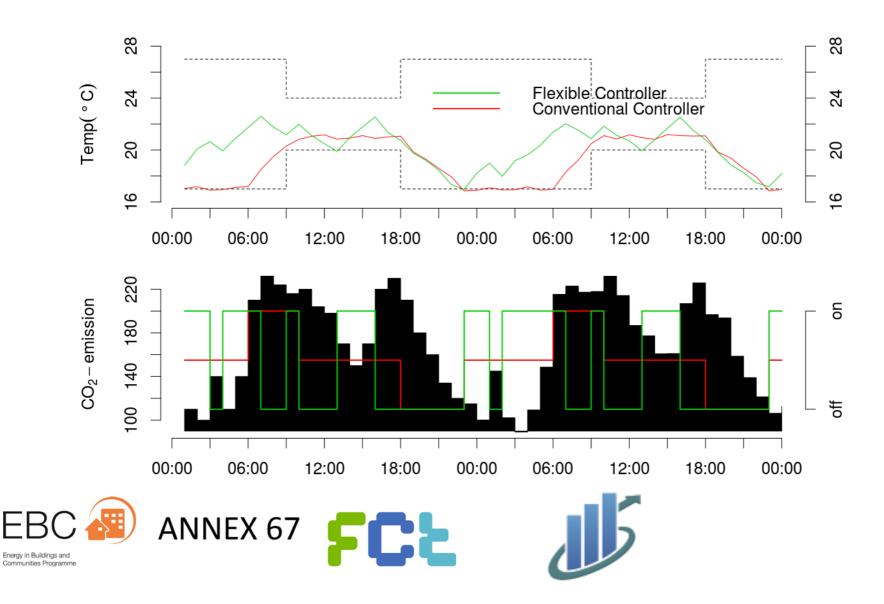


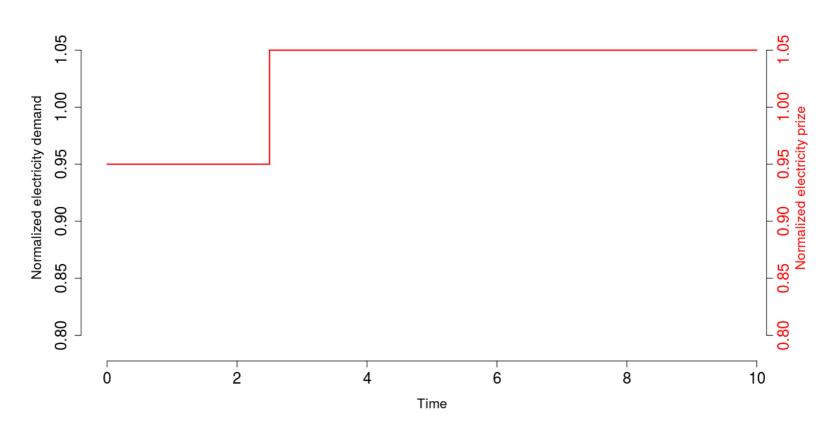










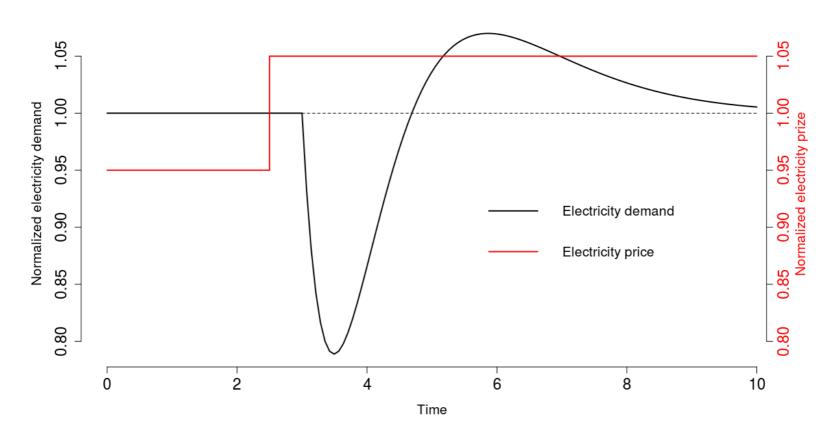










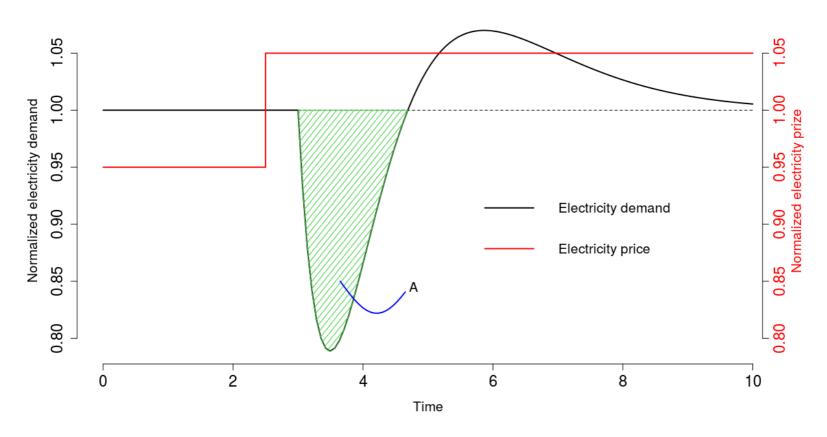










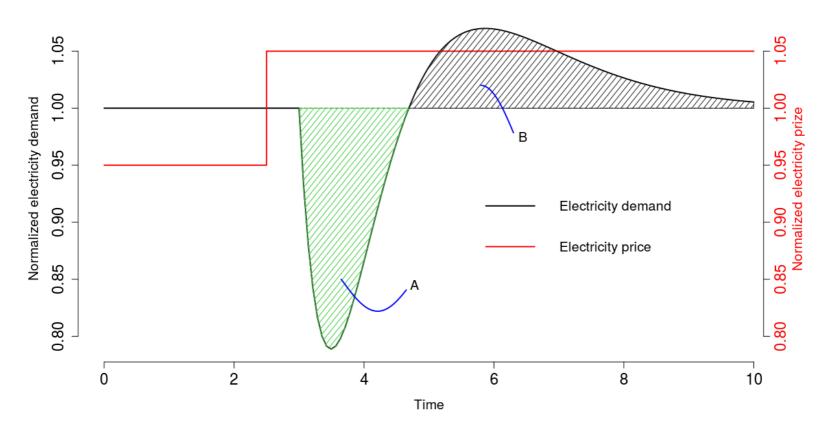










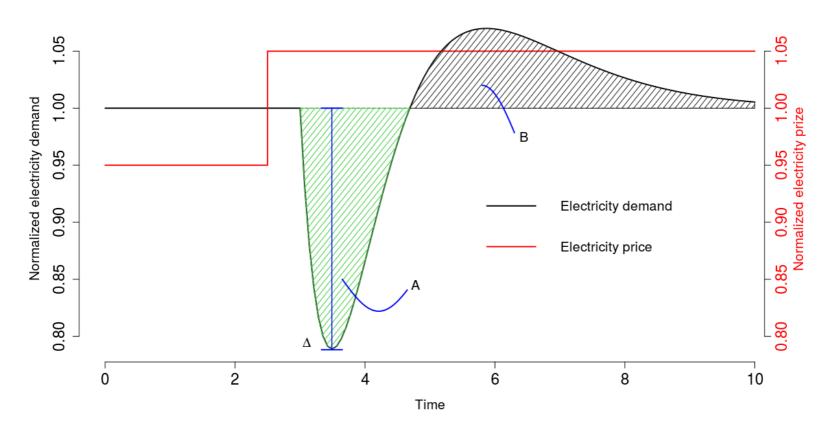










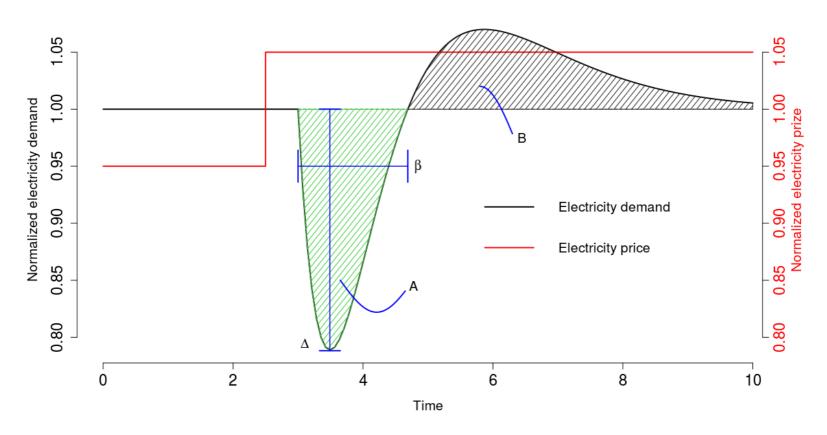










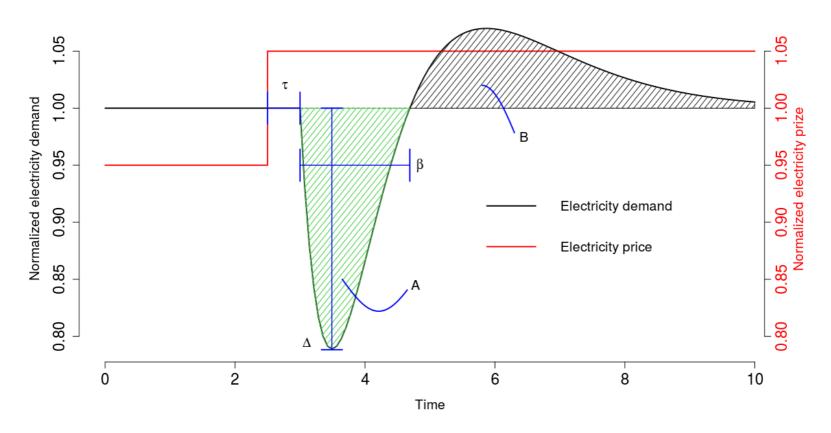










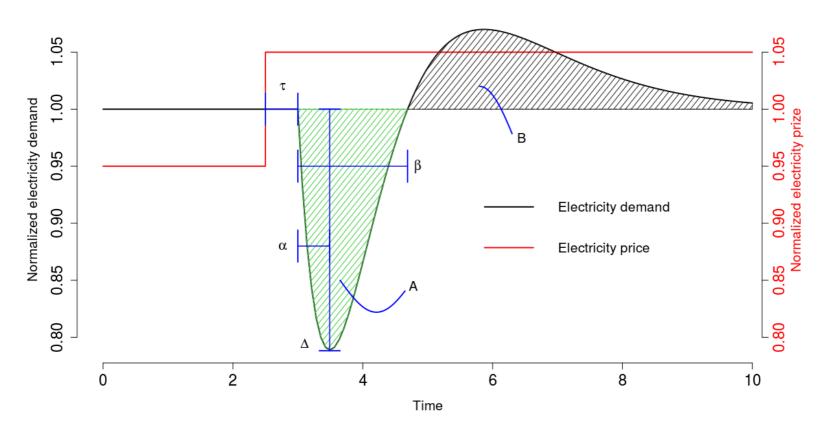












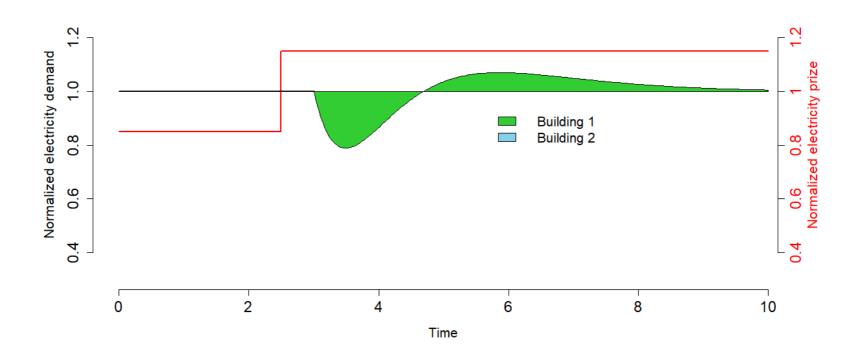








Districts of Buildings

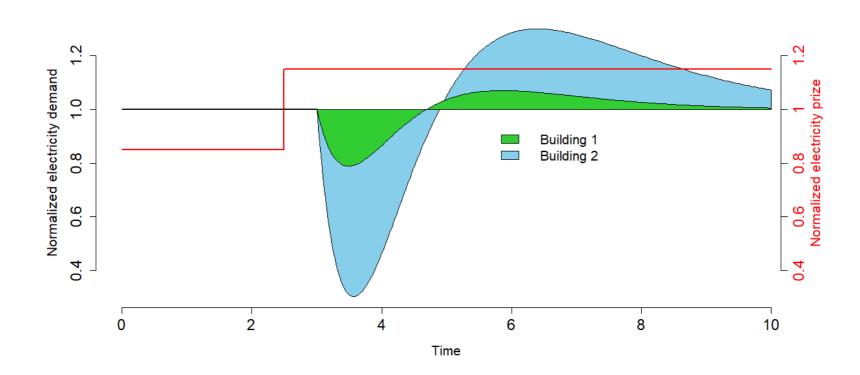










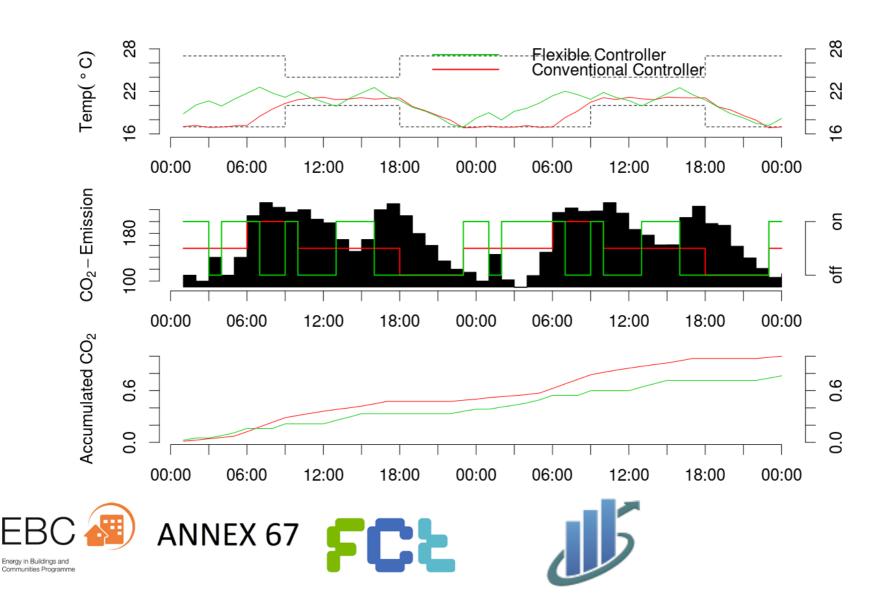


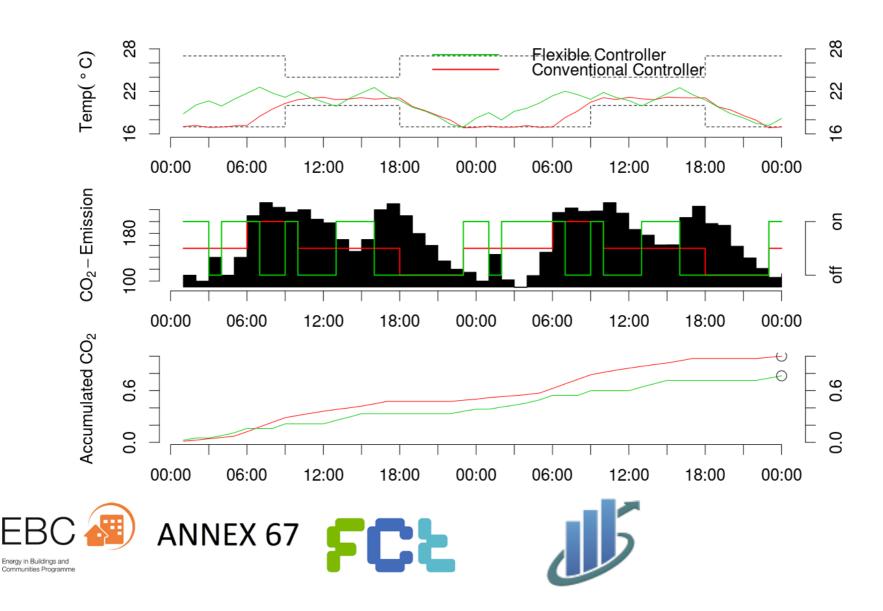


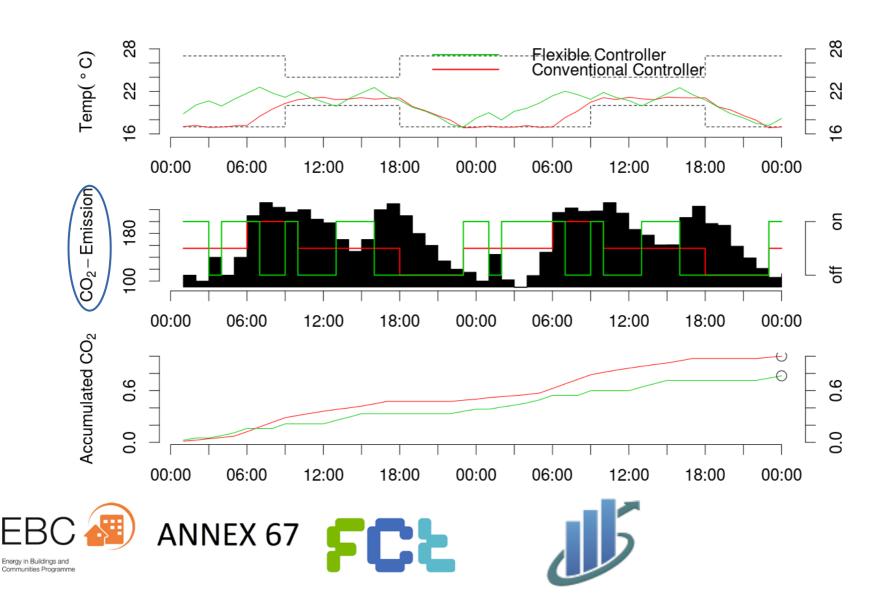


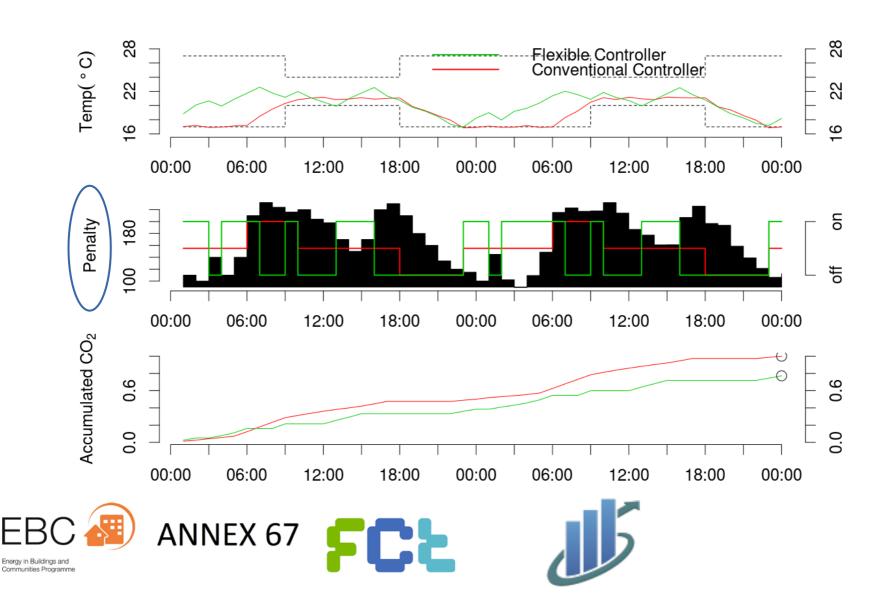












• Let λ_t be the penalty at time t.







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• Simulate the control of the building without considering the penalty, and let u_t^\bullet be the electricity consumption at time t.

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- Simulate the control of the building without considering the penalty, and let u_t^\bullet be the electricity consumption at time t. Simulate the control of the building without considering the
- penalty, and let u^1 be the electricity consumption at time t. The total operation cost of the
- penalty-ignorant control is given by: $C^{\bullet} \sum_{t=0}^{\infty} \lambda_t u_t^{\bullet}$







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• The total operation cost of the penalty-ignorant control is given by: $C^{\bullet} = \sum_{k=0}^{N} \lambda_k u_t^{\bullet}$

• Similarly the operation cost of the penalty-aware control is given by:

$$C^1 - \sum_{t=0}^{t=0} \lambda_t u_t^1$$







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- The total operation cost of the penalty-ignorant control is given by: $C^{\bullet} = \sum_{t=0}^{N} \lambda_t u_t^{\bullet}$
- Similarly the operation cost of the penalty-aware control is given by: $\sum_{t=0}^{N} \sum_{t=0}^{N} x^{t}$
- The fractional reduction is the result: $C^1 \sum \lambda_t u_t^1$

$$1 - \frac{\overset{t-\bullet}{C}^1}{C}$$





