# Residential demand response

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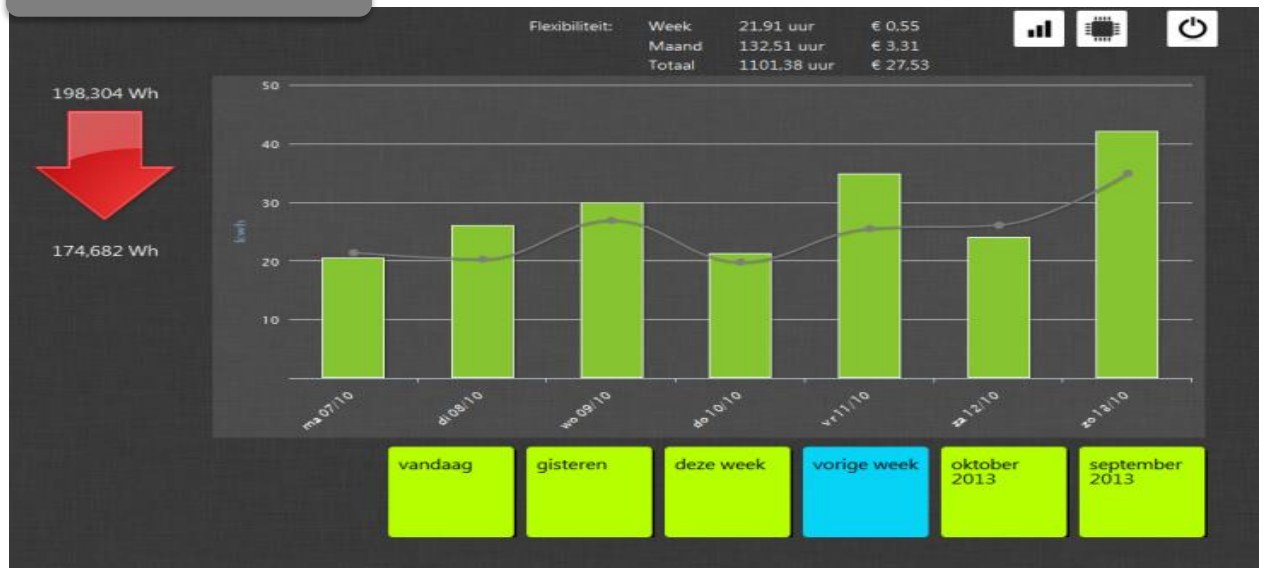
# The Linear project: end in 2015 but still relevant


**Recruiting demand response pilot participants requires incentives**

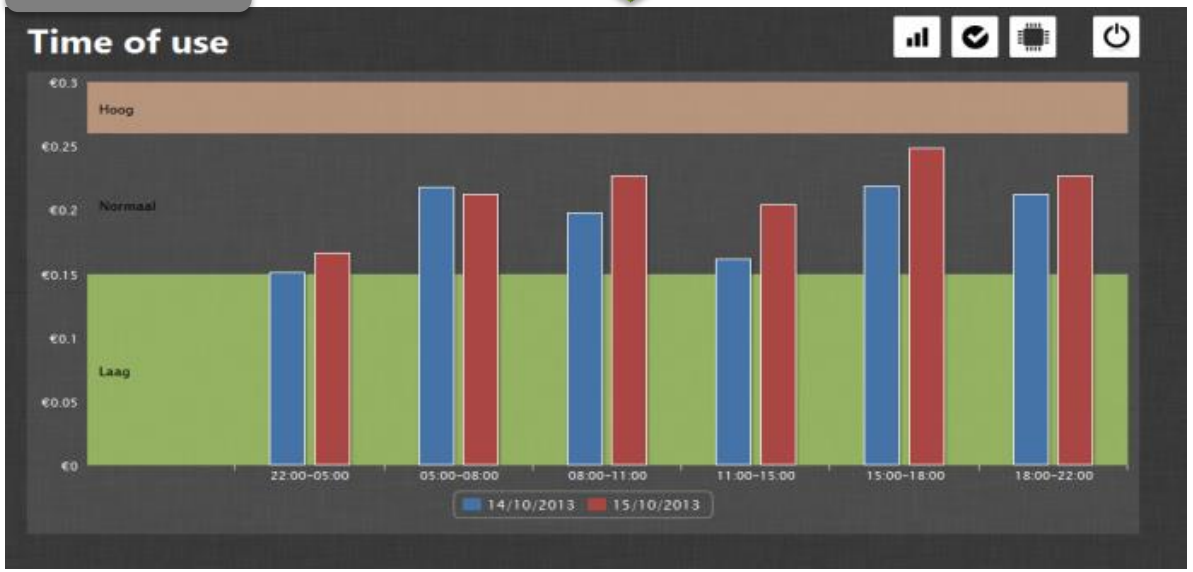
# The user interaction

2 groups of families
Smart Start ⇔ Time of Use

Smart Start




tariff



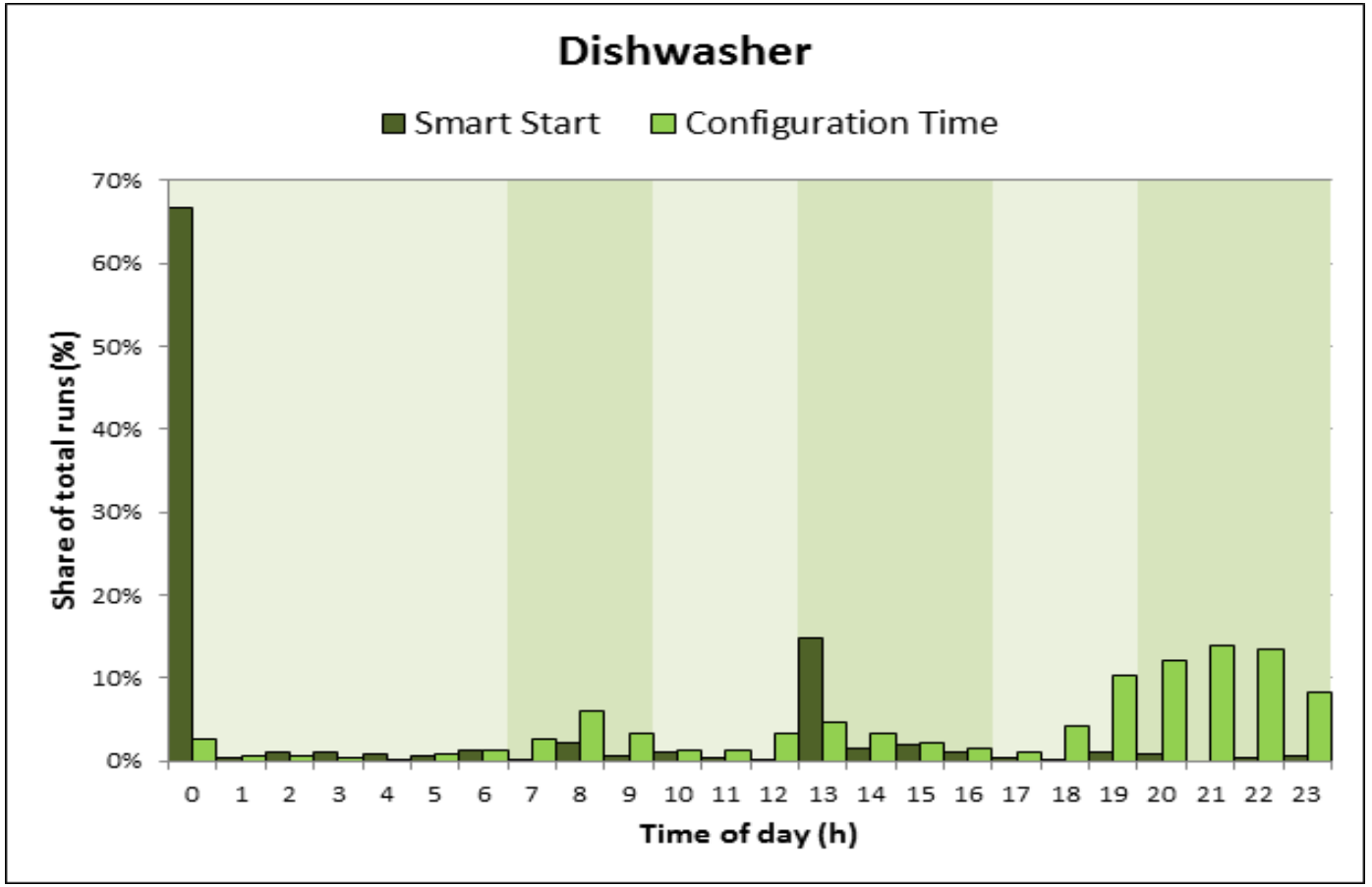

- **Manual Demand Response suffered from ‘user fatigue’**
- **Automatic demand response … works!**
- **COMFORT is key**

# Possible savings in an advanced tariff scenario

| | Profit (%) | Standard deviation (%) |
|---|---|---|
| **Dishwashers** | 18% | 19% |
| **Tumble Dryers** | 9% | 20% |
| **Washing Machines** | 11% | 19% |
| **DHW buffer 1** | 9% | / |
| **DHW buffer 2** | 5% | / |
| **DHW buffer 3** | 2% | / |
| **DHW buffer 4** | 2% | / |

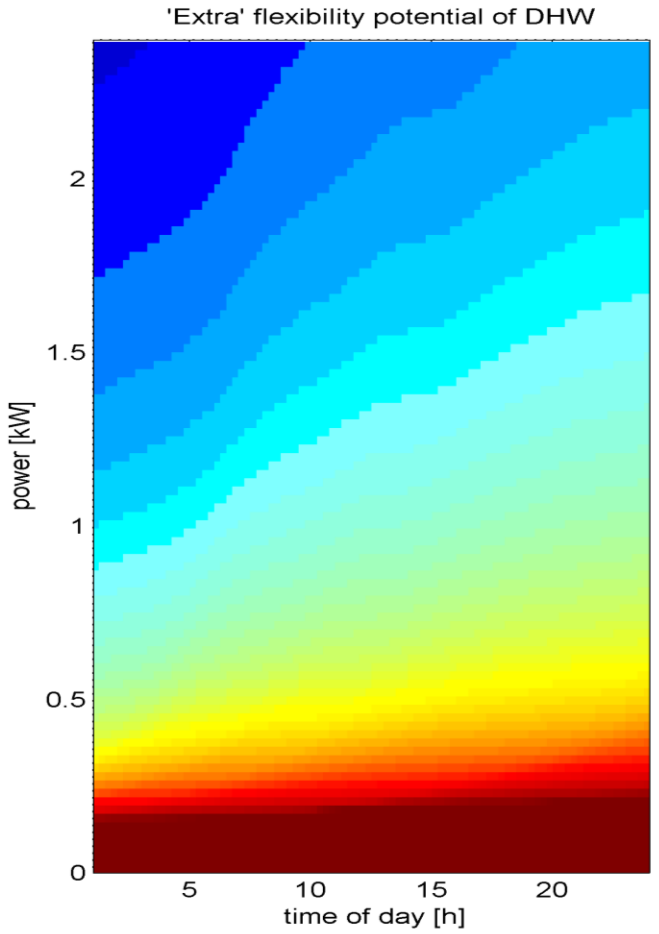
- **Significant savings are possible, depending on the device**
- **Hot water buffers are the most interesting**

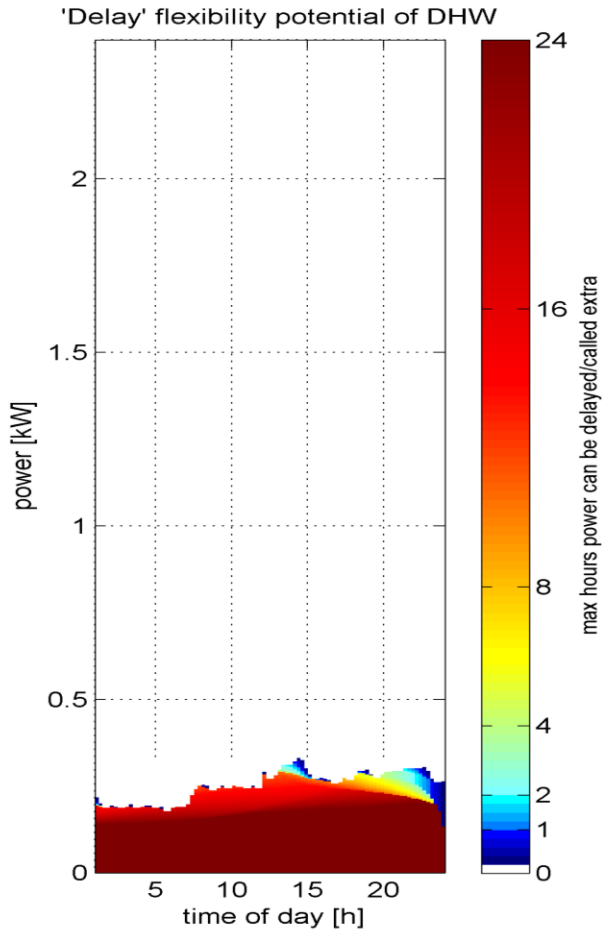
# Appliance performance: WetGoods




**Residential demand response, problem or solution for the grid?**

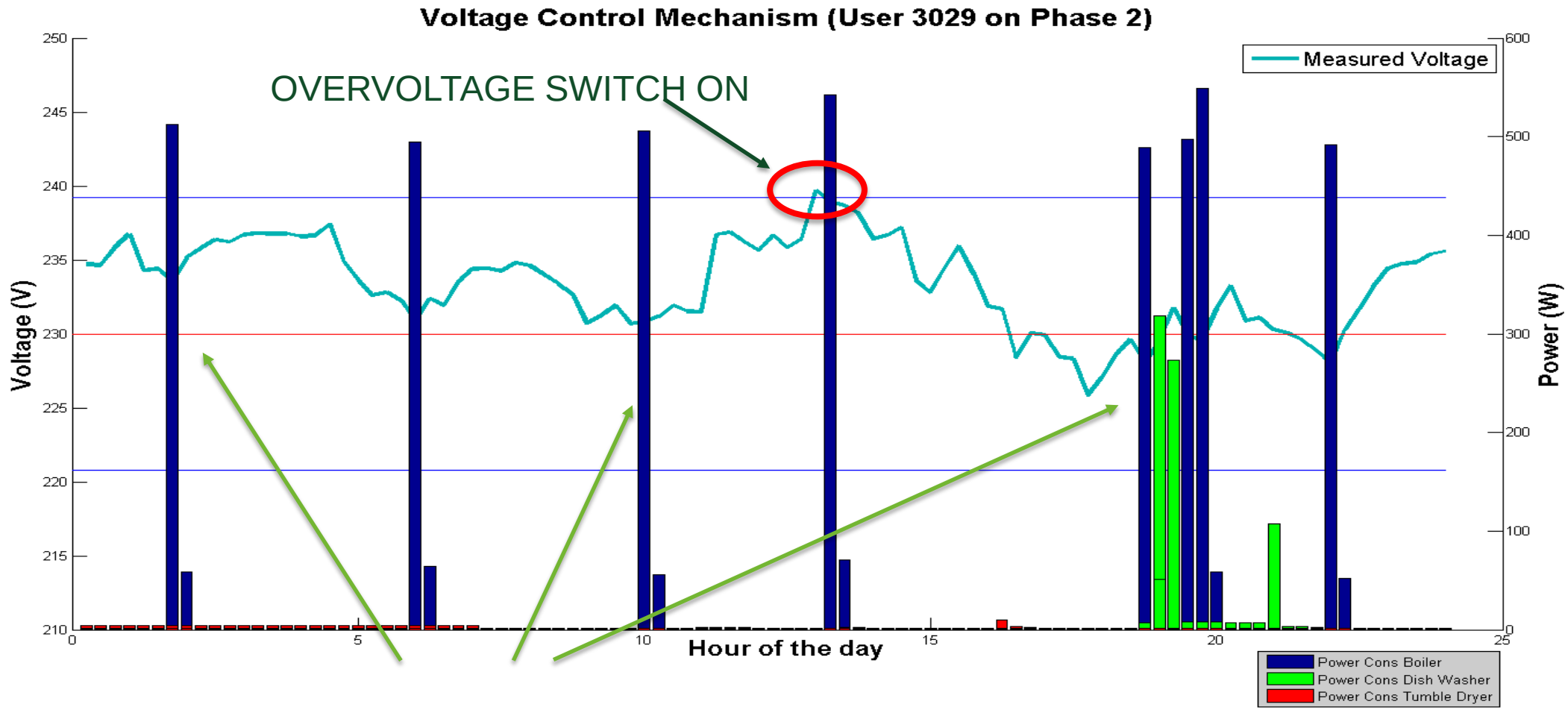
# Smart Domestic Hot Water buffer


- **Flexibility is ‘asymmetric’, increasing consumption is easier than delaying**
- **Response of residential demand flexibility can be very fast**

# Voltage control with demand response: boiler switch on

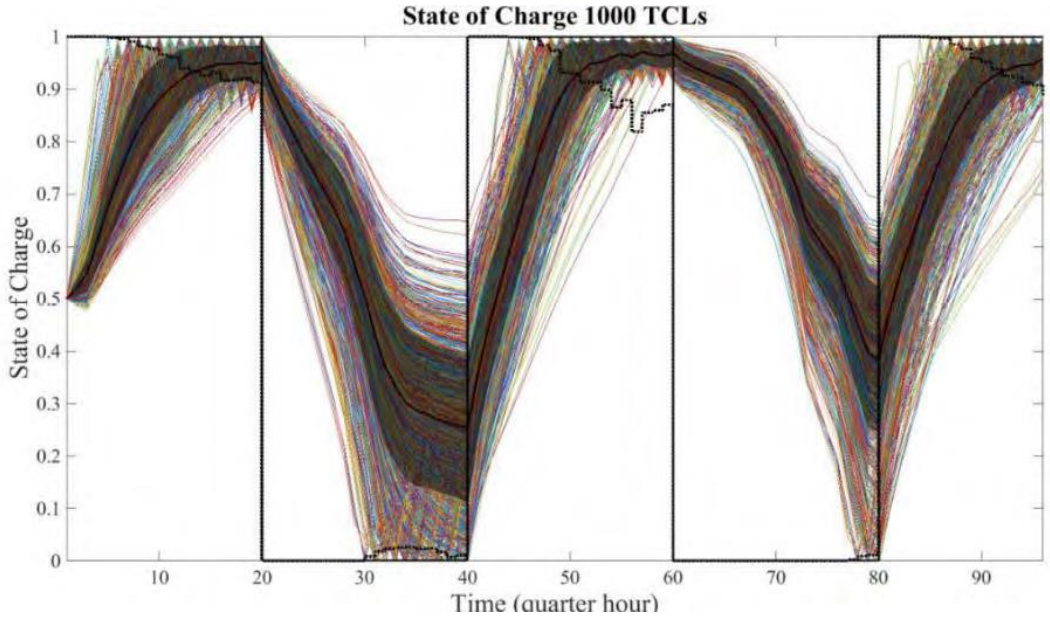



- **Effects are measurable but… limited and feeder-dependent**
- **Grid upgrades are cost effective in comparison to smart LV grid control**

# Technical challenges: cost of communication

# NEXT STEPS 1: Start-Up ‘Thermovault’

- Tracer model developed for cluster control of Thermostatically Controlled Loads
- Aggregate optimize and dispatch approach
- Field trial on student dorm room fridges

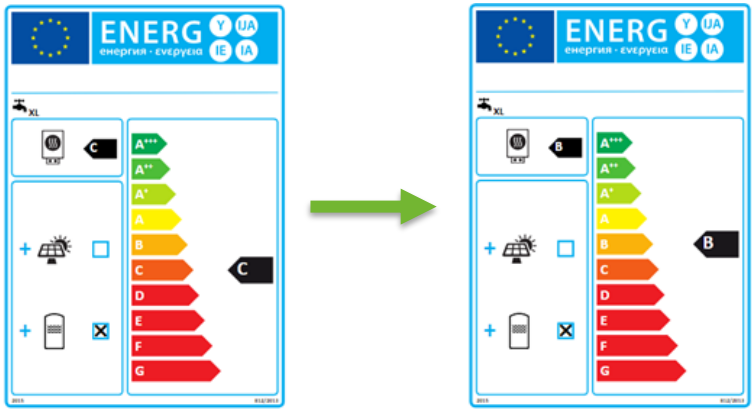




- S. Iacovella, F. Ruelens, P. Vingerhoets, B. Claessens, G. Deconinck, "Cluster Control of Heterogeneous Thermostatically Controlled Loads Using Tracer Devices," IEEE Trans. on Smart Grid, Vol. 8, Iss. 2, Mar. 2017, pp. 528-536.
- Sandro Iacovella(Dec. 2016): Demand Response of Clusters of Residential Appliances Using Reduced-Order Models -Bridging the Gap Between Theory and Deployment,PhD dissertation KU Leuven (sup: G. Deconinck)

# NEXT STEPS 1: Start-Up ‘Thermovault’

- Quantified energy savings according to EU Ecodesign regulation 12.5% - 28.8%




- Providing 1MW of distributed storage for grid balancing in their first 9 months

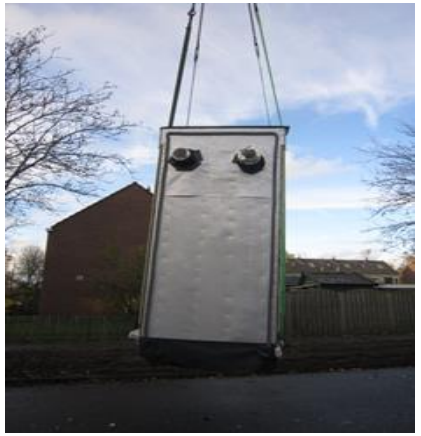
# NEXT STEPS 2: Bigger loads and cross-energy storage

## The Rennovates project

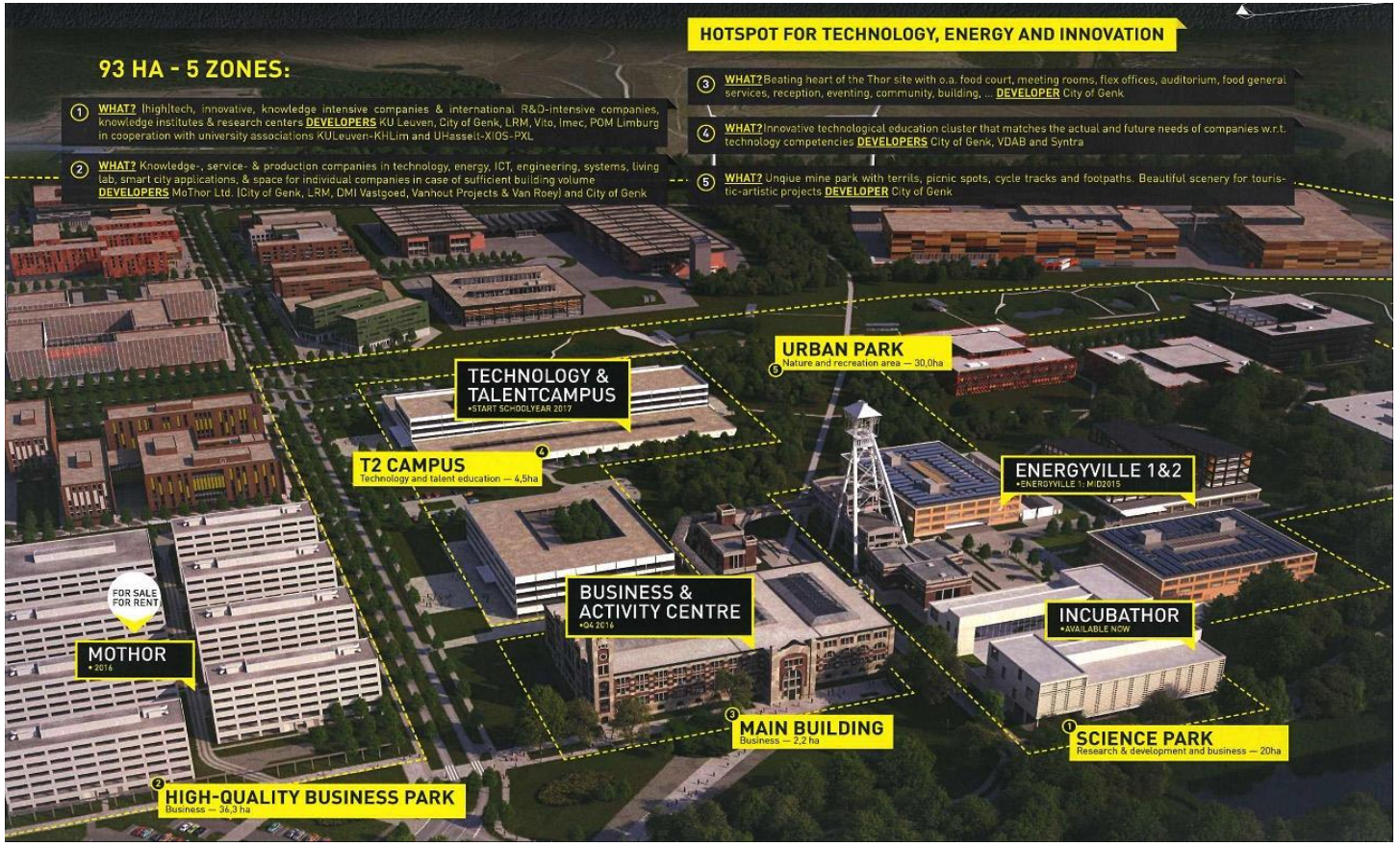
https://rennovates.eu/

Residential dwelling refurbishment:

- Add shell around house (in 7 days)
- Add energy box (HP, hot water storage, battery)
- Add PV



# Next steps 3: the Thor Park




- **Living lab environment**
- **Renewable energy generation**
- **Cross-technology research**
- **Integrate research, enterpreneurship and education**
- **ICT platform to test innovative market concepts**
- **Energy-neutral zone**
- **Regulation-free zone**

- **Regulation free zones as test bed for future technologies and user interaction**

## Conclusions

- User comfort is key for residential demand response
- Large sources of flexibility (heat pumps, batteries, …) will add to the benefits
- Residential demand response can be both solution and problem for the local grid

## Next steps

- Tracer algorithms to manage a large number of appliances
- Cross-energy vector research in large-scale Rennovates demonstration
- EnergyVille Thor campus: Living lab environment

# Thank you!

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