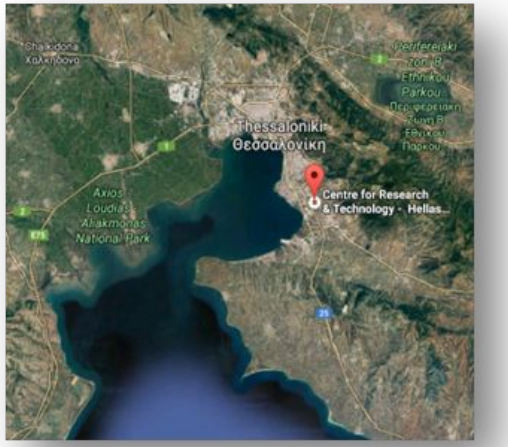

# Upgrading building smartness – from perceived potential to management of upgraded buildings

# CERTH / Information Technologies Institute

- Founded in 1998 as a non-profit organisation. Part of CERTH since 2000.
- Leading Institution of Greece in the fields of Informatics, Telematics and Telecommunications, etc.
- Personnel (~350 employees): **9 Senior Researchers, 60 Post docs, 80 MSc, 200 Assoc. Researchers**
- CERTH-ITI is currently involved in more than
  - **130 Horizon2020** EC co-funded Research Projects
  - **50 Research/Innovate** National R&D Projects
- Around **12 M€ funding per year** during the last 3 years
- Publication record:
  - 300 journals, 650 conferences, 100 books and book chapters, 6.500 citations




CERTH is listed among **TOP-20 E.U. institutions** with the highest participation in competitive research grants

# Experience in the field of IoT and smart building energy management

## IoT Platforms & Interoperability

- Integrated **IoT sensors & actuators**
- **Interoperability** among different IoT platforms
- **IoT for assisted living and eHealth** (Big IoT pilots, EU-brazil IoT)

## Energy/IOT

- **Individual** and **Group** "energy **behavior**" analytics of buildings
- **Simulations** of building **energy consumption**, user **profiling**
- **Secure and Verifiable Active Demand Response** programs
- **Behavioral change techniques** for energy saving

## Security &Trust

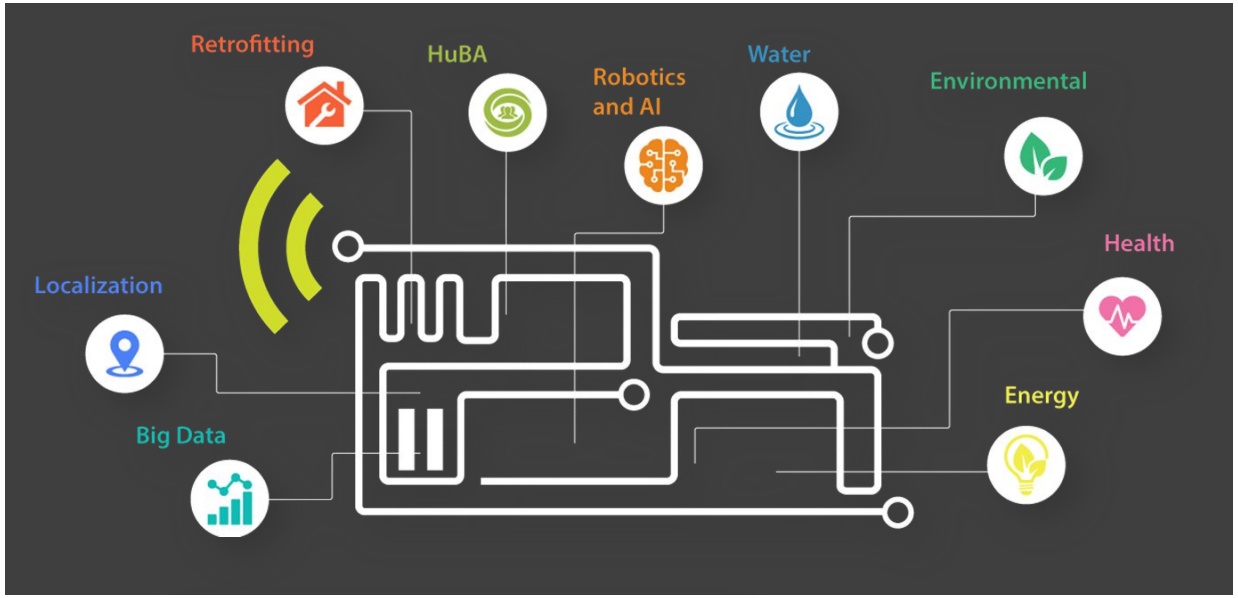
- **Blockchain** & **smart contracts**
- **Cyber-physical security** & **privacy**
- **Mobile network security**
- **Surveillance** & **Drones**
- **Biometrics**

Secure and Trusted Paradigm for Interoperable eHealth Services

# Experience in the field of IoT and smart building energy management

## ITI nZEB Smart Home ecosystem

A rapid prototyping & novel technologies demonstration infrastructure resembling a real domestic building where occupants can experience actual living scenarios while exploring various innovating smart IoT-based technologies. The first Smart near-Zero Energy Building in Greece.



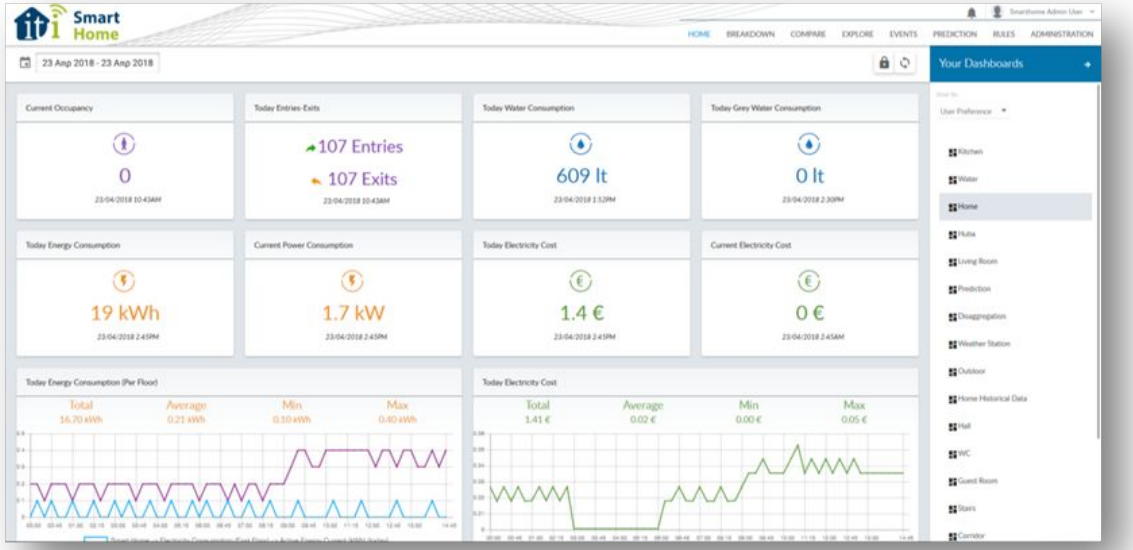

10kWp Thin Film PVs

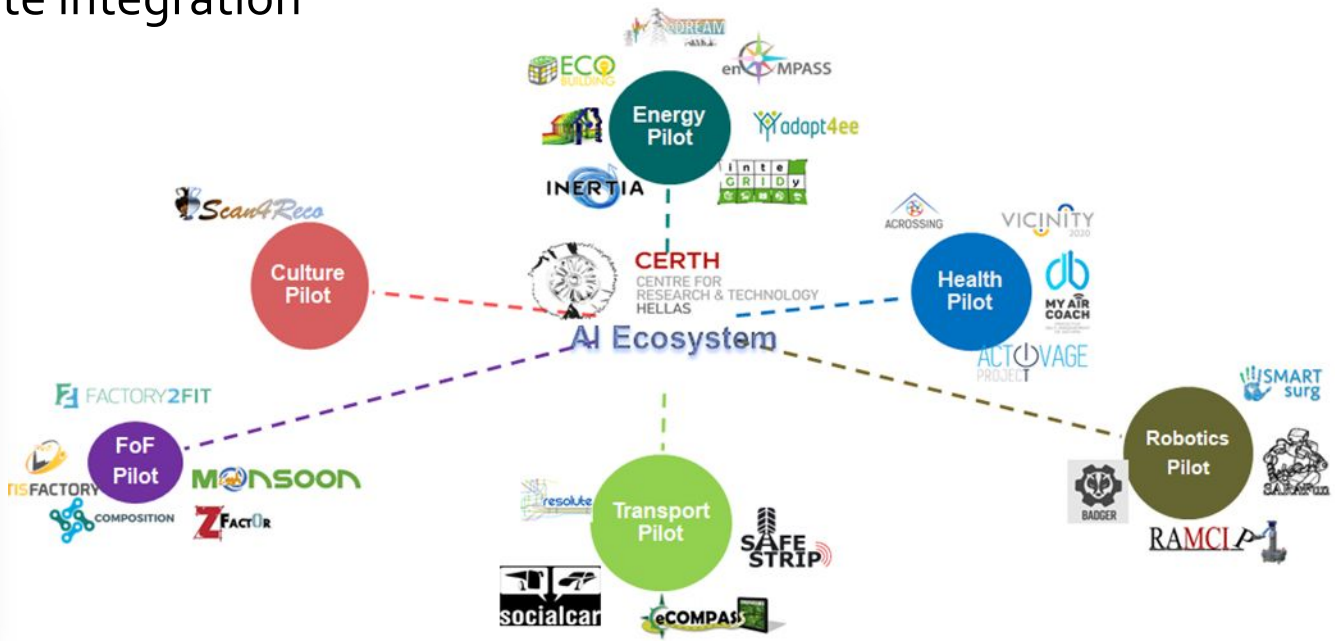
~5kWh Lion Batteries

# Experience in the field of IoT and smart building energy management

## Holistic Building Energy Management :

- Complete monitoring & control of electrical assets
- Integration with Smart Appliances (washing machine, HVAC, fridge, oven, dishwasher, drier)
- Economic Analysis of Energy Use
- Energy Consumption & Generation Prediction/Forecasting
- Energy Consumption Disaggregation
- Voice Activated Intelligent Agent for HMI Interaction
- Occupant-based Building Automation
- Islanding capability through PV and ESS complete integration

# Commercial vs residential demand response

## Commercial

- Currently dominates DR deployments
- Involves hundreds of large prosumers
- More cost-effective going after fewer large clients
- Clear profit motive
- Energy management systems are usually already in place and technically savvy personnel is available
- Protocols are few so interoperability is easier to implement
- Mature, “low hanging” fruit

## Residential

- Some DR aggregators push towards residential DR
- Involves millions of small prosumers
- Has yet to prove if it works
- Installation of required equipment not cost effective for end-user
- Many protocols, too many low consumption devices = difficult interoperability
- The proliferation of in-home energy saving devices are considered to “deliver” in the long-term
- Longer-term contracts = more secure business
- Grows faster than C&I DR in USA*

*Navigant research 2016

## Future

- Smart metering is underway
- Platforms allow interoperability of heterogeneous protocols and devices in the “home” domain
- 20% or more energy savings can be accomplished when energy use is tracked by residents
- In 2015, households in the European Union accounted for 25% of final energy consumption*

- EPRI found back in 2009 that over the coming decades DR to be evenly split between sectors

*http://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20170328-1

# DR potential of building vs. actual available load for commercial DR


- Up to 2013 Europe was almost shut to Demand response
- Slow progress: Retailers already offer price-based demand response programs in small scale, while aggregators are mostly active in incentive-based DR with mainly industrial customers.

- There is huge potential for DR services: Residential and tertiary buildings = 44% of final consumption in Europe

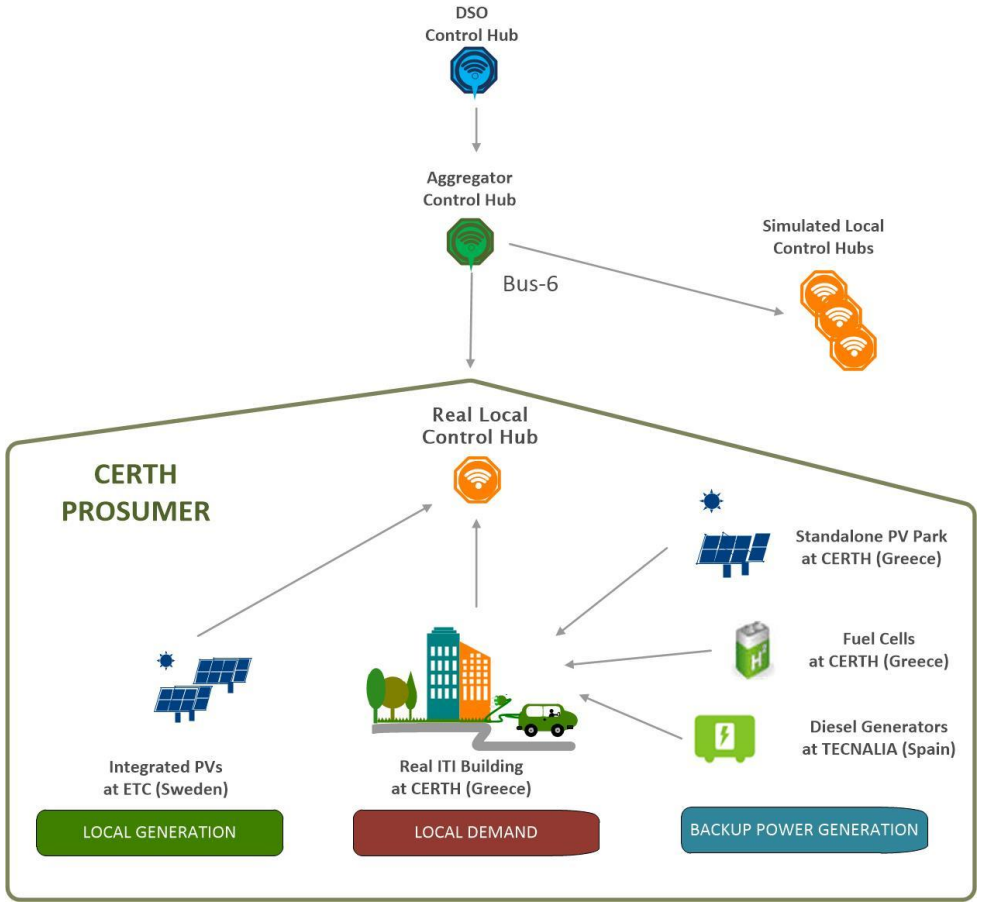
- Actual DR flexibility loads are very limited due to:
  - Technological barriers
    - Smart metering is prerequisite (underway but slow/progress and regulations differ across EU)
    - Direct, automated communication between energy actors and buildings required but there is extreme fragmentation in data models, protocols and standards in BEMS and B2G communications + support for legacy devices -> high cost
  - Consumer-related barriers
    - Obtrusiveness and risk aversion
    - Lack of trust (<30%) towards retailers
    - Lack of incentives


Source: Memoori Smart Building Research, 2016-2020

# Exploiting the DR potential of buildings – CERTH/ITI experience (past)

**INERTIA Project (FP7 2012-2015)**

- Demonstrated in a tertiary prosumer (CERTH Premises –offices building with local generation) in Thessaloniki, Greece
- More than 50 end-users participated in active-DR program
  - Controllable loads (e.g. HVAC, lighting, printers, home appliances) integrated with BEMS
  - DR signals dispatched from an "aggregator" based on building profiling and user comfort levels
- Achieved energy reduction:
  - Around 18% in comfort mode (no user disturbance)
  - Up to 38% in energy-efficiency mode (respecting comfort limits)
- End-users Feedback after 3-months pilot realisation (TRL 7)
  - Acceptance >75%
  - In comfort mode up to 95%
- User engagement:
  - passive through automation
  - system fully integrated to the building's assets




*For more info: http://www.inertia-project.eu/inertia/evaluation/results.html*

# Exploiting the DR potential of buildings – CERTH/ITI experience (present)

**Integridy Project (IA 01/2017 to 12/2020)**

Integration of innovative technologies in a Cross-Functional Platform to connect existing energy networks with diverse stakeholders

30 partners, 10 pilots

**Technologies**

- Fast EV charging facilities
- Energy storage
- VES
- Photovoltaics
- Thermal storage
- MV/LV automation
- Combined Heat-Power
- Microgrids

**Services**

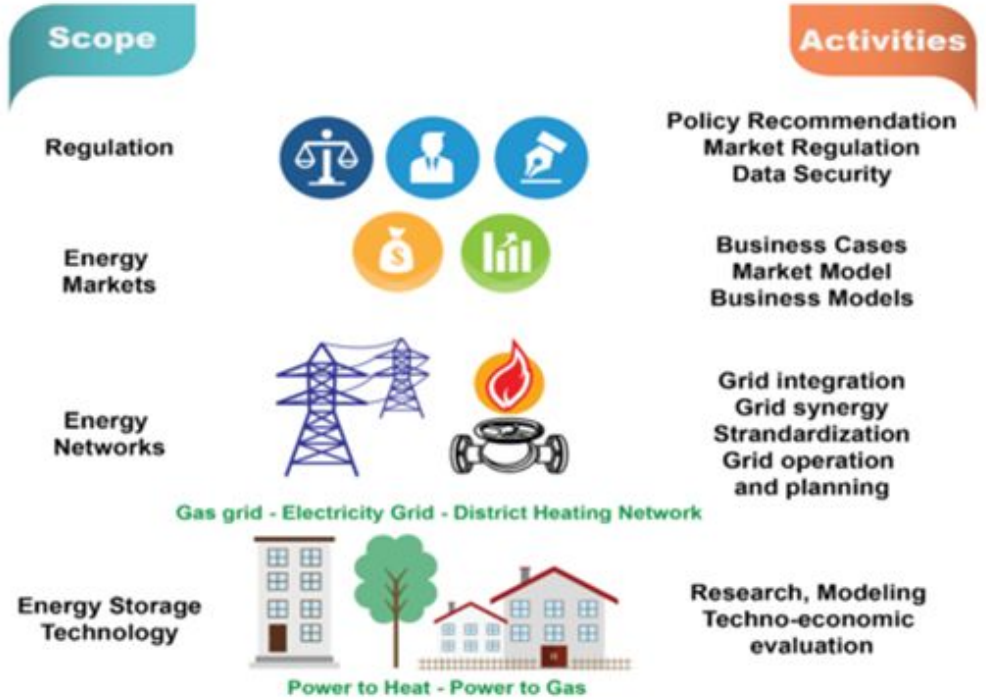
- Demand side response (residential, tertiary)
- Self-consumption
- Islanding
- Grid balancing
- Simulation (power flow)
- Monitoring
- Topology optimization

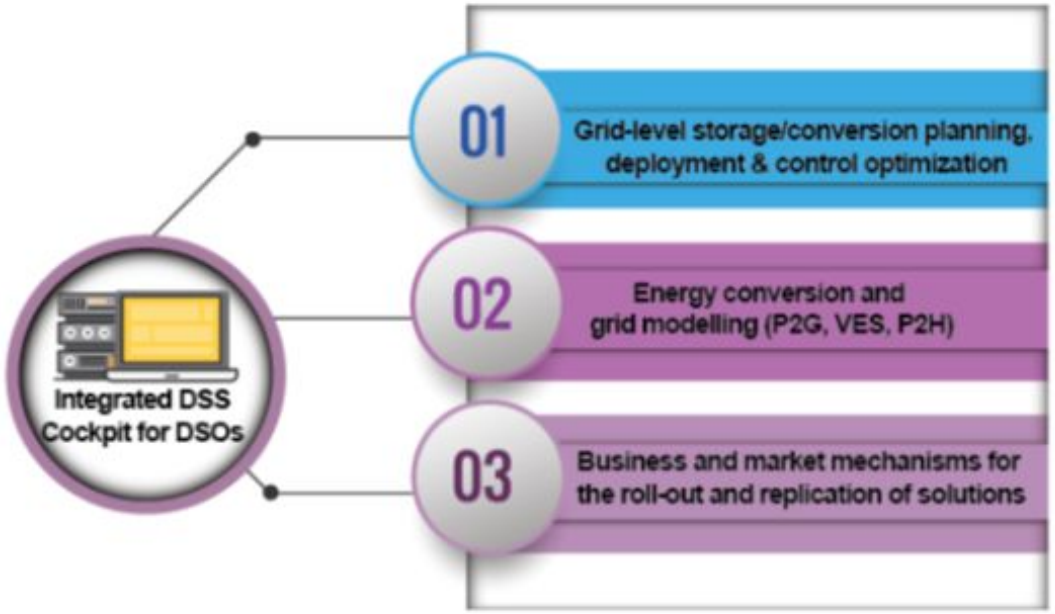

Source: InteGRIDy Newsletter 1

# Exploiting the DR potential of buildings – CERTH/ITI experience (present)

**PLANET Project (RIA 11/2017 to 11/2020)**

- Investigates the DR potential of exploiting synergies across electric, gas and heating energy carriers in districts
- Conversion of excess VRES electricity to Gas and Heat allows exploitation of the huge storage potential of gas and heating networks
- Peak demand shifting via VES and heating flexibility
- Peak load reduction via re-electrification



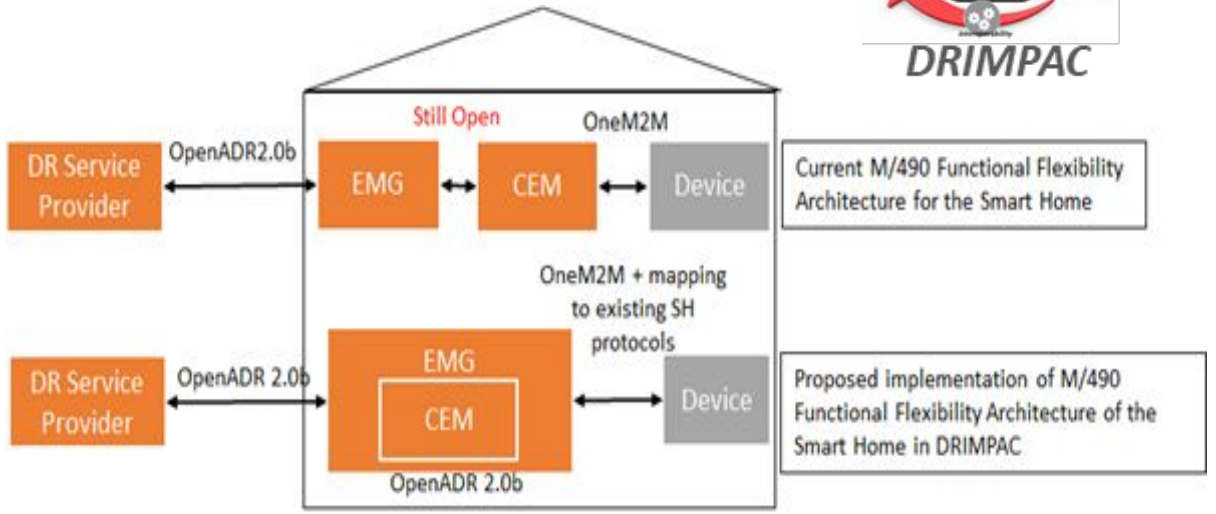

Aims:

- To reduce or even nullify the curtailment of energy production from VRES
- To fix overvoltage and congestion issues due to high RES penetration without additional grid investments

# Exploiting the DR potential of buildings – CERTH/ITI experience (future)

**DRIMPAC (H2020 Sept. 2018-2021)**

- From RIA to IA -> Apply proven concepts to large-scale pilots
- *Aim: "to give to every energy consumer the tools to interact with the energy system so as to consistently and risk-free enjoy energy cost savings of 30%, and a peak load reduction potential of 50% without noticeable impact on their daily living conditions at home or in the office."*




## Increase User engagement

- More than 1,000 occupants in tertiary and residential buildings
- At least 2,000 participants involved in the User Group activities
- Co-creation of intuitive UIs offering choice to opt-out at any moment
- Automation
- User acceptance of DRIMPAC solution exceeding 95%

## Increase interoperability

- Building types versatility covering over 90% of building types across EU
- Interoperability with main standards (OneM2M, SAREF) and proprietary protocols (at least 3 major ones) in the Smart Home and tertiary building domains
- Distributed building demand response reliability exceeding 90%

## Extend DR potential

- 30% energy cost, 25% consumption savings and 50% peak load reduction in pilot sites
- Predictive Maintenance component
- Offer access to district level energy resources to retailers (e.g. generation and storage facilities) to enable holistic optimization at the district level

# Some findings-views from hands-on experience (1/2)

- TRL of implementations ranges between 7-8. Systems (= Communications) are overall reliable but this significantly depends on system installer experience/training especially for wireless short-range comms.
- The technological barriers can be overcome when a clear business case is available for stakeholders.
- The most effective incentive for user engagement/retention is the monetary. However currently there are no clear monetary benefits for residential users. (Equipment CAPEX amortization period too long, OPEX not clearly defined).
- Automation (occupancy detection/extraction of comfort levels) reduces the user/system interactions and associated obtrusiveness. However, preliminary findings from questionnaires distributed to various agencies/organizations within tertiary buildings have provided strong indications that occupants are keener to interact with the building's infrastructure themselves than having an automated solution that suddenly makes changes to their working environment. (Greensoul project)
- Providing opting out/overriding choices to give a sense of system ownership is important.
- It makes more sense for the residential sector to apply DR on blocks of buildings and energy communities to reduce the OPEX/user. However coordination of many people makes decision process slow and difficult.

# Some findings-views from hands-on experience (2/2)

- Incentives for commercial DR include improvement of corporate profile (environment-friendly), even if monetary incentives are not compelling.
- Organization readiness level is the biggest barrier, mainly due to the lack of a clear business case and regulatory restrictions/cross-country versatility.
- Energy cost savings stemming from dynamic tariffs and demand profile modification have not been convincingly demonstrated in large scale. Monetary benefits from explicit DR campaigns are usually beyond the reach of typical buildings.
- Regulations harmonization, roll out of smart metering, IoT proliferation leading to cost decreases, electromobility smart charging at homes, connection of the other domestic energy carriers could increase the profit margin in the future and allow for achieving a critical mass for residential DR in the future.

# Thank you for listening

2018

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