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Petr Stluka

Building Management Systems for Energy Efficient Buildings

Trends in the European Energy Industry / Smart City 2016

Honeywell

Building Life-Cycle



Planning

- Location
- Accessibility
- Environmental Impact

Design

- Structure
- Envelope
- Energy equipment

Construction

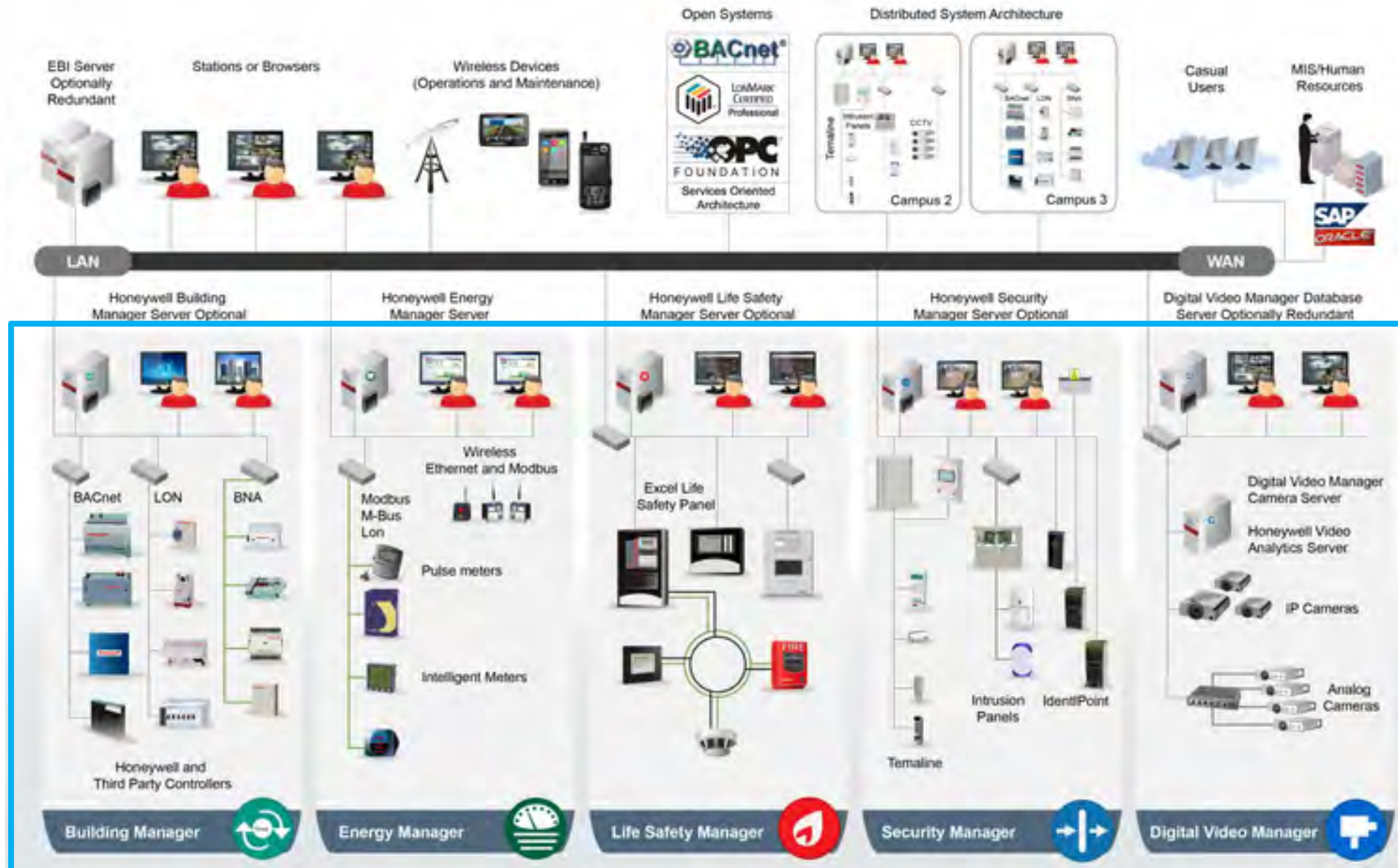
- Construction process
- Materials
- Commissioning

Operation

- Control of building's energy systems
- Monitoring of energy performance
- Smart Grid integration

Building Management Systems

Today's Building Management Systems (BMS)



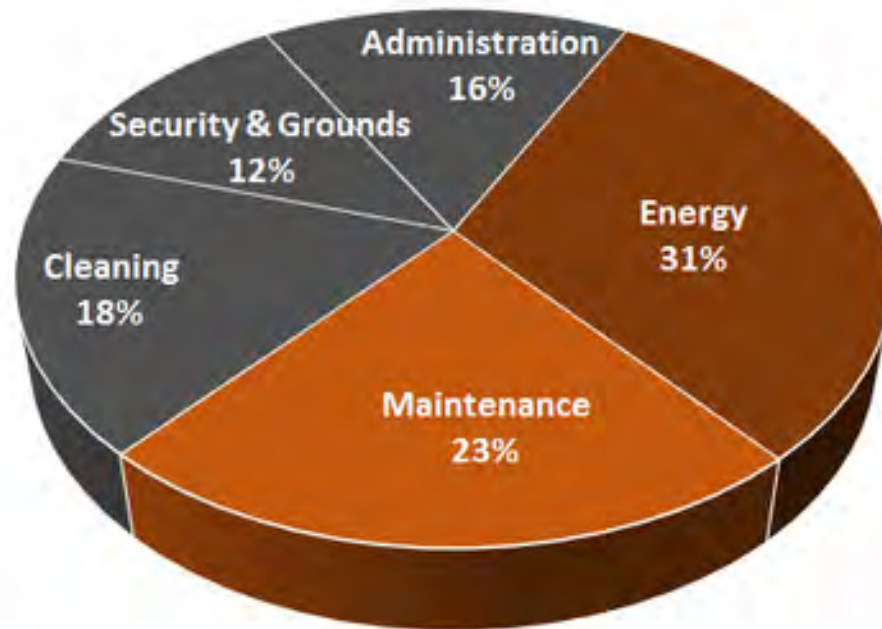
Multiple sub-systems

- HVAC Control
- Energy
- Life Safety
- Security
- Video

Building Operation: Major Costs

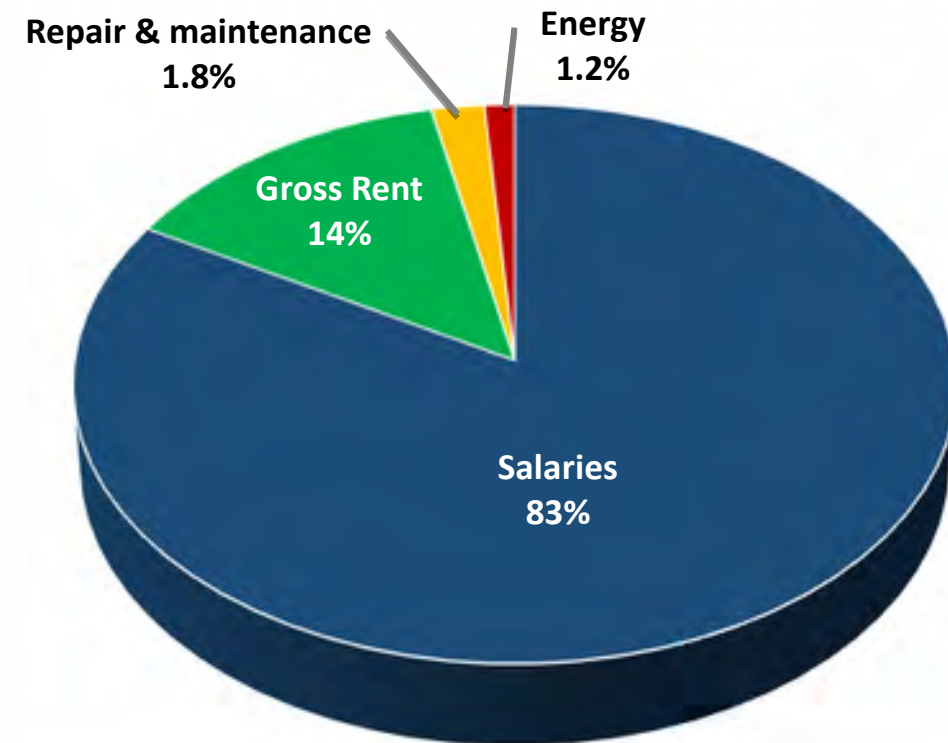
Building Owner Perspective

Source: BOMA, Building Owners and Managers Association,
www.boma.org



Energy and maintenance relate primarily to Heating, Ventilation and Air Conditioning (HVAC)

Tenant Perspective



A 'productivity' increase of 1% will completely offset the building's entire energy bill

Main Contributors to Inefficient Operation



Hardware Faults

- **Mechanical failures**
 - Stuck valve
 - Refrigerant leakage
- **Degradation faults**
 - Equipment ageing
 - Mechanical wearing



People's Behavior

- **Changes in occupancy patterns**
- **Improper use of building systems**
 - Simultaneous heating and cooling
 - Opening windows instead of using automated HVAC



Faults in Automation Systems

- **Errors in control logic**
 - Wrong sequencing
- **Errors in configuration**
- **Errors in installation**
 - Wrongly placed sensors



External Factors: Weather

- **Too hot / too cold**
- **Wet winters**
- **Heavy downpours**
- **Higher solar intensity**
- **Wind intensity**

Key Functions of Building Management Systems

- **(1) Advanced Control**

Savings 10-40% - optimizes energy distribution by adjusting HVAC system temperatures and flow rates

- **(2) Building Efficiency Analytics**

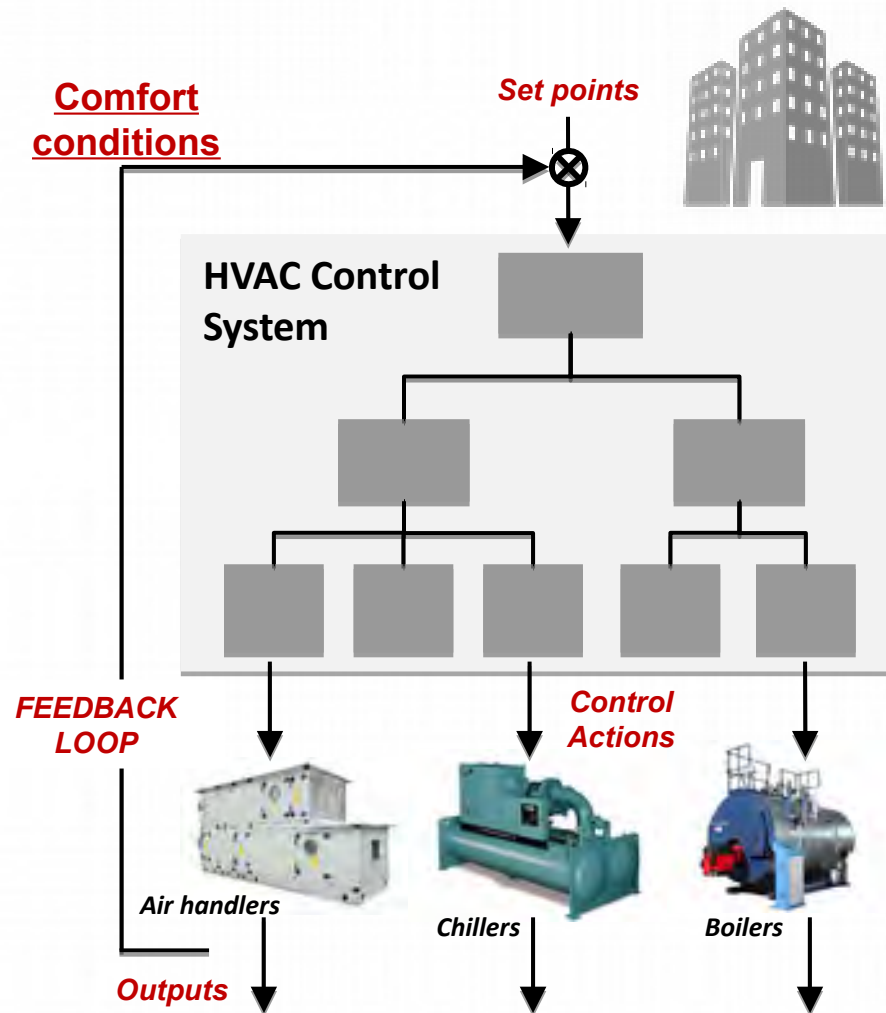
- Fault detection and diagnostics
- Predictive maintenance

Savings 2-20% - detecting inefficiencies in building operation, prioritizing actions for facility managers to fix problems

- **(3) Building to Grid Integration**

Savings up to 20% - by shedding of the electricity consumption in the peak period / upon request from the utility

(1) Advanced Control

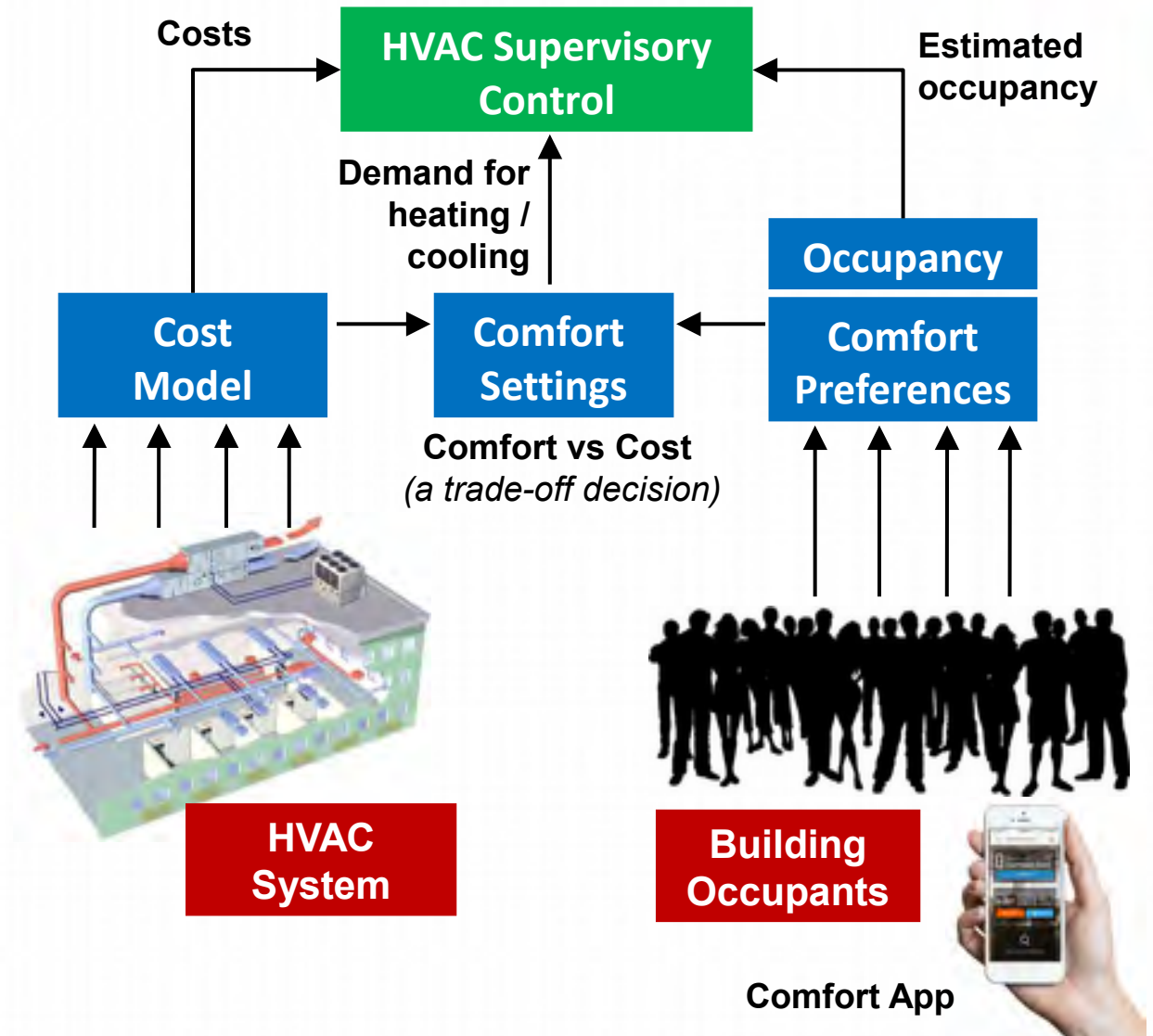


Model Predictive Control (MPC)

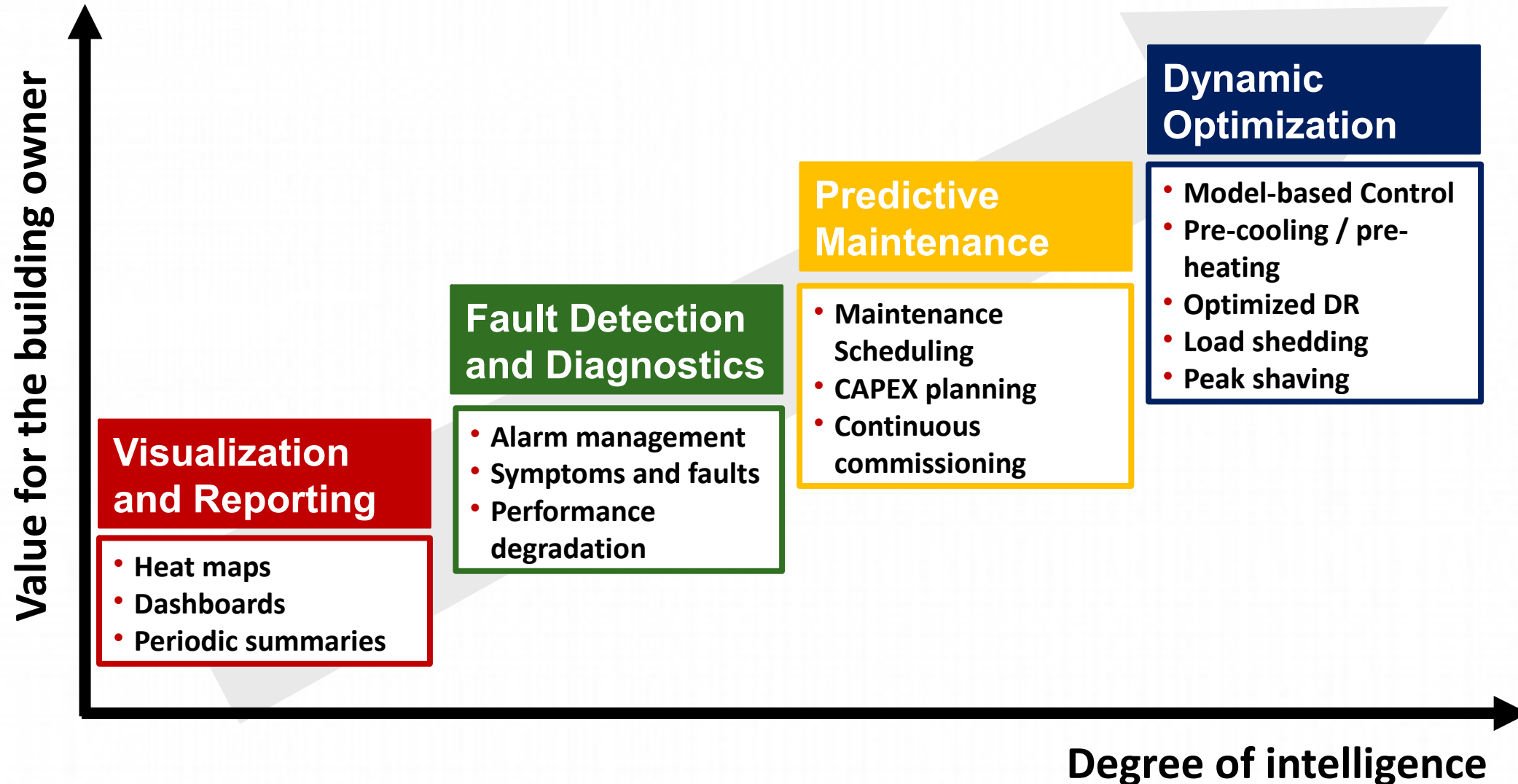
- **Minimizes energy costs**
- **Maintains comfort**
- Dynamically manipulates with internal **temperatures** (hot water, chilled water, supply air) and **flow rates** (water, air)
- Optimizes energy flow from **sources** (boilers, chillers, local generators) to the conditioned spaces (**zones, rooms**)
- Uses accurate predictive models for key uncertain parameters
 - *Weather*
 - *Occupancy*

Human-in-the-loop Control

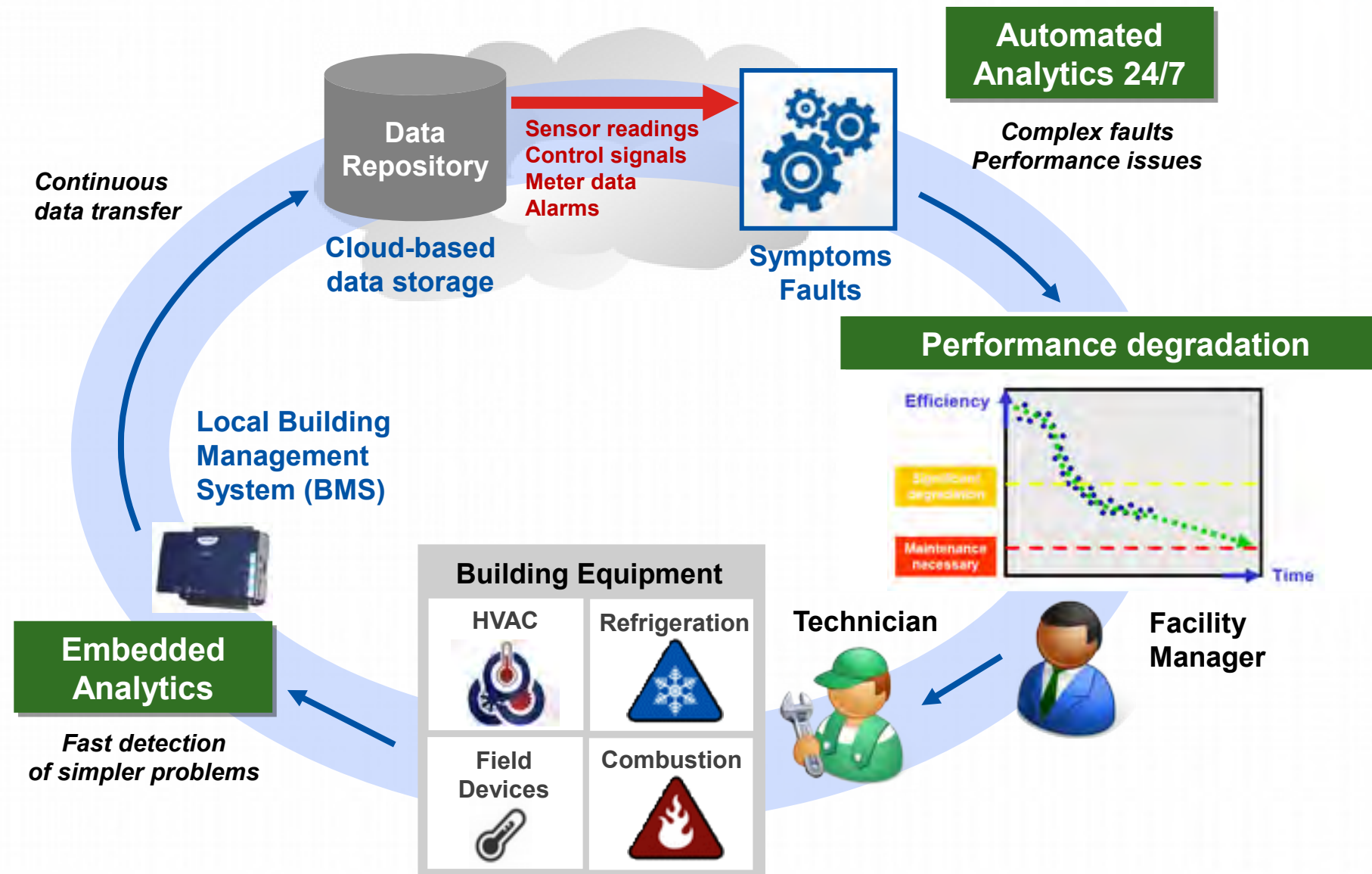
- **Emphasis on productivity, health and wellbeing**
 - **Economic view:** people's costs are much higher than energy costs
- **Crowd-sourcing in building control**
 - Individuals provide **active feedback** (vote) on how comfortable they feel
 - **Smartphone app** connected with indoor location tracking system
 - **Automatic set-point adjustments** based on the feedback
- **Occupancy patterns**
 - **Control view:** occupancy is a "disturbance" variable, difficult to measure
 - Occupancy can be learned from **access logs and/or location tracking**



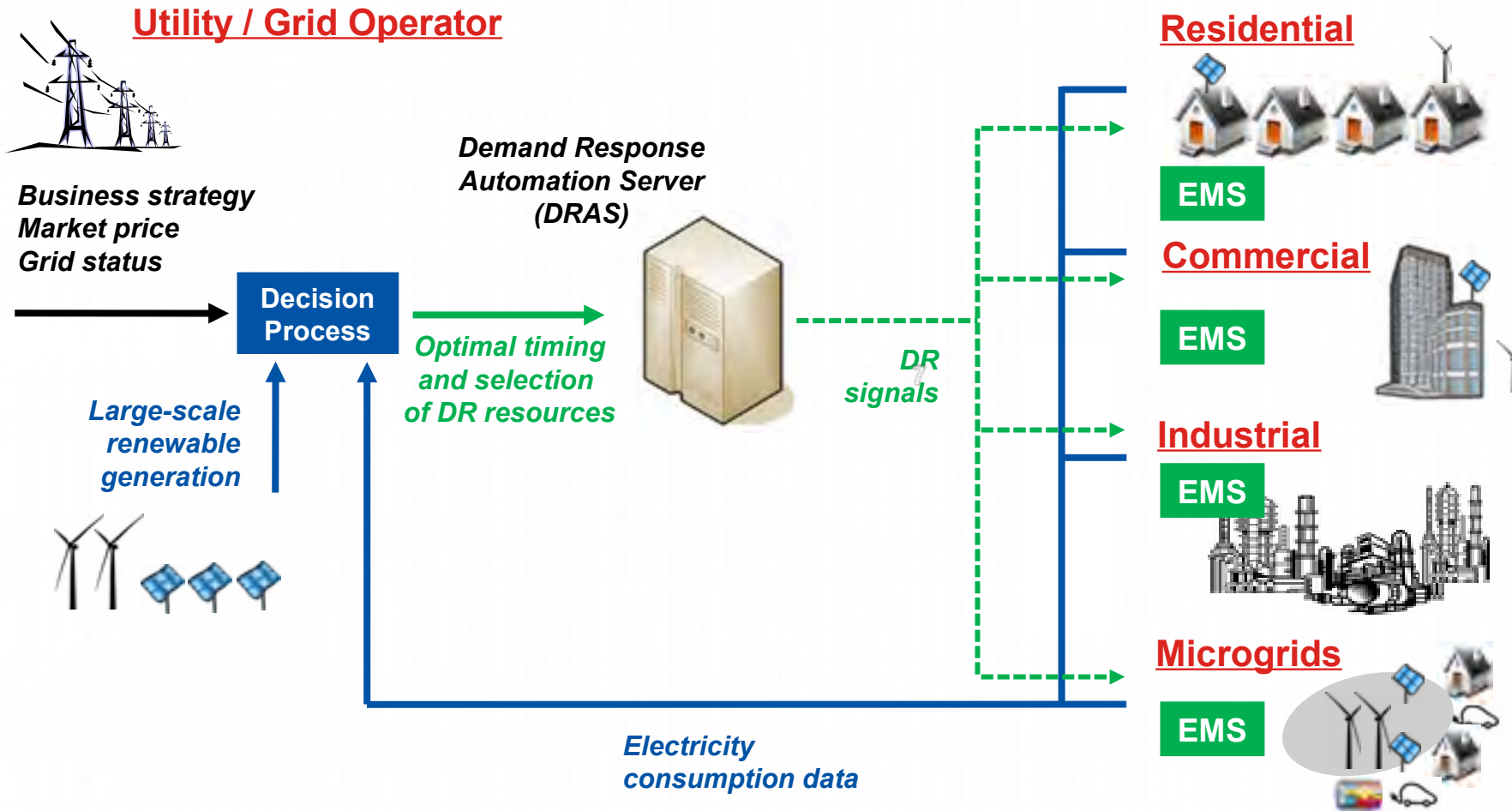
(2) Building Efficiency Analytics



Fault Detection and Diagnostics



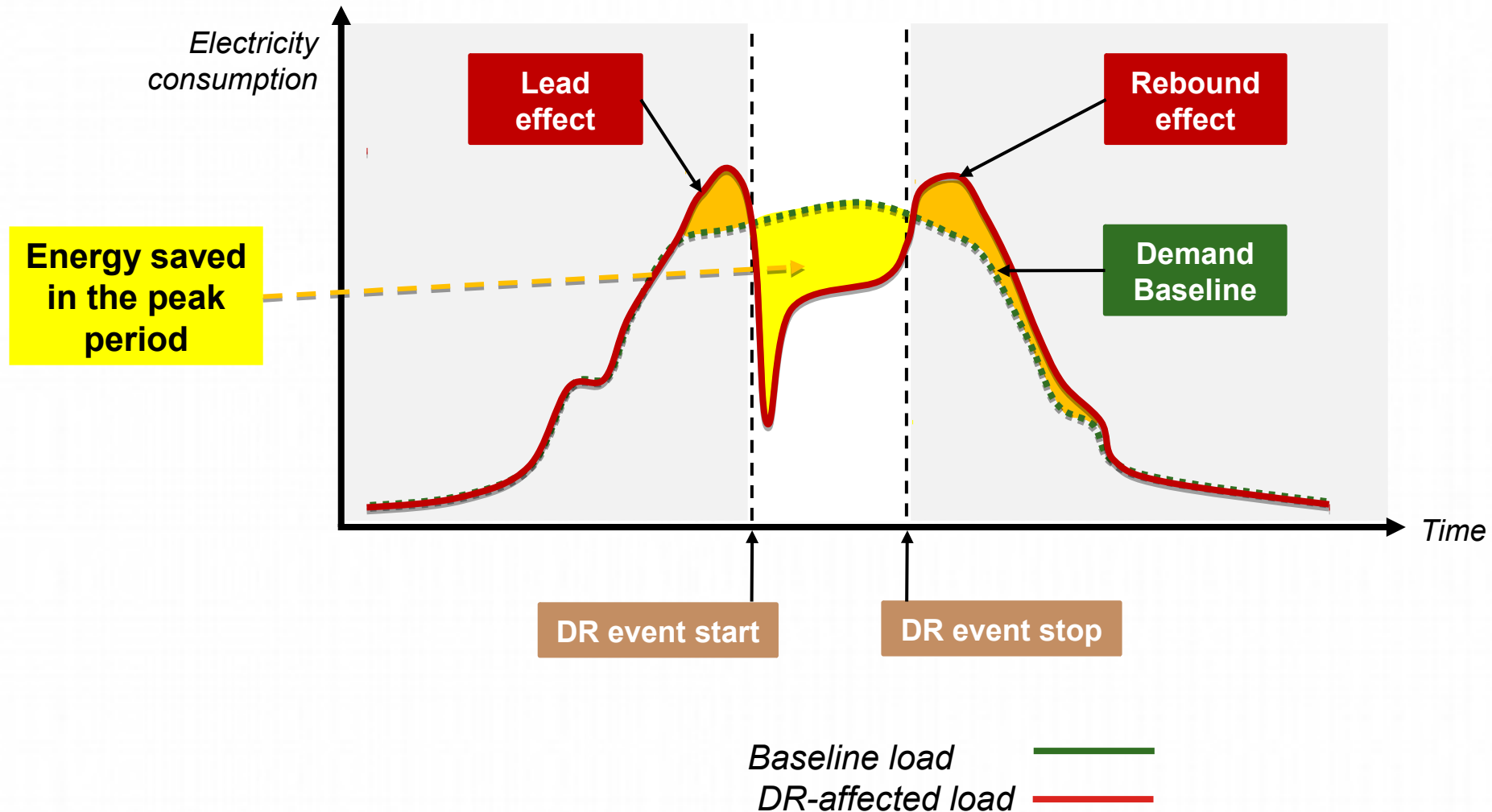
(3) Building to Grid Integration: Demand Response



- **Load management actions in buildings**

- Change temperature set-point
- Turn off 1 of 4 elevators
- Pre-cool building in early morning hours
- Turn off non-essential lighting
- Turn on emergency generator

Impact of Demand Response on Building Loads



Thank you for your attention!

petr.stluka@honeywell.com