June 2018

Sustainable Places

France

SUSTAINABLE PLACES 2018 June 27 – 29, 2018 Aix-Les-Bains, France

E² District

Community Energy, Optimisation & Control

Project Overview

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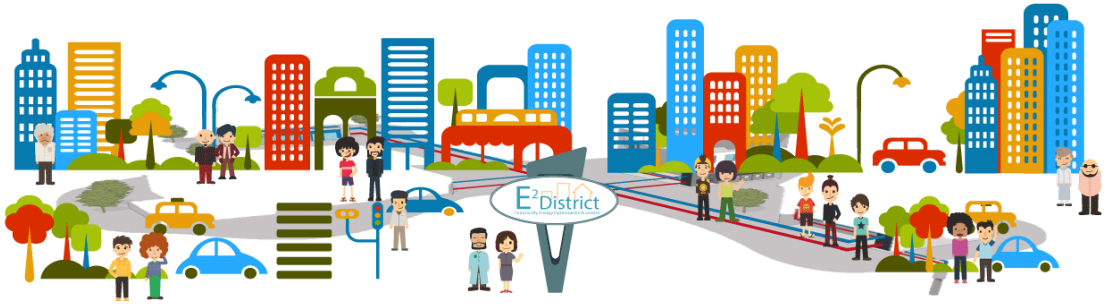
People Behaviour & Technology Integration Group

E2 DISTRICT
COMMUNITY ENERGY, OPTIMIZATION & CONTROL



Energy Efficient Optimised District Heating and Cooling

by developing

- **Optimised District Management and Decision Support framework** and
- **Optimised End-User Behaviour Demand Response (BDR) Strategies**

targeting **energy savings of up to 30%**

Period: 2016 - 2019 **Topic**: EE-13-2015 Technology for district heating and cooling

CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

VEOLIA

acciona Infraestructuras

CSTB le futur en construction

United Technologies Research Center

Vision

DHC is expected to **double its share** reaching 20% of the European market by **2020** compared to 2010 [EC].

This translates to **2.6% reduction** of prime energy need and **9.3% of carbon emission** in Europe.

Market Barriers:

- **Lack of tools** to support the holistic **optimisation** of the **whole life-cycle**
- **Inflexibility** of the existing **business models** preventing
  - Dynamic energy optimisation of asset
  - Optimal Demand Response to variable operating and supply side constraints
- Limited **customer engagement** in the DHC “market”
- Limited support for **distributed generation** and **energy exchange** between prosumers.

Project Objectives – towards energy reduction

Develop a novel **Cloud Enabled District Management & Decision Support Framework for DHC systems** to deliver **30% energy reduction**

1) Develop **Asset Portfolio Decision Support Tool** based on **District Simulation Platform** to optimise DHC asset configuration and utilisation as

> 5% energy reduction

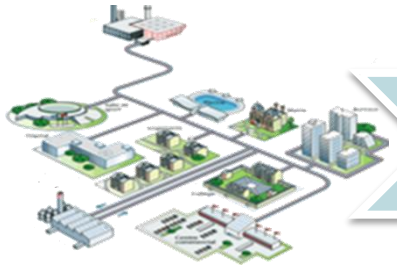
2) Develop **Adaptive supervisory control and optimisation methods** for flexible production, storage, demand asset, and system fault diagnostic

> 10-20% energy reduction

3) People **Behaviour Demand Response** adding behaviour flexibility to the system by keeping human user in the loop

> 5% energy reduction

Three DHC network Lifecycle Phases



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CONCEPT DESIGN OPERATION

- Business models.
- Service models

- DHC asset portfolio decision support tools.
- Optimisation of primary & secondary networks.

- Optimal day-ahead schedule
- Behaviour Demand Response
- Self-learning Real-Time Controls
- Poly-generation coordination
- Fault Adaptive Control

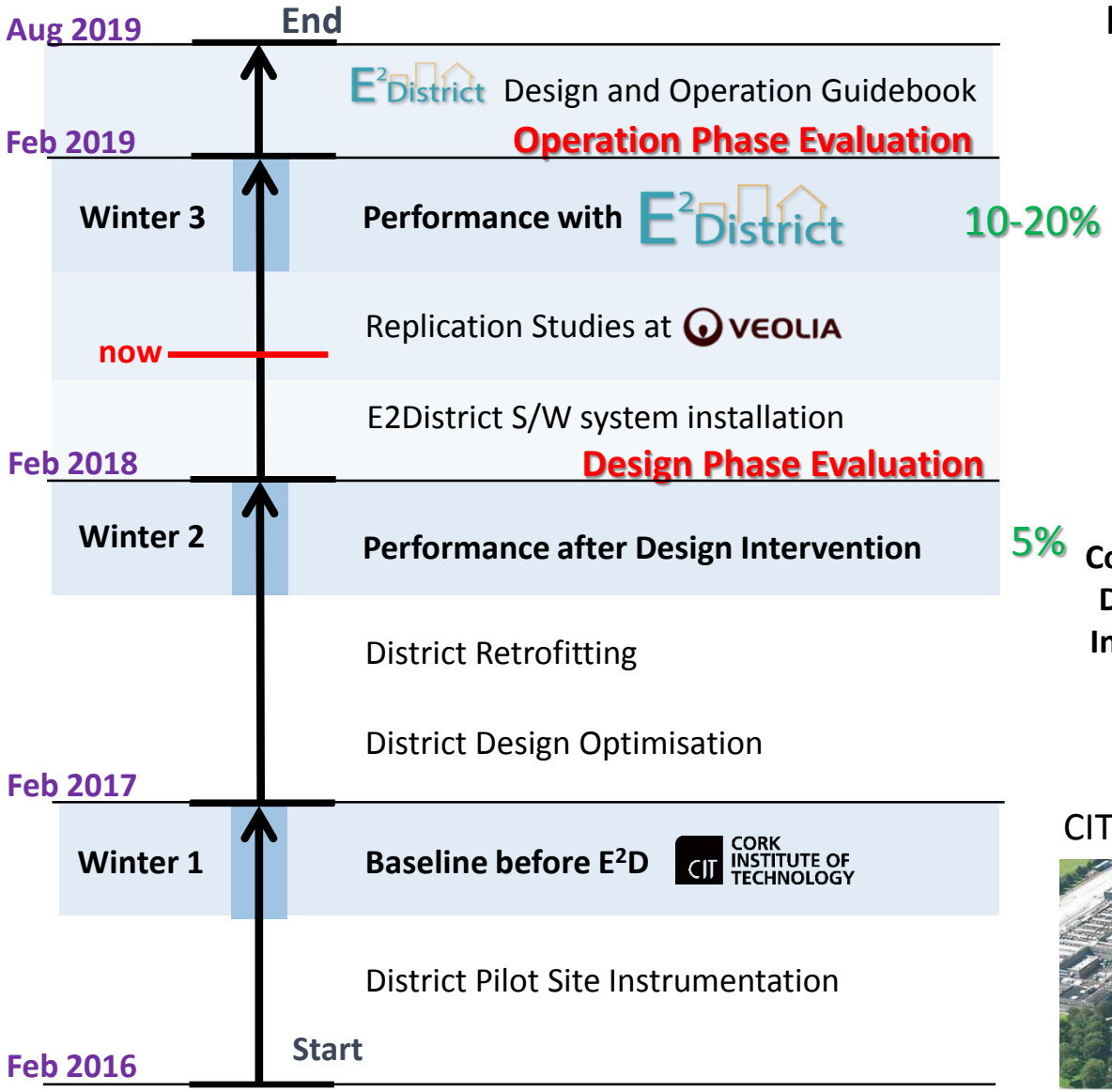
Integrated Energy Concepts

District Simulation Platform

Cloud Services

District Operation System

Timeline with Key Milestones



Residential Districts operated by Veolia

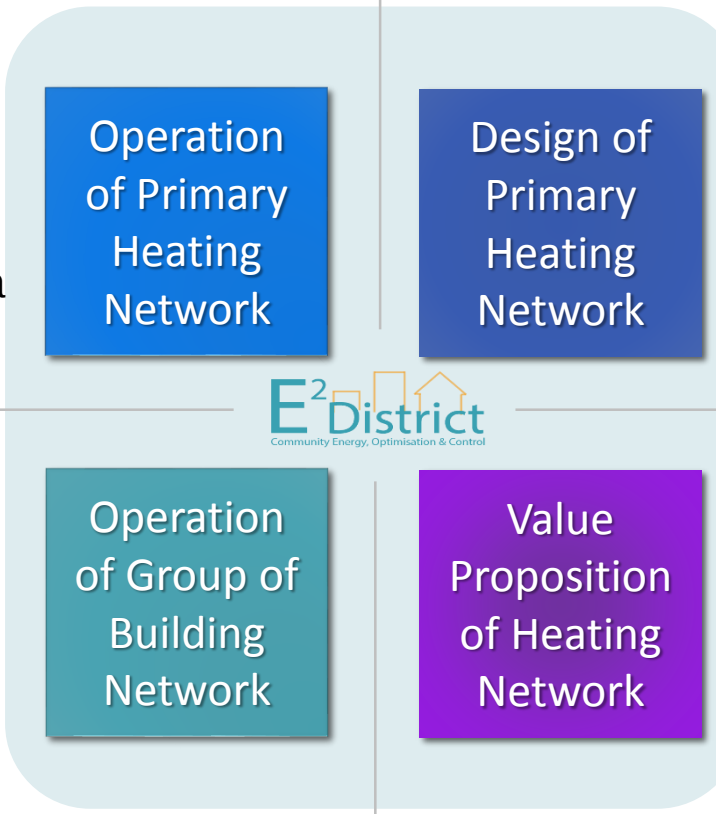
CIT Campus – The main project pilot site

Use Cases

UC3 - Optimise production Scheduling

UC4 - Supervisory control of the network

UC5 - Anomaly Diagnosis on data & performance



Optimise primary network

UC1 - existing DHCN continuous improvements

UC2 - New DHCN design

UC6 - Secondary HN behaviour flexibility

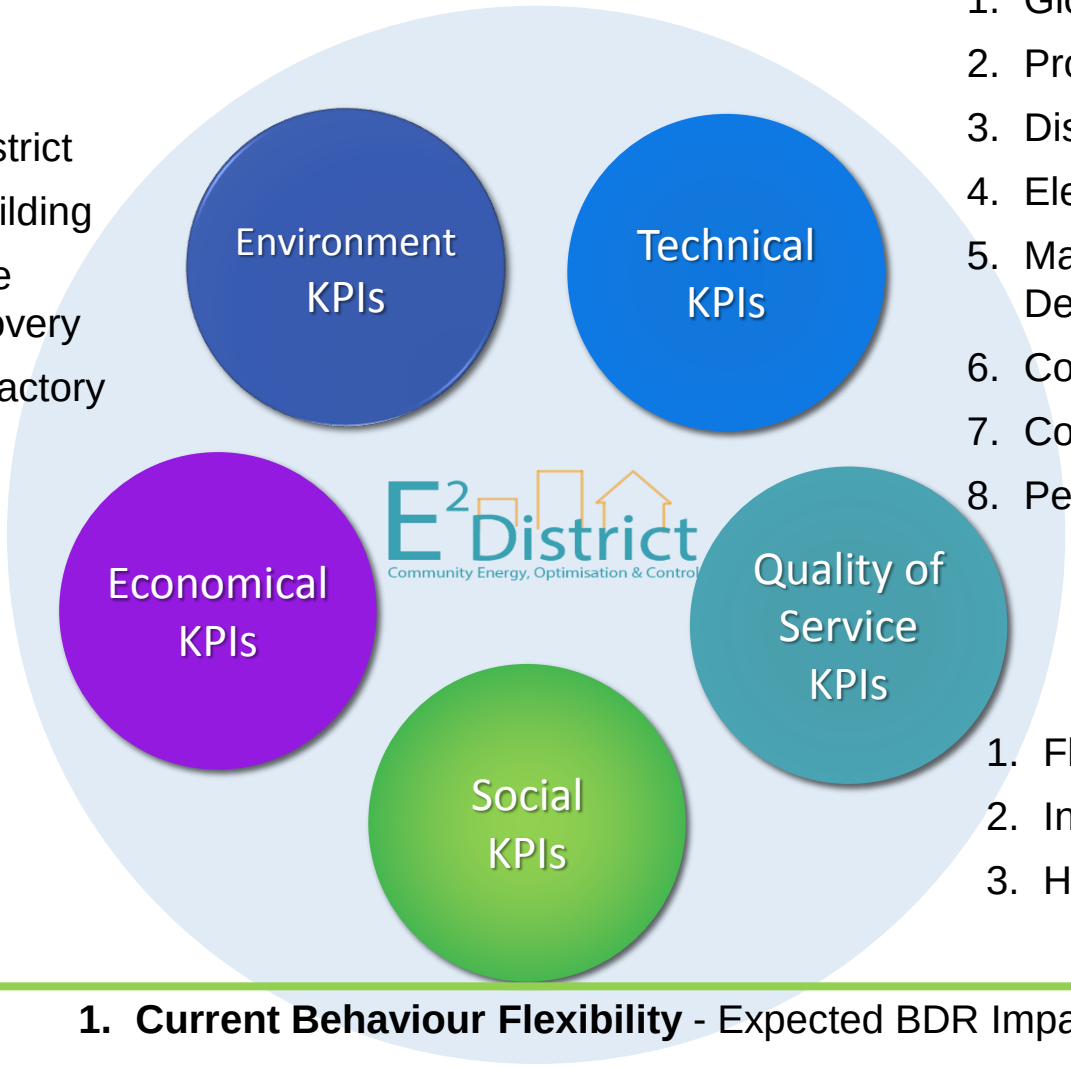
UC7 - Secondary HN building flexibility

UC8 - Automatic Reporting

- Operator
- Owner
- Local & National Authority

Cooling • RES • Prosumers • Low Temp • NZEB

KPIs



1. CO2 Emission in District
2. CO2 Emission in Building
3. Ration of Renewable Energy & Heat Recovery
4. Primary Resource Factory

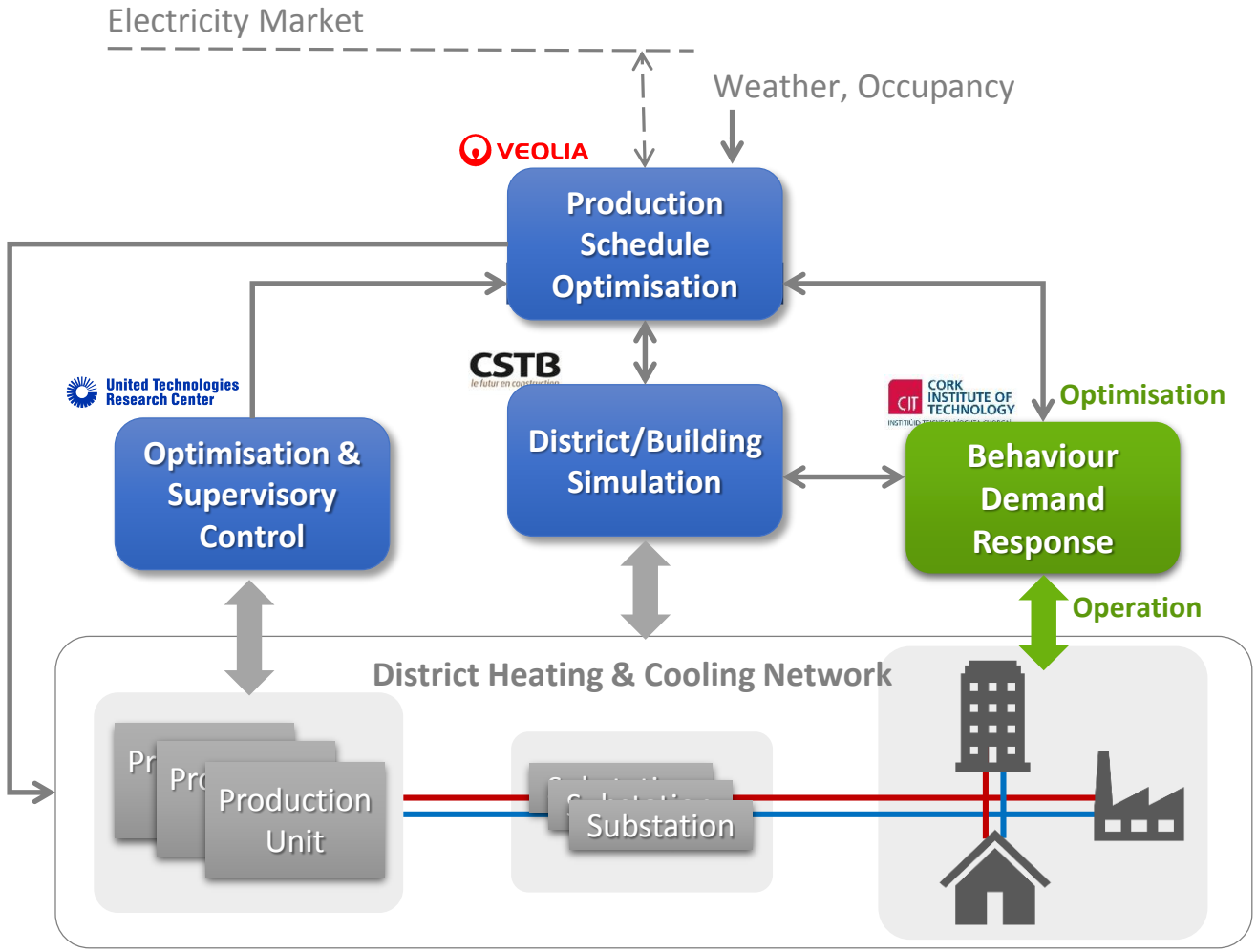
1. Global Thermal Efficiency
2. Production Thermal Efficiency
3. Distribution Thermal Efficiency
4. Electrical Consumption
5. Maximum Rate of Heat Power Demand
6. Cogeneration Availability Rate
7. Cogeneration Efficiency
8. Peak Demand Flexibility

1. Total Energy Cost
2. Gross Margin
3. Sale Margin
4. Normalized Cost of Energy
5. Net Present Value

1. Flexibility Rate of Substations
2. Indoor Temperature
3. Heat Power Interruption Rate

1. **Current Behaviour Flexibility** - Expected BDR Impact
2. **Maximum Behaviour Flexibility**
3. **Aggregated Occupants' Intention to Act** – Level Engagement

Simulation-based Optimised Operation with Behaviour Demand Response (BDR)



E2District at Sustainable Places 2018

Day 1

- Wed 11:30 *Workshop – Room 04*: **Reducing the Performance Gap,** *M Klepal, Ch Beder*, People & Technology Integration, Cork Institute of Technology

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Production Schedule Optimisation

- Wed 11:30 *Session – Room 03*: **Optimization of district heating production operations**", Gabriela N. Maschietto, Veolia Research

CORK INSTITUTE OF TECHNOLOGY

Optimiser

Engagement

- Wed 14:30 *Session – Room 02*: Demand Response Strategies: "Towards Integrating **Behaviour Demand Response** into Simulation Based Heat Production Optimisation", *Ch Beder, M Klepal*; Cork Institute of Technology"

Day 2

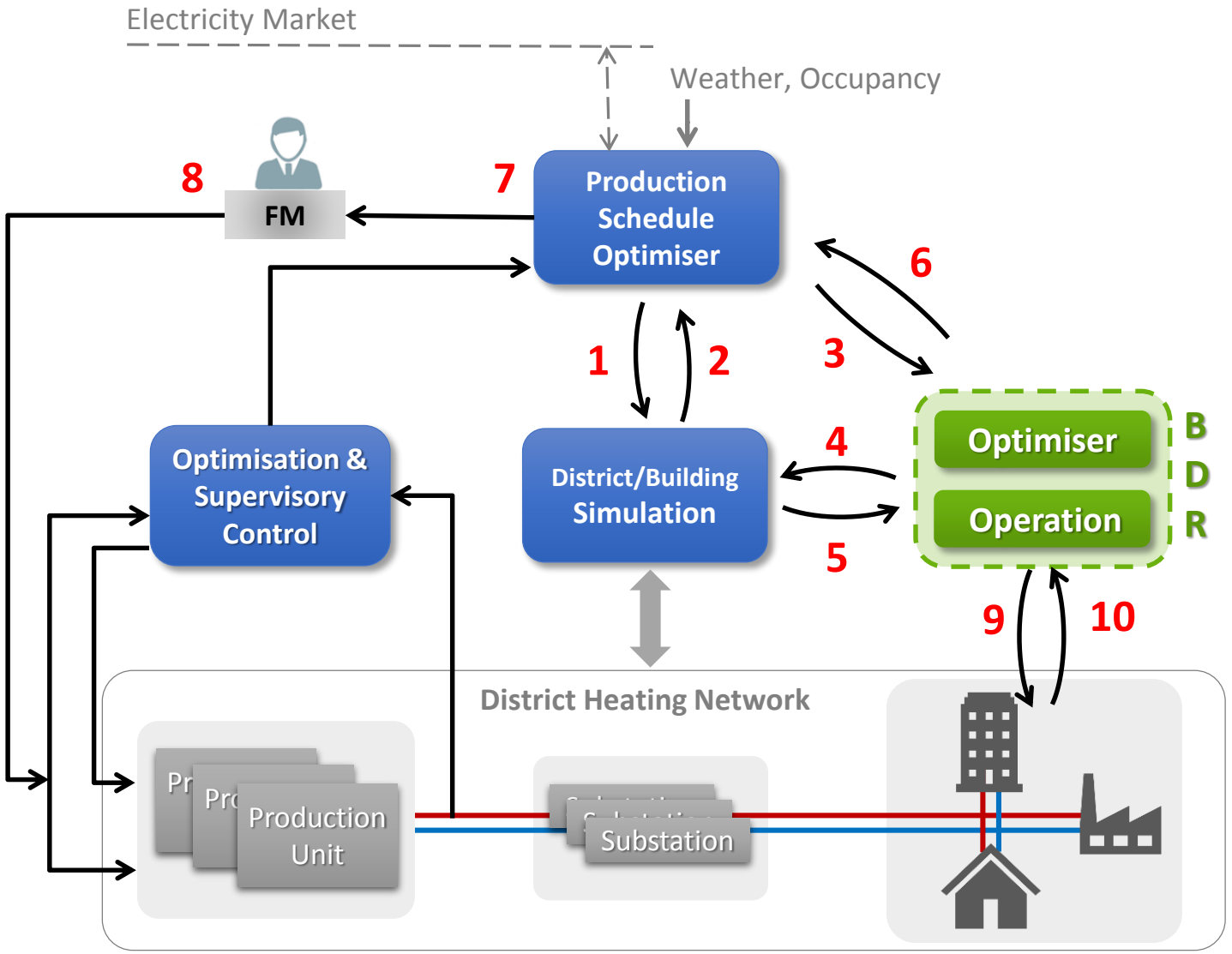
- Thu 8:30 *Workshop – Room 03*: **District Energy Systems** - M Klepal, Ch Beder, People Behaviour & Technology Integration, Cork Institute of Technology

United Technologies Research Center

Supervisory Control

- Thu 8:30 *Session – Room 05*: "**Energy Management Systems** in smart electrical & thermal grids: Behaviour two case studies" – *G. Manganini, M. Torchio*; United Technologies Research Centre (ELSA, E2District)

Integration of BDR with Production Optimisatio..

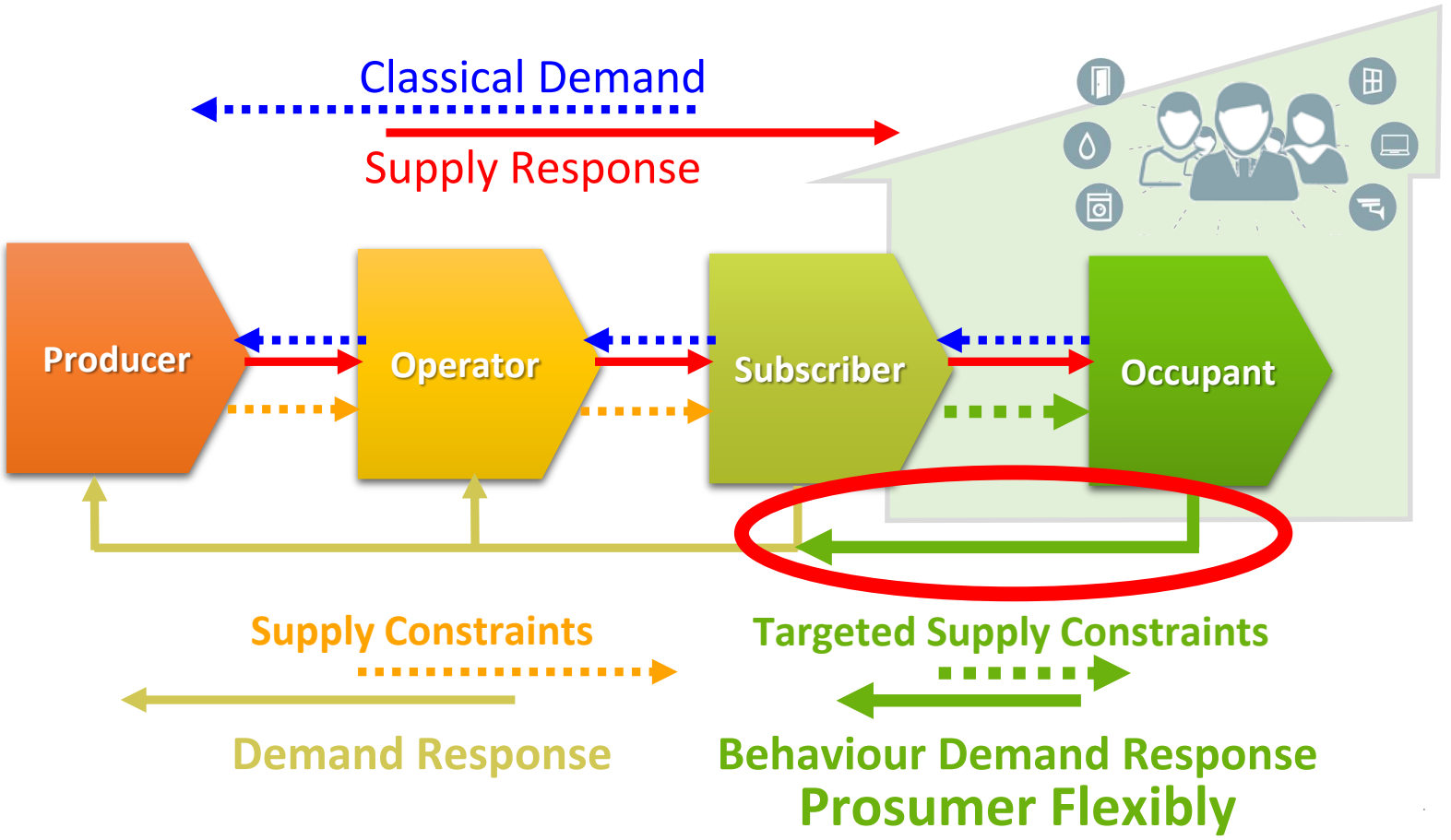


1. **Scheduler** calls **Simulator** to evaluate potential production schedules
2. **Simulator** returns predicted performance for optimisation of production schedules
3. **Scheduler** can decide to trigger **BDR** to provide additional flexibility
4. **BDR Optimiser** calls **simulator** to evaluate potential demand response actions to support **Scheduler**
5. **Simulator** returns predicted performance to **BDR Optimiser** for optimisation of behaviour demand response actions
6. **BDR Optimiser** provides the available behavioural flexibility to **Scheduler** to consider in the optimisation
7. **FM** confirmers the proposed production schedule
8. **Scheduler** sends the optimised schedule to **Supervisory Control** and **BDR**
9. **BDR Operation** module triggers **BDR Engagement** actions
10. **BDR** collects data to continuously calibrate the behavioural model as well as to adapt the ongoing execution of **BDR** actions accordingly

Value Chain of Energy Supply

Additional Value created by - Demand Response

- Dynamic Behaviour Change



Thank you!

Any Questions?