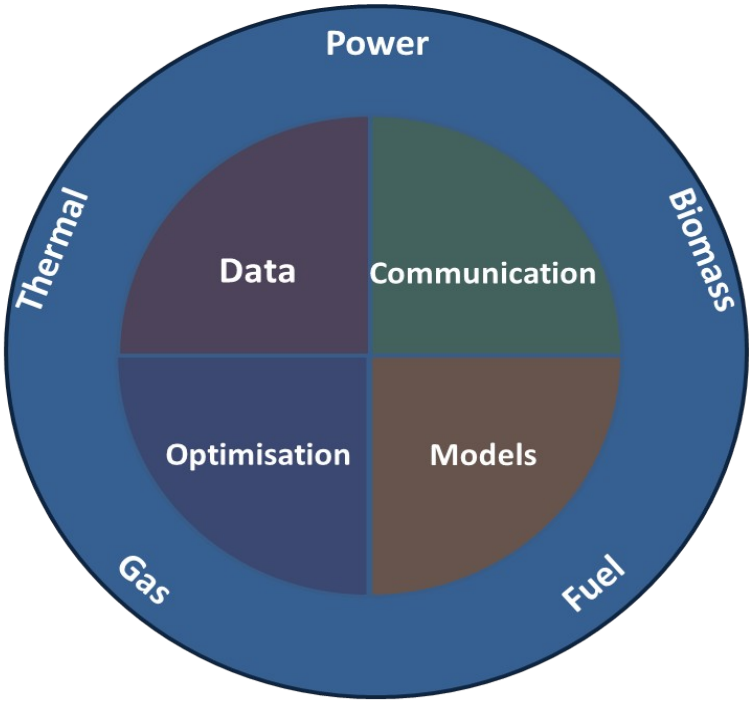
CITIES



Centre for IT-Intelligent Energy Systems in Cities

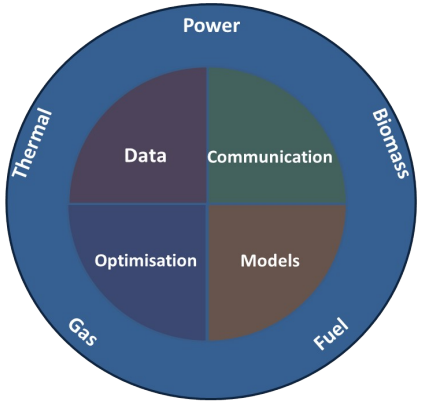
DSF - 1305-00027B

DTU Compute
Department of Applied Mathematics and Computer Science

CITIES – Hypothesis

The **central hypothesis** of CITIES is that by **intelligently integrating** currently distinct energy flows (heat, power, gas and biomass) in urban environments we can enable very large shares of renewables, and consequently obtain substantial reductions in CO2 emissions.

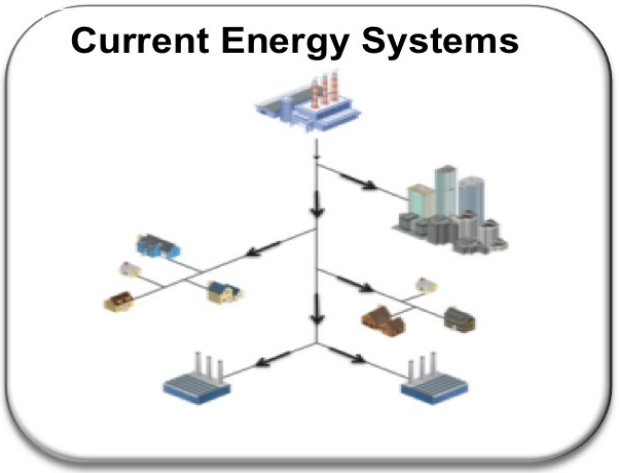
Intelligent integration will enable lossless ‘virtual’ storage on a number of different timescales.

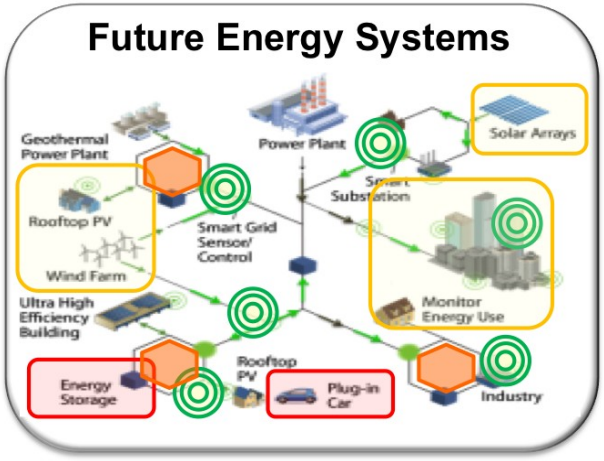


Project Ideas

Background, Concepts, Methodology, Objectives and Partners

Transition in the Energy World



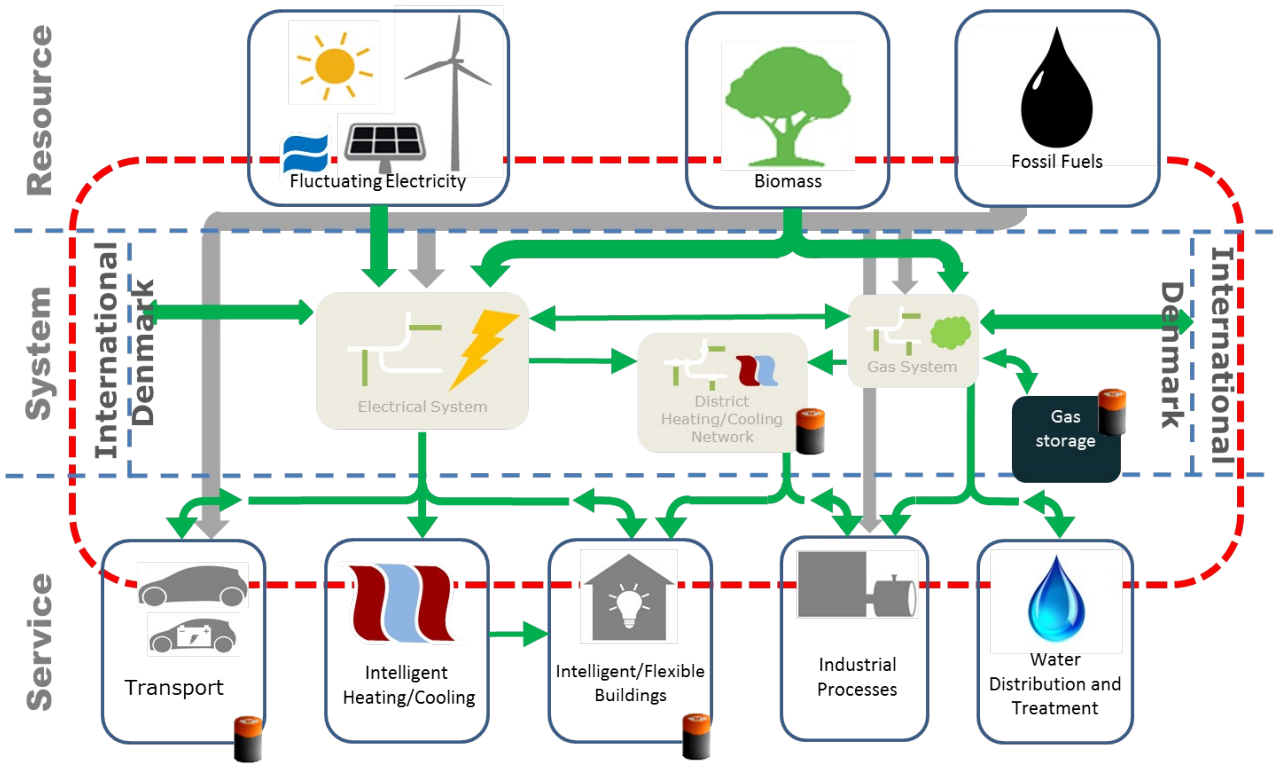


Due to the rapidly changing energy world we observe a need for the next generation of tools for simulation, planning, optimization, decision support, control and operation. These tools calls for research focusing on:

- Increasing penetration of variable RE in grid
- Increasing ultra high energy efficiency buildings and controllable loads
- New data, information, communications and controls
- Electrification of transportation and alternative fuels
- Enable (virtual) energy storage by energy systems integration
- Interactions between electricity/thermal/fuels/data pathways
- Increasing system flexibility and intelligence

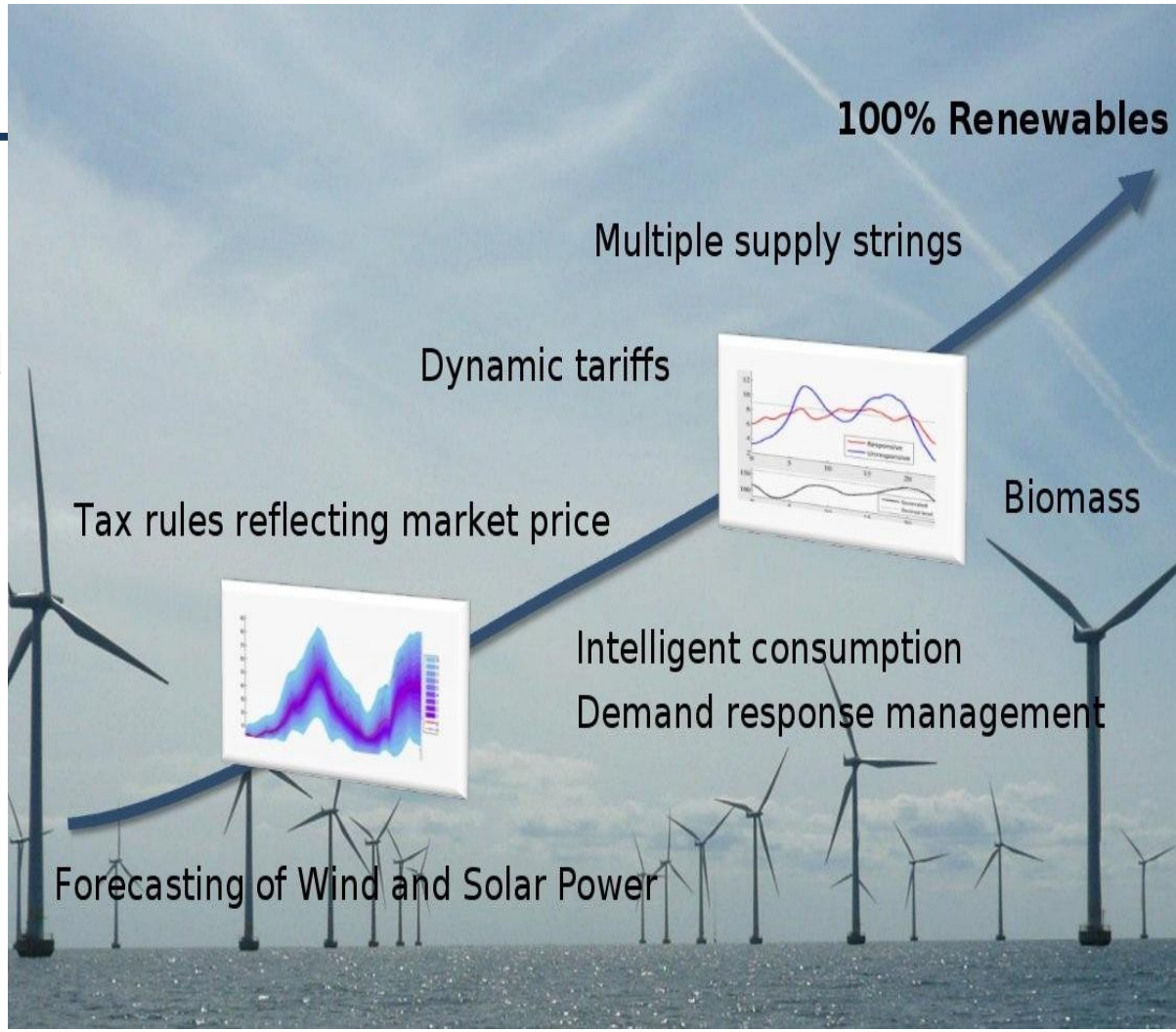
Concept

Integration based on *ITC solutions* leading to methods for *operation* and *planning* for future energy systems



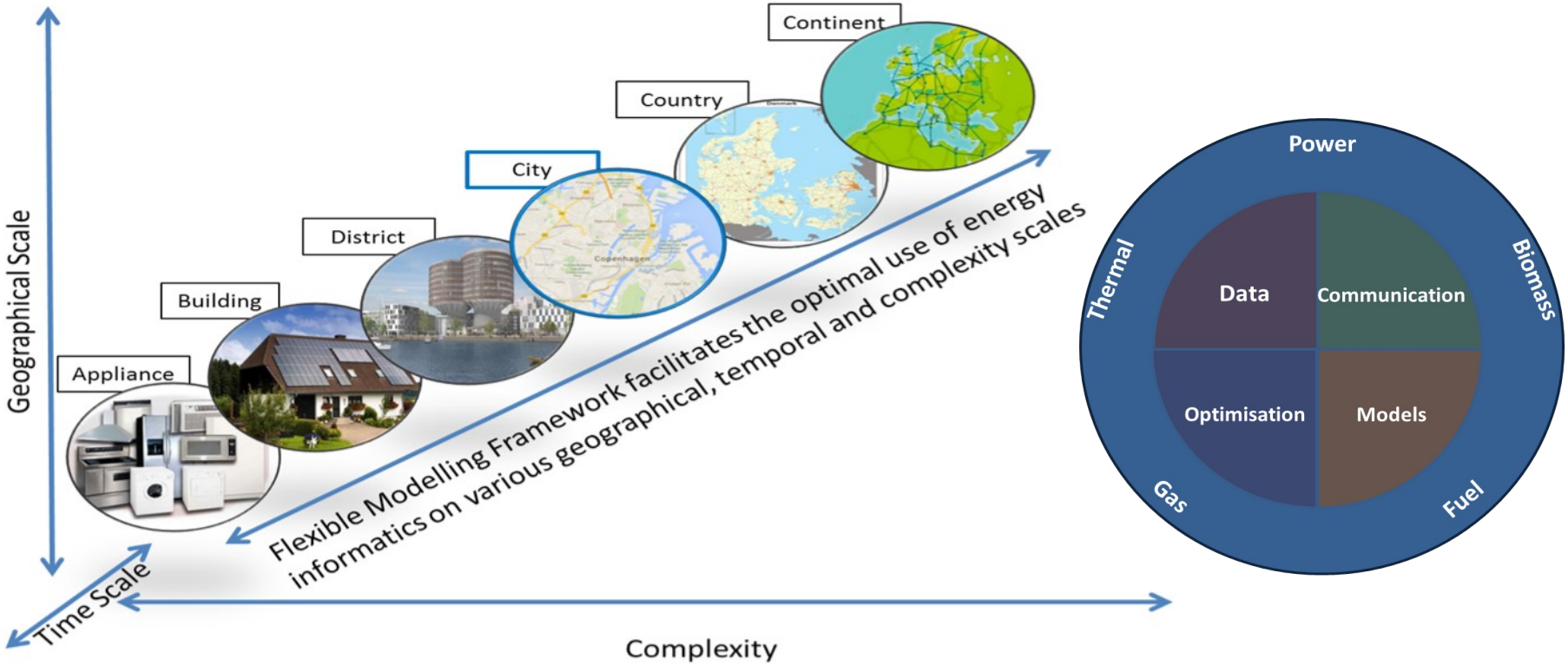
Societal Objectives

To establish methods and realistic scenarios for ultimately achieving independent from fossil fuels by harnessing the latent flexibility of energy systems in cities through *intelligence, integration*, and *planning*.



Scientific Objectives

To establish methodologies and ITC solutions for design and operation of integrated electrical, thermal, fuel pathways at all scales

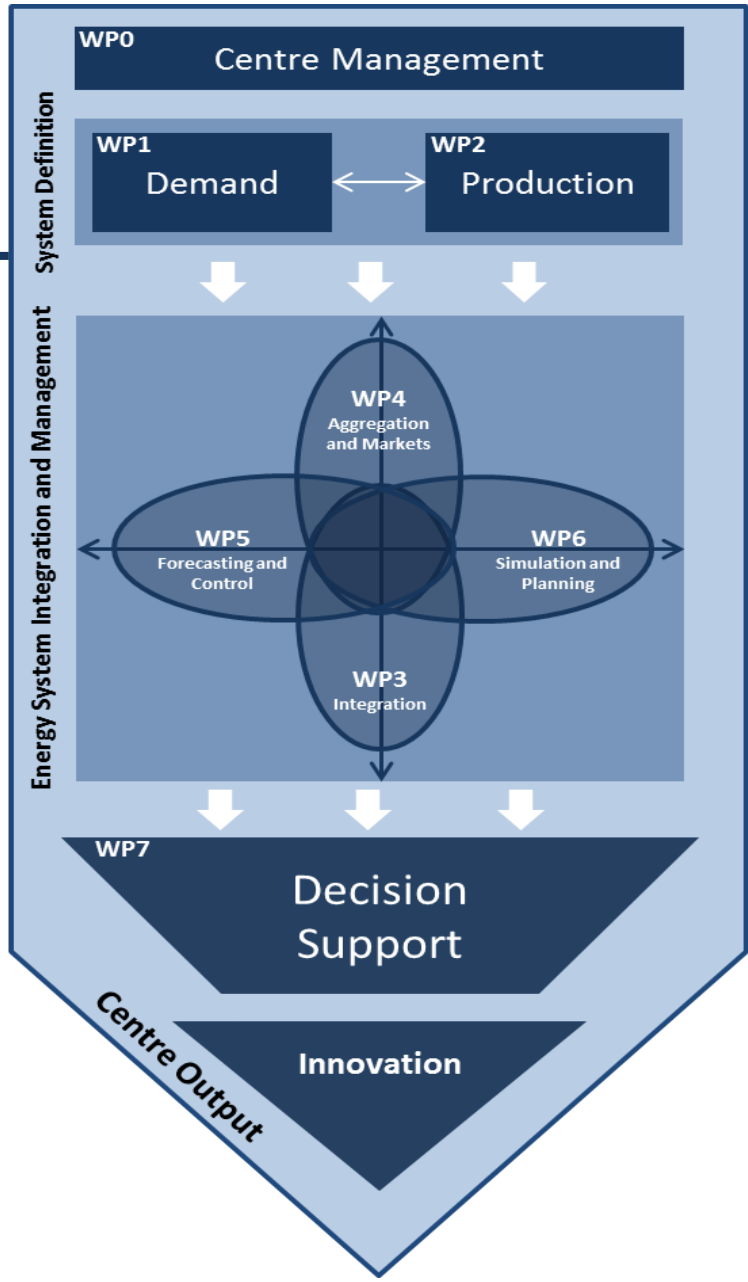


Research Structure

Work Packages

Methodology

Research and work flow arranged into **work packages**.



WP0 - Centre Management

Aim: Efficient and effective communication and management to ensure the success of CITIES.

WP0.1: Establish and maintain a web-based project management tool, efficient communication, and content management system (CMS)

WP0.2: Manage education of PhDs and PDs (incl. seminars and summer schools)

WP0.3: Communication with external/industrial partners through website/workshops/accessible open source CMS. Interface with political sphere to ensure CITIES outcomes/results are reflected in policy, e.g. guiding development of regulations/energy tax structures etc.

WP0.4: Dissemination of methods, results and tools to the wider public, policy makers and academia through series of seminars, wider audience “townhall” style events, summer schools for university students and high profile international conferences (hosted by CITIES), traditional scientific journal/conference style dissemination

Research instruments

- Ensure collaboration between WPs and between Departments/Universities – in an interaction with the companies
- PhD project rules: Supervisors from two departments, allocated to a primary and a secondary WP
- Interaction with International partners ensured
- Strong interaction with EERA activities (Smart Cities, Smart Grid. .....)
- PDs are focusing on a single WP while their research management tasts will involve arrangement of seminars, workshops, meetings, PhD supervision, etc.
- Synergies with new parallel activities focusing on innovation and development (EUDP, PSO, INNO+, H2020, Innovation Network, Industrial post docs, etc.)

Test Facilities

** Kubic (Tecnalia)

** Ireland

** PowerLab.dk (SYSLAB/Bornholm)

** Grundfos' test buildings

** Danfoss' test fac. for supermarket cooling

** DTU's test houses (eg Sissimiut)

** ESIF (NREL)

+ **A number of Smart Cities projects**

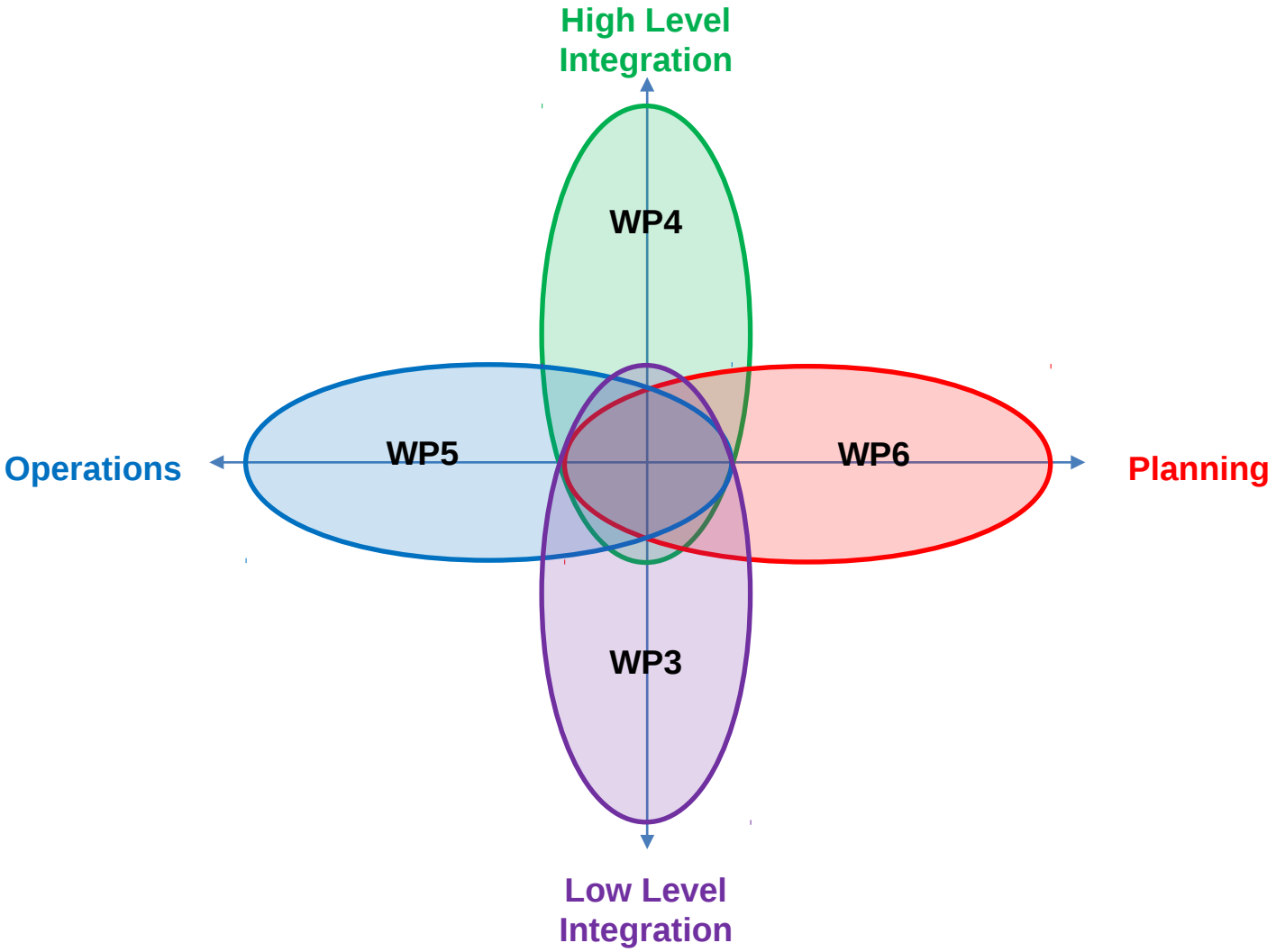
WP1- Energy Services and Demand

Aim: Characterise and model energy services and demand in cities, and their geographical and temporal variations

WP2: Energy Supply, Transmission, Storage and Conversion

Aim: Characterise energy supply, transmission, storage and conversion possibilities and identify opportunities for increased efficiency and flexibility.

Energy Systems Integration and Management



WP3: Intelligent Energy Systems Integration [Low Level Integration]

Aim: Optimise the interactions and synergies between individual system components

WP4: Intelligent Aggregation and Markets [High Level Integration]

Aim: Develop aggregate models and market structures for city level systems (and subsystems)

WP5: Forecasting and Control [Short Term/Operational]

Aim: Develop tools for short term (probabilistic) forecasting and control of integrated energy systems with flexible geographic scope.

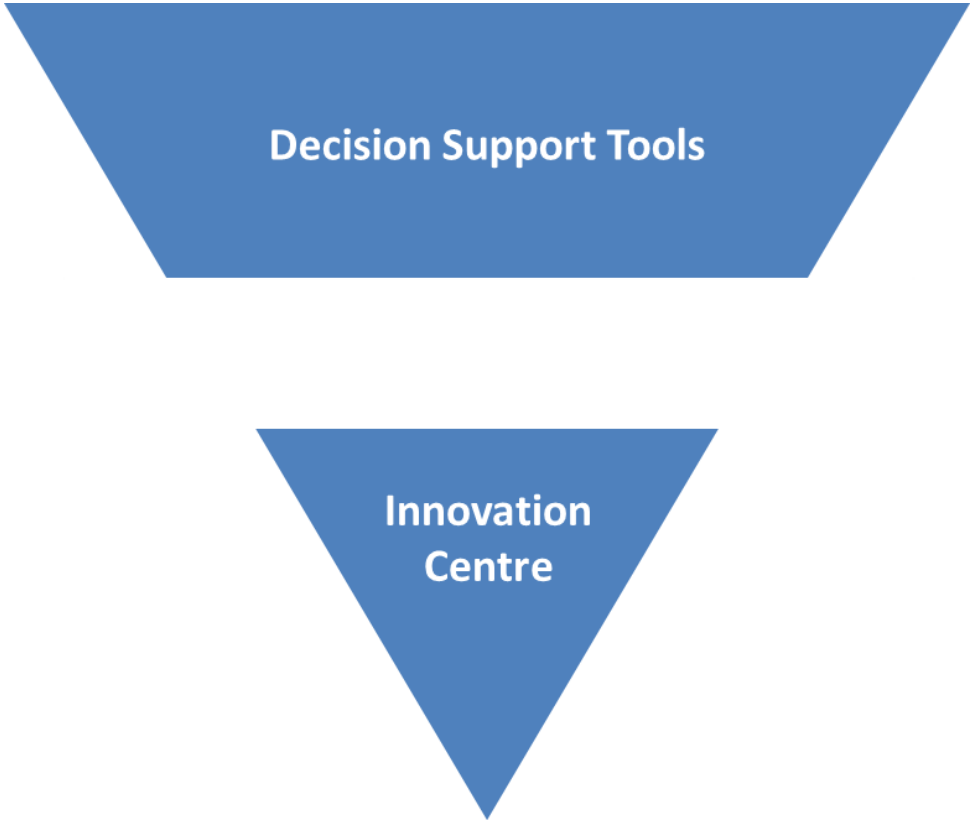
WP6: Simulation and Planning [Long Term/Planning]

Aim: Develop long term simulation platform for system planning. Focus on longer term energy planning scenarios and methodologies.

WP 7: Decision Making Models and Support Systems

Aim: Methods and tools to assist private and public agents in making “good” decisions to fully benefit from Smart Cities and guarantee a proper city development

CITIES Output



Key Outcomes

Key Outcomes

- Operational methods and scenarios for energy systems integration and management, paving scenarios towards a fossil free future
- Component level, modular and aggregate models of energy supply, consumption, and transmission, suitable for simulation, control and optimisation frameworks
- Market structures that support energy systems integration
- Modular forecasting and control models for a variety of energy system components, including their interactions
- Integration of short-term operational models in models for long-term planning.
- Models of energy consumption and production accounting for their stochastic and dynamic features.
- Methods for controlling energy consumption and demand side management.
- CITIES is aiming at being a leading knowledge centre for Smart Cities development and operational tools.
- Synergies with existing and new smart cities development projects

Innovation and Commercial Platform

Innovation Centre

Development of ideas for business opportunities in partnership with the energy sector, business partners and decision makers.

Development of new methods for aggregation, forecasting and control for future energy systems (eg. low temp. district heating)

Development of methods related to Energy Informatics (Eg. use of Smart Meter data for identifying potentials for energy savings)

Development of products such as apps and other software tools to suit niche applications revealed through CITIES research

Key partners: Dansk Industri, Lean Energy Cluster, VE-net (TI)

ENFOR
Forecasting and Optimization for the Energy Sector

DANSK ENERGI

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DONG energy

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HALDOR TOPSOE
CATALYSING YOUR BUSINESS

RAMBØLL

Ea Energy Analyses

NEAS ENERGY

GRØN ENERGI

FREDERIKSSUND KOMMUNE

DFF | EDB

Danish Partners

Dansk Fjernvarme

LEAN ENERGY CLUSTER

Dansk Industri

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AARHUS KOMMUNE

DTU Compute
Department of Applied Ma

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HØJE TAASTRUP
fjernvarme amba

TEKNOLOGISK INSTITUT

International Partners