4DH
4th Generation District Heating Technologies and Systems

ECODISTR-ICT

PRESENTING YOU THE ECODISTR-ICT IDSS

An integrated descision support system for district renovations

2016-09-29 // Kevin Vervuurt // Kevin.Vervuurt@arup.com

AGENDA

1. Introduction	Arup
	Project Factsheet
2. Ecodistr-ict tool	Problem Statement
	Objective
	Approach
	IDSS Dashboard
3. Warsaw case study	Case Study Issues
	Stakeholders
	Modules and Alternatives
	Overview of KPI scores
4. Conclusion	

“Total Architecture” implies that all relevant design decisions have been considered together and have been integrated into a whole by a well organised team. This is an ideal which is well worth striving for, for artistic wholeness or excellence depends on it.

- Ove Arup

Services

A

Acoustic consulting
Advanced technology and research
Airport planning
Architecture
Audio visual and multimedia

B

Bridge engineering
Building design
Building Information Modelling
Building physics
Building retrofit

C

Carbon management
Catastrophe risk and insurance
Civil engineering
Cost management

D

Distributed energy

E

Economic planning
Economics and planning
Electrical engineering
Energy strategy
Environmental consulting
Expert witness

F

Façade engineering
Facilities management
Fire safety
Fluid dynamics

G

Geographic information systems
Geotechnics

H

Hydrogeology

I

Infrastructure design
Interchange design
International development
IT and communications systems

J

K

L

Landscape architecture
Lighting design

M

Management consulting
Maritime engineering
Masterplanning
Materials
Mechanical engineering

N

Nuclear energy

O

Oil and gas
Operations consulting
Organisational behaviour

P

Planning policy advice
Product design
Programme and project management
Public health engineering

Q

Quantity surveying

R

Rail engineering
Renewable energy
Research
Resilience, security and risk

S

Seismic design
Site development
Software products
Specialist technical services
Structural engineering
Sustainability consulting
Sustainable buildings design
Sustainable infrastructure design

T

Theatre consulting
Thermal energy
Town planning
Transaction advice
Transmission and distribution
Transport consulting
Tunnel design

U

V

Vertical transportation design

W

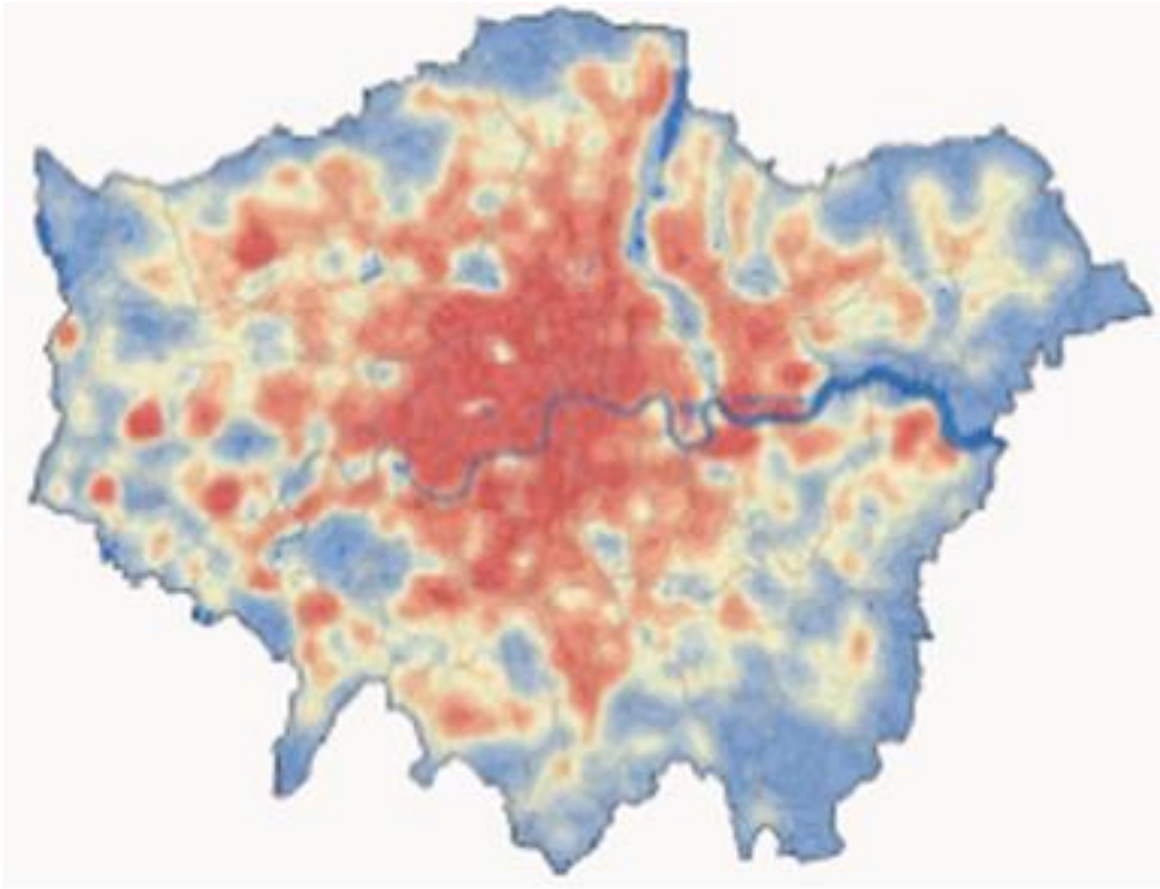
Waste management strategies
Waste to Energy solutions
Water engineering
Wind engineering

X

Y

Z


LONDON
HEAT NETWORK
MANUAL
MAYOR OF LONDON
Co-funded by the Intelligent Energy Europe Programme of the European Union



FACTSHEET

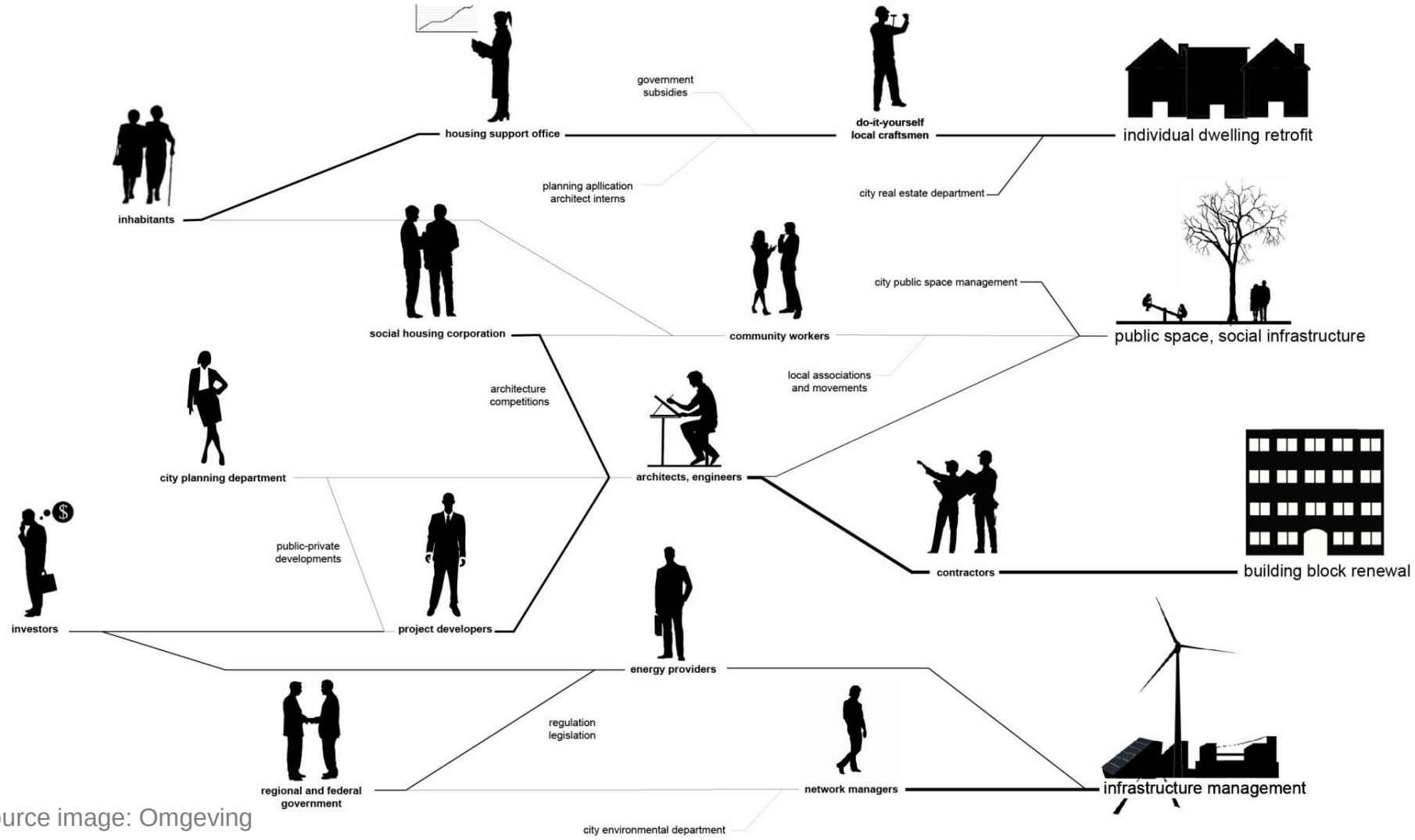
Full title	Integrated decision support tool for retrofit and renewal towards sustainable districts
Duration	December 2013 – November 2016
Total budget	4.1M€, of which 3.0M€ EU FP7 funding
Website	www.ecodistr-ict.eu
Coordinator	VITO, Belgium
Consortium	vito Project Coordinator, ARUP, bipolaire arquitectos, CSTB, OMGEVING, SP, StruSoft, TNO innovation for life, vabi, white

5 ECODISTR-ICT CASE STUDIES THROUGHOUT EUROPE

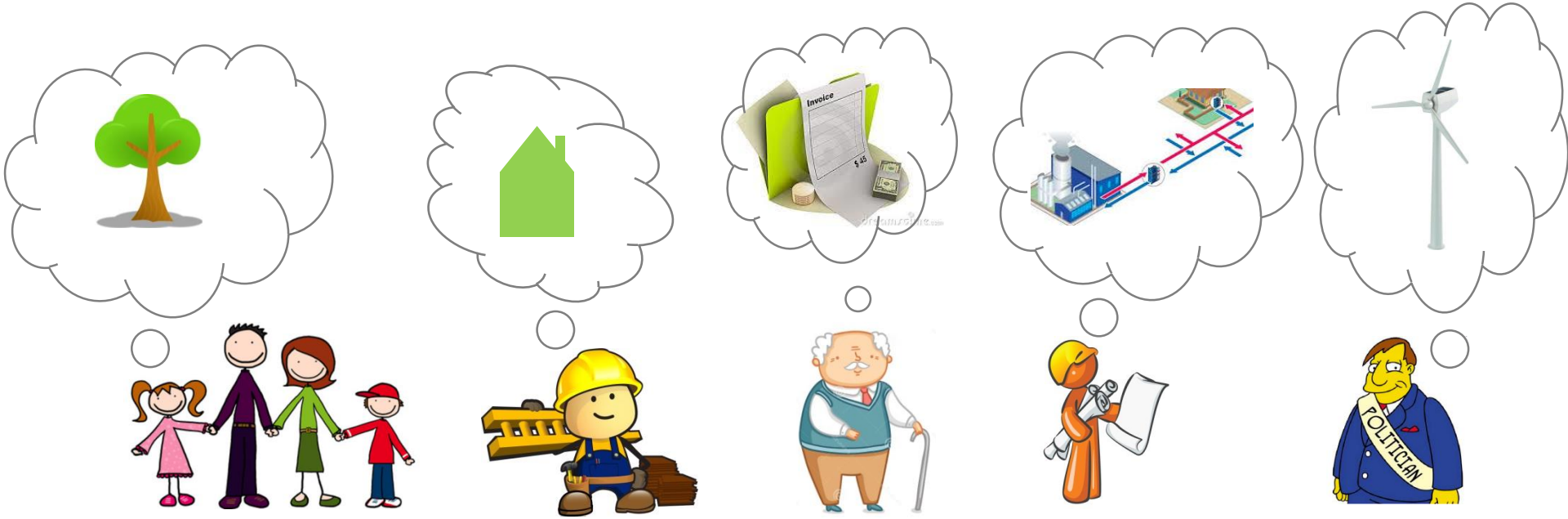
How shall we renew an existing district and its composing buildings?

Campanar district, Valencia (Spain)

MULTISTAKEHOLDER



Source image: Omgeving


Invoice
$ 45
POLITICIAN

MULTIDISCIPLINARY PROBLEM

- Energy
- Local green space and ecologic values
- Resource efficiency
- Social quality
- Life cycle costing
- Heat stress
- ...

MULTI-SCALE PROBLEM

Example: **Energy**

From building elements and buildings to district level analysis

How shall we renew an existing district and its composing buildings?

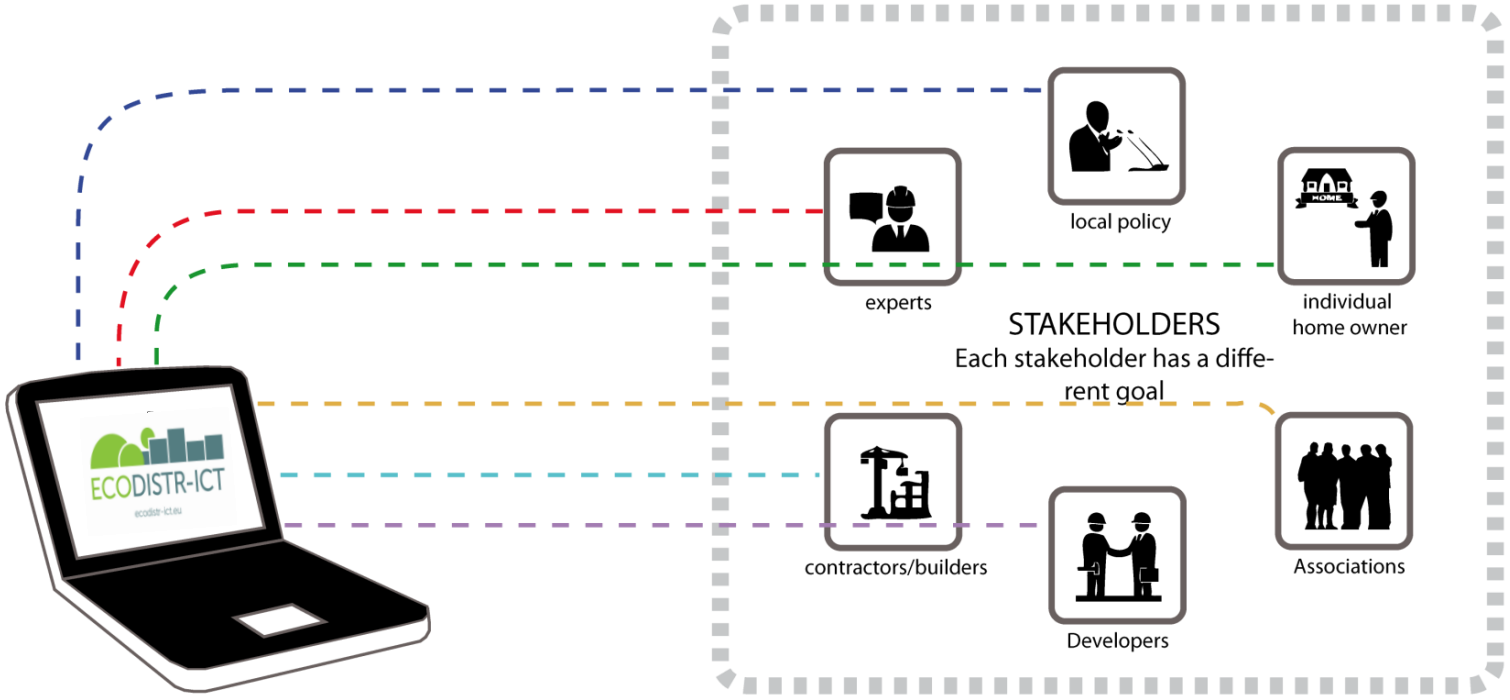
- connect the main **stakeholders and decision makers**
- use (open) **data** for better informed decision making

→ there is a need for a better coordinated approach that allows for optimization and prioritization of decision-making.

ECODISTRICT IDSS

Integrated decision support system

aimed at facilitating sustainable renewal of districts

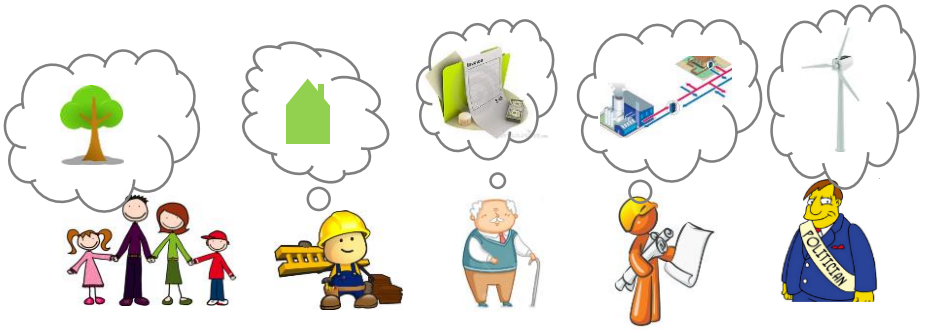


Source image: Bipolaire

INTEGRATED DECISION SUPPORT TOOL

MULTI-ACTOR

Connecting the main stakeholders in urban district transformation programs



MULTI-SCALE

From building elements and buildings to district level analysis

MULTI-DISCIPLINARY

Connecting tools on water use, energy, nature based solutions, social aspects, economic analysis

Approach of Ecodistr-ICT IDSS

- KPI set is composed by users at the beginning of the process
  - no predefined set of KPI's
- Weight and ambitions set by stakeholders individually
  - Not 'forced to agree' before starting the analysis
- No new calculation modules developed in the project
  - We implemented / adapted existing (open source) calculation tools
- 'Facilitator': expert user + process guidance
  - to balance ease of use for broad range of stakeholders while dealing with complex issues and expert software
- IMB: inter-model broker
  - Connects multiple calculation modules, data module and user interface (dashboard)

Step by step approach implemented in IDSS

- Analyse problem → choose set of KPI's + calculation modules
- Collect data → Qualitative or quantitative
- As is situation → Visualise KPI's for current situation
- To be situation → Set ambitions
- Develop alternatives → Manual, or using design tool
- Compare alternatives → And discuss with other stakeholders

IN REALITY: ITERATIVE PROCESS





As is situation

KPI list | Map

KPI's set by user

ECODISTR-ICT

KPI database

Change of global warming potential
Use Edit

LCC
Use Edit

PV_kWh_year_dwelling_Rubroek
Use Edit

PV kWh/year per dwelling Rubroek

Test_Energy Consumption
Use Edit

Biotope area factor
Use Edit

Change of global warming potential per heated area
Use Edit

KPI set for this decision process

ENERGY - Distribution of Energy Consumption: Fossil for heating

ENERGY - Distribution of Energy Consumption: Electricity for heating

ENERGY - Distribution of Energy Consumption: Electricity for cooling

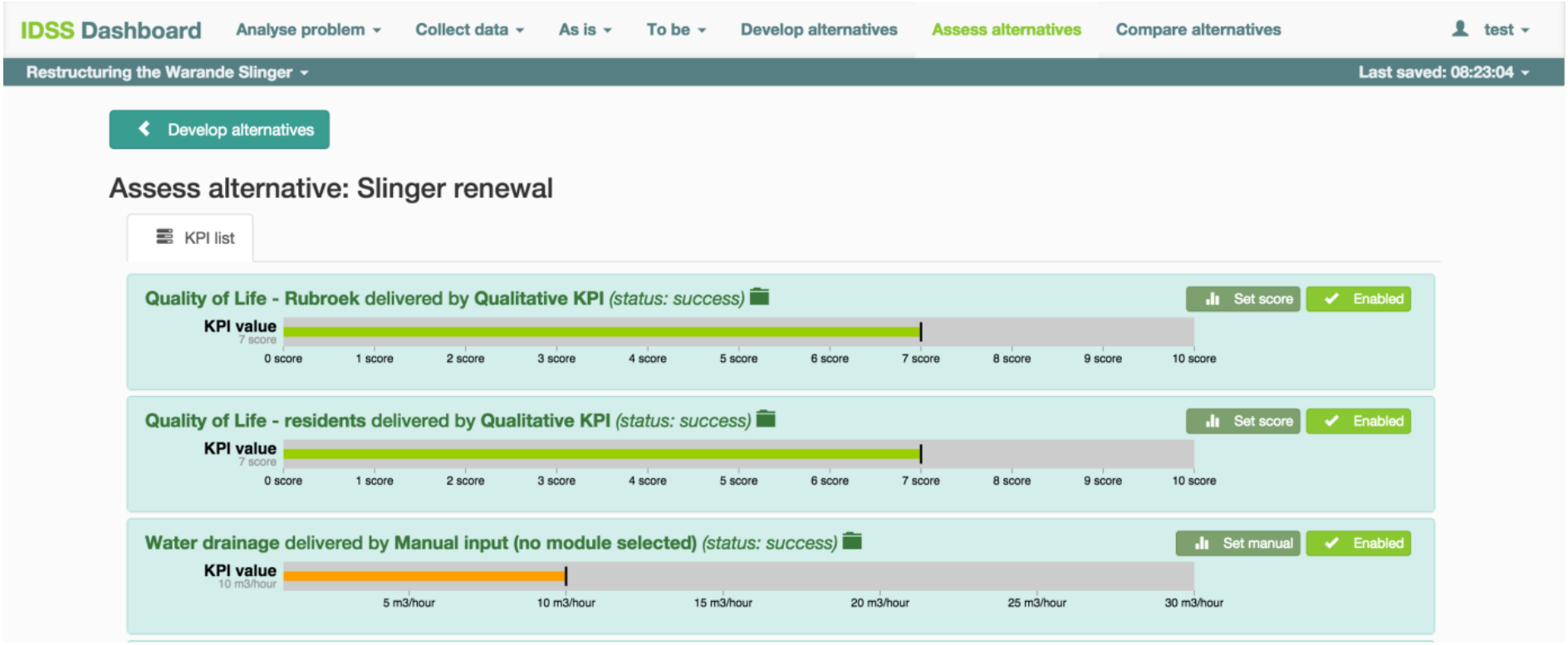
ENERGY - Total Energy Consumption for Heating per Built Area

LCC payback period

LCC - NPV renewal solutions - District scale

LCC - Payback period renewal solutions - district scale

Qualitative KPI's alongside quantitative

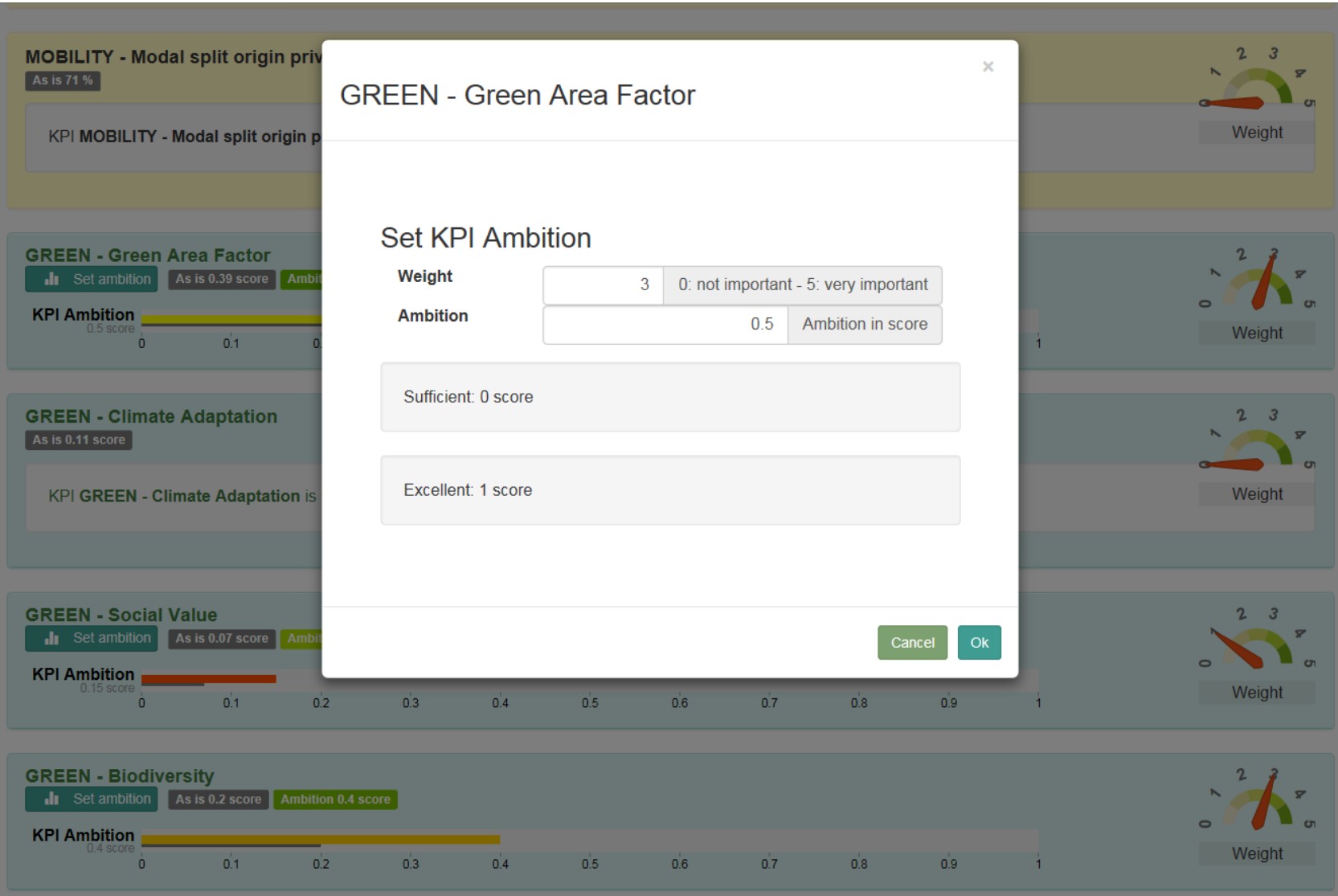


→ Gathered by 'epert judgement' or data crowdsourcing module

KPI weights and ambition

ECODISTR-ICT

⟶ Can be set by each stakeholder individually



IDSS Dashboard

Analyse problem | Collect data | As is | To be | Develop alternatives | Assess alternatives | Compare alternatives

Blanca

Sustainable Urban Renovation of Campanar | Last saved: 12:15:10

Send data to MCMSMV module

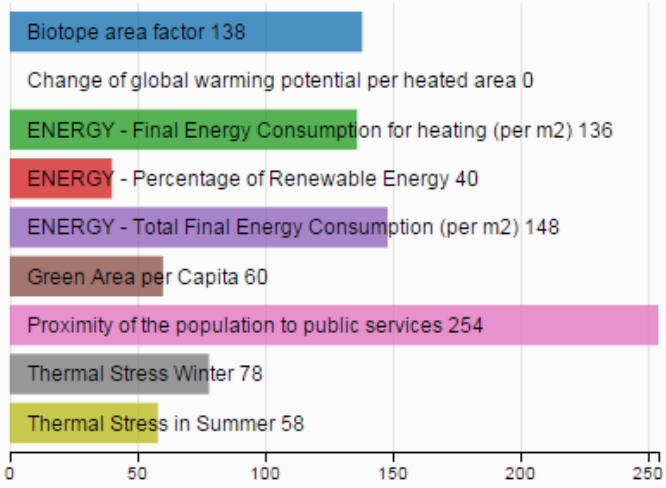
Compare alternatives

Show scores | Show kpi values

Stakeholder filter

Alternative filter

KPI filter



KPI List

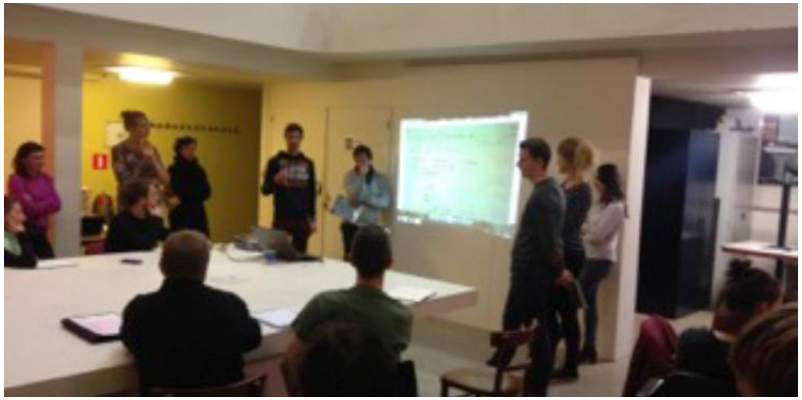
KPI name	Stakeholder	KPI score	Weight	Sufficient	Excellent
1. Conservative Scenario					
Biotope area factor	Architects & Engineers	3	5	0.3 score	0.5 score
Biotope area factor	Facilitator	3	0	0.3 score	0.5 score

Expert view of KPI scores for 1 stakeholder

ECODISTR-ICT

Results displayed on map

Stakeholder interaction



ONGOING

Warsaw - case study

Location

Key data

- Since the early 1920s it was one of the industrial areas of Warsaw, many important works and factories were located there - the area being previously (20 years ago) fully occupied by factories.
- In last 6 years most of the big factories were transformed into offices - the area is now retrofitting into modern office / residential district with other complimentary services (shopping centre, cinema, medical facilities etc).
- Currently it changed his function from typical offices district to mixed function apartment house and office

Past and ongoing developments

Warsaw - Issues

Main issues

1. Outdated utilities network
2. **Insufficient capacity of energy and transport network**
3. **Too many private vehicles**
4. Unclear landownership status of some plots
5. No visions/ masterplans by the city authority
6. Ongoing office/residential construction
7. Many old (60's, 70's, 80's) residential buildings
8. **Fossil fuel based energy system**

Main stakeholders

- Energy providers
- City authority
- **Transport planning authority**
- Housings associations
- Residents
- **Commuters (people working in the area)**
- **Real estate developers**
- **Engineers**
- Financial institutions

Main stakeholder objectives

- Efficient, reliable, flexible and affordable energy system
- Integrated planning; more mixed use planning in relation with transport planning
- Improve energy efficiency of old buildings
- Green certification of buildings
- Improved car accessibility
- Enough parking spaces
- Higher public transport accessibility
- Attractive public space

Warsaw - Stakeholders

Key stakeholder	Module	Issues	Ambitions
- Researcher/ Engineer	Energy (Dimosim)	- Insufficient capacity of energy network - Fossil fuel based	- Future proofed energy system (Energy trilemma)
- Developer - Energy/utility company	LCC	- High investment costs	- Economic efficiency and cost effectiveness
- EC - City (green) planning department	Green spaces	- No integrated green infrastructure	- Biodiversity, - Water management, - Attractive public space
- City Transport planning department	Mobility	- Bad accessibility during peak hours - Private transport as the dominant mode - Capacity of public transport limited	- Good accessibility (drastic reduction of traffic congestion)
- Developer - Researcher/ Engineer	Energy Performance improvement (Energy label)	- Old building stock with a high energy demand	- Reduce energy demand of consumers

Warsaw – modules

Modules	As is (Existing situation)	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Dimosim	HTDH	Drastic energy demand reduction (building skin)	LTDH (building skin + energy system)	All electric + PV (building skin + energy system)	LTDH + DC (building skin + energy system)
LCC (Dimosim)	Retrofitting requirement	See Dimosim variant	See Dimosim variant	See Dimosim variant	See Dimosim variant
Energy Performance Improvement	Inefficient	See Dimosim variant	See Dimosim variant	See Dimosim variant	See Dimosim variant
Mobility	Car oriented	Improved public transport	Reduced private transport	Improved traffic management	*Sum off all**
Greenspaces	Not managed	Green roofs	Permeable surfaces	Green roofs + Permeable surfaces	*Microclimate (public space)**

Warsaw – DIMOSIM

Scenario	Description	Appliances	Windows	Walls	Heating system	Cooling system	Energy supply
1. As is	- Existing situation	- Existing situation	- BAU	- BAU	HTDC	- Only office functions	
2. Energy demand reduction	- Energy demand reduction by insulating the building skin - Energy efficient appliances	- Energy efficient lighting	- Tripple glazing for all functions except office functions	- Additional insulation for all functions except office functions	HTDC	- Only office functions	
3. LTDH	- Scenario 2 measures - Low temperature district heating	- Energy efficient lighting	- Tripple glazing for all functions except office functions	- Additional insulation for all functions except office functions	LTDH	- Only office functions	
4. All electric	- Individual Heat pumps, energy production	- Energy efficient lighting	- Tripple glazing for all functions except office functions	- Additional insulation for all functions except office functions	LTDH	- Only office functions	- 50% of all roof area
5. LTDH + district cooling	- Scenario 3 measures - District cooling	- Energy efficient lighting	- Tripple glazing for all functions except office functions	- Additional insulation for all functions except office functions	LTDH	- District cooling for office functions	

Heat demand approach

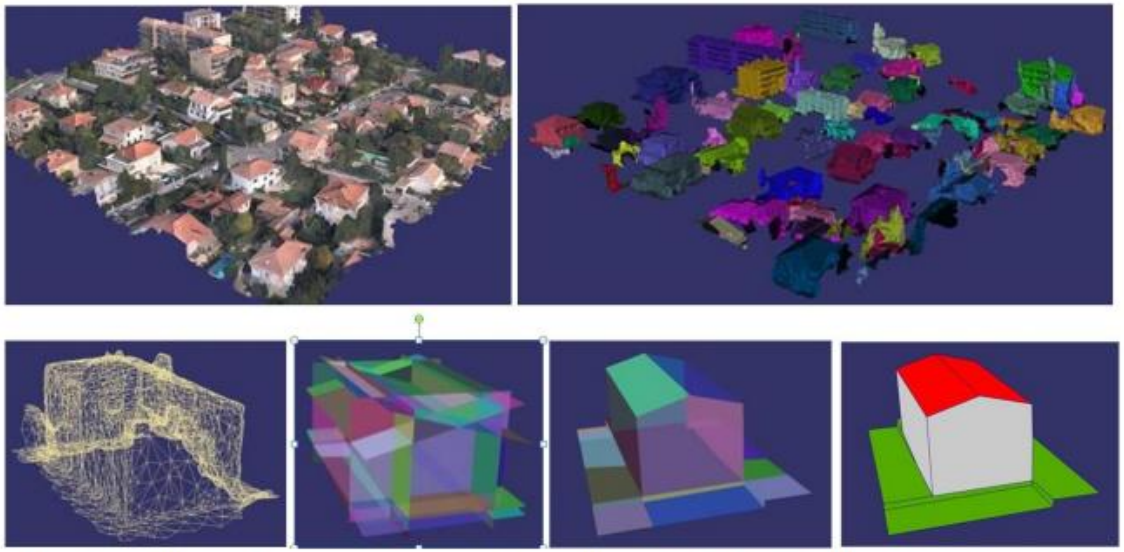
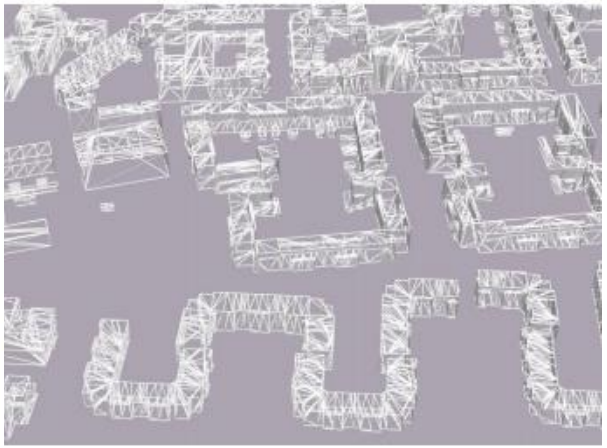
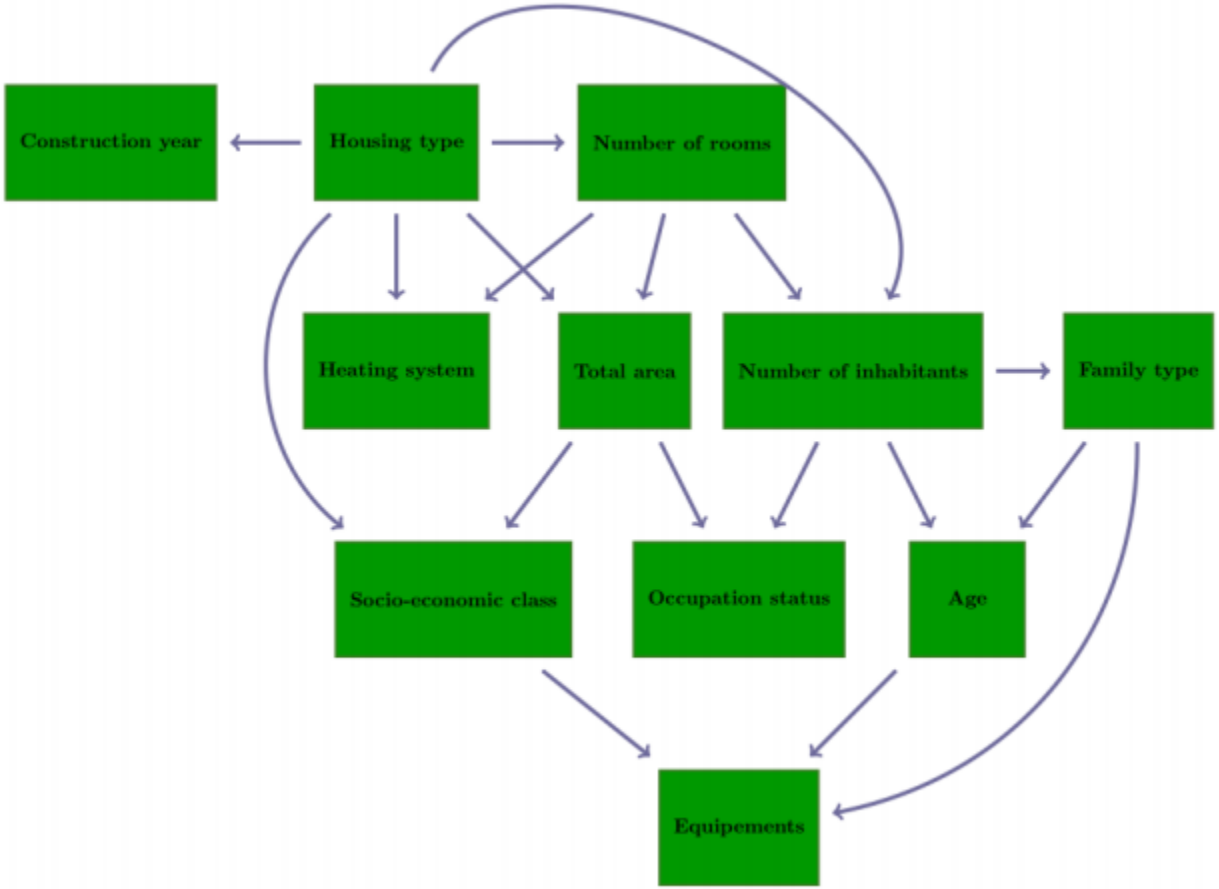
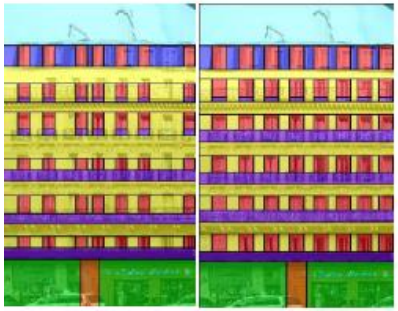


Figure 9 - From 3D automatic geometric reconstruction to semantic modelling. (left to right and top to bottom) Automatic 3D reconstruction from aerial images; Extraction of buildings; Zoomed view on a single building (approx. 5000 triangles); Construction of a polyhedral complex with extracted planar primitives; Buliding shape extraction from the complex; Semantic modelling of the building (red: roof, gray: walls, green: ground).



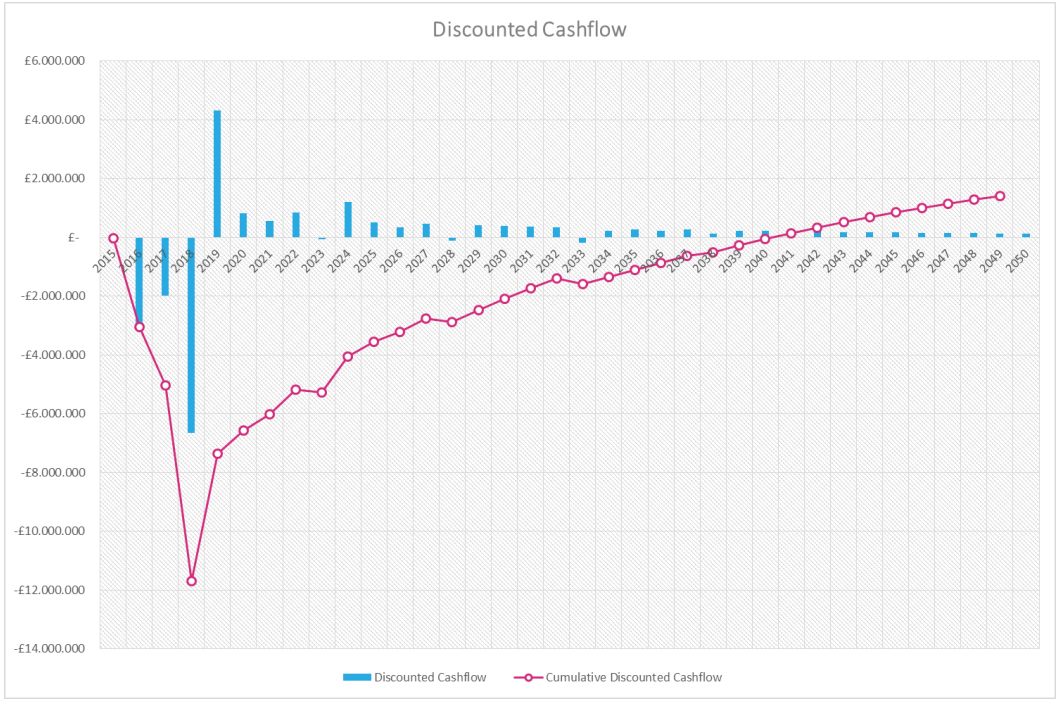
Heat demand approach



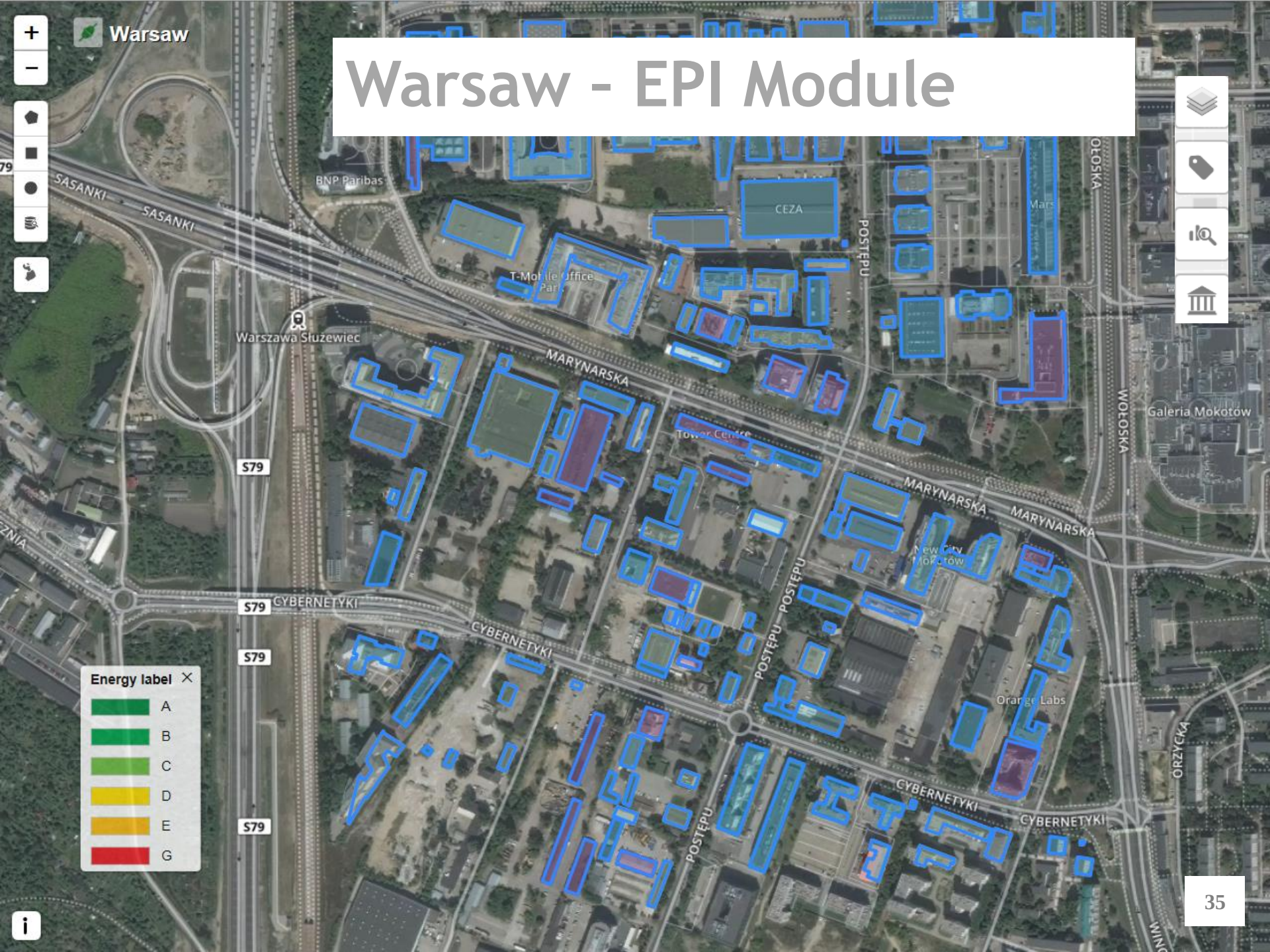


Warsaw – LCC module

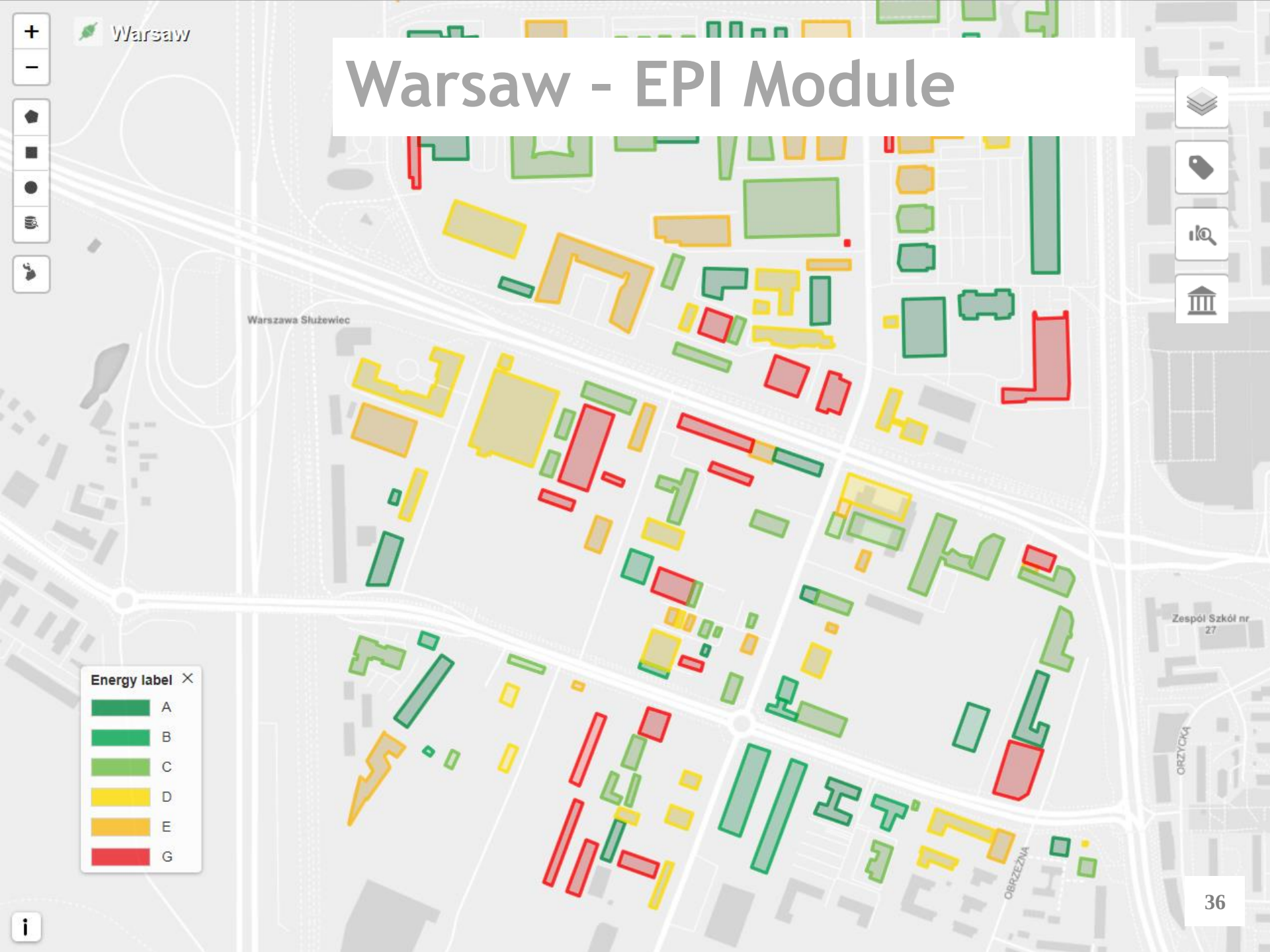
Scenario	Description
1. As is	- Existing situation
2. Energy demand reduction	- Energy demand reduction by insulating the building skin - Energy efficient appliances
3. LTDH	- Scenario 2 measures - Low temperature district heating
4. All electric	- Individual Heat pumps, energy production
5. LTDH + district cooling	- Scenario 3 measures - District cooling



Warsaw - EPI Module



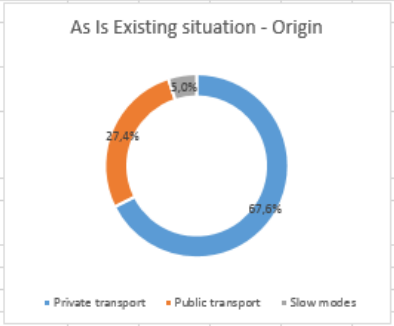
Warsaw - EPI Module

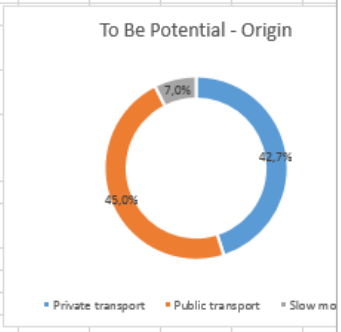


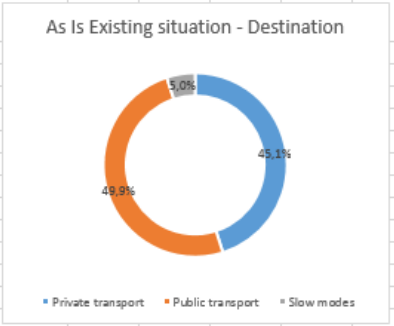
Warsaw – Mobility module

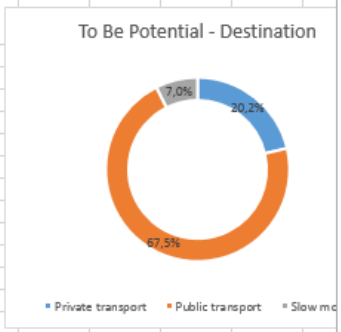
Measures				OUTPUT		
	Typology	Application	Y/N	Private transport	Public transport	Slow modes
1	Public transport	Combine tram and bus infrastructure	Y	-3,0%	3,0%	0,0%
2	Public transport	Larger tram and bus vehicles up to max. 20% increase	Y	-1,0%	1,0%	0,0%
3	Public transport	Higher frequency tram and bus services up to max. 20% increase of tram and bus stop service.	Y	-1,0%	1,0%	0,0%
4	Public transport	Optimisation of bus routes	Y	-0,5%	0,5%	0,0%
5	Public transport	Modification of tram and bus routes to connect to P&R	Y	-3,0%	3,0%	0,0%
6	Private transport	Parking zone policy	Y	-2,8%	2,8%	0,0%
7	Private transport	P&R	Y	-5,0%	5,0%	0,0%
8	Traffic management	Flex working	Y	-2,7%	-2,7%	0,0%
9	Traffic management	Promotion of public transport (employers paying for public transport)	Y	-5,0%	5,0%	0,0%
10	Traffic management	Mixed use planning	Y	-1,0%	-1,0%	2,0%
	AS IS					
	Modal split		Origin	67,6%	27,4%	5,0%
			Destination	45,1%	49,9%	5,0%
	TO BE					
	Modal split potential		Origin	42,7%	45,0%	7,0%
			Destination	20,2%	67,5%	7,0%

Graphs

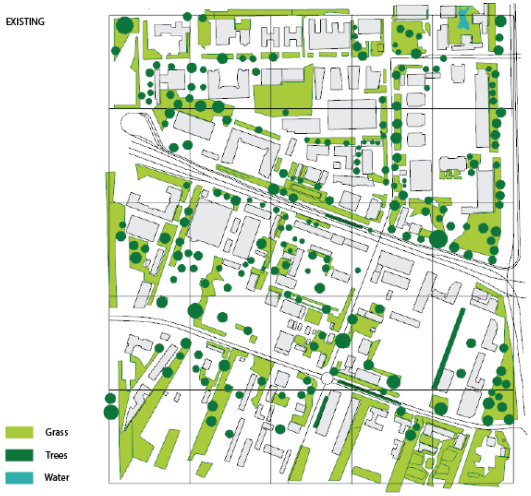


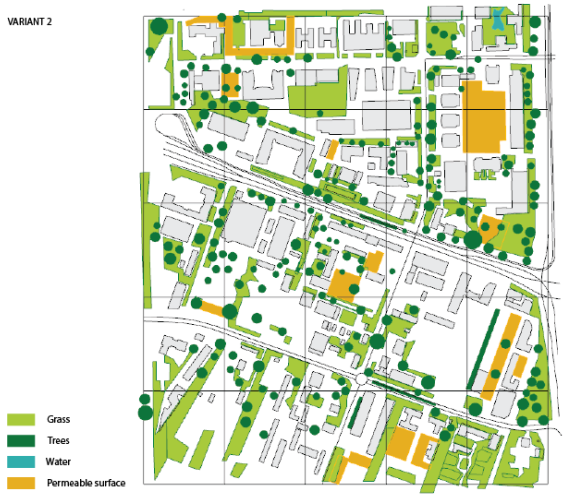






Warsaw – Biotope module

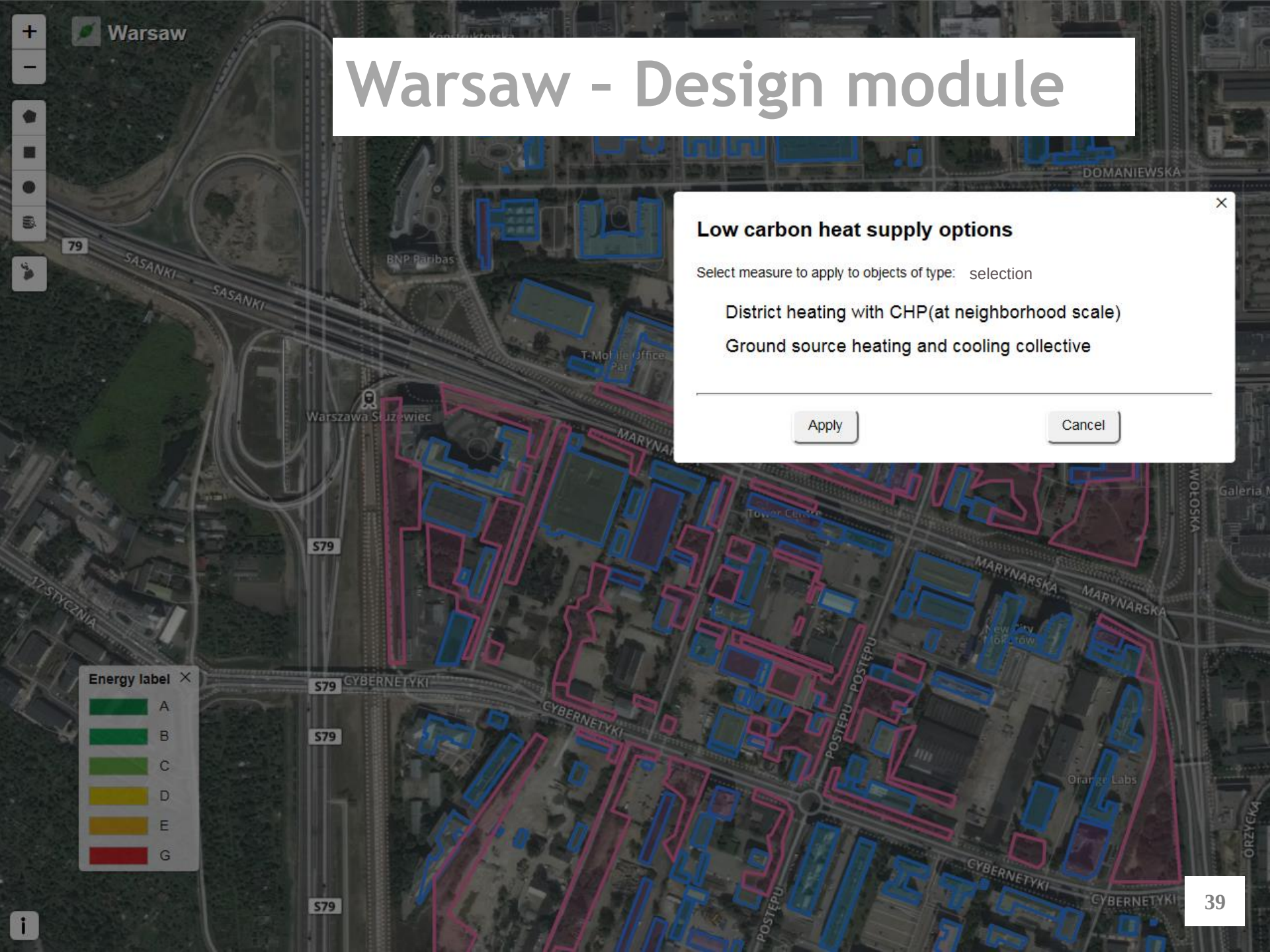




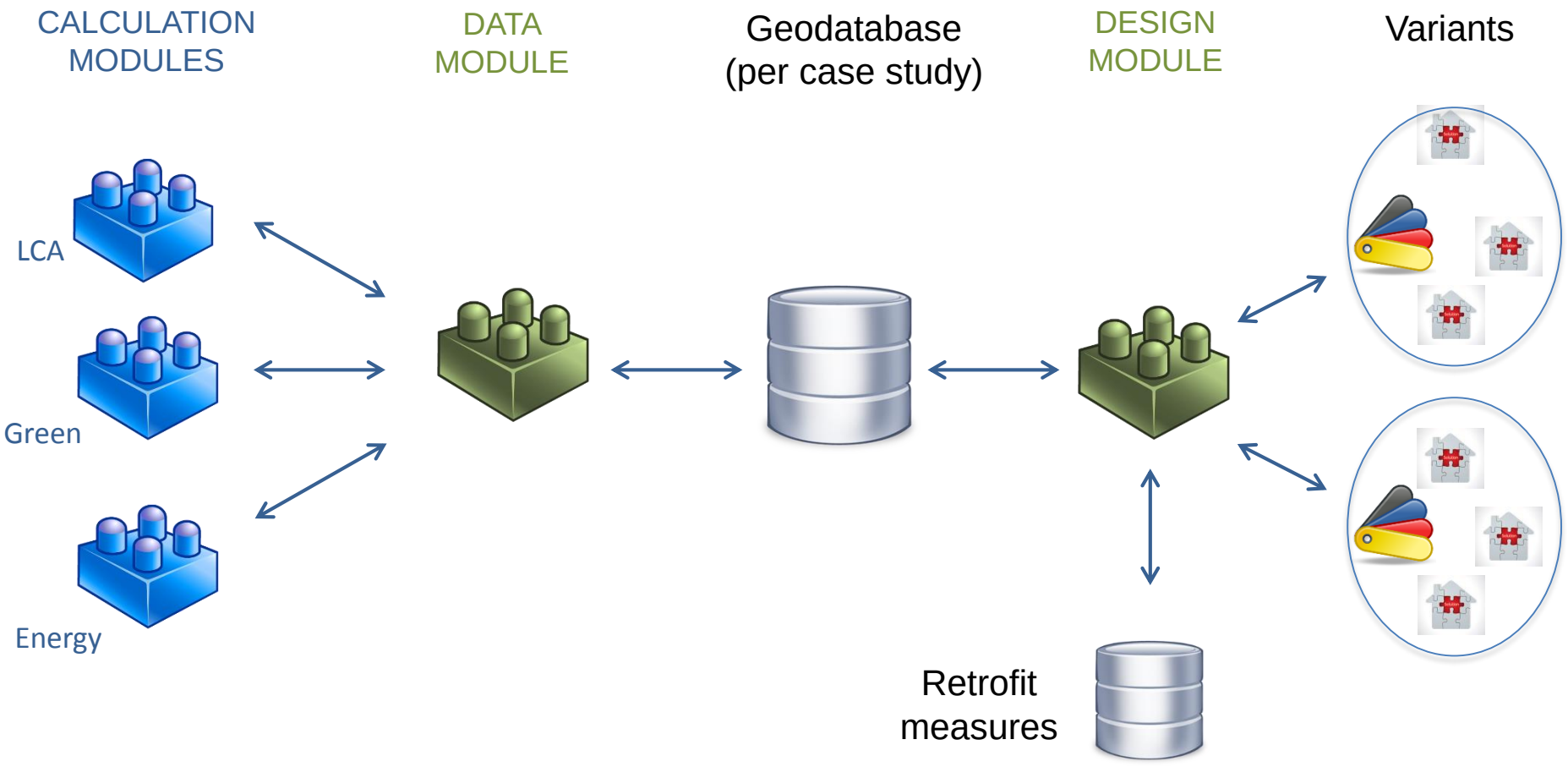
Renewal solutions

1. Permeable car parking
2. Grass
3. Trees
4. Water
5. Green roofs
6. Permeable areas

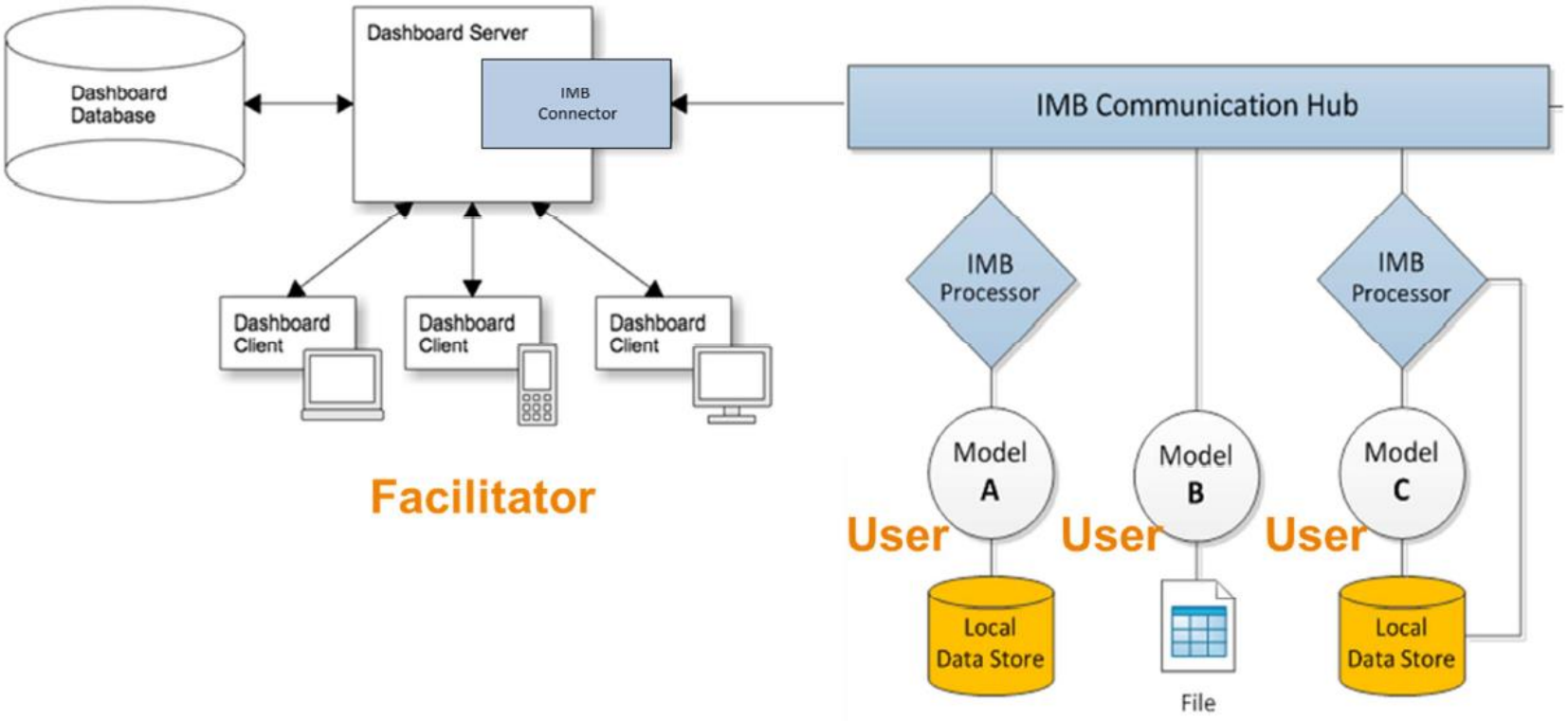
Warsaw – Design module



Database and module connections



System architecture



Warsaw - KPI overview

Conclusion

- Ongoing work
  - Calculations of results
  - Calibration of MCMSMV
  - Stakeholder workshop/management
- Content
  - Complexity of linking approach to calculations and output
  - Data management
  - Energy important but not the priority for stakeholders
- Process
  - A lot of time and budget in meetings with partners
  - Handbook before instead of after process
- Communication
  - Visuals to be more simple
  - Clarity of steps in dashboard

Moving forward

- Wrap up of case studies
  - Warsaw
  - Antwerp
- Conference
  - Final conference 27th October in Antwerp
- Reporting
  - December 2016
- Follow up project

ECODISTR-ICT

Supported by the European Union
through its 7th Framework Programme

THANK YOU FOR YOUR ATTENTION

Get connected http://ecodistr-ict.eu/ info@ecodistr-ict.eu Kevin.vervuurt@arup.com