
ENERGY COMMUNITY AND SOCIAL ACCEPTANCE

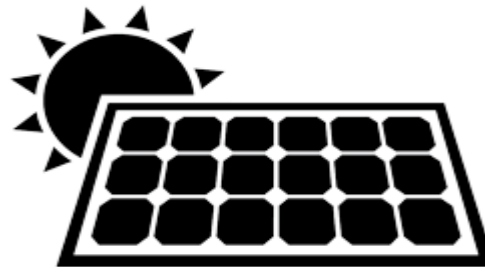
MULTI-CRITERIA PLANNING TOOL FOR A NET ZERO ENERGY VILLAGE

Prospect2030 on line Meeting – 28.01.2021- Promotion of PV initiatives

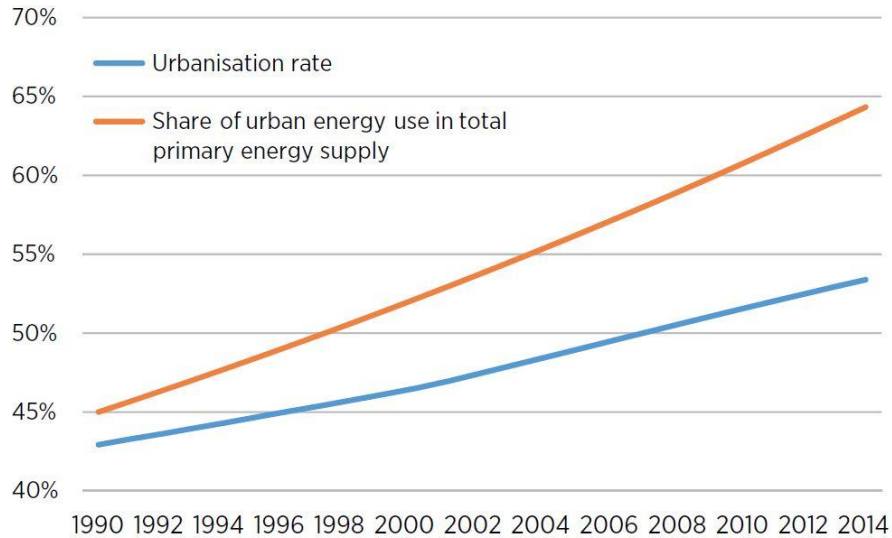
P.Lombardi. B. Arendarski, P. Komarnicki

AGENDA

1. Motivation
2. The role of RES in rural areas
3. Planning net zero energy village
4. NZEV Study case: Punsok 2050



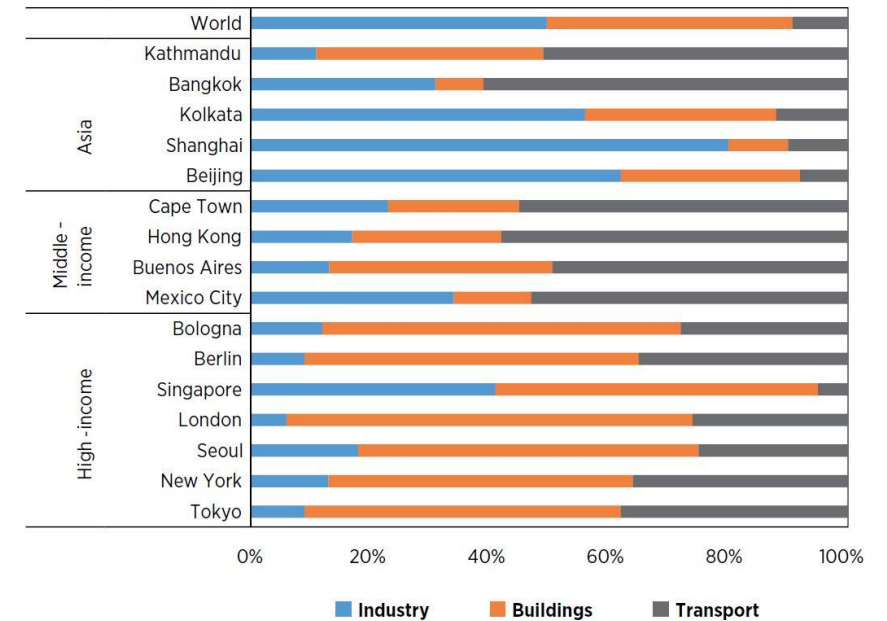
THE ROLE OF RENEWABLE IN URBAN AREAS



Source: IRENA (2016)

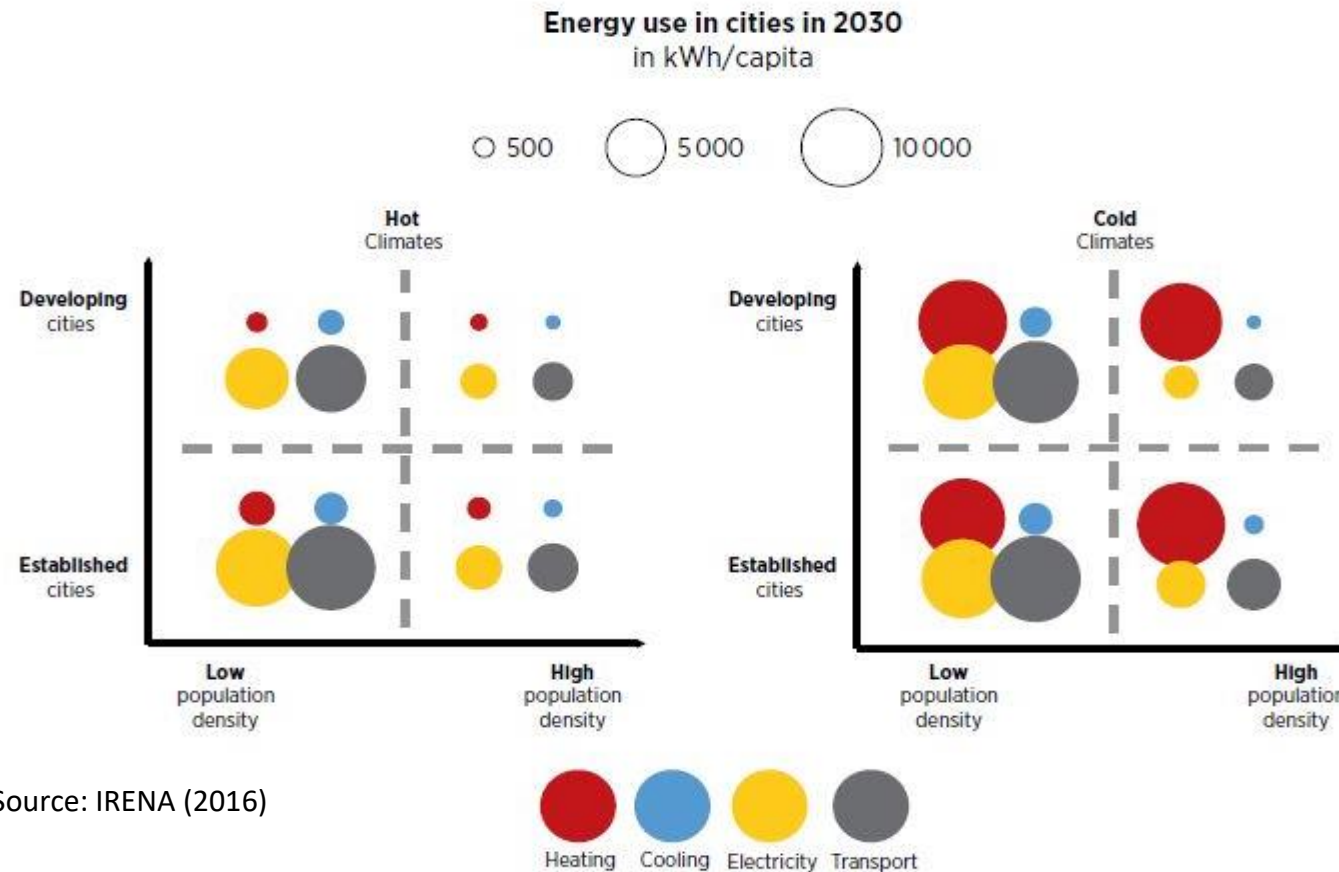
Share of urban energy use in total primary energy supply

Share of urban energy use in total primary energy supply



Source: IRENA (2016)

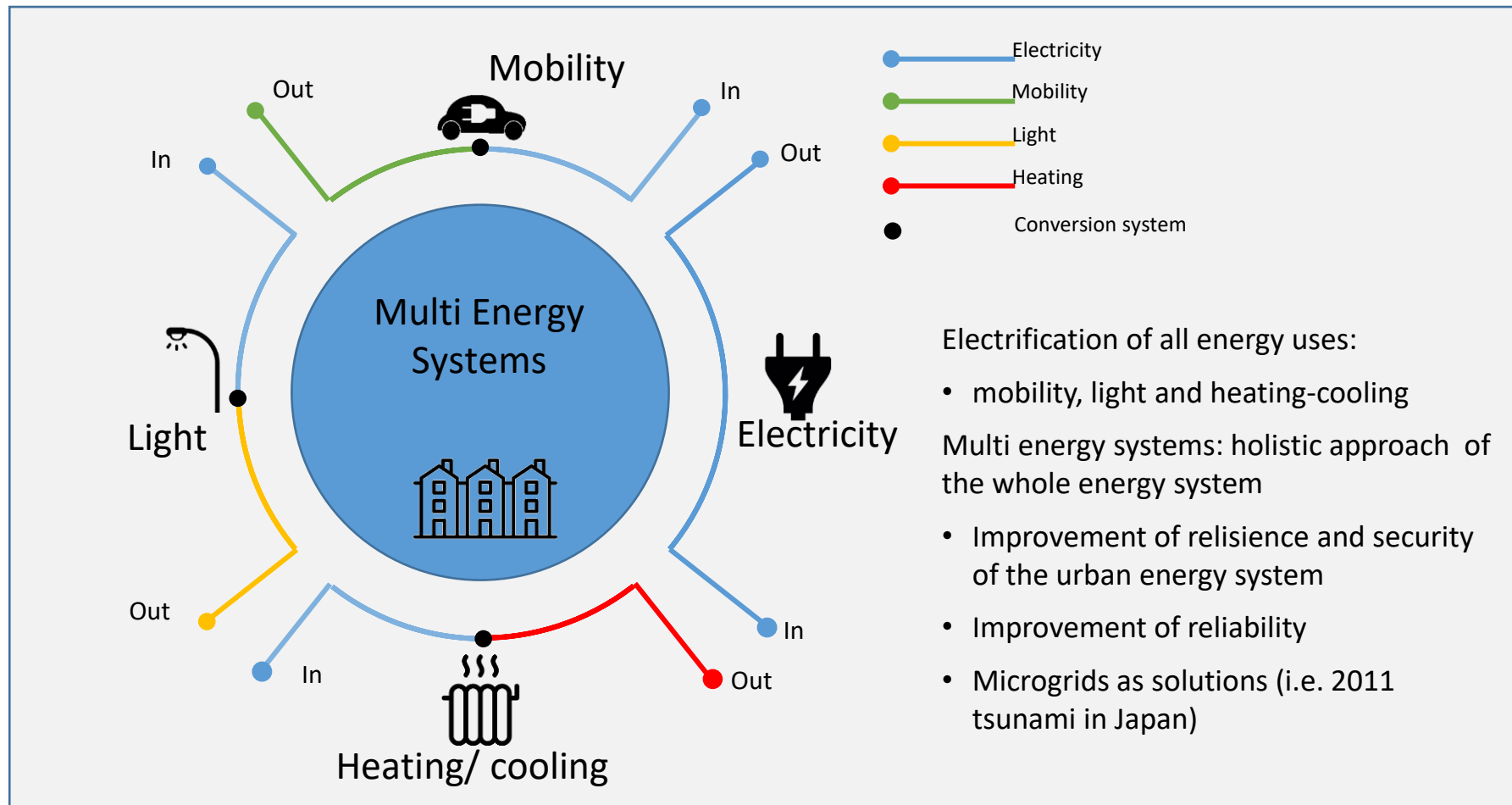
ENERGY USE IN URBAN AREAS IN 2030



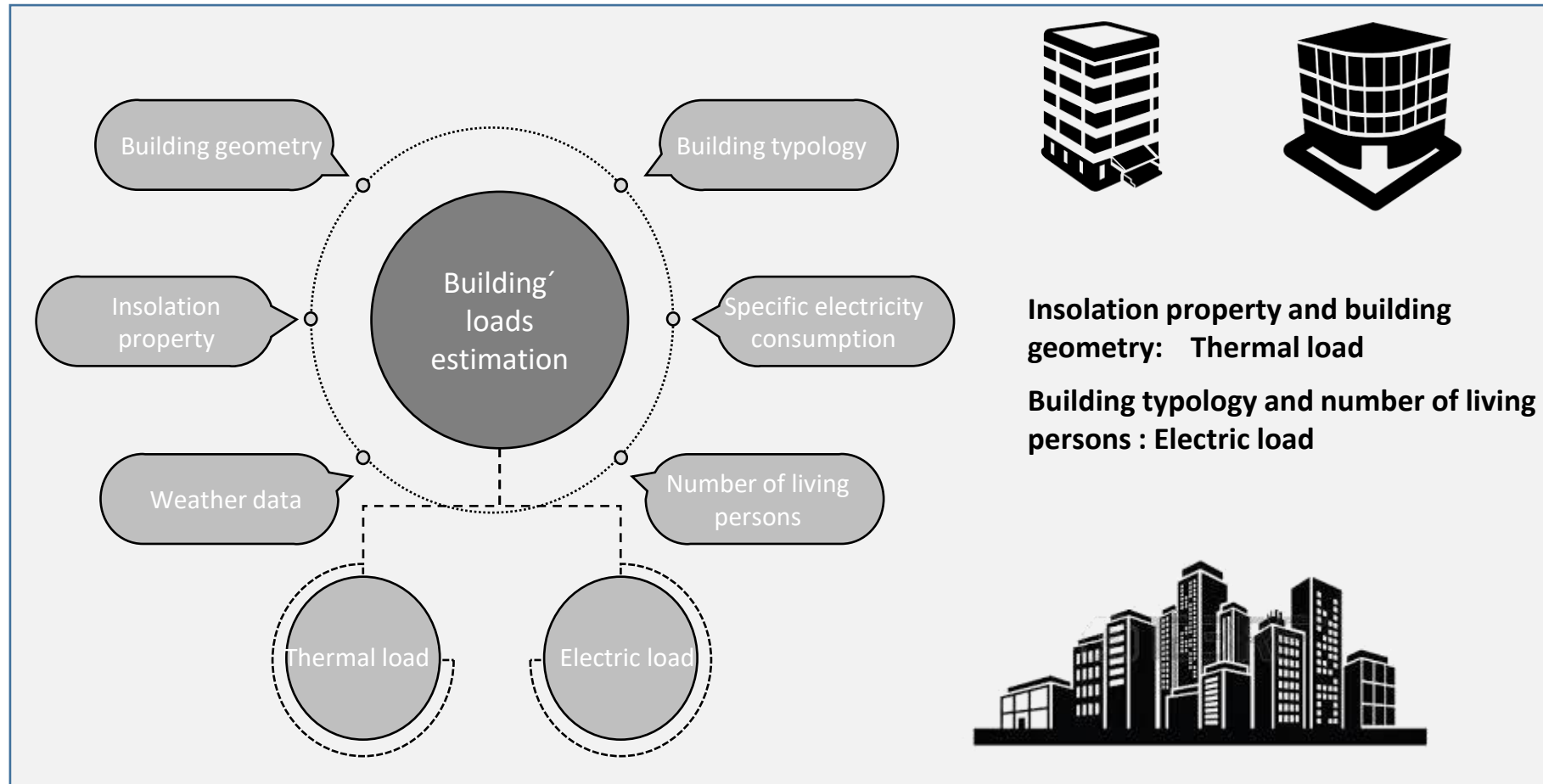
Source: IRENA (2016)

- Cold climate zones the heating energy accounts about 90% of the total consumption
- In hot climate zone the electricity and transportation dominate the energy use
- Population impacts more on energy for transportation

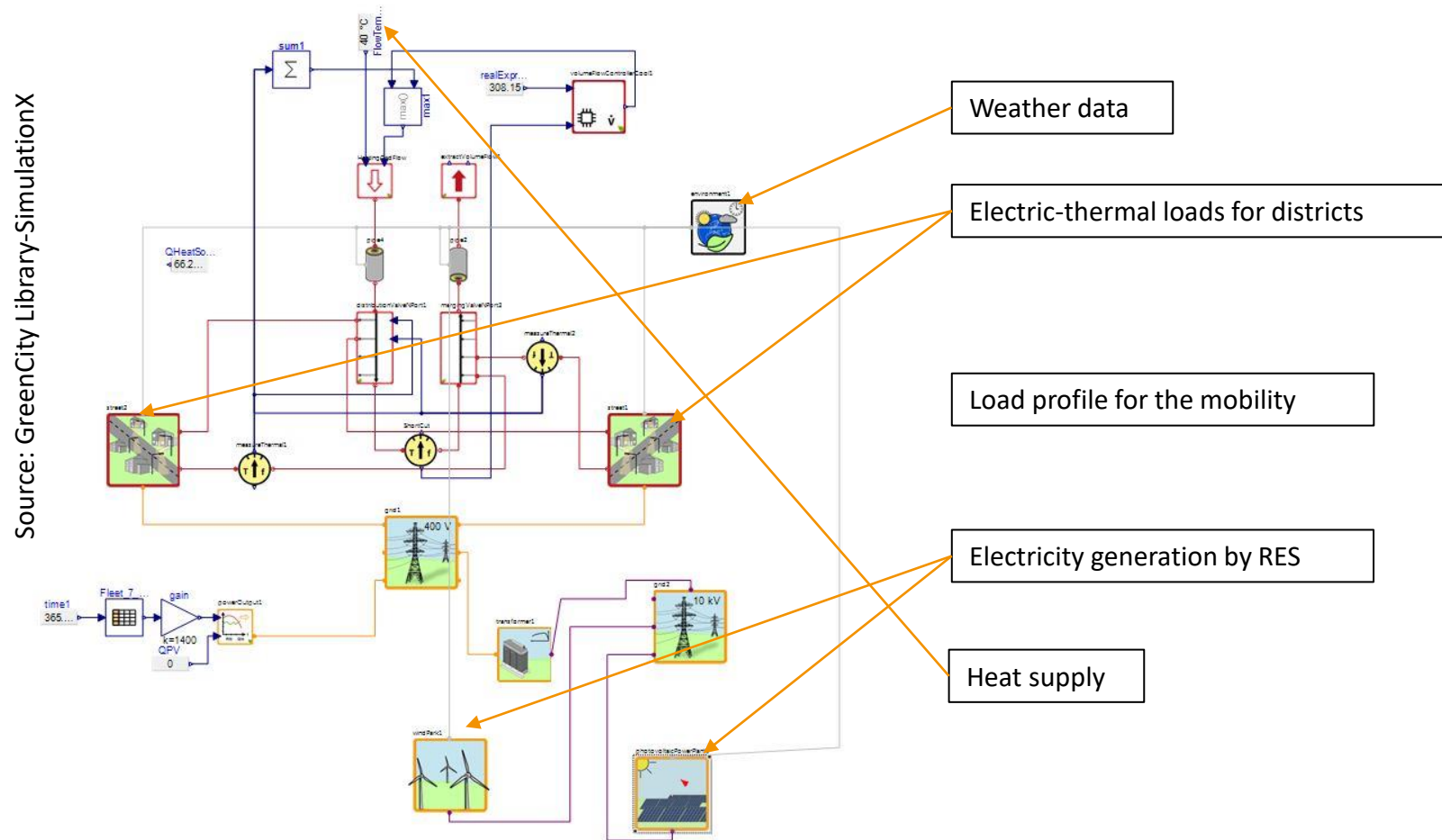
PLANNING NET ZERO ENERGY VILLAGE: ENERGETIC HOLISTIC APPROACH



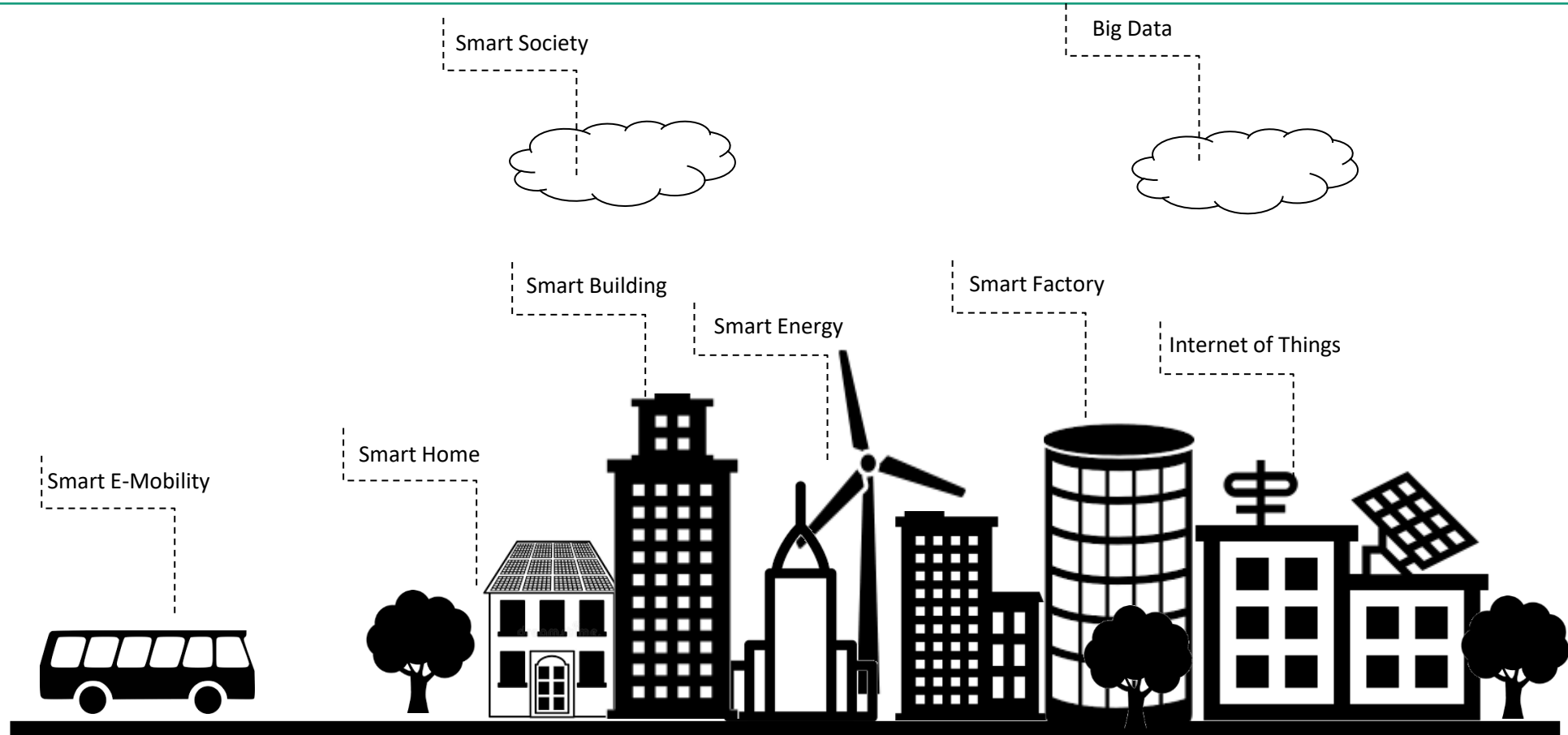
PLANNING NET ZERO ENERGY VILLAGE: MODELLING TOOLS FOR ENERGY USE IN BUILDINGS



PLANNING NET ZERO ENERGY CITIES: MODELLING TOOLS FOR ENERGY USE IN BUILDINGS, MOBILITY AND FOR ENERGY GENERATION



STUDY CASE: PUNSK 2050 NET ZERO ENERGY SYSTEM

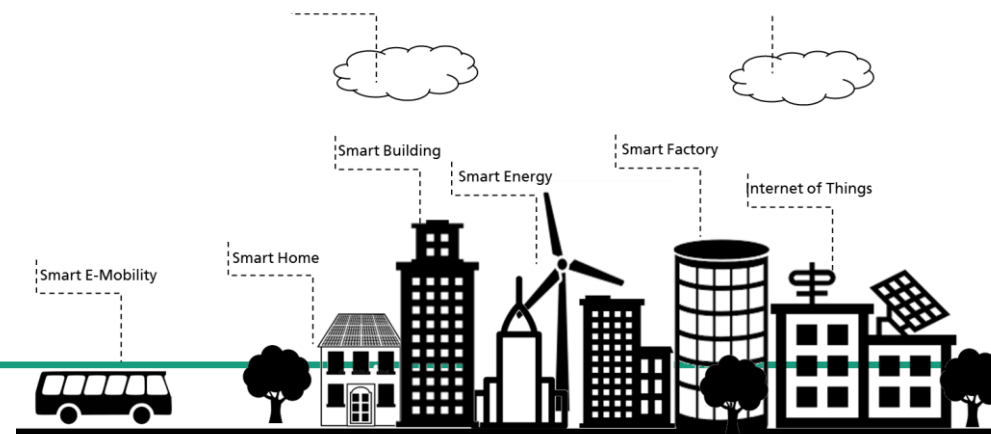
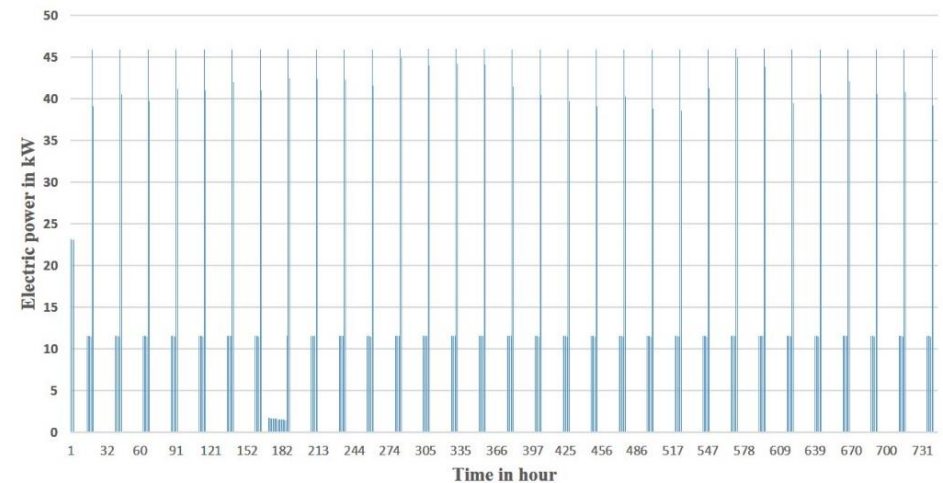


PUNSK 2050 NET ZERO ENERGY SYSTEM: BUILDING TYPOLOGY AND E-MOBILITY ASSUMPTIONS

Building typology and characteristics

Building Typology	Building age	Nr. of floors	Annual specific elec. consume [kWh/m ²]	Nr. of persons living in 100 m ²	Amount of buildings
Educational	1995-2002	3	15	12	2
Residential	1995-2002	2	11	4.8	250
Farm	1995-2002	2	10.2	1.5	9
Office	1995-2002	2	36	2.5	2

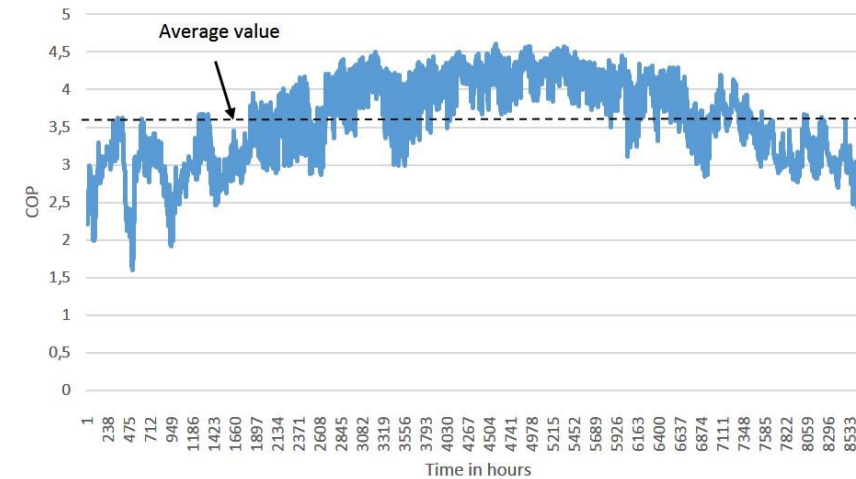
Electric power consumption for e-mobility



PUNSK 2050 NET ZERO ENERGY SYSTEM: HEAT PUMP PERFORMANCE EVALUATION

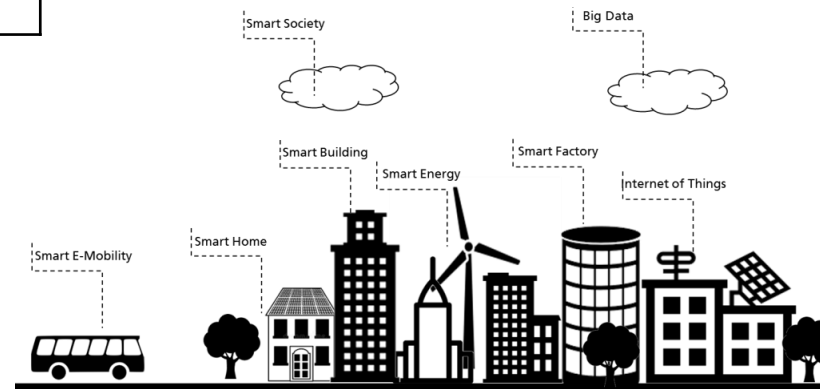
Air-to-Water Heat Pump

Heat source temperature (K)	Sink side temperature (K)				
	288.15	308.15	318.15	328.15	333.15
253.15	3.2	1.9	1.4	1.2	1.1
258.15	3.6	2.3	1.8	1.4	1.2
266.15	4.0	2.9	2.5	2.1	1.9
275.15	4.7	3.4	2.9	2.5	2.4
280.15	5.6	4.0	3.3	2.8	2.7
283.15	5.5	4.1	3.5	2.9	2.7
288.15	6.3	4.6	3.7	3.1	2.9
293.15	6.5	4.8	3.8	3.2	3.0

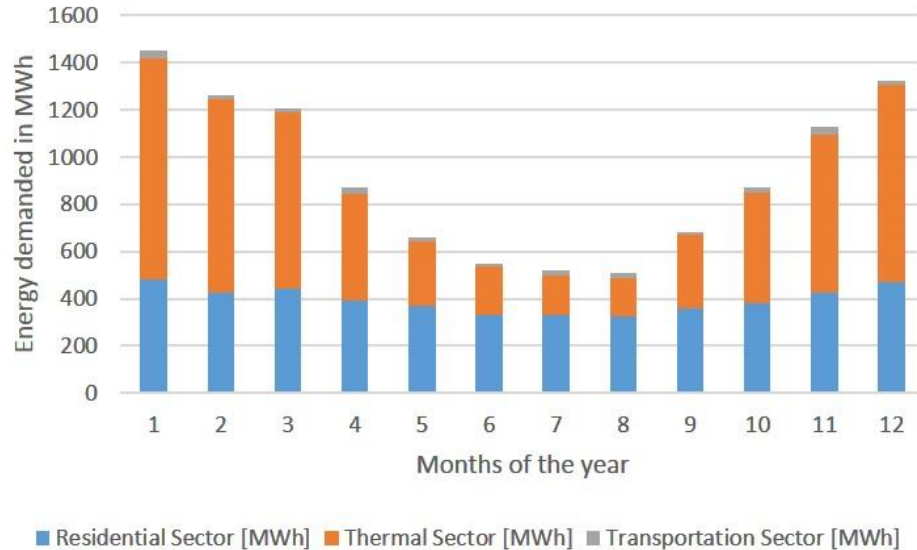


Air Temperature 2010

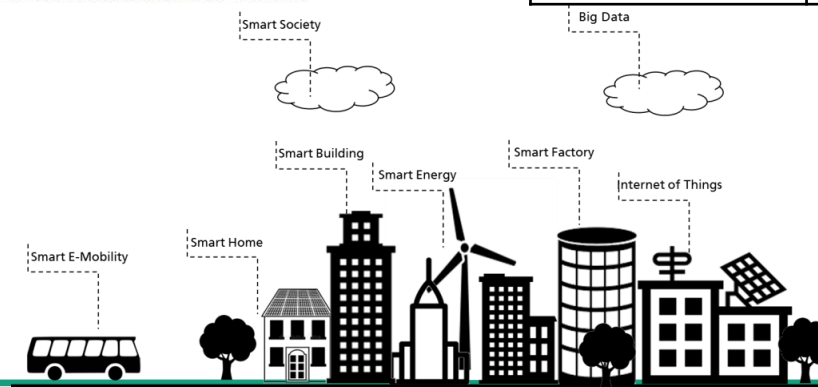
Min (°C)	Max (°C)	Average (°C)
-20.8	29.9	7.26



PUNSK 2050 NET ZERO ENERGY SYSTEM: ENERGY CONSUMPTION PER SECTOR



	Residential sector	Thermal sector	Transportation sector
Max demanded electric power [kW]	1221	2874	460
Yearly demanded electricity [MWh]	4718	6029	240



PUNSK 2050- NET ZERO ENERGY SYSTEM- ENERGY AND ECONOMIC INDEXES

$$SSCI = \frac{\int_{t=t_1}^{t_2} \min \{ Load(t), RES_{gen}(t) \}}{\int_{t=t_1}^{t_2} RES_{gen}(t)}$$

System Self Consumption Index



$$NPV = \sum_{t=0}^N \frac{CF_t}{(1+i)^t}$$

$$IRR = \sum_{t=0}^N \frac{CF_t}{(1+r)^t} = 0$$

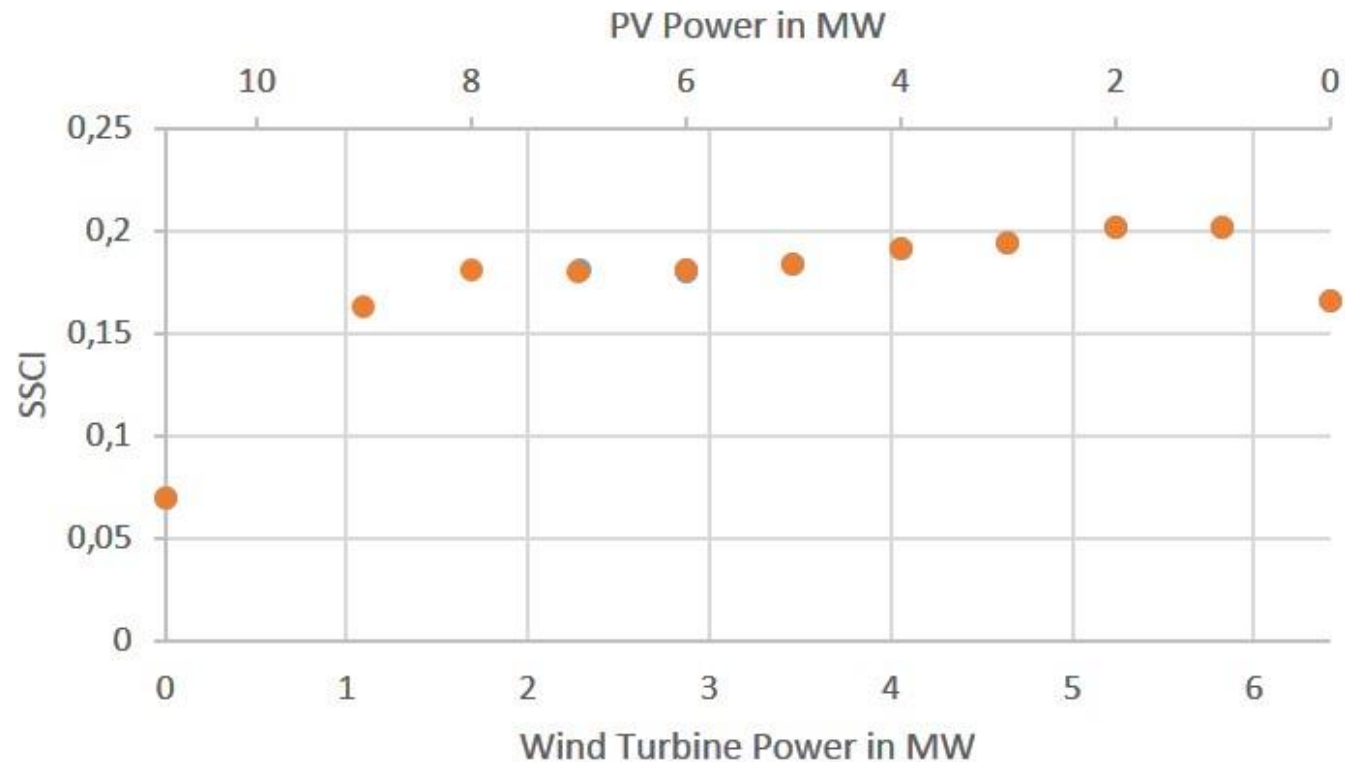
$$SSSI = \frac{\int_{t=t_1}^{t_2} \min \{ Load(t), RES_{gen}(t) \}}{\int_{t=t_1}^{t_2} Load(t)}$$

System Self Sufficiency Index



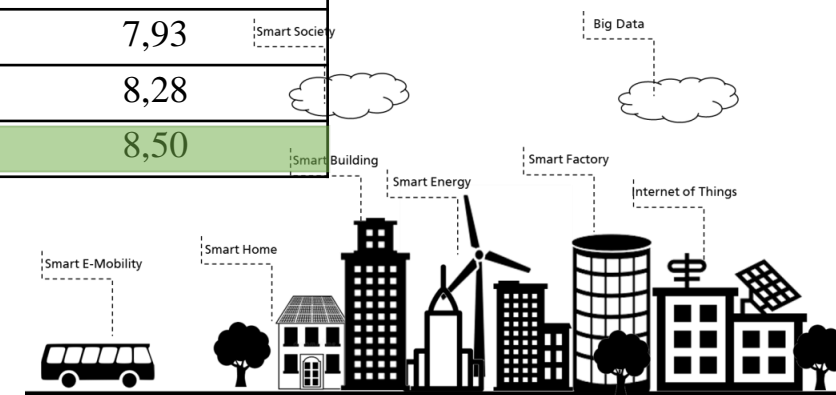
$$LUEC = \frac{\gamma \cdot i}{h \cdot [1 - (1+i)^{-y}]} + \frac{M \& O}{E_{el}}$$

PUNSK 2050 NET ZERO ENERGY SYSTEM: ENERGY AND ECONOMIC INDEXES 1/2



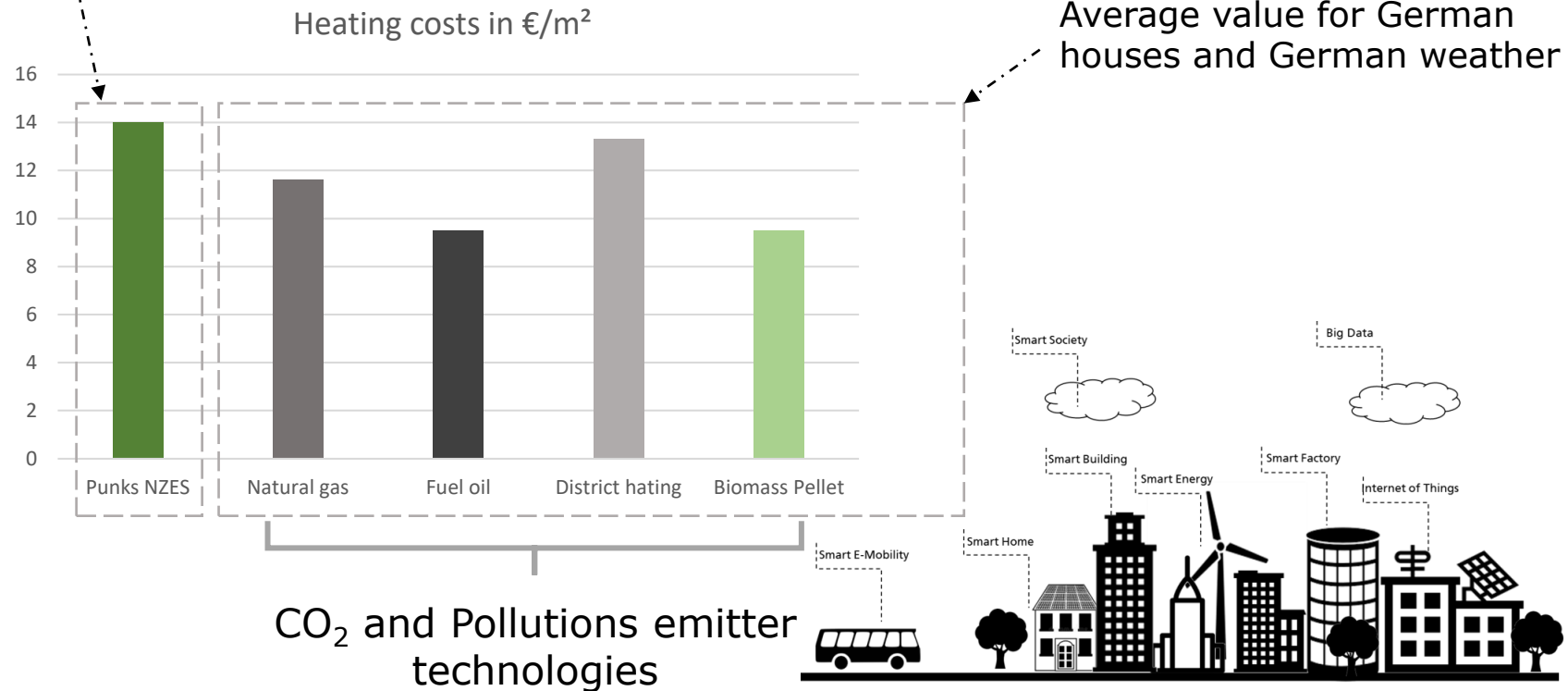
PUNSK 2050 NET ZERO ENERGY SYSTEM: ENERGY AND ECONOMIC INDEXES 2/2

PV (kW)	Wind (kW)	LUEC _{NZES} (€/MWh)	NPV (k€)	IRR (%)
10850	0	128	640	5,34
9000	1100	127	3056	6,7
8000	1621	118	2850	6,7
7000	2282	108	2663	6,78
6000	2873	98	2839	7,06
5000	3464	89	2643	7,1
4000	4055	79	2572	7,25
3000	4646	70	2625	7,55
2000	5237	61	2678	7,93
1000	5828	51	2607	8,28
0	6420	46	2591	8,50



PUNKS 2050- NET ZERO ENERGY SYSTEM- ECONOMIC EVALUATION- HEATING COSTS

Pollutions free solution



RIGRID TOOL