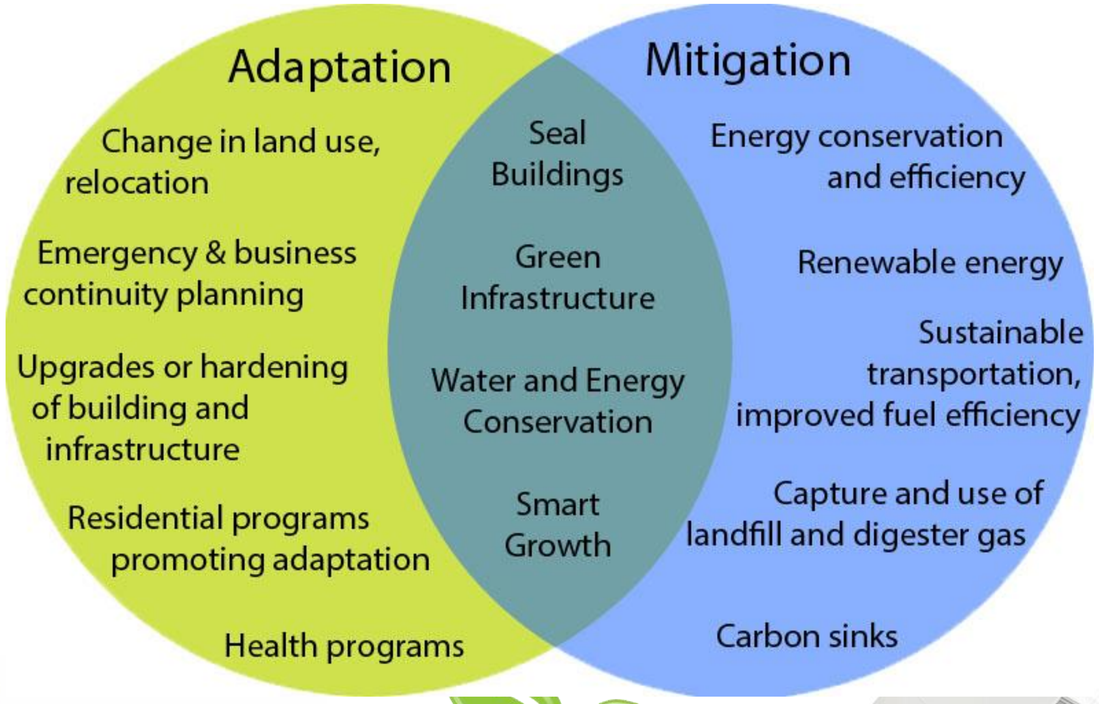
PLANNING PITTBURGH'S PATHWAY

REDUCING CARBON EMISSIONS AND INCREASING ECONOMIC DEVELOPMENT VIA DECARBONIZATION

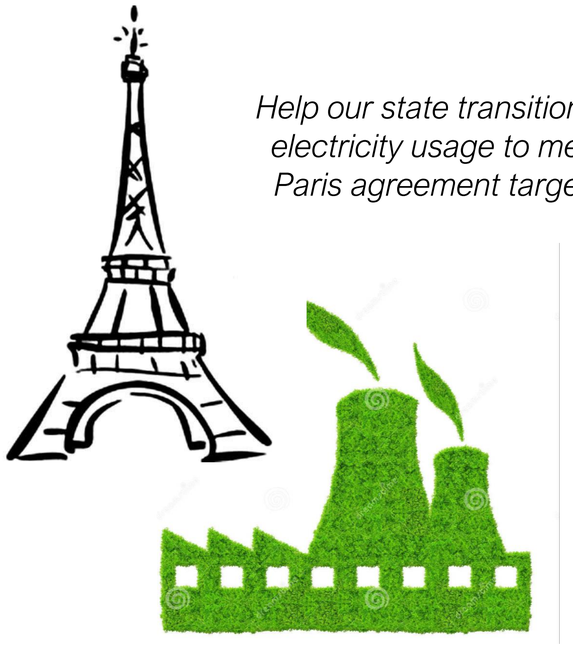
WE MUST MOVE FORWARD IN THREE AREAS: LOCAL, STATE-LEVEL, AND INSTITUTIONAL ADJUSTMENTS TO SUPPORT DECARBONIZATION

Adapt our cities to include more resilient and cleaner infrastructures

Figure 3: Adaptation, mitigation, and adaptive capacity



Help our state transition its electricity usage to meet Paris agreement targets

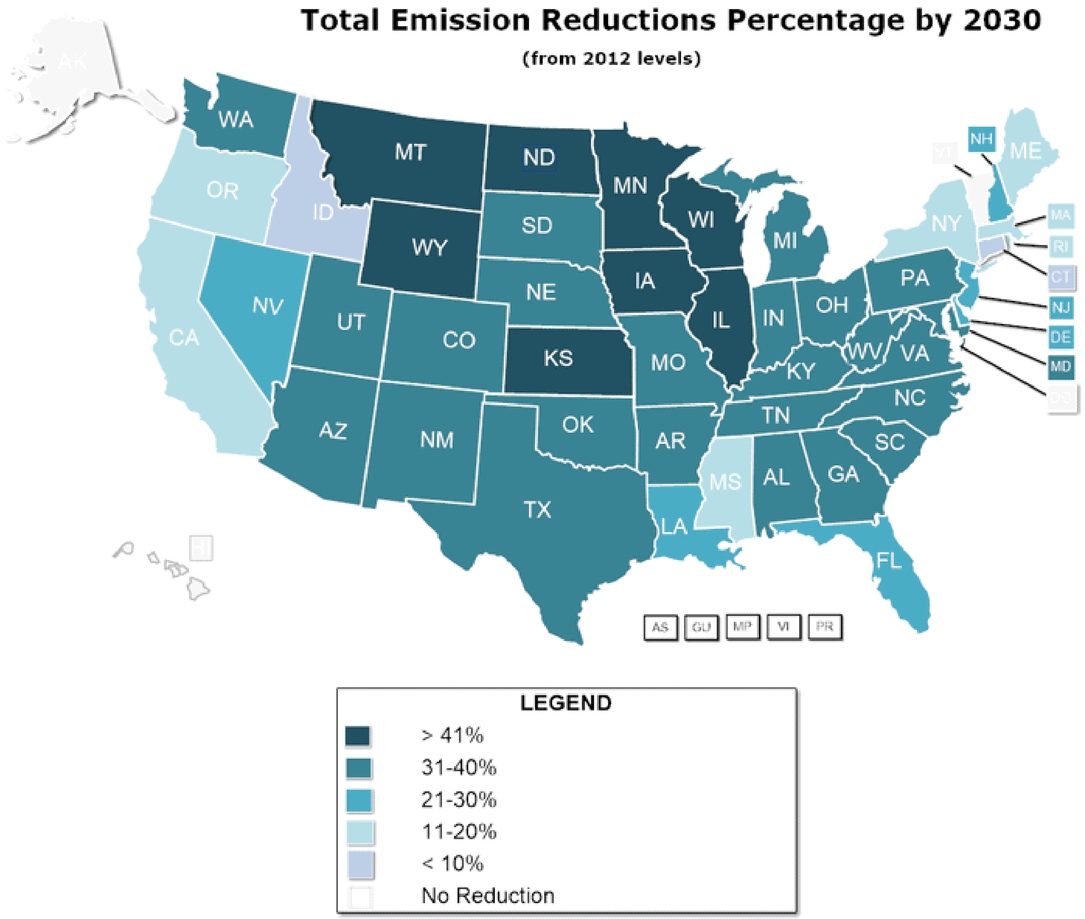


Ensure our citizens are knowledgeable and informed on their carbon footprint and energy consumption, including greening our transport in PA

Make sure our governments help to lead by example and provide the support needed to monitor, revise, and improve upon the path to decarbonization

Source: Kelly, 2015

YET WE KNOW THAT THE ENERGY THAT WE CONSUME COMES FROM WAY BEYOND OUR BORDERS; THEREFORE, WE NEEDED TO UNDERSTAND OUR "EMISSIONS FOOTPRINT" VS WHAT WE CAN TANGIBLY CHANGE

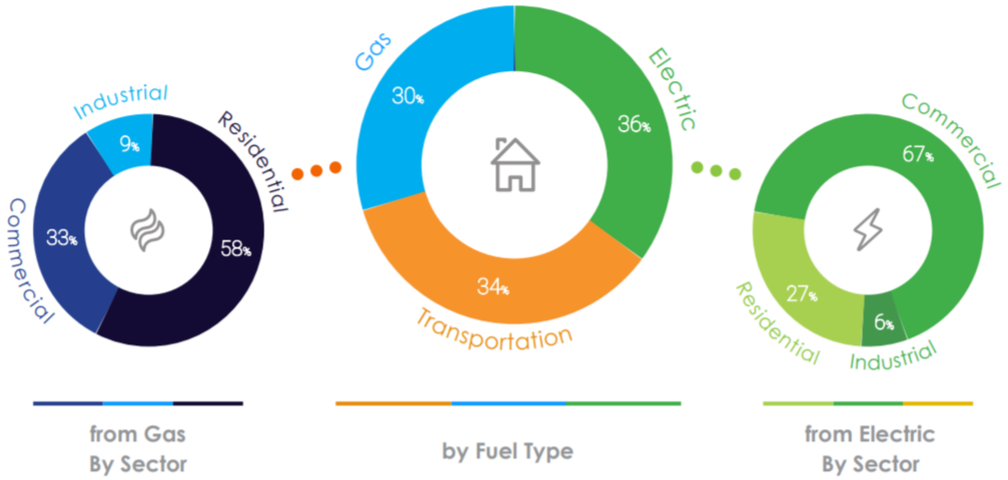


- Pennsylvania is suggested under the CPP to reduce its emissions by 29 million tons, or 24 percent below 2012 levels, by 2030
- This represents a **33% reduction in CO2 from 2005 levels**
- PA is nearly halfway there- we cut emissions by 16% from 2005-2012
- 38% of PA's electricity generation came from nuclear power, 36% from coal, and 22% from natural gas in 2011; however, coal went down (so did CO2!)
- Hydropower, wind, and solar make up roughly 4% of all other power
- **Pennsylvania will need to build 4,370 MW of wind capacity and nearly 6,400 MW of solar capacity including almost 2,000 MW of rooftop solar on homes and businesses to meet the CPP goals; therefore a large portion of our goals depends on the state's energy shift**
- PA has Renewable Portfolio Standard Policies: 18% requirement by 2021
- PA also has Solar/Distributed integration requirements including 0.5% PV by 2021

DEFINING PITTSBURGH'S ENERGY FOOTPRINT WITHIN THE PA CONTEXT

WHEN LOOKING THEREFORE AT THE STATE OF PA'S EMISSIONS PROFILE, AND PITTSBURGH'S ENERGY CONSUMPTION WE CAN BEGIN TO ESTIMATE THE EMISSIONS FOOTPRINT FOR EACH SECTOR

Pittsburgh energy consumption



Pittsburgh's emissions profile

Residential Carbon Footprint	Commercial Carbon Footprint	Industrial Carbon Footprint
222,641*	567,517*	48,020*

*Measured in co2/mmbtu

BUILT ENVIRONMENT ENERGY CONSUMPTION

TOTAL NON-RESIDENTIAL BUILDING FOOTPRINT

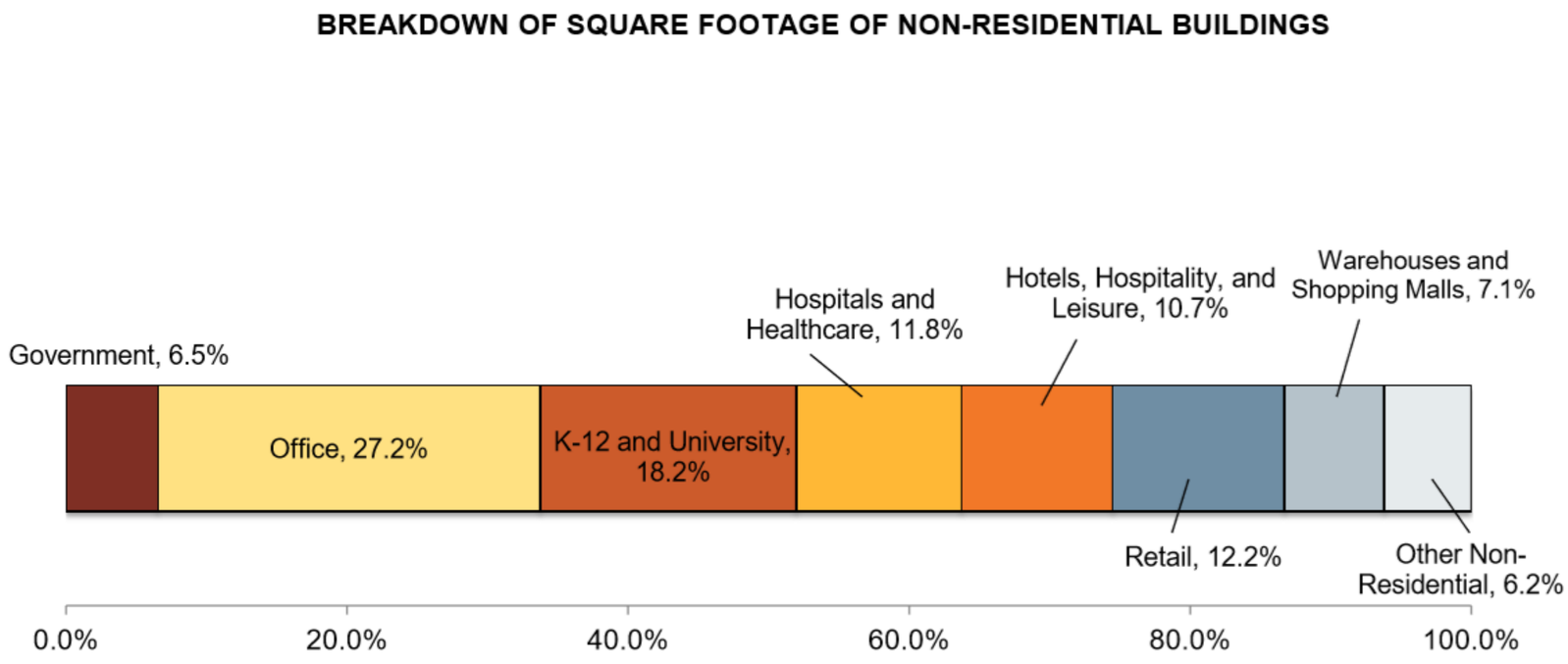
223M ft^2

TOTAL ELECTRICITY CONSUMPTION

4,147,331 MWh

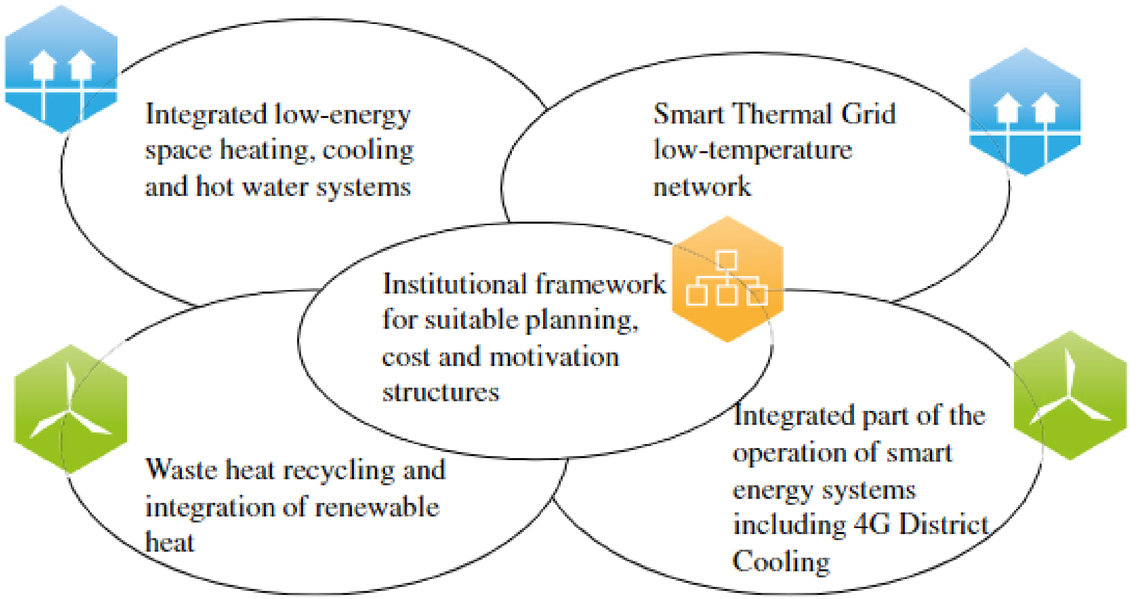
AVERAGE ENERGY USE INTENSITY

145 $kBtu/ft^2$



Source: Siemens, 2019

	1st Generation	2nd Gen	3rd Gen	4th Gen
BAT Time	1880-1930	1930-1980	1980-2020	2020-2050
Heat Production	Coal, steam, boilers, some CHP	Coal and oil-based CHP and some heat-only boilers	Large-scale CHP, distributed CHP, biomass and waste, or fossil fuel boilers	Low temperature heat recycling and renewable sources
Integration with Electricity Supply	CHP as heat source	CHP as heat source	CHP as heat source, some electric boilers, and heat pumps in countries with temporary electricity surpluses. Few CHP's on spot markets.	CHP systems integrated with heat pumps and operated on regulating and power reserve markets as well as spot markets.



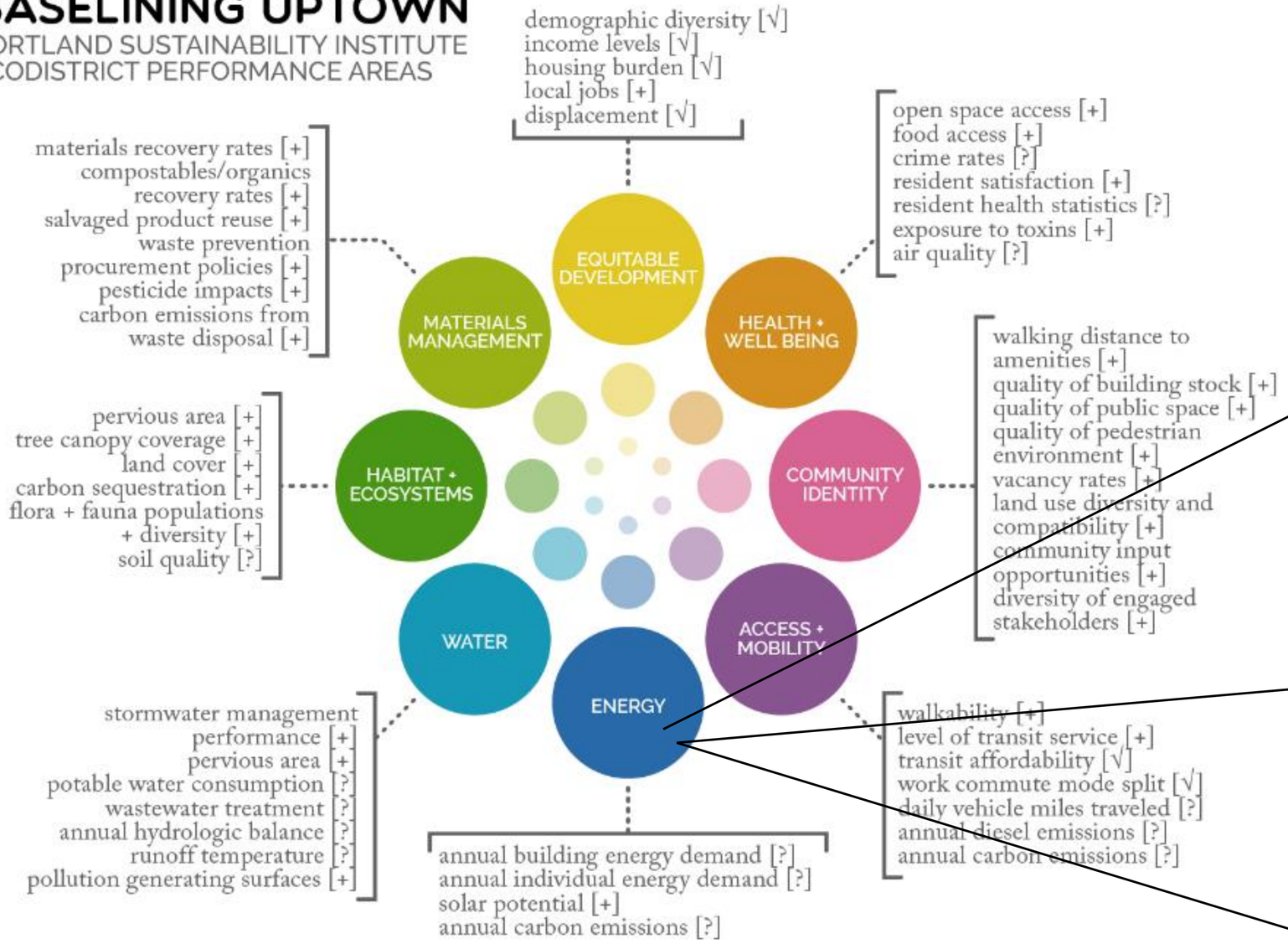
Source: Adapted from Rismanchi, B. "District energy network (DEN), current global status and future development." *Renewable and Sustainable Energy Reviews* 75 (2017): 571-579.

DISTRICT VS CITY?

Who bears the burden?

BASELINING UPTOWN

PORTLAND SUSTAINABILITY INSTITUTE
ECODISTRICT PERFORMANCE AREAS



Source: Uptown EcoInnovation District

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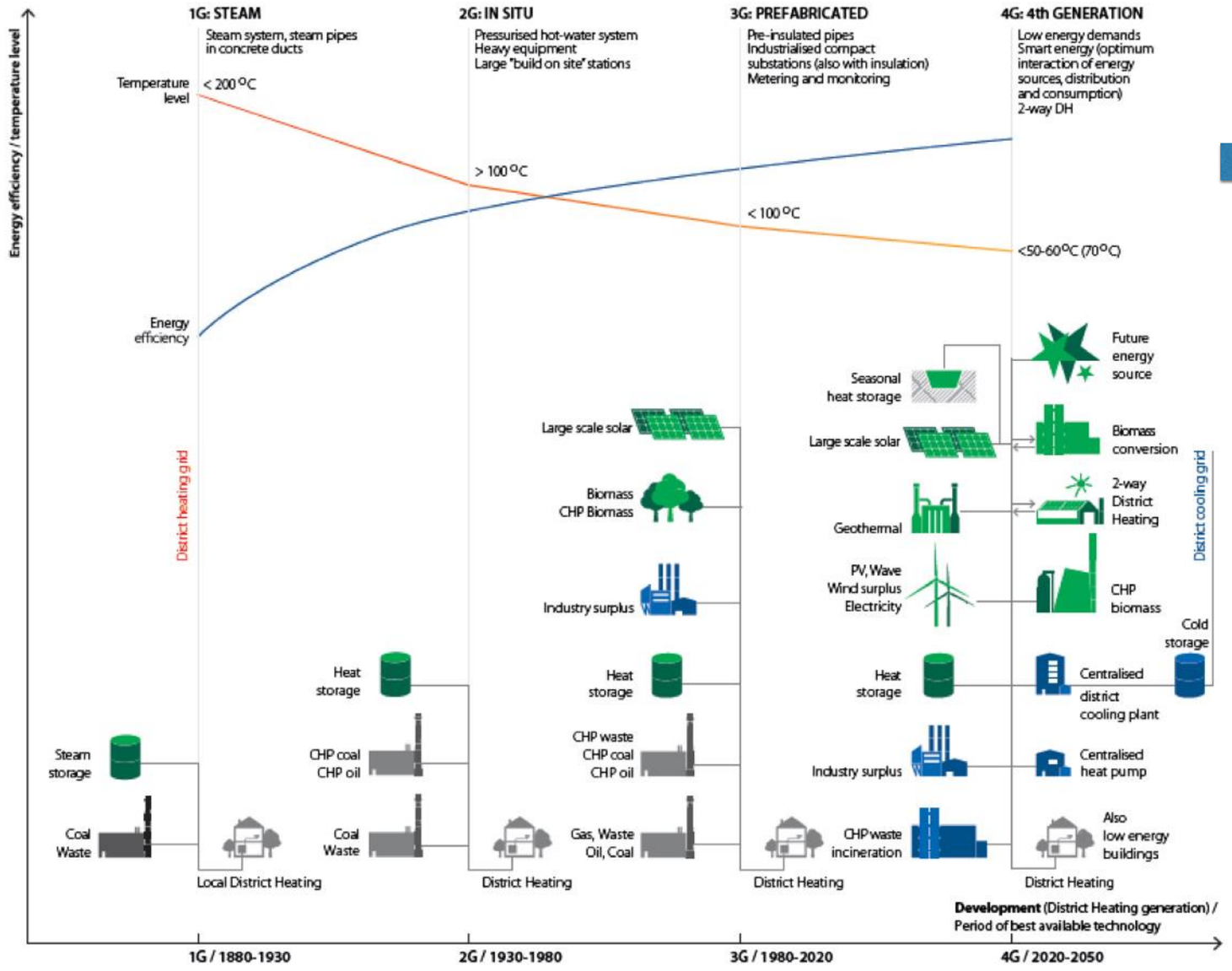
Comparing case-study model with Danish district model

Baselining the neighborhood and estimating demand profiles (now and future)

Investigating governance mechanisms against SDG goals



Economic Parameters	
LCOE Discount Rate	4%
Net Tax Factor	1.17
Calculation Rate	4%
VAT	5%
Distortion Loss	20%
Net Price Index	0.70%
Long-Term Loan Rate	4%
Short-Term Loan Rate (debt)	2%
Short-Term Loan Rate (profit)	0%

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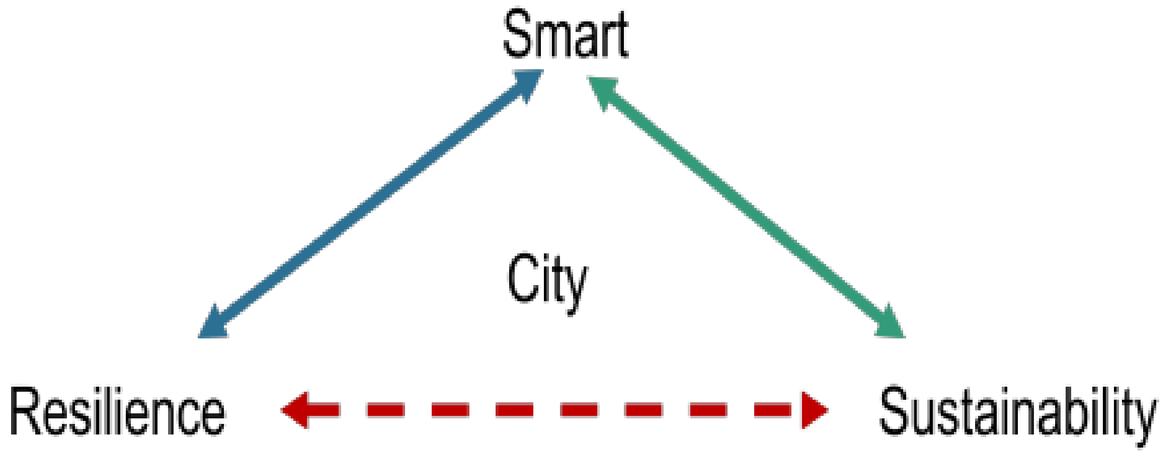
DTU Technical University of Denmark

AARHUS UNIVERSITET

Source:Buffa, Simone, Marco Cozzini, Matteo D'Antoni, Marco Baratieri, and Roberto Fedrizzi. "5th generation district heating and cooling systems: A review of existing cases in Europe." *Renewable and Sustainable Energy Reviews* 104 (2019): 504-522.



Source: Velagapudi, Kelly-Pitou, Tipper, 2019

Easy access to data and information in regards to energy consumption related to home, business, and buildings

Report, monitor, communicate consumption data

Identify the best technical efficiency changes or BAT at the local level for citizens

Support the upfront capital gap required for deployment

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