DELFT IN TRANSITION

Towards a Sustainable Energy System for Dutch Municipalities

P5 Presentation
Tess Blom
25.01.2018

Research Framework
Problem description

It’s time to make the transition to a more sustainable world

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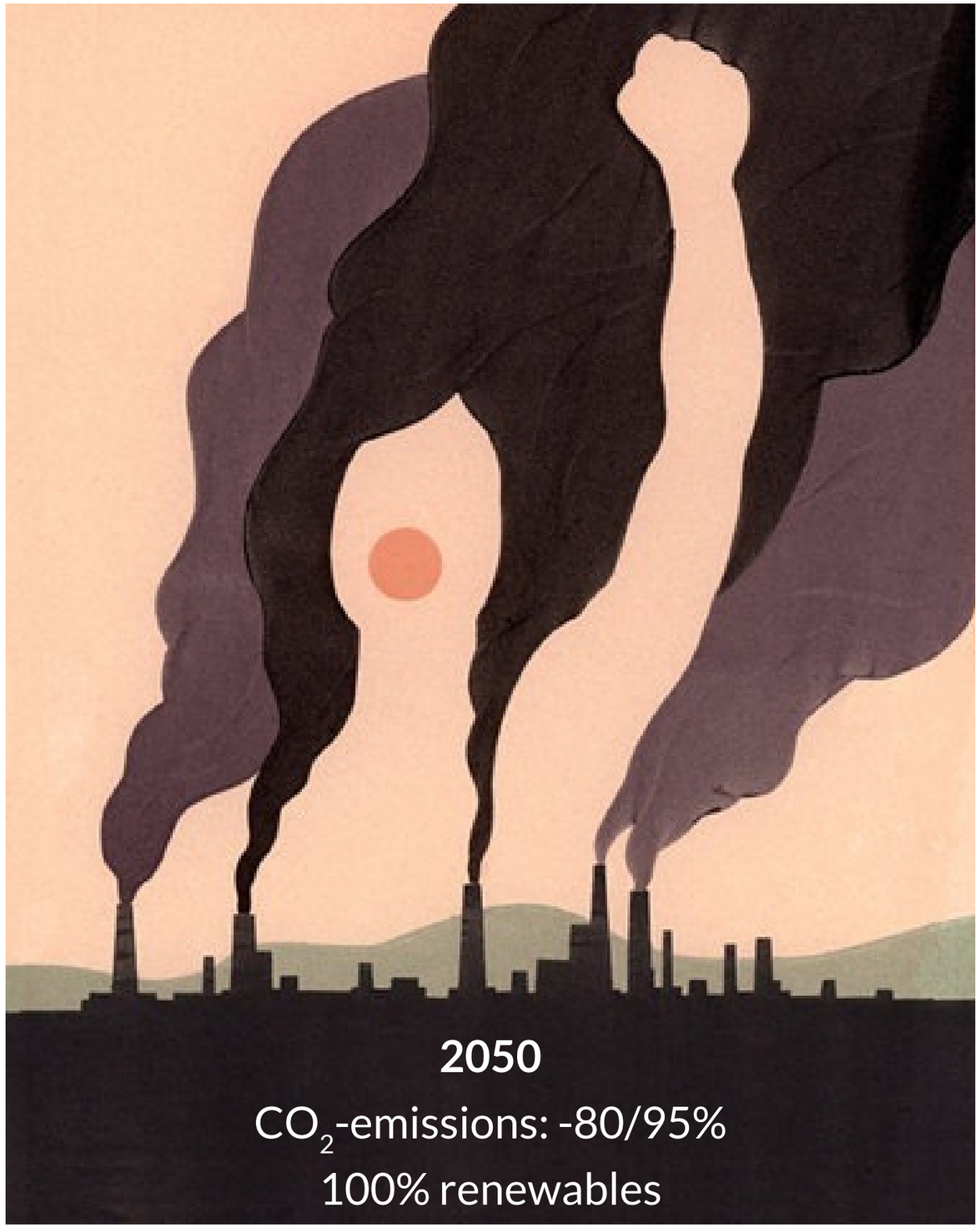
It’s time to make the transition to a more sustainable world

Paris Climate Agreements 2015

Limit the global warming with 2°C

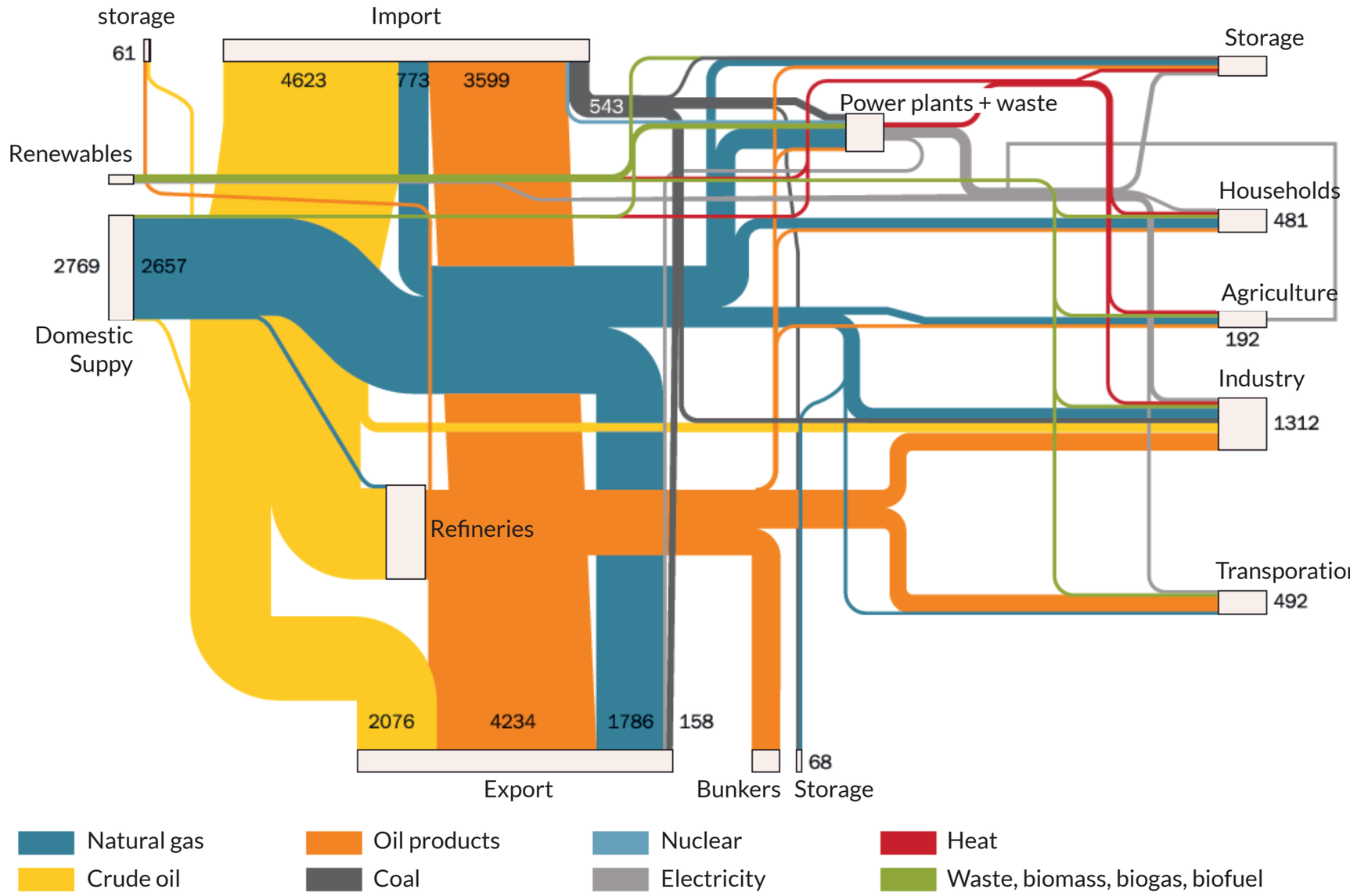

2050
CO_2-emissions: -80/95%
100% renewables

The Netherlands is still far from reaching the transition goals

as stated in February last year:

(www.nos.nl)

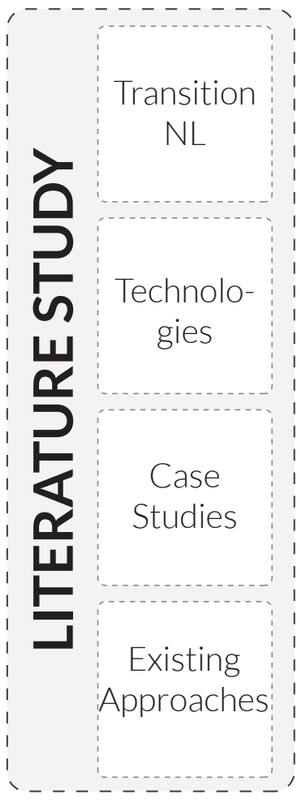
Fossil energy is highly intervowen with the Dutch economy

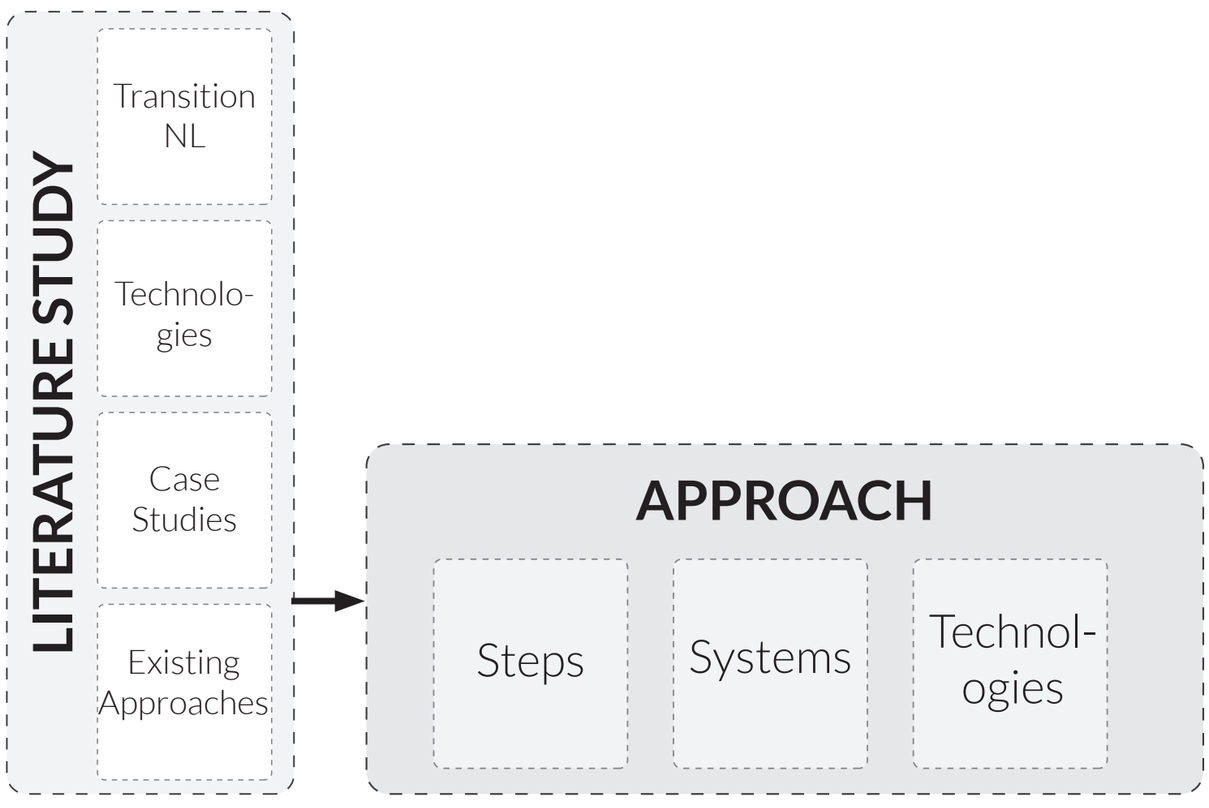


(Weterings et al., 2013, p. 20).

Bottom up movement by Dutch municipalities
how often transition mostly to complex to make a difference.
(.. later I will more deeply explain the role of the municipality)

‘How should the roadmap for the energy transition of the built environment towards energy neutrality for the city Delft look like, with technical interventions based on local sustainable energy potentials integrated at different scales and what is the general approach for the energy transition of Dutch municipalities?’


LITERATURE STUDY
Transition NL
Technolo-gies
Case Studies
Existing Approaches


LITERATURE STUDY
Transition
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APPROACH
Steps
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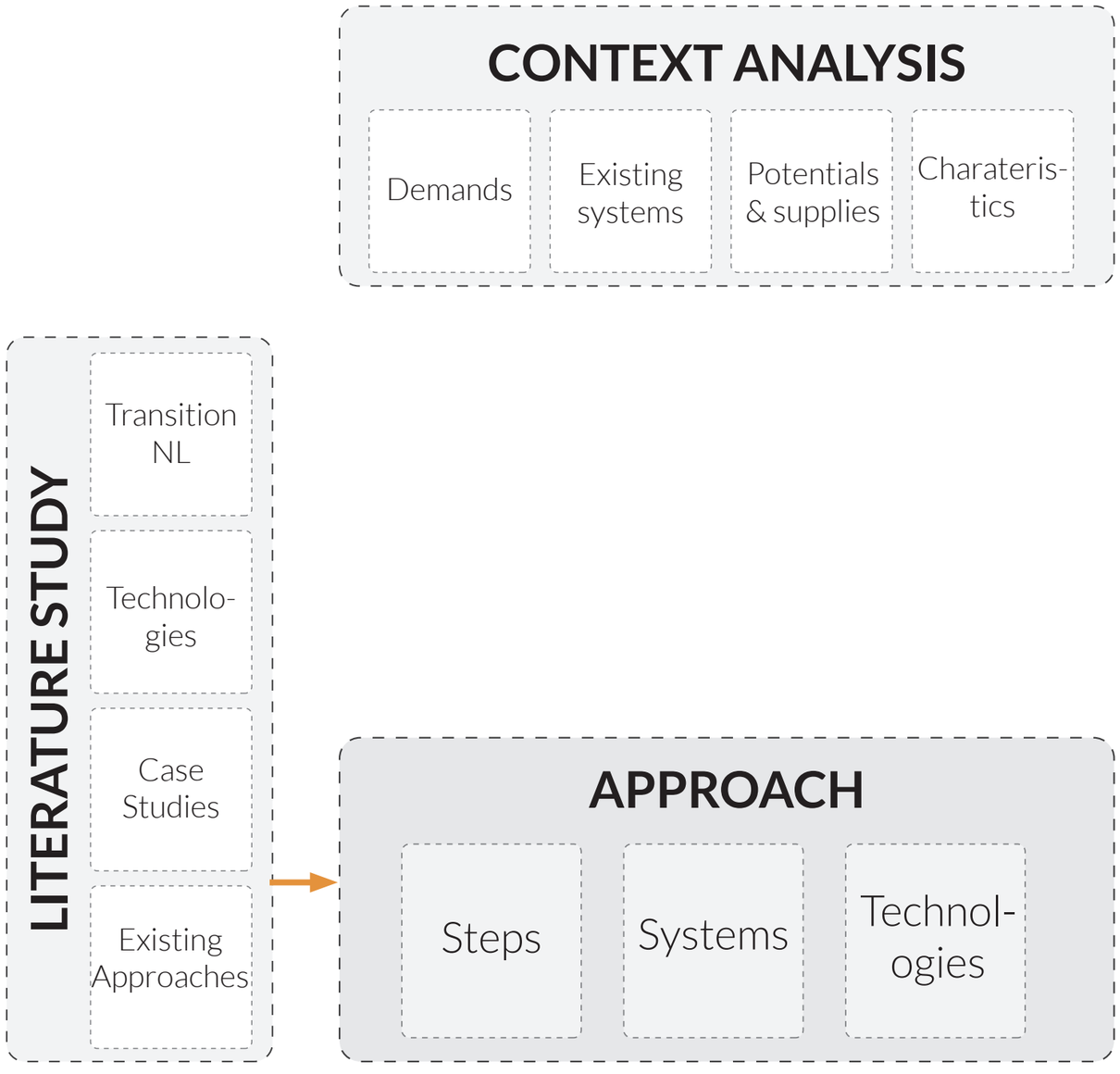
CONTEXT ANALYSIS
Demands
Existing systems
Potentials & supplies
Charateris-tics
LITERATURE STUDY
Transition NL
Technolo-gies
Case Studies
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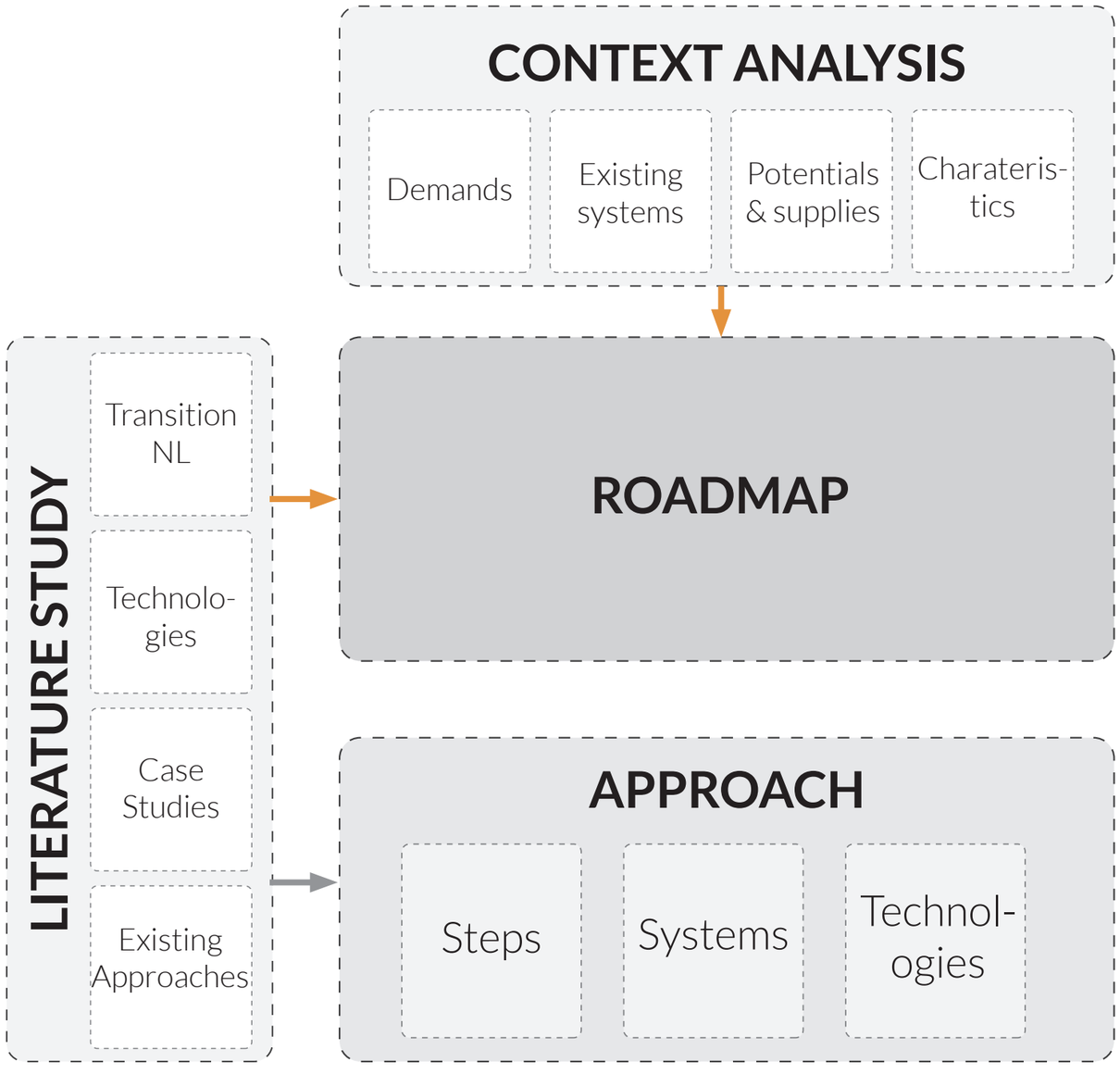
APPROACH
Steps
Systems
Technol-ogies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ROADMAP
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Case Studies
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APPROACH
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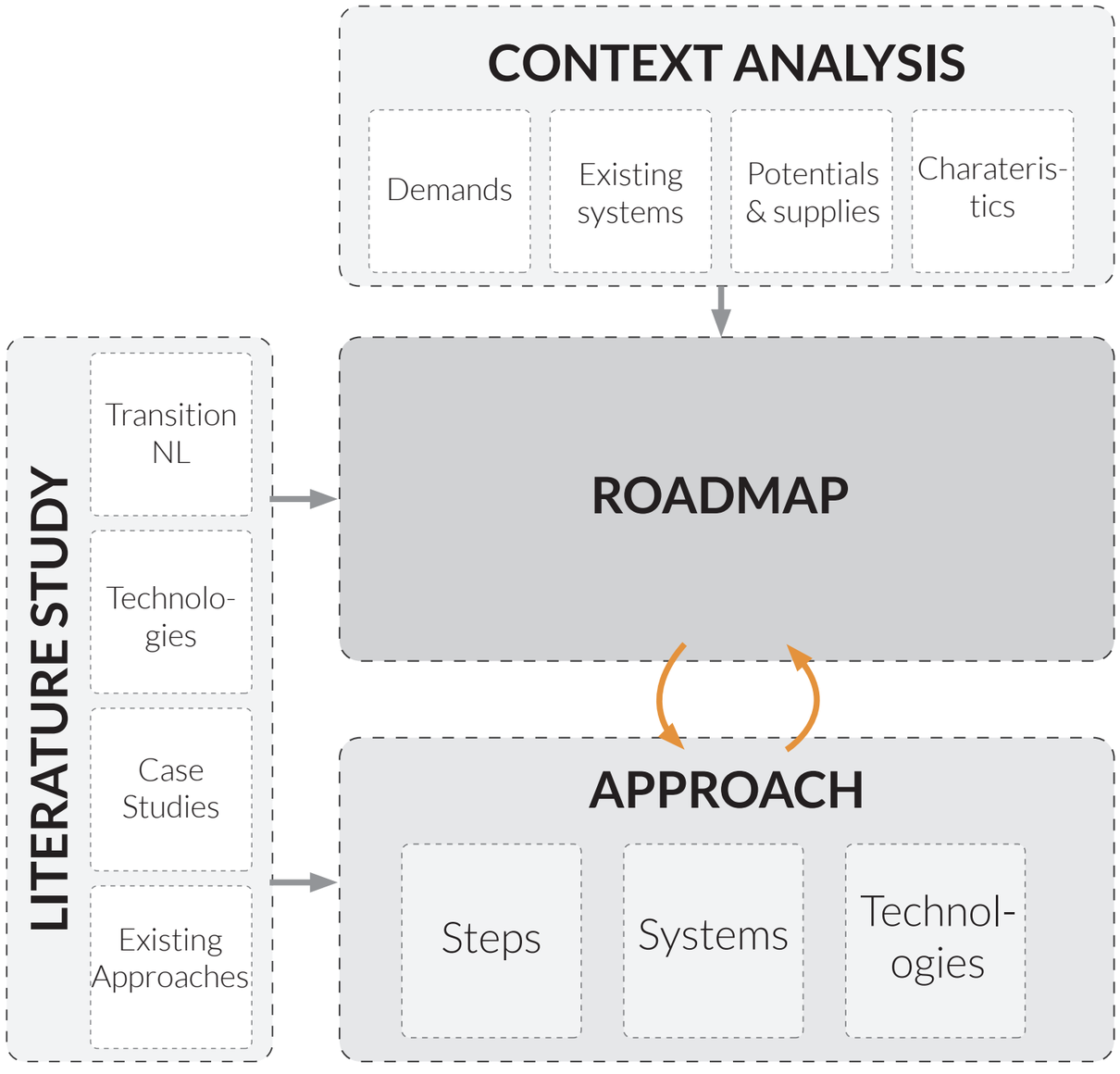
Technol-ogies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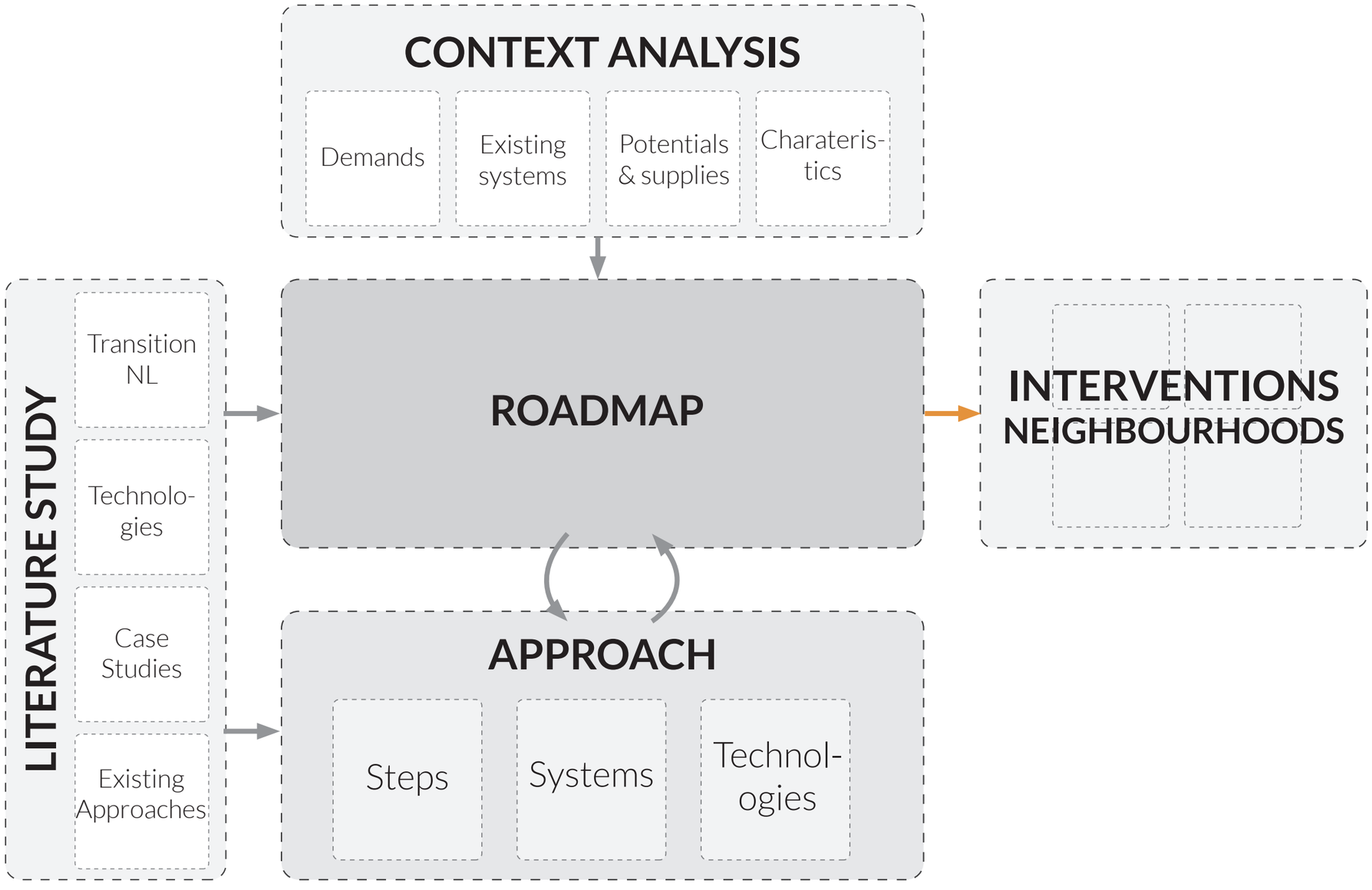
CONTEXT ANALYSIS
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INTERVENTIONS NEIGHBOURHOODS
LITERATURE STUDY
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APPROACH
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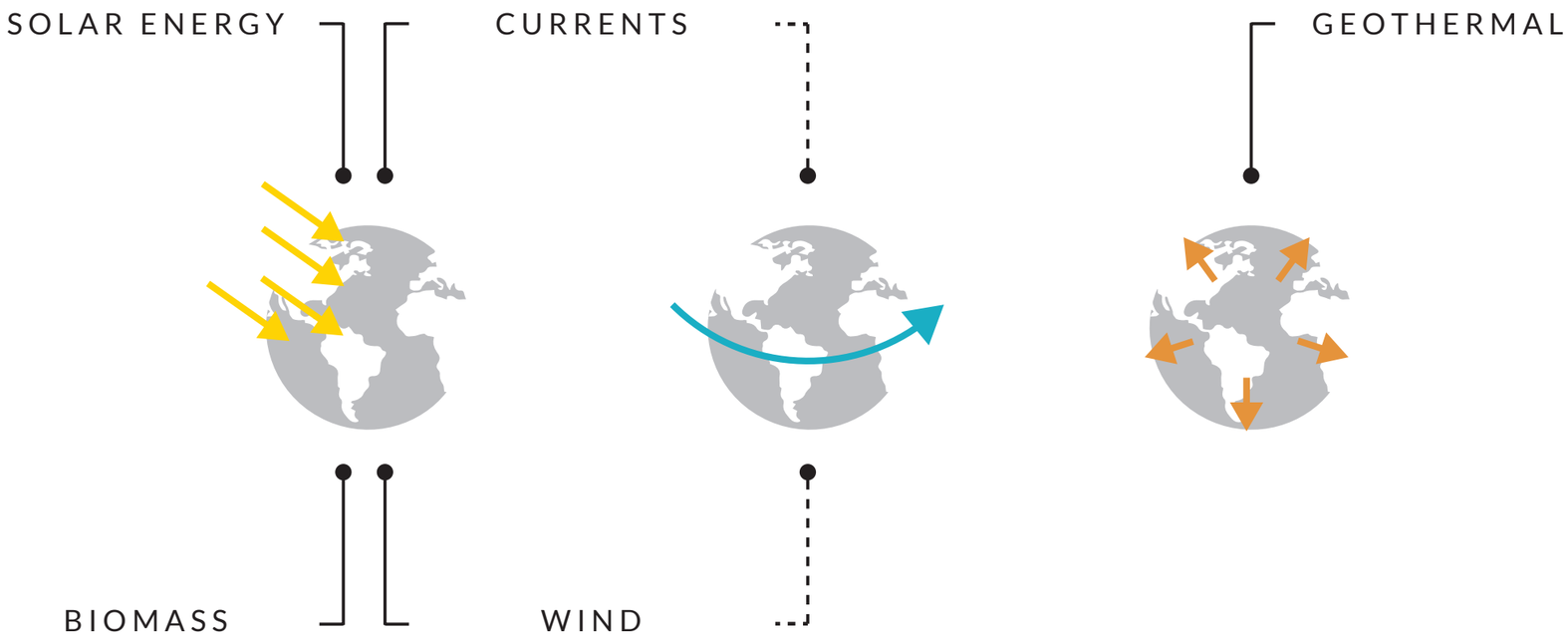
Technol-ogies

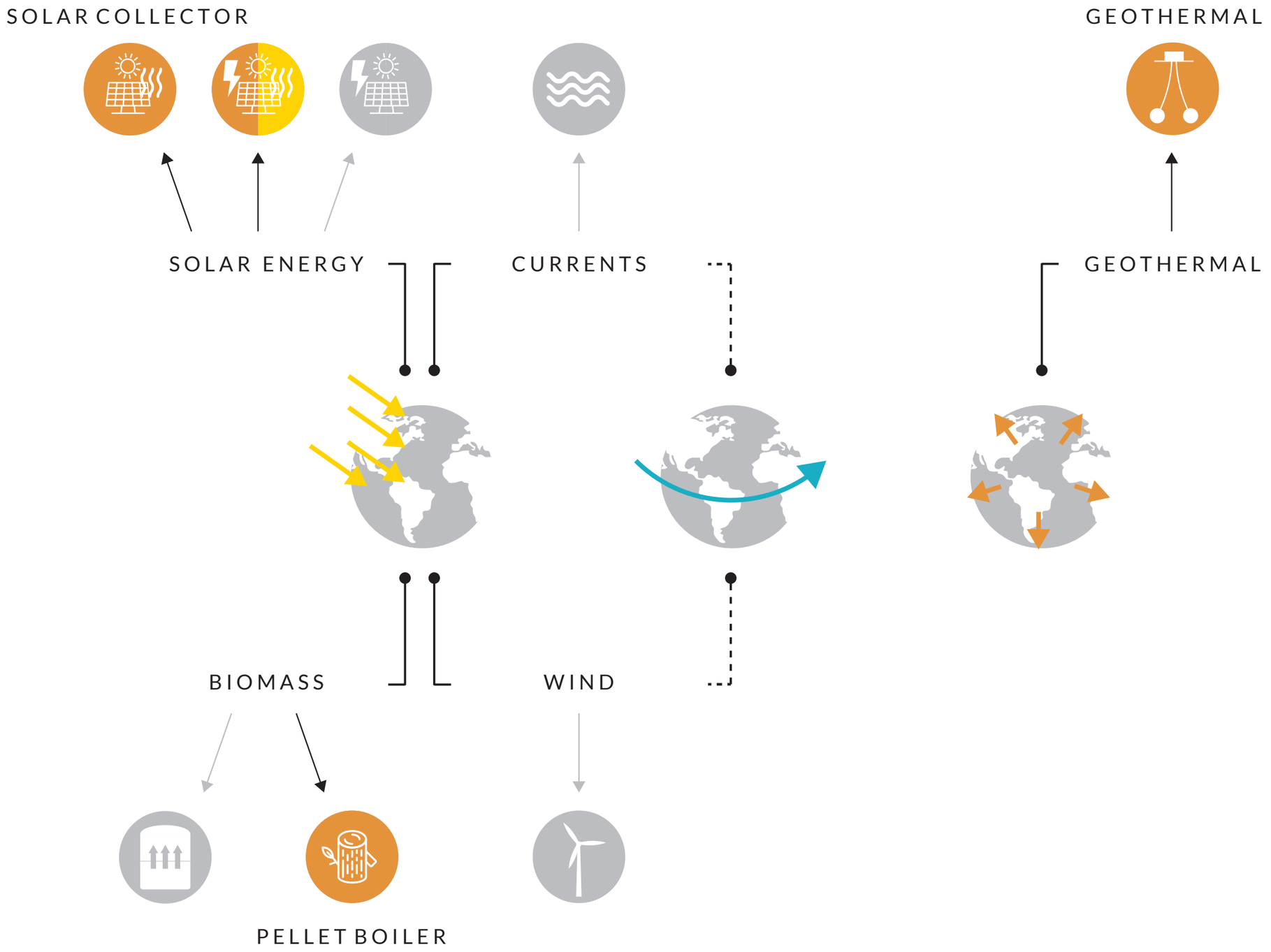
2

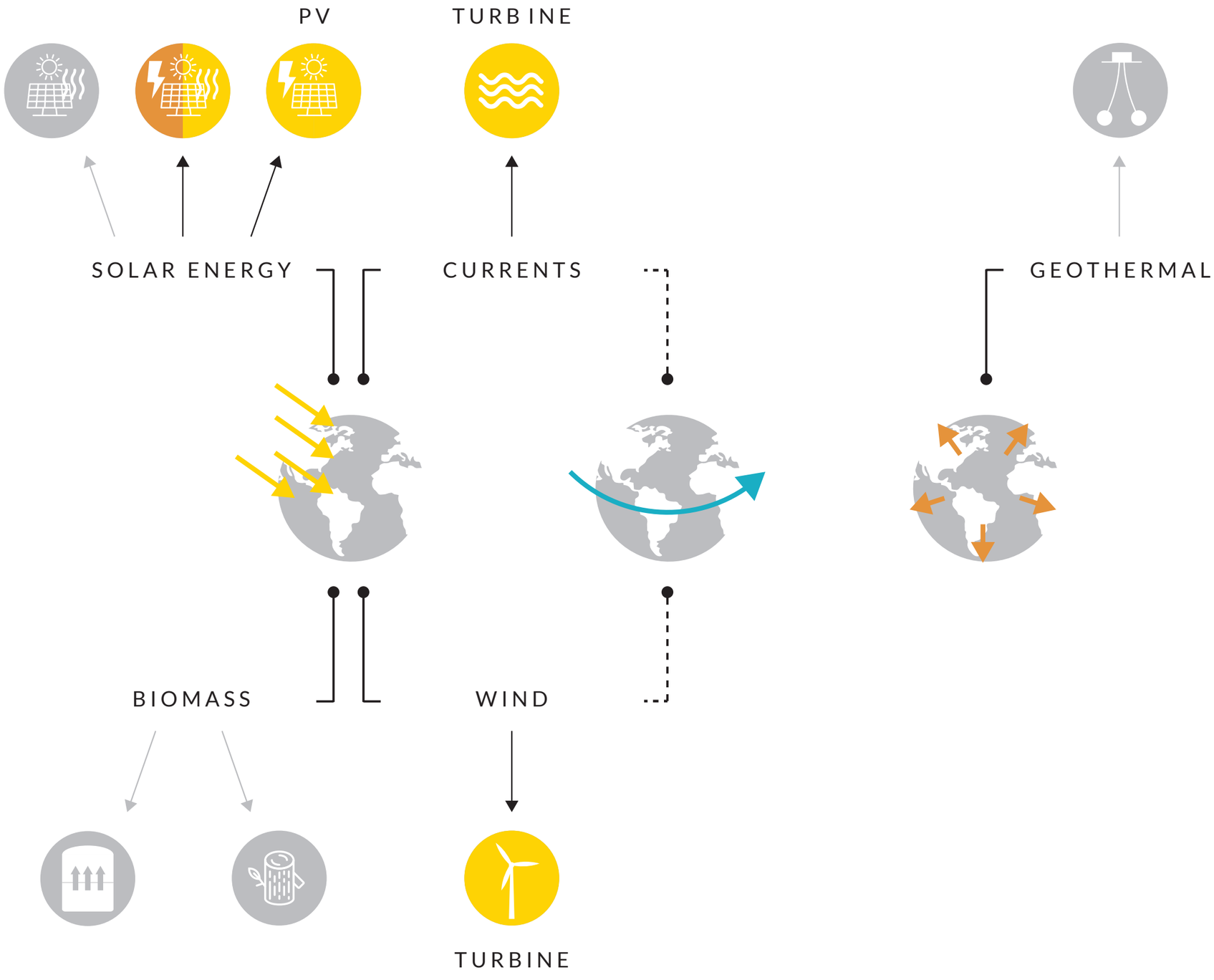
The Basics

(Donat, 2017).

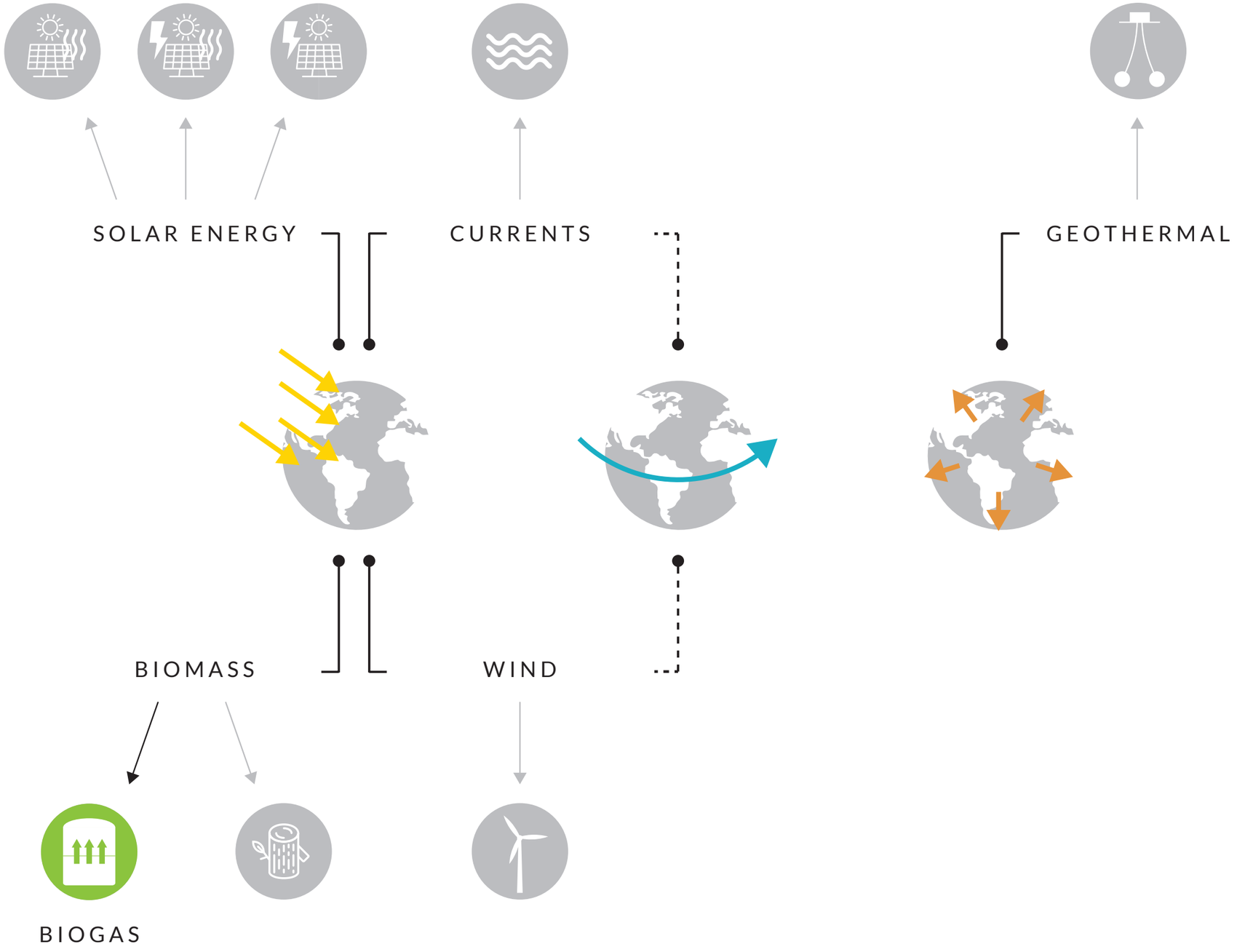

SOLAR ENERGY
CURRENTS
GEOTHERMAL
BIOMASS
WIND

Basics of the energy transition
Conversion Primary Sources



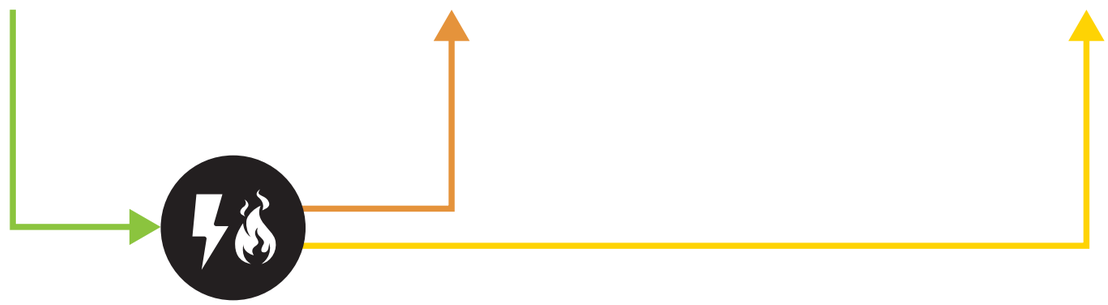

PV
TURB INE
SOLAR ENERGY
CURRENTS
GEOTHERMAL
BIOMASS
WIND
TURBINE

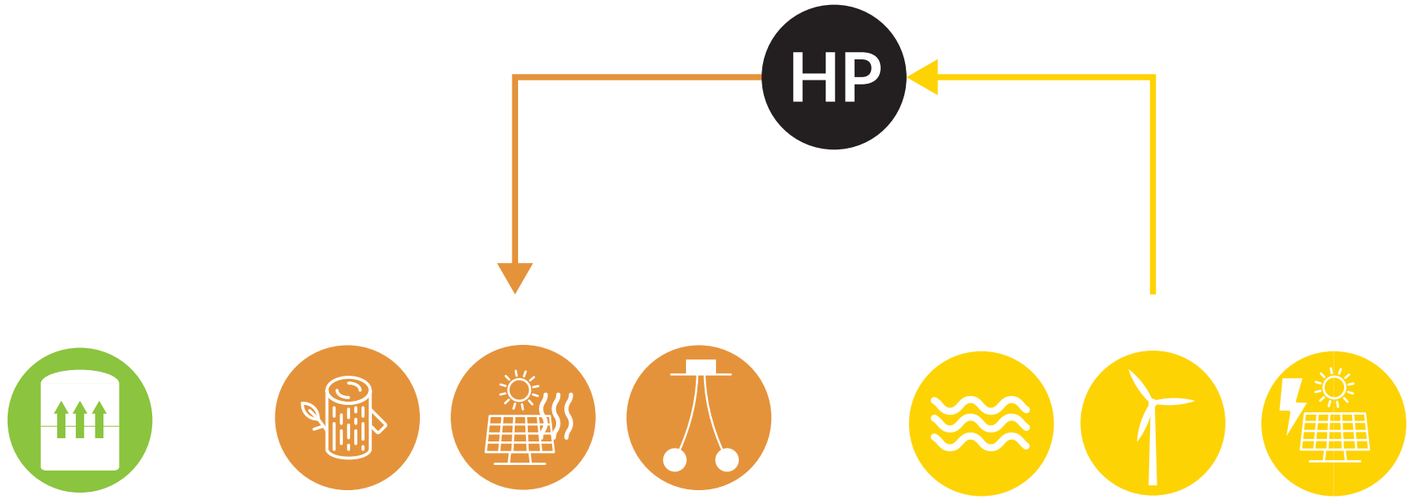
Basics of the energy transition
Conversion Primary Sources



BIOGAS HEAT ELECTRICITY

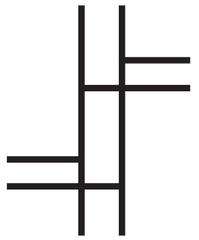
BIOGAS HEAT ELECTRICITY




HP
BIOGAS
HEAT
ELECTRICITY

Basics of the energy transition
4 heat systems

INDIVIDUAL — COLLECTIVE

BIOMASS	BIOGAS	ALL-ELECTRIC	HEAT GRID
			
Pellet boiler	*Boiler*	*Heat Pump*	*Heat exchanger*

INDIVIDUAL

COLLECTIVE

BIOMASS	BIOGAS	ALL-ELECTRIC	HEAT GRID
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Basics of the energy transition
4 heat systems

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COLLECTIVE

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Basics of the energy transition
4 heat systems

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		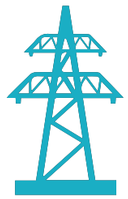	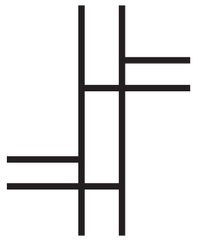
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Basics of the energy transition
4 heat systems

INDIVIDUAL

COLLECTIVE

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			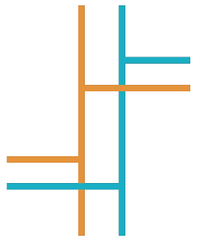
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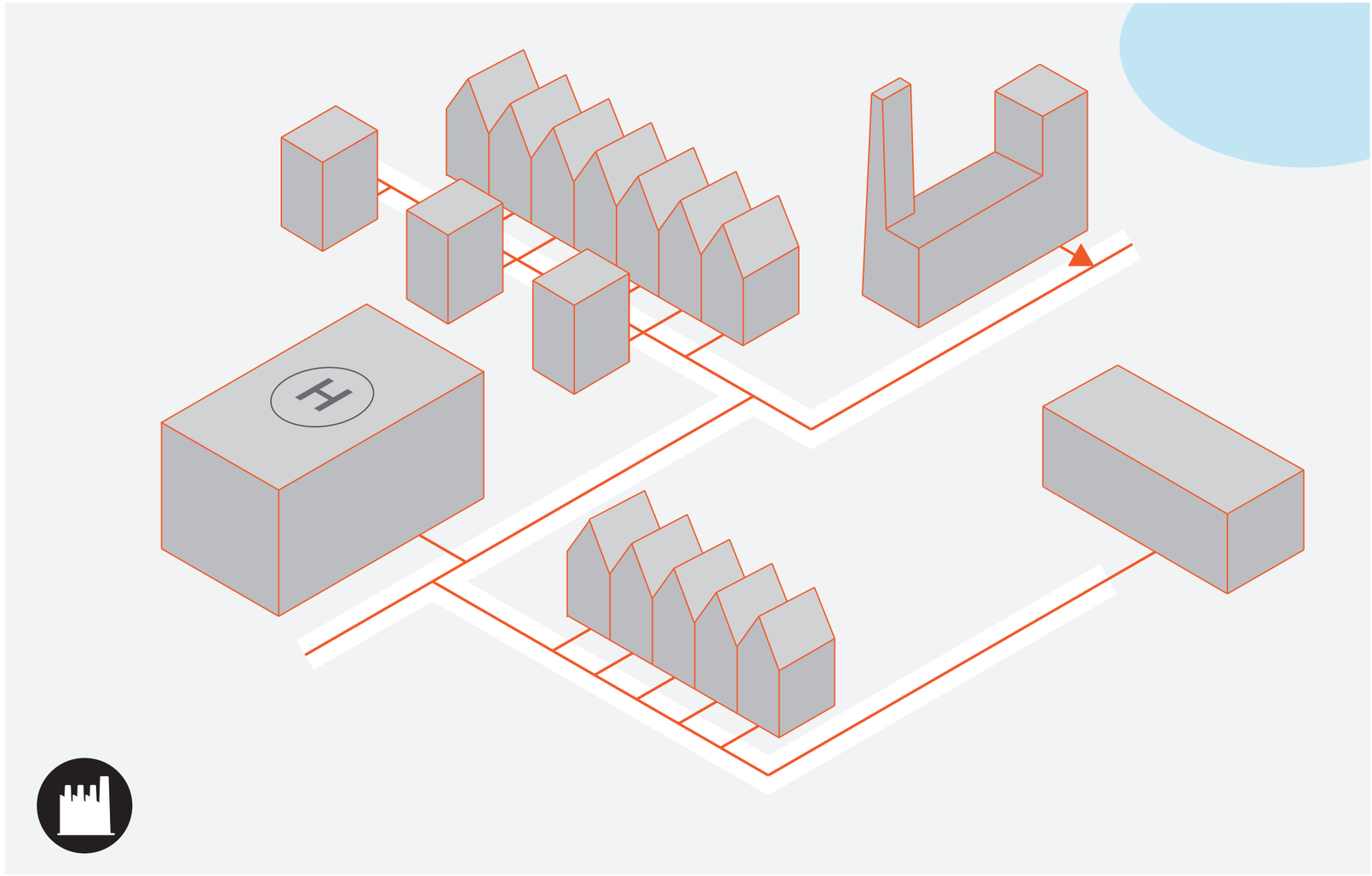
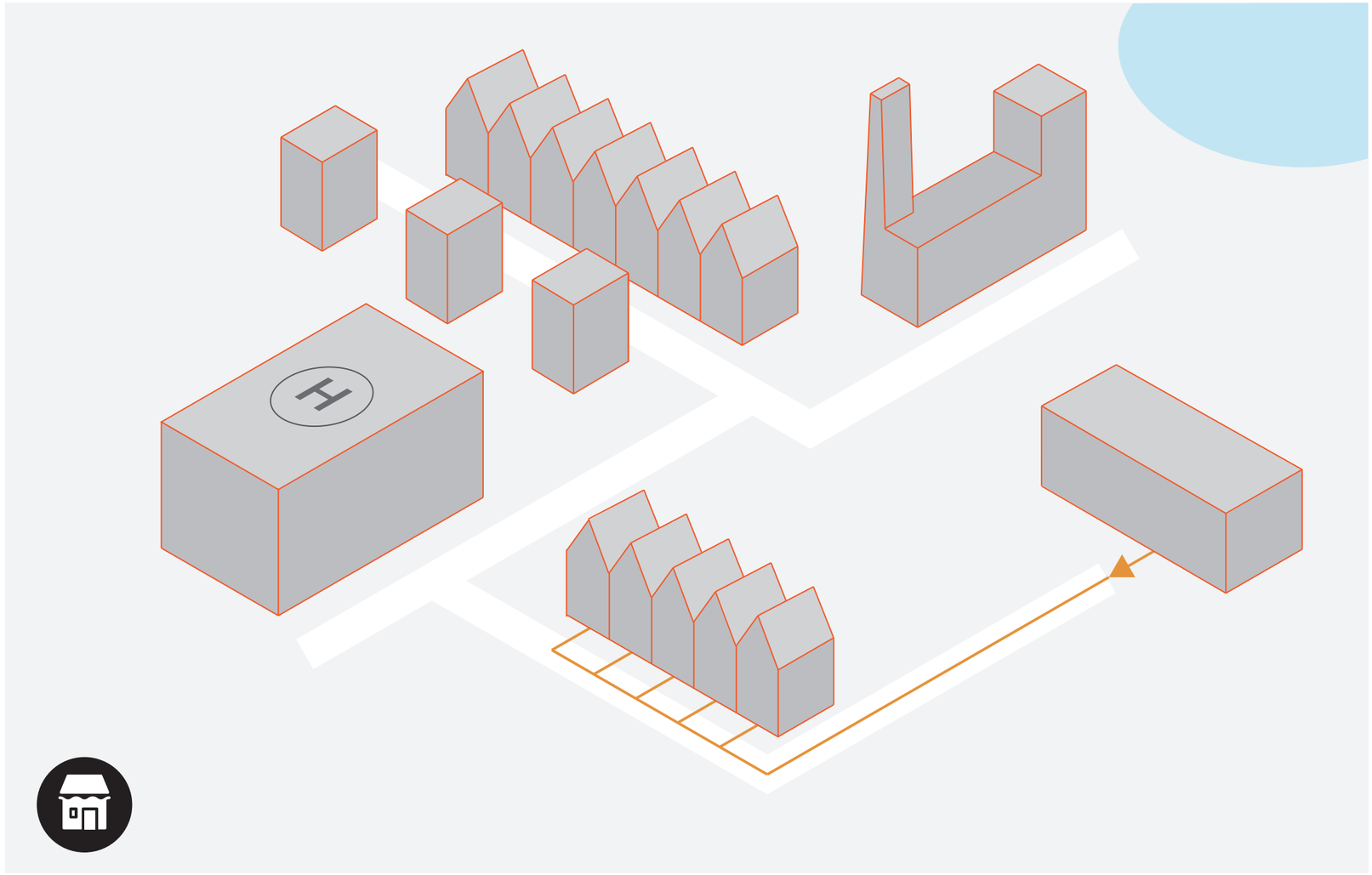
Limit the energy demands

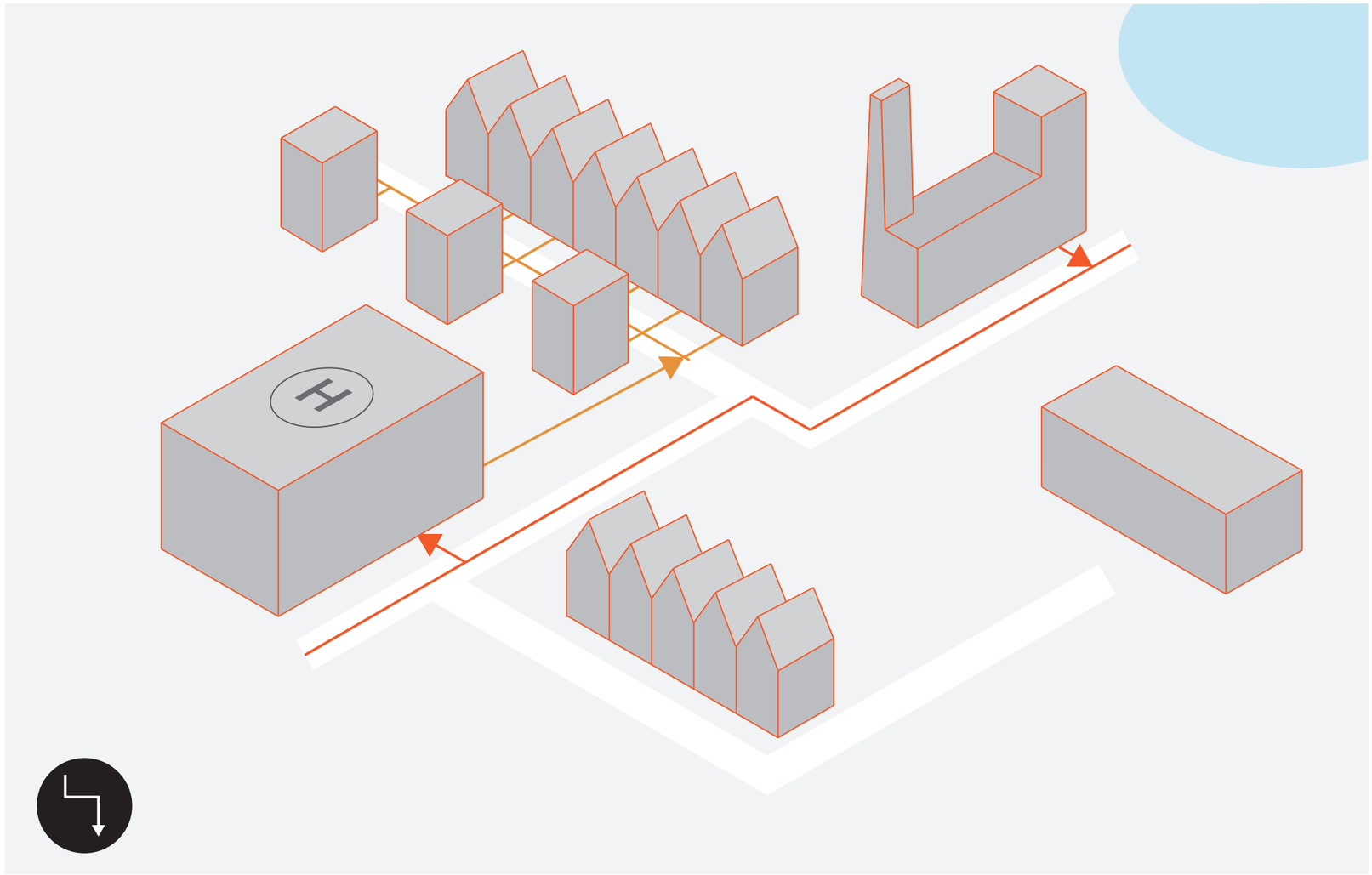
Industrial waste heat

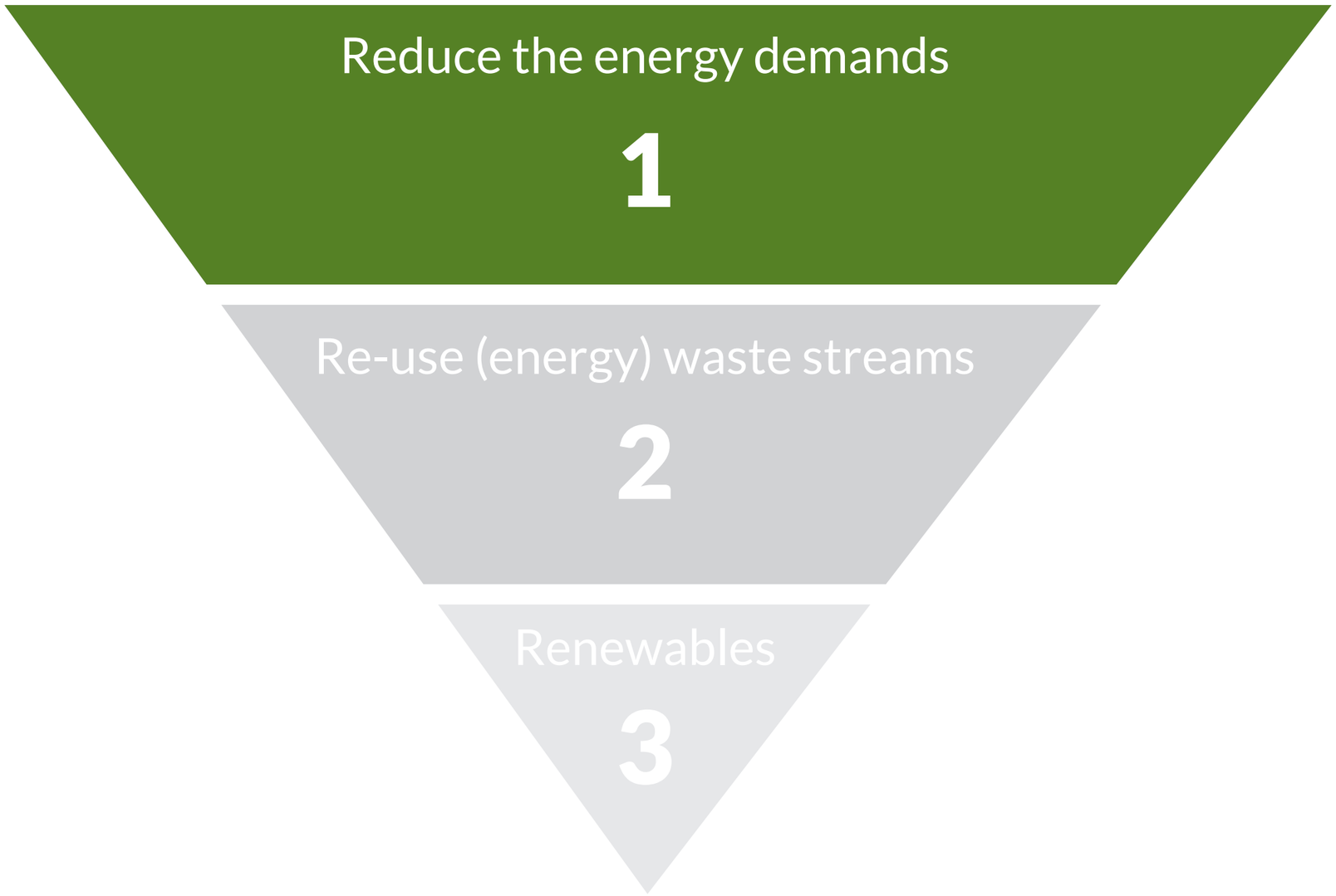


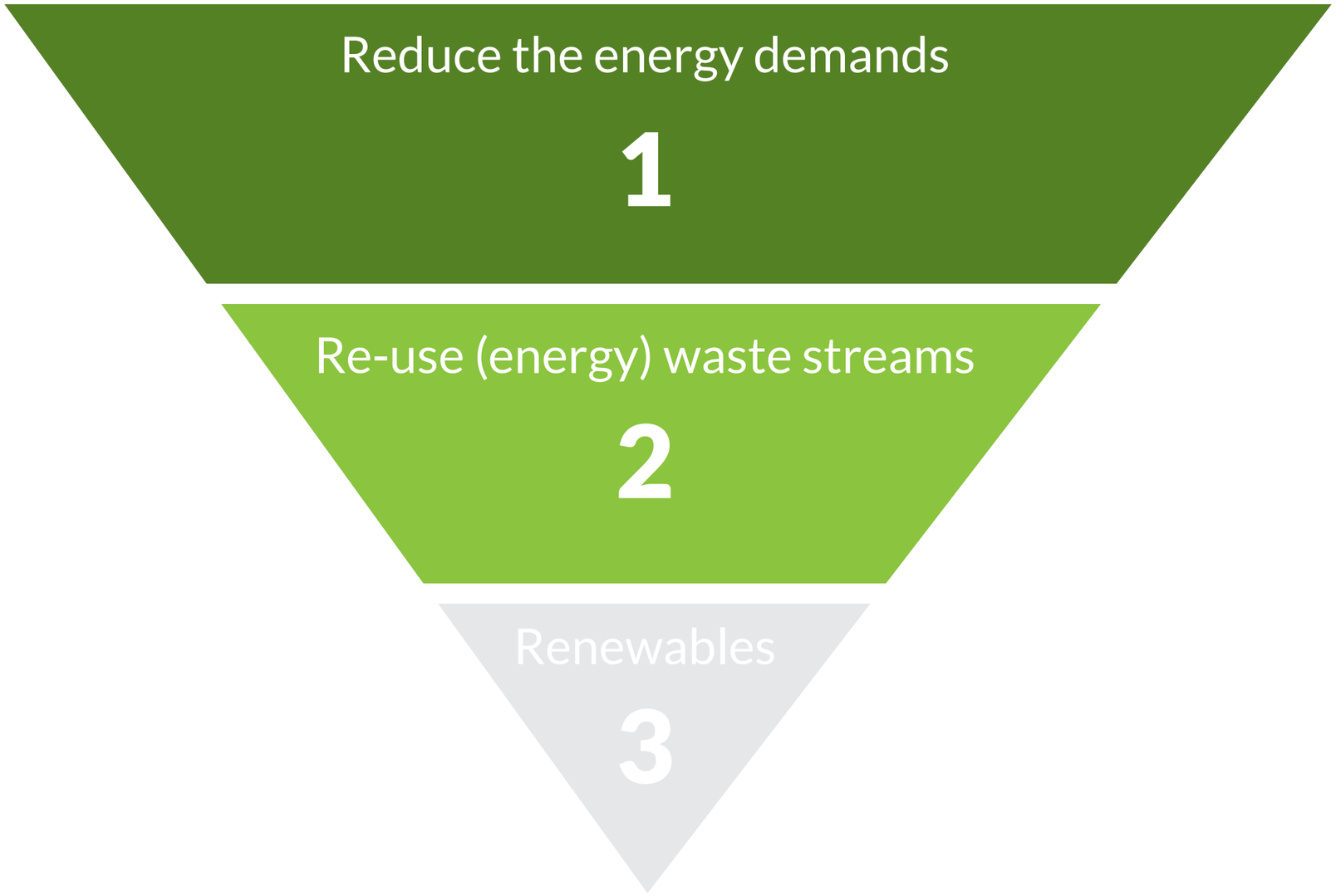
Residual heat, small scale



Cascade




Reduce the energy demands
1
Re-use (energy) waste streams
2
Renewables
3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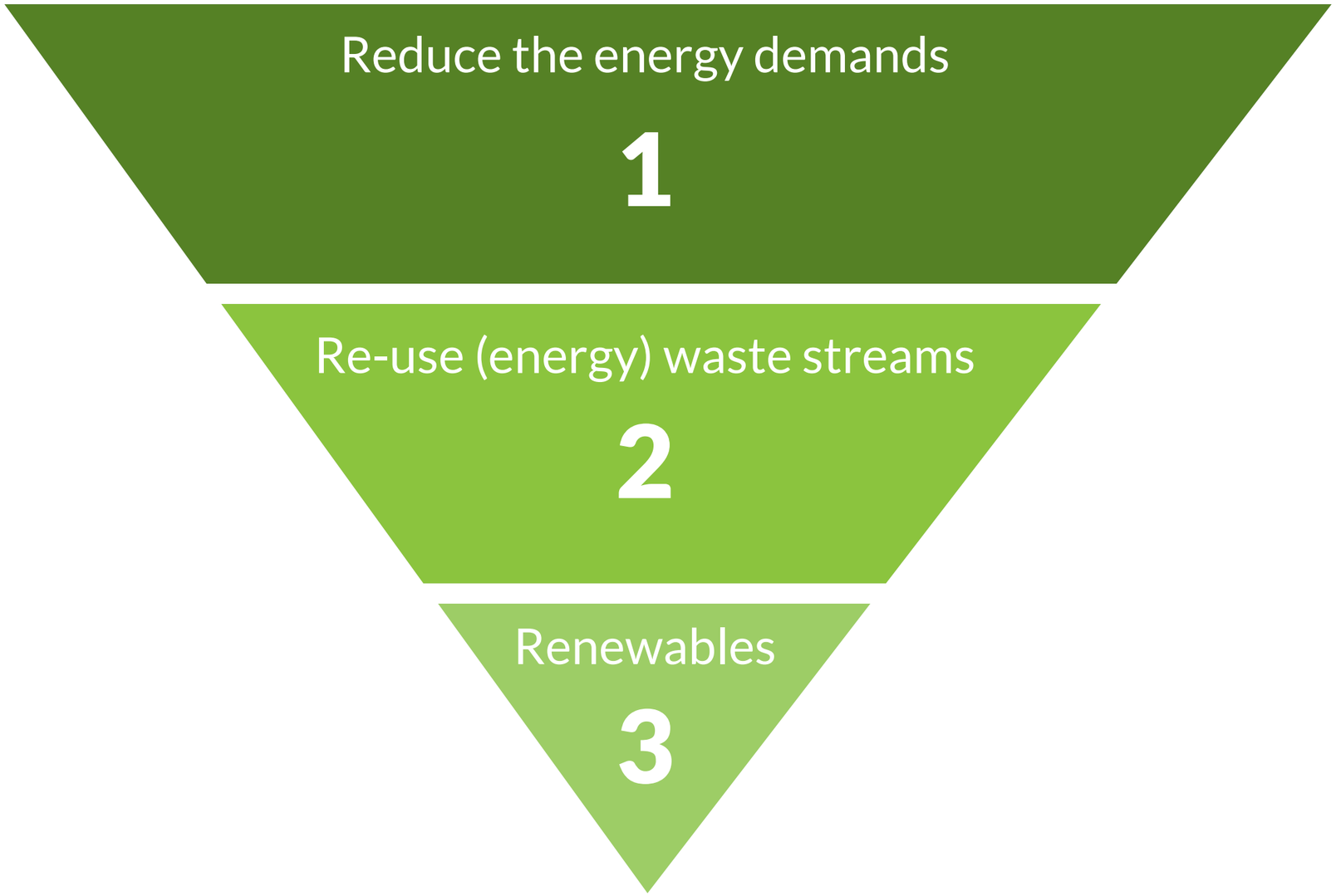
Reduce the energy demands
1
Re-use (energy) waste streams
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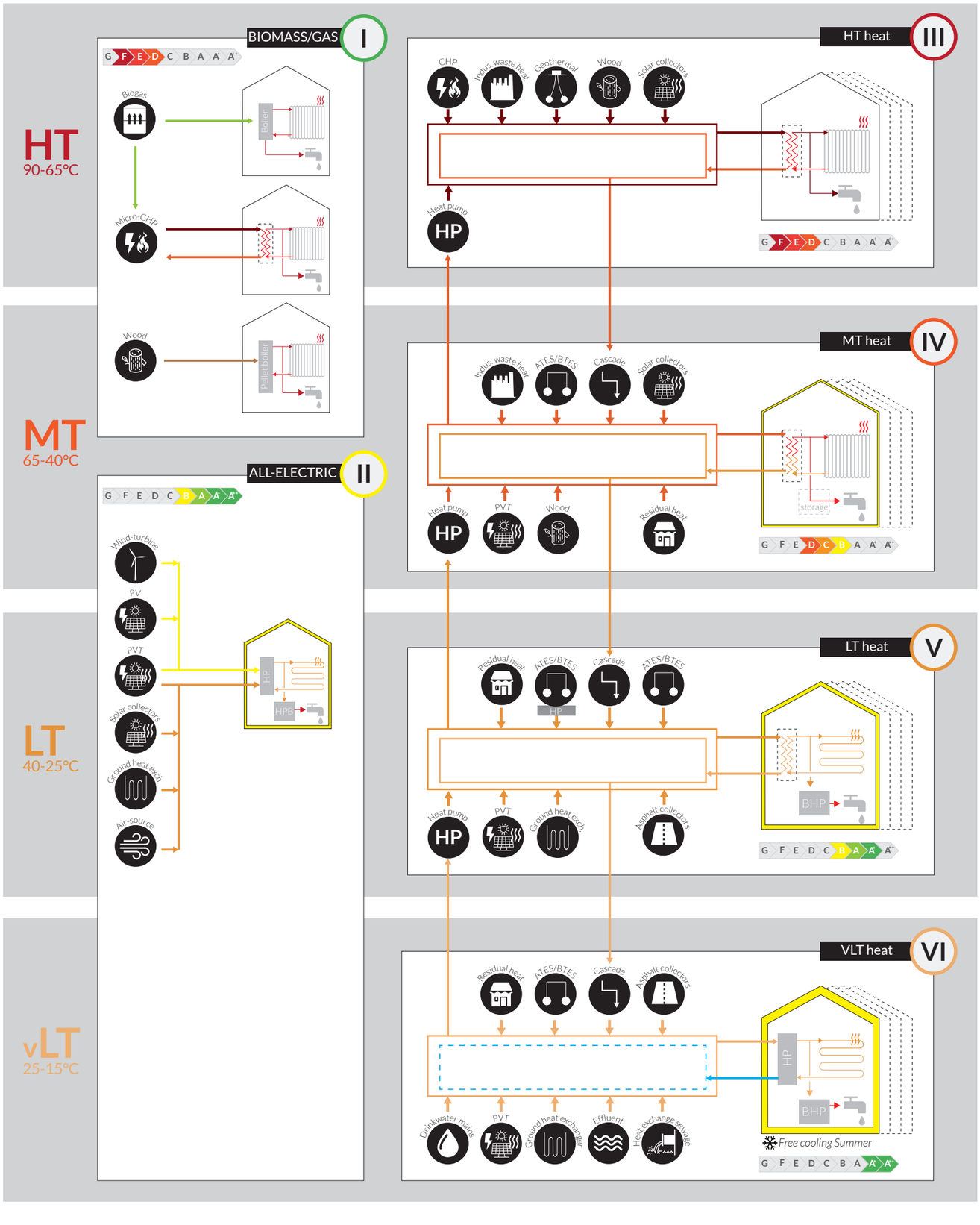
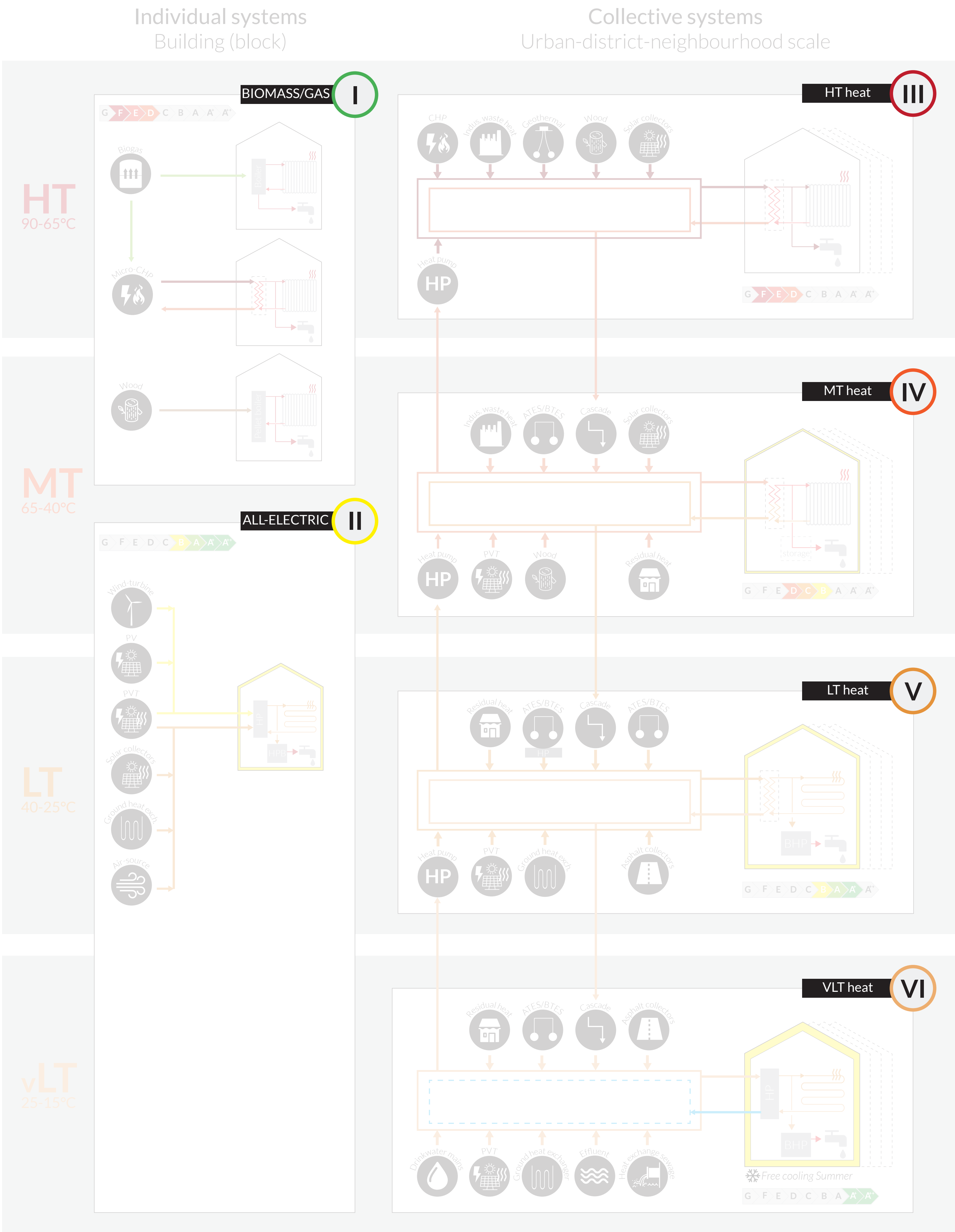
Renewables
3

Basics of the energy transition
Sustainable heat systems tool

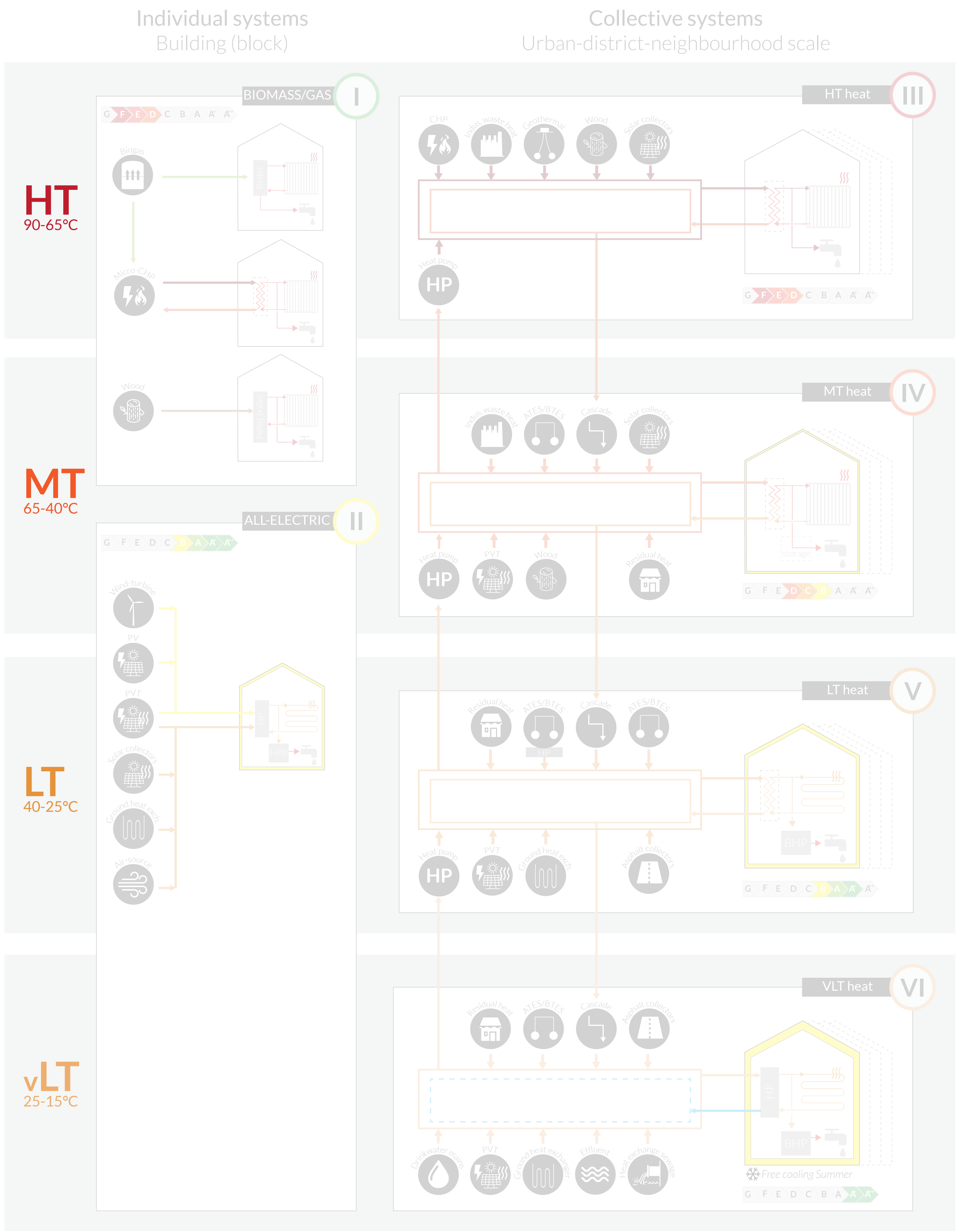
Individual systems
Building (block)

Collective systems
Urban-district-neighbourhood scale

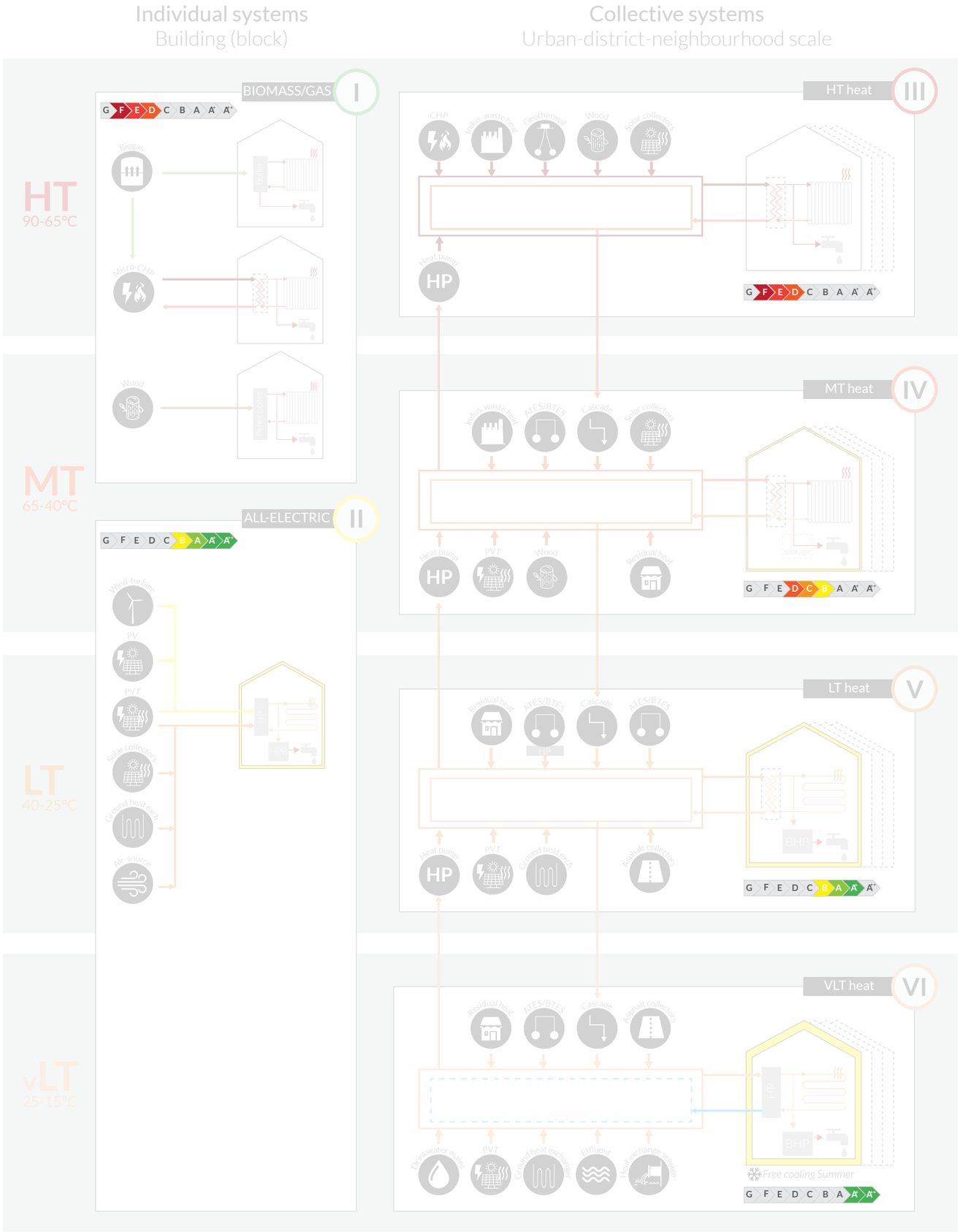




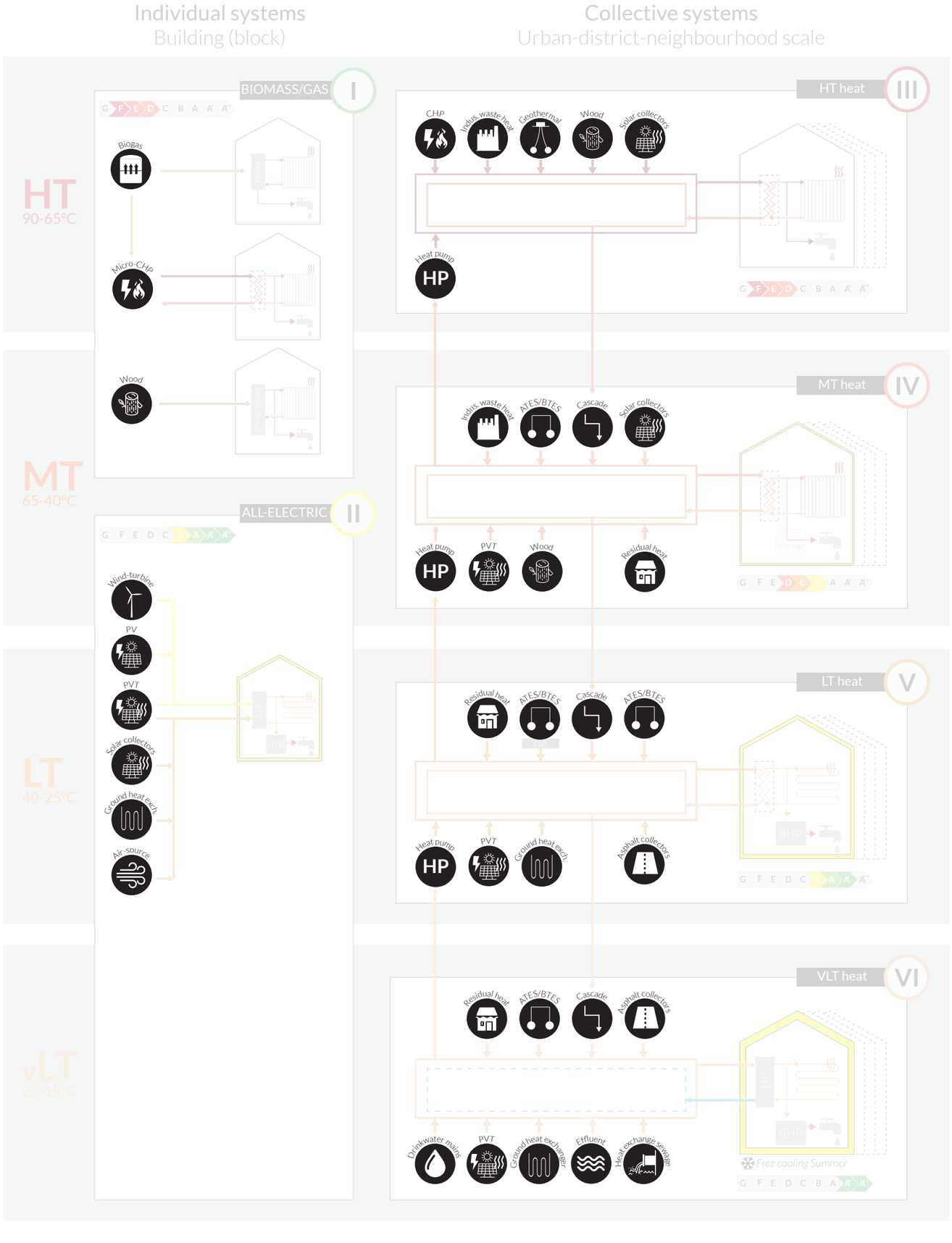
HEAT SYSTEMS



SUPPLY TEMPERATURE

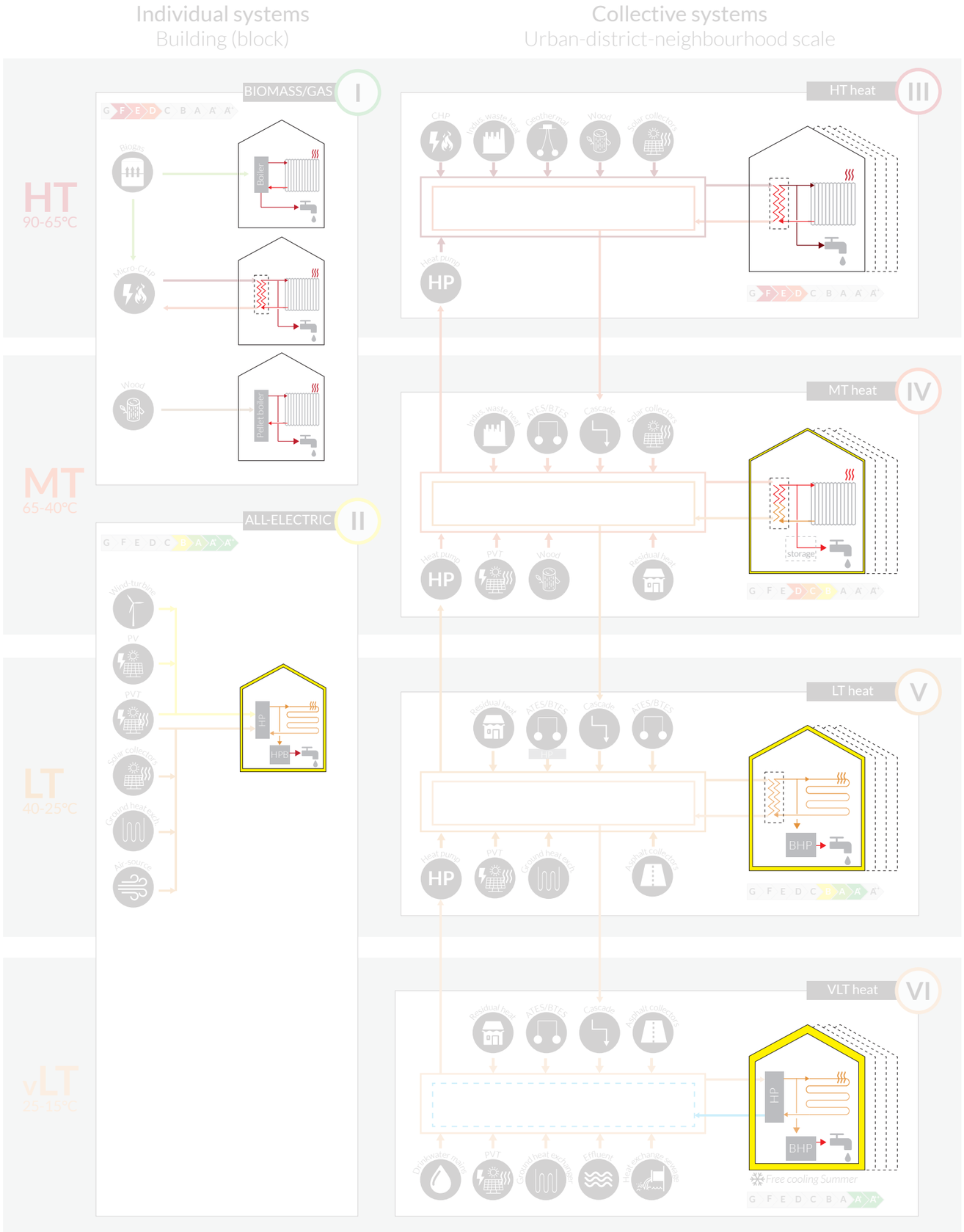


REQUIRED RENOVATION

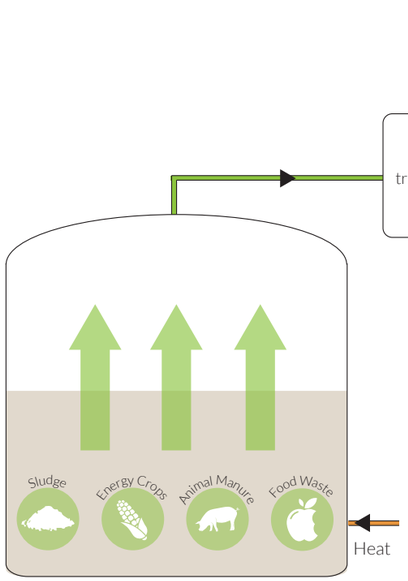

Individual systems
Building (block)
Collective systems
Urban-district-neighbourhood scale
HT
90-65°C
MT
65-40°C
LT
40-25°C
vLT
25-15°C
BIOMASS/GAS
I
ALL-ELECTRIC
II
HT heat
III
MT heat
IV
LT heat
V
VLT heat
VI
Biogas
Micro-CHP
Wood
PV
PVT
Solar collectors
Ground heat exch.
Air-source
Wind-turbine
CHP
Indus. waste heat
Geothermal
Heat pump
HP
ATES/BTES
Cascade
Residual heat
Asphalt collectors
Drinkwater mains
Effluent
Heat exchange sewage
Free cooling Summer
BHP

SOURCES

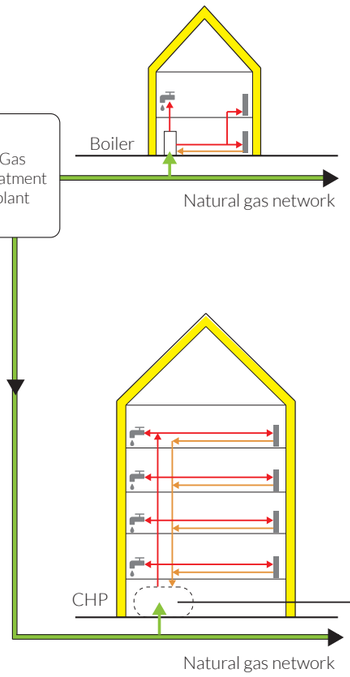
Basics of the energy transition
Sustainable heat systems tool

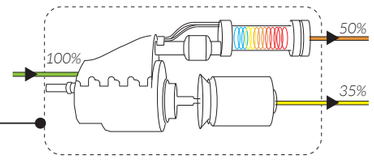


INSTALLATIONS BUILDING

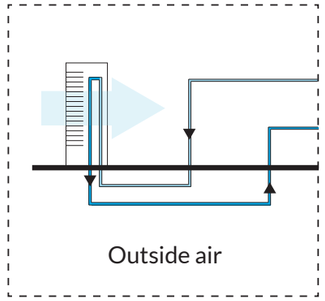


Fermentation

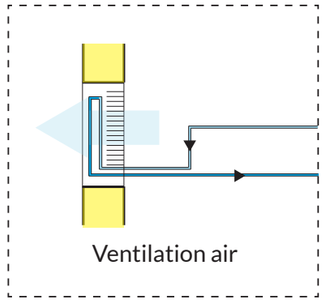




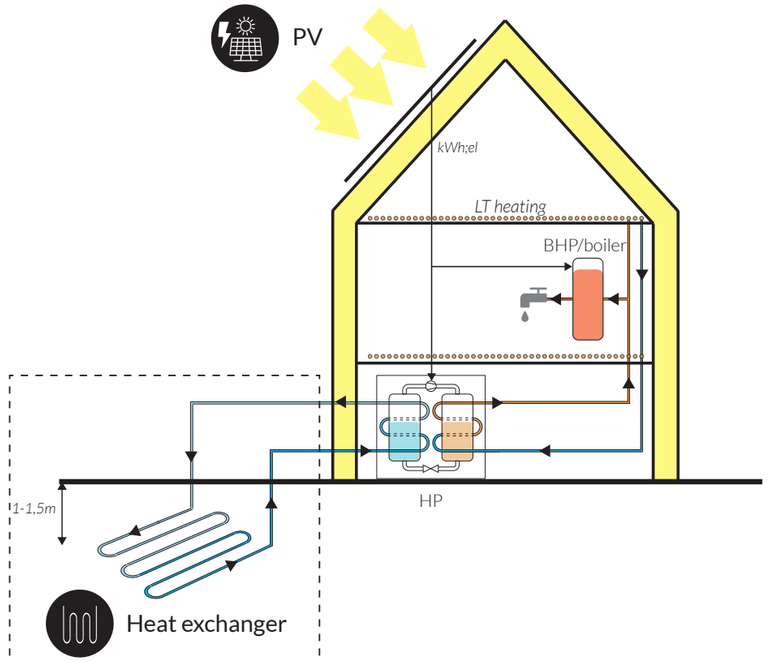
Micro-CHP



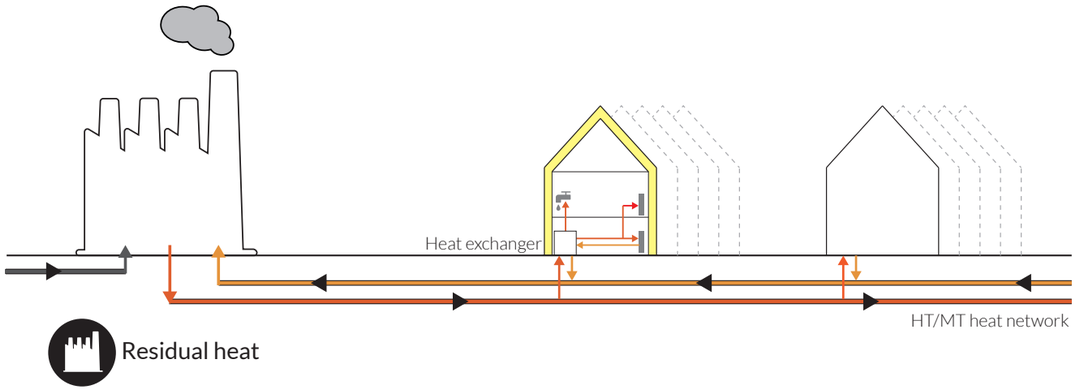
Outside air



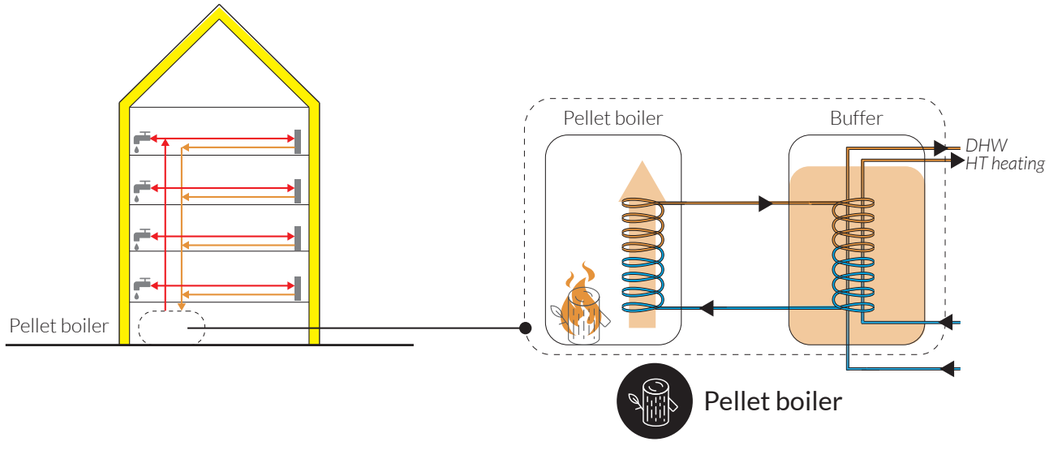
Ventilation air



Heat exchanger

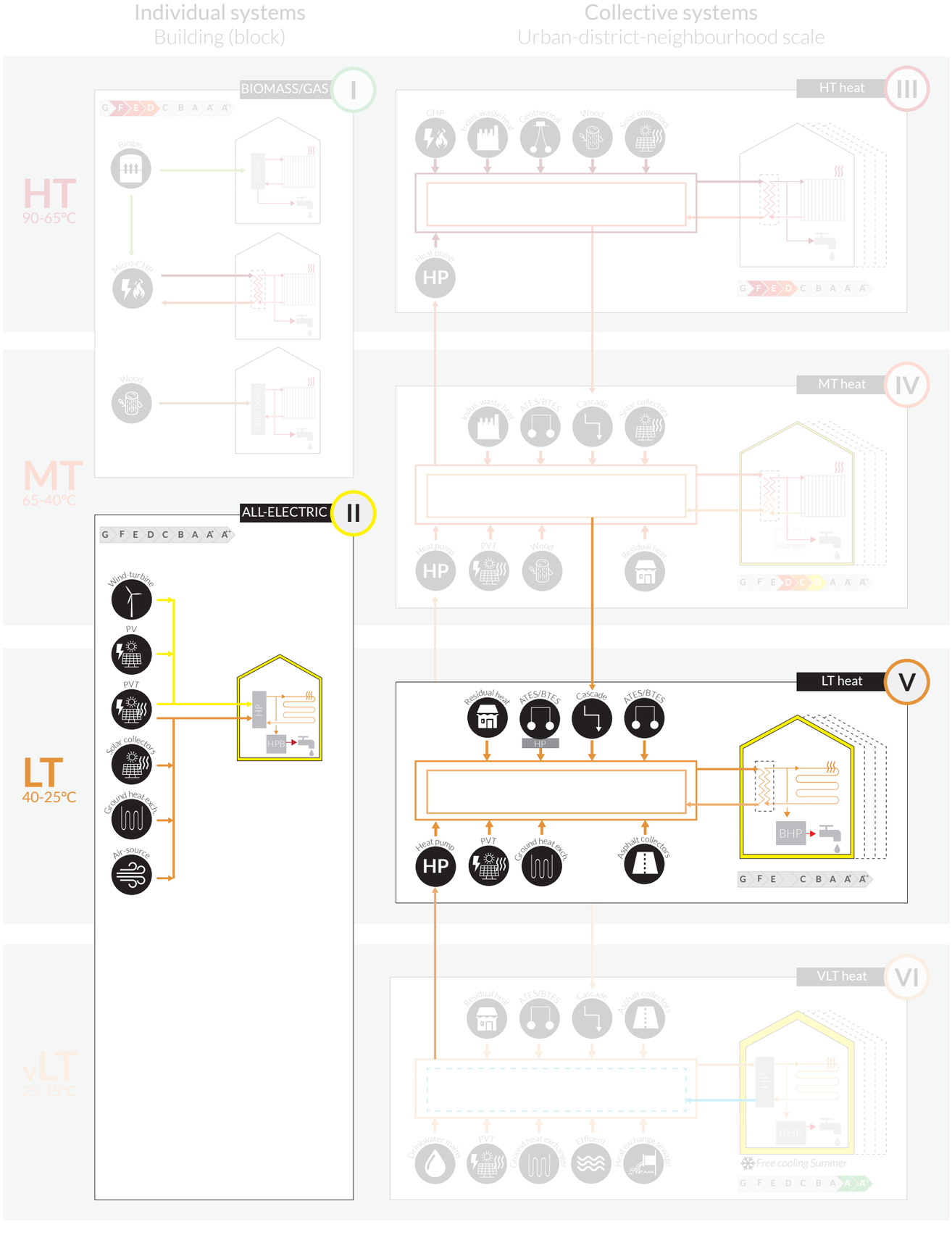


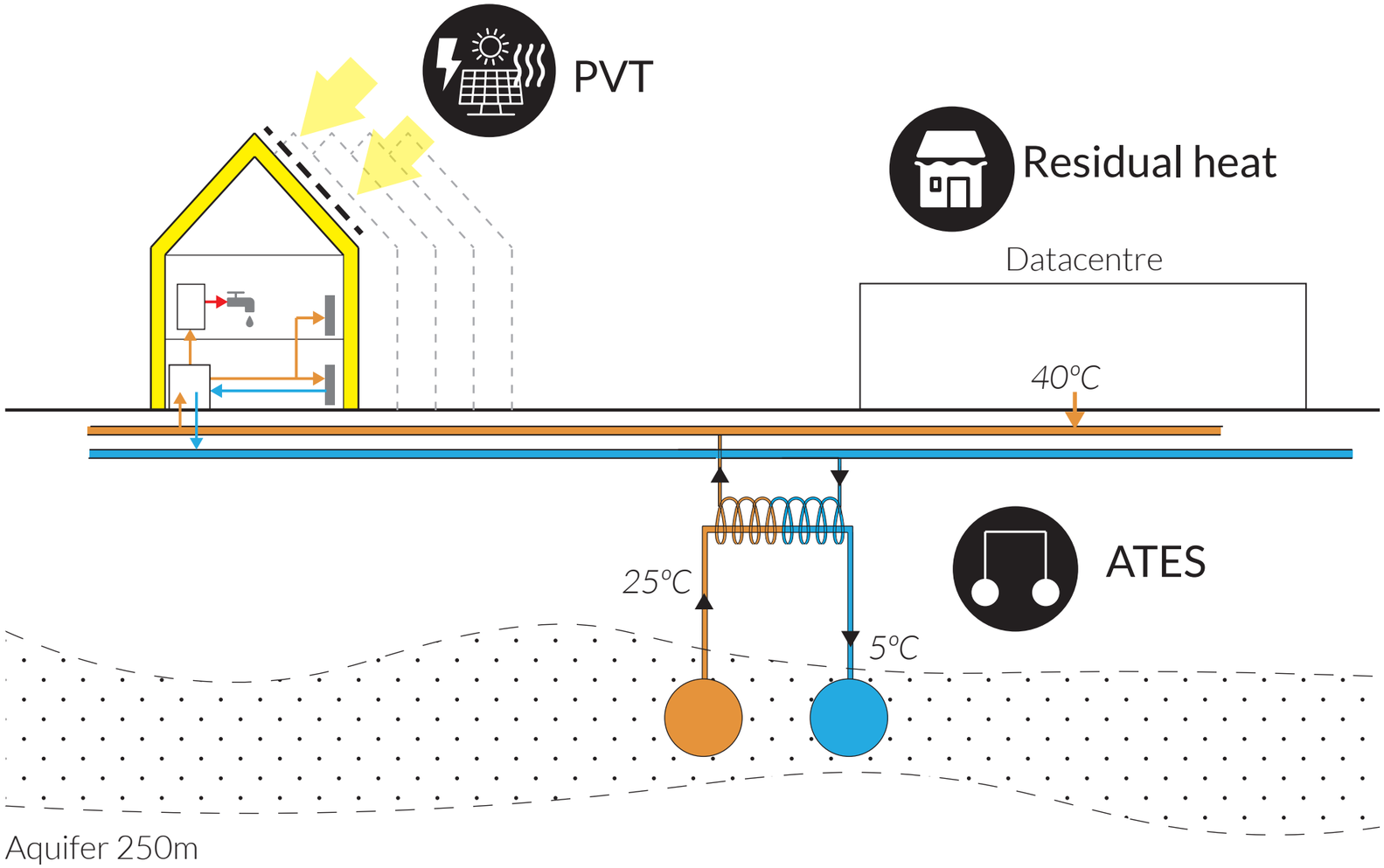
Residual heat

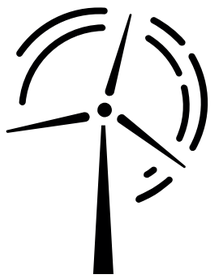


Pellet boiler

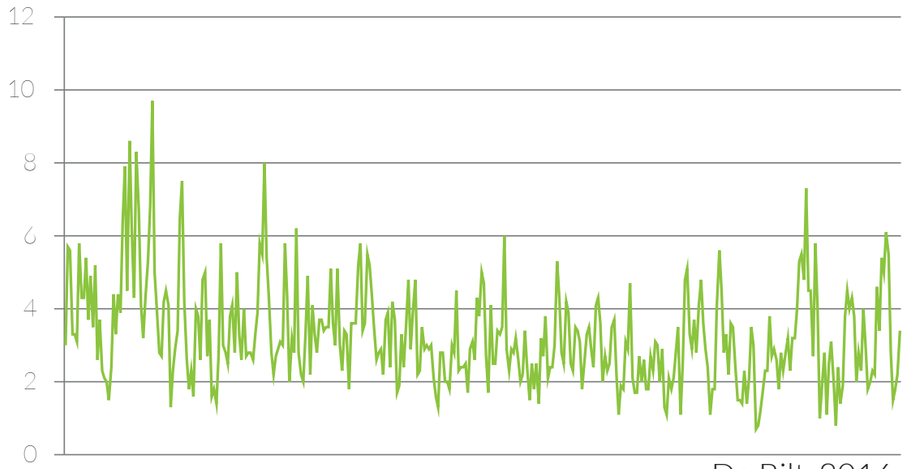
Basics of the energy transition
Example




PVT
Residual heat
Datacentre
40°C
25°C
5°C
ATES
Aquifer 250m

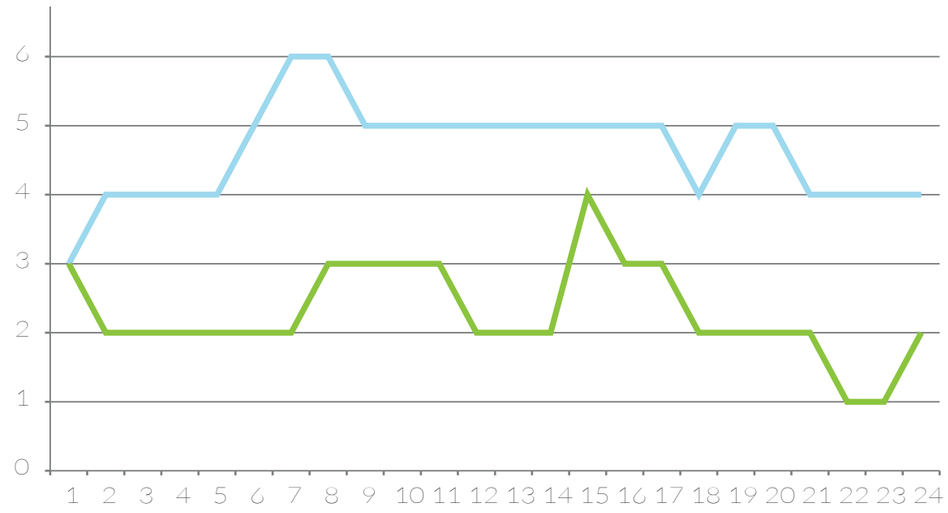


Yearly average windspeeds per day [m/s]

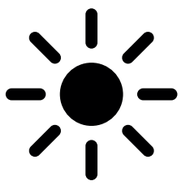


De Bilt, 2016

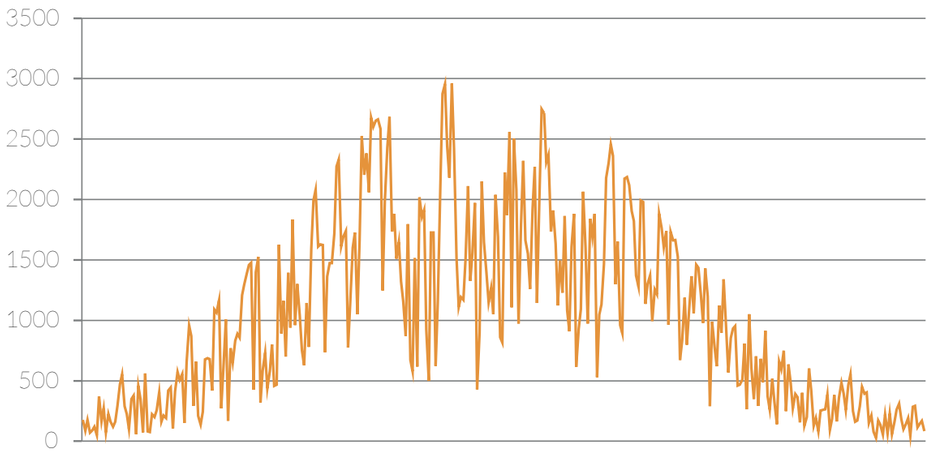
Average windspeeds per hour [m/s]



De Bilt, 2016

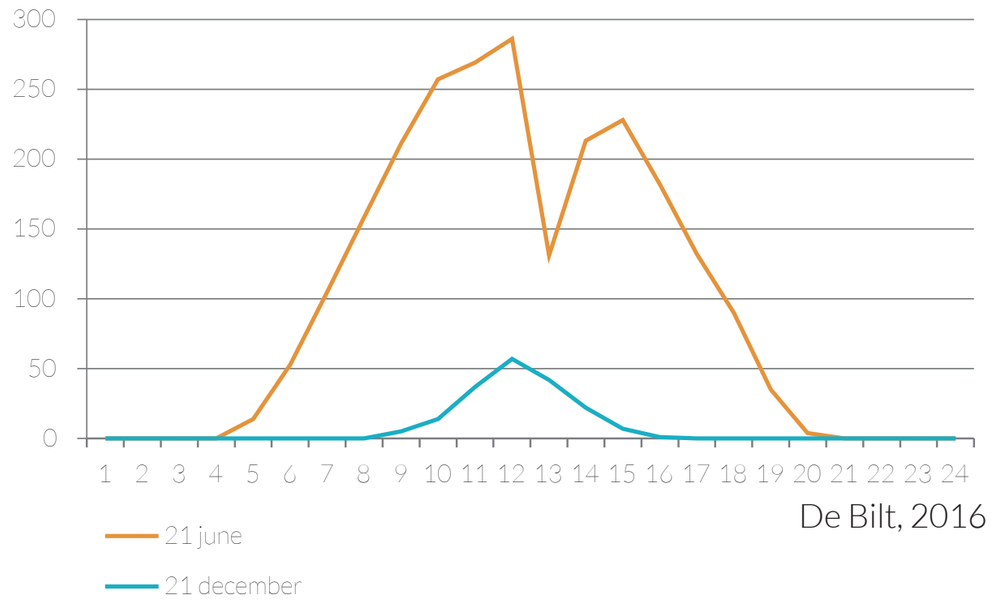


Yearly solar radiation [J/cm²]



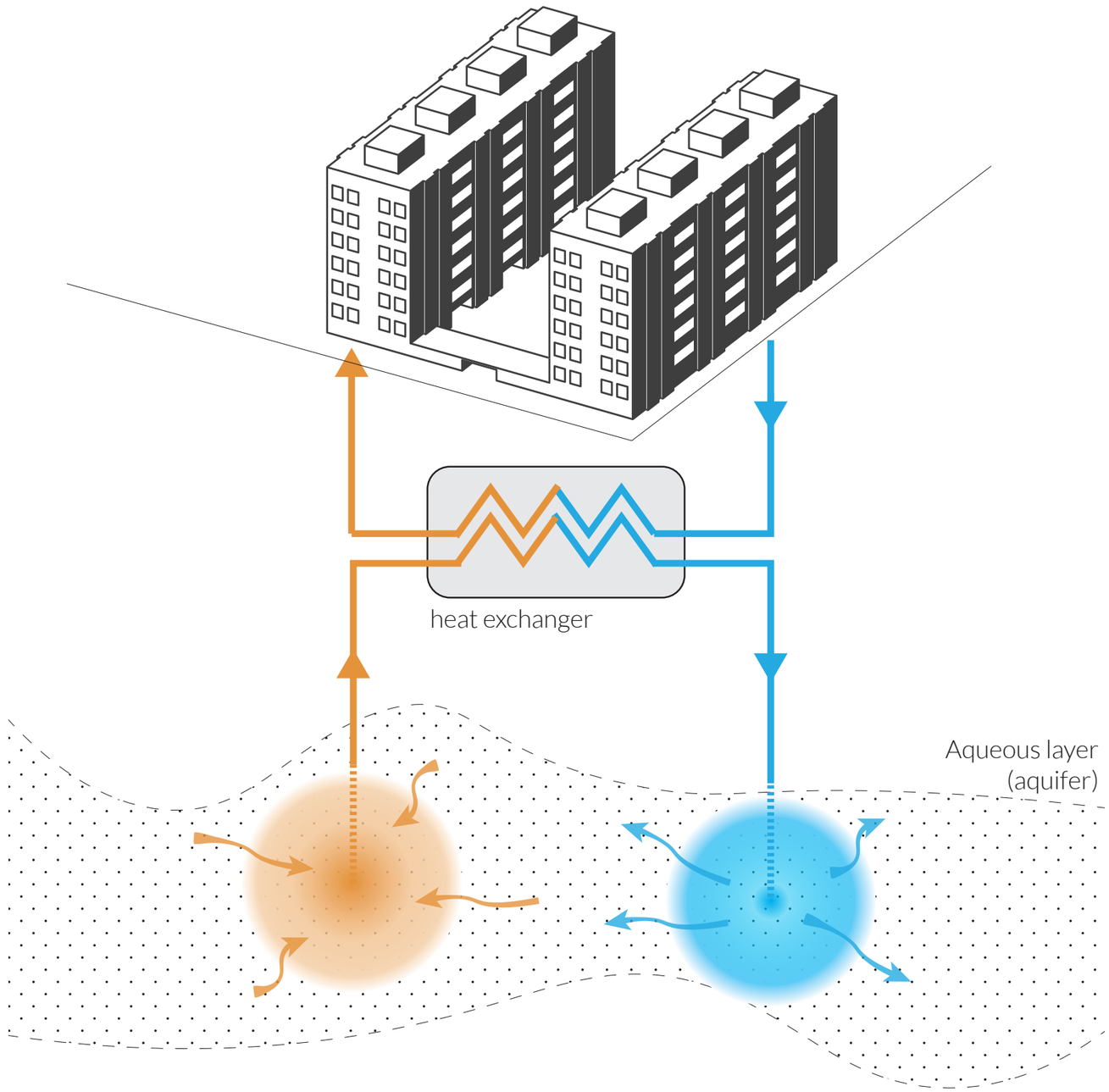
De Bilt, 2016

Daily solar radiation [J/cm²]



De Bilt, 2016

Seasonal electricity storage no option: The Netherlands is too flat


heat exchanger
Aqueous layer
(aquifer)

ELECTRICITY = GOVERNMENT

International network

Windparks North Sea

THERMAL = MUNICIPALITY

Local energy potentials

Local characteristics & building stock

Guidelines

Heat supplies

- self-sufficient

Guidelines

Heat supplies

- self-sufficient
- Decrease demands by energy retrofitting buildings

Guidelines

Heat supplies

- self-sufficient
- Decrease demands by energy retrofitting buildings
- Optimally implement the local potentials
  - Never use HT heat for LT purposes

Guidelines

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Electricity
- Minimize the demands, maximize generation

Guidelines

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Electricity
- Minimize the demands, maximize generation
  - To optimize generation 70% available roof surface PV

Guidelines

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- Optimally implement the local potentials
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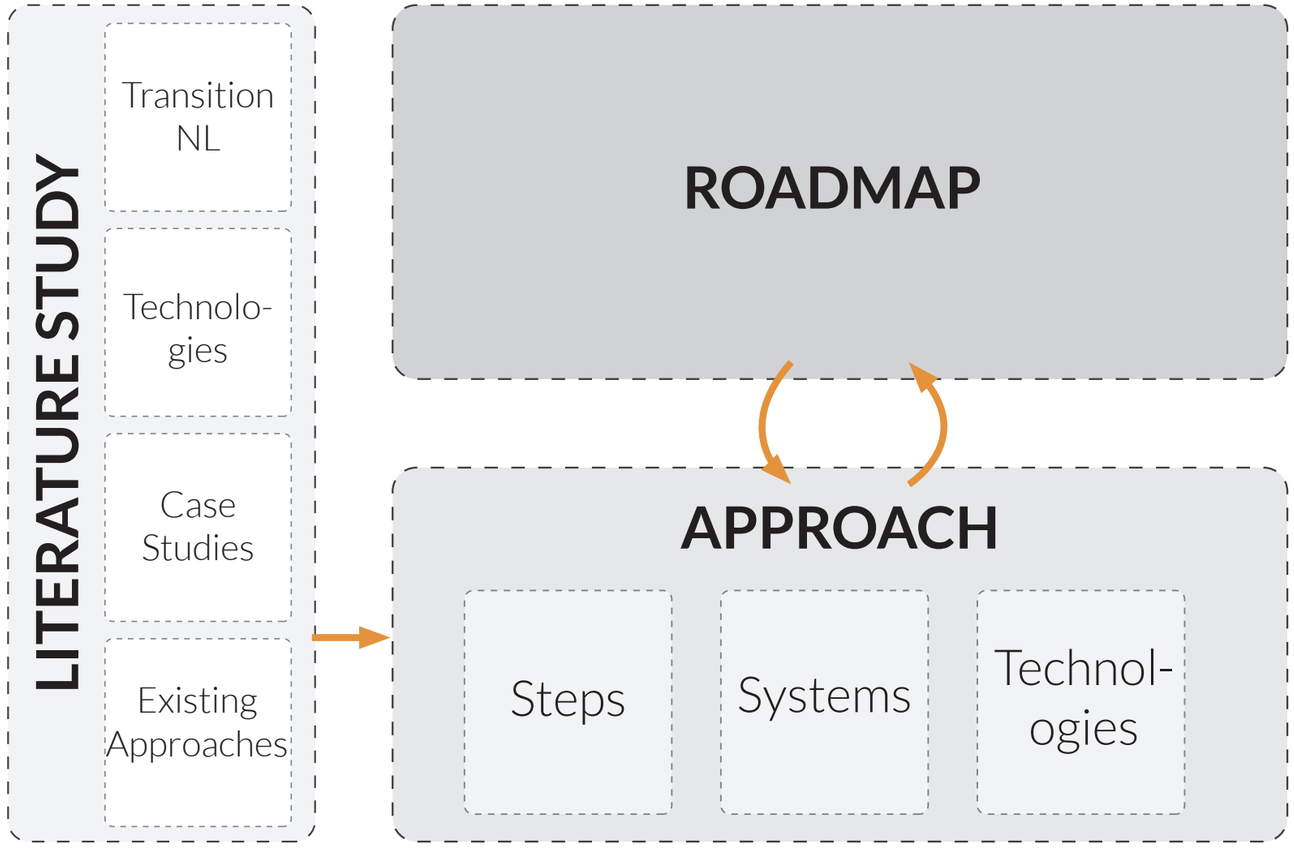
Electricity
- Minimize the demands, maximize generation
  - To optimize generation 70% available roof surface PV
  - To limit peak demands: max.10-15% heated all-electric

3

The Approach


LITERATURE STUDY
Transition NL
Technolo-gies
Case Studies
Existing Approaches
ROADMAP
APPROACH
Steps
Systems
Technol-ogies

Analysis

DEMANDS

E-SYSTEM

STAKEHOLDERS

STATUS QUO

0

VISION & TARGETS

EPM

EPM

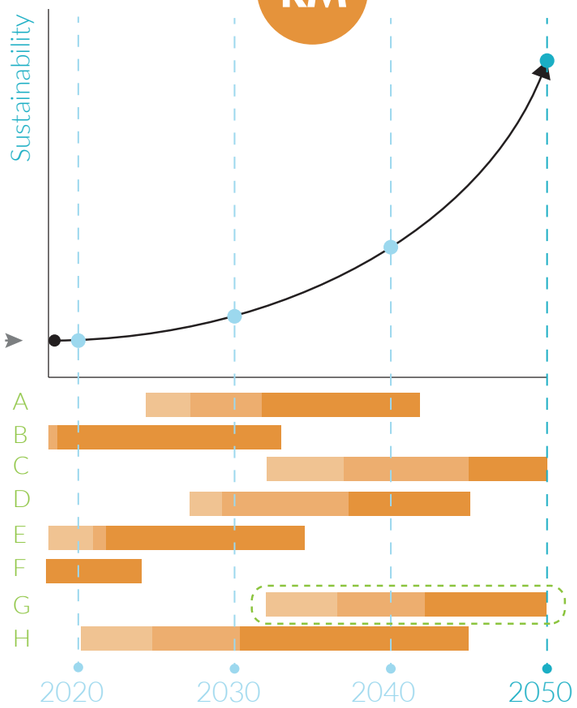
Roadmap

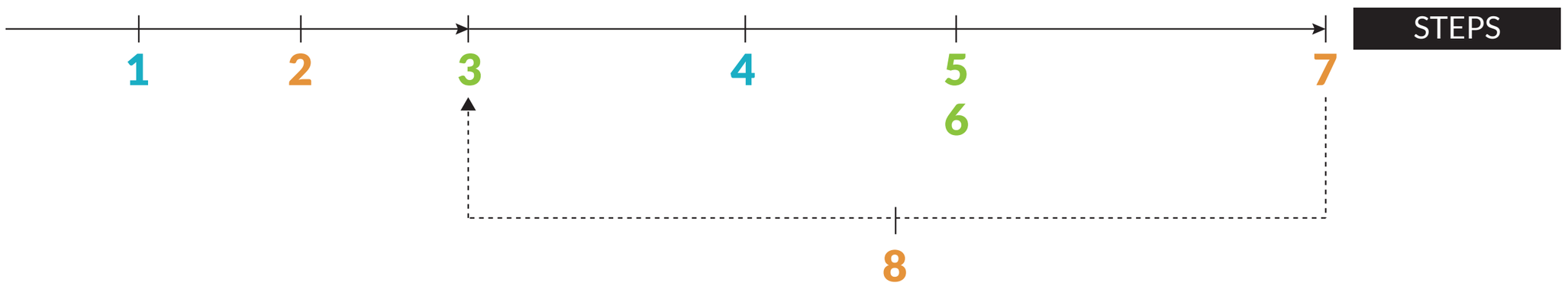
URBAN STRATEGY

INTERVENTIONS

ROADMAP

RM





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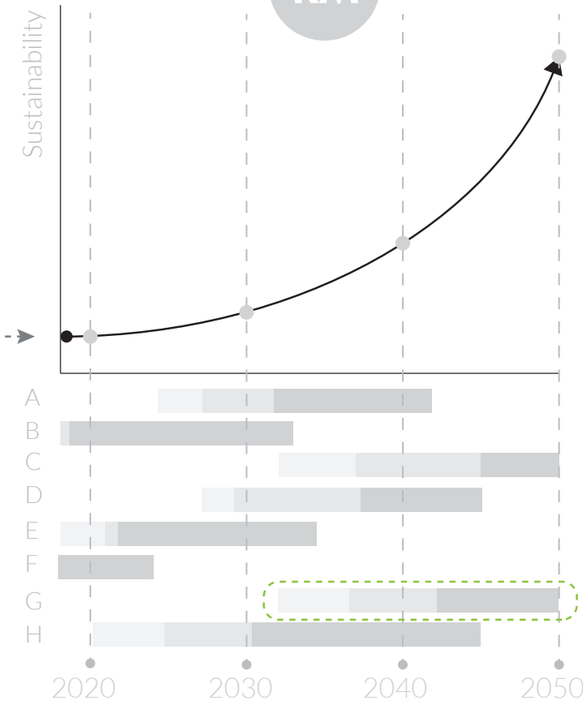

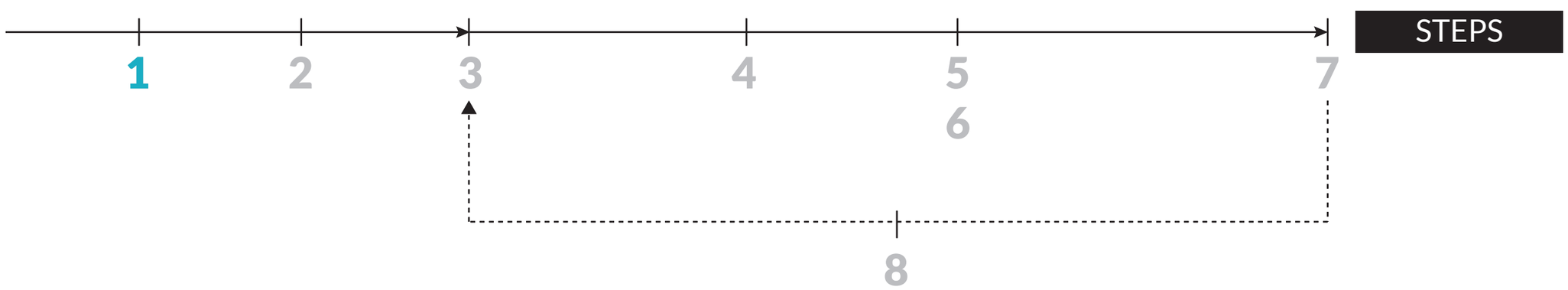

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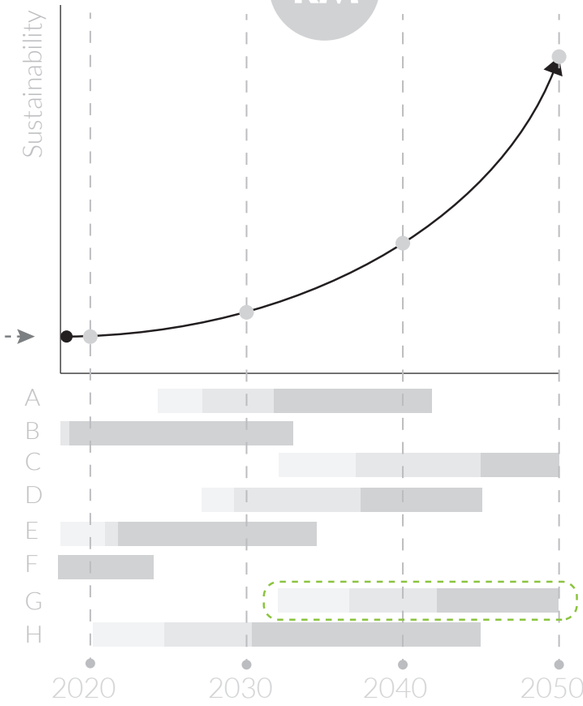

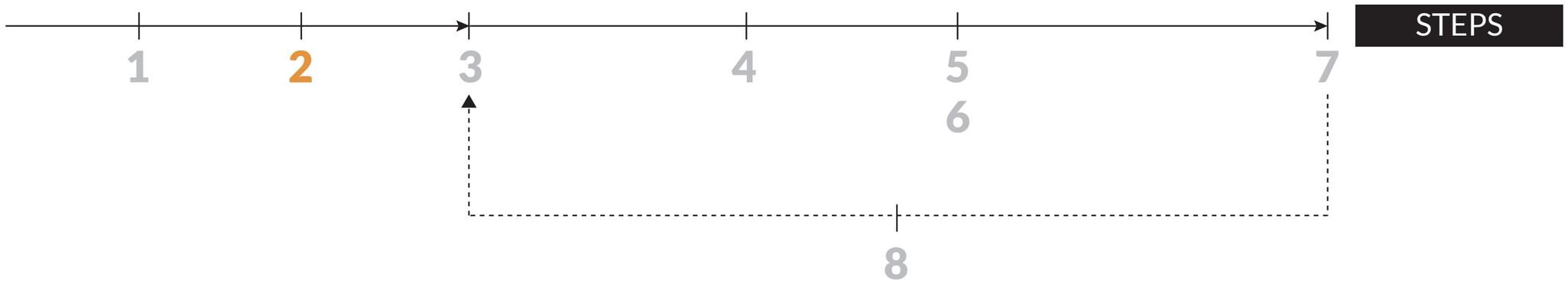

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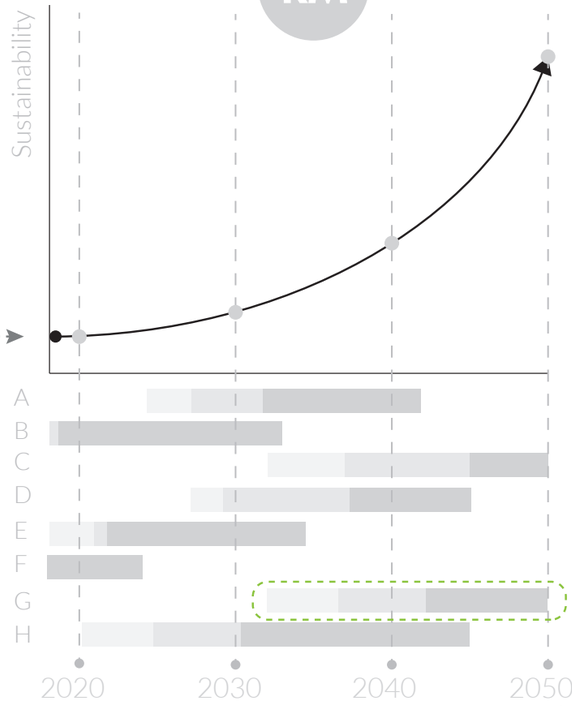

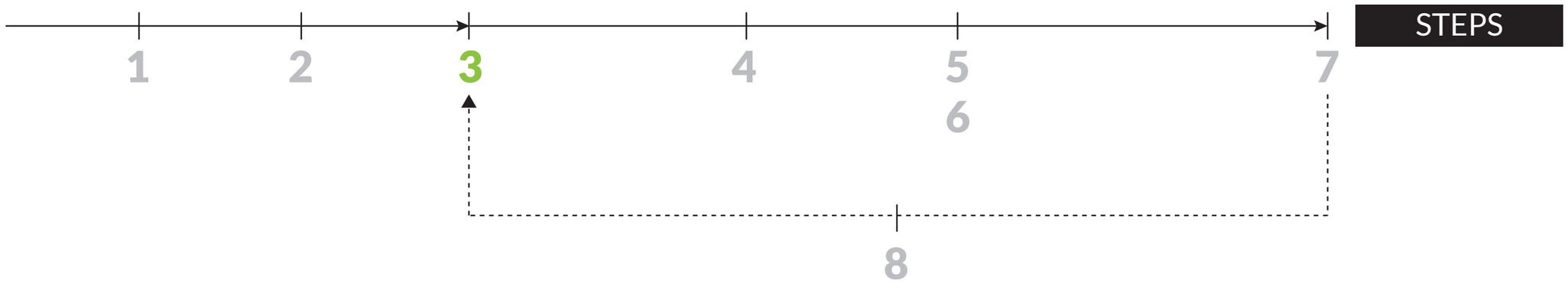

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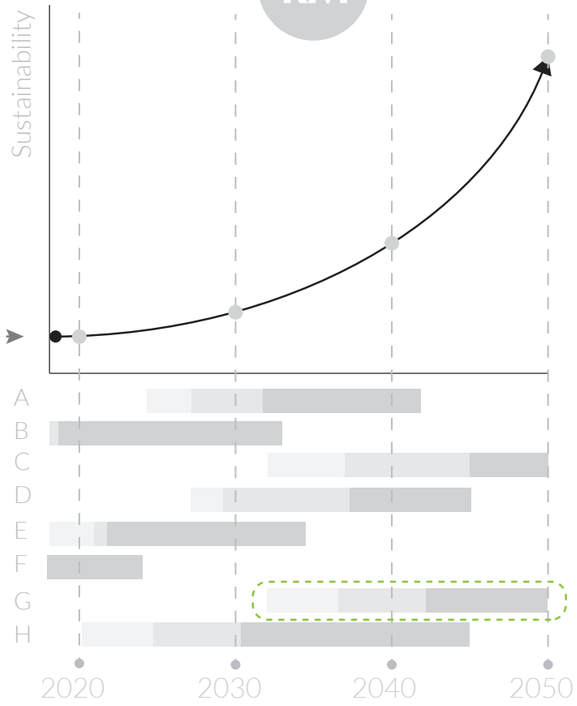

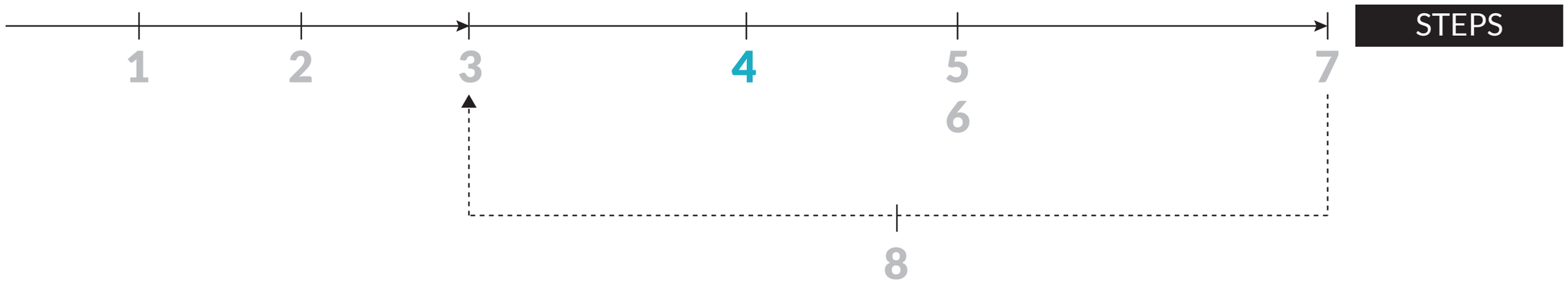

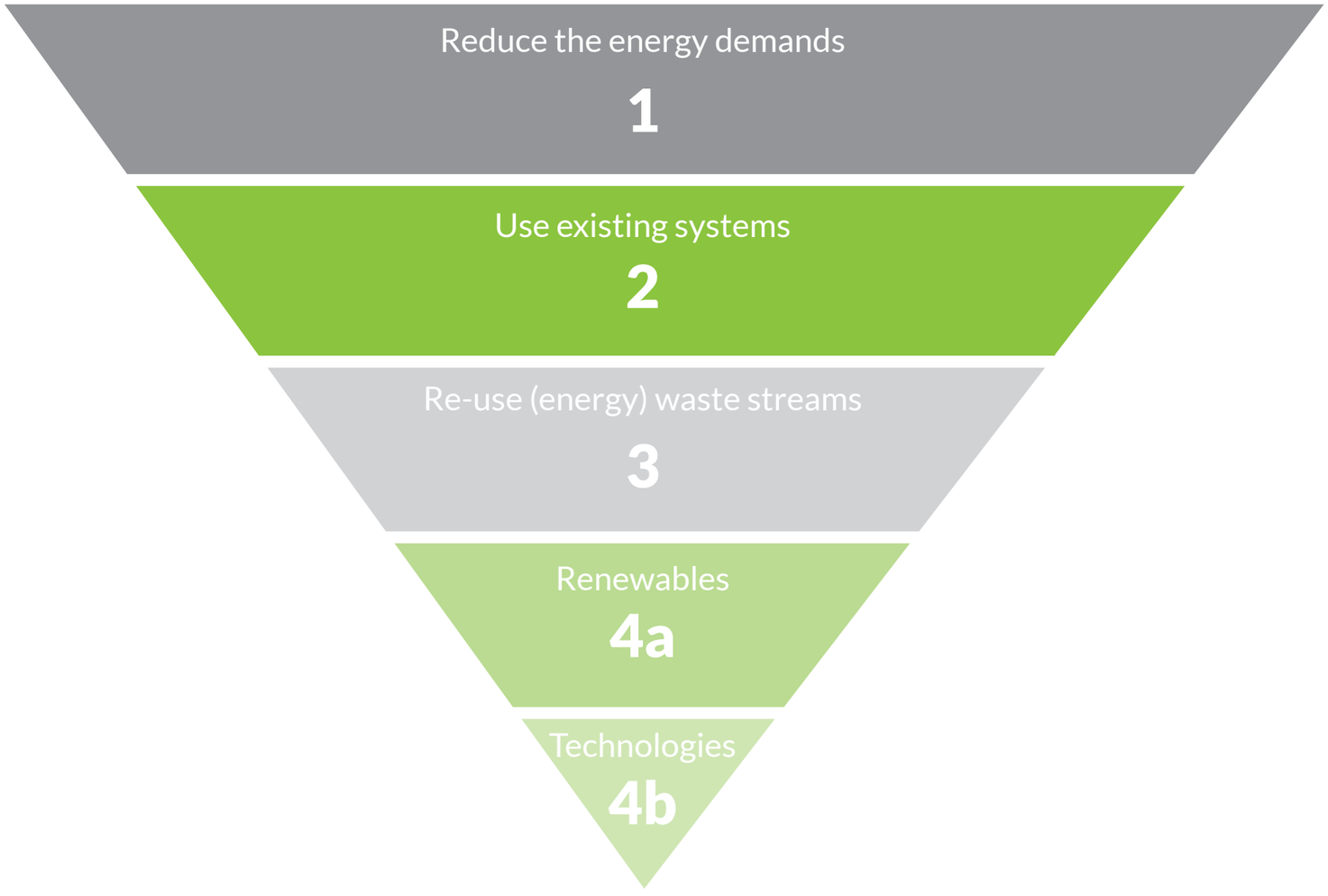
Reduce the energy demands
1
Use existing systems
2
Re-use (energy) waste streams
3
Renewables
4a
Technologies
4b

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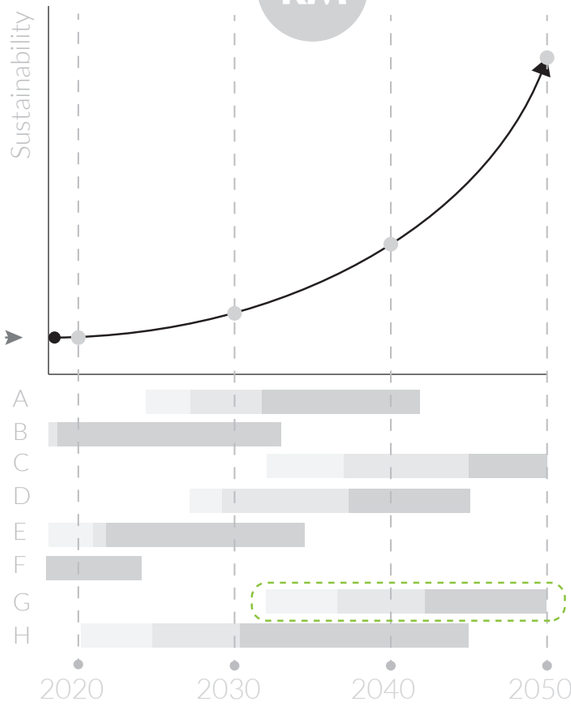

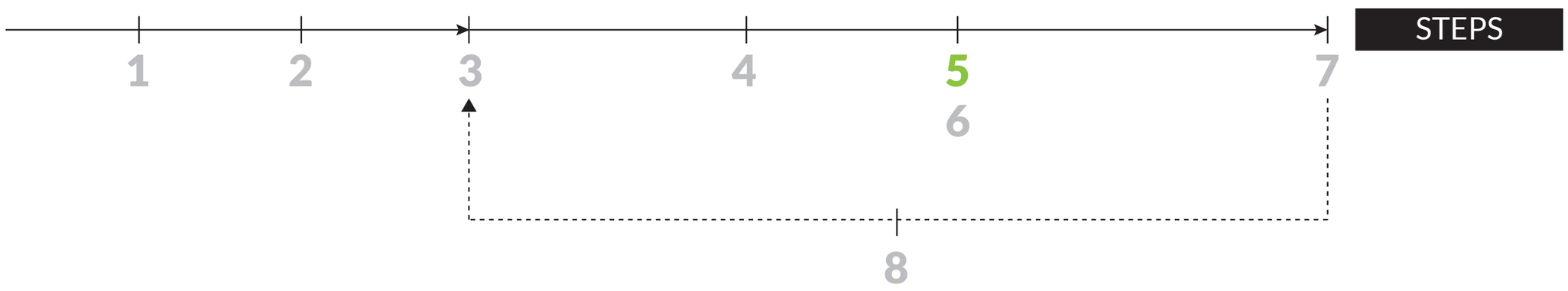

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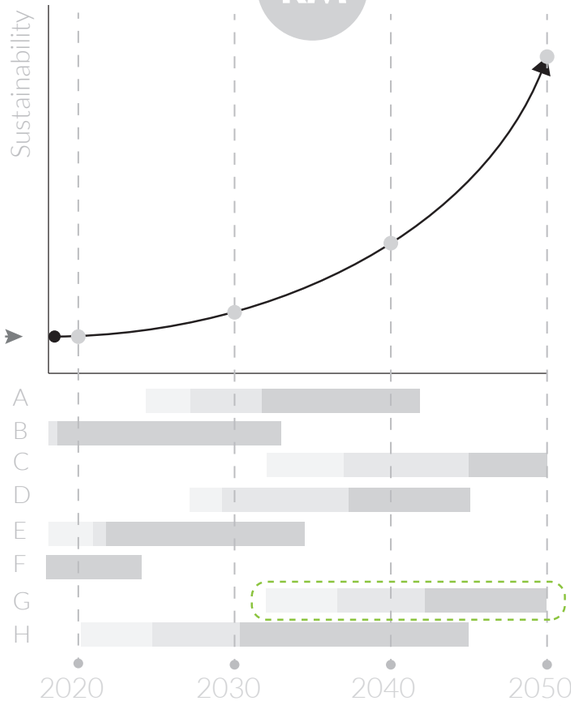

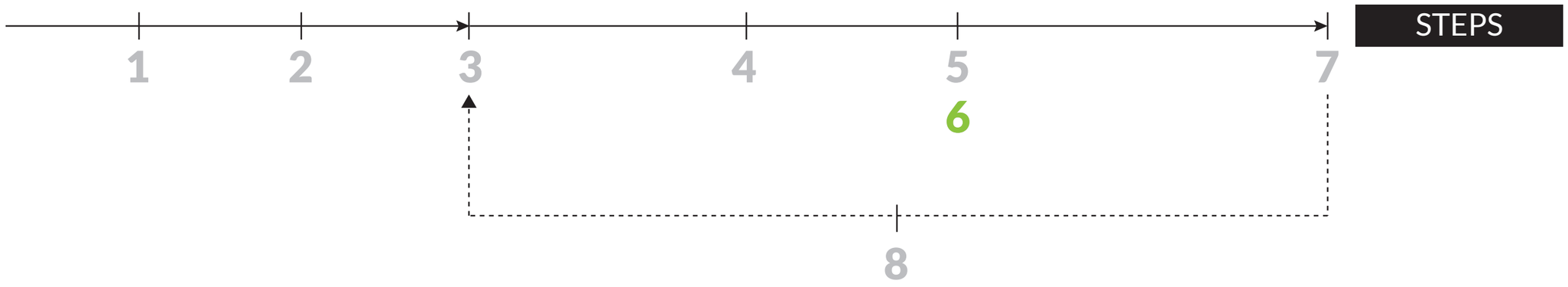

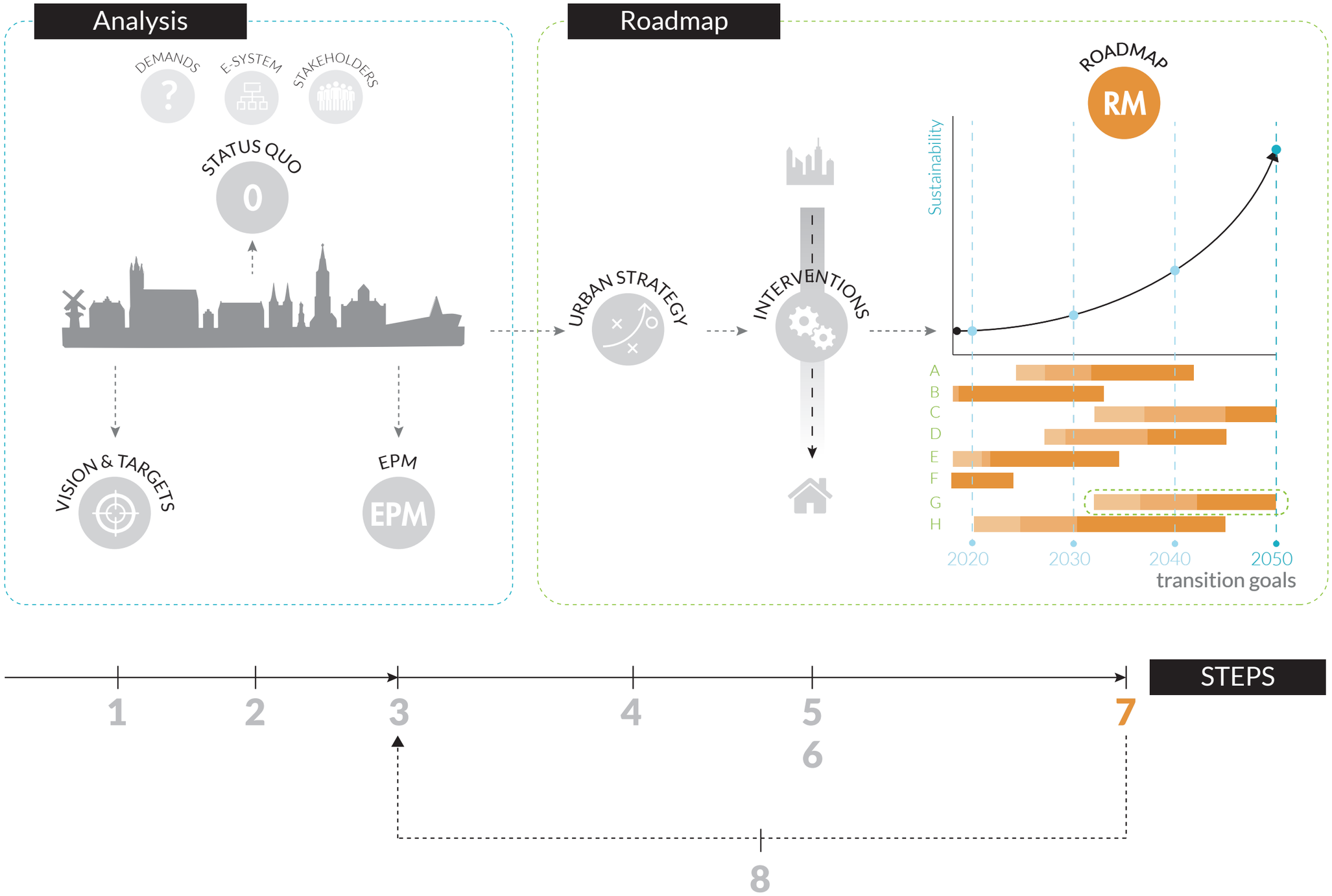
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Sustainability
A
B
C
D
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G
H
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2030
2040
2050
transition goals

STEPS
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3
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7
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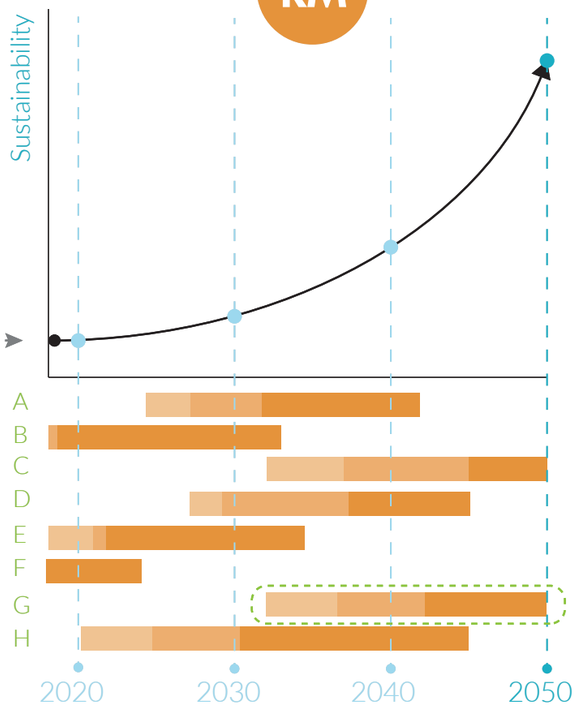
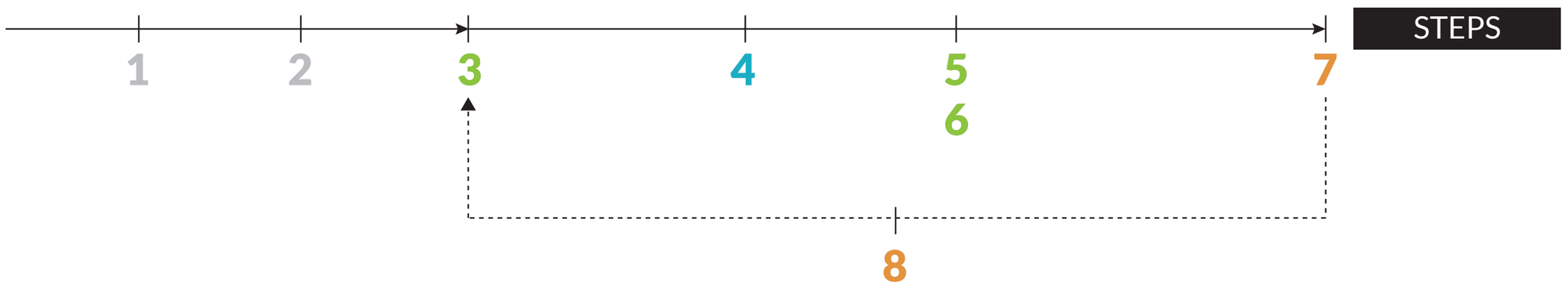




4

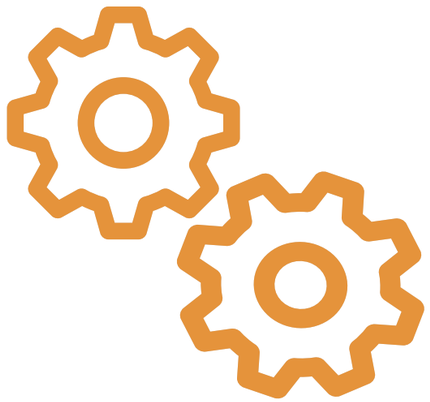
Roadmap Delft

Energy neutral city

"Only energy of renewable sources will be used for heating, cooling, illumination and other processes of all buildings and for all the traffic and transport in between the city boundaries of Delft."
(Leguit, 2011)

Energy neutral city

"Only energy of renewable sources will be used for heating, cooling, illumination and other processes of all buildings ~~and for all the traffic and transport~~ in between the city boundaries of Delft."
(Leguit, 2011)



CITY OF TECHNOLOGY

Collaboration TU-TIC-Delft
Mobilize & Implement their knowledge

COHERENT CITY

CORPORATIONS

CITY OF TECHNOLOGY

COHERENT CITY

Feel connected & contribute to the
cities developments
& transition

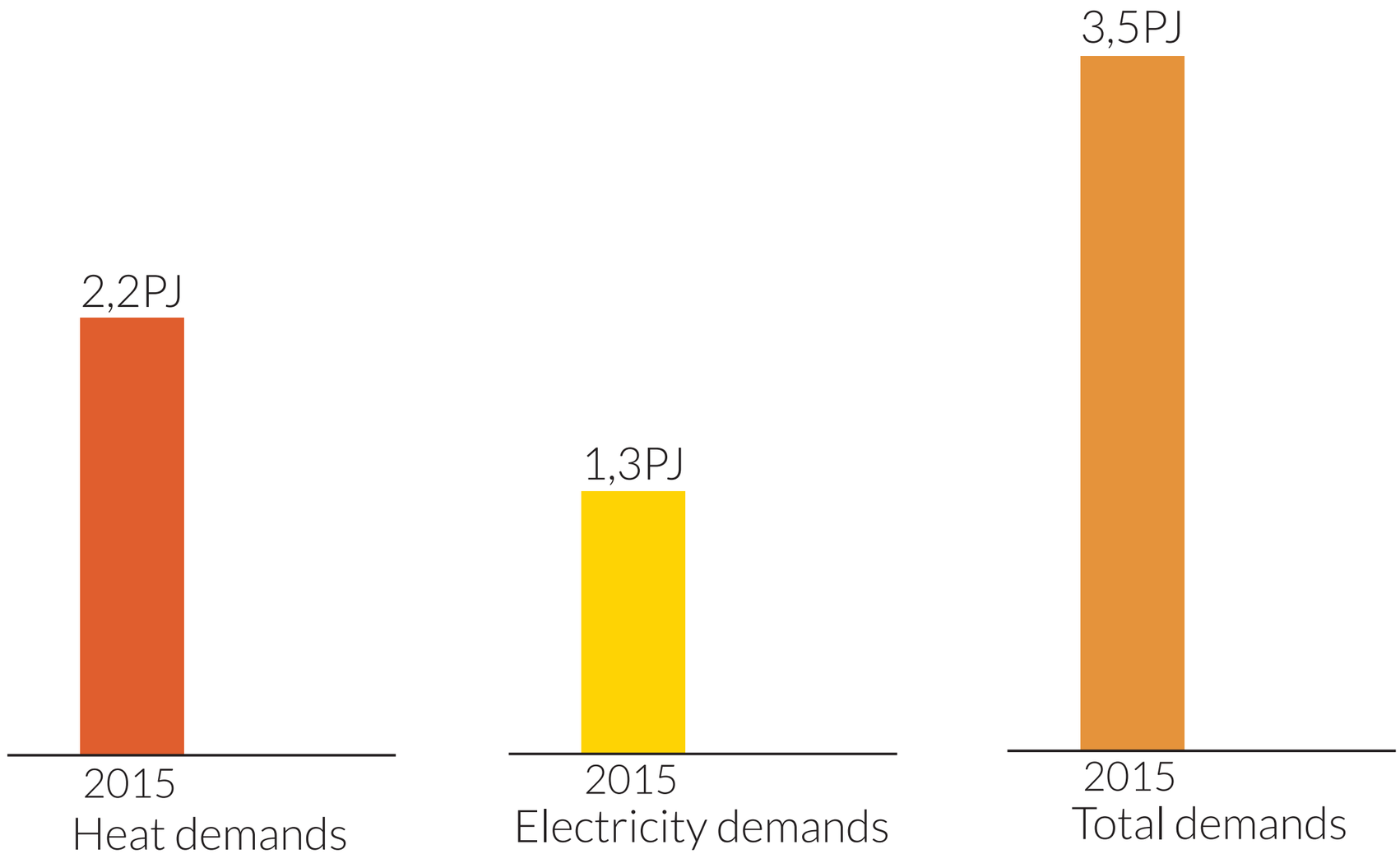
CORPORATIONS

CITY OF TECHNOLOGY

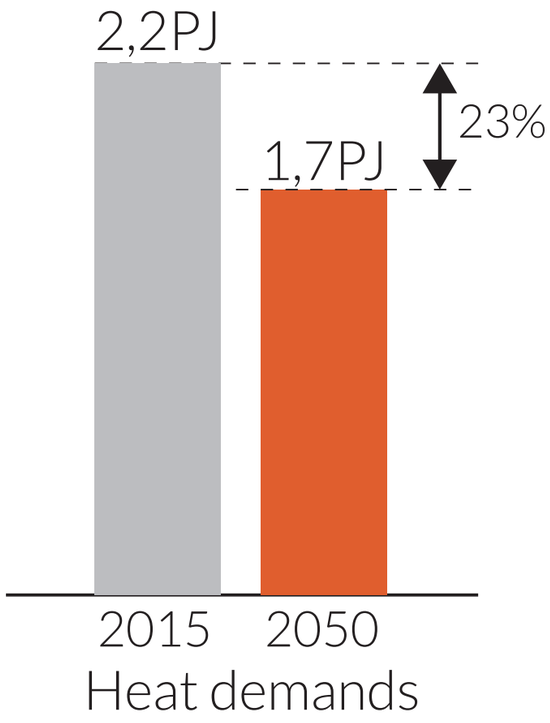
COHERENT CITY

CORPORATIONS

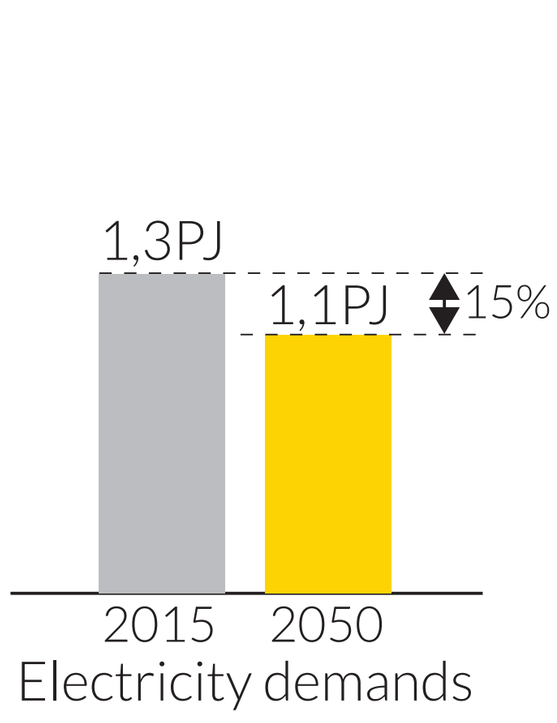
47% property of corporations
Upgrade to label B/A
(E-Deals)



(CBS, Klimaatmonitor)



Heat demands



Electricity demands

Total demands

(PICO Webtool)

Roadmap for Delft
Urban scale strategy

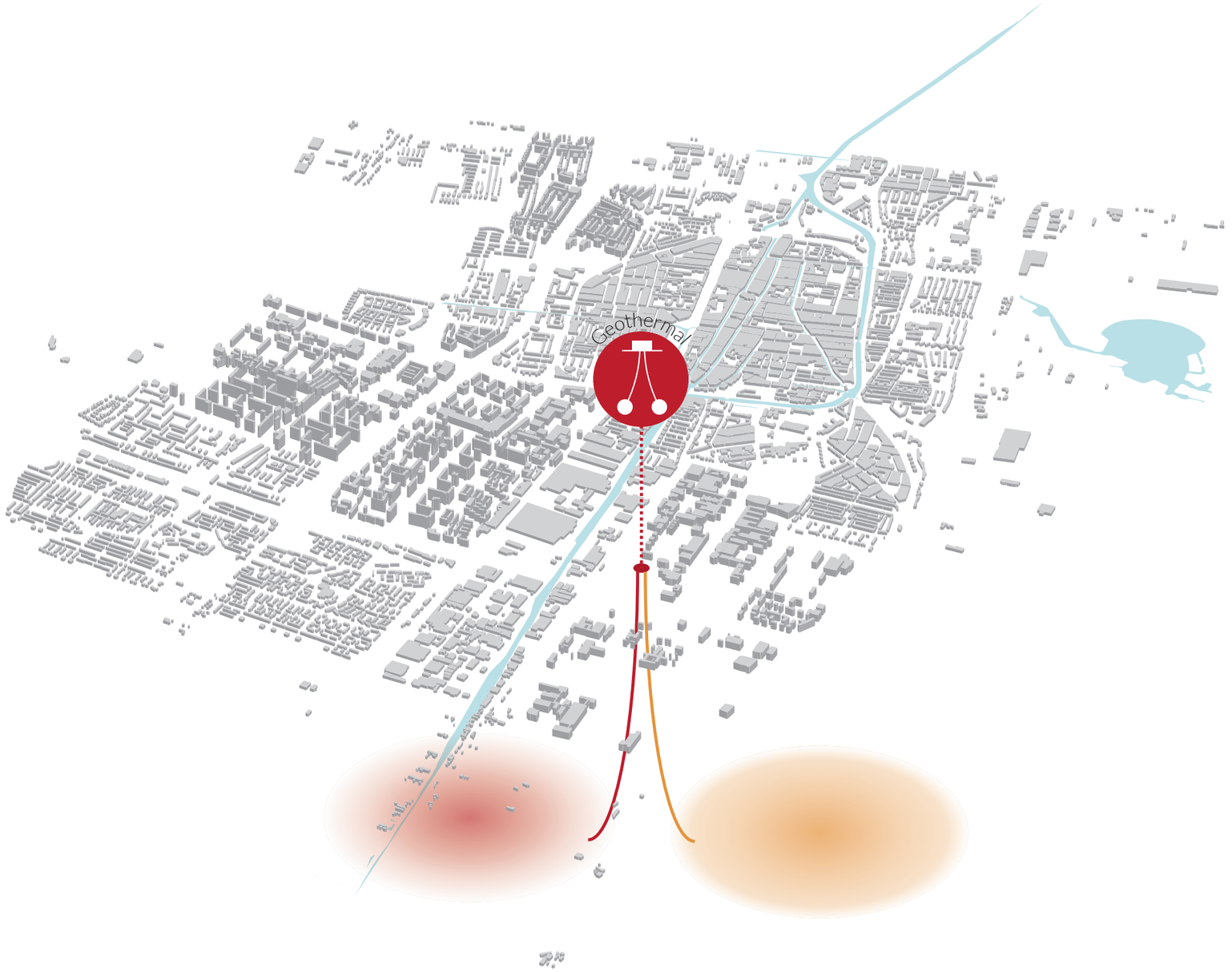
Typology	Retrofitting	°C	Energy potentails
>1900 Residences & offices	Small or no renovations limited possibilities due to monumental status G F E D C B A A+ A++ *by 100% of the Private house-owners*	HT	I Biogas III CHP, Geothermal, Solar collectors, Indus. waste heat
1900-1945 Single-family housing	Moderate renovations G F E D C B A A+ A++ *by 55% of the Private house-owners*	MT	IV Cascade, Residual heat, Solar collectors, Indus. waste heat, Heat Pump HP
	Deep renovations G F E D C B A A+ A++ *by 45% of the Private house-owners*	LT	II PV, PVT, Ground heat exch, Air-source V Cascade, Residual heat, PVT, ATES/BTES, Heat Pump HP
50-60's Single-family housing	Moderate renovations G F E D C B A A+ A++ *by 55% of the Private house-owners* *by 50% of the Corporation*	MT	IV Cascade, Residual heat, Solar collectors, Indus. waste heat, Heat Pump HP
	Deep renovations G F E D C B A A+ A++ *by 45% of the Private house-owners* *by 50% of the Corporation*	LT	II PV, PVT, Ground heat exch, Air-source V Cascade, Residual heat, PVT, ATES/BTES, Heat Pump HP
50-60's Multi-family 3-6layers	Moderate renovations G F E D C B A A+ A++ *by 55% of the Private house-owners* *by 50% of the Corporation*	MT	IV Cascade, Residual heat, Solar collectors, Indus. waste heat, Heat Pump HP
	Deep renovations G F E D C B A A+ A++ *by 45% of the Private house-owners* *by 50% of the Corporation*	LT	V Cascade, Residual heat, PVT, ATES/BTES, Heat Pump HP
50-60's Multi-family high-rise	Small/Moderate renovations G F E D C B A A+ A++ *by 20% of the Private house-owners*	MT	IV Cascade, Residual heat, Solar collectors, Indus. waste heat, Heat Pump HP
	Deep renovations G F E D C B A A+ A++ *by 80% of the Private house-owners* *by 100% of the Corporation*	LT	V Cascade, Residual heat, PVT, ATES/BTES, Heat Pump HP

Typology	Retrofitting	°C	Energy potentails
70-80's Single-family housing	Renovations G F E D C B A A+ A++ *by 100% of the Private house-owners* *by 100% of the Corporation*	LT	II PV, PVT, Ground heat exch, Air-source V Cascade, Residual heat, PVT, ATES/BTES, Heat pump HP
70-80's Multi-family 3-6layers	Small/Moderate renovations G F E D C B A A+ A++ *by 55% of the Private house-owners*	MT	IV Cascade, Residual heat, Solar collectors, Indus. waste heat, Heat pump HP
	Moderate/Deep renovations G F E D C B A A+ A++ *by 45% of the Private house-owners* *by 100% of the Corporation*	LT	V Cascade, Residual heat, PVT, ATES/BTES, Heat pump HP
90-00's Single-family housing	Small/Moderate renovations G F E D C B A A+ A++ *by 100% of the Private house-owners*	LT	II PV, PVT, Ground heat exch, Air-source V Cascade, Residual heat, PVT, ATES/BTES, Heat pump HP
90-00's Multi-family 3-6layers	Small/Moderate renovations G F E D C B A A+ A++ *by 100% of the Private house-owners* *by 100% of the Corporation*	LT	V Cascade, Residual heat, PVT, ATES/BTES
>2010	Moderate renovations G F E D C B A A+ A++ *by 100% of the Private house-owners*	vLT	II PV, PVT, Ground heat exch, Air-source VI Cascade, Residual heat, PVT, ATES/BTES, Effluent
Farm & low density	Little renovations G F E D C B A A+ A++ *by 50% of the Private house-owners*	HT	I Biogas, Wood
	Deep renovations G F E D C B A A+ A++ *by 50% of the Private house-owners*	LT	II PV, PVT, Ground heat exch, Air-source

PV


Solar collectors

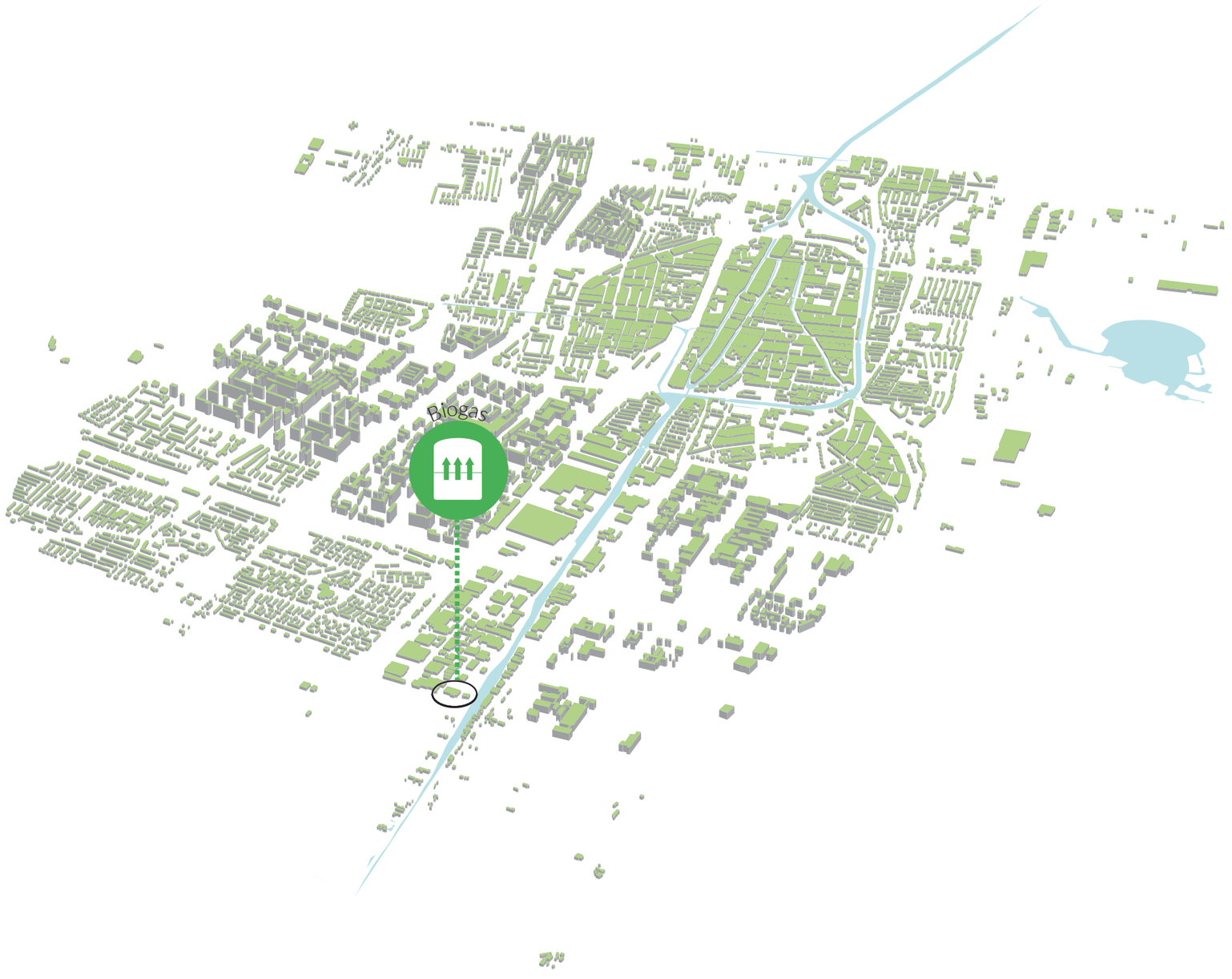
Roadmap for Delft
Energy sources



Roadmap for Delft
Energy sources

Roadmap for Delft
Energy sources

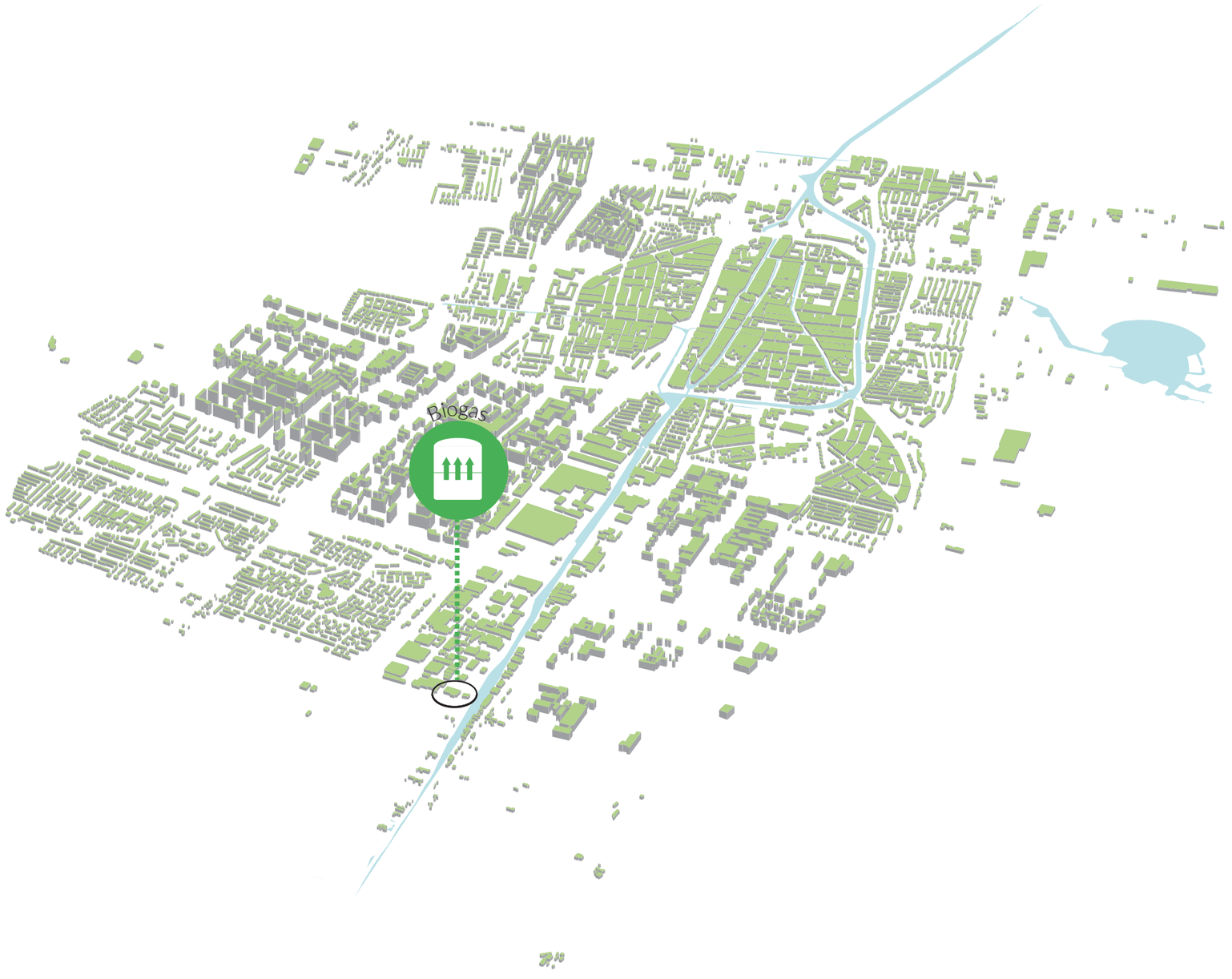

Effluent


Biogas

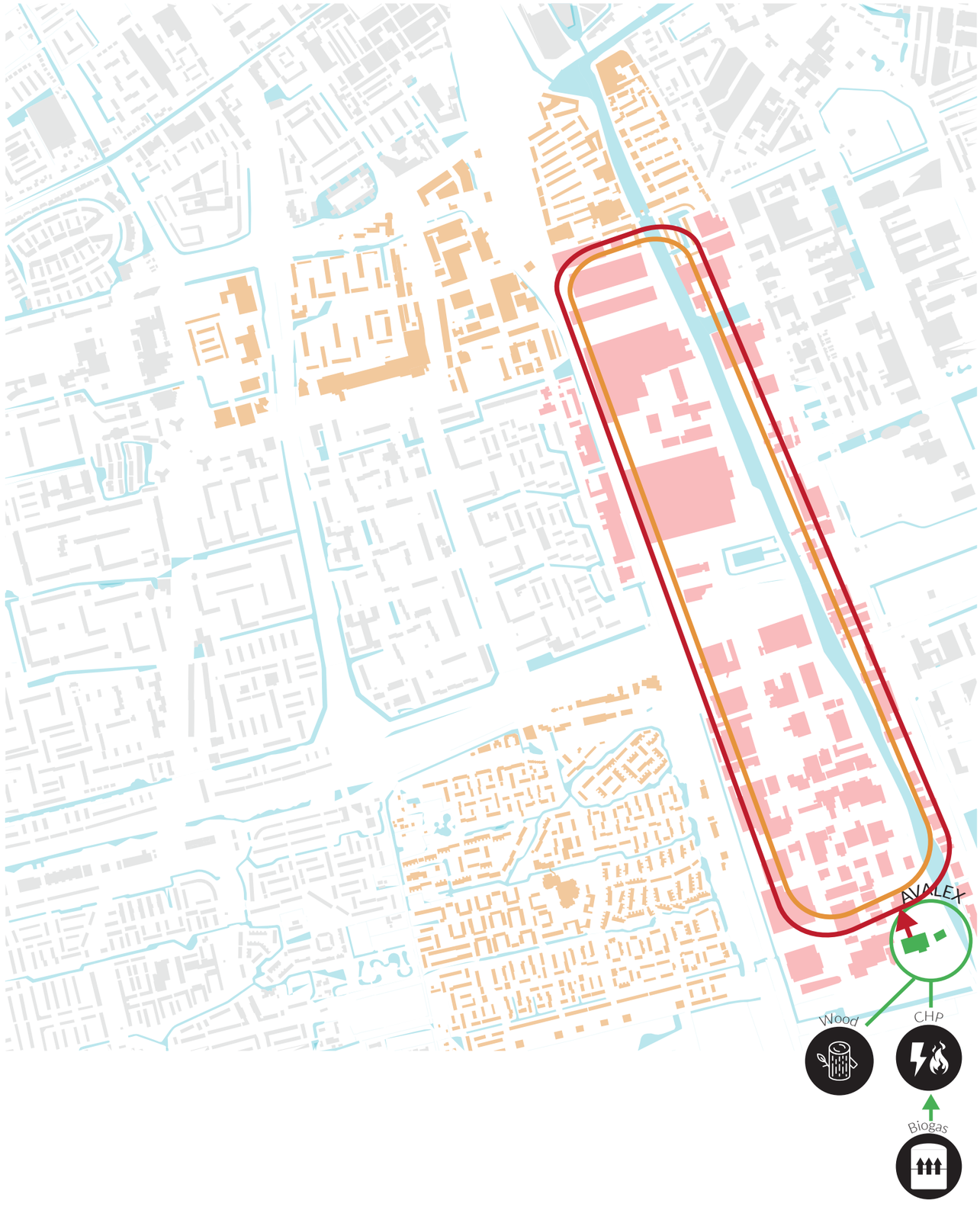

Wood
Wood

Intervention Schie-area

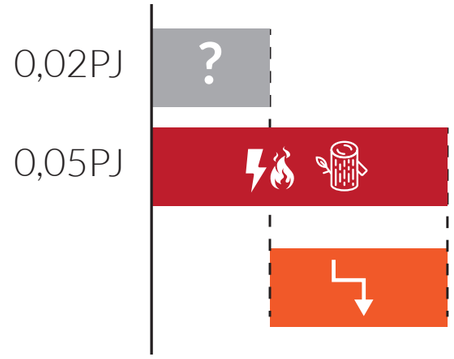
Source HT Network

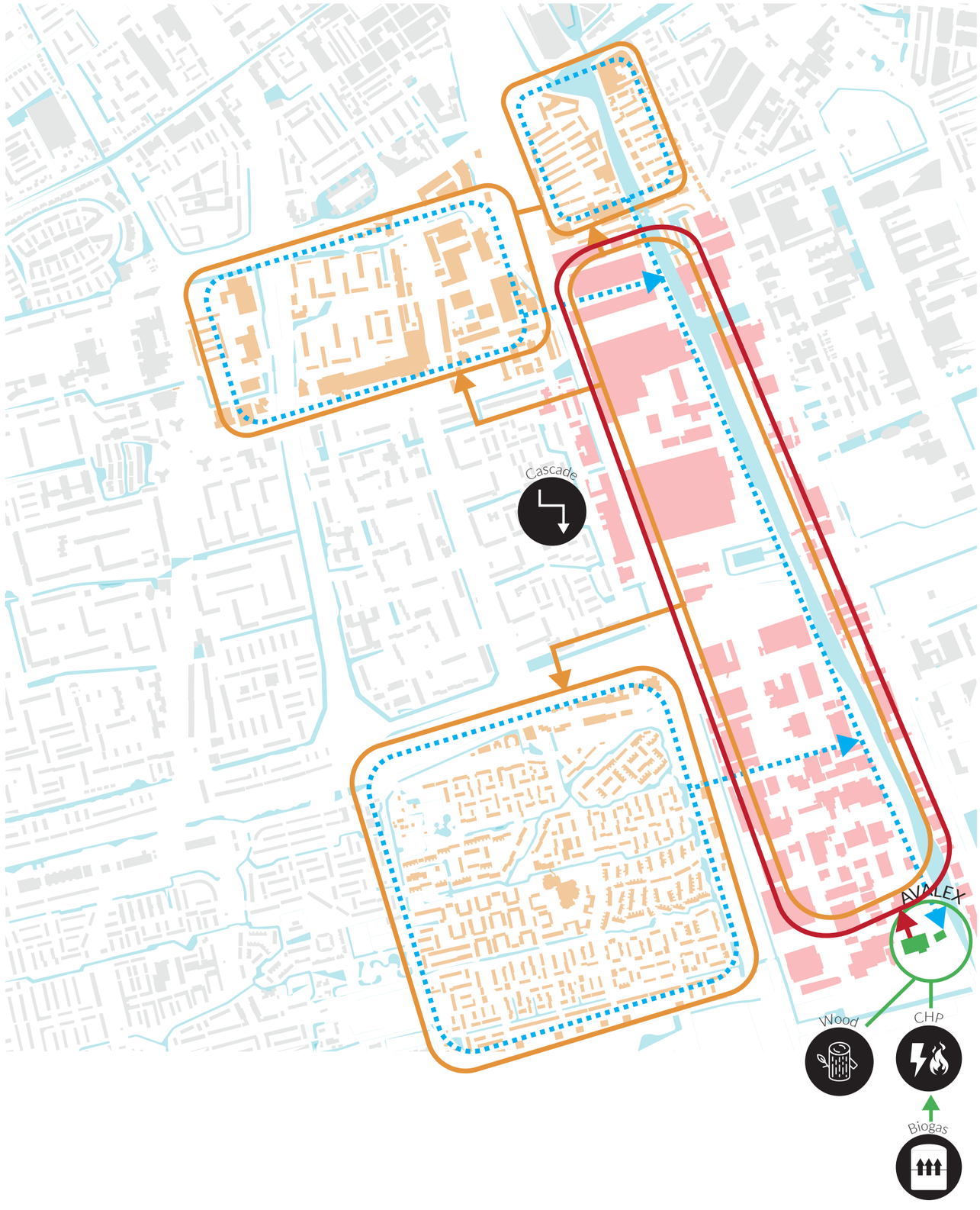


Source HT Network

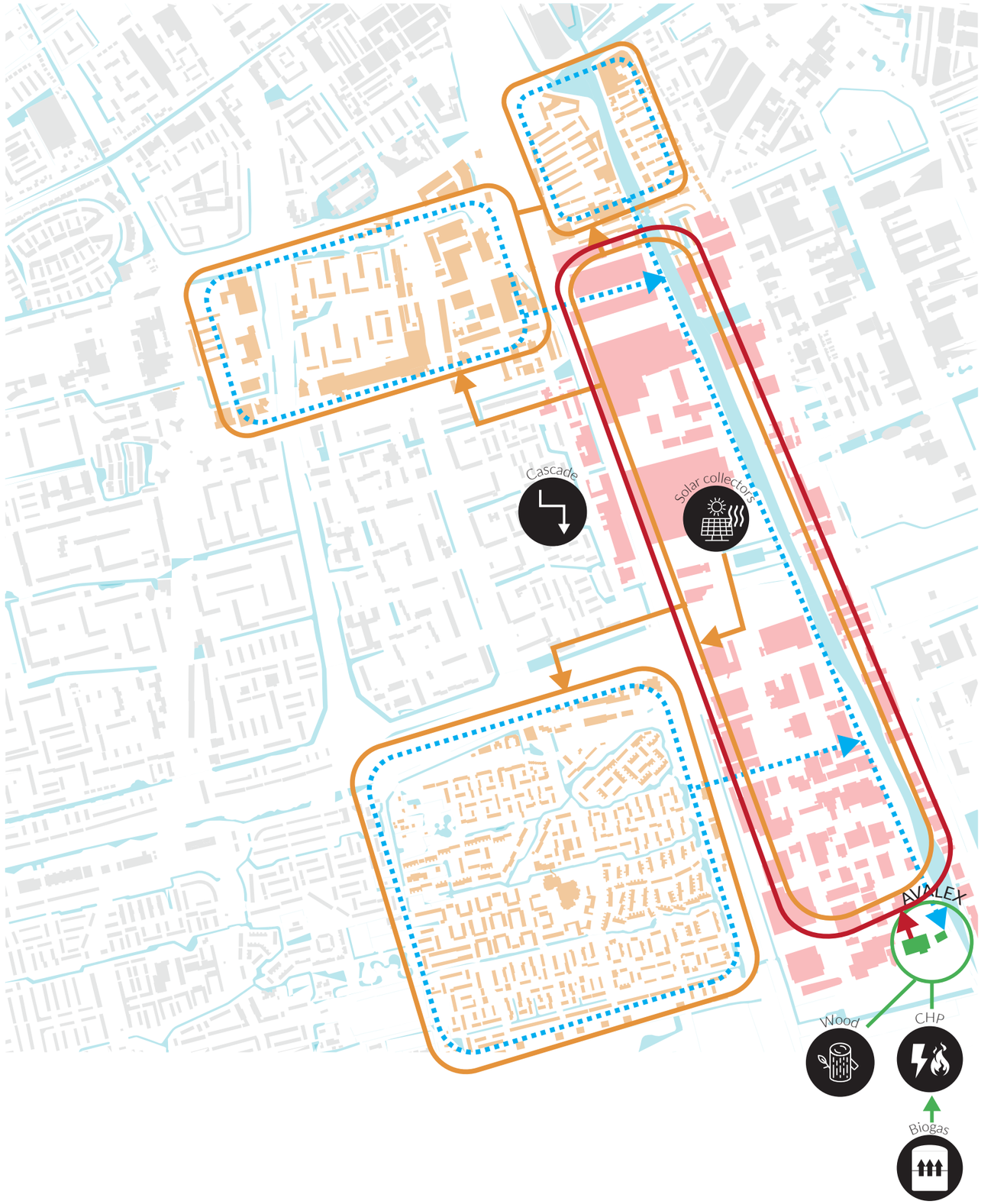

AVALEX
Wood
CHP
Biogas

Roadmap for Delft
Intervention: Schie-area

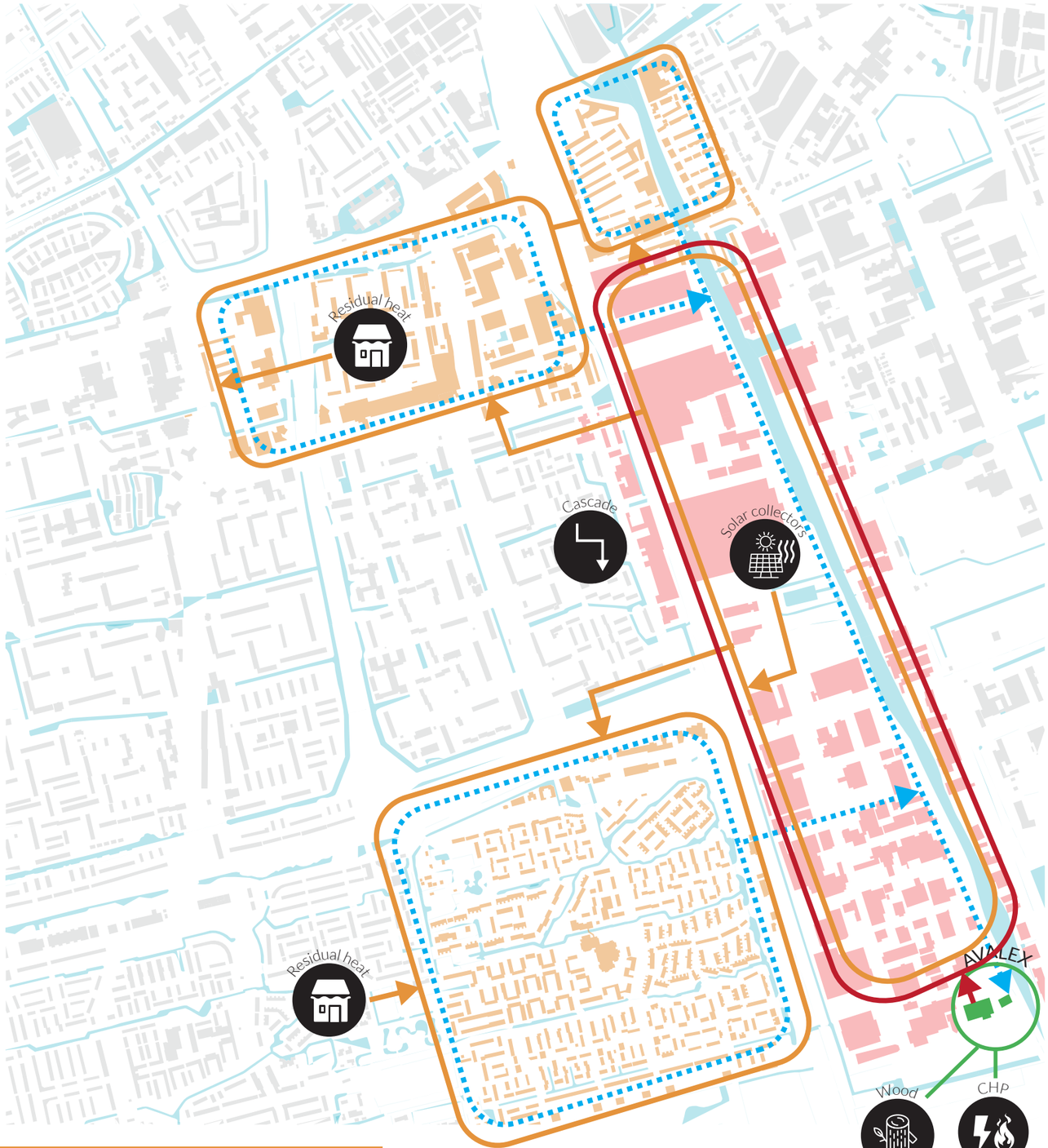


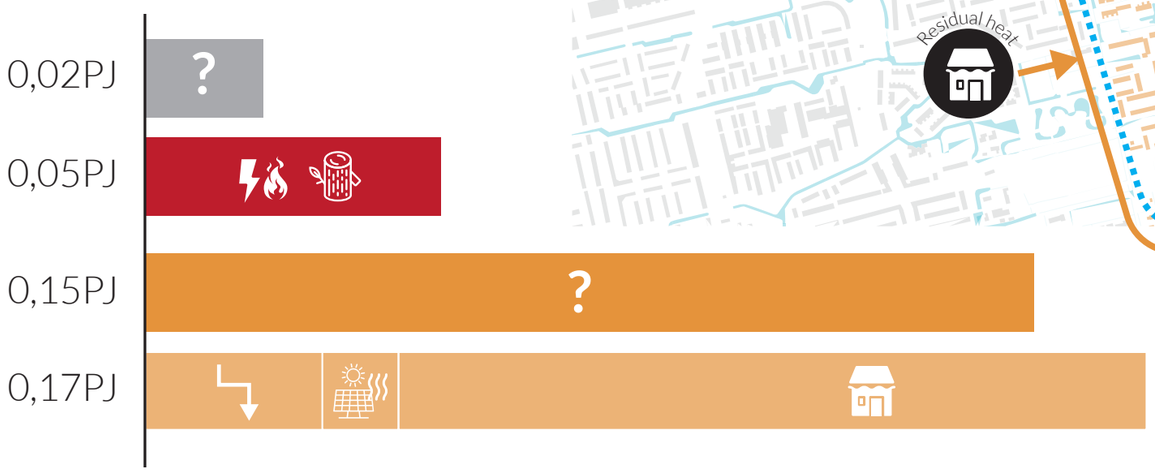


Roadmap for Delft
Intervention: Schie-area

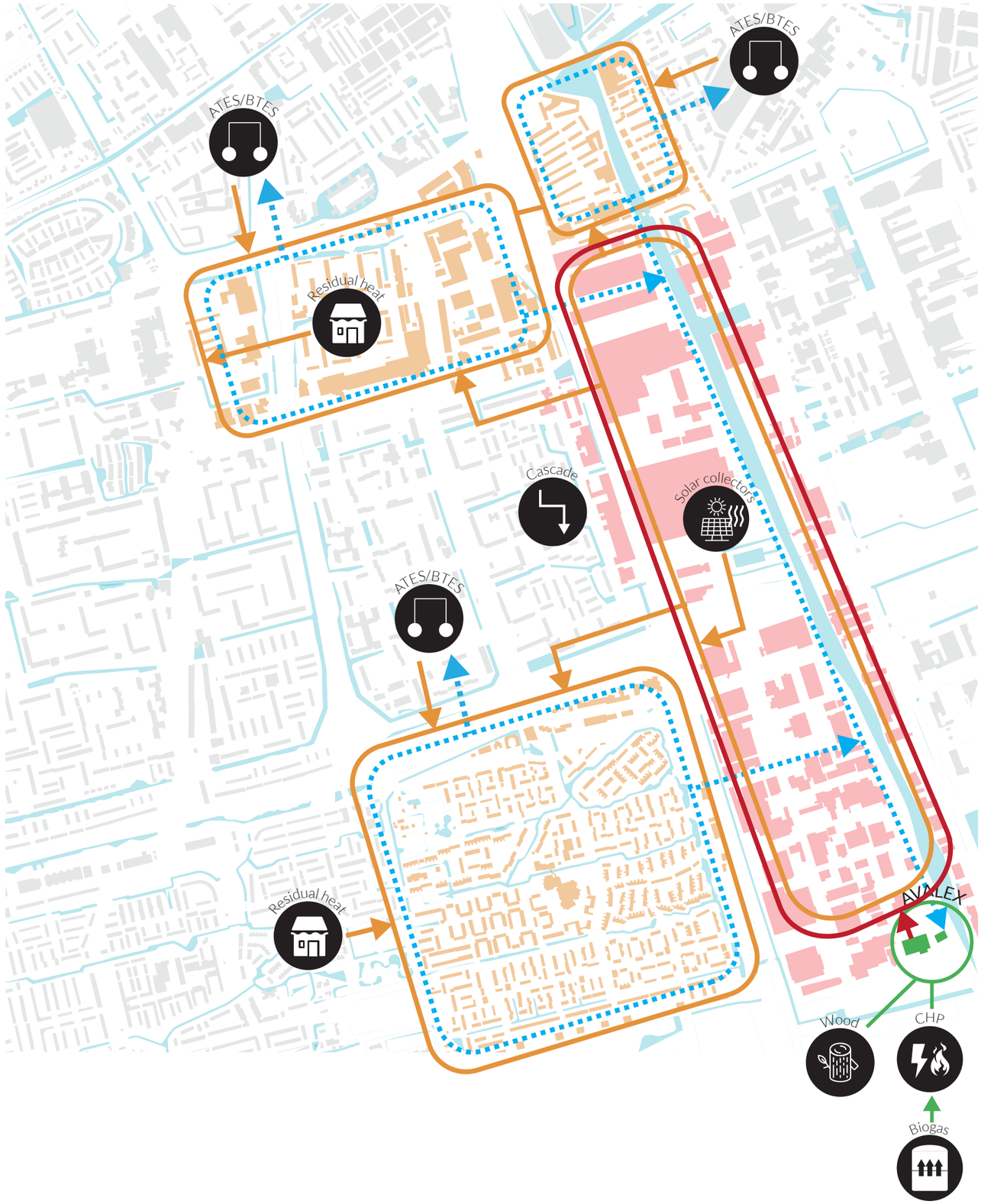

Cascade
Solar collectors
AVALEX
Wood
CHP
Biogas

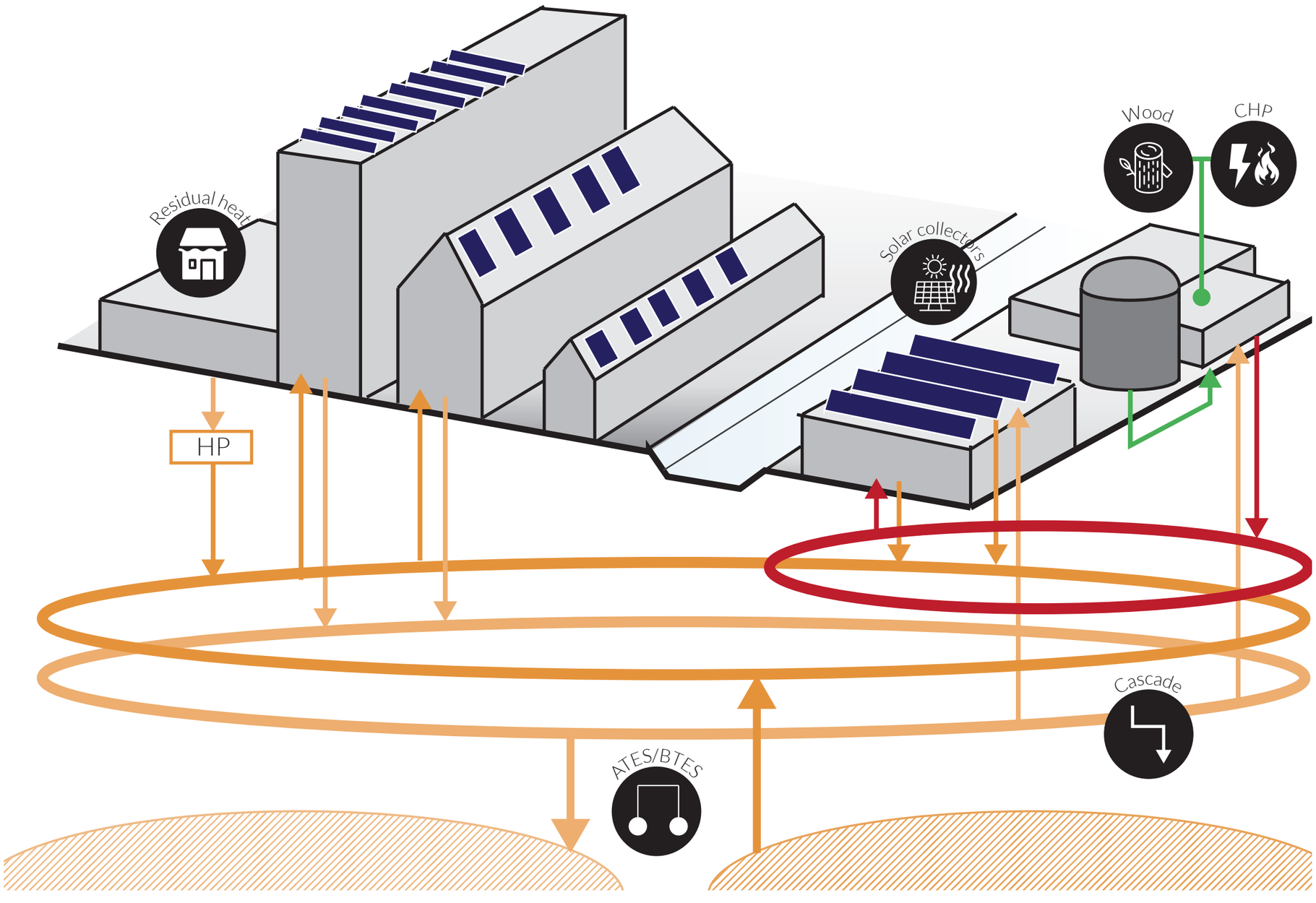
Roadmap for Delft
Intervention: Schie-area



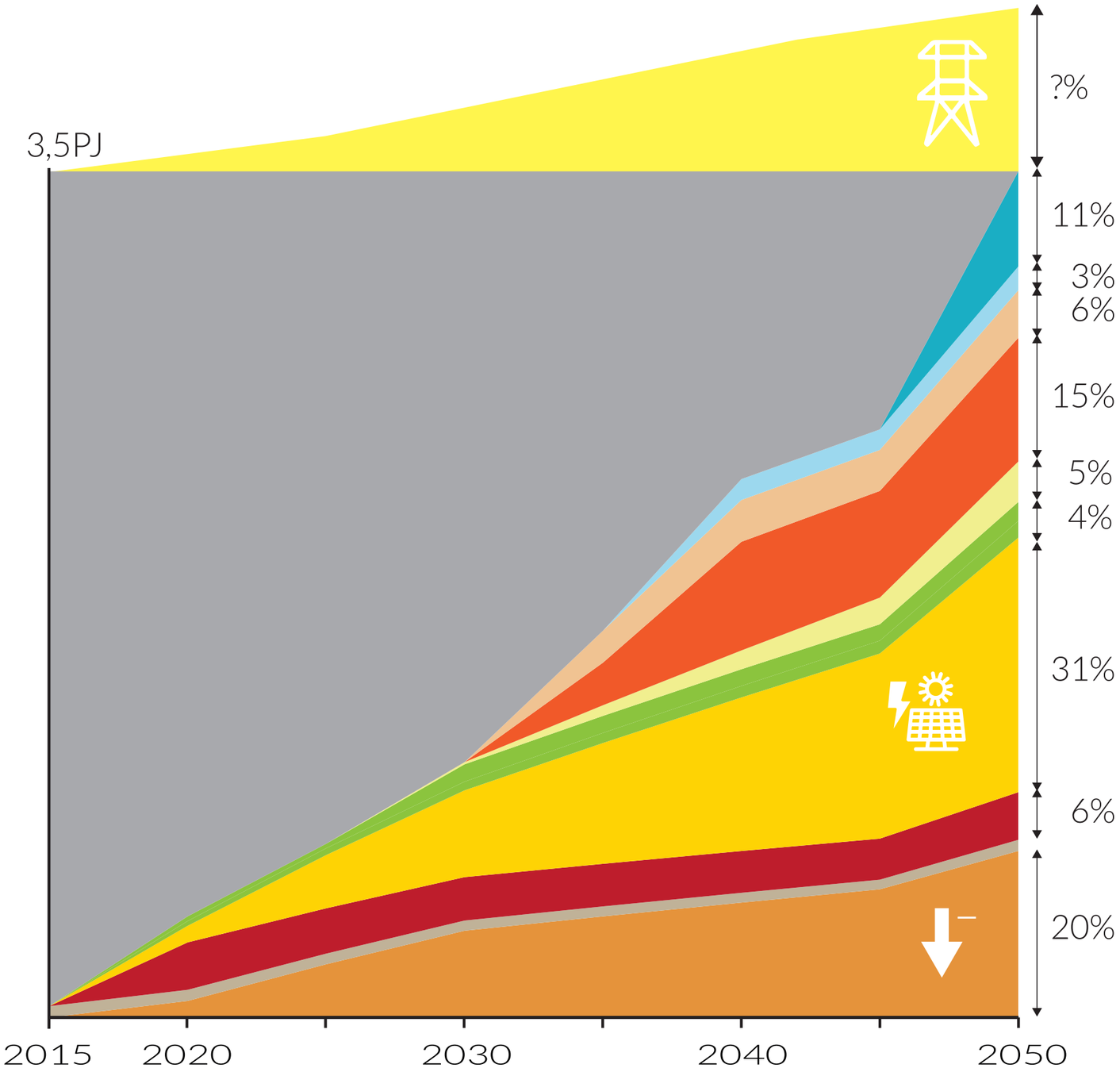


Roadmap for Delft
Intervention: Schie-area




Residual heat
HP
Solar collectors
Wood
CHP
ATES/BTES
Cascade

Roadmap for Delft
Energy balance



- Import electricty (HP comp)
- Natural gas
- City centre & Hof v. Delft
- Effluent
- Residual heat small scale
- ATES/BTES &Solar coll./PVT
- All-electric
- Biomass/Biogas(CHP)
- Photovoltaics
- Geothermal TU
- Existing
- Savings

5

Conclusions

Conclusions

By following the steps & guidelines a roadmap for Delft is designed, showing that:

- Multiple outcomes can result in the same goal: energy neutral Delft; The design differs per designer.
While sometimes multiple potentials are possible, it's important to match these as much as possible with the characteristic of the district/ neighbourhood.

- The energy transition is achievable; however it requires active participation by the citizens and companies.
They should become aware of urgency of the energy transition and actively be stimulated to energy retrofit their property.

- Also municipality should become aware of both the urgency of the transition and the enormous size of the assignment.
They should no longer wait, start now;
create a bottom-up movement for the energy transition of the Netherlands.

Recommendations for further research

- A business case of the proposed roadmap should be created: including stakeholders, financial models and risks.
- Included the demands and supplies for traffic and transporation and at which scale should be looked to this?
- The created roadmap will be outdated relatively fast due to the fast developments in the energy (generation) technologies. A roadmap should be analysed and updated on regular basis.

Thank you!