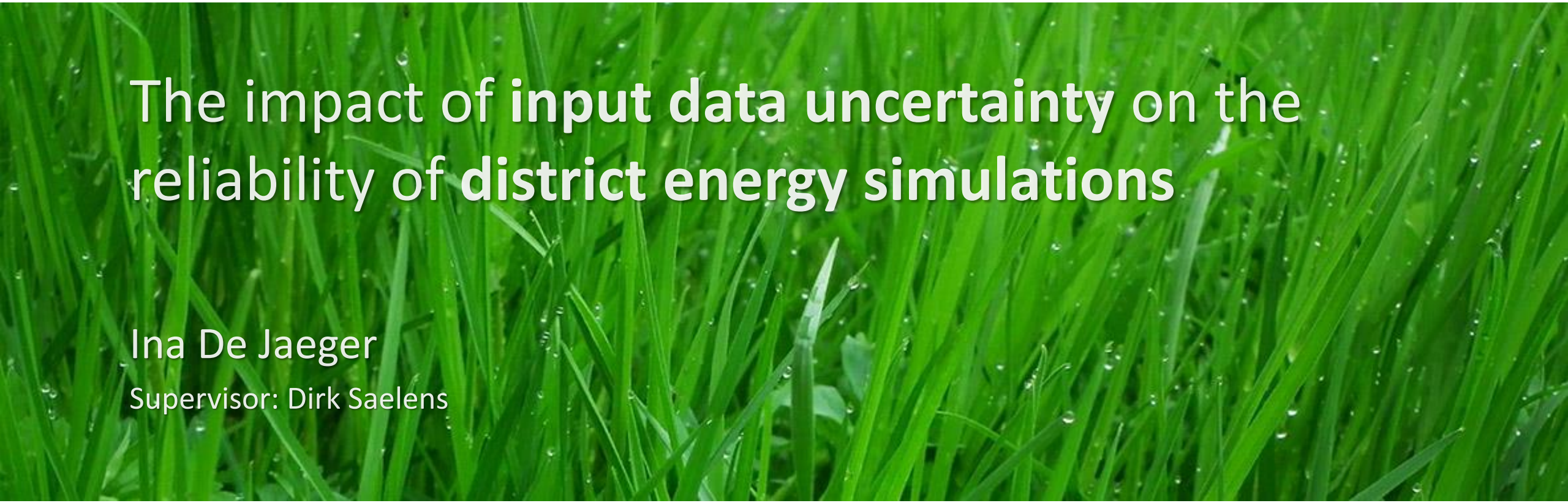


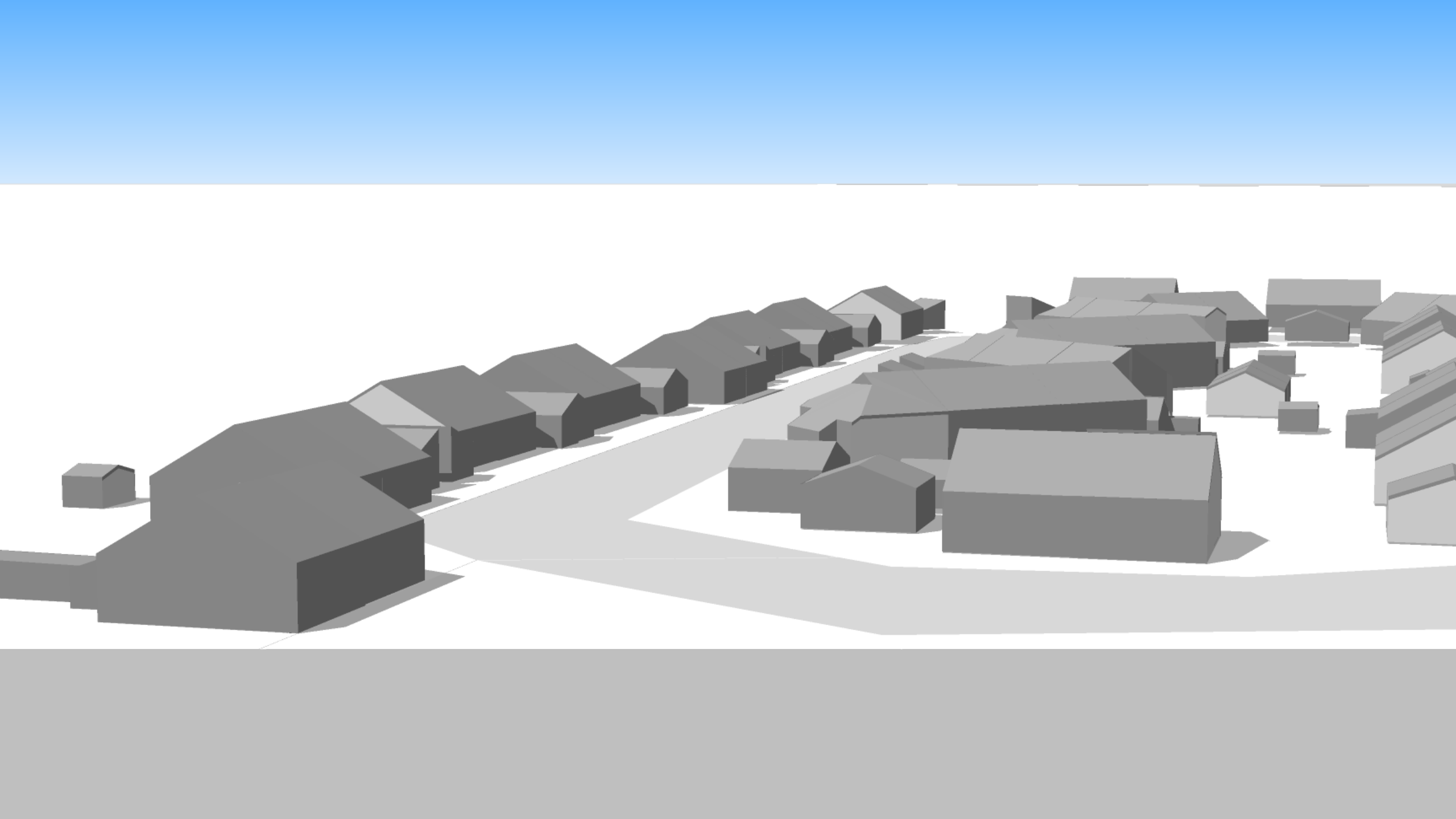
The impact of **input data uncertainty** on the reliability of **district energy simulations**

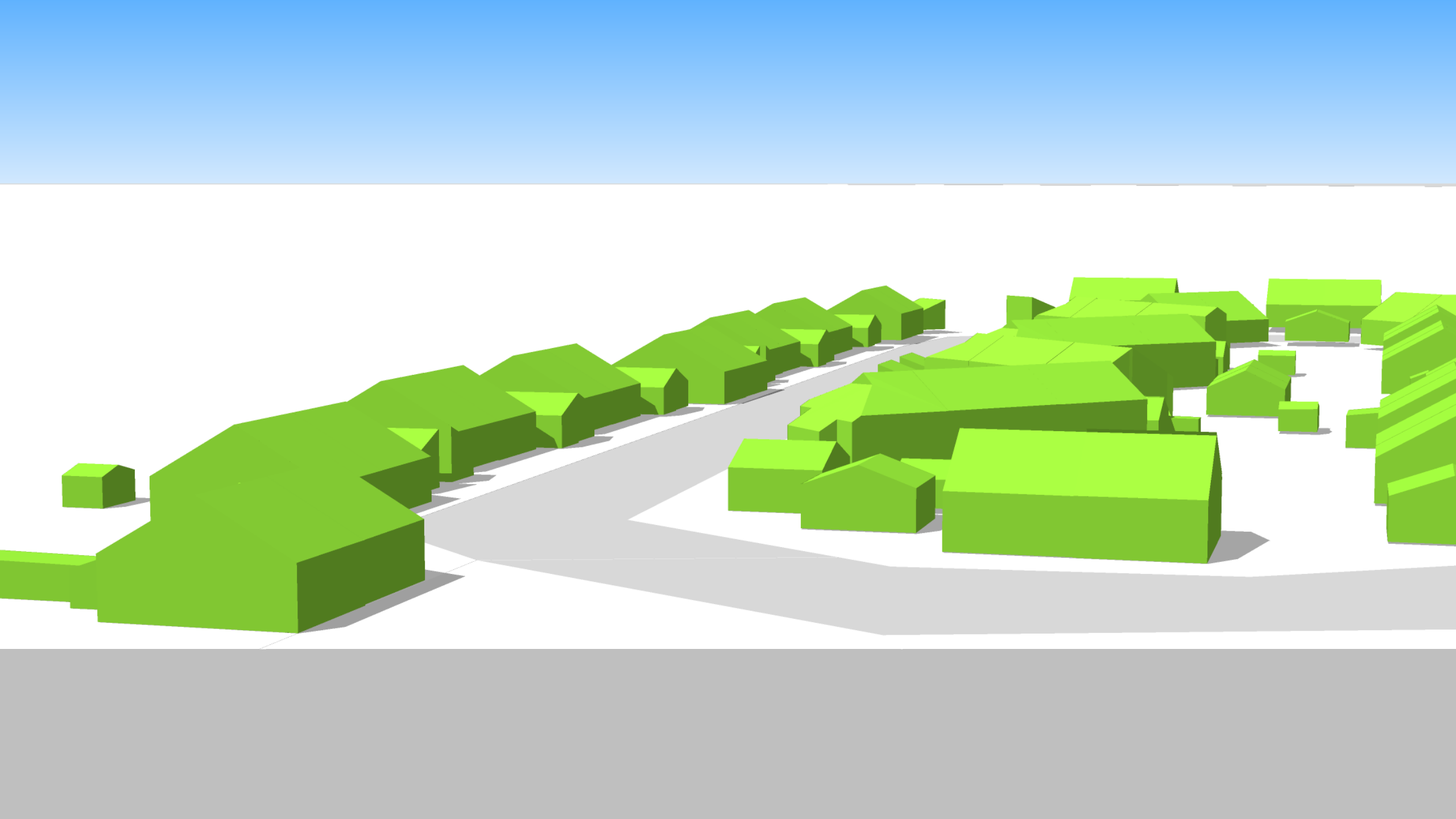
Ina De Jaeger

Supervisor: Dirk Saelens

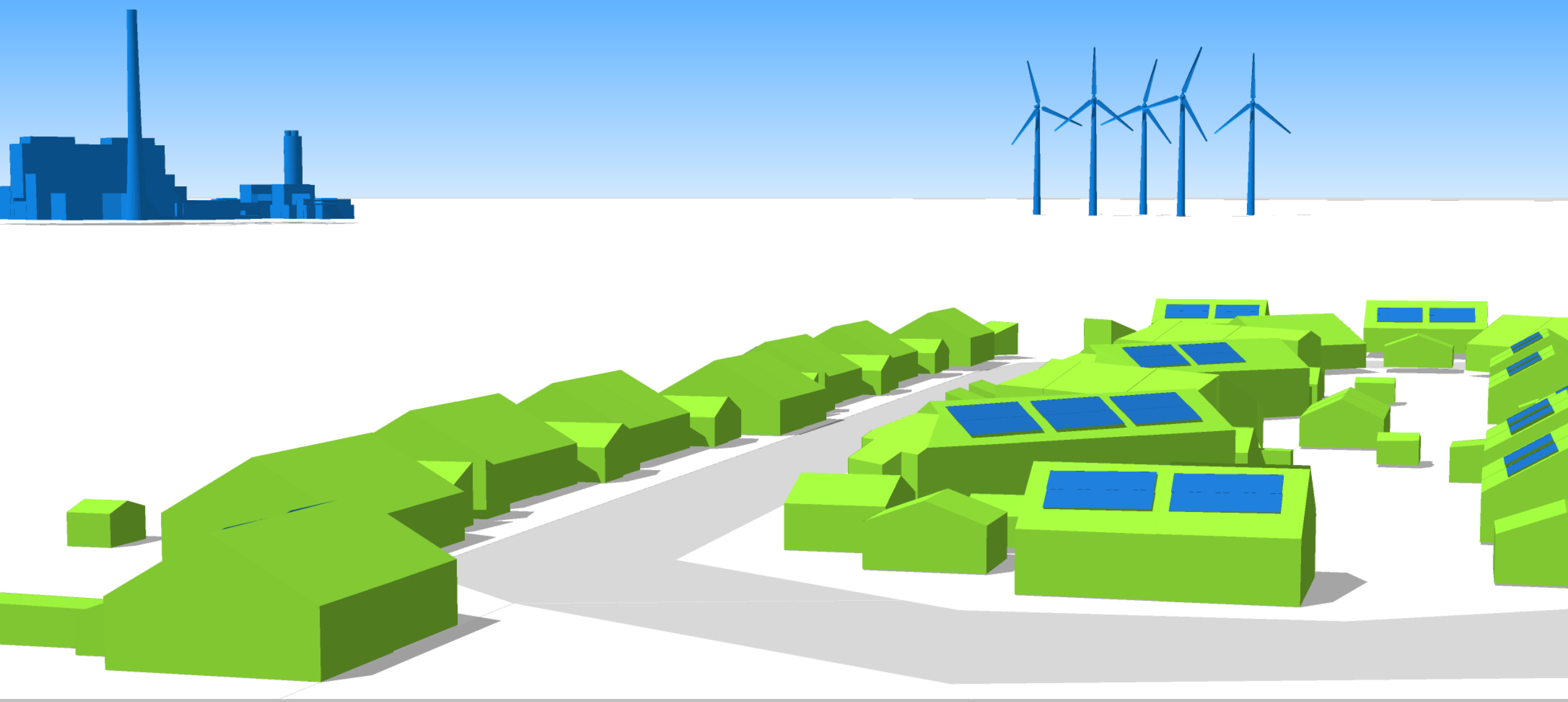
CONTENT

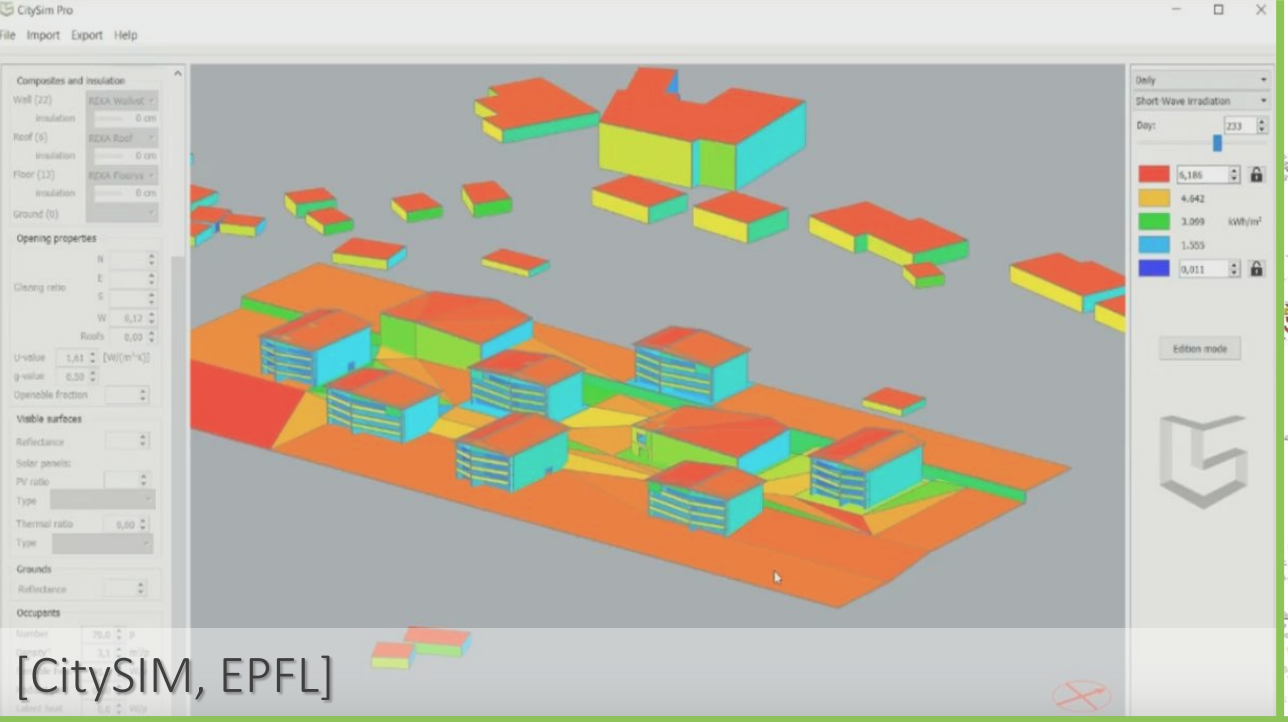
CONTENT



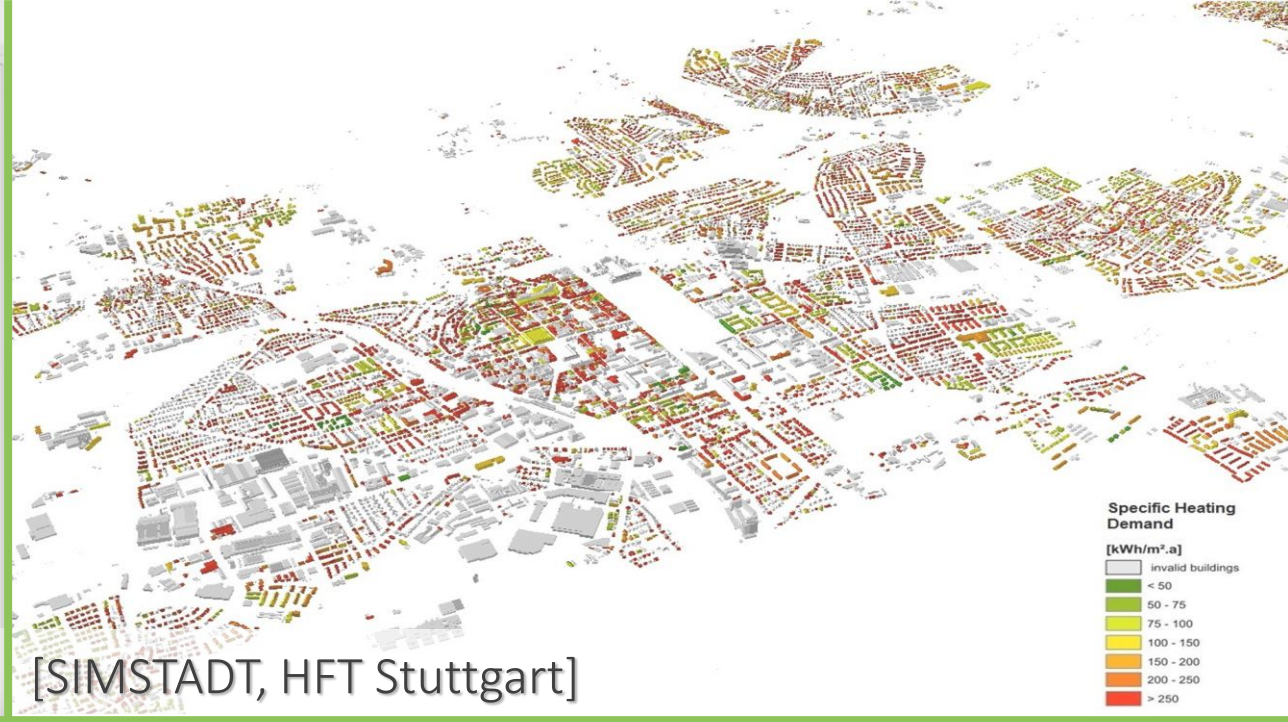



(geothermal)
(wind)
(solar)

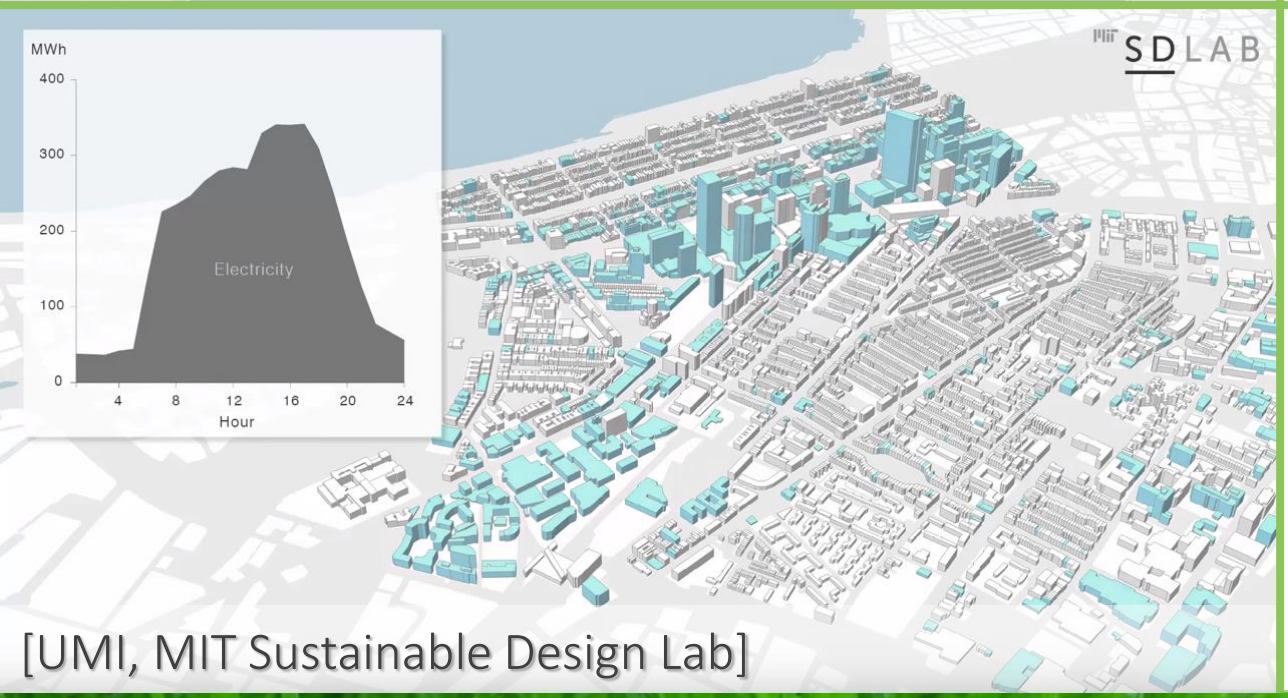

P_{heat}
Time
P_{el}
Time
P_{heat}
Time
P_{el}
Time



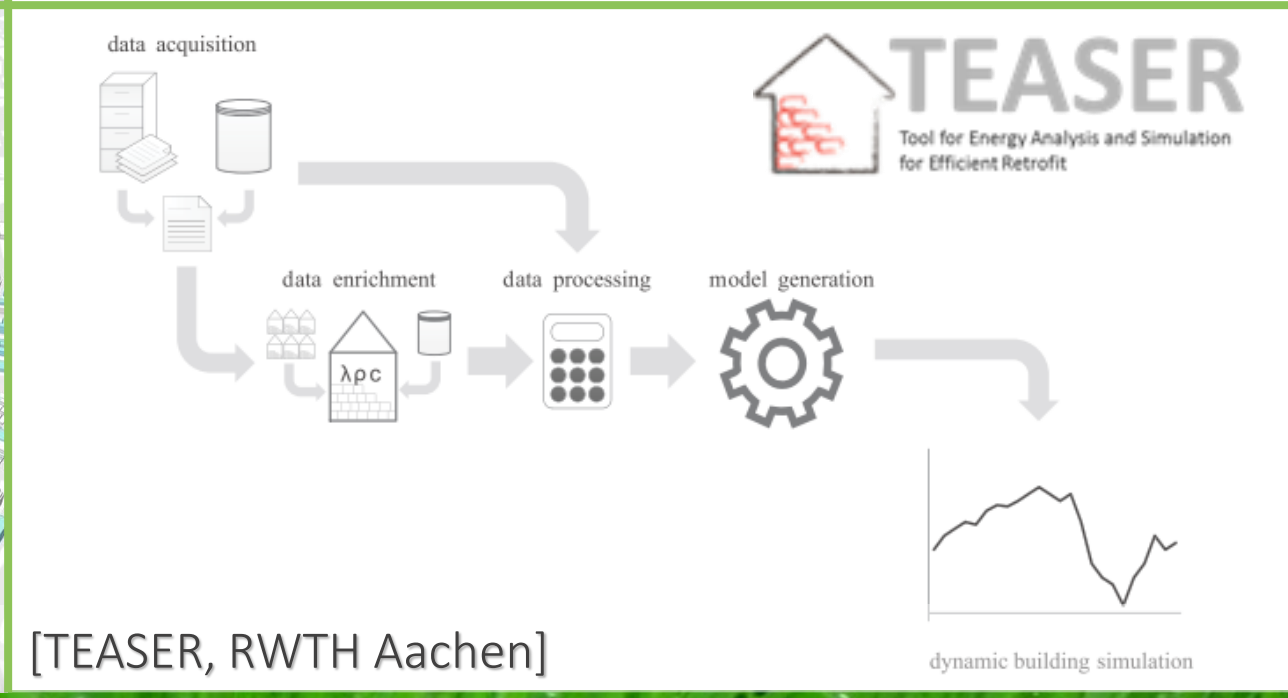
[CitySIM, EPFL]



[SIMSTADT, HFT Stuttgart]



[UMI, MIT Sustainable Design Lab]



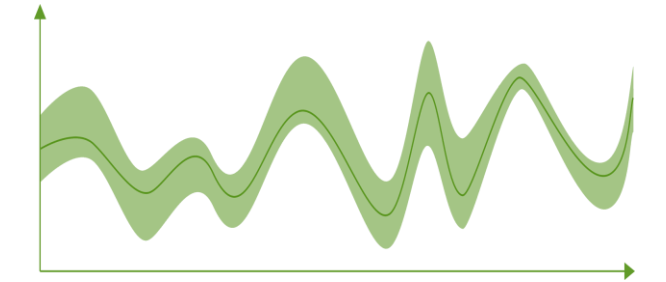
[TEASER, RWTH Aachen]

How to *quantify the uncertainty on the district energy demand as a result of the uncertainty and intrinsic variability of input data?*

e.g. occupant behaviour

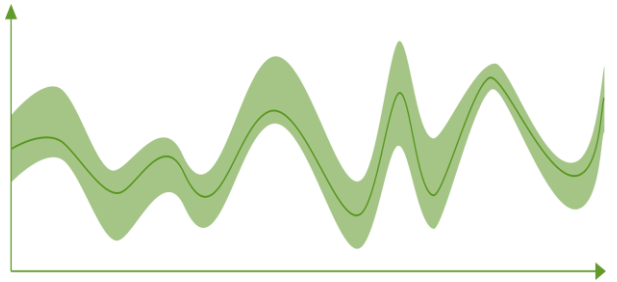
e.g. thermal performance of the building envelope

(~ archetype ~ construction year and building geometry)



How to *quantify the uncertainty on the district energy demand as a result of the uncertainty and intrinsic variability of input data?*

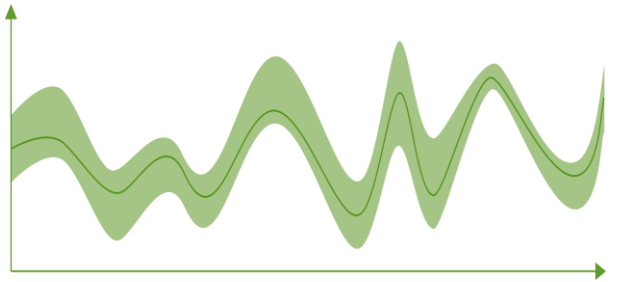
(For existing residential neighborhoods)



DISTRICT ENERGY DEMAND
+ UNCERTAINTY

How to *quantify the uncertainty on the district energy demand as a result of the uncertainty and intrinsic variability of input data?*

(For existing residential neighborhoods)

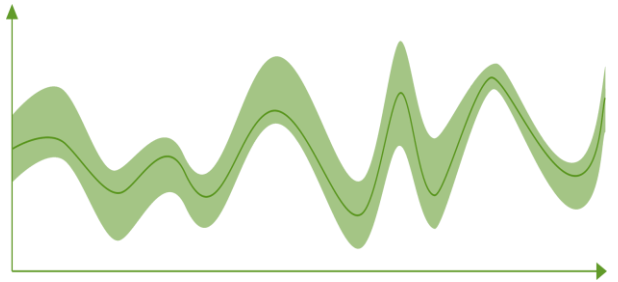


DISTRICT ENERGY DEMAND
+ UNCERTAINTY

(Through Monte Carlo simulations)

How to *quantify the uncertainty on the district energy demand as a result of the uncertainty and intrinsic variability of input data?*

(For existing residential neighborhoods)



DISTRICT ENERGY DEMAND
+ UNCERTAINTY

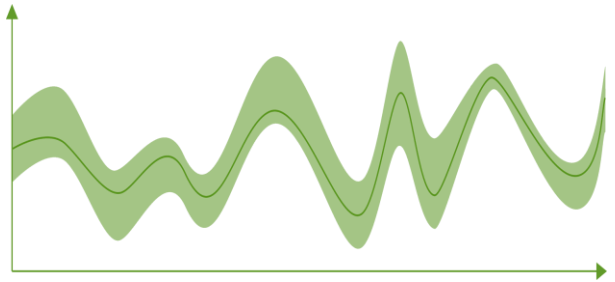
(Through Monte Carlo simulations)

How to *quantify the uncertainty on the district energy demand as a result of the uncertainty and intrinsic variability of input data?*

PROBABILISTIC DATA

+

(For existing residential neighborhoods)



DISTRICT ENERGY DEMAND
+ UNCERTAINTY

(Through Monte Carlo simulations)

How to *quantify the uncertainty on the district energy demand as a result of the uncertainty and intrinsic variability of input data?*

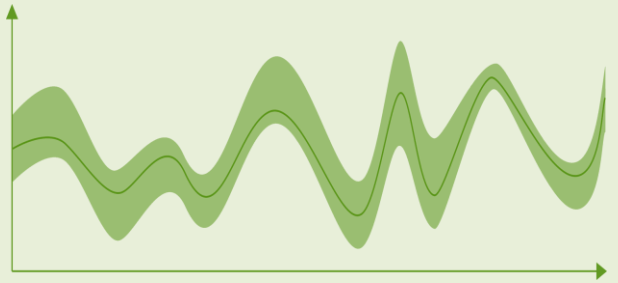
DATA

PROBABILISTIC DATA

+

MODELLING

(For existing residential neighborhoods)



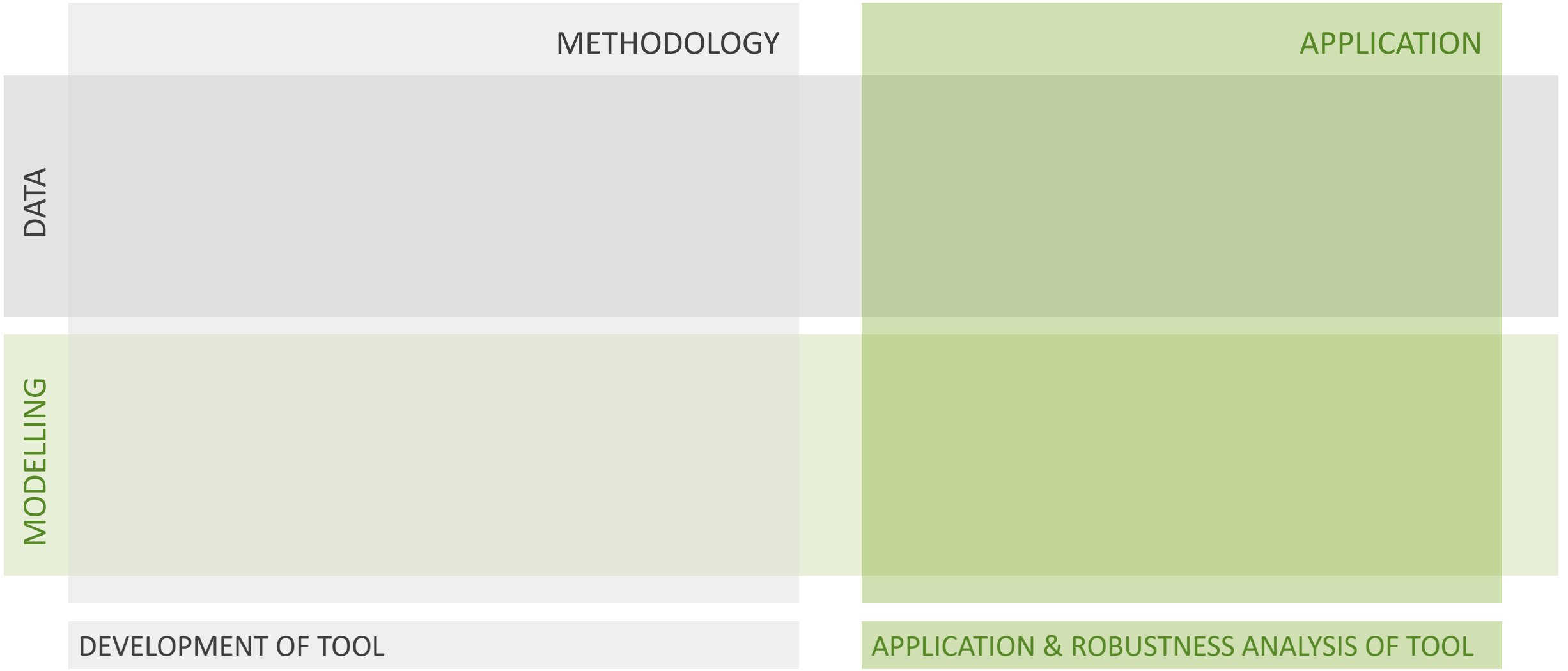
DISTRICT ENERGY DEMAND
+ UNCERTAINTY

(Through Monte Carlo simulations)

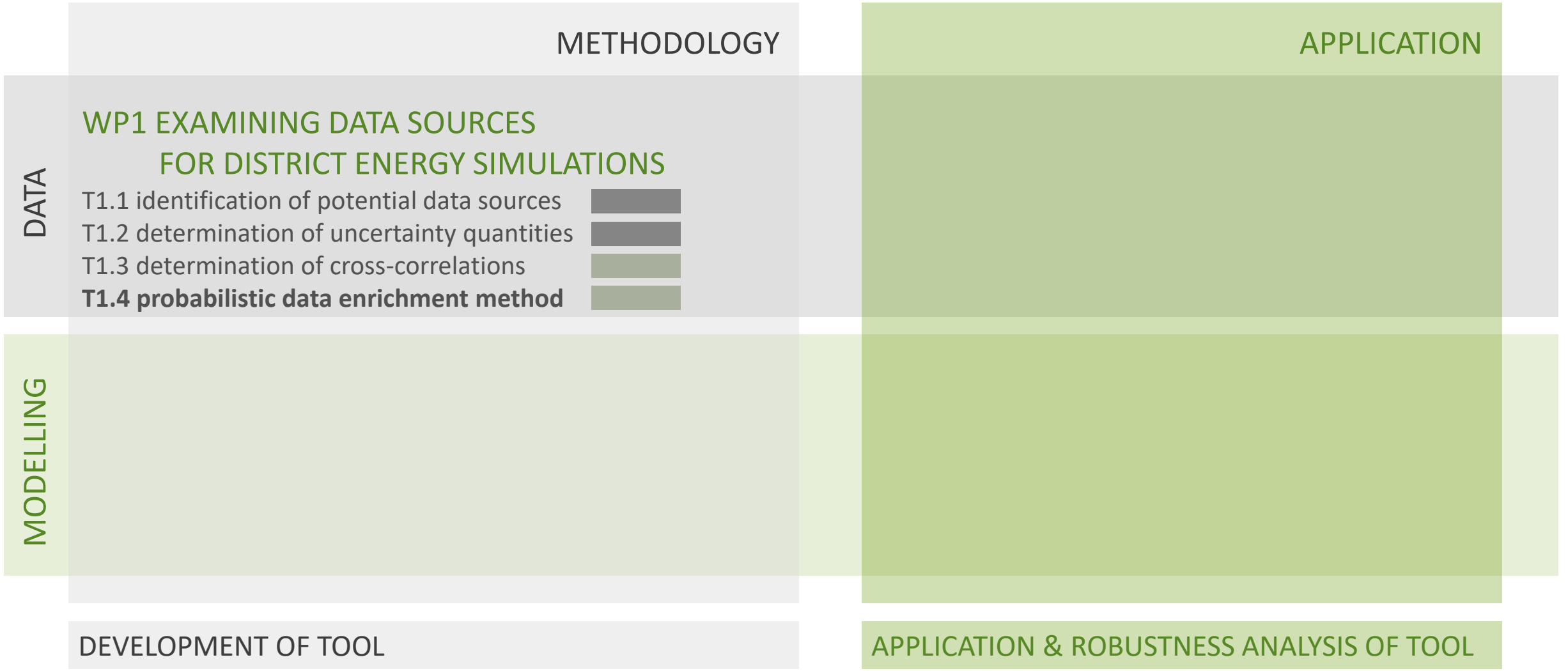
CONTENT

Scientific approach

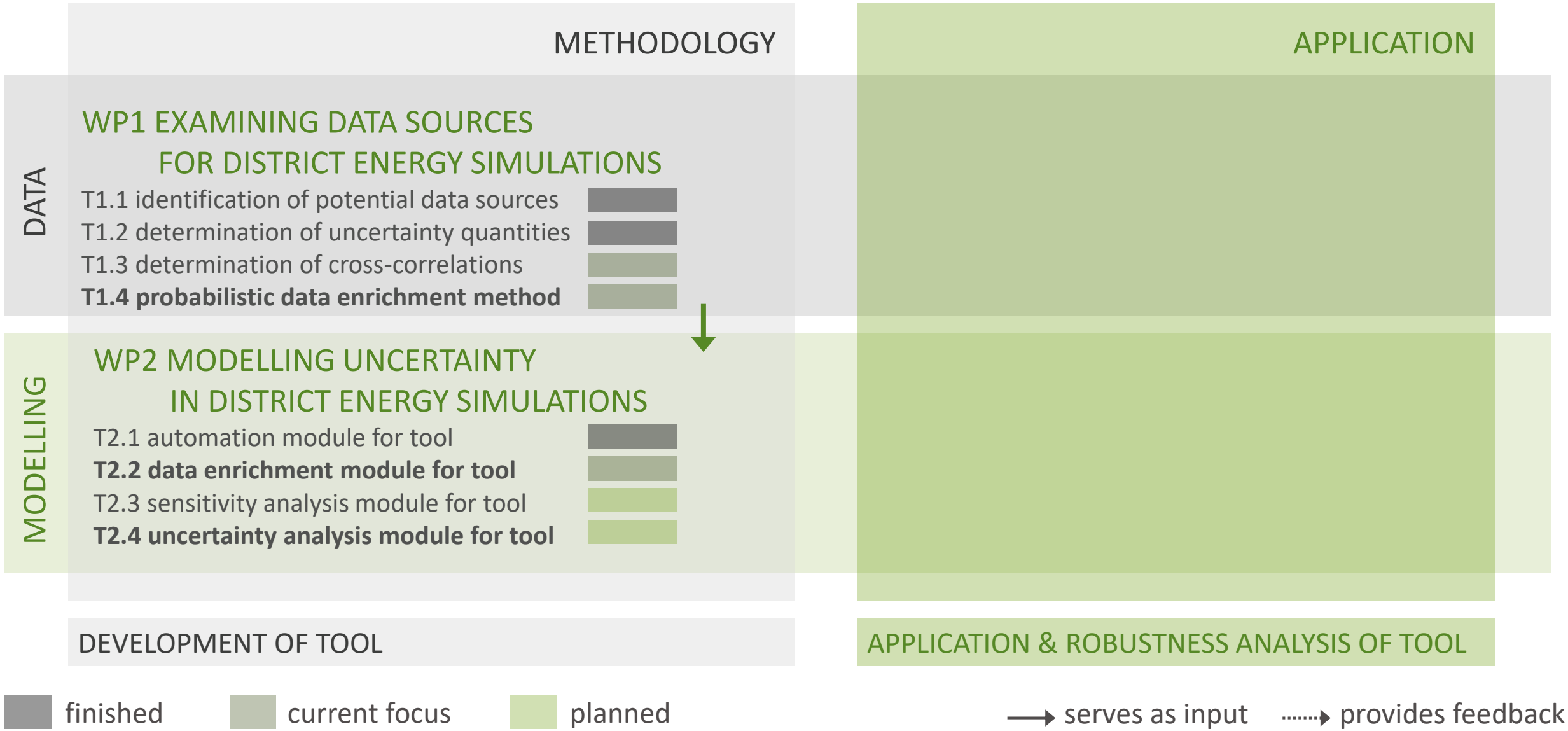
Scientific approach



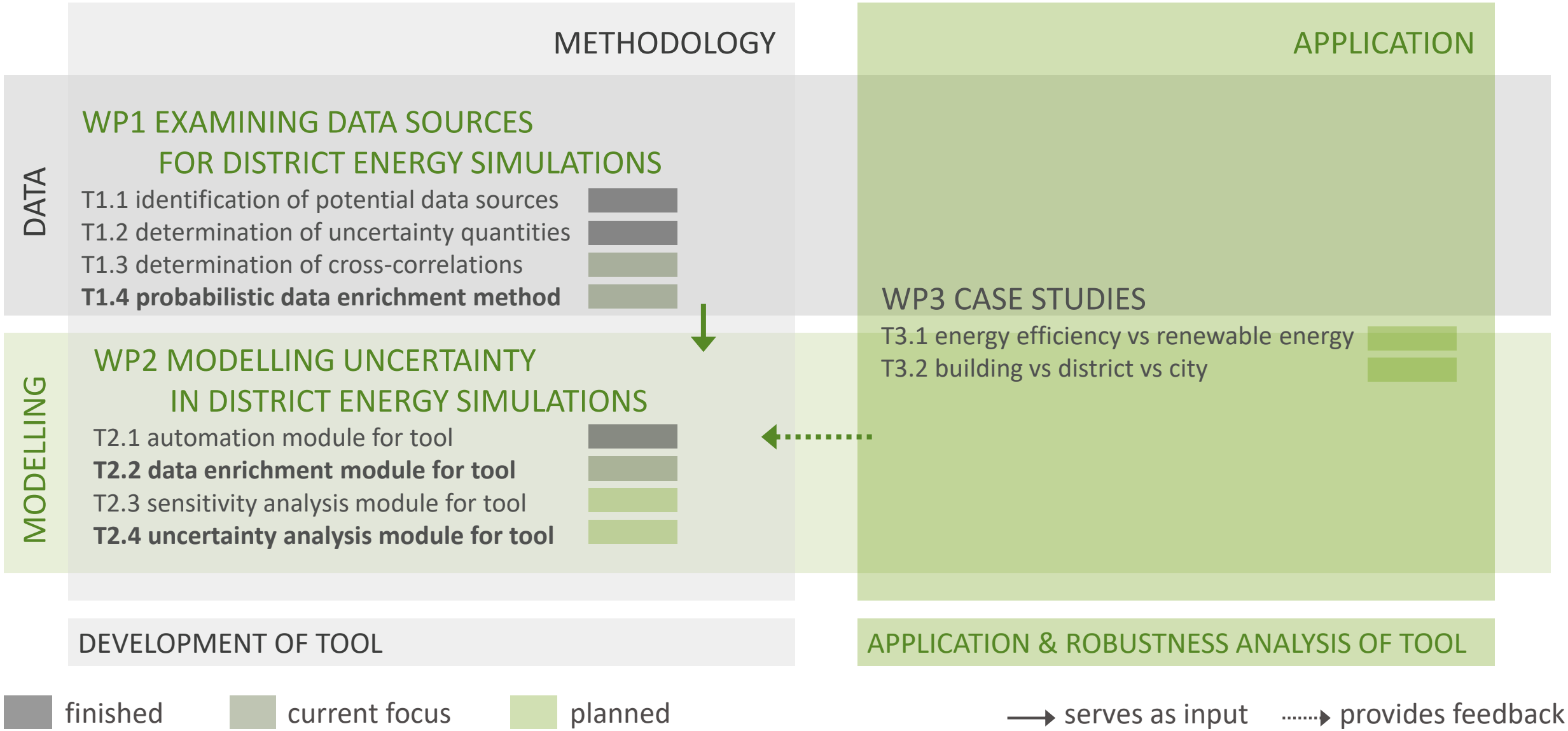
Scientific approach



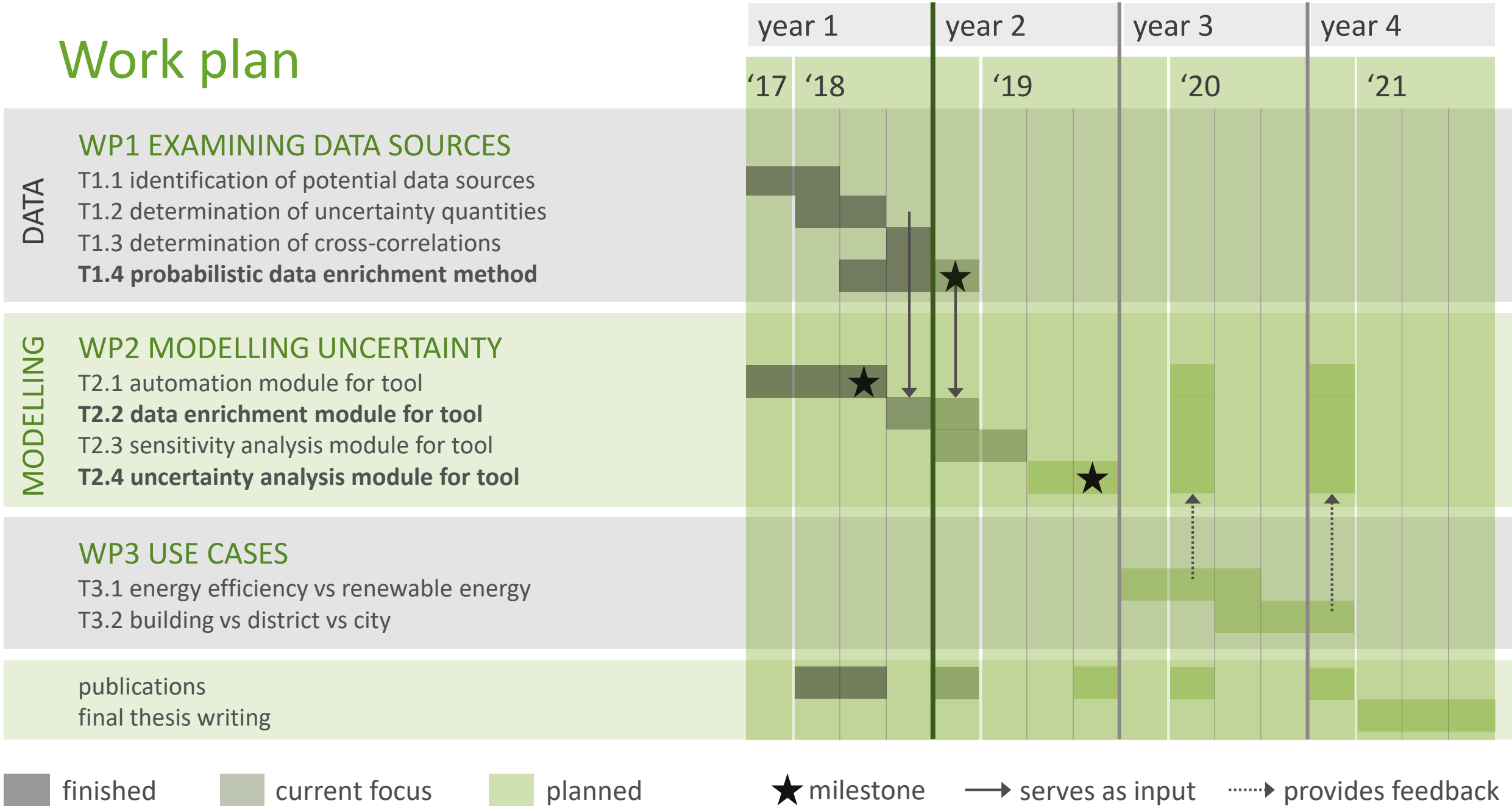
Scientific approach



Scientific approach

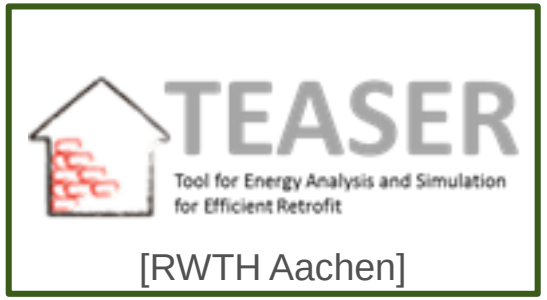


Work plan


year 1
year 2
year 3
year 4
‘17
‘18
‘19
‘20
‘21
DATA
WP1 EXAMINING DATA SOURCES
T1.1 identification of potential data sources
T1.2 determination of uncertainty quantities
T1.3 determination of cross-correlations
T1.4 probabilistic data enrichment method
MODELLING
WP2 MODELLING UNCERTAINTY
T2.1 automation module for tool
T2.2 data enrichment module for tool
T2.3 sensitivity analysis module for tool
T2.4 uncertainty analysis module for tool
WP3 USE CASES
T3.1 energy efficiency vs renewable energy
T3.2 building vs district vs city
publications
final thesis writing
finished
current focus
planned
milestone
serves as input
provides feedback

CONTENT

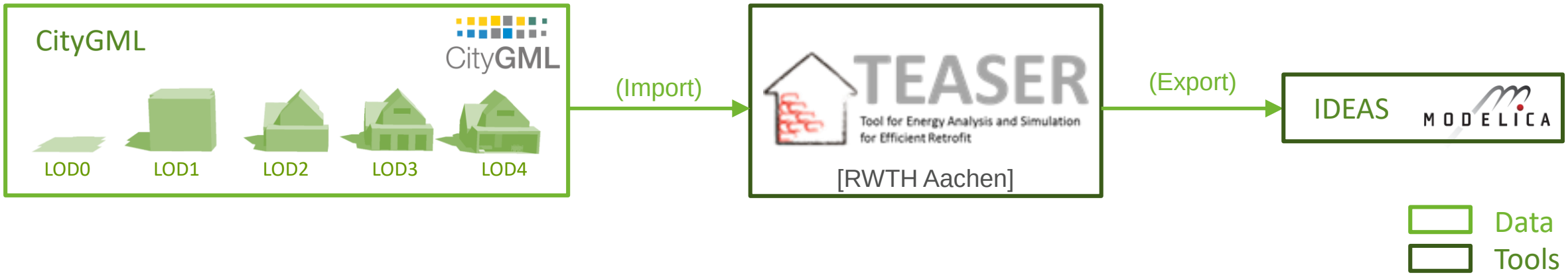
Methodology



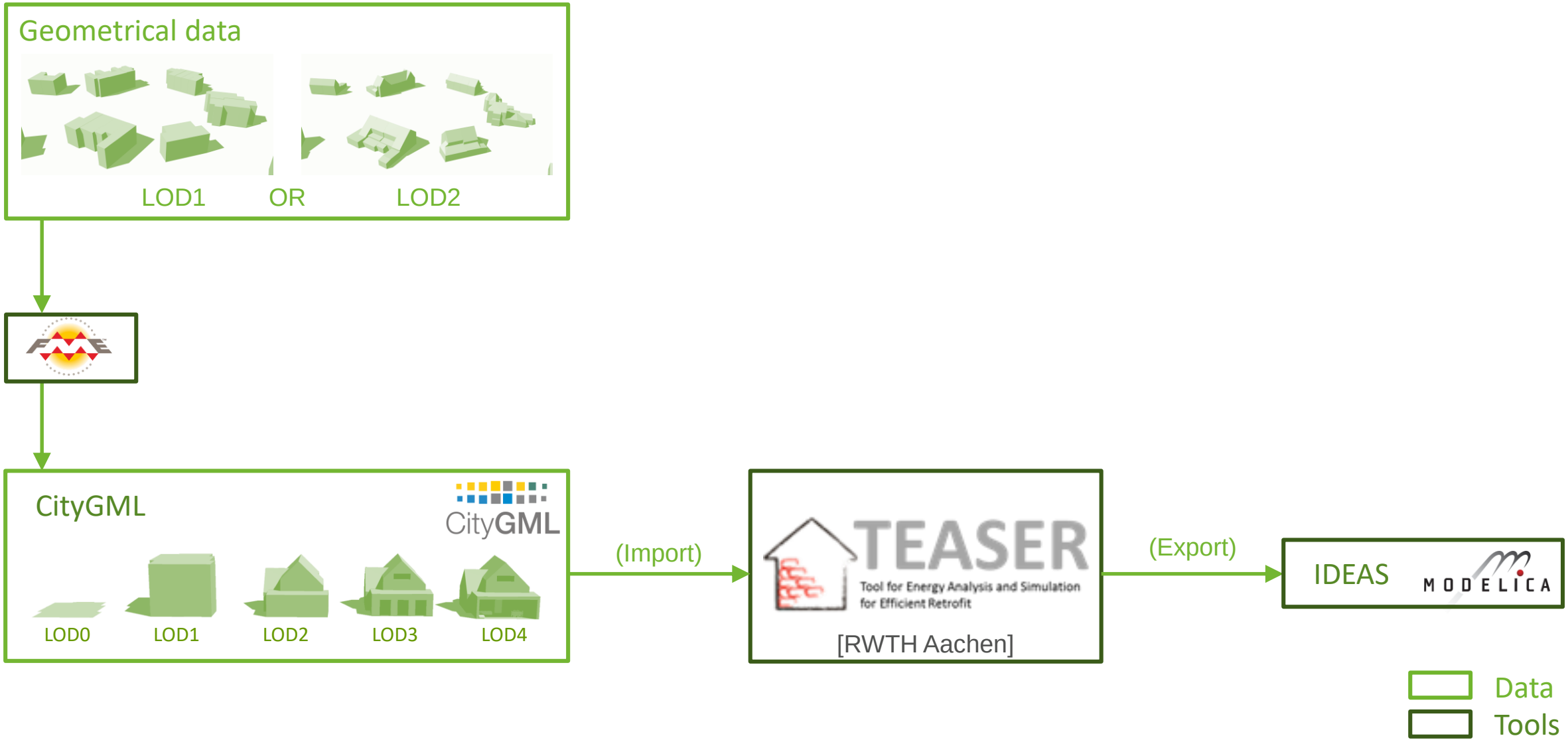
Data
Tools

Methodology

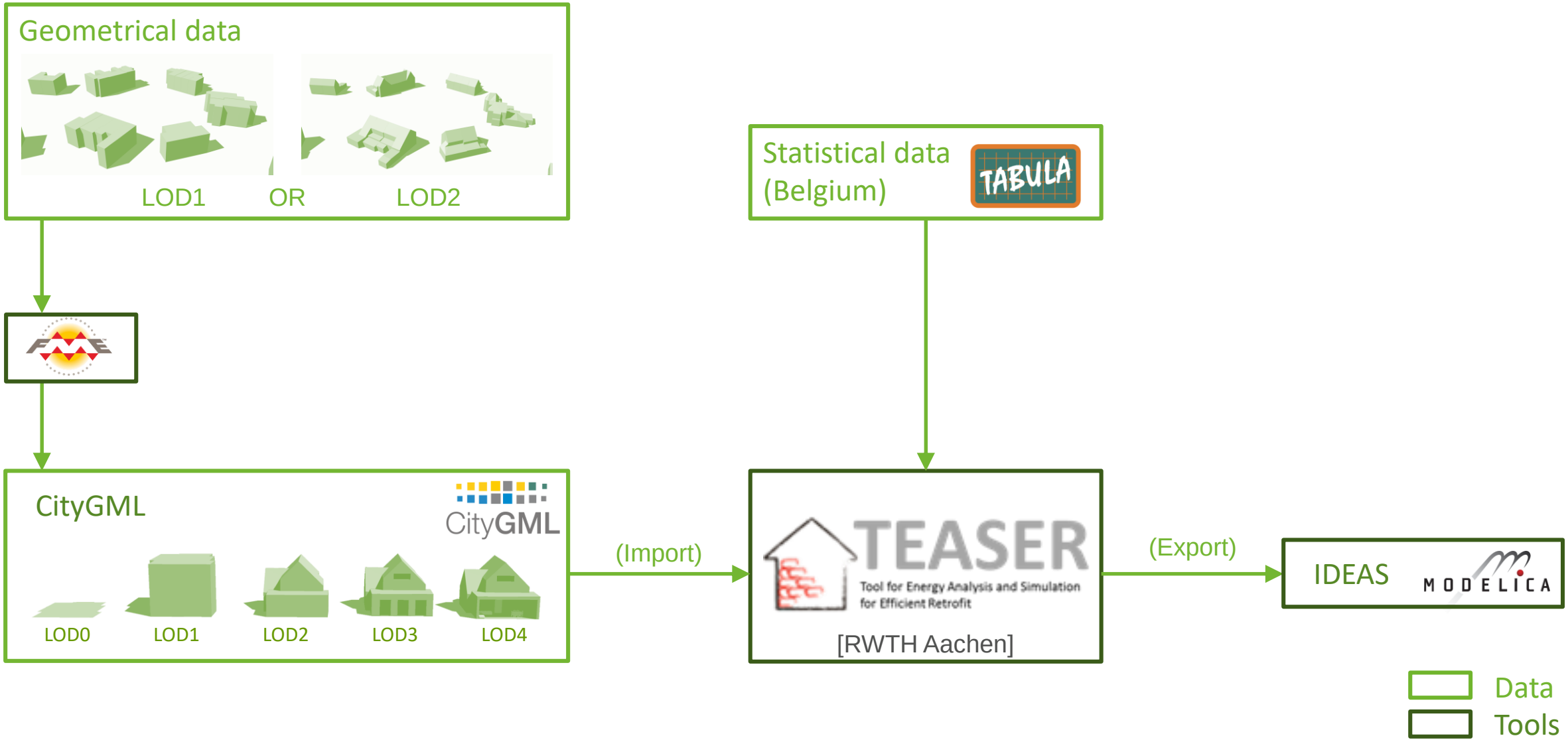
Methodology



Methodology

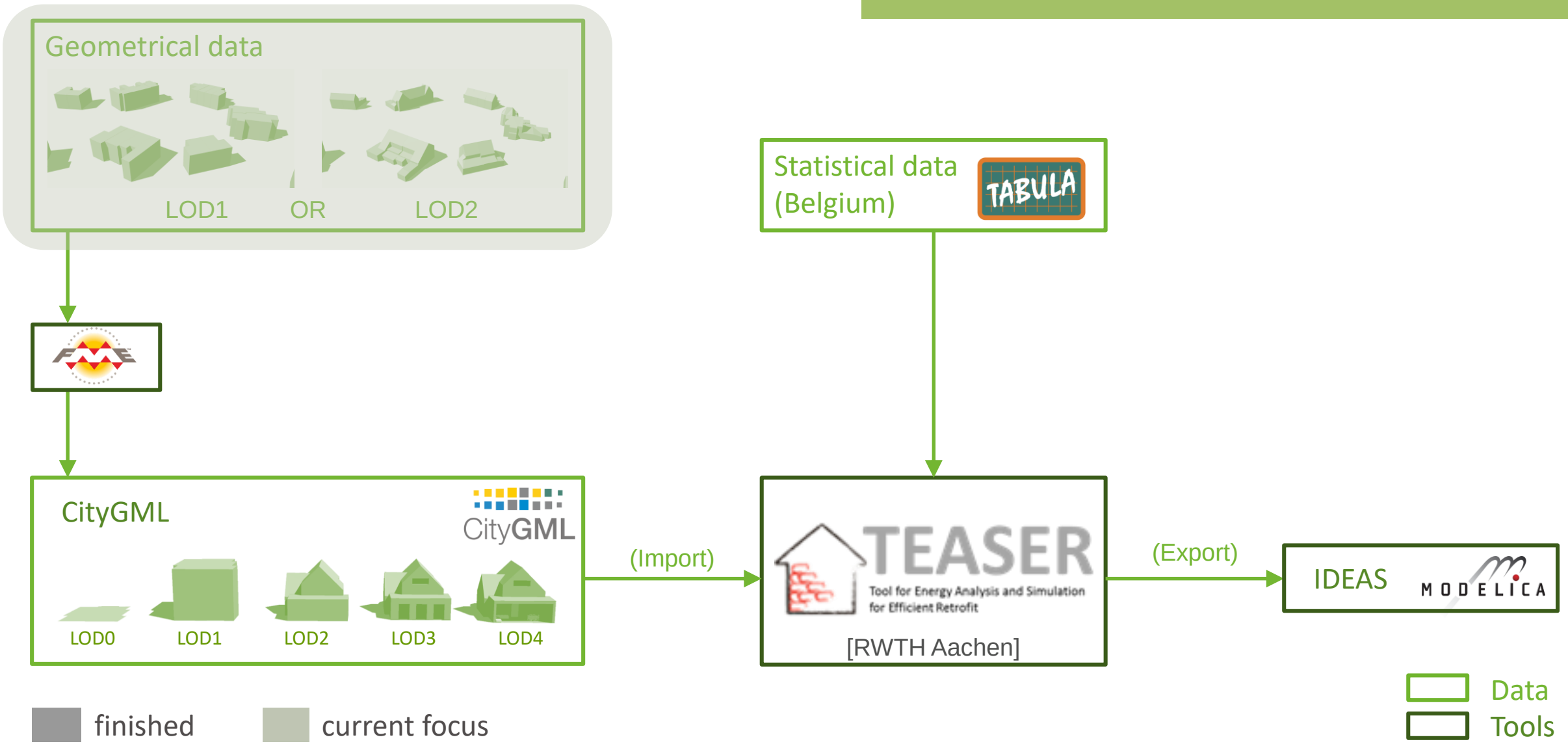


Methodology



Methodology

De Jaeger, I., Reynders, G., Saelens, D. (2017). Impact of spatial accuracy on district energy simulations. *Energy Procedia*.



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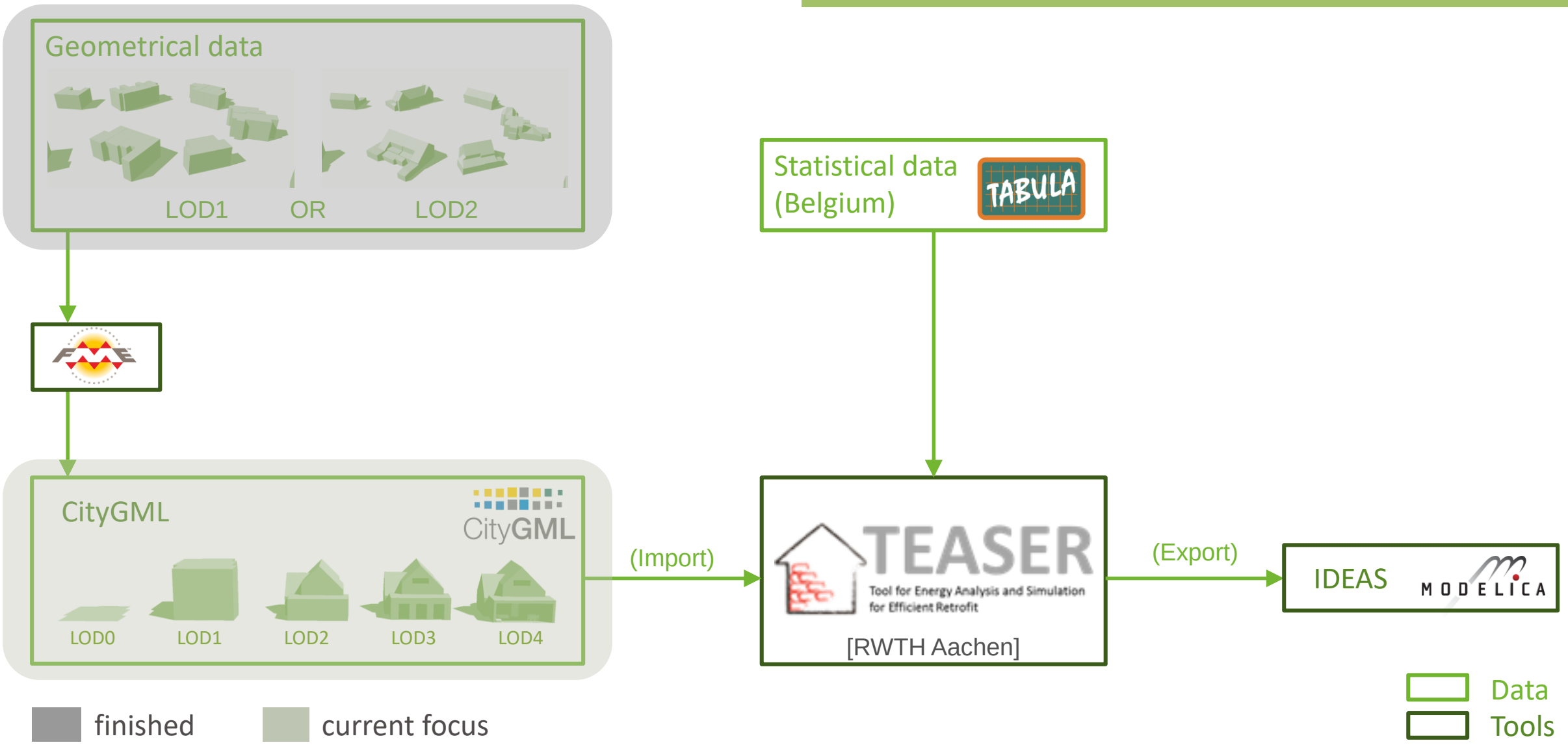
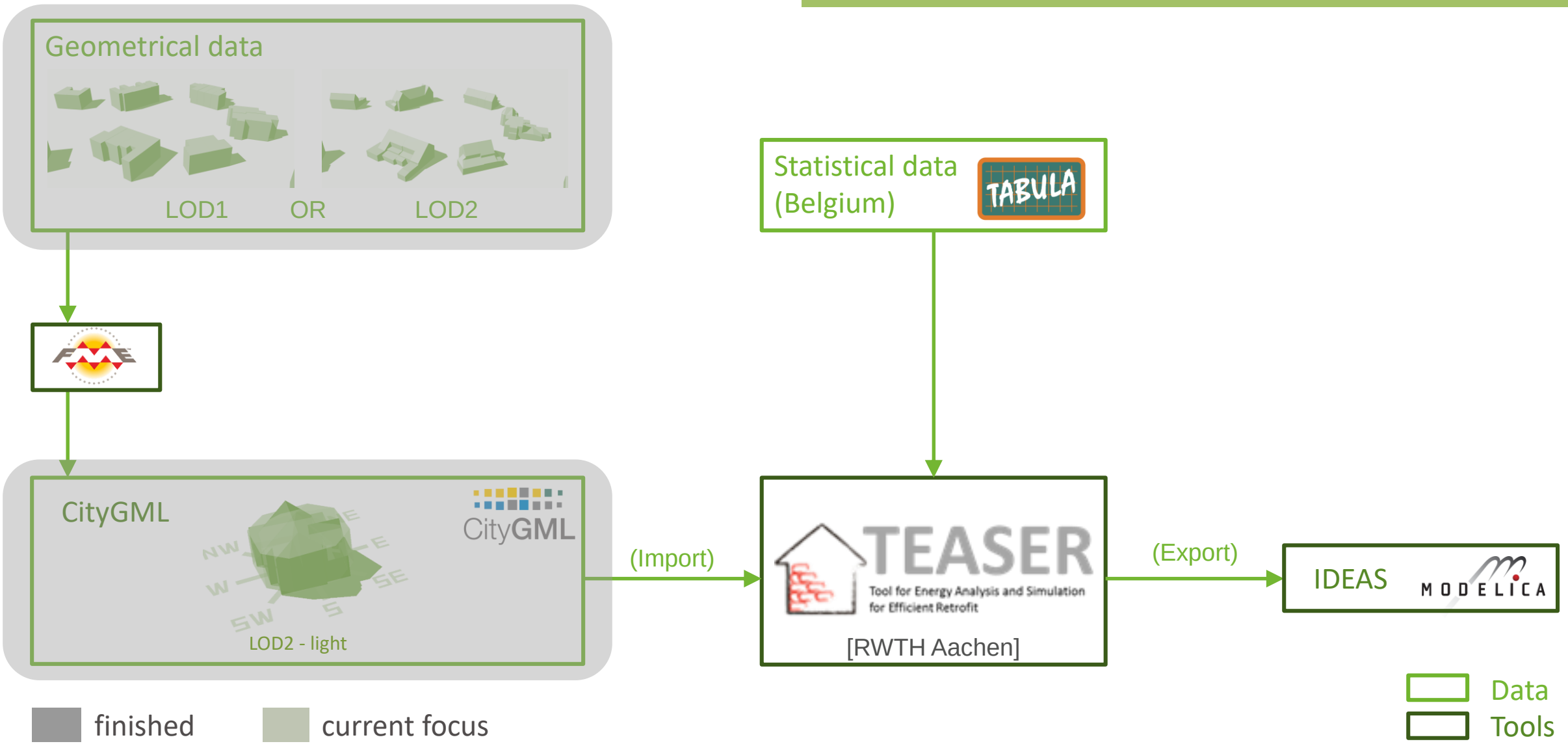
De Jaeger, I., Reynders, G., Ma, Y., Saelens, D. (2018). Impact of building geometry description within district energy simulations. *Energy*, 158.



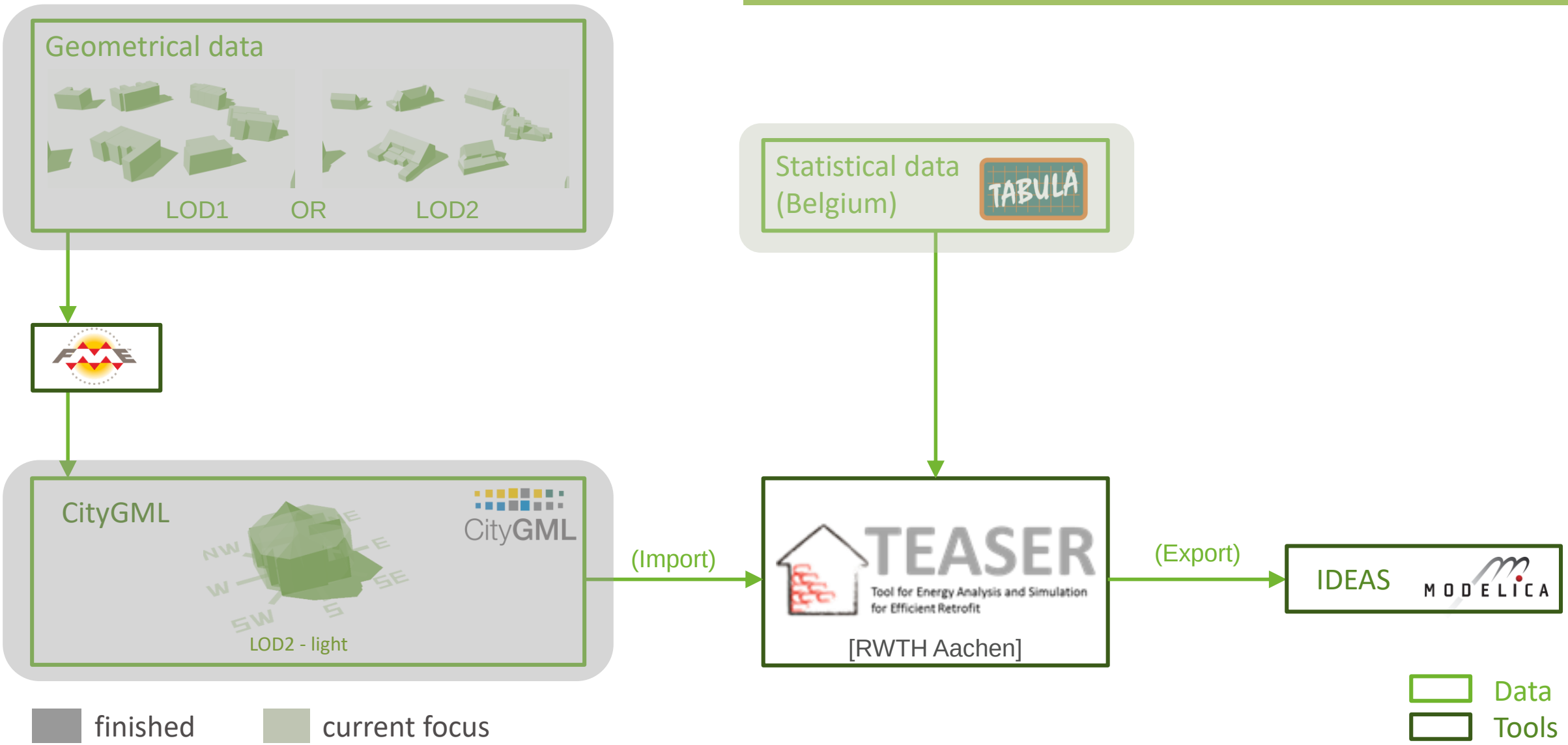
Methodology

De Jaeger, I., Reynders, G., Ma, Y., Saelens, D. (2018). Impact of building geometry description within district energy simulations. *Energy*, 158.



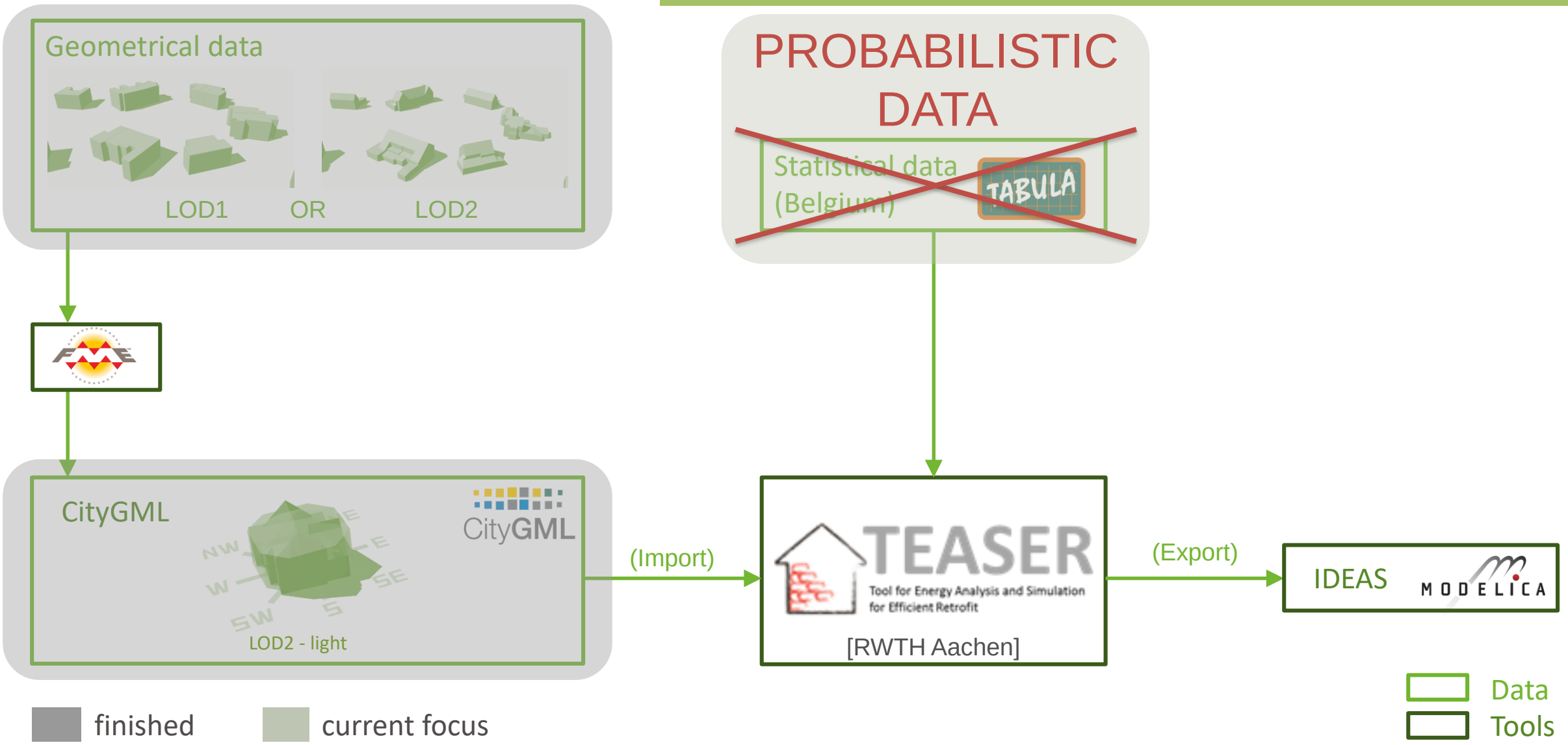
Methodology

De Jaeger, I., Ma, Y., Saelens, D. (2018). Estimating window dimensions of residential buildings in district energy models. Accepted for BPACS 2018.



Methodology

De Jaeger, I., Lago, J., Saelens, D. (2018). A probabilistic approach to allocate building parameters within district energy simulations. Accepted for USIM 2018.



CONTENT

How to *obtain (probabilistic) data?*

Construction year
Location
Building geometry
- Building type
- Floor area
- Loss surface area
- Protected volume

How to *obtain (probabilistic) data?*

Construction year
Location
Building geometry
- Building type
- Floor area
- Loss surface area
- Protected volume

U-values
- Walls
- Roof
- Ground floor
- Windows

Window-to-wall ratio
(Heating system type)

How to *obtain (probabilistic) data?*

Construction year
Location
Building geometry
- Building type
- Floor area
- Loss surface area
- Protected volume

Supervised learning?
Unsupervised learning?

U-values
- Walls
- Roof
- Ground floor
- Windows

Window-to-wall ratio
(Heating system type)

How to *obtain (probabilistic) data?*

Construction year
Location
Building geometry
- Building type
- Floor area
- Loss surface area
- Protected volume

Supervised learning?
Unsupervised learning?

STATISTICAL DATA
(containing all inputs
and outputs)

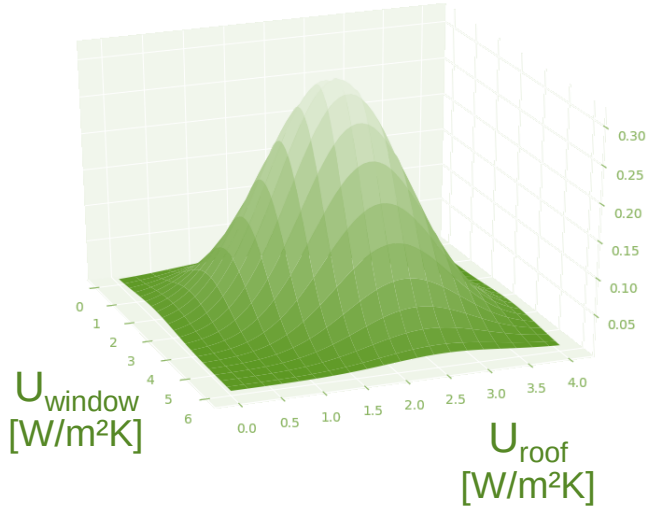
U-values
- Walls
- Roof
- Ground floor
- Windows

Window-to-wall ratio
(Heating system type)

How to *obtain (probabilistic) data?*

Construction year
Location
Building geometry
- Building type
- Floor area
- Loss surface area
- Protected volume

Supervised learning?
Unsupervised learning?

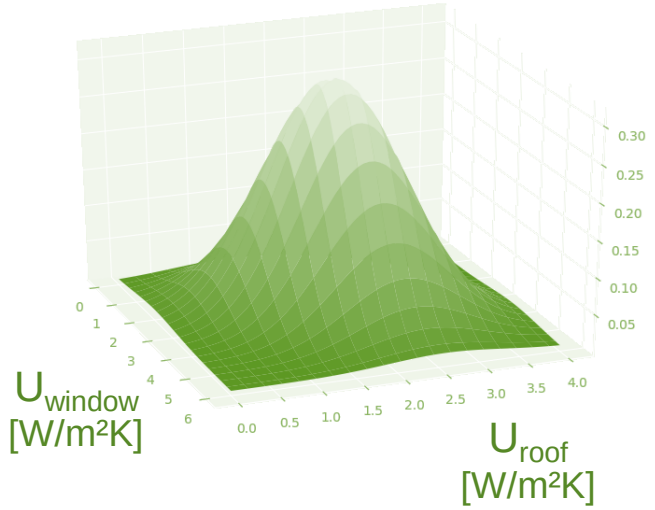


+ U-values
  - Walls
  - Ground floor
+ Window-to-wall ratio

How to *obtain (probabilistic) data?*

Construction year
Location
Building geometry
- Building type
- Floor area
- Loss surface area
- Protected volume

QUANTILE REGRESSION MODEL



+ U-values
  - Walls
  - Ground floor
+ Window-to-wall ratio

First working version …

Construction year = 1960
Location = “Ieper”
Building geometry
- Building type = “Semi-detached”
- Floor area = 102.2 m²
- Loss surface area = 242.68 m²
- Protected volume = 319.19 m³

First working version …

Construction year = 1960
Location = “Ieper”
Building geometry
- Building type = “Semi-detached”
- Floor area = 102.2 m²
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QUANTILE REGRESSION MODEL

First working version …

Construction year = 1960
Location = “Ieper”
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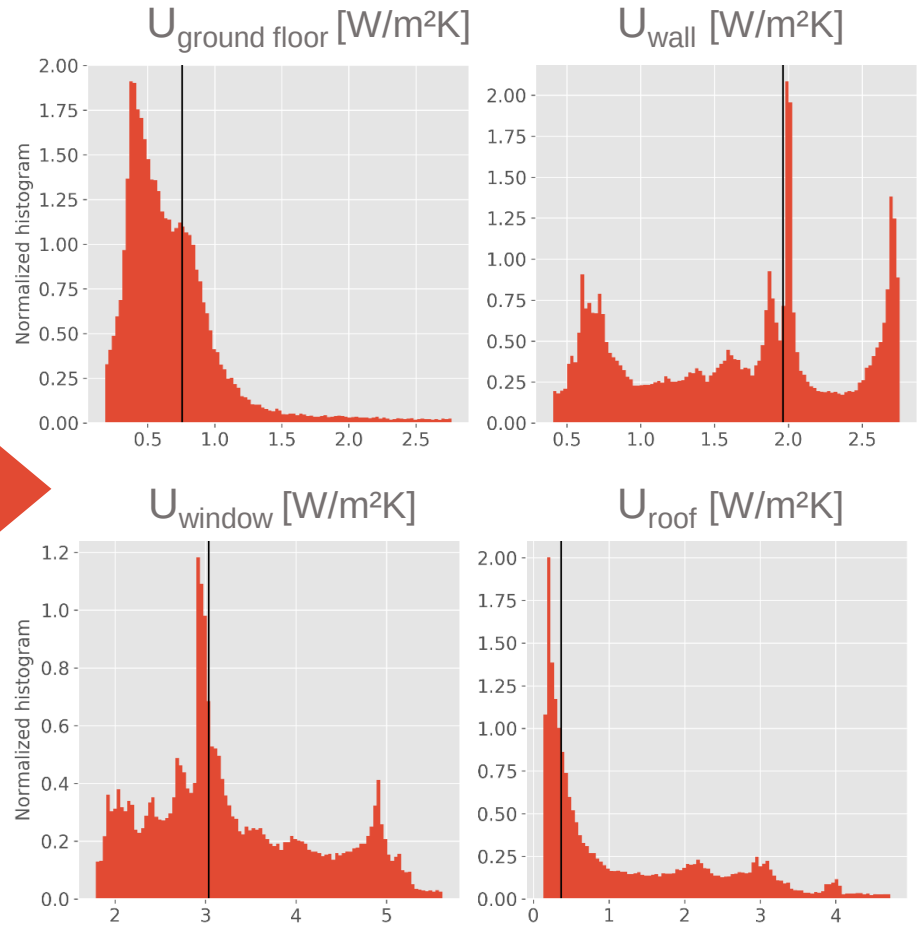
QUANTILE REGRESSION MODEL



How to *obtain (probabilistic) data?*

→ *How to obtain correlated probabilistic data?*

- “Sequential” QR (different orders)
- Vector QR (Carlier et al.)
- Scenario generation method (Pinson et al.)

Questions? Suggestions?

Thank you!

ina.dejaeger@kuleuven.be

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