

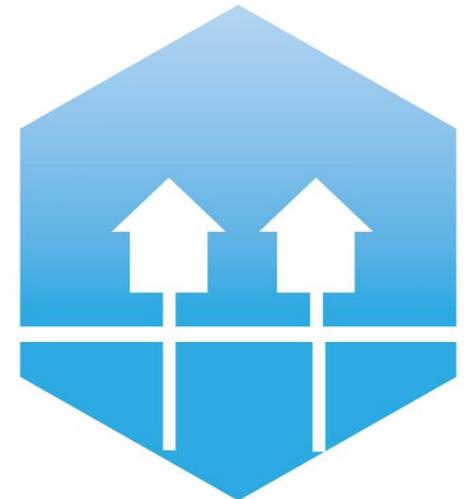
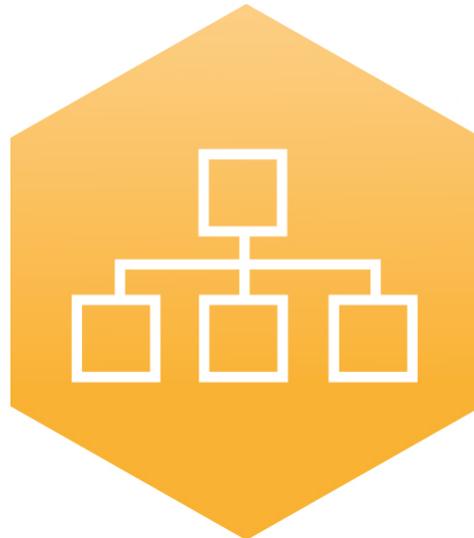
2nd International Conference on Smart Energy Systems and 4th Generation District Heating
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A review of modeling approaches for analyzing building energy demand in district heating systems

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4DH

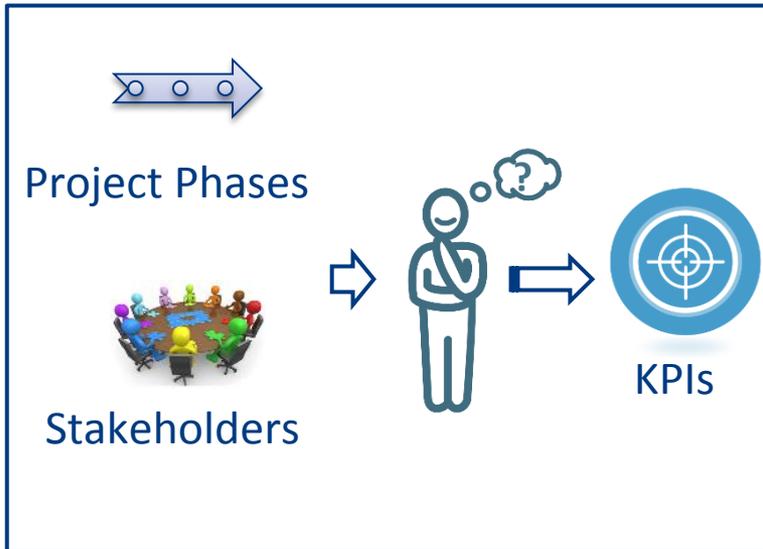
4th Generation District Heating
Technologies and Systems

PhD Research Project

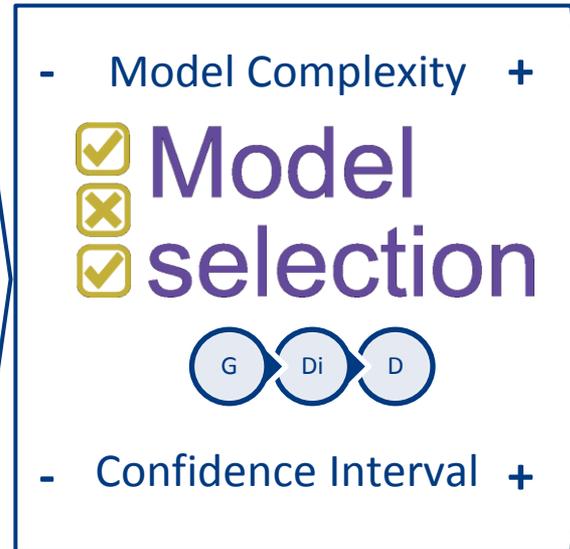
- Objectives:

- 1) develop a fit-for-purpose simulation testbed for new generation district heating systems;
- 2) validate the virtual testbed with measured data.

Step 1



Step 2



Step 3



Introduction



4DH

4th Generation District Heating
Technologies and Systems

Non-Governmental Organizations

Environmental protection and social sustainability.

Authorities
Make regulations.

Consumers

Consume energy.

Prosumers

Consume and produce energy.



Producers

Produce energy and sell to retailers.

Operators

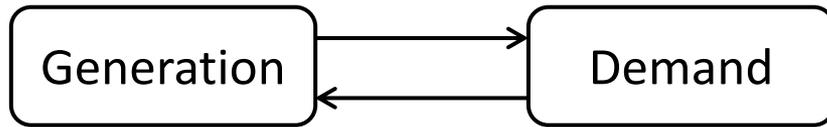
Responsible for operating network and relative equipment.

Energy Retailors

Buy and sell energy.

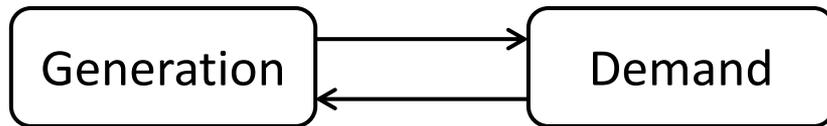
Service Provider

Building Energy Demand Modelling in DHS



- kWh

- Method 1-Fixed demand profile
 - Yearly → Hourly

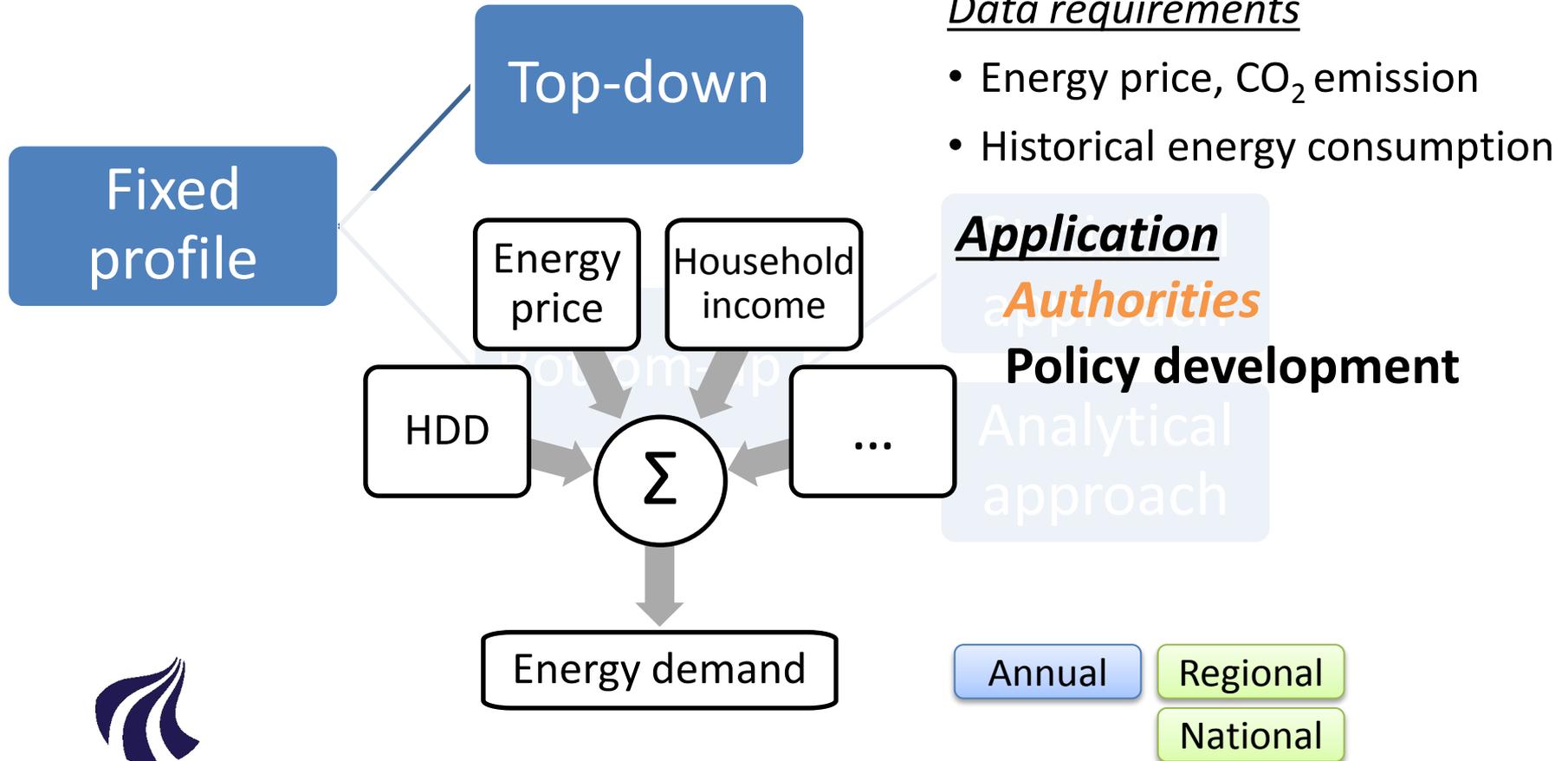


- T
- \dot{m}

- Method 2- Dynamic demand simulation
 - Hourly or even less



Method 1-Fixed profile

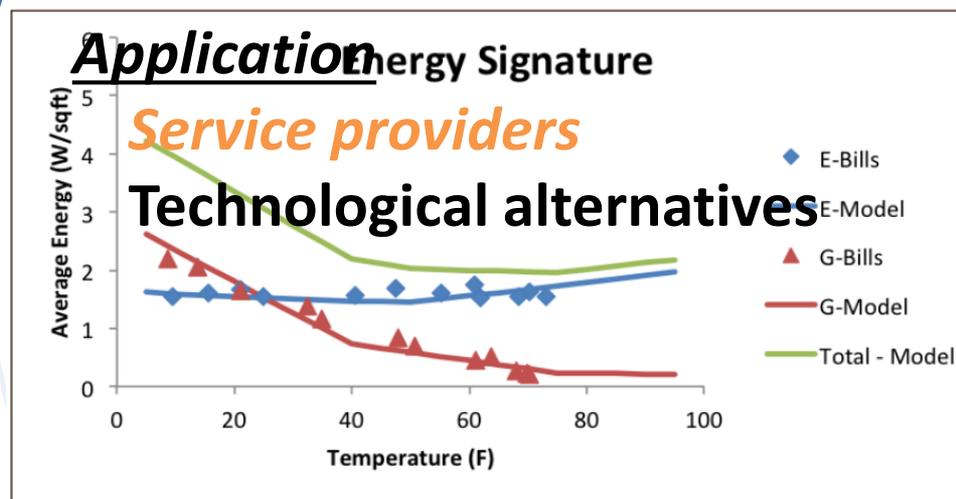


Method 1-Fixed profile

Statistical
approach

- Normalization of measurements
- Regression

Bottom-up



Source: *New Buildings Institute*
Source: U.S. Energy Information Administration, *Annual Energy Review 2011*, Table 1.9 (September 2012)

approach

Annual

District

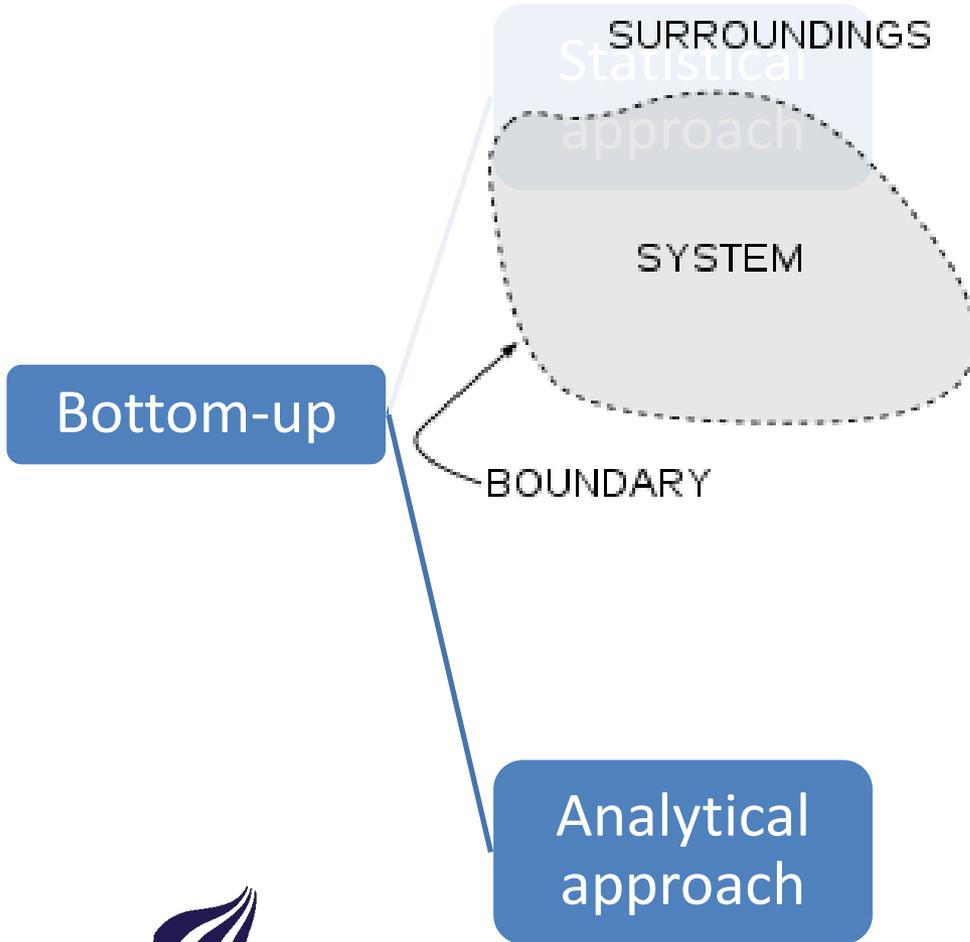
Monthly

Building

Daily



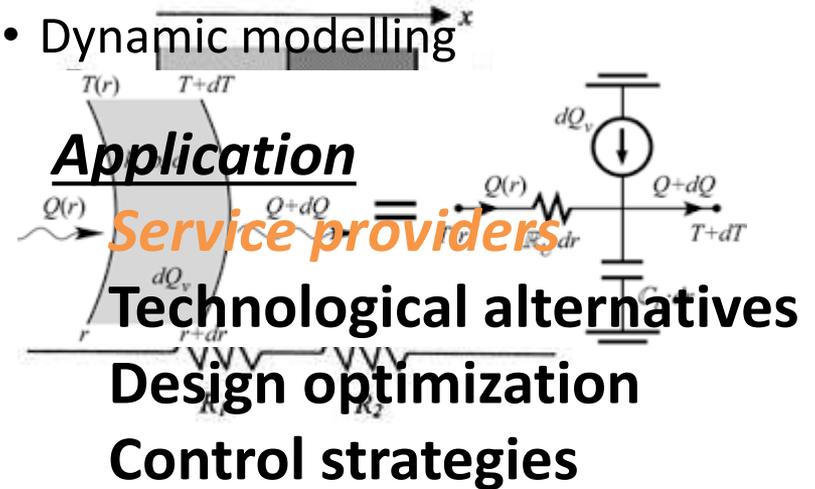
Method 1-Fixed profile



- Steady-state modelling

~~Time~~

- Dynamic modelling^x



- | | |
|------------|----------|
| Hourly | District |
| Sub-Hourly | Building |



Method 2- Dynamic demand simulation



Samliar approach as dynamic modelling in M1

Application

Consumers

Indoor thermal comfort level;

Service provider

Operational optimization;

Control strategy;

Demand response management.

Hourly

District

Sub-Hourly

Building



Challenges in new generation DHS



Facts in DHS



Challenges



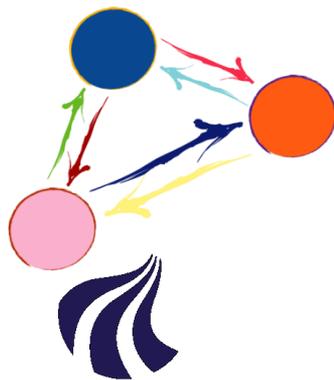
Solution

teating
tems

Complexity



Interaction



Viable sources?



Most suitable system capacities?

Operational control strategy?

...





4DH
4th Generation District Heating
Technologies and Systems

Input
Uncertainty

Available
Knowledge
Increase

Complex model – not always good

BEDM in
DES

Fixed
Profile

Dynamic
simulation

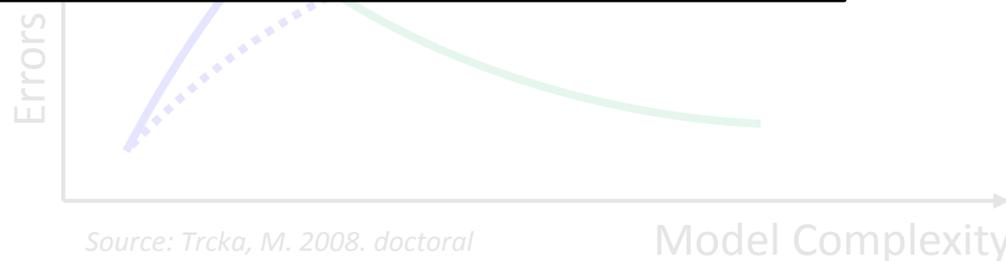


**LEAST COMPLEX model within certain
CONFIDENCE LEVEL for different
QUESTIONS**

Top-down

Steady-
state

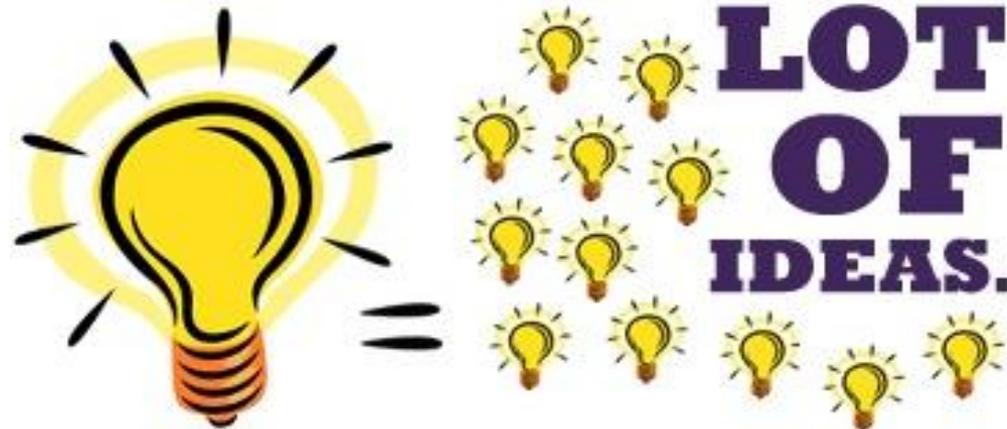
Dynamic



Source: Trcka, M. 2008. doctoral
dissertation, Technische Universiteit
Eindhoven

- Model Complexity +

**THE BEST
WAY TO HAVE
A GOOD IDEA
IS TO HAVE A**



– Dr. Linus Pauling

