

WP3 TRANSFORM

Decision Support Environment



"Enabling cities to become Smart Energy Cities"



Deliverable
3.1

**Finalized prototype quantitative decision support model
ready for replication in other cities**

Disclaimer

About the Structure of the Deliverables D3.1 and D3.2

The two TRANSFORM WP3 deliverables

D3.1 Finalised prototype quantitative decision support model ready for replication in other cities and

D3.2 Guidance for the replicable use of the model and/or methodology developed in this work package and recommendations for further development

aim at different audiences and have to be seen as separate documents. Where D3.1 describes the tool itself, D3.2 is giving advice to cities which want to adopt the DSE in order to be able to use it **in the future**, so some content of the deliverables has been duplicated in order to serve the different audiences and should not confuse the readers of the two documents.

Since these are public documents the WP3 team tried to make the deliverables as consumable as possible for future external readers.



Outline, contents and target audience of deliverable 3.1

✓ Process of the DSE development

Content:

Description of the DSE development process

Audience:

Parties interested in the DSE development process

✓ User Manual

Content:

Instructions for using the DSE through the user interface, including a case study.

Audience:

Users of the Decision Support Environment.

✓ Technical documentation

Content:

Technical details regarding the development of the DSE software.

Audience:

Technicians/IT specialists interested in the software architecture of the DSE.

✓ Deployment Guide

Content:

Document about the required hardware for running the DSE.

Audience:

Parties interested in installing the DSE on their own servers.

Table of Contents

1. <u>Introduction</u>	5
2. <u>Glossary</u>	6
3. <u>Process within TRANSFORM</u>	7
3.1 <u>Why a decision Support Environment?</u>	8-9
3.2 <u>Analysis of existing tools</u>	10-11
3.3 <u>Decision Support Environment embedded in TRANSFORM as WP3</u>	12
3.4 <u>The DSE development process – Involving the stakeholders</u>	13
3.5 <u>Design focus: from key city energy themes to key energy measures</u>	14
3.6 <u>Defining the energy measures using an integrated 4-step approach</u>	15
4. <u>User manual</u>	16-51
5. <u>Technical Documentation</u>	52-80
6. <u>Appendix: Deployment Guide (Word .doc)</u>	81

(The headlines are clickable hyperlinks!)

1. Introduction

WP3 Objectives in TRANSFORM

To develop a prototype Decision Support Environment (DSE), which enables decision makers to evaluate the impacts of different transformation plans, under varying scenarios, based on open energy data. In addition to the prototype DSE, documentation materials are developed for dissemination of the DSE to other cities.

The Deliverable 3.1 contains all the developed documentation material, describing the process and methodology of the DSE development and all relevant technical components, including step by step guidance through the DSE functionalities.

2. Glossary

Smart Energy City

The Transform program has set a definition for the Smart Energy City which places the energy targets within the social, economical and ecological context.

The Smart Energy City is highly energy and resource efficient, and is increasingly powered by renewable energy sources; it relies on integrated and resilient resource systems, as well as insight-driven and innovative approaches to strategic planning. The application of information, communication and technology are commonly a means to meet, these objectives.

The Smart Energy City, as a core to the concept of the Smart City, provides its users with a livable, affordable, climate-friendly and engaging environment that supports the needs and interests of its users and is based on a sustainable economy.

City Theme

A specific subject that a city has chosen to focus on for the duration of the Transform project, e.g. district heating, urban refurbishment, renewables, smart grids etc.

Measure

A specified intervention applied in a district or on the city level by a stakeholder or a group of stakeholders.

Scenario

A potential future state of a district and/or city described through a set of factors , e.g. population, gas price, electricity price, economic conditions

City Data

City specific information that describes the state of the city in accordance with the specified Key Performance Indicators (KPI's)



3. DSE development process

Content:

Description of the DSE development process

Audience:

Parties interested in the DSE development process

- 3.1 Why a Decision Support Environment
- 3.2 Analysis of existing Tools
- 3.3 WP3 embedded within the TRANSFORM program
- 3.4 DSE development: involving the stakeholders
- 3.5 Design focus: from key energy themes to key energy measures
- 3.6 Defining the energy measures using a 4-step approach

3.1 Why a Decision Support Environment? 1/2

The quantitative decision support environment enables informed decision making. It simulates outcomes of energy measures and supports fact-based and sustainable planning for city transformations and contains following five benefits.

Reliable & effective analyses to increase sustainability

Decision making based on reliable analyses, taking all relevant city factors and KPIs into account. Future scenarios and expected impact on KPIs are visualized in a clear overview (maps, statistics, etc.).



Long term cooperation between stakeholders

The model is accessible online and serves as an online platform. Stakeholders can add data, analyze data and cooperatively propose investments and develop business plans.



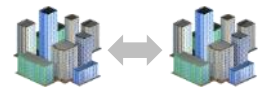
Open data support

The model serves as a growing, dynamic database. data is stored and added online on a continuous basis. For every data set access levels can be managed, from fully accessible to completely secured.



City expertise exchange

Measure definitions can be exchanged between cities to share knowledge. Exchanged measures can then be applied to specific local city data to ensure local applicability.



Cost savings

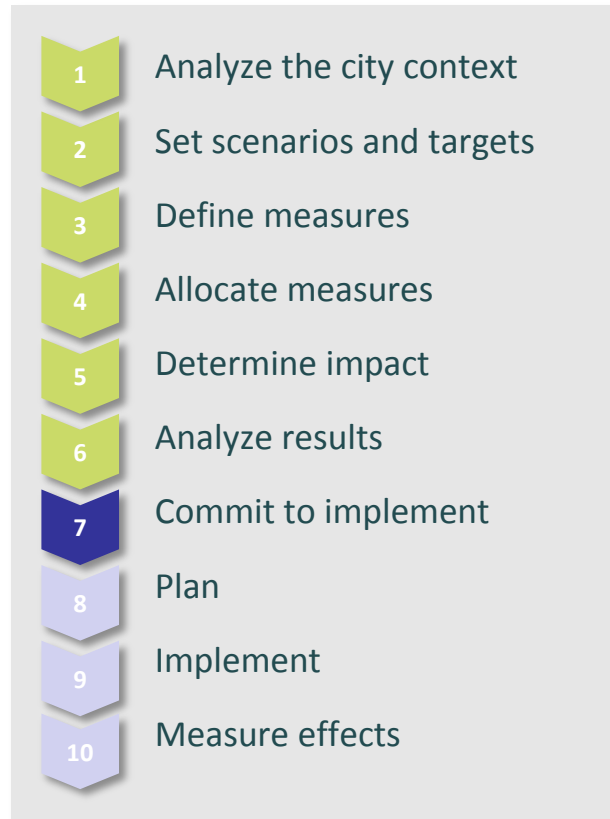
The model gives direct access to the right data, measures, scenarios and tools. This prevents the city from starting every project with new data gathering and analysis, which saves project costs and time.



3.1 Why a Decision Support Environment? 2/2

DSE helps in identifying opportunities, allocating measures, determining potential impacts, and gaining stakeholder commitment

Decision making process



Support for the transformation of the city's strategic agenda

- Focusing on city data and insights from these data required for decision making
- Viewing city and district data in a spatial form for assessing the opportunities to improve
- Model for developing and allocating measures and viewing their impact on energy indicators
- Analysis of the effects of measures under multiple future demand and pricing scenarios

Support for implementation plans

- Opportunities and impacts of measures can be viewed and analyzed at district or building levels
- An overview of additional and more detailed models to support planners in decision making

3.2 Analysis of existing tools – 1/2

Categories by which existing tools were screened

Energy demand		Calculation of the energy demand of the target location in terms of electric and thermal energy. Basic breakdown of the calculated energy demand.
Energy supply		Energy conversion technologies used, consideration of energy conversion input and output types, energy distribution networks
Transport		Consideration of the energy that is used in the transport sector
CO2		Consideration of the CO2 emissions due to energy use, production or distribution processes
Water		Water use/management, used water lifecycle,...
Waste		Waste production/supply/collection, different uses of wastes in energy production
Society		Quality of life, comfort standards
Costs		Associated cost to energy production or energy efficiency measures implementation. E.g. fuel prices, investment cost for energy installations
Environment		assessment of the impact on the environment caused by the energy systems or different energy systems scenarios
Scenario development	Time frame	The duration of the scenario that the tool could allow the user to develop
	Time step	The time step of the calculations to determine energy demand and production
Urban design		The morphology of the city and the impact of different urban structures on the energy systems
Geographical scope		The geographical scale under which the tool could be used

3.2 Analysis of existing tools – 2/2

Categories by which existing tools were screened

Tool type			Availability		Features												
					Energy demand		Energy supply		Transport	CO2	Water	Waste	Society	Costs	Environment	Scenario development	
GIS Interface	Semi-dynamic	Dynamic	Organisation (link)	Access	Electricity	Heat	Electricity	Heat								Time frame	Time step

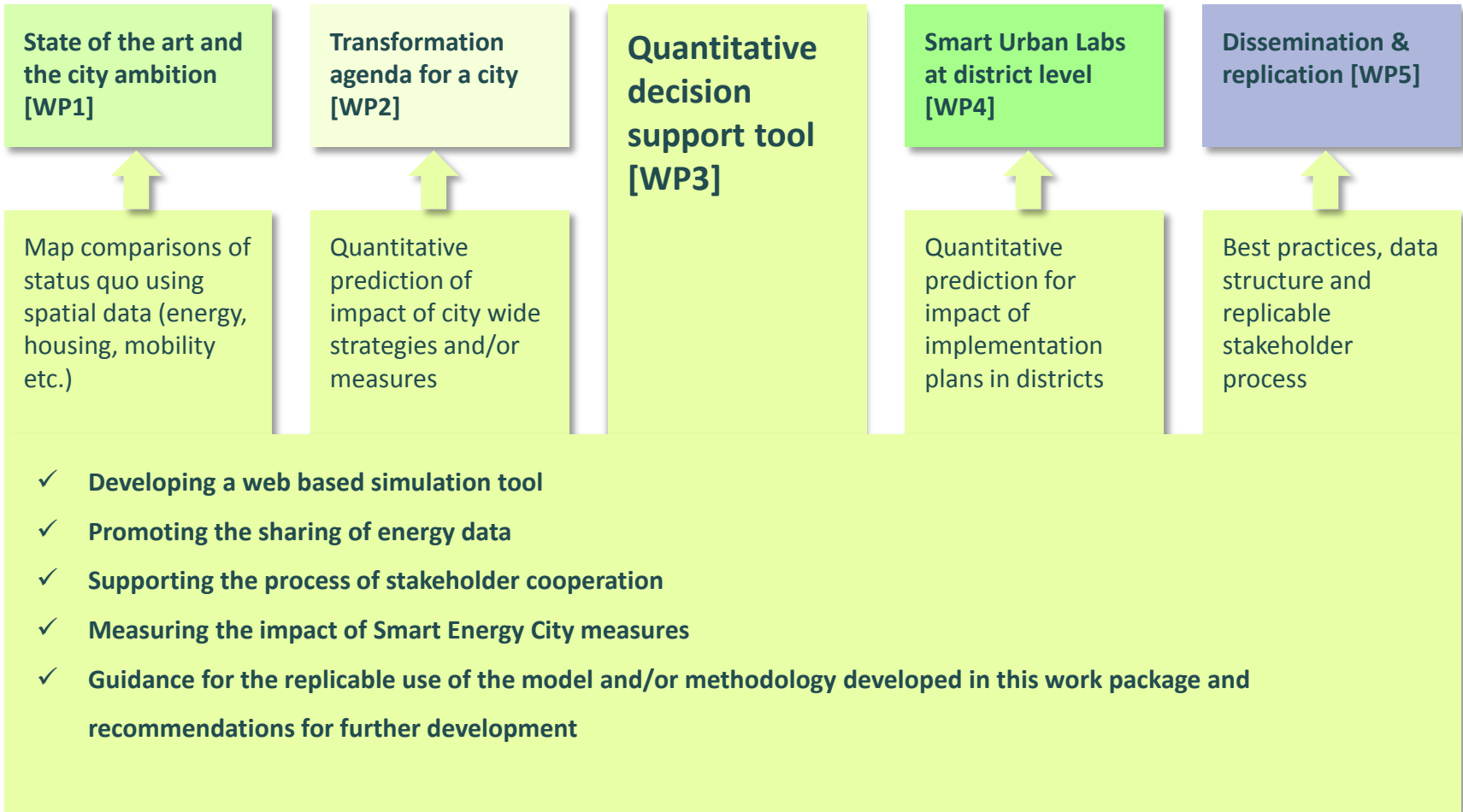
Geographical Scope	Number
City	3
City/neighborhood	6
Global	1
Global and regional	1
International	5
Island	1
Local/community	2
National/state/regional	22
National/state/regional/city	2
Single-project investigation	4
User-defined	1

Criteria	Number of Tools
CO2	29 of 59
Urban Design	11 of 59
GIS Interface	14 of 59

Existing tool analysis has exposed the need for a better spatial integration of energy related measures and linking of city wide assessment of interventions with the actions on the scale of neighborhoods/urban quarters.

3.3 Decision Support Environment embedded in TRANSFORM as WP3

The objective of WP3 is to enable informed decision making by analyzing and integrating available data and providing quantitative information in a specific spatial context of a city.



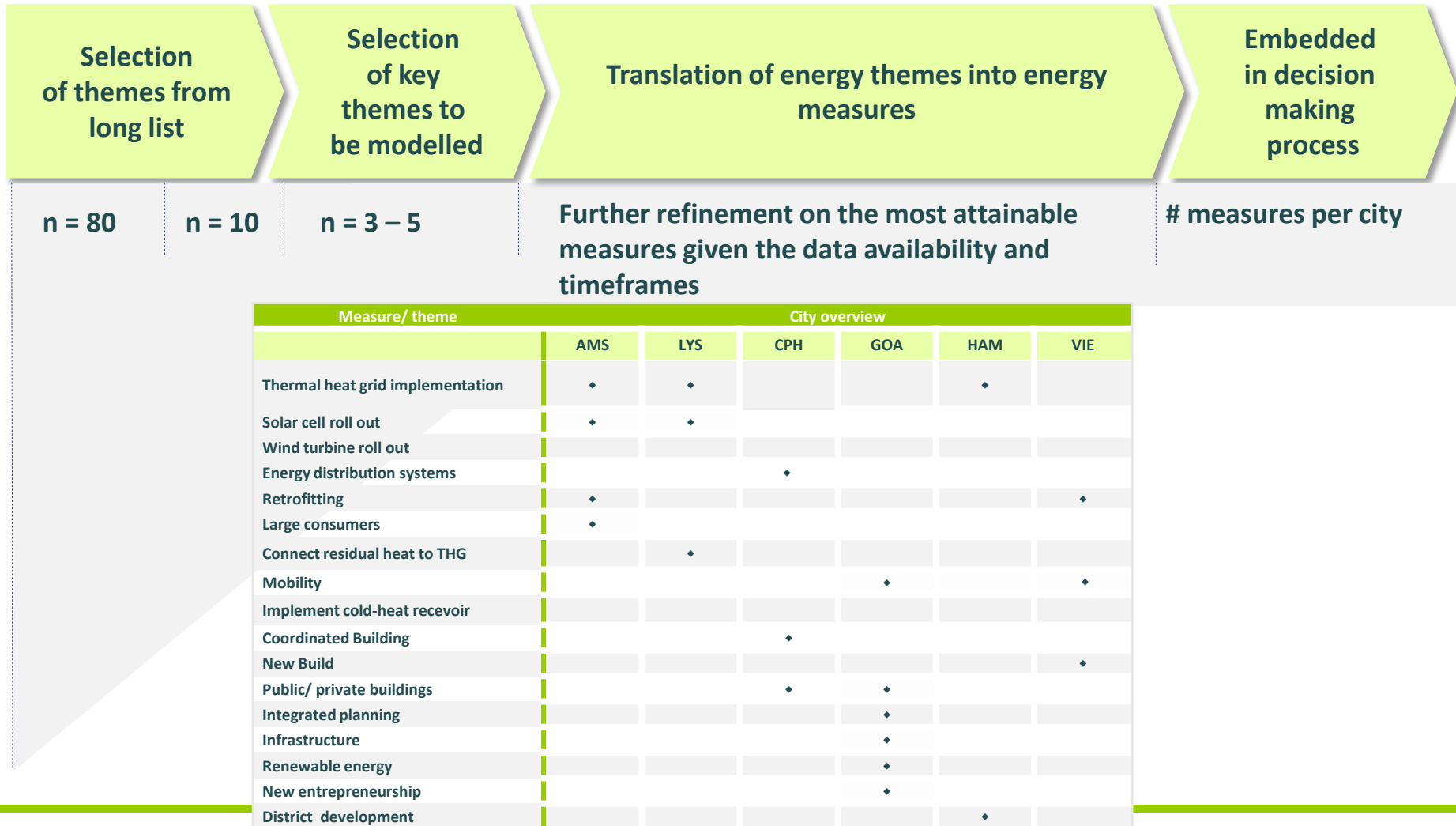
3.4 The DSE development process – Involving the stakeholders

The DSE development process had many touch points with the city representatives. One of the most important design components was to incorporate city energy themes and translate them into energy measures in the DSE. The table below contains the key phases of this process.

WP3 Project Month Planning	1 - 3	4 - 6	7 - 9	10 - 12	13 - 15	16 - 18	19 - 21	22 - 24
Methods Exploration								
Conclusions & 1 st Sketch								
First feedback from cities								
From SULs, Other WP's								
Visiting Cities & Interviews								
Requirement Gathering								
Design & Development								
Data Collection (AMS, HAM)								
Draft Prototype								
Feedback from Cities/WP's								
Fully working Prototype								
Further Data collection & Measure Development								

3.5 Design focus: from key city energy themes to key energy measures

Each transform city went through the process of the down selection from 80 to 3-5 themes during intake workshops. The themes were deepened into measures, modelled into the DSE.



3.6 Defining the energy measures using an integrated 4-step approach

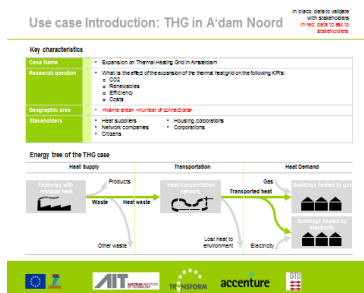
The measure modelling process enabled the translation of an energy theme into a detailed measure.



1

Key users: development of research question and user structure

Transform: guidance on development and kick-off



2

Key users: validation of model structure

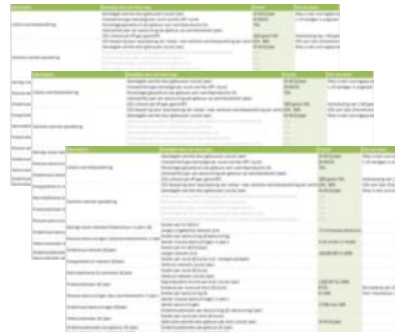
Transform: development of model structure



3

Key users: collection of required city data

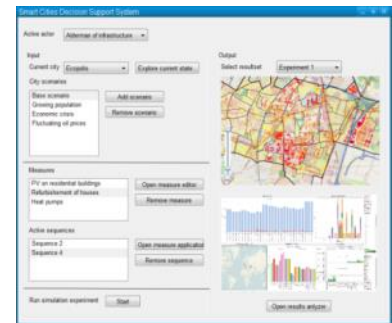
Transform: modelling of measure and data into DSE



4

Key users: validation of measure in the DSE

Transform: demonstration of modelled measure in the DSE



4. DSE Full User Manual

Link to the tool:

<http://sbc1.ait.ac.at/web/mfumarola/dst>

Content:

Instructions for using the DSE through the user interface, including a case study.

Audience:

Users of the Decision Support Environment.

Contents of the User Manual

How to Start

How to get your City Smart

How to Add & Adapt

How to Use

How to Understand

Log In

- 1 Analyze City Context
- 2 Set Scenarios
- 3 Allocate Measures
- 4 Determine Impacts

- Measure Library
- Factor Library

Case study

Glossary

Contents of the User Manual

How to Start

Log In

How to get your City Smart

- 1 Analyze City Context
- 2 Set Scenarios
- 3 Allocate Measures
- 4 Determine Impacts

How to Add & Adapt

- Measure Library
- Factor Library

How to Use

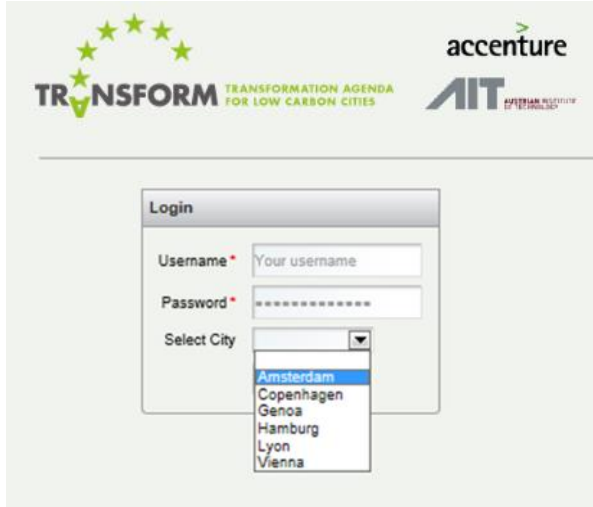
Case study

How to Understand

Glossary

How to Start: Log In

The Decision Support Environment can be accessed through the internet, and test accounts are available for new users that want to explore the options and get familiar with the DSE.



TRANSFORM TRANSFORMATION AGENDA FOR LOW CARBON CITIES

accenture
AIT AUSTRIAN INSTITUTE OF TECHNOLOGY

Login

Username * Your username

Password * *****

Select City

- Amsterdam
- Copenhagen
- Genoa
- Hamburg
- Lyon
- Vienna

1. Access the Decision Support Environment

- Go to sbc1.ait.ac.at/web/mfumarola/dst via Google Chrome

2. Type Username and Password

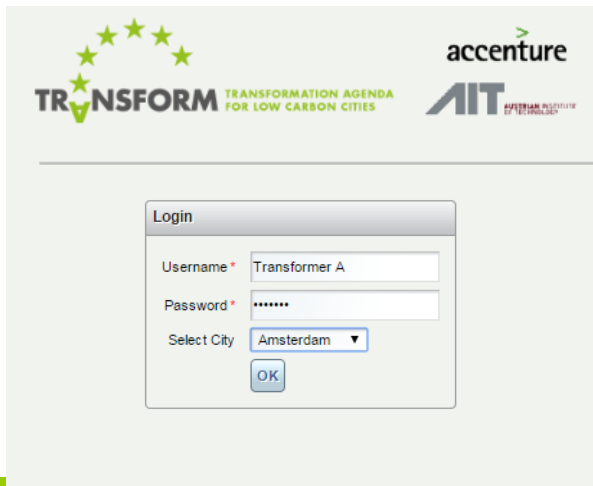
- Click on the field, enter your details. If no login details are provided, login with username 'test' and password 'test'.

3. Select the City

- City for which the scenario planning will be made

4. Click 'OK'

- Opens the Decision Support Environment



TRANSFORM TRANSFORMATION AGENDA FOR LOW CARBON CITIES

accenture
AIT AUSTRIAN INSTITUTE OF TECHNOLOGY

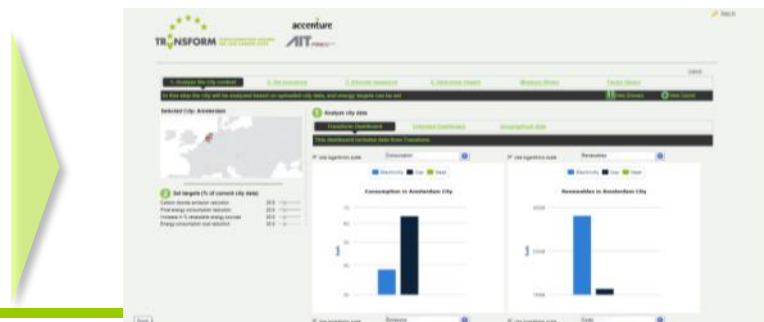
Login

Username * Transformer A

Password * *****

Select City Amsterdam

OK



Contents of the User Manual

How to Start

Log In

How to get your City Smart

- 1 Analyze City Context
- 2 Set Scenarios
- 3 Allocate Measures
- 4 Determine Impacts

How to Add & Adapt

- Measure Library
- Factor Library

How to Use

Case study

How to Understand

Glossary

How to get your city smart: Outline

The Decision Support Environment consist of four main steps. A user can (1) analyse the current energy performance of a city based on the available data, (2) set scenarios containing assumptions about the future state of a city, (3) mimic the transformation of an area by allocating measures, and (4) test the local or city-wide impact of such a transformation under the various future assumptions (scenarios).

<u>1. Analyze the city context</u>		<u>2. Set scenarios</u>	<u>3. Allocate measures</u>	<u>4. Determine impact</u>
1	Analyze City Context	View and analyze the current situation of the city and set targets for the future		
2	Set Scenarios	Determine the future state of the city by allocating factors of uncertainty that will influence the outcomes over time		
3	Allocate Measures	Design transformation plans for the city via measure portfolios in certain areas and for certain time frames		
4	Determine Impacts	Analyze the outcomes of the experiment created in the preceding steps, compare different experiments to each other to assess feasibility		

1. Analyze City Context

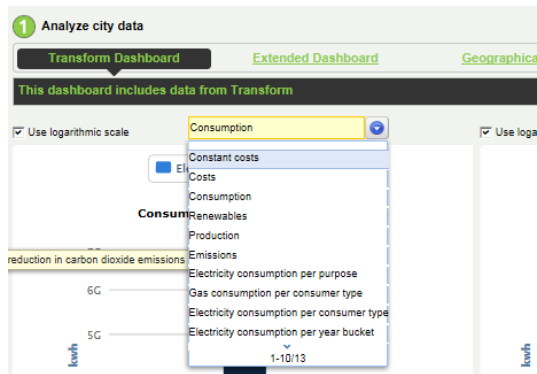
1 Analyze City Context

2 Set Scenarios

3 Allocate Measures

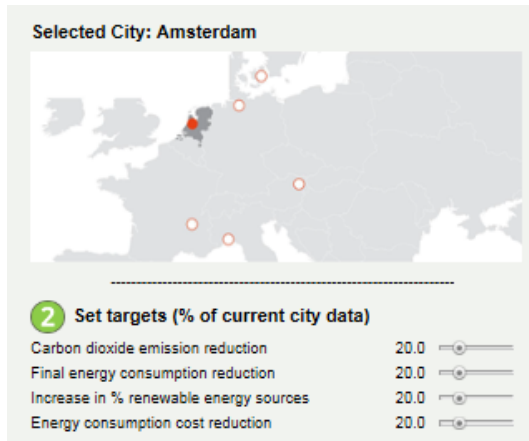
4 Determine Impacts

The first step is a representation of the available city data in the Decision Support Environment, that can be viewed in bar charts, and on a map through an interactive geographical interface. This provides a clear insight in the 'as is' situation in the corresponding city, and enables the user to identify areas with opportunities for improvement. Next to exploring the current status of a city, the user can set sustainability targets, referring to the 'to be' situation of the city.



Analyze the city data

- Transform Dashboard (Data from Transform)
- Extended Dashboard (Data from other sources)
- Geographical Data (Selection of city area)



Set targets

- Future city targets as a function (%) of the current city data

2. Set Scenarios

1 Analyze City Context

2 Set Scenarios

3 Allocate Measures

4 Determine Impacts

In the second step, different futures for the city can be defined, with regard to the uncertain, uncontrollable factors for a city actor. Examples of these factors are energy prices and interest rate.

Scenario Overview

Scenario Name
Test 1 - As proposed
Test 2
bbb
hallo
test 3
what happens now

Create Remove

Set Scenarios

- Create new scenario
- Select Existing Scenario (follow steps below to validate accuracy)
- Delete existing scenario (select scenario from list and 'remove')

Create/Edit a scenario

1 Name the scenario and its description

Name

New scenario1

Description

Create New Scenario

- Name the Scenario, Add a description
- This makes the scenario traceable and explicable to others

2 Add factors to scenario, and customize them by edit button

All factors

Select a factor to add it to this scenario

Selected factor description

Create a new factor

Edit factor

Add to Scenario

Remove from Scenario

Scenario

Factors in this scenario

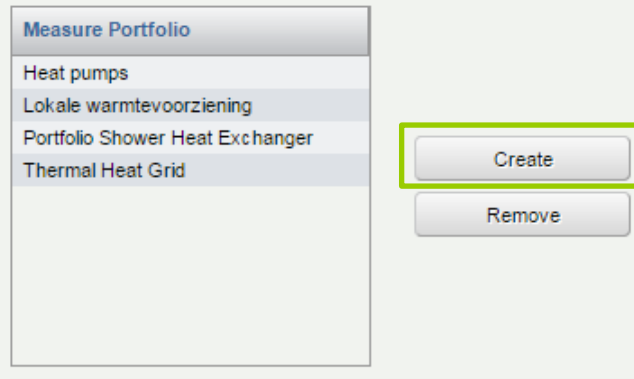
Add factors to the Scenario

- Customize by adding under which factors the scenario will be run

3. Allocate Measures (1/3)

Step 3 is dedicated to the design of transformation plans, or 'measure portfolios'. These refer to factors that city actors do have control over. Each measure portfolio contains a set of measures, allocated to certain entities in the city (e.g. buildings) and to a specific time frame for implementation.

Measure Portfolio Overview



Create Measure Portfolio

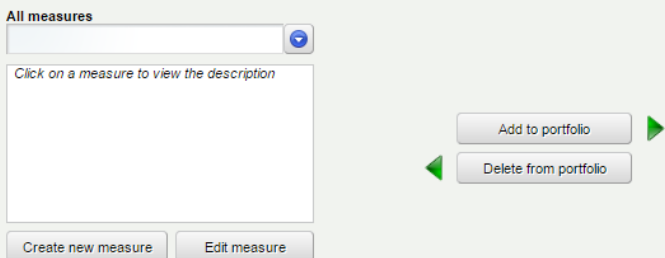
- Name the new measure portfolio and add a description

Create/Edit a measure portfolio

1 Name the new measure portfolio and its description



2 Add measures to the portfolio, and customize them by the edit buttons



Add measures to the portfolio:

- Select measures from the dropdown list
- Either 'Add to portfolio' or
- Edit/Create a new measure

**Instead of creating a new measure portfolio, an existing measure portfolio can be selected and either edited or applied via the outlined steps.*

3. Allocate Measures (2/3)

1 Analyze City Context

2 Set Scenarios

3 Allocate Measures

4 Determine Impacts

Step 3 is dedicated to the design of transformation plans, or 'measure portfolios'. These refer to factors that city actors do have control over. Each measure portfolio contains a set of measures, allocated to certain entities in the city (e.g. buildings) and to a specific time frame for implementation.

Measure portfolio

Measure	1) Time	2) Area
Air source Heat Pump	Allocate Time	Allocate Area
Solar PV panels	Allocate Time	Allocate Area
Facade PV panels	Allocate Time	Allocate Area
Wind turbines	Allocate Time	Allocate Area
Aquifer Thermal Storage op	Allocate Time	Allocate Area

Allocate time and penetration rate

- Select a measure and choose Allocate Time
- Allocate a start and end date for implementation of this measure
- Use slider to set a penetration rate

3 Allocate measure in time

Please select the time period (from date - to date) in which the measure has to be implemented for a TOTAL percentage given by the penetration rate. The model will distribute this percentage linearly over the complete period on a monthly basis.

From

01/15



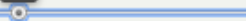
To

04/16



Total penetration rate

50



3. Allocate Measures (3/3)

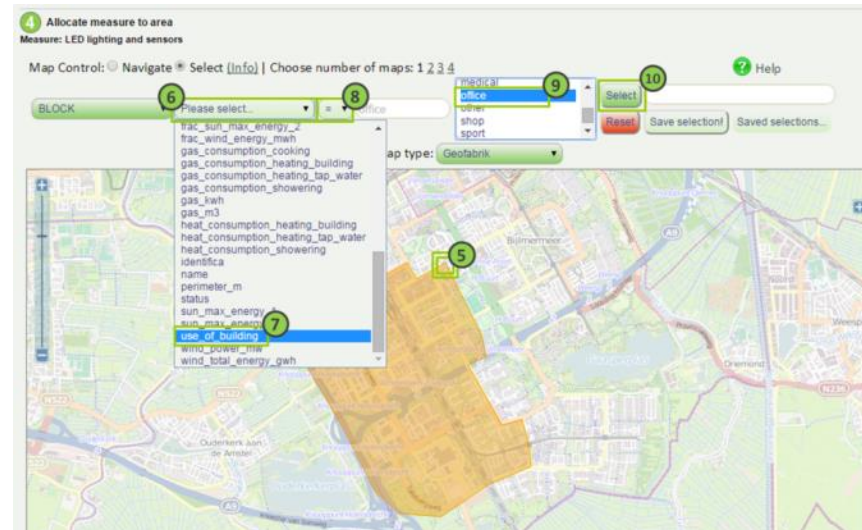
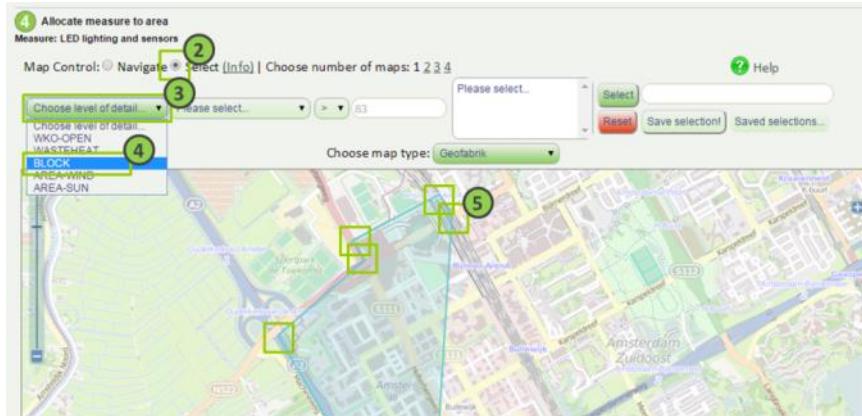
1 Analyze City Context

2 Set Scenarios

3 Allocate Measures

4 Determine Impacts

Step 3 is dedicated to the design of transformation plans, or 'measure portfolios'. These refer to factors that city actors do have control over. Each measure portfolio contains a set of measures, allocated to certain entities in the city (e.g. buildings) and to a specific time frame for implementation.



Allocate area

- Choose the appropriate level of detail (block / building / network / ...)
- Select an area for implementation of the measure
- End the selection by double-clicking on the map

- Choose a filter criterion to select only certain types of buildings
- Press Select to confirm the selection

4. Determine Impacts

1 Analyze City Context

2 Set Scenarios

3 Allocate Measures

4 Determine Impacts

In the last step, the user can determine the impacts of a measure portfolio (defined in step 3), given a certain scenario (step 2). A combination of measure portfolio and scenario is called an experiment. One experiment basically represents a possible future for the city. The user can view and compare the outcomes of different experiments, measured on four city KPIs.

1 Create experiment

Scenarios

Scenario Name

New scenario

New scenario1

New scenario2

New scenario3

New scenario4

New scenario5

Test 1 - As proposed

Test 2

Measure portfolios

Measure Portfolio

District Heating extension

Heat Pumps

Lokale warmtevoorziening

New measure

New measure1

New measure2

New measure3

Measure portfolio description

Scenario description

Start Simulation Date

01/16

End Simulation Date

04/16

Add experiment

Create experiment

- Select Scenario
- Select Measure Portfolio
- Select simulation start date and simulation end date
- Click 'Add experiment'

The created experiment is now sent to the simulation engine and the results are being calculated.

2 Select experiment to view results

End date	Status	Delete	Impact	Log	View
015-07-01	finished with errors		Impact	Log	Add
016-01-01	finished with errors	delete	Impact	Log	Add
017-01-01	finished with errors	delete	Impact	Log	Add

Total City Impact

Selected Area Impact

Select experiment(s) to view results

- Select the experiment you want to view the results for
- Click 'Total City Impact', 'Selected Area Impact' or 'Impact' to view the actual results on KPIs / changes in KPIs
- View results in 'Transform Dashboard' or as 'Geographical Data'

Contents of the User Manual

How to Start

Log In

How to get your City Smart

- 1 Analyze City Context
- 2 Set Scenarios
- 3 Allocate Measures
- 4 Determine Impacts

How to Add & Adapt

- Measure Library
- Factor Library

How to Use

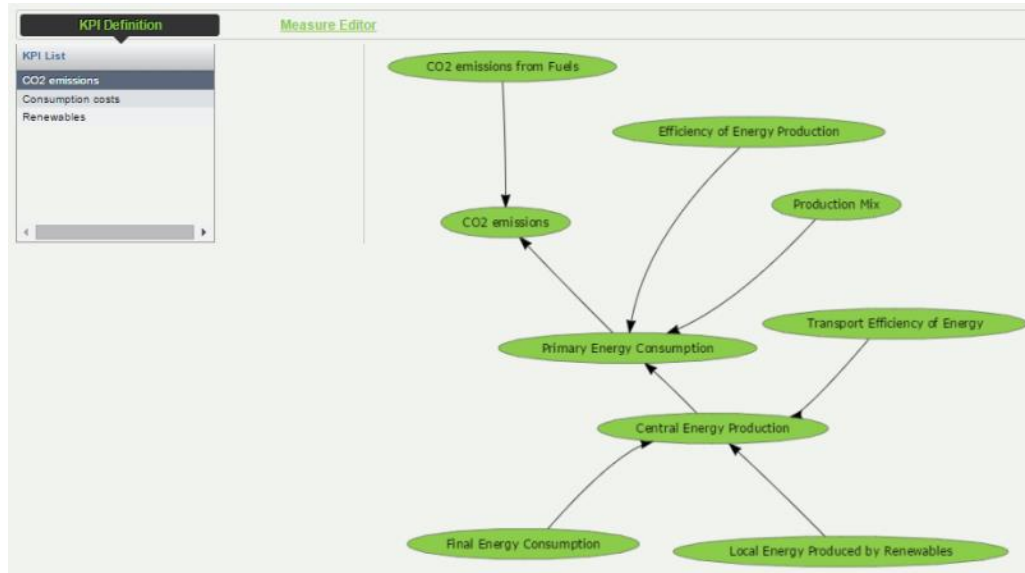
Case study

How to Understand

Glossary

How to Add & Adapt: Measure Library – KPI Definition

In case a user wants to go more in-depth and review the assumptions behind the calculations of the four KPIs, or change the values of city parameters, the user is referred to the KPI Definition tab of the Measure Library. A mindmap-like structure gives an easy insight in the relations between variables, and the mathematical relations behind can be reviewed by double-clicking nodes in the mindmap.

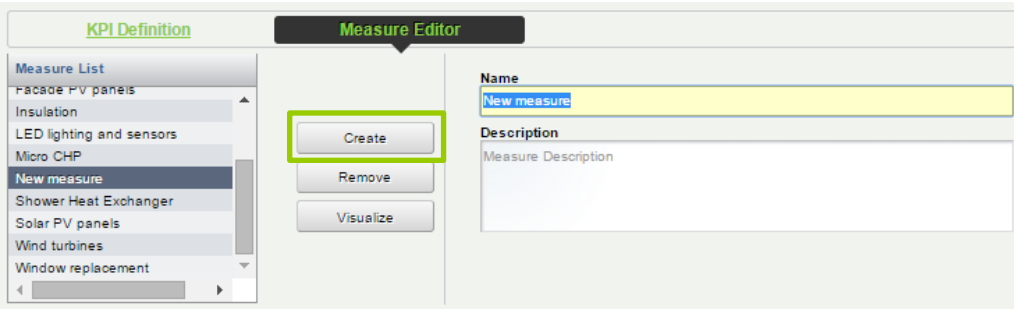


Review KPI definitions

- Choose a KPI and see how it is calculated
- Double-click on nodes to view the equations behind
- View and modify city parameter values

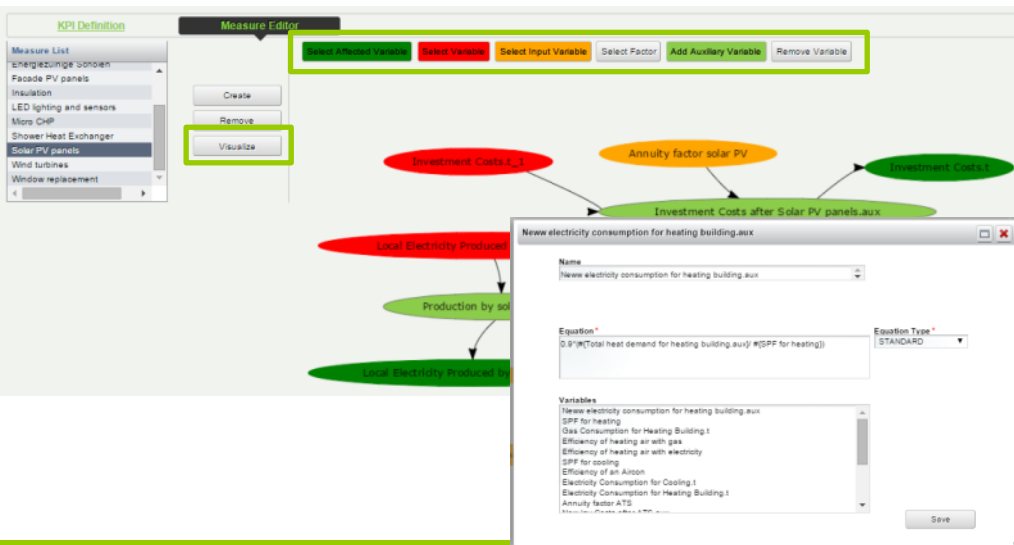
How to Add & Adapt: Measure Library – Measure Editor

In case a user wants to go more in-depth and review the assumptions behind the measure impact calculations, the user is referred to the Measure Editor tab of the Measure Library. A mindmap-like structure gives an easy insight in the relations between variables, and the mathematical relations behind can be reviewed and modified by double-clicking nodes in the mindmap. A user can also create new measures by itself, using the Measure Editor interface.



Create a measure

- Name the measure and add a description



Review / Edit a measure

- Visualize an existing measure
- Double-click on existing nodes* to view and change the equations
- Add new nodes* by clicking on one of the colored buttons in the top menu

**See glossary for the meanings of the different types of nodes, or variables*

How to Add & Adapt: Factor Library

In the factor library, the user can review and modify the assumptions about different futures of a city. These assumptions are stored in factors: different evolutions of variables with a high uncertainty. Next to reviewing and customizing these factors, a user can also create new factors itself.

1. Analyze the city context 2. Set scenarios 3. Allocate measures 4. Determine impact

this step is to make assumptions regarding the direction (increase/decrease) that a predefined variable will take in the future

Factor Name

Create

Remove

Variable to link factor

Electricity Price

Increasing electricity price

Remove a value of the factor

Create a factor

- Select a variable to link the factor to
- Name the factor and add a description

Factor Name

Increasing electricity price

Create

Remove

Variable to link factor

Electricity Price

Name

Increasing electricity price

Description

There is no description of this factor

Add a value to the factor

New Value

0.227

Timestamp

2020

Add Value

Remove a value of the factor

Remove

Select date to remove

Review / Edit a factor

- Select an existing factor
- Add values and corresponding dates

Contents of the User Manual

How to Start

Log In

How to get your City Smart

- 1 Analyze City Context
- 2 Set Scenarios
- 3 Allocate Measures
- 4 Determine Impacts

How to Add & Adapt

- Measure Library
- Factor Library

How to Use

Case study

How to Understand

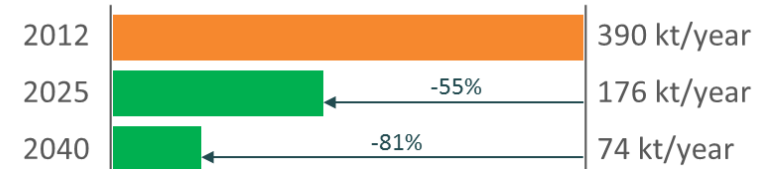
Glossary

Case study: Instructions

In the following slides, background information is provided about an area of Amsterdam which will serve as a case study area. This background information is interspersed with specific instructions on how to move through the Decision Support Environment successfully, in order to generate insightful results.



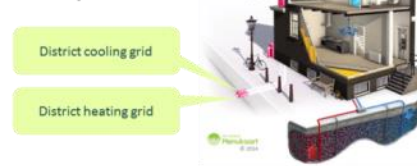
Current and target CO₂ emissions:



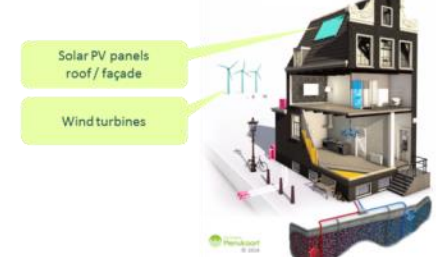
A: Energy Saving



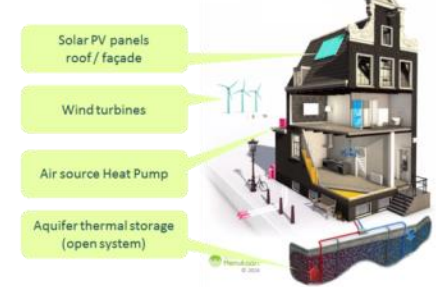
C: City Grids



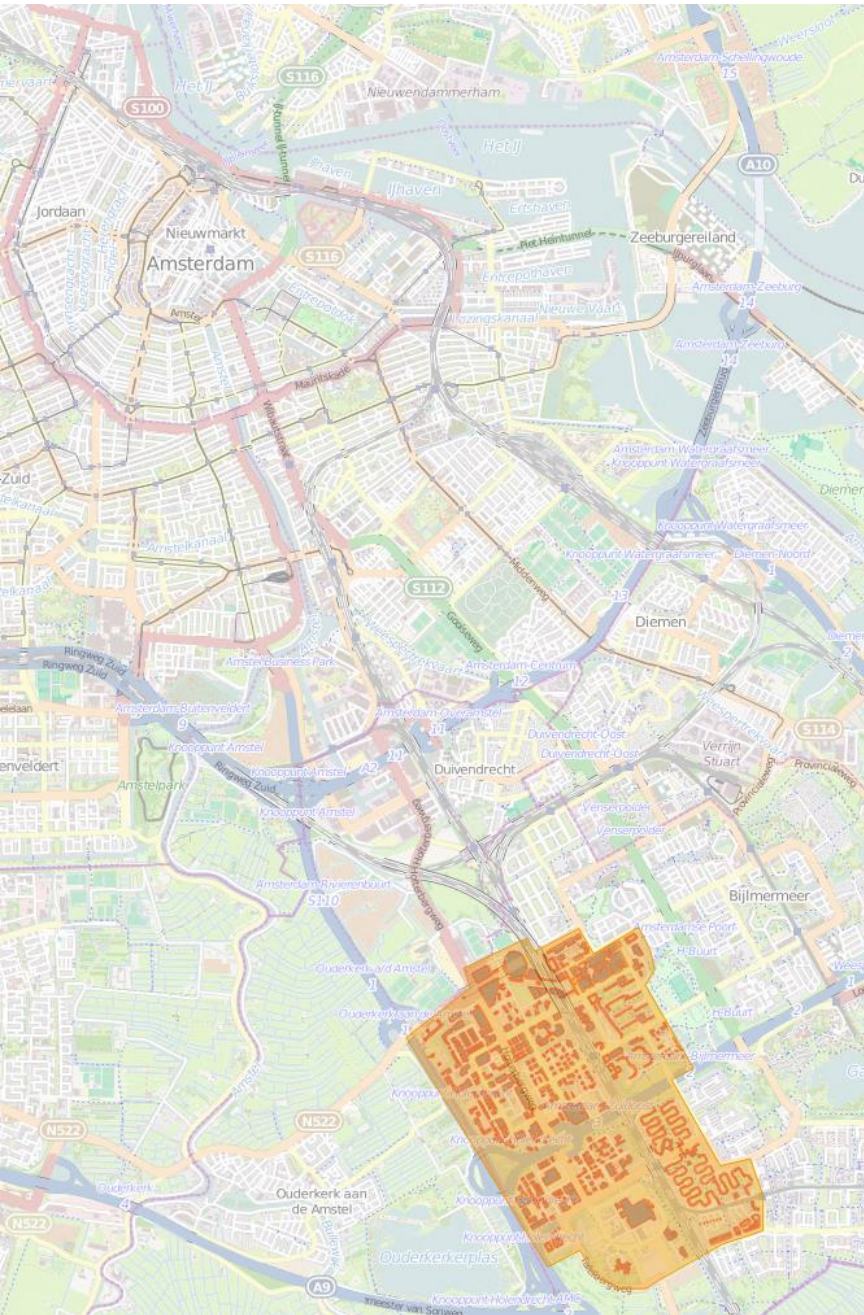
B: Max Renewables



D: All Electric



Case study: Amsterdam Zuid Oost

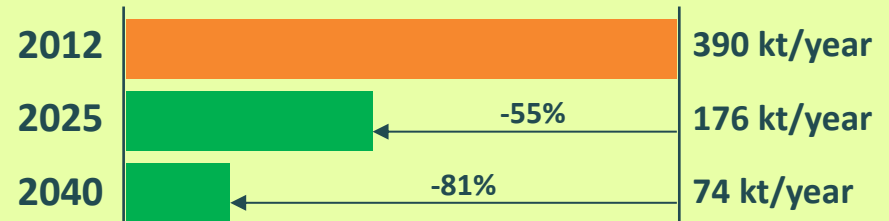


Background

Amsterdam Zuid Oost is a mixed-used area with low prices and little restrictions, which makes it suitable for urban innovation and experiments.

Challenge

Current and target CO2 emissions



Ambition

Become a self-sufficient neighborhood where energy is produced locally, from renewable sources, and where energy losses are minimized.

Go to step 1.1

1.1 Analyze city data

1 Analyze City Context

2 Set Scenarios

3 Allocate Measures

4 Determine Impacts

Login with the test account,
in the city of Amsterdam:

Login

Username * Transformer A

Password * *****

Select City Amsterdam

OK

and look up different maps of the Zuid
Oost area under “Geographical data”.

1. Analyze the city context

2. Set scenarios

3. Allocate measures

4. Determine impact

Measure library

Factor library

View Glossary

View Tutorial

In this step the city will be analyzed based on uploaded city data, and energy targets can be set

Selected City: Amsterdam



2 Set targets (% of current city data)

Carbon dioxide emission reduction 20.0

Final energy consumption reduction 20.0

Increase in % renewable energy sources 20.0

Energy consumption cost reduction 20.0

1 Analyze city data

Transform Dashboard

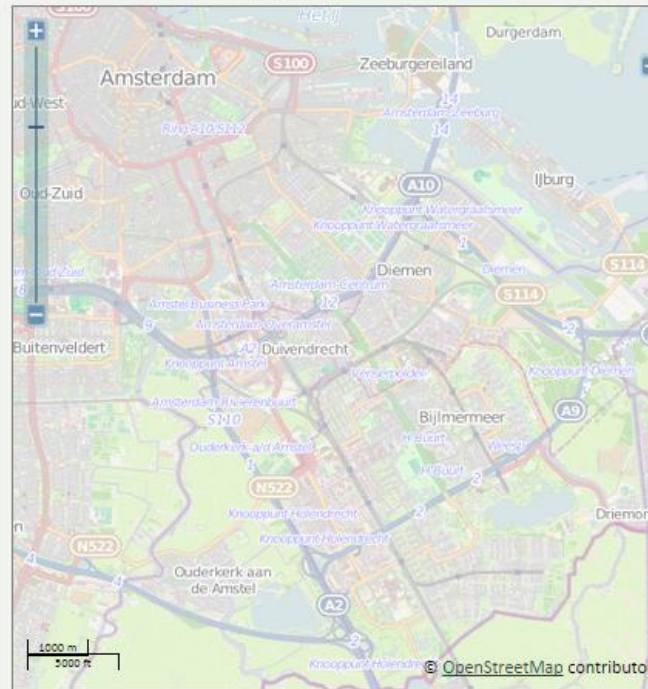
Extended Dashboard

Geographical data

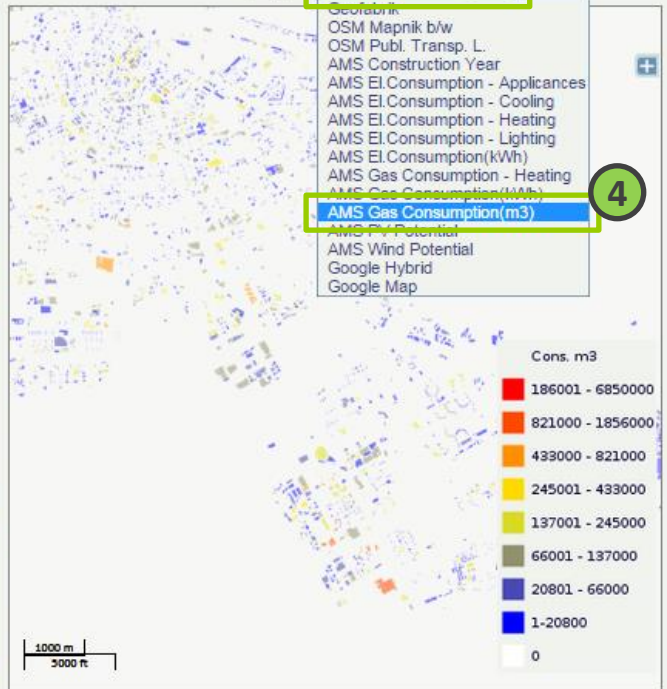
Map Control: ☒ Navigate ☐ Select (Info) | Choose number of maps: 2

Choose level of detail... Please select... = Enter value(s)...

Choose map type: Geofabrik



Choose map type: AMS Gas Consumpt



Geofabrik
OSM Mapnik b/w
OSM Publ. Transp. L.
AMS Construction Year
AMS EI Consumption - Appliances
AMS EI Consumption - Cooling
AMS EI Consumption - Heating
AMS EI Consumption - Lighting
AMS EI Consumption (kWh)
AMS Gas Consumption - Heating
AMS Gas Consumption (kWh)
AMS Gas Consumption (m3)
AMS PV Potential
AMS Wind Potential
Google Hybrid
Google Map

Cons. m3

186001 - 6850000
821000 - 1856000
433000 - 821000
245001 - 433000
137001 - 245000
66001 - 137000
20801 - 66000
1-20800
0

Case study: Question

Stimulate energy saving?

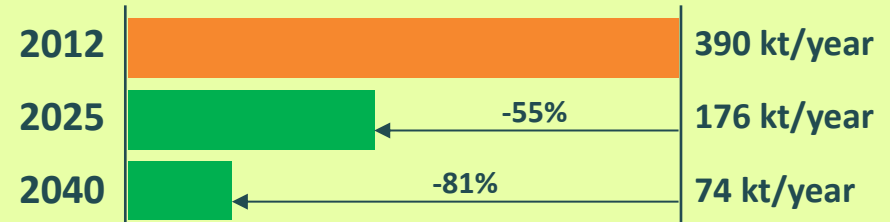
Subsidy on solar panels?

Push for District grids?

Retrofit old buildings?

Challenge

Current and target CO2 emissions



Question

What is the most cost-effective way for reducing CO2 emissions in this area of the city (taking into consideration the local characteristics of the area)?

Go to step 1.2

1.2 Set targets

1 Analyze City Context

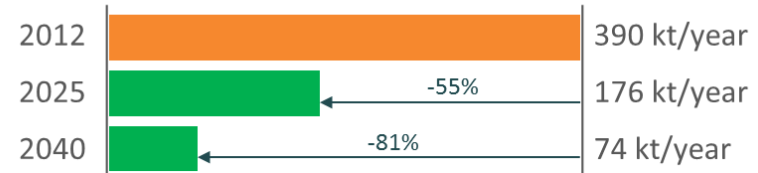
2 Set Scenarios

3 Allocate Measures

4 Determine Impacts

Set reduction targets for the area

Current and target CO₂ emissions:



1. Analyze the city context

2. Set scenarios

3. Allocate measures

4. Determine impact

Measure library

Factor library

In this step the city will be analyzed based on uploaded city data, and energy targets can be set

[View Glossary](#)

[View Tutorial](#)

Selected City: Amsterdam



1 Analyze city data

[Transform Dashboard](#)

[Extended Dashboard](#)

[Geographical data](#)

Map Control: ☒ Navigate ☐ Select [\(Info\)](#) | Choose number of maps: 1 2 3 4

[? Help](#)

Choose level of detail...

Please select...

=

Enter value(s)...

Please select...

Select

Give selection a name...

Reset

Save selection!

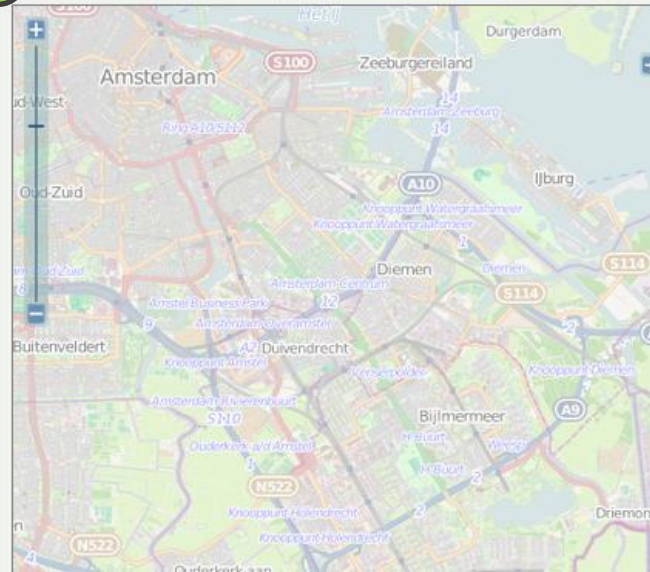
Saved selections...

2 Set targets (% of current city data)

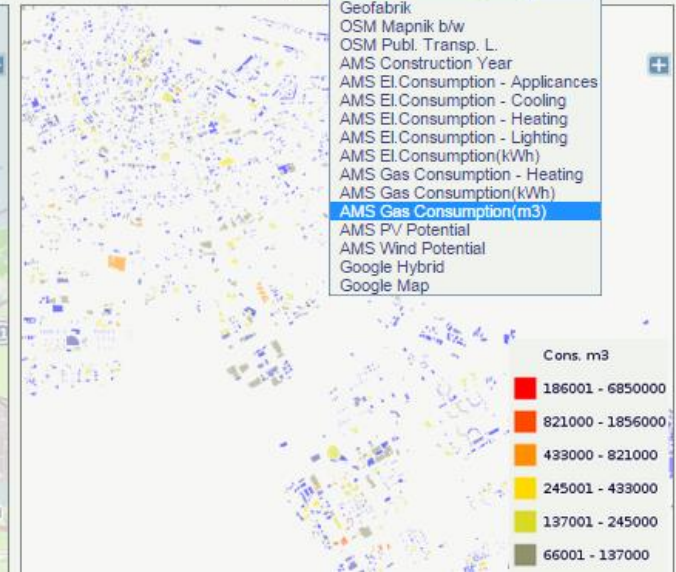
Carbon dioxide emission reduction	20.0
Final energy consumption reduction	20.0
Increase in % renewable energy sources	20.0
Energy consumption cost reduction	20.0

1

Choose map type: Geofabrik



Choose map type:



AMS Gas Consumpt
Geofabrik
OSM Mapnik b/w
OSM Publ. Transp. L.
AMS Construction Year
AMS EI Consumption - Appliances
AMS EI Consumption - Cooling
AMS EI Consumption - Heating
AMS EI Consumption - Lighting
AMS EI Consumption(kWh)
AMS Gas Consumption - Heating
AMS Gas Consumption(kWh)
AMS Gas Consumption(m3)
AMS PV Potential
AMS Wind Potential
Google Hybrid
Google Map

Cons. m3

186001 - 6850000
821000 - 1856000
433000 - 821000
245001 - 433000
137001 - 245000
66001 - 137000

The municipality considers three scenarios

Scenario 1: Baseline

<i>Factor name</i>	<i>Change</i>
Constant electricity price	0%
Constant gas price	0%

Scenario 2: Increasing prices

<i>Factor name</i>	<i>Change</i>
Increasing electricity price	+ 2% / year
Increasing gas price	+ 2% / year

Scenario 3: Decreasing prices

<i>Factor name</i>	<i>Change</i>
Decreasing electricity price	+ 2% / year
Decreasing gas price	+ 2% / year

No one knows what the future brings, and different futures can mean different outcomes for plans that we make now. We can test the plans we make, under different future scenarios.

The aim is to find the most cost-effective way for reducing emissions, and this cost-effectiveness is highly dependent on energy prices. Therefore, the uncertainty in energy prices is where the municipality is most interested in. We create three scenarios that together represent a range of possible future energy prices.

Go to step 2

2. Set Scenarios

1 Analyze City Context

2 Set Scenarios

3 Allocate Measures

4 Determine Impacts

- Start creating a scenario by clicking on “Create”
- Give the scenario a name (e.g. “Baseline”) and start adding factors to the scenario
- If the factor list is empty, create factors in the factor library (see next slide)
- When you’re finished with the Baseline scenario, continue with the “Increasing prices” and “Decreasing prices” scenarios and add the corresponding factors to these scenarios.

1. Analyze the city context

2. Set scenarios

3. Allocate measures

4. Determine impact

Measure library

Factor library

In this step one or more city scenarios can be created by setting factors for (future) city characteristics.

View Glossary

View Tutorial

Scenario Overview

Scenario Name

Fossil fuel favoured

Fossil fuel opposed

Baseline

New scenario

1 Create

Remove

Create/Edit a scenario

1 Name the scenario and its description

Name

New scenario

2

Description

Scenario Description

2 Add factors to scenario, and customize them by edit button

All factors

3

4

5

Increasing electricity price

Decreasing electricity price

Constant electricity price

Increasing gas price

Decreasing gas price

Constant gas price

Interest rate

Energy Savings heat Exchanger

Increasing heat price

Decreasing heat price

1-10/15

Scenario

Factors in this scenario

Constant electricity price

Add to Scenario

Remove from Scenario

Go to Factor library

Factor library

These steps show how the factor “Increasing electricity price” is created

1. Analyze the city context

2. Set scenarios

3. Allocate measures

4. Determine impact

Measure library

Factor library

This step is to make assumptions regarding the direction (increase/decrease) that a predefined variable will take in the future

[View Glossary](#)

[View Tutorial](#)

Factor Name

Create

Remove

Variable to link factor

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

36

37

38

39

40

41

42

43

44

45

46

47

48

49

50

51

52

53

54

55

56

57

58

59

60

61

62

63

64

65

66

67

68

69

70

71

72

73

74

75

76

77

78

79

80

81

82

83

84

85

86

87

88

89

90

91

92

93

94

95

96

97

98

99

100

101

102

103

104

105

106

107

108

109

110

111

112

113

114

115

116

117

118

119

120

121

122

123

124

125

126

127

128

129

130

131

132

133

134

135

136

137

138

139

140

141

142

143

144

145

146

147

148

149

150

151

152

153

154

155

156

157

158

159

160

161

162

163

164

165

166

167

168

169

170

171

172

173

174

175

176

177

178

179

180

181

182

183

184

185

186

187

188

189

190

191

192

193

194

195

196

197

198

199

200

201

202

203

204

205

206

207

208

209

210

211

212

213

214

215

216

217

218

219

220

221

222

223

224

225

226

227

228

229

230

231

232

233

234

235

236

237

238

239

240

241

242

243

244

245

246

247

248

249

250

251

252

253

254

255

256

257

258

259

260

261

262

263

264

265

266

267

268

269

270

271

272

273

274

275

276

277

278

279

280

281

282

283

284

285

286

287

288

289

290

291

292

293

294

295

296

297

298

299

300

301

302

303

304

305

306

307

308

309

310

311

312

313

314

315

316

317

318

319

320

321

322

323

324

325

326

327

328

329

330

331

332

333

334

335

336

337

338

339

340

341

342

343

344

345

346

347

348

349

350

351

352

353

354

355

356

357

358

359

360

361

362

363

364

365

366

367

368

369

370

371

372

373

374

375

376

377

378

379

380

381

382

383

384

385

386

387

388

389

390

391

392

393

394

395

396

397

398

399

400

401

402

403

404

405

406

407

408

409

410

411

412

413

414

415

416

417

418

419

420

421

422

423

424

425

426

427

428

429

430

431

432

433

434

435

436

437

438

439

440

441

442

443

444

445

446

447

448

449

450

451

452

453

454

455

456

457

458

459

460

461

462

463

464

465

466

467

468

469

470

471

472

473

474

475

476

477

478

479

480

481

482

483

484

485

486

487

488

489

490

491

492

493

494

495

496

497

498

499

500

501

502

503

504

505

506

507

508

509

510

511

512

513

514

515

516

517

518

519

520

521

522

523

524

525

526

527

528

529

530

531

532

533

534

535

536

537

538

539

540

541

542

543

544

545

546

547

548

549

550

551

552

553

554

555

556

557

558

559

560

561

562

563

564

565

566

567

568

569

570

571

572

573

574

575

576

577

578

579

580

581

582

583

584

585

586

587

588

589

590

591

592

593

594

595

596

597

598

599

600

601

602

603

604

605

606

607

608

609

610

611

612

613

614

615

616

617

618

619

620

621

622

623

624

625

626

627

628

629

630

631

632

633

634

635

636

637

638

639

640

641

642

643

644

645

646

647

648

649

650

651

652

653

654

655

656

657

658

659

660

661

662

663

664

665

666

667

668

669

670

671

672

673

674

675

676

677

678

679

680

681

682

683

684

685

686

687

688

689

690

691

692

693

694

695

696

697

698

699

700

701

702

703

704

705

706

707

708

709

710

711

712

713

714

715

716

717

718

719

720

721

722

723

724

725

726

727

728

729

730

731

732

733

734

735

736

737

738

739

740

741

742

743

744

745

746

747

748

749

750

751

752

753

754

755

756

757

758

759

760

761

762

763

764

765

766

767

768

769

770

771

772

773

774

775

776

777

778

779

780

781

782

783

784

785

786

787

788

789

790

791

792

793

794

795

796

797

798

799

800

801

802

803

804

805

806

807

808

809

810

811

812

813

814

815

816

817

818

819

820

821

822

823

824

825

826

827

828

829

830

831

832

833

834

835

836

837

838

839

840

841

842

843

844

845

846

847

848

849

850

851

852

853

854

855

856

857

858

859

860

861

862

863

864

865

866

867

868

869

870

871

872

873

874

875

876

877

878

879

880

881

882

883

884

885

886

887

888

889

890

891

892

893

894

895

896

897

898

899

900

901

902

903

904

905

906

907

908

909

910

911

912

913

914

915

916

917

918

919

920

921

922

923

924

925

926

927

928

929

930

931

932

933

934

935

936

937

938

939

940

941

942

943

944

945

946

947

948

949

950

951

952

953

954

955

956

957

958

959

960

961

962

963

964

965

966

967

968

969

970

971

972

973

974

975

976

977

978

979

980

981

982

983

984

985

986

987

988

989

990

991

992

993

994

995

996

997

998

999

1000

Remove a value of the factor

Remove

Select date to remove

Remove

Variable to link factor

Electricity Price

Name

Increasing electricity price

Initial factor value:
0.206

Description

There is no description of this factor

Add a value to the factor

New Value

0.227

Timestamp

2020-01-01

Add Value

Remove a value of the factor

Remove

Select date to remove

Remove

Increasing electricity price values

0.23

0.225

0.227

0.206

Return to step 2

2. Set Scenarios

1 Analyze City Context

2 Set Scenarios

3 Allocate Measures

4 Determine Impacts

Make sure all three scenarios are created and filled out

1. Analyze the city context 2. Set scenarios 3. Allocate measures 4. Determine impact

In this step one or more city scenarios can be created by setting factors for (future) city characteristics.

Scenario Overview

Scenario Name

Fossil fuel favoured

Fossil fuel opposed

Baseline

New scenario

1 Create

Remove

Create/Edit a scenario

1 Name the scenario and its description

2

Name

New scenario

Description

Scenario Description

2 Add factors to scenario, and customize them by edit button

All factors

3

4

5

Increasing electricity price

Decreasing electricity price

Constant electricity price

Increasing gas price

Decreasing gas price

Constant gas price

Interest rate

Energy Savings heat Exchanger

Increasing heat price

Decreasing heat price

1-10/15

Add to Scenario

Remove from Scenario

Scenario 1: Baseline

Factor name	Change
Constant electricity price	0%
Constant gas price	0%

Scenario 2: Increasing prices

Factor name	Change
Increasing electricity price	+ 2% / year
Increasing gas price	+ 2% / year

Scenario 3: Decreasing prices

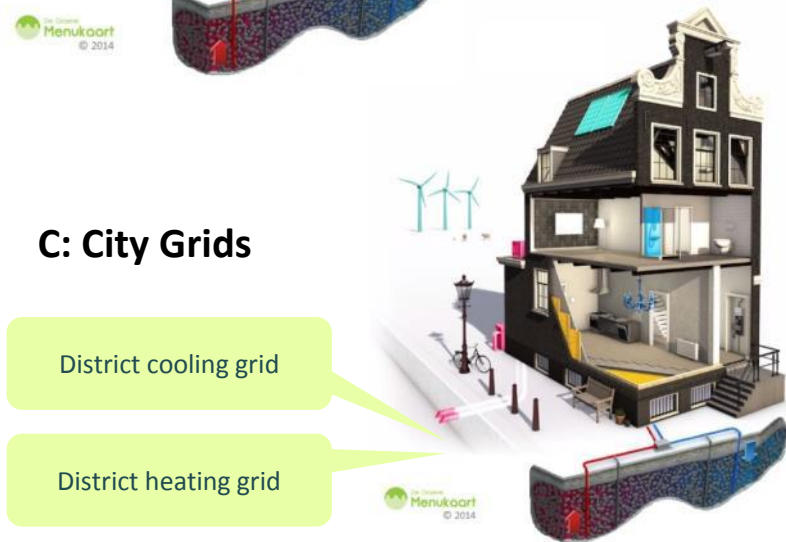
Factor name	Change
Decreasing elec. price	+ 2% / year
Decreasing gas price	+ 2% / year

The municipality considers four major alternatives for 'transforming' the area

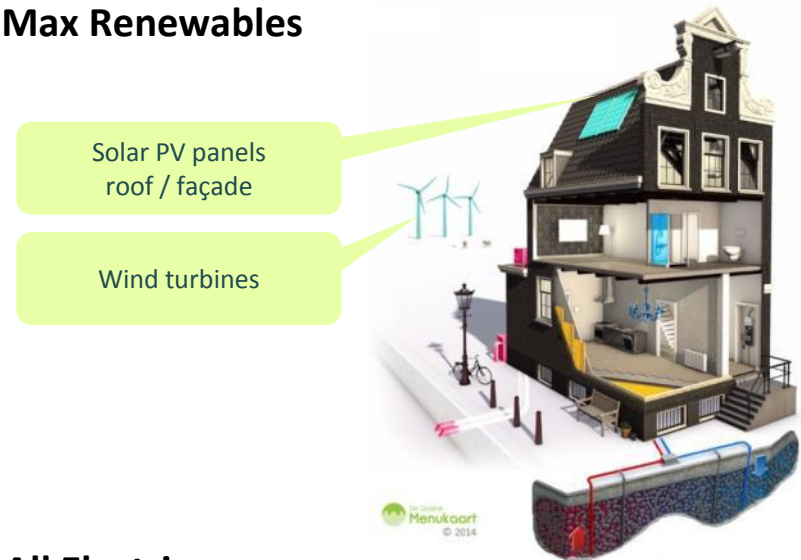
A: Energy Saving



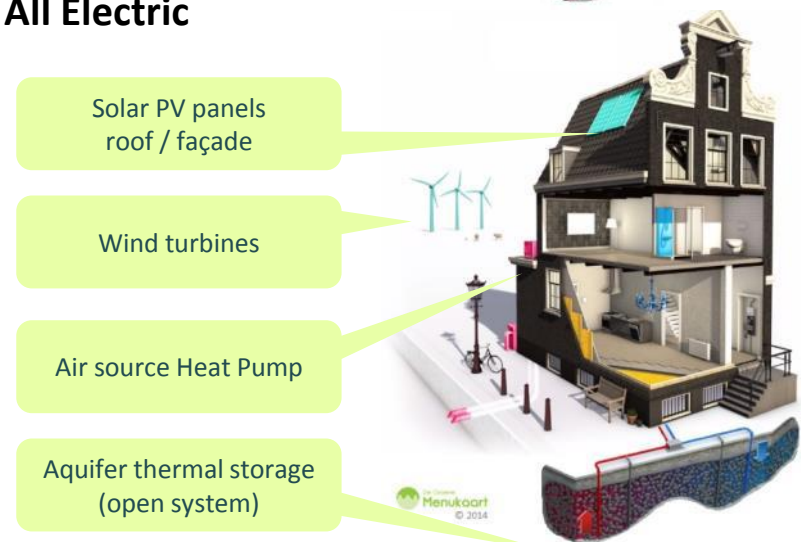
C: City Grids



B: Max Renewables



D: All Electric



We will start by testing the All Electric alternative

The municipality has provided realistic timeframes and implementation details for the measures within the “All Electric” portfolio:

Solar PV panels
roof / façade

Wind turbines

Air source Heat Pump

Aquifer thermal
storage (open system)



Measure	Start date	End date	Pen. rate	Filter criterion
Solar PV panels	1 July 2015	1 January 2016	70%	elec_kwh > 1000
Air source Heat Pump	1 January 2016	1 July 2016	80%	use_of_building <> office
Façade PV panels	1 July 2016	1 January 2017	100%	use_of_building = office
Aquifer Thermal Storage open system	1 January 2017	1 July 2017	70%	use_of_building = office
Wind turbines	1 July 2017	1 January 2018	100%	

Go to steps 3.1 – 3.3

3.1 – 3.3 Allocate measures

1 Analyze City Context

2 Set Scenarios

3 Allocate Measures

4 Determine Impacts

Create the “All electric” measure portfolio and start adding measures to it (repeat step 3 – 5 for each measure). Allocate the corresponding timeframes to each measure (step 6 – 9).

1. Analyze the city context

2. Set scenarios

3. Allocate measures

4. Determine impact

Measure library

Factor library

In this step a measure portfolio can be created containing one or more measures that are allocated to a specific city area and implementation period

View Glossary

View Tutorial

Measure Portfolio Overview

Measure Portfolio

1

Create

Remove

Measure portfolio: New measure portfolio

Create/Edit a measure portfolio

1 Name the new measure portfolio and its description

Name

New measure portfolio

Description

There is no description of this measure portfolio

2 Add measures to the portfolio, and customize them by the edit buttons

All measures

Shower Heat Exchanger

LED lighting and sensors

Aquifer Thermal Storage open system

Solar PV panels

Wind turbines

District Cold Grid

Micro CHP

Facade PV panels

District Heating Grid

Window replacement

1-10/12

Add to portfolio

Delete from portfolio

3 Allocate measure in time

Please select the time period (from date - to date) in which the measure has to be implemented for a TOTAL percentage given by the penetration rate. The model will distribute this percentage linearly over the complete period on a monthly basis.

From

07/15

To

01/16

Total penetration rate

70

Measure: Solar PV panels

From	To	Penetration rate
07/01/2015	01/01/2016	70.0

Go to step 3.4

Remove

3.4 Allocate measures to area

1 Analyze City Context

2 Set Scenarios

3 Allocate Measures

4 Determine Impacts

Find the Zuid Oost area (south east), and select the corresponding area and filter criterion for each measure

Measure portfolio

Measure	(1) Time	(2) Area
Solar PV panels	Allocate Time	Allocate Area
Facade PV panels	Allocate Time	Allocate Area
Aquifer Thermal Stor	Allocate Time	Allocate Area
Wind turbines	Allocate Time	Allocate Area

1

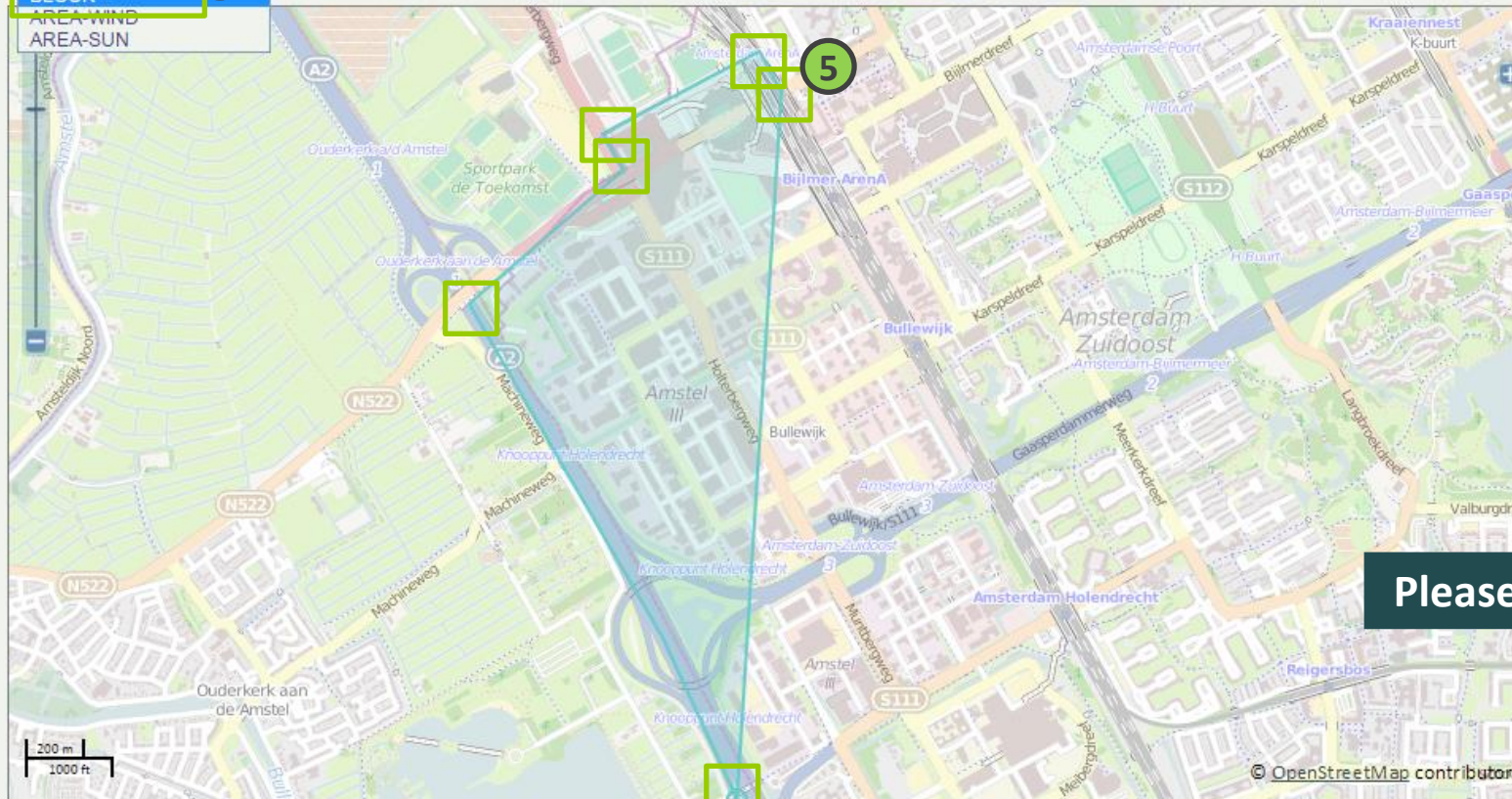
4 Allocate measure to area

Measure: LED lighting and sensors

Map Control: ☐ Navigate ☒ Select [\(Info\)](#) | Choose number of maps: 1 2 3 4

Choose level of detail...

Choose level of detail...
WKO-OPEN
WASTEHEAT
BLOCK
AREA WIND
AREA-SUN



5

Please continue

3.4 Allocate measures to area

Find the Zuid Oost area (south east), and select the corresponding area and filter criterion for each measure

Measure portfolio

Measure	(1) Time	(2) Area
Solar PV panels	Allocate Time	Allocate Area
Facade PV panels	Allocate Time	Allocate Area
Aquifer Thermal Stor	Allocate Time	Allocate Area
Wind turbines	Allocate Time	Allocate Area

11

4 Allocate measure to area

Measure: LED lighting and sensors

Map Control: ☐ Navigate ☒ Select (Info) | Choose number of maps: 1 2 3 4

? Help

BLOCK

Please select...

=

Office

medical

office

other

shop

sport

Select

Reset

Save selection!

Saved selections...

Map type: Geofabrik

use of building

wind_total_energy_gwh

Repeat for each measure

Continue when done

You have now defined the following scenarios and measure portfolio

Scenarios

Scenario 1: Baseline

Factor name	Change
Constant electricity price	0%
Constant gas price	0%

Scenario 2: Increasing prices

Factor name	Change
Increasing electricity price	+ 2% / year
Increasing gas price	+ 2% / year

Scenario 3: Decreasing prices

Factor name	Change
Decreasing elec. price	+ 2% / year
Decreasing gas price	+ 2% / year

Measure portfolio

All Electric

Solar PV panels
roof / façade

Wind turbines

Air source Heat Pump

Aquifer thermal
storage (open system)



Go to step 4

Continue with initiating simulation runs and obtaining results

4. Determine Impact

1 Analyze City Context

2 Set Scenarios

3 Allocate Measures

4 Determine Impacts

1. Analyze the city context

2. Set scenarios

3. Allocate measures

4. Determine impact

Measure library

Factor library

In this step the impact on the city KPIs is determined by analyzing the effect of a measure portfolio on a specific city scenario

[View Glossary](#)

[View Tutorial](#)

1 Create experiment

Scenarios

Scenario Name

Baseline

Increasing prices

Decreasing prices

Measure portfolios

Measure Portfolio

All Electric

Scenario description

Click on a scenario to view its description

Measure portfolio description

There is no description of this measure portfolio

Start Simulation Date

01/15

End Simulation Date

01/20

Add experiment

2 Select experiment to view results

ID

Scenario Name

Measure Portfolio

Progress

1718

Baseline

All Electric

1719

Baseline

Energy Saving

Total City Impact

Selected Area Impact

Transform Dashboard

Geographical Data

Click on an item in the legend to add/remove data from the graphs.

☐ Use logarithmic scale

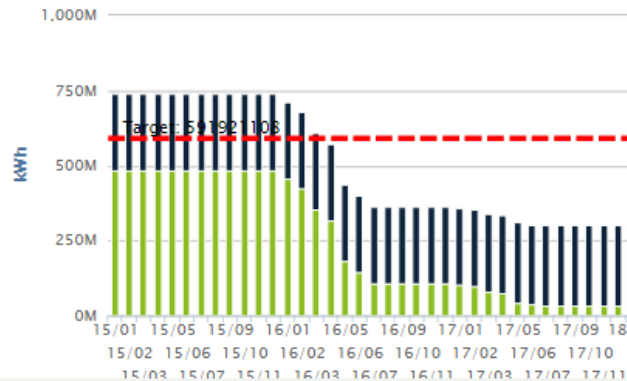
Consumption

☐ Use logarithmic scale

Renewables

cold (id 1) electricity (id 1) gas (id 1) heat (id 1)

Monthly consumption from 2015 to 2018



☐ Use logarithmic scale

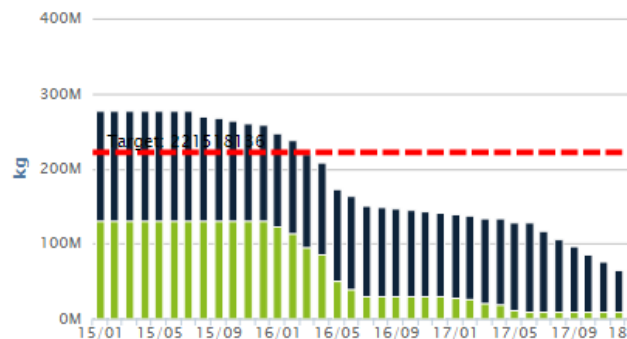
Emissions

☐ Use logarithmic scale

Costs

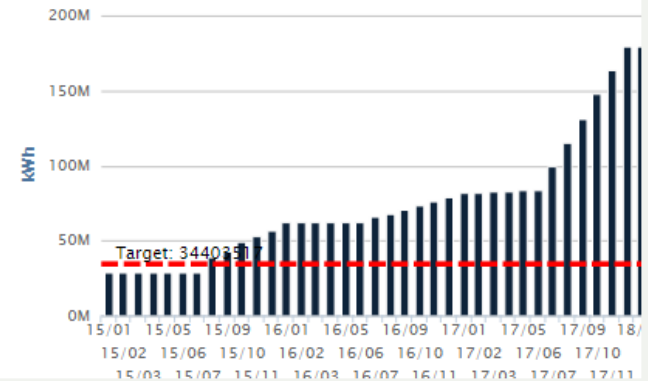
cold (id 1) electricity (id 1) gas (id 1) heat (id 1)

Monthly emissions from 2015 to 2018



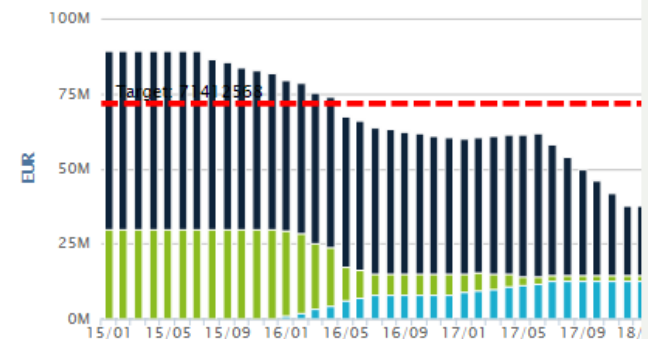
cold (id 1) electricity (id 1) heat (id 1)

Monthly renewables from 2015 to 2018



cold (id 1) electricity (id 1) gas (id 1) heat (id 1) investments (id 1)

Monthly costs from 2015 to 2018



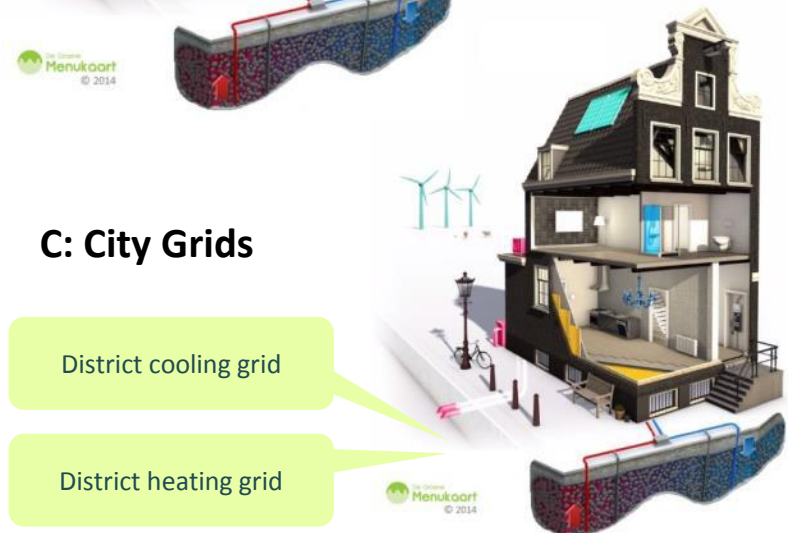
After step 5, wait till experiment is finished, then view results

Continue with the other measure portfolios, or create your custom experiment!

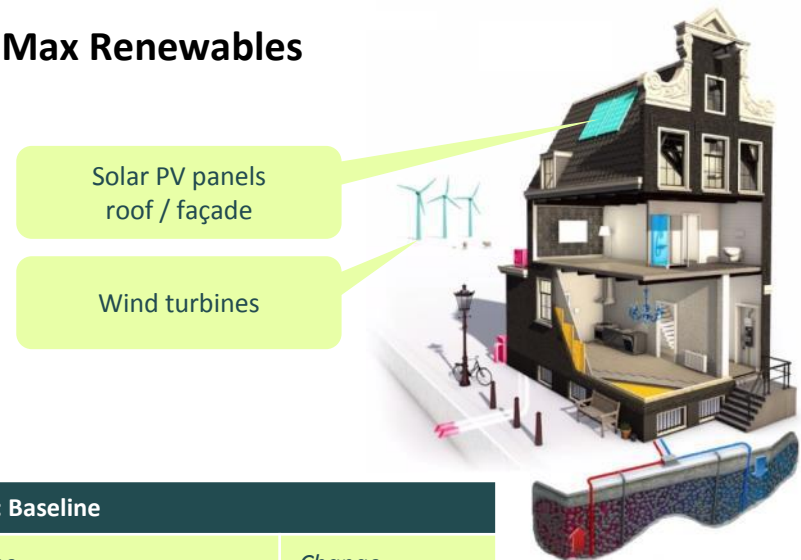
A: Energy Saving



C: City Grids



B: Max Renewables



Scenario 1: Baseline

Factor name	Change
Constant electricity price	0%
Constant gas price	0%

Scenario 2: Increasing prices

Factor name	Change
Increasing electricity price	+ 2% / year
Increasing gas price	+ 2% / year

Scenario 3: Decreasing prices

Factor name	Change
Decreasing electricity price	+ 2% / year
Decreasing gas price	+ 2% / year

Contents of the User Manual

How to Start

Log In

How to get your City Smart

- 1 Analyze City Context
- 2 Set Scenarios
- 3 Allocate Measures
- 4 Determine Impacts

How to Add & Adapt

- Measure Library
- Factor Library

How to Use


Case study

How to Understand

Glossary

How to Understand: Glossary

DSE Step	Title	Terminology	Description
1	Analyze City Data	City Data	Viewing of the city specific data that describes the state of the city on the specified KPI's.
			Viewing of the city specific data in a maps functionality with the option to select (via 'freehand polygon') specific areas.
2	Set Scenarios	Scenario	A potential future state of a city described through a set of factors, e.g. population, gas price, electricity price, economic conditions.
		Factor	An independent (market) that provides the context for any future city transformation plans (e.g. gas price, oil price, population growth).
3	Allocate Measures	Measure	Specified interventions that are applied by stakeholders to a city.
		Enabler	Technique of method that supports the implementation/effectiveness of a measure.
		Portfolio	A set of measures each allocated to a certain geographic area in time, forming a transformation plan for a city.
4	Determine Impact	Experiment	The combination of a scenario plus its measures (measure portfolio) on a city or city area resulting in outcomes on the predetermined KPI's.
Measure Library			Area where all measures are stored, made visible and are adaptable.
Measure Editor			Area for adapting measure, in structure, in values or both.
Affected Variable			Future / to-be value of a building attribute
Variable			Current value of a building attribute
Input Variable			A constant value that represents an assumption/parameter
Auxiliary Variable			A node that serves as intermediate step in an equation, used to simplify equations. A node that connects a group of nodes to be used in another node.
Factor Library			Area where all factors are stored, made visible and are adaptable.



5. Technical Documentation

Content:

Technical details regarding the development of the DSE software.

Audience:

Technicians/IT specialists interested in the software architecture of the DSE.

5.1 General architecture

5.2 User interface

5.2.1 Database structure

Step 1 Analyse city context tables

Step 2 Set scenarios tables

Step 3 Allocate measures tables

Step 4 Determine impact tables

5.2.2 Measure library tables

5.2.3 Factor library tables

5.3 Package Diagram

5.4 Simulation model

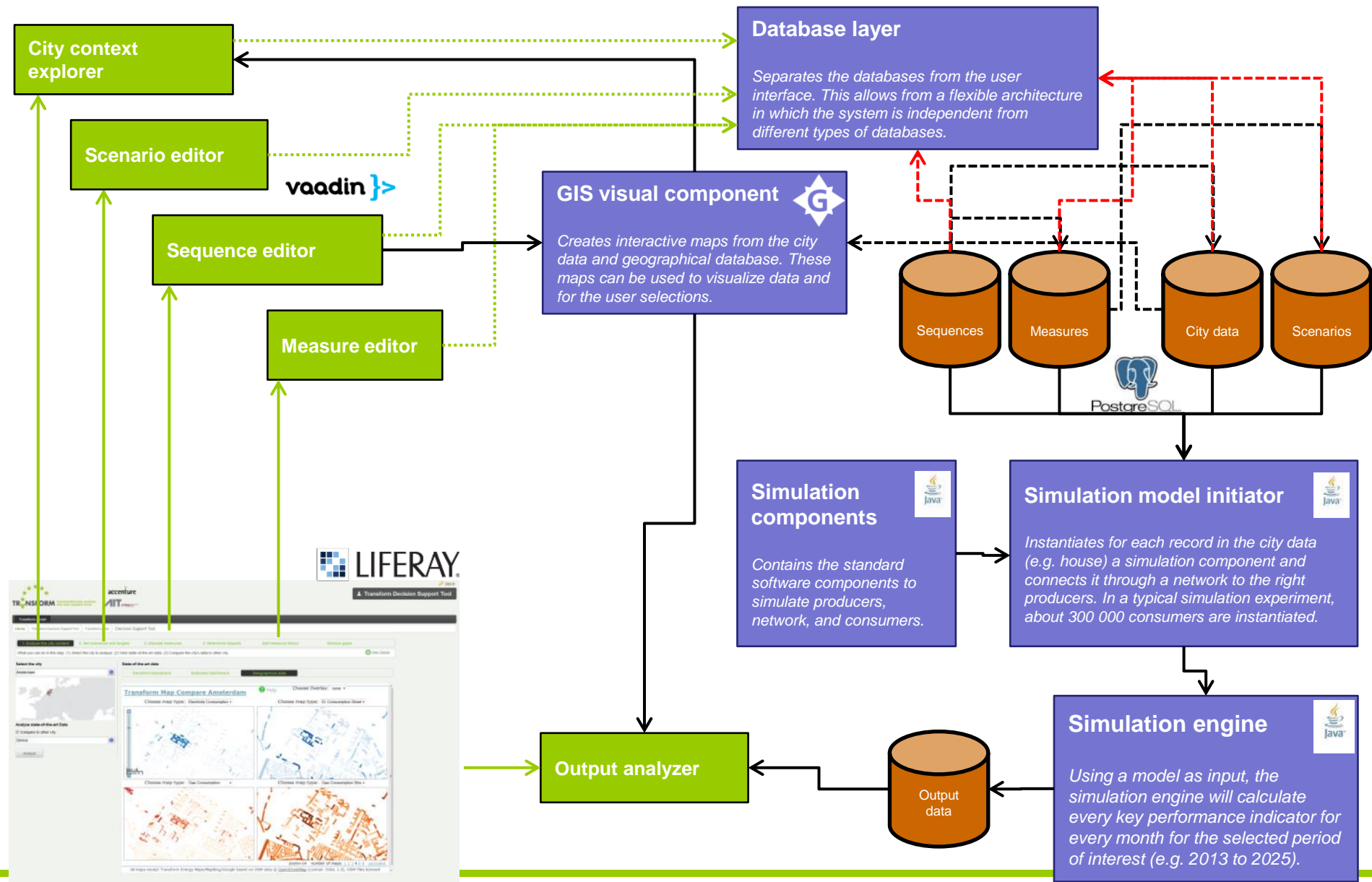
5.4.1 Conceptual model TRANSFORM

5.4.2 Package overview

5.4.3 Internal data structure

5.4.4 Simulation scheduler

5.1 General Architecture



5.2 User Interface

This part of the documentation provides an overview of the database tables and classes used to create the web user interface.

5.2.1 Database structure

Step 1 Analyse city context tables

Step 2 Set scenarios tables

Step 3 Allocate measures tables

Step 4 Determine impact tables

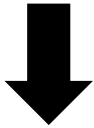
5.2.2 Measure library tables

5.2.3 Factor library tables

5.2.1 Database structure

Step 1 Analyse city context tables 1/3

public.trnsfrm_meta_startingconditions	
city:	varchar(75)
kpiname:	varchar(75)
fuel:	varchar(75)
value:	double precision
unit:	varchar(75)
trnsfrm_meta_startingconditions_pkey	



This table holds the information which is shown in the high charts in step 1 of the tool (“Transform Dashboard”. It is manually filled based on the information that resides in the city provided data.

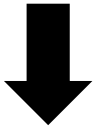
One option to avoid manually filling in the information is to create a view in the database based on the city provided data.



5.2.1 Database structure

Step 1 Analyse city context tables 2/3

public.trnsfrm_meta_citylevelmultvalue	
id: bigint	
theme: varchar(75)	
dashboard: varchar(75)	
name: varchar(75)	
unit: varchar(75)	
city: varchar(75)	
year: bigint	
components: varchar(75)	
value: varchar(75)	
source: varchar(75)	
trnsfrm_meta_citylevelmultvalue_pkey	



This table holds the information which is shown in the high charts in step 1 of the tool (*“Extended Dashboard”*). It is manually filled based on the information that comes from the ARUP data.

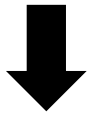


5.2.1 Database structure

Step 1 Analyse city context tables 3/3

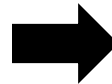
public.trnsfrm_meta_scenariotarget	
username:	varchar(75)
city:	varchar(75)
targetname:	varchar(75)
value:	double precision
trnsfrm_meta_scenariotarget_pkey	

This table stores the targets (per user and city). Targets are defined to check if a certain measure portfolio has the desired impact (this could be seen in step 4).



2 Set targets (% of current city data)

Carbon dioxide emission reduction	52.0	<input type="text"/>
Final energy consumption reduction	55.0	<input type="text"/>
Increase in % renewable energy sources	57.0	<input type="text"/>
Energy consumption cost reduction	52.0	<input type="text"/>



5.2.1 Database structure

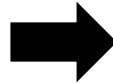
Step 2 Set scenarios tables

public.trnsfrm_meta_scenario	
id: bigint	
scenarioname: varchar(75)	
description: varchar(75)	
username: varchar(75)	
cityname: varchar(75)	
trnsfrm_meta_scenario_pkey	

1

N

public.trnsfrm_meta_scenariotofactor	
id: bigint	
scenarioid: bigint	
factorid: bigint	
trnsfrm_meta_scenariotofactor_pkey	



Different factors can be associated to one scenario. Furthermore, a scenario is saved based on user and city in analysis.

Create/Edit a scenario

1 Name the scenario and its description

Name
Decreasing energy prices

Description
Scenario Description

2 Add factors to scenario, and customize them by edit button

All factors
Select a factor to add it to this scenario

Selected factor description

Create a new factor Edit factor

Add to Scenario Remove from Scenario

Scenario
Factors in this scenario
Decreasing Electricity price
Decreasing Heat price
Decreasing gas price

5.2.1 Database structure

Step 3 Allocate measures tables 1/2

public.trnsfrm_meta_sequence	
sequenceid: bigint	sequenceid: bigint
cityname: varchar(75)	cityname: varchar(75)
description: varchar(75)	description: varchar(75)
id: bigint	id: bigint
user_name: varchar(75)	user_name: varchar(75)
trnsfrm_meta_sequence_pkey	trnsfrm_meta_sequence_pkey

1

sequenceid=sequence.id

N

public.trnsfrm_meta_sequencetomeasures	
sequencetomeasureid: bigint	sequencetomeasureid: bigint
sequenceid: bigint	sequenceid: bigint
measurename: varchar(75)	measurename: varchar(75)
priority: bigint	priority: bigint
nodespercentage: double precision	nodespercentage: double precision
trnsfrm_meta_sequencetomeasures_pkey	trnsfrm_meta_sequencetomeasures_pkey

Different measures can be added to a measure portfolio (named sequence in the db). Measures added to a measure portfolio appear in the sequence to measure table

Create/Edit a measure portfolio

1 Name the new measure portfolio and its description

Name
ILS Effic Solar PV

Description
There is no description of this portfolio

2 Add measures to the portfolio, and customize them by the edit buttons

All measures
Click on a measure to view the description

Create new measure Edit measure

Add to portfolio Delete from portfolio

Measure portfolio

Measure	(1) Time	(2) Area
Efficiency	Allocate Time	
Solar PV	Allocate Time	

5.2.1 Database structure

Step 3 Allocate measures tables 2/2

public.trnsfrm_meta_sequenceplanning	
sequencetomeasureid:	bigint
startdate:	timestamp
percentage:	double precision
f_measure:	boolean



3 Allocate measure to time

From: 11/11/14

Penetration rate:

Measure: Efficiency

From	Penetration rate
09/01/2020	100.0

Remove

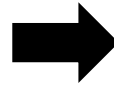
When allocating a measure to time the information is stored in the sequence planning table. The `f_measure` attribute is by default set to false and it is not currently used. This attribute might become handy when desiring to achieve certain conditions in the city data (*because the city has not provided that data*) before applying a measure. For instance, the city of Vienna wanted to test two different scenarios (*normal scenario and efficiency*) scenario. However, the initial situation data (which was a kind of improvement of the normal scenario) for the efficiency scenario was not provided. In this case you can create a measure and set the `f_measure` (*fictitious measure*) to true. The simulation will then apply this fictitious measure first to transform the initial data and later the rest of the measures.

Note: A check box should be added to the measure portfolio table if it is desired to activate the functionality of the `f_measure` attribute from the GUI

5.2.1 Database structure

Step 4 Determine impact tables 1/3

public.trnsfrm_meta_mainkpioutput	
cityname:	varchar(75)
startdate:	timestamp
enddate:	timestamp
user_name:	varchar(75)
kpiname:	varchar(75)
timestamp:	timestamp
fuel:	varchar(75)
expid:	bigint
scenarioid:	bigint
sequenceid:	bigint
value:	double precision
affectedentityvalue:	double precision
trnsfrm_meta_mainkpioutput_pkey	

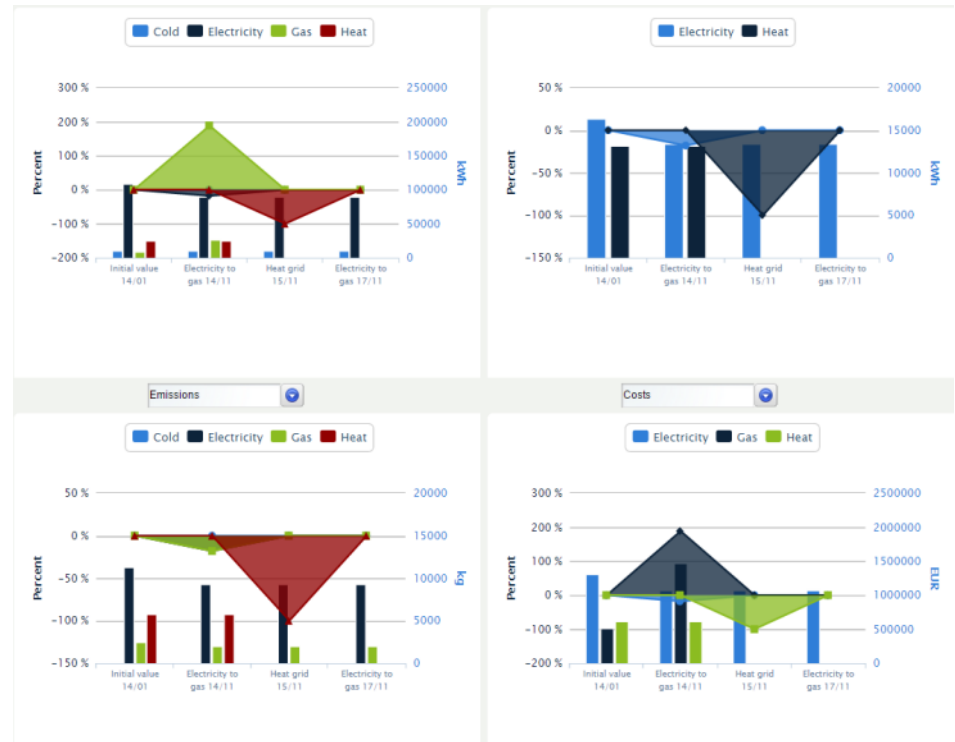
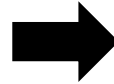


The impact of a measure portfolio on either a city or in the area(s) in which this measure portfolio has been applied is outputted by the simulation to the mainkpioutput table.

5.2.1 Database structure

Step 4 Determine impact tables 2/3





public.trnsfrm_meta_measureimpactoutput	
startdate: timestamp	
enddate: timestamp	
city: varchar(75)	
user_name: varchar(75)	
kpiname: varchar(75)	
fuel: varchar(75)	
timestamp: timestamp	
measure: varchar(75)	
expid: bigint	
scenarioid: bigint	
sequenceid: bigint	
relativechange: double precision	
absolutechange: double precision	
relativechangeaffected: double precision	
totalvalue: double precision	
trnsfrm_meta_measureimpactoutput_pkey	

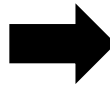


The individual impact of measures, within a measure is outputted by the simulation to the measureimpactoutput table.

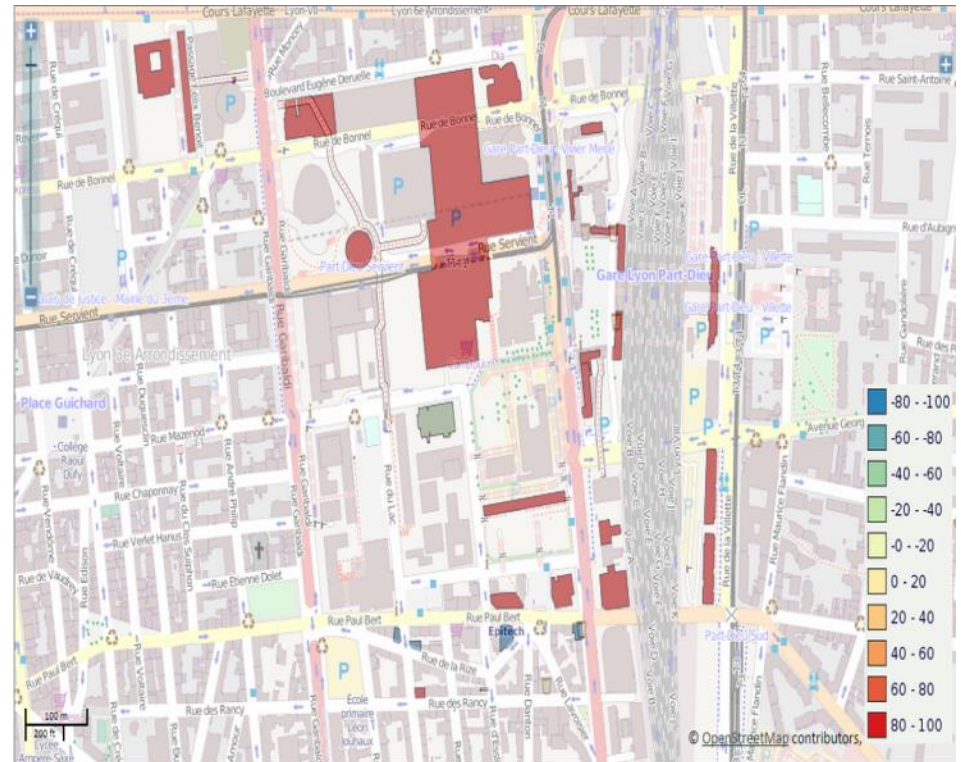
5.2.1 Database structure

Step 4 Determine impact tables 3/3

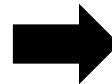
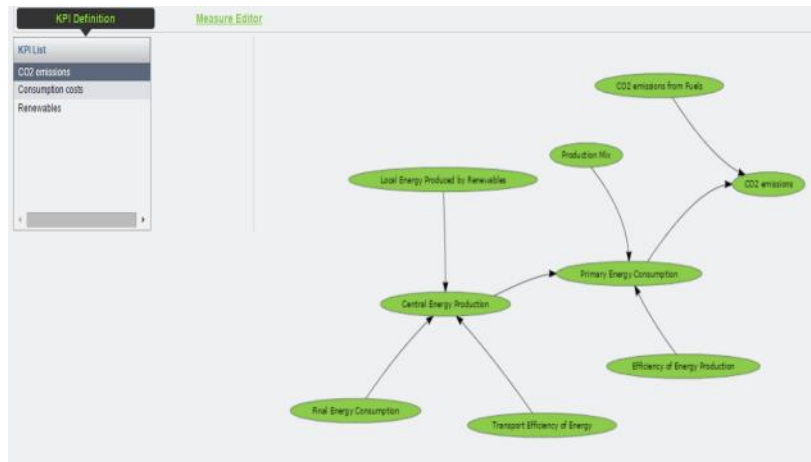
public.trnsfrm_meta_sequencetogeometries	
 sequencetomeasureid: bigint	
 fk_geometry: bigint	
 the_geom: bigint	
 trnsfrm_meta_sequencetogeometries_pkey	



Simulation results shown in the maps are stored in the sequence togeometries table.



5.2.2 Measure library (KPI definition) tables 1/2



Central Energy Production

Equation:
$$\frac{(\#(\text{Final Energy Consumption}) - \#(\text{Local Energy Produced by Renewables}))}{\#(\text{Transport Efficiency of Energy})}$$

1

Transport Efficiency of Energy

Name	Percentage
Transport Efficiency of Gas	0.98
Transport Efficiency of Electricity	0.98
Transport Efficiency of Heat	0.6
Transport Efficiency of Cold	0

2

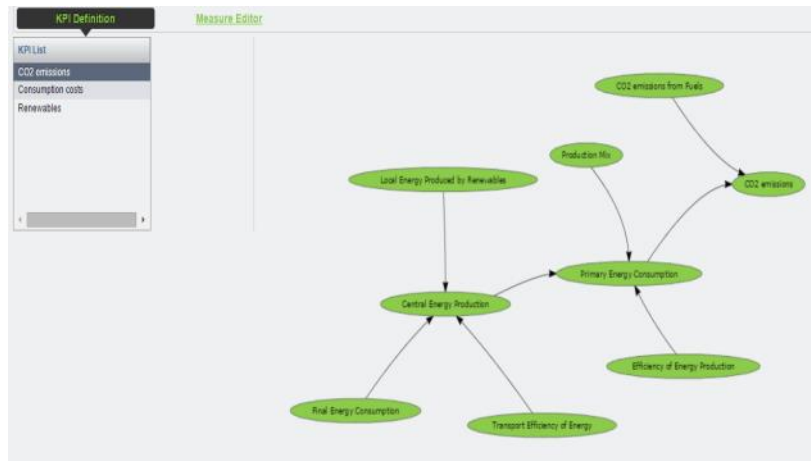
Save






The KPI definition tap shows how predefined KPI's (*CO2 emissions, renewables and consumption costs*) are structured. By double clicking on the nodes two different type of windows can be seen.

- 1) Window that shows the structure of the equations that form a node
- 2) Window that shows a table in which some city specific variables can be adapted.

Note: City specific variables are located in the cityvariable table in the db. Their values in the cityvariablevalue table.

5.2.2 Measure library (KPI definition) tables 2/2



public.trnsfrm_meta_formula	
	indicator: varchar(75)
	nodename: varchar(75)
	nodetype: varchar(75)
	formulacomponent: varchar(1500)
	trnsfrm_meta_formula_pkey

The *formula* table stores all the information needed to create the nodes. Because, KPI's are predefined, the information in this table needs to be manually added. The meaning of the table attributes is as follows:

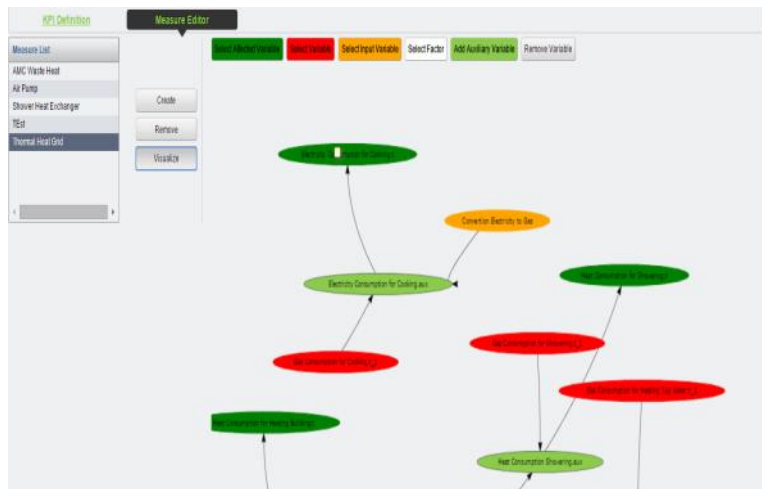
Indicator: Is the name of the KPI (i.e CO2 emissions)

nodename: the name of the node.

nodetype: The type of node (which is use to handle which type of window is shown)

formulacomponent: Equations linked to a specific node

5.2.2 Measure library (measure editor) tables 1/5



The name of the variables (user friendly names) in the GUI differ from the names that appear in the DB. The names given in the db to these variables is as follows:

Affected Variables-> Measure Node

Variable -> Building Attribute

Auxiliary Variable-> Purpose Node

Input Variable ->Purpose Node

The measure editor is integrated by 23 tables which relation is shown in the next slides. However, hereby it is introduced some terminology which is needed to further understand the structure of the measure editor.

Affected Variable: Affected variable (dark green in the GUI) is a variable which informs the simulation about the variables that will change their previous value after a measure is applied at time t .

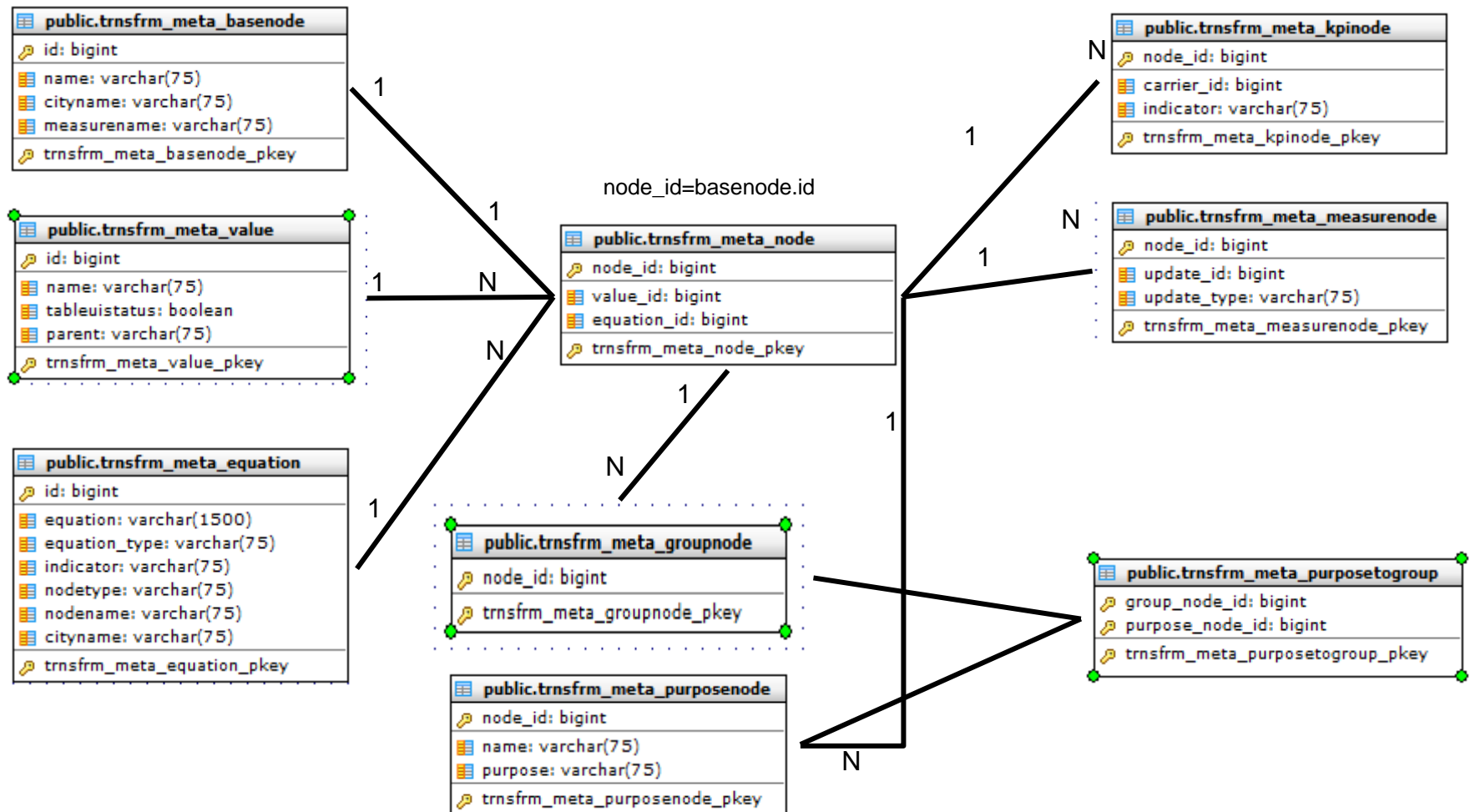
Variable: A variable (red in the GUI) which represents a building related variable. Its initial value comes from the city provided data. At the time of applying a measure (t) the initial value of this variable is seen by the simulation as $(t-1)$. That is why in the GUI it has a " t_1 " suffix.

Input Variable: A variable(orange in the GUI) that serves as input for the calculations. It could be either a table or a constant. Tables are mainly used in the LOOK UP equation types.

Factor: Factor (white in the GUI) are created in the factor library and could be added to measures as a way to include variation of input variables in time.

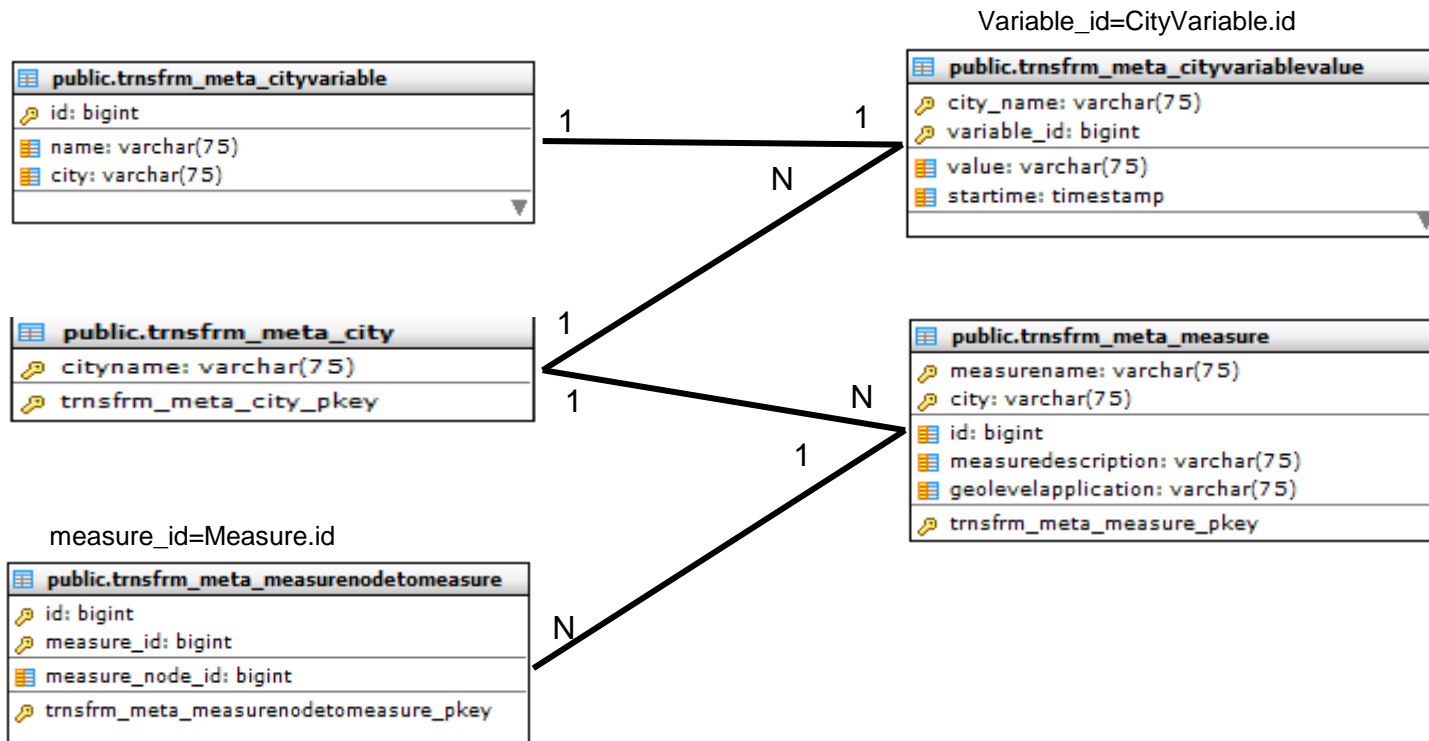
Auxiliary Variable: Variable used as an auxiliary (intermediate step in calculations). Auxiliary variables are most of time connected to other auxiliary variables or to a measure node. Furthermore, they are mainly dependent on input, factor or building attribute variables.

5.2.2 Measure library (measure editor) tables 2/5



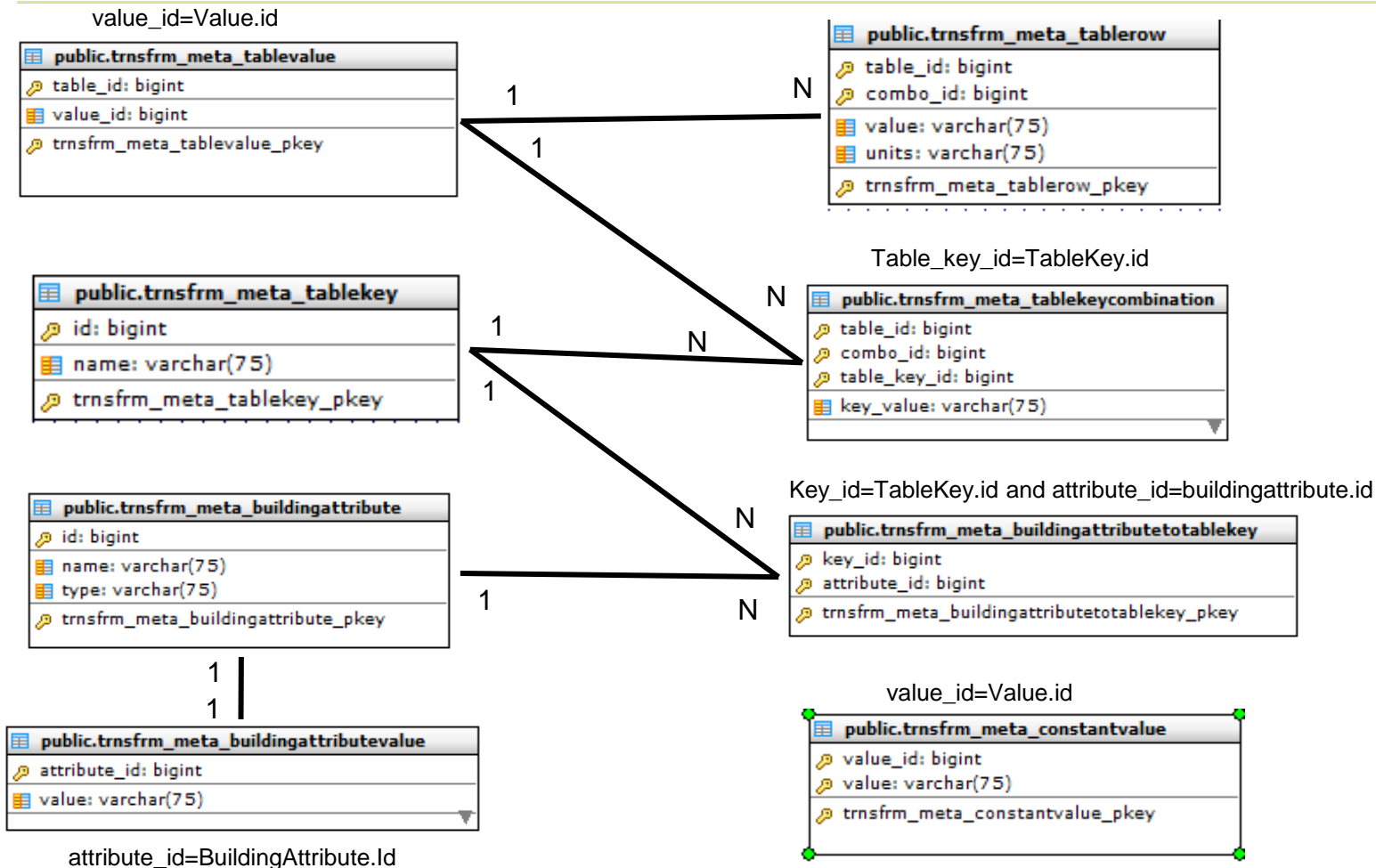
Note: the group node table is not used (it was initially thought as a way to give the same equations to different nodes

5.2.2 Measure library (measure editor) tables 3/5



Note: For future update of the database is the id in the measure table the one that needs to be a PK and not the measure name field.

5.2.2 Measure library (measure editor) tables 4/5



Note: Building attribute value table is currently empty. The values are stored now in the table cityTobuildingattribute. In addition, the buildingattribute table serves as a dictionary for the values in citytobuildingattribute table

5.2.2 Measure library (measure editor) tables 5/5

public.trnsfrm_meta_citytobuildingattribute	
id:	bigint
cityname:	varchar(75)
attributerealname:	varchar(75)
unit:	varchar(75)
buildingattributeid:	bigint
tablename:	varchar(75)
function:	varchar(75)
measurevariable:	boolean
trnsfrm_meta_citytobuildingattribute_pkey	

The meaning of the fields is as follows:

1.cityname: the name of the city

2.attributerealname: is the name of column found in the table referenced in 5 (*every time the name of this attribute is changed in the db or a different table is used. This field needs to be updated.*)

3.unit: units

4.Buildingattributeid:the id in the building attribute table to which the attribute realname is linked to.

5.tablename:The name of a table in the public schema. This table is the one that shall contain the city data (*if a new table is used in the db. This field needs to be updated as well.*)

6.function: Sometimes the cities give aggregated information (BLOCKS) or disaggregated (BUILDING). In case this information is aggregated, cities need to give a attributerealname (i.e area/typeofbuilding or function) from which the calculation could be disaggregated by the simulation and aggregated back again for the ouput. In that case the field **measurevariable** needs to be put to FALSE. See example below.

31	32	Amsterdam	gas_consumption_cooking	m3	22	trnsfrm_ams_tmp	''	TRUE
32	33	Amsterdam	gas_consumption_heating_building	m3	19	trnsfrm_ams_tmp	''	TRUE
33	34	Amsterdam	gas_consumption_heating_tap_water	m3	20	trnsfrm_ams_tmp	''	TRUE
34	35	Amsterdam	gas_consumption_showering	m3	21	trnsfrm_ams_tmp	''	TRUE
35	36	Amsterdam	heat_consumption_heating_building	Kwh	23	trnsfrm_ams_tmp	''	TRUE
36	37	Amsterdam	heat_consumption_heating_tap_water	Kwh	24	trnsfrm_ams_tmp	''	TRUE
37	38	Amsterdam	heat_consumption_showering	Kwh	25	trnsfrm_ams_tmp	''	TRUE
38	39	Vienna	a_residential	m2	4	trnsfrm_block_vie_	Residential	FALSE
39	40	Vienna	a_office	m2	4	trnsfrm_block_vie_	Office	FALSE
40	41	Vienna	a_commerce	m2	4	trnsfrm_block_vie_	Commerce	FALSE
41	42	Vienna	a_industrialhall	m2	4	trnsfrm_block_vie_	IndustrialHall	FALSE
42	43	Vienna	a_trade_service	m2	4	trnsfrm_block_vie_	Trade/Service	FALSE
43	44	Vienna	a_social	m2	4	trnsfrm_block_vie_	Social	FALSE
44	45	Vienna	a_culture	m2	4	trnsfrm_block_vie_	Culture	FALSE

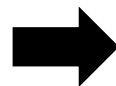
5.2.3 Factor library tables

public.trnsfrm_meta_factor	
id: bigint	
factordescription: varchar(75)	
city_variable_name: varchar(75)	
user_name: varchar(75)	
cityname: varchar(75)	
trnsfrm_meta_factor_pkey	

1

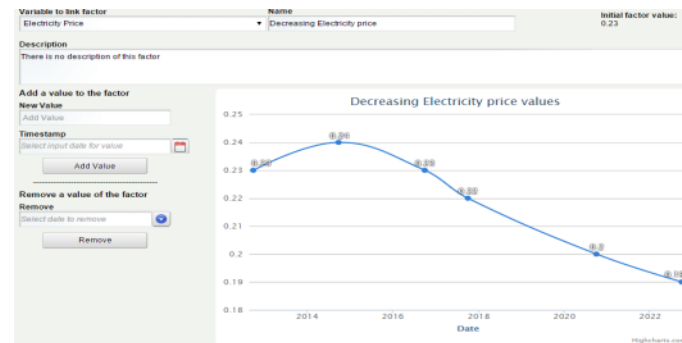
N

public.trnsfrm_meta_factorentry	
factordescription: varchar(75)	
timestamp: timestamp	
value: double precision	
trnsfrm_meta_factorentry_pkey	



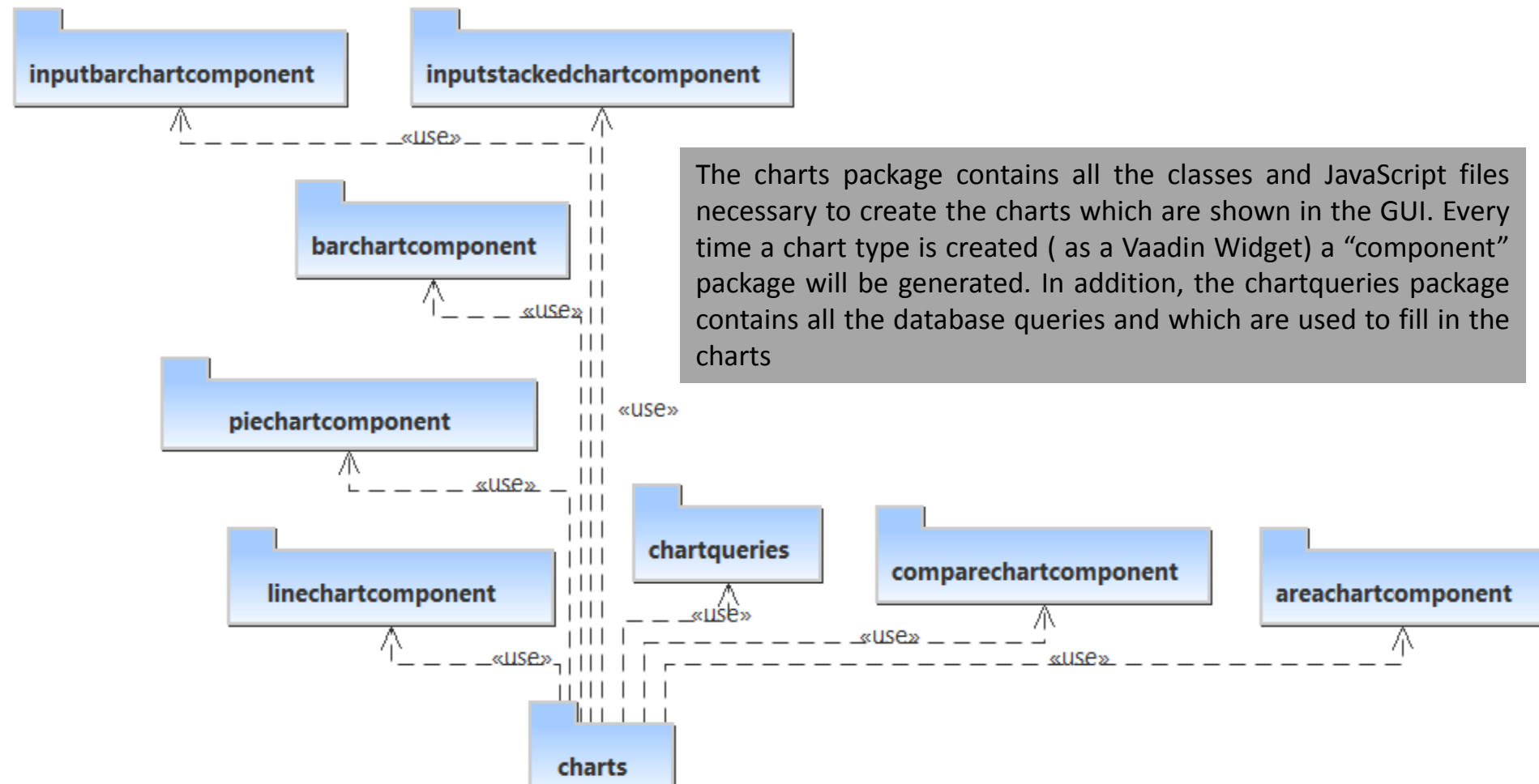
Factors are assumptions regarding the values that city specific variables will take in the future (way to take uncertainty into account). Factors can be created linked to a predefined city variable, or as independent ones to be used in the measure library (in this case the user should select the [Input Variable] name from the “Variable to link factor” combo box)

In addition, factors are defined per user and city. However, at this moment, all users from the same city are able to see/edit the factors defined by other users. This is because measures in the measure library are only defined per city, and if a factor needs to be added to specific measure it needs to be defined in the same way. Otherwise, the same measure could have a different behaviour per user.

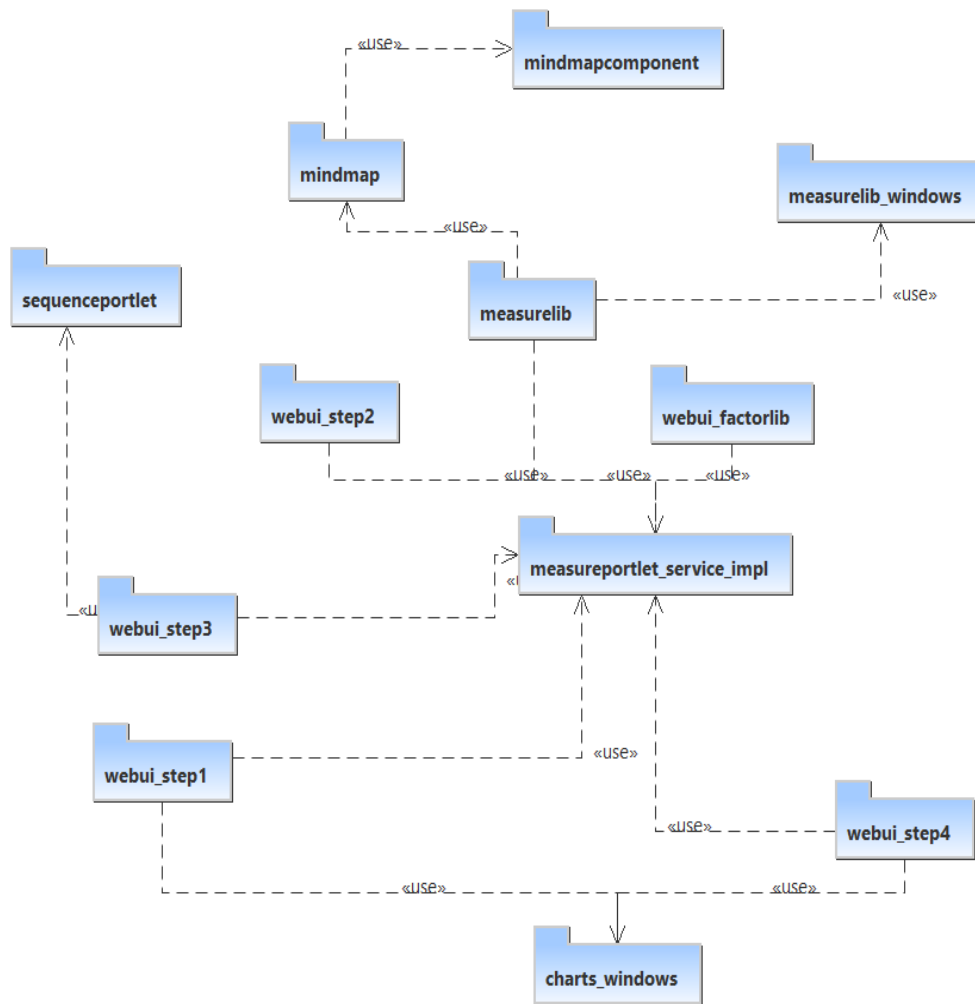


Note: Instead of the factor name as a FK in the factor entry table the factor.id should be used.

5.3 Package Diagram 1/4

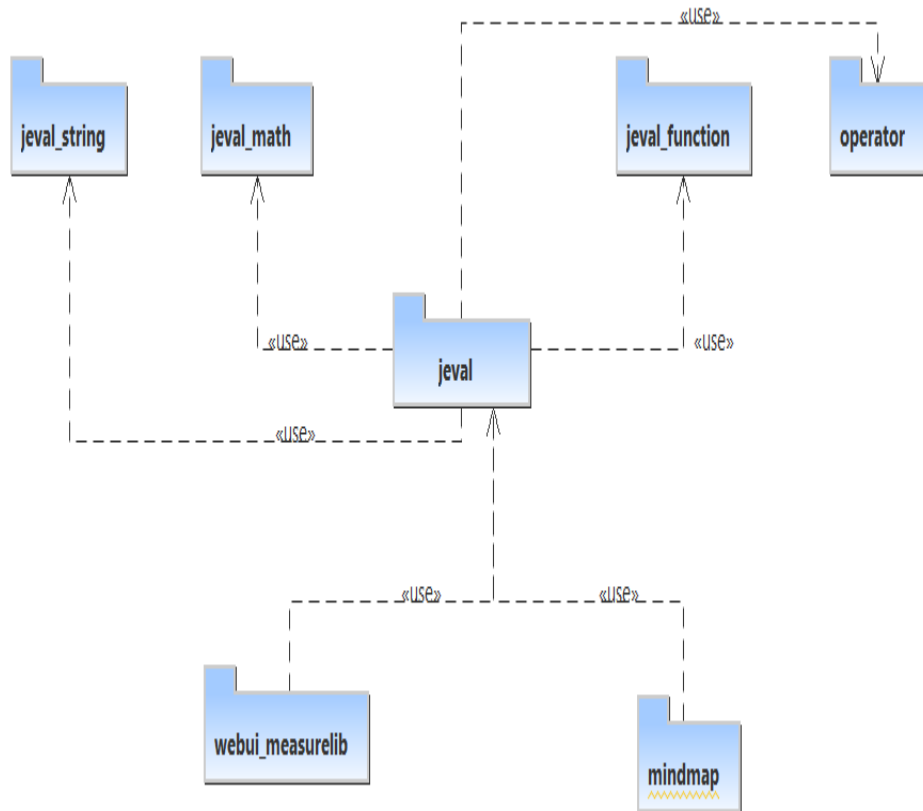


5.3 Package Diagram 2/4



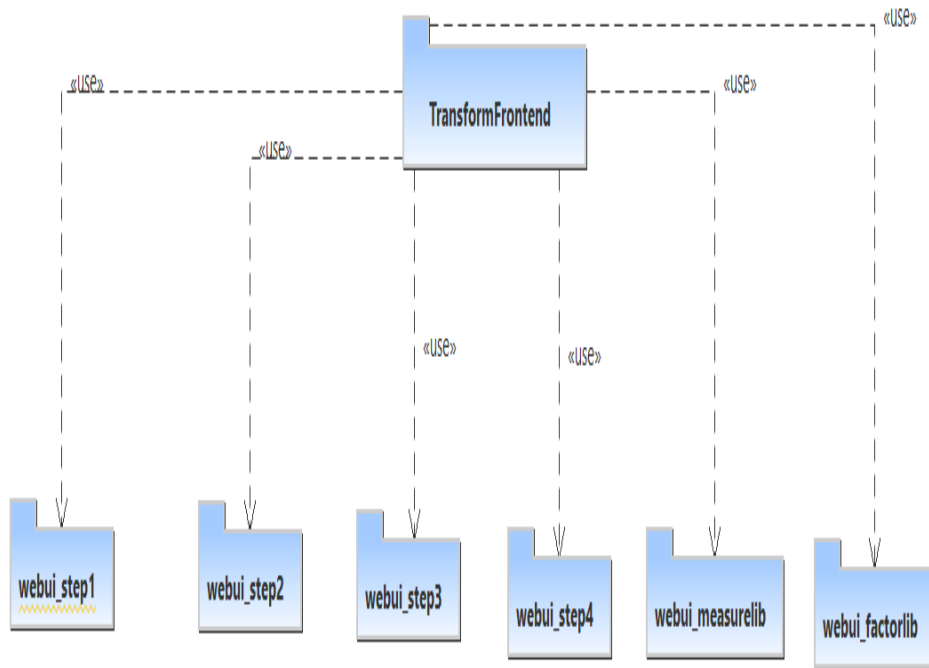
1. **Measureporlet_service_impl**: Stores all the custom methods used to make queries to the database by using the liferay service builder.
2. **Webui_step1**: Contains all the classes needed to create the “Analyze city Context” step
3. **Webui_step2**: Contains all the classes needed to create the “Set scenarios” step.
4. **Webui_step3**: Contains all the classes needed to create the “Allocate measures” step.
5. **Sequenceportlet**: It is used by the webui_step3 package and it contains the classes needed to allocate a measure to time
6. **Webui_step4**: Contains all the classes needed to create the “Determine Impact” step.
7. **Measurelib**: Contains all the classes needed to create the “Measure Library”
8. **MindMap**: Contains all the classes needed to create the MindMaps which are shown in the Measure Library.
9. **Measurelib_windows**: Contains all the pop up windows which are shown when double clicking in any of the nodes of the mindmaps.
10. **Webui_factorlib**: Contains all the classes need to create the factor library.
11. **Charts_windows**: Contains the classes which to create the windows in which the charts in step 1 and 4 are shown.

5.3 Package Diagram 3/4



Jeval is the library which is used to connect the nodes in the mindmaps from equations. This library is used by the webui_measurelib and mindmap packages respectively.

5.3 Package Diagram 4/4



The TransformFrontend package contains the classes to build the main (parent) layout of the GUI which will eventually contain the taps step 1 till 4 measurelib and factorlib

5.4 Simulation model

This part of the documentation provides an overview of the simulation model, its internal data structure and the simulation scheduler.

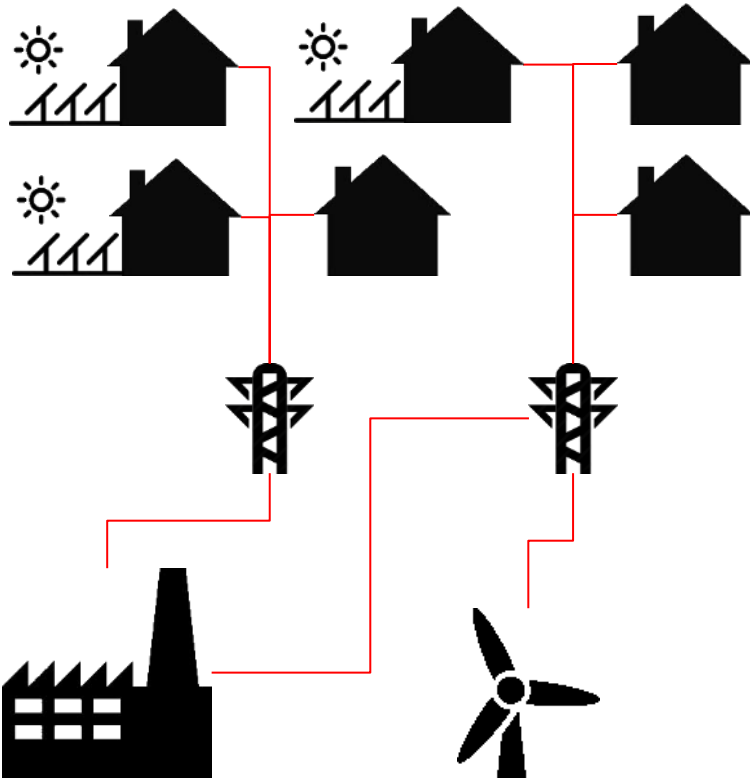
5.4.1 Conceptual model TRANSFORM

5.4.2 Package Overview

5.4.3 Internal data structure

5.4.4 Simulation scheduler

5.4.1 Conceptual model TRANSFORM



The model distinguishes consumers, network and producers. Consumers and producers are entities in the system that contain attributes (e.g. consumption values). At each event in time (i.e. scenario change or measure application), a recalculation will be done on the attributes of these entities.

The recalculation is done using a calculator that evaluates the formulas that the users input in the measures and assigns the values to the entities.

The calculator will eventually calculate the formulas that are made to determine the KPIs, which are finally outputted to the output database.

5.4.2 Package overview

- `Src.nl.macomi.transform.data`
 - A data representation of the data loaded from the database
- `Src.nl.macomi.transform.database`
 - Classes to support database loading and outputting
- `Src.nl.macomi.transform.equations`
 - Classes to represent an equation and its components
- `Src.nl.macomi.transform.measure`
 - Classes to represent a measure
- `Src.nl.macomi.transform.model`
 - Classes built from atomic and coupled models that is the actual representation of the simulation model
- `Src.nl.macomi.transform.calculator`
 - Classes to evaluate equations
- `Src.nl.macomi.transform.model.data`
 - The internal data structure of the simulation model
- `Src.nl.macomi.transform.model.modelbuilder`
 - -classes that use automatically generate the simulation model from input data
- `Src.nl.macomi.transform.model.utils`
 - Various utils functions that we need in other classes

5.4.3 Internal data structure

- Src.nl.macom.transform.data
 - This package contains the internal representation of the data from the database, it contains the following classes whose name corresponds to the data it contains:
 - AggregatedEntity
 - BuildingAttribute
 - BuildingAttributeValue
 - Carrier
 - CityVariable
 - ConstantValue
 - Entity: **this contains data from the city tables**
 - Equation
 - Groupnode
 - KeyValuePair
 - KPINode
 - Measure
 - MeasureApplication
 - MeasureNode
 - MeasureUpdatableNode
 - Node
 - NodeValue
 - PurposeNode
 - TableKey
 - TableKeyCombination
 - TableValue
 - Value

5.4.4 Simulation scheduler

The simulation scheduler is a java application that is **continuously** running and reads the experiments table in the database to check whether there is an experiment that has not been executed yet. As soon as it finds an experiment that has not been executed, it will simply spawn the simulation model with the appropriate sequence and scenario ID.

The simulation scheduler consists of 3 classes:

- Dataservice: to read the database table containing the experiments
- Scheduler: the main class that runs the program that will check the table regularly
- Tunnel: a helper class to start a SSH tunnel programmatically



6. Deployment Guide

Content:

Document about the required hardware for running the DSE.

Audience:

Parties interested in installing the DSE on their own servers.

1 Introduction

1.1 Intended audience

2 Glossary

3 Hardware Requirements

4 Software Requirements

4.1 Specification

4.2 Installation

4.3 Data

(see attached Word document: *DSE Deployment Guide v1.0.docx*)