City-zen ‘Roeselare’ Roadshow

Een Duurzame Stadsvisie

This project has received funding from the European Union’s Seventh Programme for research, technological development and demonstration under grant agreement No 608702

ROADSHOW METHODOLOGY: Prof. Dr. Craig Lee Martin, TU Delft, The Netherlands

Roeselare, Belgium. April 2018
Aim: Zero-Energy

Heart of process
Co-creation
Fun / Reachable

ROADSHOW METHODOLOGY: Prof. Dr. Craig Lee Martin, TU Delft, The Netherlands

Roeselare, Belgium. April 2018
Maandag 23 april | Introductie
9.30 u. - 11.30 u.: 'Het loopt op wieltjes'-fietstocht*

ROADSHOW METHODOLOGY : Prof. Dr. Craig Lee Martin, TU Delft, The Netherlands

Roeselare, Belgium. April 2018
Maandag 23 april | Introductie
9.30 u. - 11.30 u.: 'Het loopt op wieltjes'-fietsstocht*

What went on …
What went on …

Maandag 23 april | Introductie 13.30 u. - 15.30 u.: Inspirerende presentaties #VANRSL

ROADSHOW METHODOLOGY : Prof. Dr. Craig Lee Martin, TU Delft, The Netherlands

Roeselare, Belgium. April 2018
What went on …

ROADSHOW METHODOLOGY : Prof. Dr. Craig Lee Martin, TU Delft, The Netherlands
Donderdag 25 april | Evalueren Fun-shops 'Buurten van de Toekomst' & 'Energie'

What went on …
Woensdag 25 april | Design
9 u. - 12:30 u.:
Serious Game ‘Go2Zero’

What went on …
<table>
<thead>
<tr>
<th>Name</th>
<th>Energy</th>
<th>Mobility</th>
<th>Waste</th>
<th>Water</th>
<th>TOT kg CO2-eq/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>John</td>
<td>3,739</td>
<td>2,081</td>
<td>217</td>
<td>59</td>
<td>7,055</td>
</tr>
<tr>
<td>Bert</td>
<td>2,812</td>
<td>4,260</td>
<td>417</td>
<td>97</td>
<td>3,810</td>
</tr>
<tr>
<td>Janne</td>
<td>3,018</td>
<td>0</td>
<td>417</td>
<td>97</td>
<td>3,591</td>
</tr>
<tr>
<td>Timo</td>
<td>1,914</td>
<td>233</td>
<td>417</td>
<td>97</td>
<td>2,700</td>
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<td>Sybil</td>
<td>2,131</td>
<td>852</td>
<td>594</td>
<td>122</td>
<td>3,699</td>
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</table>

Woensdag 25 april | Design
13 u. - 14.30 u.: Mini-masterclass C02-voetafdruk en de stappen die we moeten zetten

ROADSHOW METHODOLOGY: Prof. Dr. Craig Lee Martin, TU Delft, The Netherlands
Woensdag 25 april | Design
14.30 u – 17.00.: VRP Urban Design Session - Vlaamse Vereniging voor Ruimte en Planning: VRP

ROADSHOW METHODOLOGY: Prof. Dr. Craig Lee Martin, TU Delft, The Netherlands
What went on ...

ROADSHOW METHODOLOGY: Prof. Dr. Craig Lee Martin, TU Delft, The Netherlands

Donderdag 26 april | Evalueren fun-shops 'Buurten van de Toekomst' & 'Energie'

Roeselare, Belgium. April 2018
What went on ...

ROADSHOW METHODOLOGY: Prof. Dr. Craig Lee Martin, TU Delft, The Netherlands

Donderdag 26 april | Evalueren fun-shops 'Buurten van de Toekomst' & 'Energie'

Roeselare, Belgium. April 2018
Vrijdag 27 april | Outro

10 u. - 11 u.:
Een duurzame stadsvisie #VANRSL met de Roadies

11 u. - 12 u.:
Roadshow discussie & Food for thought
CARBON ACCOUNTING EXPLAINED

UNIT kg CO₂-eq

GWP CO₂ = 1
GWP CH₄ = 34
GWP N₂O = 298

EMISSION FACTOR

I DON'T BELIEVE IN GLOBAL WARMING

Carbon Accounting: Riccardo M. Pulselli, University of Siena

Roeselare, Belgium. April 2018
## Emission Factor of Electricity Grid Mix in Belgium

### BELGIUM 2016

<table>
<thead>
<tr>
<th></th>
<th>LCA based EF</th>
<th>DATA</th>
<th>%</th>
<th>GHG EMISSION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GENERAL DATA</strong></td>
<td>kgCO2/kWh</td>
<td>kWh</td>
<td>%</td>
<td>kt CO2-eq/yr</td>
</tr>
<tr>
<td><strong>ELECTRICITY DEMAND</strong></td>
<td>8.35E+10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ELECTRICITY PRODUCTION</strong></td>
<td>7.98E+10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IMPORT</strong></td>
<td>0.46</td>
<td>3.65E+09</td>
<td>4.4%</td>
<td>1.68E+09</td>
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<tr>
<td><strong>TERMO-ELECTRICITY</strong></td>
<td>2.31E+10</td>
<td>2.31E+10</td>
<td>29.0%</td>
<td>1.03E+10</td>
</tr>
<tr>
<td>natural gas</td>
<td>0.443</td>
<td>2.31E+10</td>
<td>29.0%</td>
<td>1.03E+10</td>
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<tr>
<td>petroleum products</td>
<td>0.778</td>
<td>0.00E+00</td>
<td></td>
<td>0.00E+00</td>
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<tr>
<td>coal</td>
<td>1.050</td>
<td>0.00E+00</td>
<td></td>
<td>0.00E+00</td>
</tr>
<tr>
<td><strong>RENEWABLES</strong></td>
<td></td>
<td>1.43E+10</td>
<td>17.9%</td>
<td>2.14E+08</td>
</tr>
<tr>
<td>solar thermal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solar PV</td>
<td>0.032</td>
<td>2.95E+09</td>
<td>3.7%</td>
<td>9.45E+07</td>
</tr>
<tr>
<td>wind</td>
<td>0.010</td>
<td>5.11E+09</td>
<td>6.4%</td>
<td>5.11E+07</td>
</tr>
<tr>
<td>hydro</td>
<td>0.012</td>
<td>3.19E+08</td>
<td>0.4%</td>
<td>3.83E+06</td>
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<tr>
<td>geothermal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>biomass</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>biogas</td>
<td>0.011</td>
<td>5.91E+09</td>
<td>7.4%</td>
<td>6.50E+07</td>
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<tr>
<td>hydrogen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NUCLEAR</strong></td>
<td></td>
<td>4.13E+10</td>
<td>51.7%</td>
<td>2.72E+09</td>
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<tr>
<td>nuclear</td>
<td>0.066</td>
<td>4.13E+10</td>
<td>51.7%</td>
<td>2.72E+09</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>0.181</td>
<td>8.23E+10</td>
<td>1.49E+10</td>
<td></td>
</tr>
</tbody>
</table>

Carbon Accounting: Riccardo M. Pulselli, University of Siena
## HOUSEHOLD PROFILING

### ROESELARE CITY (BELGIUM)

#### ROESELARE HOUSEHOLD PROFILE

<table>
<thead>
<tr>
<th>Emission sources</th>
<th>unit</th>
<th>rawdata</th>
<th>%</th>
<th>kg CO2-eq</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENERGY</strong></td>
<td>kWh</td>
<td>15840</td>
<td></td>
<td>3476</td>
<td>51.3%</td>
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<tr>
<td>Lighting &amp; Appliance</td>
<td>kWh</td>
<td>3563</td>
<td>100%</td>
<td>643</td>
<td>9.5%</td>
</tr>
<tr>
<td>Electricity</td>
<td>kWh</td>
<td>3563</td>
<td>100%</td>
<td>643</td>
<td>9.5%</td>
</tr>
<tr>
<td>Heat + DHW + cooking</td>
<td>kWh</td>
<td>12277</td>
<td>100%</td>
<td>2833</td>
<td>41.8%</td>
</tr>
<tr>
<td>Nat gas</td>
<td>kWh</td>
<td>10021</td>
<td>82%</td>
<td>2522</td>
<td>37.2%</td>
</tr>
<tr>
<td>LGP</td>
<td>kWh</td>
<td>460</td>
<td>4%</td>
<td>121</td>
<td>1.8%</td>
</tr>
<tr>
<td>Biomass</td>
<td>kWh</td>
<td>1662</td>
<td>14%</td>
<td>189</td>
<td>2.8%</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>kWh</td>
<td>43</td>
<td>0.3%</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Geothermal</td>
<td>kWh</td>
<td>91</td>
<td>1%</td>
<td>0</td>
<td>0.0%</td>
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<tr>
<td><strong>MOBILITY</strong></td>
<td>kWh</td>
<td>10858</td>
<td>100%</td>
<td>2972</td>
<td>43.8%</td>
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<tr>
<td>Electric car</td>
<td>kWh</td>
<td>2</td>
<td>0.0%</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>LGP + Gas</td>
<td>kWh</td>
<td>28</td>
<td>0.3%</td>
<td>7</td>
<td>0.1%</td>
</tr>
<tr>
<td>Diesel</td>
<td>kWh</td>
<td>8945</td>
<td>82%</td>
<td>2550</td>
<td>37.6%</td>
</tr>
<tr>
<td>Gasoline</td>
<td>kWh</td>
<td>1554</td>
<td>14%</td>
<td>414</td>
<td>6.1%</td>
</tr>
<tr>
<td>Bio-fuel</td>
<td>kWh</td>
<td>328</td>
<td>3%</td>
<td>0</td>
<td>0.0%</td>
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<tr>
<td><strong>WASTE</strong></td>
<td>kg</td>
<td>1076</td>
<td>100%</td>
<td>276</td>
<td>4.1%</td>
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<tr>
<td>% waste-to-energy</td>
<td>kg</td>
<td>312</td>
<td>29%</td>
<td>204</td>
<td>3.0%</td>
</tr>
<tr>
<td>% organic</td>
<td>kg</td>
<td>230</td>
<td>21%</td>
<td>21</td>
<td>0.3%</td>
</tr>
<tr>
<td>% landfill</td>
<td>kg</td>
<td>44</td>
<td>4%</td>
<td>51</td>
<td>0.8%</td>
</tr>
<tr>
<td>% recycling</td>
<td>kg</td>
<td>490</td>
<td>46%</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>WATER</strong></td>
<td>m³</td>
<td>96</td>
<td>100%</td>
<td>56</td>
<td>0.8%</td>
</tr>
<tr>
<td>m³ per yr (house)</td>
<td>m³/yr</td>
<td>96</td>
<td>100%</td>
<td>56</td>
<td>0.8%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>6779</td>
<td>100%</td>
</tr>
</tbody>
</table>

**ROESELARE CITY (BELGIUM)**

- Typical household profiling
  - People: 2.34 inhab./house
  - Electricity: 3500 kWh/yr
  - Natural gas: 12300 kWh/yr
  - Mobility: 18000 km/yr
  - Waste: 467 kg/cap yr
  - Water: 114 L/cap day

Carbon Accounting: Riccardo M. Pulselli, University of Siena

Roeselare, Belgium. April 2018
HOUSEHOLD PROFILE

Roeselare, Belgium. April 2018

Carbon Accounting: Riccardo M. Pulselli, University of Siena

HOUSEHOLD PROFILING

People: 2.34 inhab./house
Electricity: 3500 kWh/yr
Natural gas: 12300 kWh/yr
Mobility: 18000 km/yr
Waste: 467 kg/cap yr
Water: 114 L/cap day

CARBON FOOTPRINT

6.78 t CO$_2$eq/yr

0.50 ha forestland

Roeselare, Belgium. April 2018
COLLIEVIJVER NEIGHBOURHOOD

1358 households
2795 inhabitants
77 ha area
36 inhab./ha

CF: 9206 t CO$_2$-eq

Carbon Accounting: Riccardo M. Pulselli, University of Siena
COLLIEVIJVER NEIGHBOURHOOD

X 8.9

CF: 9206 t CO₂-eq

= 682 ha forestland

 COLLIEVIJVER NEIGHBOURHOOD
 1358 households
 2795 inhabitants
 77 ha area
 36 inhab./ha

Carbon Accounting: Riccardo M. Pulselli, University of Siena

Roeselare, Belgium. April 2018
COLLIEVIJVER NEIGHBOURHOOD

CF: 9206 t CO₂-eq

= 682 ha forestland

COLLIEVIJVER NEIGHBOURHOOD

ELECTRICITY
NATURAL GAS
MOBILITY
WASTE

Carbon Accounting: Riccardo M. Pulselli, University of Siena

Roeselare, Belgium. April 2018
# Carbon Footprint of Roeselare City

## Emission Sources

<table>
<thead>
<tr>
<th>Source</th>
<th>Unit</th>
<th>Raw Data</th>
<th>%</th>
<th>t CO2-eq</th>
<th>%</th>
</tr>
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<tbody>
<tr>
<td><strong>Energy</strong></td>
<td>MWh</td>
<td>415222</td>
<td></td>
<td>91,118</td>
<td>22.1%</td>
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<tr>
<td>Lighting &amp; Appliances</td>
<td>MWh</td>
<td>93402</td>
<td>100%</td>
<td>16,867</td>
<td>4.1%</td>
</tr>
<tr>
<td>Electricity</td>
<td>MWh</td>
<td>93402</td>
<td>100%</td>
<td>16,867</td>
<td>4.1%</td>
</tr>
<tr>
<td>Heat + DHW + Cooking</td>
<td>MWh</td>
<td>321820</td>
<td>100%</td>
<td>74,251</td>
<td>18.0%</td>
</tr>
<tr>
<td>Nat gas</td>
<td>MWh</td>
<td>262681</td>
<td>82%</td>
<td>66,115</td>
<td>16.0%</td>
</tr>
<tr>
<td>LGP</td>
<td>MWh</td>
<td>12071</td>
<td>4%</td>
<td>3,171</td>
<td>0.8%</td>
</tr>
<tr>
<td>Biomass</td>
<td>MWh</td>
<td>43560</td>
<td>14%</td>
<td>4,965</td>
<td>1.2%</td>
</tr>
<tr>
<td>Solar thermal</td>
<td>MWh</td>
<td>1124</td>
<td>0%</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Geothermal</td>
<td>MWh</td>
<td>2383</td>
<td>1%</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Mobility</strong></td>
<td>MWh</td>
<td>284617</td>
<td>100%</td>
<td>77,894</td>
<td>18.9%</td>
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<tr>
<td>Electric car</td>
<td>MWh</td>
<td>63</td>
<td>0.0%</td>
<td>11</td>
<td>0.0%</td>
</tr>
<tr>
<td>LGP + Gas</td>
<td>MWh</td>
<td>731</td>
<td>0.3%</td>
<td>192</td>
<td>0.0%</td>
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<tr>
<td>Diesel</td>
<td>MWh</td>
<td>234482</td>
<td>82.4%</td>
<td>66,836</td>
<td>16.2%</td>
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<tr>
<td>Gasoline</td>
<td>MWh</td>
<td>40733</td>
<td>14.3%</td>
<td>10,855</td>
<td>2.6%</td>
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<tr>
<td>Bio-fuel</td>
<td>MWh</td>
<td>8608</td>
<td>3.0%</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Waste</strong></td>
<td>t</td>
<td>28345</td>
<td>100%</td>
<td>7,260</td>
<td>1.8%</td>
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<tr>
<td>% waste-to-energy</td>
<td>t</td>
<td>8231</td>
<td>29%</td>
<td>5,367</td>
<td>1.3%</td>
</tr>
<tr>
<td>% organic</td>
<td>t</td>
<td>6049</td>
<td>21%</td>
<td>548</td>
<td>0.1%</td>
</tr>
<tr>
<td>% landfill</td>
<td>t</td>
<td>1159</td>
<td>4%</td>
<td>1,345</td>
<td>0.3%</td>
</tr>
<tr>
<td>% recycling</td>
<td>t</td>
<td>12919</td>
<td>46%</td>
<td>0</td>
<td>0.0%</td>
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<tr>
<td><strong>Water</strong></td>
<td>m³</td>
<td>2521692</td>
<td>100%</td>
<td>1,476</td>
<td>0.4%</td>
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<td>m³ per yr (house)</td>
<td>m³/yr</td>
<td>2521692</td>
<td>100%</td>
<td>1,476</td>
<td>0.4%</td>
</tr>
<tr>
<td><strong>Residential</strong></td>
<td></td>
<td>177,748</td>
<td>43%</td>
<td></td>
<td></td>
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<tr>
<td><strong>Tertiary (private + public)</strong></td>
<td>MWh</td>
<td>442647</td>
<td>100%</td>
<td>99,898</td>
<td>24.2%</td>
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<tr>
<td><strong>Agriculture</strong></td>
<td>MWh</td>
<td>28392</td>
<td>100%</td>
<td>7,666</td>
<td>1.9%</td>
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<tr>
<td><strong>Industry</strong></td>
<td>MWh</td>
<td>639487</td>
<td>100%</td>
<td>124,644</td>
<td>30.2%</td>
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<tr>
<td>Public transport</td>
<td>MWh</td>
<td>5270</td>
<td>100%</td>
<td>1,439</td>
<td>0.3%</td>
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<tr>
<td>Public lighting</td>
<td>MWh</td>
<td>5546</td>
<td>100%</td>
<td>1,002</td>
<td>0.2%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>412,396</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Carbon Footprint

- **Roeselare City**: 61,657 inhabitants
- **26,349 households**
- **5979 ha area**

**Carbon Footprint of Roeselare City**: 412 kt CO₂eq/yr

Carbon Accounting: Riccardo M. Pulselli, University of Siena
CARBON FOOTPRINT OF ROESELARE CITY

Carbon Accounting: Riccardo M. Pulseli, University of Siena

30548 ha forestland grabbing vs 5979 ha area

CARBON FOOTPRINT
412,000 t CO2 eq

FORESTLAND GRABBING
30,548 ha

Roeselare City

NEW URBAN ENERGY ROADSHOW

Roeselare, Belgium. April 2018
CARBON FOOTPRINT OF ROESELARE CITY

Carbon Accounting: Riccardo M. Pulselli, University of Siena

Roeselare, Belgium. April 2018
Energy strategy: Siebe Broersma MSc, Technical University, Delft.
Heat demand Roeselare 2015 (GWh)

- **Residential**: 300 GWh (46%)
- **Industrial**: 100 GWh (15%)
- **Non-Residential**: 250 GWh (39%)
- **Industrial Process**: 320 GWh

Current Heat Demand

620 GWh-th in 2015
+ 320 GWh-pr

Energy strategy: Siebe Broersma MSc, Technical University, Delft.

Roeselare, Belgium. April 2018
Electricity potentials in Roeselare

- **Electricity Demand**: 495 GWh (100%)
- **Electricity Potential**: 777 GWh (157%)

- **Incineration**: 17 GWh (2%)
- **Wind**: 240 GWh (31%)
- **PV-Non-Roof**: 120 GWh (15%)
- **PV-Roof**: 400 GWh (52%)

Space for production

- 40 Wind turbines
- 50% of all roofs (235 ha)
- 80 ha non-roof

Energy strategy: Siebe Broersma MSc, Technical University, Delft.

Roeselare, Belgium. April 2018
Heat potentials in Roeselare

**Heat Demand**
- Heat Demand: 650 GWh (100%)

**Heat Potential (HT)**
- Sunboiler: 1480 GWh (86%)
- Industrial: 100 GWh (6%)
- Incineration: 130 GWh (8%)
- Heat Potential: 1710 GWh (263%)

**Heat Potential (MT)**
- PV-Thermal: 2000 GWh (99%)
- Residual: 25 GWh (1%)
- Heat Potential: 2025 GWh (312%)

**Heat Potential (LT)**
- ATES / BTES: 1000 GWh (100%)
- Heat Potential: 1000 GWh (154%)

**Temperature levels**
- High-T for district heat network (DHN)
- Mid-T needs energy renovation
- Low-T needs heat pumps and energy renovation

Energy strategy: Siebe Broersma MSc, Technical University, Delft.

Roeselare, Belgium. April 2018
Heat Balance towards 2050

Temperature levels

- 30% High-T for DHN
- 25% Mid-T
- 25% Low-T
- 20% reduction

Energy strategy: Siebe Broersma MSc, Technical University, Delft.
Sustainable transport scenario

Main directions

Modal shift
Electrification

Energy strategy: Siebe Broersma MSc, Technical University, Delft.

Roeselare, Belgium. April 2018
Electricity demand scenario towards 2050

- **Assumptions**
  - 30% reduction of current demand for appliances
  - 15% total increase due to Electrification of Heating + transport

Energy strategy: Siebe Broersma MSc, Technical University, Delft.

Roeselare, Belgium. April 2018
Electricity Balance towards 2050

Main measures

25 Wind Turbines

240 ha PV panels

Co-generation of waste incineration

Energy strategy: Siebe Broersma MSc, Technical University, Delft.
Roeselare, Belgium. April 2018
Temperature levels for heating of buildings towards 2050

Required temperatures

HT = > 65°C
MT = 40°C - 65°C
LT = < 45°C

Energy strategy: Siebe Broersma MSc, Technical University, Delft.
Required energy renovations of building stock towards 2050

19,400 Residential equivalents over a period of 32 years (600 Res. eq. / year)
16,500 Residential equivalents over a period of 32 years (500 Res. eq. / year)

Building stock
57,000 residential unit equivalents of which:
26,000 residential
31,000 non-residential
Main measures

DHN extension

Maximize waste heat use of industrial waste by 2035

Partly reduced and replaced by solar heat and underground storage towards 2050

**Roadmap for sustainable heating (HT) of Roeselare’s current building stock**

<table>
<thead>
<tr>
<th>Now</th>
<th>2020</th>
<th>2035</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heat grid ext.</strong></td>
<td>Expand HT dist. heat network with 10 GWh/year, 850 res. eq. conn./yr</td>
<td>From current 32 GWh/year now up to 220 GWh HT DHN connections in 2030</td>
<td></td>
</tr>
<tr>
<td><strong>Waste incineration</strong></td>
<td>Increase HT waste heat 20 -&gt; 120 GWh/yr</td>
<td>Only non-recyclable waste is incinerated, from 2035 no more waste from fossil based electricity production</td>
<td></td>
</tr>
<tr>
<td><strong>Industry, waste heat</strong></td>
<td>0 GWh</td>
<td>Utilise and increase 10 GWh/year</td>
<td>Reduce to 55 GWh in 2050</td>
</tr>
<tr>
<td><strong>Solar collectors</strong></td>
<td>Current use</td>
<td>Due to efficiency measures in industry</td>
<td></td>
</tr>
<tr>
<td><strong>HT storage</strong></td>
<td>Test</td>
<td>Facilitate 4 GWh/year HT storage up to 100 GWh</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Underground planning</td>
<td>Underground high-temperature storage in deep aquifers and storage tanks</td>
<td></td>
</tr>
</tbody>
</table>

**Test**

<table>
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<tr>
<th>Now</th>
<th>2020</th>
<th>2035</th>
<th>2050</th>
</tr>
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</tbody>
</table>

Energy strategy: Siebe Broersma MSc, Technical University, Delft.

Roeselare, Belgium. April 2018
Roadmap for sustainable heating (MT + LT) of Roeselare’s current building stock

- **Renovate 500 res. eq. /year from G/F/E/D labels to C/B labels**
  - These buildings will be heated with mid-temperature heat

- **Use 2.5 GWh/year of MT waste heat in heat grids up to 35 GWh**
  - Mid-temperature waste heat from local sources

- **Facilitate 3 GWh/year MT storage up to 80 GWh**
  - To store summer heat on mid-temperature levels (i.e. central heat pumps in case MT-storage is not allowed)

- **Install 1 ha/year of solar thermal collectors on roofs**
  - And optimize for seasonal storage in ATES / BTES and supply by mid-temperature systems

- **Renovate 600 res. eq. /year from C/B to A labels**
  - These buildings will be heated with low-temperature heat

- **Facilitate 3 GWh/year ATES/BTES systems up to 80 GWh**
  - For non residential functions with similar heating and cooling demands

**Main measures**

- **60% of building stock moderately renovated by 2050**

- **Solar collectors and MT-storage in underground**

---

Energy strategy: Siebe Broersma MSc, Technical University, Delft.

Roeselare, Belgium. April 2018
Roadmap for sustainable electricity production in Roeselare

Main measures
- 235 ha PV panels
- 25 4MW Wind Turbines
- 17 GWh-e from Waste Incineration

Energy strategy: Siebe Broersma MSc, Technical University, Delft.
Schematic section of Roeselare’s sustainable energy systems in 2050
Main directions
Central HT-DHN
Cascaded to
235 ha PV panels
25 4MW Wind Turbines
17 GWh-e from Waste Incineration

Sustainable Energy Systems in Roeselare in 2050
Sustainable transport and mobility

Regional connectivity

People

Packages

Heavy materials

Energy strategy: Siebe Broersma MSc, Technical University, Delft.
Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.
Urban Analysis

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Roeselare, Belgium. April 2018
Urban Analysis

Low Density

1300 Houses
85 Hectares
15 Homes/Ha

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.
Urban Analysis

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Low Intensity

- No bars
- No cafes
- No civic functions
Urban Analysis

Over-engineered Roads

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Roeselare, Belgium. April 2018
Urban Analysis

Over-engineered water ways

Flooding an issue

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Roeselare, Belgium. April 2018
Urban Analysis

Empty but full

75 Homes/Ha

17 Hectares

68 Hectares empty

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Roeselare, Belgium. April 2018
Urban Analysis

Small green spaces

- Individual gardens
- Grass verges
- Road infrastructure

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Roeselare, Belgium. April 2018
Urban Analysis

Over-engineered water ways

Flooding issues

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Roeselare, Belgium. April 2018
Urban Analysis

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Car-orientated

Highest mobility impact
Urban Analysis

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Egg-like structure

Neighbourhood is isolated, both from city and nature.
Urban Analysis

City of bits

Very little contact between neighbourhoods

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.
Urban Design: blurring boundaries

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.
Urban Analysis

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.
Urban Analysis

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.
Urban Design: flood proofing naturally

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Sustainable urban drainage

Cheap

Easy

Bio-diverse
Urban MOves

Interface between blue and green

- Create blue route
- Create Green cycle route
- Connect in neighbourhood

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.
Urban Design

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Community Agora

Food focussed neighbourhood

Community food trading

Paddy field
Urban Design

Blurred boundaries

Bring city to neighbourhood

Bring neighbourhood to city

Increase density

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Roeselare, Belgium. April 2018
Modal shift provides urban space

Source: www.verkehrswende-ev.de

Source: www.wegcode.be

Source: http://www.iedereengorilla.be/

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.
Urban Analysis

No need to visit

Very generic

No difference

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Roeselare, Belgium. April 2018
Urban Design: New green ring of exciting neighbourhoods

Lots of reasons to visit!

Each neighbourhood is individual and productive!

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.
Urban Proposal  Super sharing, low impact, urban agriculture neighbourhood

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Shared surface

Productive

Flood proof

Community focussed

Roeselare, Belgium. April 2018
Urban agriculture: low impact with technical food systems

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Productive Landscapes

Urban Castles

Productive street systems

Techno terps

Roeselare, Belgium. April 2018
Urban Design. Aquaponic people first highways

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Urban Agriculture everywhere
Aquaponic cycleway

Roeselare, Belgium. April 2018
Urban Design - Blue Green castles

Consolidation of green space
- Energy renovation
- Urban Agriculture
- Community focussed
- Sharing

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Roeselare, Belgium. April 2018
Urban Design - Blue Green castles

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Roeselare, Belgium. April 2018
All-electric self-sufficient renovation – *Green blue castle*

- PV-Thermal roof
- Collective Heat pump
- Triple glazing
- Roof insul.
- Greenhouse garden
- SUDS

Main measures

Energy strategy: Siebe Broersma MSc, Technical University, Delft.

Roeselare, Belgium. April 2018
All-electric self-sufficient renovation – Techno terp

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Consolidation of green space

List 1
List 2
List 3

Roeselare, Belgium. April 2018
All-electric self-sufficient renovation – *Techno terp*

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Techno terps

Technical food system with aquaponics

Fishtanks provide flood protection

Bio-swales in street

Roeselare, Belgium. April 2018
All-electric self-sufficient renovation – Techno terp

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.
Main measures

- PV-Thermal roof
- Underground heat storage
- Ground source HP
- DHW booster
- Greenhouse roof
- Triple glazing + roof insul.
- Aquaponics

All-electric self-sufficient renovation – Techno terp

Energy strategy: Siebe Broersma MSc, Technical University, Delft.

Roeselare, Belgium. April 2018
Urban Design

Unsafe and unnatural

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Roeselare, Belgium. April 2018
Urban Design

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Safe and Natural

Roeselare, Belgium. April 2018
Urban Design

Unpacking the city into the neighbourhood

Increased intensity
Community services
Increased density
Reason to visit

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Roeselare, Belgium. April 2018
Food-LETTS Agora

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Community Agora

- Food focussed neighbourhood
- Community food trading
- Paddy fields

Roeselare, Belgium. April 2018
All-electric self-sufficient renovation – *Collievijver agora*

- **PV-Thermal roof**
- **Waste heat from refrigeration**
- **BTES**
- **MT mini heat grid**
- **Greenhouse roof**
- **Water storage**

**Main measures**
- Full PV-roof
- Collective Heat pump
- DHW booster
- Greenhouse garden
- Moderate renovation: Triple glazing + roof insul.

*Energy strategy: Siebe Broersma MSc, Technical University, Delft.*

*Roeselare, Belgium. April 2018*
Enjoy the environmental tax!

Short coppice willow provides carbon sink

Amenity space

bio-diversity

Urban Design: nature reconnection

Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

Roeselare, Belgium. April 2018
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE

1km square

ELECTRICITY (HOUSING)
HEAT (HOUSING)
MOBILITY (PRIVATE CARS)
WASTE (URBAN)
WATER USE (HOUSING)
TERTIARY
INDUSTRY
AGRICULTURE
Public transport
Public lighting

Carbon Accounting:  Riccardo M. Pulselli, University of Siena
Roeselare, Belgium. April 2018
MEASURE #1
ENERGY SAVING
Building energy retrofitting

ELECTRICITY (HOUSING)
HEAT (HOUSING)
MOBILITY (PRIVATE CARS)
TERTIARY
INDUSTRY

CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE

GROWTH
2050 forecast

Carbon Accounting: Riccardo M. Pulselli, University of Siena

Roeselare, Belgium. April 2018
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE

MEASURE #2
BIOMASS
Industrial use

ELECTRICITY (HOUSING)
HEAT (HOUSING)
MOBILITY (PRIVATE CARS)
TERTIARY
INDUSTRY

Carbon Accounting: Riccardo M. Pulselli, University of Siena

Roeselare, Belgium. April 2018
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE

1km square

MEASURE #3
DISTRICT HEATING NETWORK
Waste incineration

ELECTRICITY (HOUSING)
HEAT (HOUSING)
MOBILITY (PRIVATE CARS)
TERTIARY
INDUSTRY

Carbon Accounting: Riccardo M. Pulselli, University of Siena
Roeselare, Belgium. April 2018
MEASURE #4
DISTRICT HEATING NETWORK
Solar collectors + HT storage

- ELECTRICITY (HOUSING)
- HEAT (HOUSING)
- MOBILITY (PRIVATE CARS)
- TERTIARY
- INDUSTRY

Roeselare, Belgium. April 2018
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE

MEASURE #5
DISTRICT HEATING NETWORK
HT industrial waste

Carbon Accounting: Riccardo M. Pulselli, University of Siena

Roeselare, Belgium. April 2018
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE

MEASURE #6
MINI HEAT GRIDS
Solar collectors + MT storage

- ELECTRICITY (HOUSING)
- HEAT (HOUSING)
- MOBILITY (PRIVATE CARS)
- TERTIARY
- INDUSTRY

Carbon Accounting: Riccardo M. Pulselli, University of Siena

Roeselare, Belgium. April 2018
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE

MEASURE #8
LT MINI HEAT GRID
LT ATES Aquifer
Thermal Energy Storage

- ELECTRICITY (HOUSING)
- HEAT (HOUSING)
- MOBILITY (PRIVATE CARS)
- TERTIARY
- INDUSTRY

Carbon Accounting: Riccardo M. Pulselli, University of Siena
Roeselare, Belgium. April 2018
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE

MEASURE #9
PV on ROOF

Carbon Accounting: Riccardo M. Pulselli, University of Siena
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE

MEASURE #9
PV non ROOF

Carbon Accounting: Riccardo M. Pulselli, University of Siena

Roeselare, Belgium. April 2018
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE

MEASURE #10
SUSTAINABLE MOBILITY
Cycling roads, electric public/sharing

- **ELECTRICITY (HOUSING)**
- **HEAT (HOUSING)**
- **MOBILITY (PRIVATE CARS)**
- **TERTIARY**
- **INDUSTRY**

Roeselare, Belgium. April 2018
MEASURE #11
TRANSITION TO ELECTRIC MOBILITY

CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE

Carbon Accounting: Riccardo M. Pulselli, University of Siena
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE

MEASURE #12
WIND FARM

Carbon Accounting: Riccardo M. Pulselli, University of Siena

Roeselare, Belgium. April 2018
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE

MEASURE #13
Waste recycling %
LED public lights
Electric public transport

- ELECTRICITY (HOUSING)
- HEAT (HOUSING)
- MOBILITY (PRIVATE CARS)
- TERTIARY
- INDUSTRY

Carbon Accounting: Riccardo M. Pulselli, University of Siena

Roeselare, Belgium. April 2018
MEASURE #14
URBAN FORESTRY

CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE

Carbon Accounting: Riccardo M. Pulselli, University of Siena
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE

MEASURE #15
NEW FOREST

ELECTRICITY (HOUSING)
HEAT (HOUSING)
MOBILITY (PRIVATE CARS)
TERTIARY
INDUSTRY

Carbon Accounting: Riccardo M. Pulselli, University of Siena
Nu is’t aan junder, veel succes!

Web:
https://www.klimaatswitch.be/programma-city-zen
https://www.cityzen-smartcity.eu/nl/home-nl/

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Contact: c.l.martin@tudelft.nl