City-zen: New Urban Energy
Roeselare 'City-zen Roadshow' REPORT

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NEW URBAN ENERGY

Roeselare Roadshow REPORT

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3	Universiteit van Amsterdam	UVA	NL
4	Westpoort Warmte B.V.	WPW	NL
5	Alliander	LIAN	NL
6	HESPUL Association	HESP	FR
7	The Queens University of Belfast	QUB	UK
8	Th!nk E	THNK	BE
9	KEMA Nederland BV	KEMA	NL
10	Technische Universiteit Delft	TUD	NL
11	Stichting Waternet	WAT	NL
12	Greenspread Projects BV (subject to reservation, provided acceptance by EU)	GREE	NL
13	Sanquin (subject to reservation, provided acceptance by EU)	SANQ	NL
14	AEB Exploitatie BV	AEBE	NL
15	Daikin Airconditioning Netherlands B.V.	DAIK	NL
16	Siemens Nederland NV	SIEM	NL
17	Universita'degli Studi di Siena	UNIS	IT
18	Ville de Grenoble	MUNG	FR
19	Commissariat a l'Energie Atomique et aux Energies Alternatives	CEA	FR
20	Compagnie de Chauffage Intercommunale de l' Agglomeration Grenobloise	CCIA	FR
21	Gaz Electricite de Grenoble	GEG	FR
22	SAS ATOS Worldgrid	ATOS	FR
23	Clicks and Links Ltd&L	C&L	UK
24	Grenoble-Alpes Métropole	METRO	FR

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The Huis van de Voeding (House of Food) in the city centre of Roeselare would be the home of the SWAT Studio and Roadshow during our co-creative efforts to develop a sustainable City Vision. We'd like to thank organises for the hospitality they showed to the SWAT and Roadshow team during our extended stay there. The activities and energy within the House of Food gave even greater impetus to the Roadshow team and their stakeholder partners to go to zero carbon!

ABSTRACT

The City-zen Roadshow travels with a team of internationally recognized experts, in the field of energy planning and design to help develop a sustainable agenda for cities and their neighbourhoods. It will visit 10 cities in total over a 4-year period who are seeking expert guidance on how to become more sustainable and wish to move towards energy neutrality. The overall aim of the Roadshow team is to work closely with people from the hosting city, whether they be city leaders, energy planners, local architect, professionals, academics, students and citizens. The Roadshow spends 5 days in each hosting city to deliver energy and urban design fun-shops in which all local stakeholders are welcome and encouraged to join and to take ownership of the final outcomes. Outcomes that will allow the cities recourses, both people and energy, to be directed effectively, by highlighting the energy challenges and potentials to be found in their neighbourhoods, and to finally present a sustainable 'City Vision'.

The following report will describe the activities and outcomes of the City-zen Roeselare Roadshow that took place in Roeselare (Belgium), between the 23rd & 27th of April 2018.

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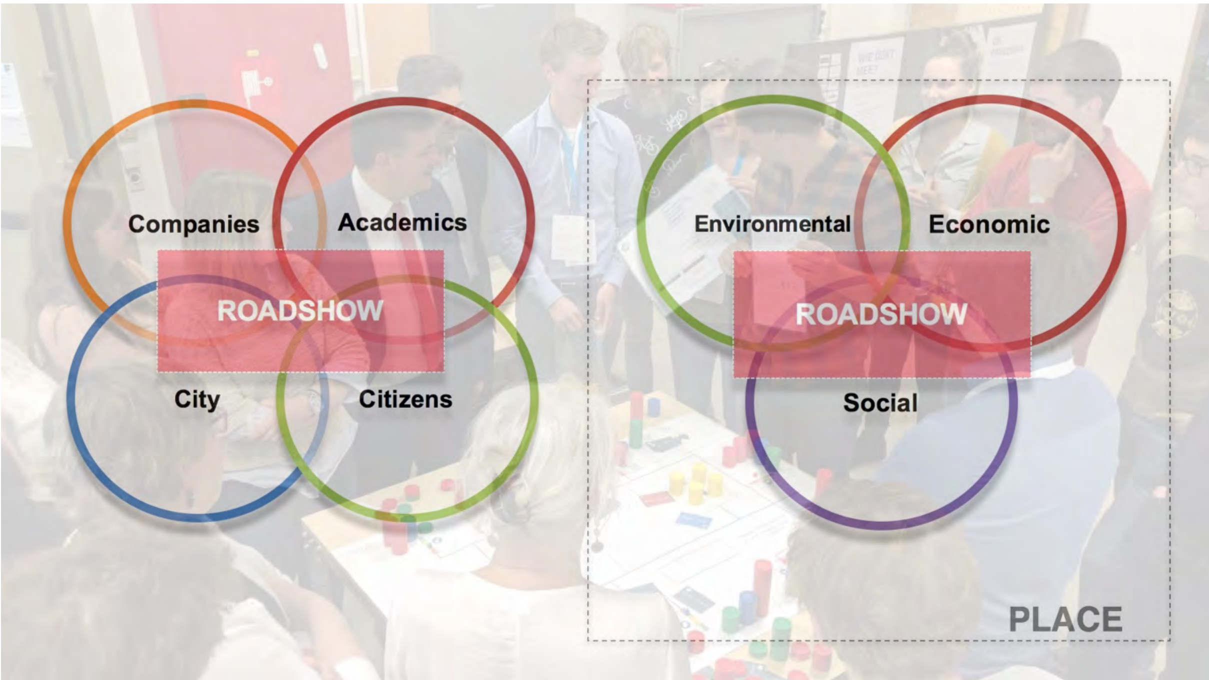
CHAPTER 1 – Introduction

The Roadshow travels with a team of internationally recognized experts in the field of architectural design and energy planning to co-create a sustainable 'City Vision' with city stakeholders. It will visit 10 cities that are seeking expert guidance on how to become zero energy and carbon neutral over a 4-year period. The project has already successfully collaborated with Belfast, Izmir, Dubrovnik, Menorca and Sevilla. The overall aim of the project team, is to work closely with people from each hosting city, whether they be city leaders, neighbourhood associations, energy planners, architects, academics, students and of course most significantly the citizens themselves. The project consists of a 5-Day event model, a culmination of a 3-month preparation including an educational design studio (The SWAT Studio) that promotes the Roadshow whilst building relationships and trust between all contributing partners. Local stakeholders are welcomed and encouraged to join and to take ownership of the process and the final outcomes. Outcomes that will allow the cities resources, people, knowledge and renewable energy potential to be directed effectively over a realisable timescale that will meet their energy transition. The process starts by identifying a neighbourhood's urban lifestyle and energy challenges. Then, on the final day of the event model, a definitive sustainable 'City Vision' is presented to the city, which responds to all scales of their built and natural environment.



(a) *(b)*

Fig 1. (a) The Roadshow investigates Environmental, Economic and Social aspects of each Roadshow city to develop a 'City Vision' that is specifically tailored to respond to place. (b) The Roadshow team brings together all stakeholders, it facilitates this 5-Day event to propose a sustainable 'City Vision' that is 'owned' by the City itself.

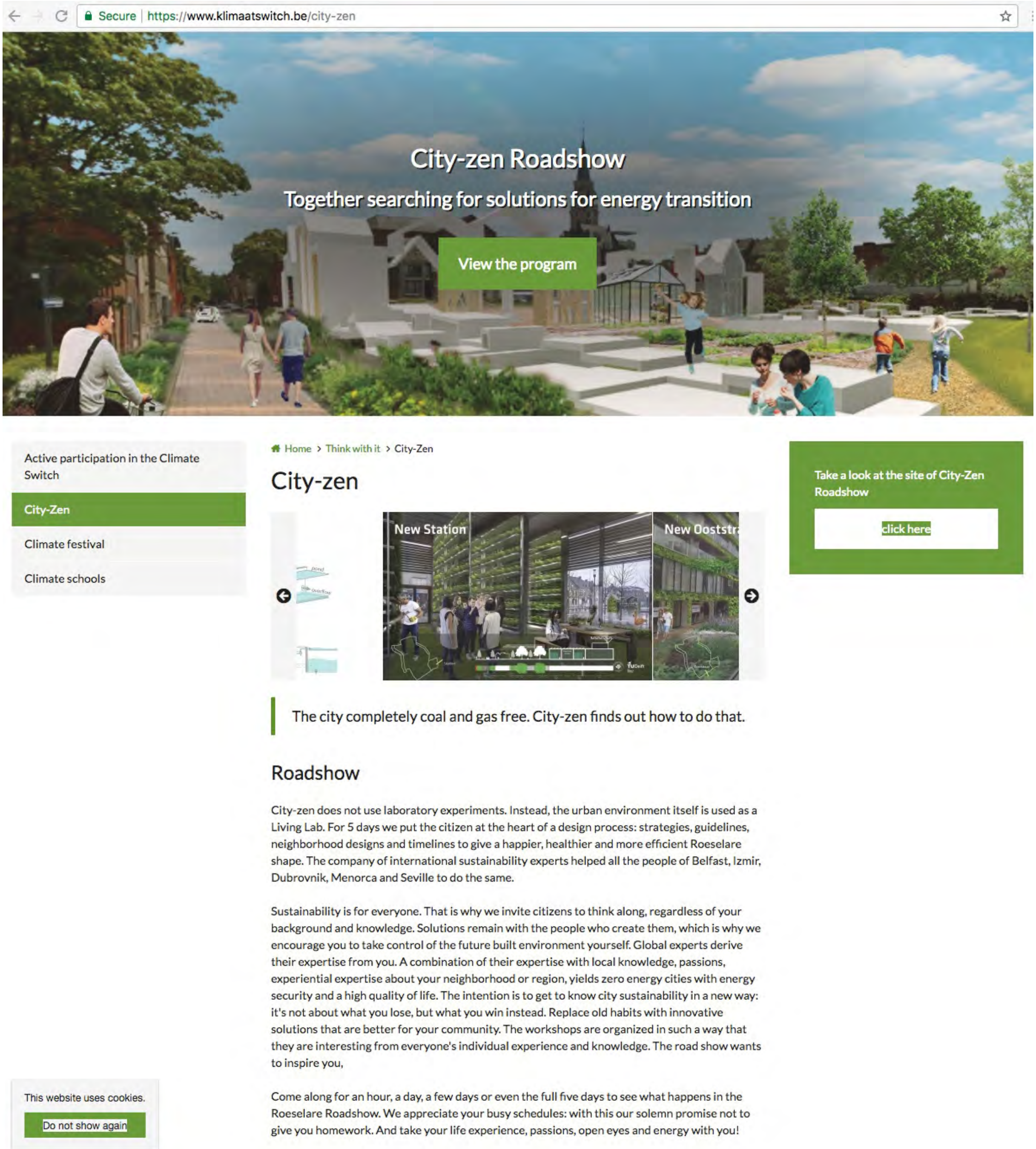
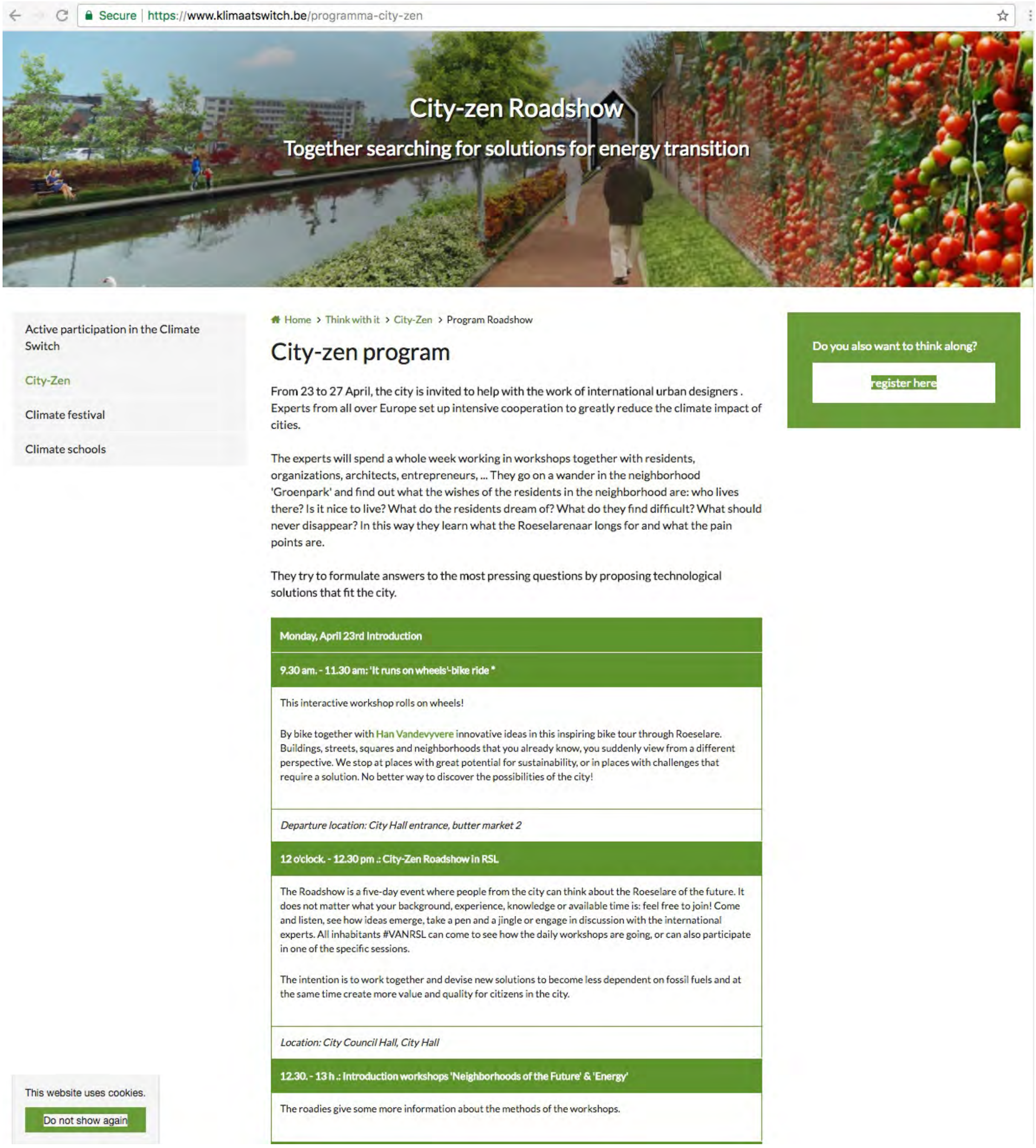


Fig 2. City-zen Roadshow 5- published on the Roeselare Municipality Website (Klimaatswitch.be). The pages setting out the aims and previous experiences of the Roadshow.



Secure | https://www.klimaatswitch.be/programma-city-zen

City-zen Roadshow

Together searching for solutions for energy transition

Active participation in the Climate Switch

City-Zen

Climate festival

Climate schools

Home > Think with it > City-Zen > Program Roadshow

City-zen program

From 23 to 27 April, the city is invited to help with the work of international urban designers . Experts from all over Europe set up intensive cooperation to greatly reduce the climate impact of cities.

The experts will spend a whole week working in workshops together with residents, organizations, architects, entrepreneurs, ... They go on a wander in the neighborhood 'Groenpark' and find out what the wishes of the residents in the neighborhood are: who lives there? Is it nice to live? What do the residents dream of? What do they find difficult? What should never disappear? In this way they learn what the Roeselarenaar longs for and what the pain points are.

They try to formulate answers to the most pressing questions by proposing technological solutions that fit the city.

Monday, April 23rd Introduction

9.30 am. - 11.30 am: 'It runs on wheels'-bike ride *

This interactive workshop rolls on wheels!

By bike together with Han Vandevyvere innovative ideas in this inspiring bike tour through Roeselare. Buildings, streets, squares and neighborhoods that you already know, you suddenly view from a different perspective. We stop at places with great potential for sustainability, or in places with challenges that require a solution. No better way to discover the possibilities of the city!

Departure location: City Hall entrance, butter market 2

12 o'clock. - 12.30 pm .: City-Zen Roadshow in RSL

The Roadshow is a five-day event where people from the city can think about the Roeselare of the future. It does not matter what your background, experience, knowledge or available time is: feel free to join! Come and listen, see how ideas emerge, take a pen and a jingle or engage in discussion with the international experts. All inhabitants #VANRSL can come to see how the daily workshops are going, or can also participate in one of the specific sessions.

The intention is to work together and devise new solutions to become less dependent on fossil fuels and at the same time create more value and quality for citizens in the city.

Location: City Council Hall, City Hall

12.30. - 13 h .: Introduction workshops 'Neighborhoods of the Future' & 'Energy'

The roadies give some more information about the methods of the workshops.

Do you also want to think along?

register here

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Fig 3. City-zen Roeselare Roadshow 5-Day Timetable published on the Roeselare Municipality Website (Klimaatswitch.be). A register for citizens to sign up for each fun-shop 'drop-in'.

13.30. - 3.30 pm .: Inspiring presentations #VANRSL

Pecha Kucha inspiration to build the RSL of the future, with ao

- SWAT students on 'Food route 8800', water buffers, city parks and innovation hubs!
- Evi Swinnen, about man in public space. Evi works at Timelab, a city lab for new cooperation models.
- Griet Juwet , researcher at the Vrije Universiteit Brussel (VUB), about her research into the heat network and the opportunities for Roeselare and surroundings
- Ine Petry from Inagro about 'Agrotopia'. The new roof greenhouse on the box shed of the REO Auction will be a unique test location where stakeholders can meet and work together.
- Cedric Depuydt from Association of Flemish Cities and Municipalities (VVSG), with inspiration from other cities
- Peter Hantson , chairman of Natuurpunt , the organization that protects the most beautiful and vulnerable nature in Flanders
- Jelle Rabaut, about the heating network
- WVI, David Vandecasteele is coordinator spatial planning and mobility at WVI, center of expertise for urban planning and spatial planning. He will teach you about Roeselare from a regional perspective!

Location: City Council Hall, City Hall

Tuesday 24 April Future views

9 am. - 10.30. or 14 hrs. - 3.30 pm: workshops 'Neighborhoods of the Future' & 'Energy'

Workshop 'Neighborhoods of the Future' *

The design workshop of Professor Greg Keeffe wants to show how existing facades, buildings, streets and neighborhoods in Roeselare can become more sustainable through creative and practical design interventions. Ideas with the aim of making life better, more lively and healthier for the residents of Roeselare, because they take their own energy future into their own hands.

Workshop 'Energy' *

In the Siebe Broersma 'Energy' workshop you will see how much energy we can save, reuse and recycle in the built environment of Roeselare. Systems such as heat pumps, energy cascades, green roofs / green facades, extensions to the existing heating network and many other technological applications show how we can reduce the energy consumption of Roeselare to zero. An important focus is near the 'Collievijverbeek', a typical urban neighborhood for Roeselare and the region.

Location: House of Nutrition, room Wheat

Wednesday 25 April Design

9 am. - 12.30 pm: Serious Game 'Go2Zero'

Go2Zero is a fun and interactive game about energy transition: the conversion from an environmentally harmful energy source to a less environmentally harmful energy source. The game helps local residents and policy makers to understand the driving force behind the energy transition in a neighborhood and to gain insight into which role they can play in this.

Play as one of the local stakeholders: resident, developer, grid operator, energy company, technology company or government. Your goal is to reduce CO2 emissions in your neighborhood. Build and install new technologies, work together and negotiate with other players to reach your common goal 'zero'!

Location: RSL Op Post, Hugo Verrieststraat 119 (Old post office)

13 you. - 2.30 pm .: Mini-masterclass C02 footprint and the steps we have to take

Dr. Riccardo Maria Pulselli will hold an informal and interactive workshop of one hour. In it he shows how we can calculate our own daily CO2 consumption. From individual CO2 consumption, Riccardo continues to determine the CO2 impact of the neighborhood, district, city and region.

Anyone who understands the challenge of sustainability can think about solutions. Riccardo demonstrates how design interventions and technologies can reduce the footprint over a feasible time period.

Fig 4. City-zen Roeselare Roadshow 5-Day Timetable published on the Roeselare Municipality Website (Klimaatswitch.be). Each fun-shop 'drop-in' would be best described to engage with the general public and gain maximum attendance and active participation.

Thursday, April 26 To evaluate

9 am. - 10.30. or 14 hrs. - 3.30 pm: workshops 'Neighborhoods of the Future' & 'Energy'

Workshop 'Neighborhoods of the Future' *

The design workshop of Professor Greg Keeffe wants to show how existing facades, buildings, streets and neighborhoods in Roeselare can become more sustainable through creative and practical design interventions. Ideas with the aim of making life better, more lively and healthier for the residents of Roeselare, because they take their own energy future into their own hands.

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Location: House of Nutrition, room Wheat

3.30 pm. - 5 pm: Discussion on sustainable urban vision

Informal discussion to cut the last knots.

Location: House of Nutrition, room Wheat

Friday, April 27 Outro

10 hrs. - 11 h.: A sustainable city vision #VANRSL with the Roadies

For ten weeks Roeselare was the playing field of international urban designers. They set up intensive cooperation to drastically reduce the climate impact of the cities by solving pressing questions. Which technology fits in the city? How should we deal with public space? What social issues are there? The climate plan in concrete development, supported and financed by the European Union.

Come and see their solutions!

Location: House of Nutrition, room Hop & Mout

11 hrs. - 12 h.: Roadshow discussion & Food for thought

Discussion with a snack and a drink

Location: House of Nutrition, room Hop & Mout

** Workshops 'Neighborhoods of the future' and 'Energy' are in English, although Dutch speakers are present. Presentations will include an interpreter for English - Dutch translation.*

Fig 5. City-zen Roeselare Roadshow 5-Day Timetable published on the Roeselare Municipality Website (Klimaatswitch.be). The final presentation of the sustainable 'City Vision' would be promoted and several local media networks and a national Belgium radio station.

The following describes the underlying approach undertaken in Roeselare and the project neighbourhood of Collievijverbeek. It will include a explanation of the Sustainable 'City Vision' that resulted. City engagement is an exciting and thought-provoking prospect. Many questions arise at the beginning of the journey. Making first contact with a prospective project location, conducting preparations, explanations and agreements is far from an exact science. The method of achieving this successfully has evolved city-by-city and is arguably as valuable as the sustainable solutions that result. There can be many political, cultural and language obstacles that must be overcome. The outcomes have the power to inspire and potentially be realised post-project. The first questions are who is 'the City'? What are the city's sustainable expectations and aspirations? What is the current and future calculated energy demand? Where are the urban challenges and potentials? Are they purely energetic, spatial & social, administrative or a combination of all? Does the 'City' even realize or accept they have challenges, despite its desire to be sustainable?

To answer these questions and many more, the project team began the process of identifying the cities that need, and more importantly want to collaboration or co-create with the expert team. First contact begins with an educational architecture design workshop studio (known as the SWAT Studio). This takes place in the months prior to the Roadshow. Developed and led by TU Delft under Prof. Dr. Craig Lee Martin, the student-focussed event facilitates an extended and detailed discussion with city stakeholders. The later and 'expert' Roadshow event model then follows and is conducted over a 5-day period based on 'themes' that guide the evolution of the vision. Here, expert global input is delivered at key points. Each event is constructed to relate to individual citizen experiences and knowledge, giving confidence in the processes that are extended to relate to streets, neighbourhoods, districts, city and in some circumstances the region or island. The project is not intended to be a one-way stream of information and ideas, instead the process aims to activate, convince, openly invite and encourage 'the City' to be part of the process at any level that they feel comfortable with. The method includes going out of the studio and into the wider community. To engage with various initiatives, to meet and talk with their members, no matter their age or background or expertise. The project leader selects cities that have diverse climates, urban typologies, economies and cultural backgrounds to ensure that the project develops a highly adaptable and compact, yet replicable, approach whatever the city and its circumstances.

1.1. AIMS

The aim is to develop an event model capable of implementation in all cities, in order to co-create with citizens from all backgrounds, a city's sustainable vision. Proposals developed exclusively by the project team, and not by the multidisciplinary or even transdisciplinary city stakeholders, would physically and metaphorically leave with the non-resident experts. Hence, a home-grown solution is key. A legacy must remain in which all participatory groups continue to exchange knowledge and speak with a common voice, making any future research bids (beyond the scope of the City-zen project) coherent, effective and impactful. The project wishes to extend its agenda by strengthening connections and bringing together a global family of project cities. Where experiences can be shared together with collaborative research bid proposals across the European community.

The most important target group are inhabitants of the neighbourhood, city and wider hinterland of the hosting city. Companies and start-ups in the field of technology and sustainability are encouraged to be active participants during the project. A key objective is to reach 600 students across the EU by visiting local universities, colleges and secondary schools. Students are the future. It has been a mutually beneficial approach to combine the energy and enthusiasm of architecture, urban planning and building technology 'SWAT Studio' Masters students with the stakeholders and students from the hosting city. The student projects, and more significantly the close relationships that were forged whilst conducting them, lay the foundation on which to build the intensive 5-Day City-zen Roadshow. Promotion, active-participation and dissemination contribute significantly to overall success. Consequently, the Roadshow and student SWAT workshop leader encourages any, and all, interested groups such as municipalities, neighbourhood associations and universities to grasp the opportunity to do so. Taking the time to discuss what is expected and allay any reservations or doubts that may arise. The Roadshow will not criticize a city's perceived lack of sustainability. Roadshow team specialists are aware of many complex global and local level challenges that must be overcome together for a renewable energy transition to take place.

Fig 6. The Roeselare 'SWAT Studio' ('Intervention' 2-week period - 26th February to 08th March 2018). A MSc's Building Technology 'Onsite' studio (TU Delft, The Netherlands), an educational precursory event that took place 2 months prior to the start of the Roeselare Roadshow. During the SWAT Studio, the aims and objectives of the City-zen Roeselare Roadshow would be disseminated on local media streams. Student design proposals and associated renders, drawings and models would be used to prompt discussions with stakeholders and communicate the expert aims of the upcoming Roadshow.

1.2. Objectives

1.2.1 Student Engagement

A Masters Level Building Technology student workshop (known as the SWAT Studio), with identical project aims as the 'expert' professional Roadshow, develops and proposes technologically innovative and contextually driven urban interventions. A key ambition of the design workshop is to demonstrate that, through building interventions at all scales ranging from façade, building, street, neighbourhood and district, that sustainable lifestyles are possible within existing cities. The identical aim of the City-zen Roadshow during its approach to zero energy and carbon cities. In Roeselare at the hosting venue at Huis van de Voeding (http://fabriekenvoordetoekomst.be/huis-van-de-voeding) students from The Netherlands and forged pre-Roadshow relationships with key city stakeholders and Community leaders. For the Roadshow project site at Collievijverbeek, a key stakeholder would be Thierry Bouckenooghe. Thierry's support and feedback was a pivotal part of the SWAT Studios understanding of the local context. On this basis, Thierry would become an organising stakeholder, and led part of the site investigation on day 1 of the Roadshow.

The outputs of SWAT Studio would be presented to a stakeholder audience on day one of the Roadshow. An audience compromising many individuals and companies who had collaborated previously with the SWAT and now would join with the opening of the Roadshow. These included Mirom (waste recycling company); Inagro (Urban agriculture research & development company); VRP (The Flemish Association for Space & Planning); VVSG (Flemish Social Policy Organisation); Vivies (Higher Education College, KU Leuven); VRIJE (University, Brussels); WVI (Housing Support & Management for Flemish Councils).

1.2.2 Process

In Roeselare, the process of Roadshow preparation, as described previously, began 2 months prior to the project start with a collaborative Masters Level Building Technology and architecture student workshop. Both the workshop and the Roadshow itself were developed to be fun and yet 'intensive'. Components such as seminars, walking tours, design fun-shops and mini-masterclasses within the 5-Day period were strategically timed and citizen focussed. The outputs, synchronised with specific project team specialisms in energy and urban design. Outputs were qualitatively spatial and quantitatively energy focused, combining to form the Sustainable City Vision on the final day of the Roadshow on Friday 27th April 2018.

1.2.3 Daily Activities

Daily activities would involve citizens, architects, municipality staff, PhD students, academics and energy consultant's visiting the projects studio base at the Huis van de Voeding (venue donated by the Municipality of Roeselare) and various public and private chambers at the City Hall itself. The 5-Day programme was devised in such a way to encourage participants to 'drop-in' and 'drop-out' so that the project fun-shop activities and Mini-masterclasses could fit into their professional and family schedules. This a strategy that would increase city involvement dramatically. According to Roeselare Municipality figures over 300 stakeholders visited the Roadshow over the 5-day period.

'PechaKucha' style presentations (meaning 'chit-chat' in Japanese) would be the chosen format of all presentations given by partnering stakeholders and the Roadshow team. This allowed an exchange of concise and fast-paced information flows facilitating a multiple-involvement event. A strategy giving both Roadshow 'ownership' to the residents of Roeselare and communicated well what participants should expect to happen through the week. Roeselare's Municipality Klimaatswitch team also contributed with Pechakucha's outlining past, present and future aspirations for their city.

This co-creative method aims to foster an intensive working environment, yet one, allowing adequate flexibility to ensure maximum stakeholder participation at whatever level they feel comfortable. It must be respected and appreciated that all stakeholders are likely to have full time jobs and a family life beyond any project, their attendance is self-financed. Therefore, a role of the Roadshow leader is to strike a balance between stakeholder commitments and availabilities. Discussions involve conveying the urgency of being part of the process, but not to an extent that distances prospective attendees. During the Roeselare SWAT Studio, many face-to-face preparations and negotiations took place with stakeholders at their convenience. Various visual descriptors would be shown to communicate what is expected during the Roadshow. Images taken during the previous Roadshows in Belfast, Izmir, Dubrovnik, Menorca and Sevilla would be highly effective in translating what was to come in Roeselare. Coloured marker pens, rolls of tracing paper, laptops and notebooks are the tools of choice for the project participants.

Roadshow activities have the same aim, energy neutrality. However, each component is enjoyably diverse and offered new perspectives and skills on how to attain it. Whilst two parallel fun-shops ran continually over the week, participants sign up to play the Go2Zero Serious Game. Roeselare's stakeholders, which included the Mayor (Kris Declercq), 'Role' played, having fun whilst experiencing the cause and effect of energy strategy decisions made at the regional, neighbourhood and family household level.

Fig 7. Roeselare's citizens, the Mayor (Kris Declercq) and European Policy Officer (Eric Lecomte) getting into the game and having 'energetic' role-playing fun whilst learning the implications of energy choices at the large commercial and domestic level.

1.3. ROADSHOW AT A GLANCE

The following points list 18 keywords that best describe the story and ambitions of the City-zen Roadshow:

1. **ZERO ENERGY** Aims to develop and demonstrate Zero Energy Cities with a central role for citizens.
2. **MOTIVATE & EMPOWER** End-users to a long-term energy saving attitude.
3. **CITIZENS** Placed in the heart of a creative process that develops designs, strategies, guidelines and timelines at all scales of their own cities built environment.
4. **NUMBERS** 4 Cities completed - 3 months prep / city - 5 days onsite / city - All Citizens - 7 International sustainability experts - 6 Cities next.
5. **IMPACT** Healthy lifestyles, environmental comfort, building efficiency, independence from fossil fuel uncertainty. But most of all confidence that sustainability is for all who want it.
6. **TRUST** Citizen's need belief in the process, objectives and solutions, no matter how radical or unfamiliar. Students open the door!
7. **OWNERSHIP** Citizen's take ownership of their built environment without fear of hidden agendas, affiliations or political constraint.
8. **HOMEGROWN** The solutions stay with the people.
9. **WHO IS THE CITY?** Doesn't matter where the ideas come from, as long as they come and begin to be realized.
10. **DISRUPT** Project rocks the status quo to reach zero energy.
11. **GLOCAL** Specialist global expertise combined with local stakeholder energy and knowledge of context and lifestyle.
12. **GRAPHICAL** Use graphical descriptions to get your messages across.
13. **SACRIFICE?** It's not about losing, it's about what you gain. Replacing it with something better for your children and community.
14. **TIMETABLE TO SUIT** Schedule to fit stakeholders, not the other way around. Remember, stakeholders are not on the payroll, they have other daily priorities.
15. **INDIVIDUAL PERSPECTIVE** Make sure activities relate to the people and their experiences. These can be expanded later to other scales.
16. **COMPARISONS** To design what is possible is one thing, to show what has been realized or what can occur under the right circumstances is even better.
17. **HIGHLY VISUAL** Outcomes to be colourful representations of the future, before/after scenarios.
18. **BE INSPIRATIONAL** Encourage 'City Vision' participants to take the lead in the next step!

CHAPTER 2 – ROADSHOW COMPONENTS

Two parallel workshops continue throughout the project week, on arrival stakeholders are guided to select one workshop depending on their interests or specialisms, however migration to each is recommended in order to get a full overview of energy and urban strategies and their implementation. At the end of each day the workshops meet to summarise their findings and to agree on that evenings and the following day objectives. As an example of how the project approaches each city, the following describes the journey and activities undertaken in Roeselare and within one of its typical neighbourhoods - Collievijver-beek.

2.1. FUTURE NEIGHBOURHOODS (WORKSHOP 1 – DAY 1 TO 5)

Convenor: Prof Greg Keeffe Queens University Belfast.

2.1.1 Background

The car has shaped the 20th century city. In Roeselare car usage is very high and the development of very low-density suburbia around the city. Energy usage from cars is the highest proportion in any of the Roadshow cities. Once again, like so many urban neighbourhoods, Roeselare’s suburbs are surrounded by a hard edge of car-dominated space.

2.1.2 Aim & Objectives

The aim of the workshop was to develop strategies at a range of scales that allow a process-based adaptation of the city to carbon neutrality. The scales utilised were: the city, the neighbourhood, and the building. The city scale is important because city form is the basis for the behaviours engendered in the city. Here urban grain can encourage or discourage car usage, can allow safe routes for schoolchildren, and connect the inner city with the countryside. The neighbourhood scale allows us to visualise the commons- ie the things we share. This may be things such as smart grids, or other networks, but may also be spaces for meeting, playing or growing. Green networks are important too, not only allowing citizens to enjoy nature and travel free from traffic, but also that the softness helps to prevent flooding and adds eco-services to the city. Energy storage is most cost-effective at this scale too, as is car share. In addition, density is one of the key factors in making neighbourhoods function, and many behaviours are linked to this – such as car usage, local economy etc. The house or building scale is crucial, because here we see many of the technologies for neutrality being employed. Technologies such as PV cells, heat-pumps, shading devices, DHW production all have been developed to work at this scale.

2.1.3 Methodology

The workshop starts with an understanding of city form, historic and future growth, urban grain, climate, eco-system services and density. From these initial studies, an understanding of the city as a holistic super-organism is developed. This bio-climatic understanding allows new insights into current trajectories. Urban design is based on understanding urban trajectories and deflecting or manipulating them, to create new futures in a seamless way. Once a sustainable urban design strategy for the city is developed, we change to the neighbourhood and building scales to look at the issues this strategy creates at the smaller scales. More detail can be developed here, and the solutions become more technological. We then visualise the impact these technological insertions have on the built environment and the lifestyles of the residents.

2.1.4 Experiences & Insights

The City

Roeselare is a small city, situated in a rural location, which is home to many large agricultural industries associated particularly with frozen foods. Although the city is small in terms of inhabitants it covers a large area, because much of the housing density is very low. In fact, in some places it is close to American levels of 10-15 homes per hectare. The city is surrounded to the North by a motorway and to the South, East, and West by a dual carriageway ringroad structure. A series of neighbourhoods sit in a radial fashion between the city centre and this ring, separated by arterial roads. Once again, like so many of the previous neighborhoods, these arterial roads are over-sized and the connection between them and the neighbourhood is characterised by a retreating edge of grass that has few connections, so there is a lack of permeability.

Mobilities

Car usage is very high in the city, and the neighbourhood has much car infrastructure even though the density is low. The large-scale roads that bound the neighbourhood offer easy access to the city by car, and discourage cycling. Walking is not encouraged due to the lack of permeability in the neighbourhood, and there is no public transport that is routed through the neighbourhood.

Neighbourhood

The neighbourhood chosen is of low density, consisting of a mix of terraced and detached houses, In the North nearer to the city are terraced blocks of reasonable density, but towards the ringroad, house become detached and much larger (upto 300m2), and the density decreases to as low as 10 homes per hectare. Throughout the neighbourhood there is a poor disconnected urban grain.

The low density, means there is low urban intensity, and thus there are no shops or community facilities at all in the neighbourhood. Car usage is high and residents drive everywhere, for all amenities – shopping, leisure, education etc.

Buildings

All the buildings are privately owned, and range from early 20th Century terraces to detached houses of the last twenty years. Technologically the buildings are poor too, and there are few renewable systems employed.

2.1.5 Outcomes

Neighbourhood

The workshop developed a new strategy plan for the city, which aimed to reactivate neighbourhoods by giving each a focus, connecting them with green routes and blurring the connection between themselves and the city (Fig 8.).

Fig 8. Blurring boundaries.

One key issue with the neighbourhood is flooding. Although this fell outside the remit of the project, the solution to improving cycle and walking connections allowed the team to create a new green-blue infrastructure that could also help prevent flooding. By reinventing the culverted stream as a natural water course and developing a series of bio-swales that linked to it, a highly connected green route to the city was created.

In addition to this a new cycle route was developed through the neighbourhood that gave rapid connection to the city (Fig 9.).

Fig 9. Bio-swales that linked to it, a highly connected green route to the city.

Between the two infrastructures in the centre of the neighbourhood a new focus was created (Fig 10). This social hub was a local market, that allowed the selling of local produce. It was envisaged that the neighbourhood could use its lack of density to develop an urban agriculture strategy that could create a low carbon economy, supported by the agro-industrial expertise of the surrounding industry. In addition, by blurring boundaries with the city, and developing the old hospital site at a reasonably high urban density, the intensity of the neighbourhood could be improved. This would help to establish the new neighbourhood centre.

Fig 10. Bio-swales and social hub was a local market, that allowed the selling of local produce city.

<u>Building scale</u>

The neighbourhood consists of two major building types: near to the city are older terraces in blocks and to the South are larger independent dwellings. Energy and food strategies were made for both types

Terraces (Fig 11a). The blue/green castles: here the houses were renovated and linked to a smart grid and heat network. The gardens were linked together and the court created turned into a community market garden that was glass-covered. This helped not only to reduce energy, but also to create a new productive urbanism, and surplus food could be sold in the market for local currency.

Detached houses (Fig 11b). The techno-terp: here due to the low-density community sharing features are more difficult, so each house is developed as an autonomous system, not only for the production of energy, but also by utilising both roof and garden, for food.

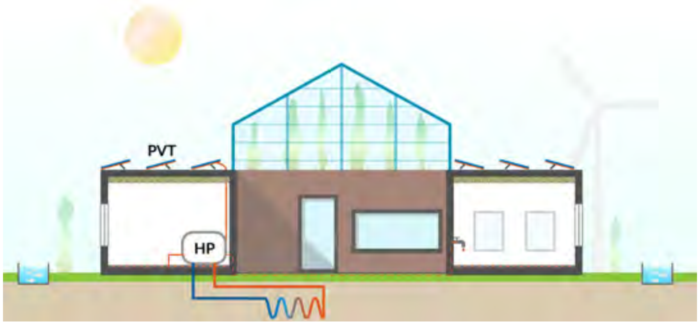

Fig 11a. Terrace strategy.

Fig 11b. Detached House strategy.

<u>Public function</u>

Here, by utilising a link between the two parallel new green infrastructures a new community facility could be created that developed a focus for the neighbourhood, and a place to buy and share food. The increased density of the new housing on the hospital site helps to support this, by increasing the number of people within 500m.

2.1.6 Future Development of Workshop

The workshop results were excellent, and the engagement with practitioners, city governance and local people was superb. The city is in an excellent position to develop energy and urban strategies that can be game-changing. The team urges the city to act directly and quickly and with vision to make sure that the opportunity is not lost. The neighbourhood could find a new focus in the sharing of food and energy infrastructures along with new mobilities through green and blue links in the city.

2.2. ENERGY TRANSITION WORKSHOP

by Siebe Broersma and Riccardo Pulselli

2.2.1 Background

The Energy Transition Approach developed for and during the roadshows has evolved in time and the results depend, amongst other factors, on the availability of data of energy use and other data. For the case of Roeselare, a lot of detailed and useful data was available, resulting in a very complete energy transition roadmap.

The energy transition workshop of the Roeselare Roadshow always starts with Carbon accounting and Energy Potential Mapping. This concerns the definition of current energy demand, the carbon emissions and energy potentials. Next, scenarios are discussed and the most feasible one, fitting the future goals, is elaborated and calculated. Different energy interventions are proposed throughout all scale levels from the scale of single households to that of building blocks and streets, up to the neighbourhood and the whole city. Finally, the proposed future scenario for the municipality is assessed again by carbon accounting.

2.2.2 Energy Analysis

<u>Carbon Accounting Roeselare</u>

The Carbon Accounting procedure developed during the Roadshows has a dual role: first, to assess the Carbon Footprint (CF) of the city and, afterwards, to ex-ante estimate the effects of CF mitigation measures.

Statistical data in this report refer to the Municipality of Roeselare (2017). The energy demand for industry has been partially considered (estimated 100 GWh) because the energy supply of industrial production has been omitted (this would need very specific interventions for optimisation and impact mitigation such as that concerning a product and its lifecycle processes). The Carbon Accounting methodology systematically follows the framework presented by Pulselli et al[1] including values of Emission Factors (EF). In particular, the EF for electricity has been assessed based on the electricity grid mix of Belgium (i.e. 0.181 kg CO_2eq/kWh, given: 29% thermoelectricity powered by natural gas; 51.7% nuclear; 17.9% renewables; 1.4% net import). The impact of energy use in different sectors has been assessed based on the use of different fuels. Both electricity and fuel mix per sector are shown in Table 1, together with the EF used per fuel type; information in this table allows for assessing the carbon emission of each sector, based on the current fuel mix.

[1] Pulselli R.M., Marchi M., Neri E., Marchettini N., Bastianoni S. 2018a. Carbon accounting framework for decarbonisation of European city neighbourhoods. *Journal of Cleaner Production* 208, 850-868

	ELECTRICITY	FUEL MIX	Nat gas	LGP	Oil	Coal	Biomass	Solar-thermal	Geo-thermal	Diesel	Gasoline	Bio fuel	TOTAL MWh
Emission Factors	**0.181**	_	**0.252**	**0.263**	**0.281**	**0.400**	**0.114**	**0.000**	**0.000**	**0.285**	**0.266**	**0.000**	_
RESIDENTIAL	**93,402**	**321,820**	81.6%	3.8%	_	_	13.5%	0.3%	0.7%	_	_	_	**415,222**
TERTIARY	**176,876**	**265,771**	85.0%	1.1%	13.8%	_	_	_	0.1%	_	_	_	**442,647**
INDUSTRY*	**215,918**	**100,000**	100.0%	_	_	_	_	_	_	_	_	_	**315,918**
PUBLIC LIGHTING	**5,546**	_	_	_	_	_	_	_	_	_	_	_	**5,546**
AGRICULTURE	**3,419**	**24,973**	47.6%	0.4%	50.0%	2.0%	_	_	_	_	_	_	**28,392**
MOBILITY	**63**	**284,554**	_	0.2%	_	_	_	_	_	82.4%	14.3%	3.0%	**284,617**
PUBLIC TRANSPORT	_	**6,122**	0.5%	_	_	_	_	_	_	93.9%	2.5%	3.0%	**6,122**
TOTAL	**495,225**	**1,003,239**	**600,694**	**15,578**	**49,280**	**492**	**43,560**	**1,129**	**2,593**	**240,233**	**40,888**	**8,791**	**1,498,464**

Table 1. Energy demand per sector in the Municipality of Roeselare and Emission Factors per source.

Results from the Carbon Accounting process are shown in Table 2 considering different emission sources. These also include impacts of waste and water management systems. In particular, the impact of domestic waste treatment depends on the waste management system that currently exists in the area (i.e. 0.256 kg CO_2eq/kg, given: 29% waste to energy; 21% organic; 4% landfill; 46% recycling). Electricity has been aggregated considering the demand of the different sectors (only electricity for public lighting is shown separately in the table). The CF of Roeselare has resulted in 351,842 t CO_2eq on annual basis (2017).

Emission source	**unit**	**rawdata**	**t CO_2-eq**	**%**	**Note**
ELECTRICITY	MWh	489,679	**88,429**	25.1%	Electricity: total multi-sectorial demand
HOUSING	MWh	321,820	**74,251**	21.1%	Fuel mix: space & water heating and cooking
TERTIARY	MWh	265,771	**67,957**	19.3%	Fuel mix: private and public service buildings
INDUSTRY	MWh	100,000	**25,169**	7.2%	Nat. gas for heating. Production processes not included
PUBLIC LIGHTING	MWh	5,546	**1,002**	0.3%	Electricity: specific use for public lights
AGRICULTURE	MWh	24,973	**6,729**	1.9%	Fuel mix: machinery and management in farms
MOBILITY	MWh	284,554	**77,881**	22.1%	Fuel mix: private car use
PUBLIC TRANSPORT	MWh	6,122	**1,689**	0.5%	Fuel mix: public transport
WASTE MANAGEMENT	t	28,345	**7,260**	2.1%	Mass: domestic waste by households
WATER MANAGEMENT	m3	2,521,692	**1,476**	0.4%	Mass: water use in households
TOTAL			**351,842**	**100%**	

Table 2. Carbon Footprint of the Municipality of Roeselare per activity sector.

In order to drive the transition process, with special attention for the housing sector, a typical household in Roeselare has been profiled by scaling down municipal data (26,349 households have been assumed within the municipality, given 3.24 inhabitants per household and 61,657 inhabitants). The CF of a household in Roeselare is therefore 6.75 tonne CO_2eq.

Household emission source	unit	rawdata	kg CO_2-eq	%	
ELECTRICITY	kWh	3,545	**640**	9.5%	Lighting & appliances, cooling
HEAT	kWh	12,214	**2,818**	41.8%	Space & water heating, cooking
MOBILITY	kWh	10,802	**2,956**	43.8%	Private car use
WASTE	kg	1,076	**276**	4.1%	Domestic waste production and management
WATER	m3	96	**56**	0.8%	Tap water use
TOTAL			**6,746**	**100%**	

Table 3. Carbon Footprint of the typical household in Roeselare per emission source.

The Carbon Accounting procedure has been incrementally developed to perform in the intensive and short period of a Roadshow. Compared to a standard greenhouse gas inventory, it allows for assumptions and approximations, nevertheless outcomes are coherent and have a required level of detail. From the scale of the household to that of the city, they are used to evaluate strategies of energy transition and drive choices of both energy and urban designers.

2.2.3. Energy Potential Mapping

Statistical data of the current energy use in Roeselare have been analysed and compared to realistic energy potentials from renewable sources in the city to plan for the most realistic energy strategy with the goal of becoming carbon neutral. Electricity demand has been calculated to be almost 500 GWh_e, whereas the potentials are estimated to be almost 780 GWh_e. For proper estimations, the physical context, local climatic conditions and technical limitations of electricity production have been studied, e.g. available roof surfaces and non-roof surfaces for energy production, annual solar radiation, average wind speeds, efficiencies of solar panels and wind turbines and the availability of waste (Fig 12).

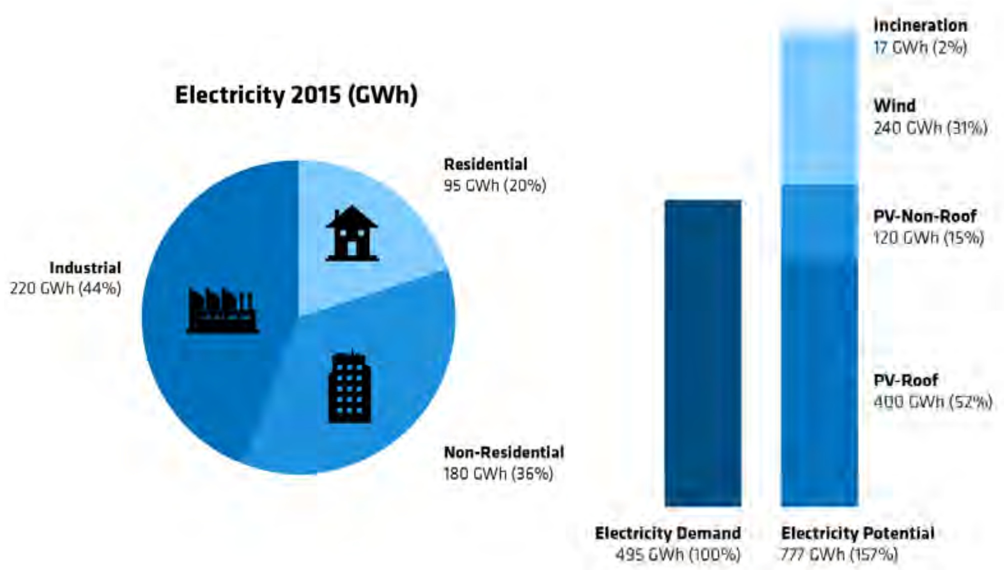

Fig 12. Current electricity demand by user type (left), compared to potentials in the Municipality of Roeselare (right).

For the installation of photovoltaic (PV) panels 235 hectares of roof are available, of which 50% is considered to be suitable for energy production. 80 hectares are estimated to be available along roads etc. (for non-roof PV installation) and there is space for 40 large 4MW wind turbines considering a reasonable distance between turbines and keeping local regulations for installation in mind (e.g. minimum distance from buildings). And finally, the amount of waste-to-energy power is estimated.

Similarly, the heat demand (around 712 GWh) can be supplied by a series of potentials of high-temperature (HT), medium-temperature (MT)) and low-temperature (LT) sources with an estimated potential of 4735 GWh (Fig 13). The use of MT and LT sources in existing buildings most often requires energy renovations.

HT sources (above 65°C) include heat from waste incineration, based on the caloric value of the current waste stream of Roeselare (130 GWh_{th}), the estimated amount of industrial waste heat (100 GWh_{th}) and some of the potential of solar heat from solar collectors mounted on the available roof surface (1480 GWh_{th}). In figure 13 half of this last potential is dotted, to indicate that the potential from energy on roofs is 'shared' with the potential of PV(T).

MT (40°C - 65°C) sources include most of the potential of solar heat from solar collectors and residual heat from cooling and some industrial processes (estimated to be 25 GWh_{th}). Heat of this temperature can be stored in closed-loop Borehole Thermal Energy Storage (BTES).

LT (below 40°C) sources are PV-thermal heat, which is heat of around 30-35°C from PVT panels, solar panels that produce electricity and heat, and waste heat from greenhouses and buildings themselves, which can be stored in open-source Aquifer Thermal Energy Storage (ATES) systems in the underground.

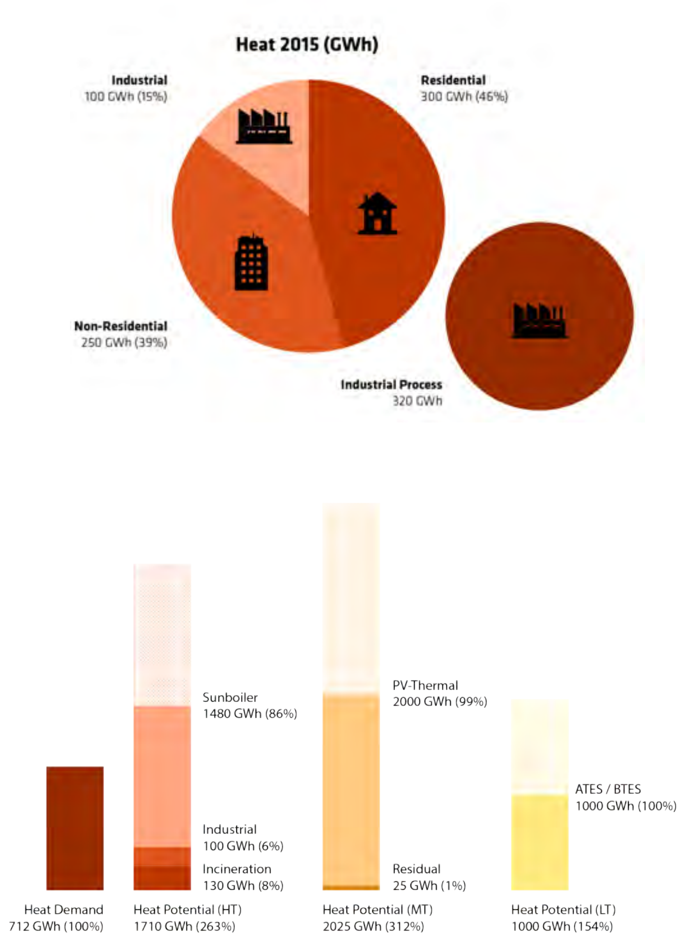

Fig 13. Current heat demand by user type (above) compared to potentials in the Municipality of Roeselare (below).

2.2.4. Energy Transition Design

The strategy to develop an energy transition design concerns an accurate selection of energy systems and technologies that are to be integrated in the urban context. The 2050 objectives of energy neutrality have been determined and specifically structured based on the most suitable solutions that are identified out of the energy potential analysis and assumptions that are made during the workshop. Now first the energy scenario for heating has to be defined with the shifts of sources and main energy technologies over time. Next the energy scenario for electricity. Successively, roadmaps can be derived with amounts of actions and measures that have to be taken in order to meet the proposed scenarios.

Energy scenarios

The heat demand of the current building stock (712 GWh_{th}) is assumed to decrease in time (Fig 14), because significant effects (-20%) can be achieved in terms of energy saving (and replacement of poor performing buildings) due to a robust campaign of building retrofitting. New buildings will have a low additional heat demand and are supposed to be almost energy neutral, so they will produce their own demand. The remaining heat demand for the current building stock (565 GWh_{th}) can potentially be generated by a combination of HT (30%), MT (25%) and LT (25%) sources and distributed at the urban scale in collective projects by District Heating Networks (DHN) and Mini Heat Grids (MHG) or by individual systems on heat pumps or other devices. The combination of sources are chosen by firstly selecting what is most easily available in HT sources (like heat from available biomass, industrial waste heat and waste incineration) and secondly from what is still needed to be produced actively at often lower temperature sources from e.g. solar collectors in combination with ATES (Aquifer Thermal Energy Storage) systems.

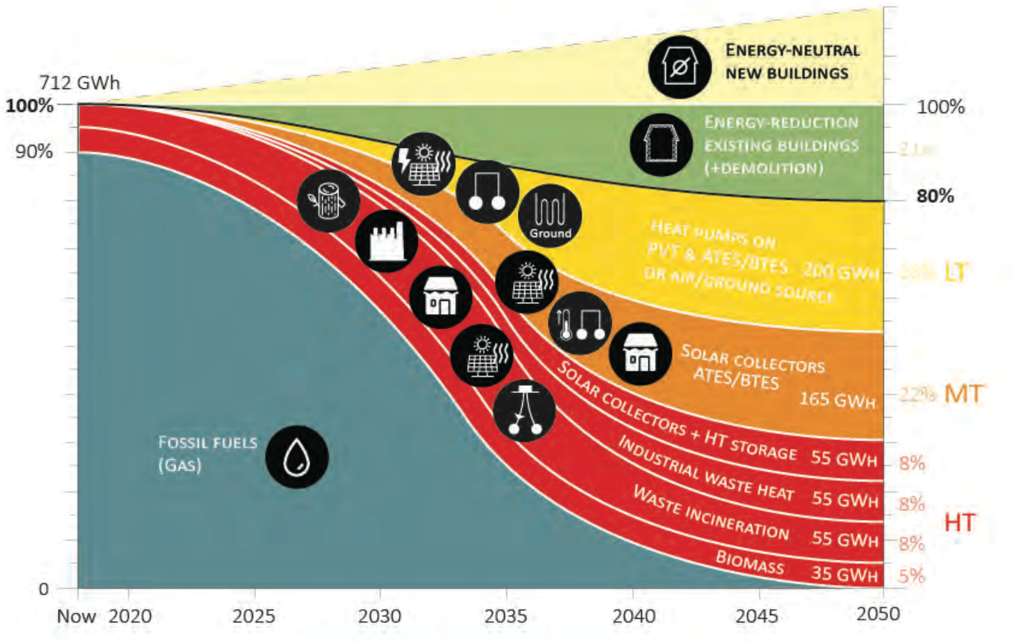

Fig 14. Current heat demand and 2050 scenario for the Municipality of Roeselare.

The electricity demand (495 GWh$_e$), is expected to further grow towards 2050 due to electrification of heating systems (by the use of heat pumps) and to the electrification of transportation. Although the urban population is expected to grow, the increase of electricity use caused by this, is expected to be compensated by a relative reduction of electricity use from residential, tertiary (non-residential) and industrial sectors (see figure 15).

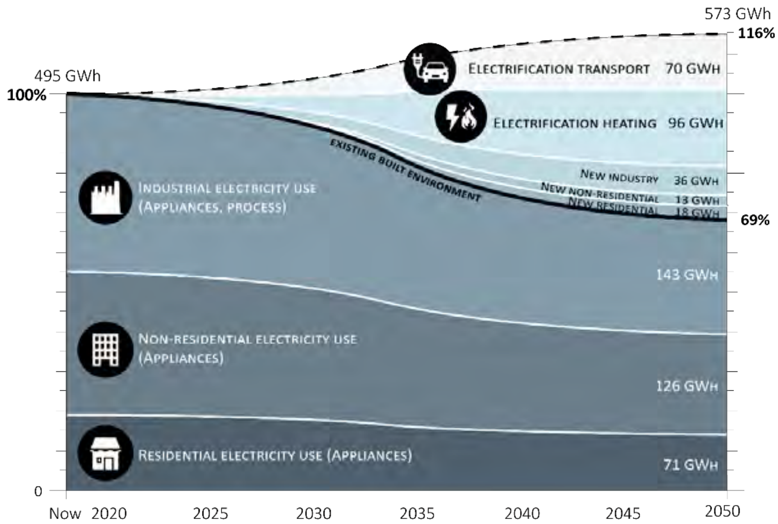

Fig 15. Current electricity demand and future scenario for the municipality of Roeselare.

The mobility system also calls for major changes, the proposed scenario foresees in a shift in modal split and electrification. The modal split scenario has a high increase (up to 40%) of light mobility systems, e.g. pedestrian and cycling. The remaining 174 GWh would be used by improved use of public transport (25%) and reduced use of private cars (35%) (figure 16, left) The electrification scenario foresees a full transition from fossil fuels to electric mobility, to 70 GWh$_e$, which would be supported by an increased production of renewable electricity.

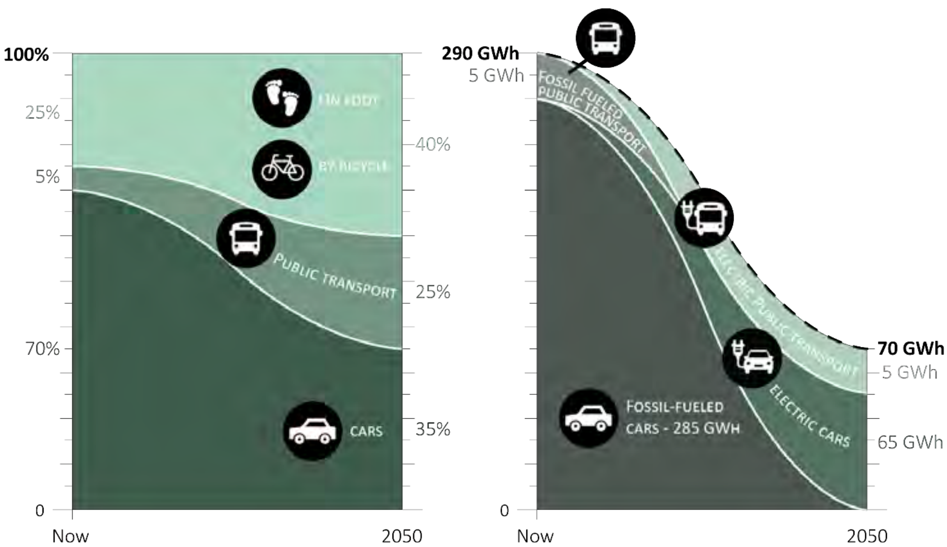

Fig 16. Modal split scenario (left) and electrification scenario (right) towards 2050 for the Municipality of Roeselare.

This final electricity demand can be supplied by a mix of renewable energy sources as indicated in figure 17, including 240 hectares of PV modules (around 350 GWh_e), 25 4MW wind turbines (around 200 GWh_e) and the co-generation by waste incineration (20 GWh_e).

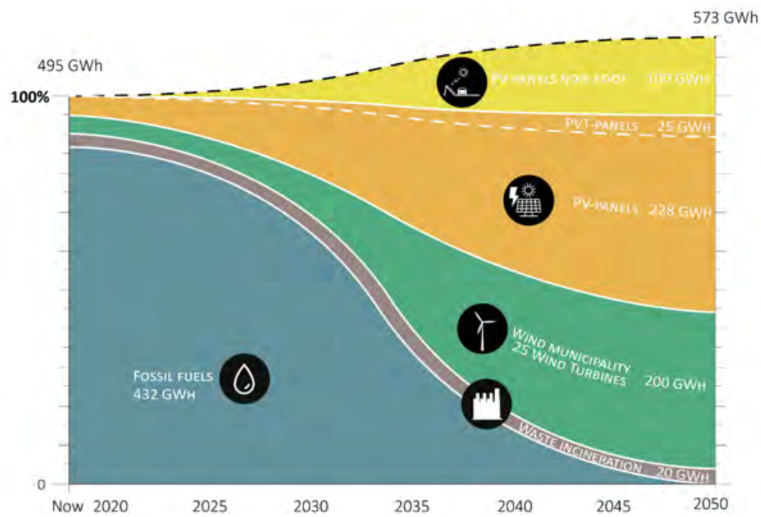

Fig 17. Current electricity demand and 2050 scenario for a carbon neutral municipality of Roeselare.

2.2.5. Energy Transition Roadmaps

In a next and successive step, roadmaps were made based on the energy transition scenarios, that show measures and actions needed in order to get towards the 2050 vision. For the heat transition for example, renewable sources of high, medium and low temperatures are proposed to replace the current gas (and other fuels) to heat buildings. Yet, the current building stock will not always be suitable to be heated with medium or low temperatures. Therefore, energy saving measures for buildings (energy retrofitting) will often be required. With knowledge of the energetic performances of the buildings, as we gradually get more and more in European cities (and as also demanded by the EU's Energy Efficiency Directive) expressed in energy performance labels, we can derive these. Assumed, in the case of Roeselare, is that buildings with an A-label performance are able to be heated with low-temperature sources and buildings with a B- or C-label can do with medium temperatures and need renovations for low-temperature sources. A large part of the building stock in Roeselare has poor labels (D, E, F or G) and can only be heated with high temperature sources or need renovations for medium (or low) temperature heating. From previous heat scenario can be derived at which temperature levels buildings have to be heated by 2050 (figure 18). The amounts and types of energy renovations can now be expressed in typical measures per year for certain time frames (e.g. 500 renovations from G, F, E or D label residential equivalents to a C or B label per year in the period of 2018-2050), see figure 19.

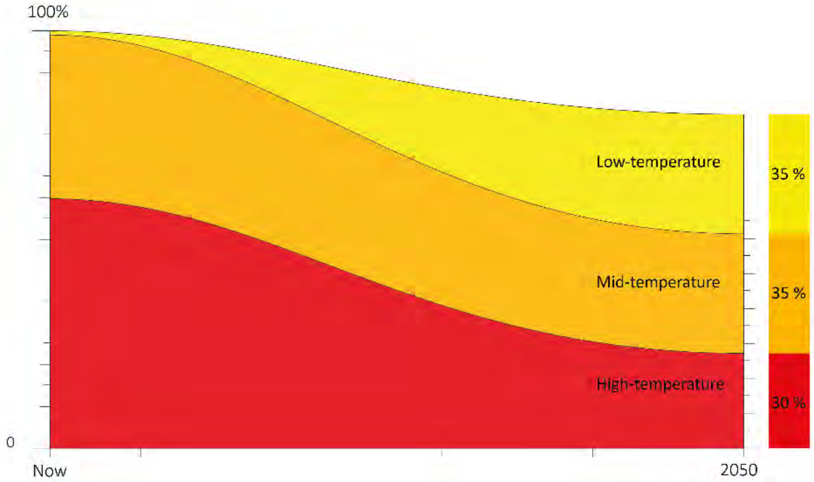

Fig 18. Shift of required temperature levels towards 2050.

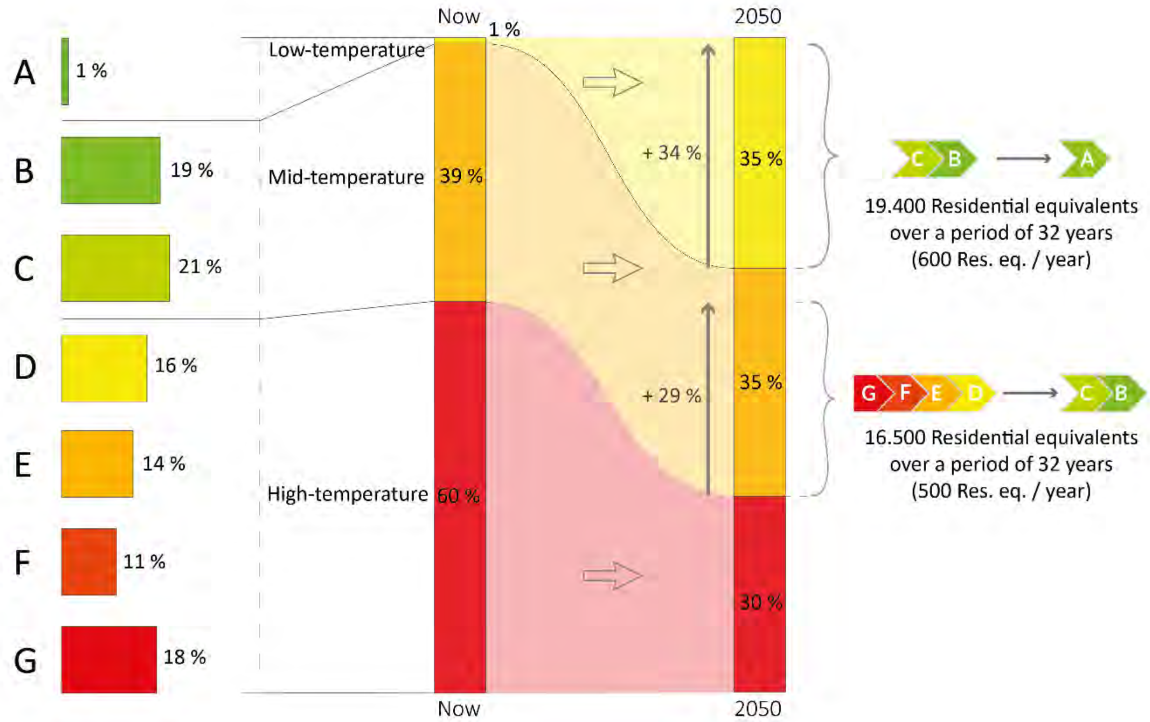

Fig 19. Division of energy labels of the current building stock and the required future energy renovations up to 2050.

Finally, all actions and measures for the sustainable heating of Roeselare, including heat production, storage and different types of renovations are put in the roadmap as shown in figure 20. Measures related to high-temperature systems are in red, measures related to mid-temperature systems are orange and low-temperature is indicated in yellow. This step again tries to unravel the complexity of energy transitions and demonstrates for city councils for example what is needed to achieve their targets.

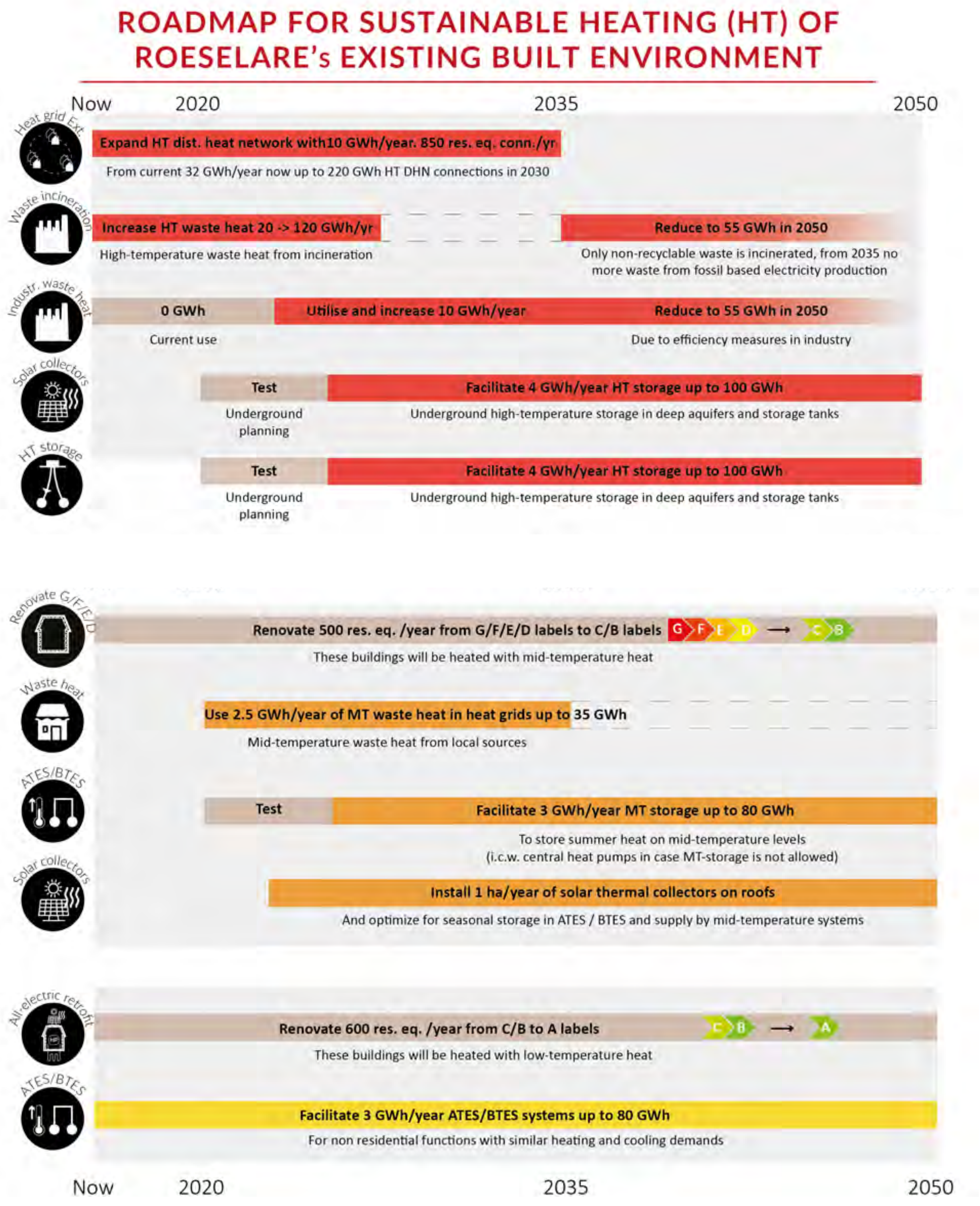

Fig 20. Energy transition roadmap for heating of the municipality of Roeselare.

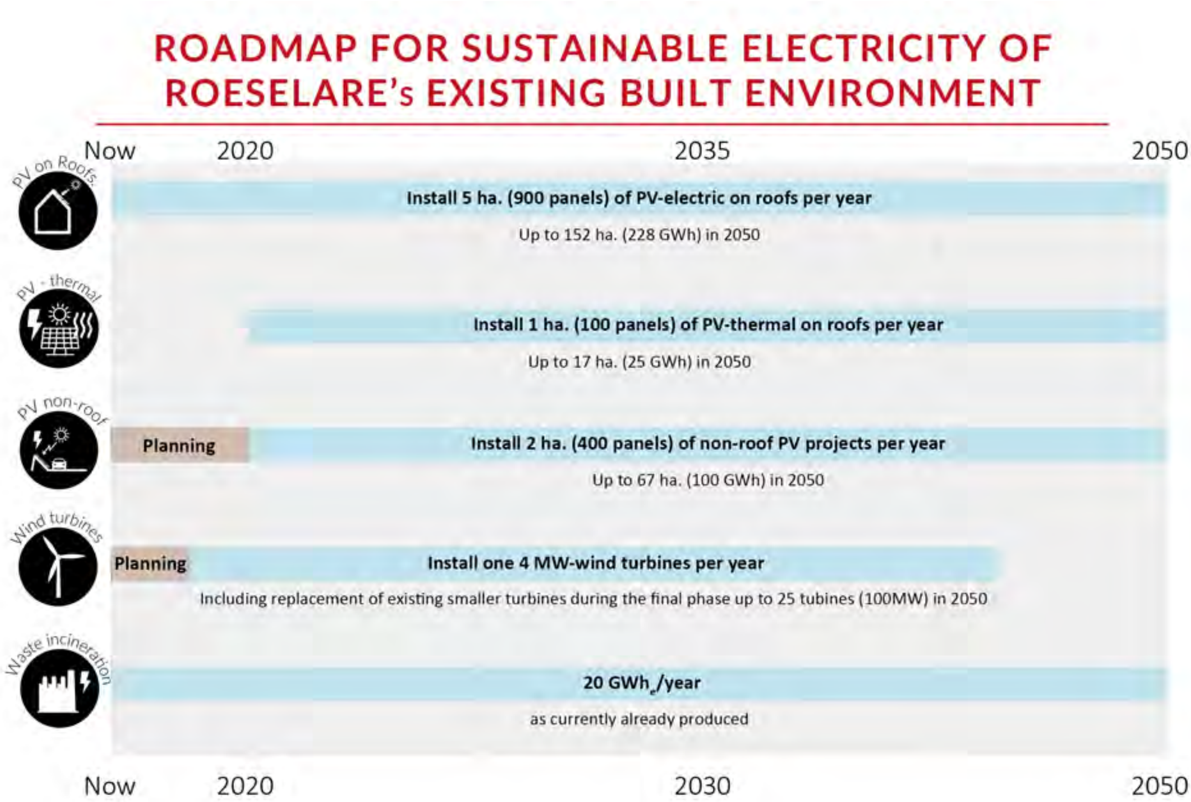

Fig 21. Energy transition timeline for electricity for the municipality of Roeselare.

2.2.6. Visualisation of Energy Transition Plans

The proposed energy strategy for Roeselare is more concretely developed in a next phase through schematic plans such as shown in Figure 2.8. It visualises the layout and size of a city-scale DHN and neighbourhood-scale MHGs, with the location of the main heat energy sources. Moreover, it simultaneously shows the spatial distribution of wind farms, including 25 large turbines and the comprehensive area for 2050 of installed PV and solar thermal collectors. A schematic section representing the integration of different infrastructures, from DHN and MHG to PV on roofs or canopies and wind farms, is shown in figures 22 and 23.

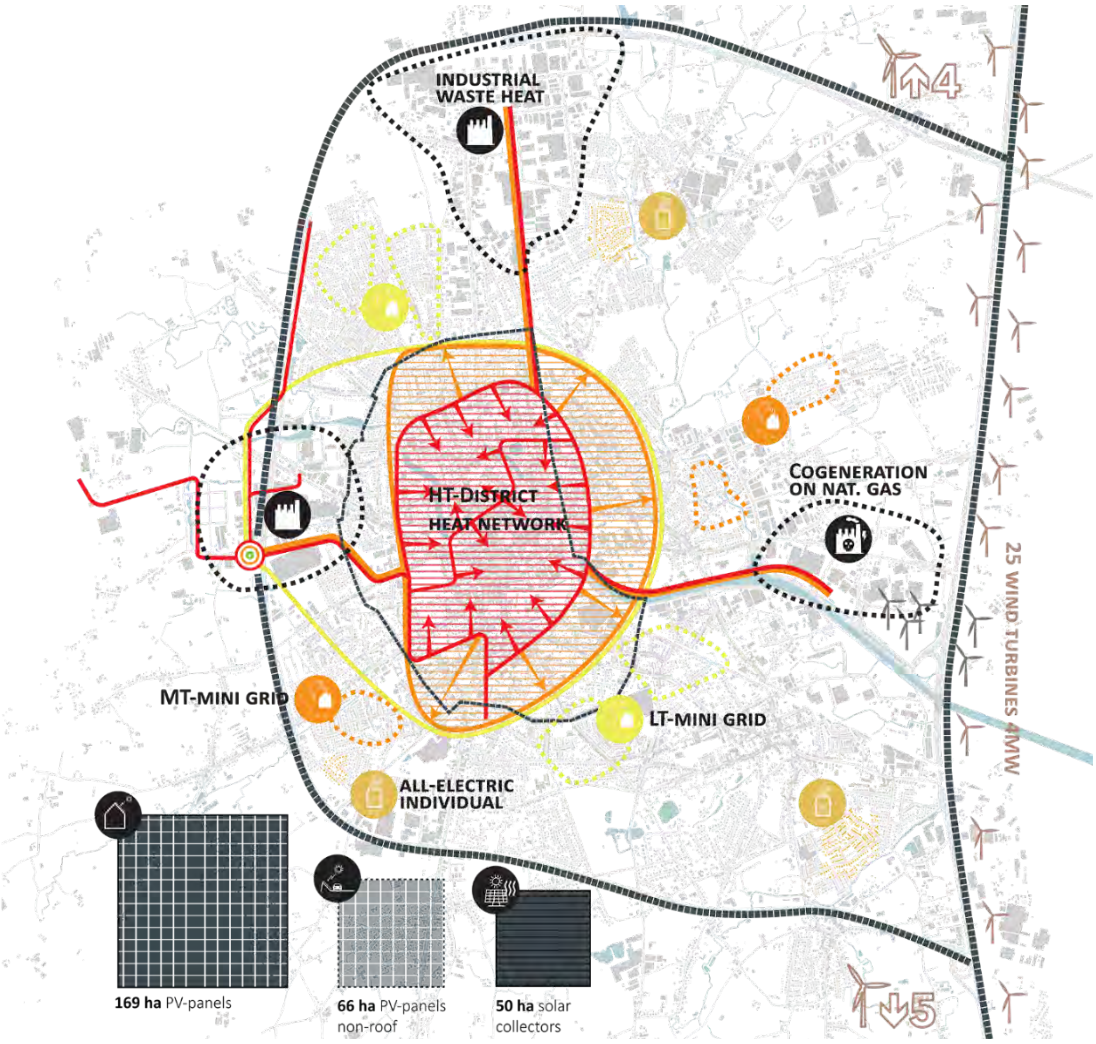

Fig 22. Energy transition plan in Roeselare – plan view.

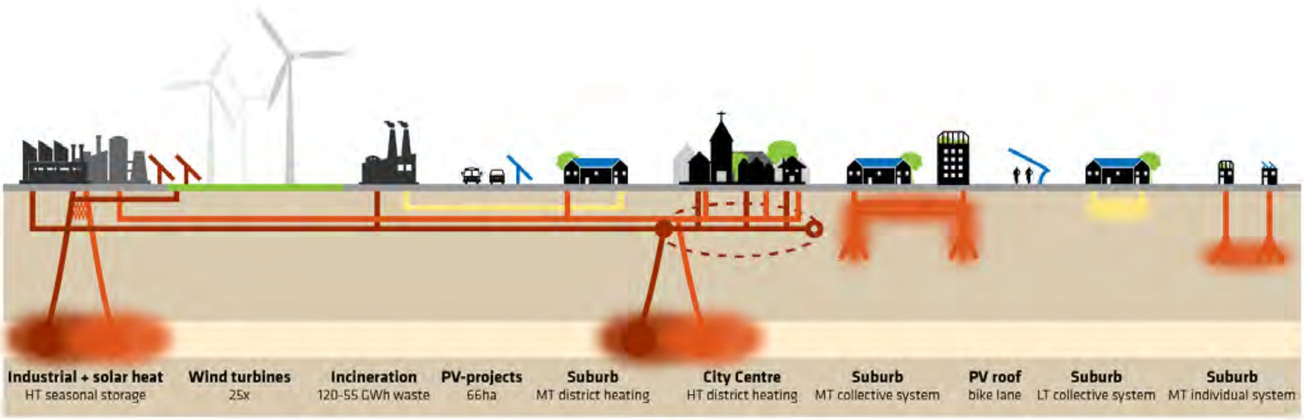

Fig 23. Schematic section view of Roeselare's energy transition.

Finally, the energy plans were also presented in some exemplary energy schemes fitting the plans of Urban Design team. The example buildings are found in the Collievijver-beek neighbourhood.

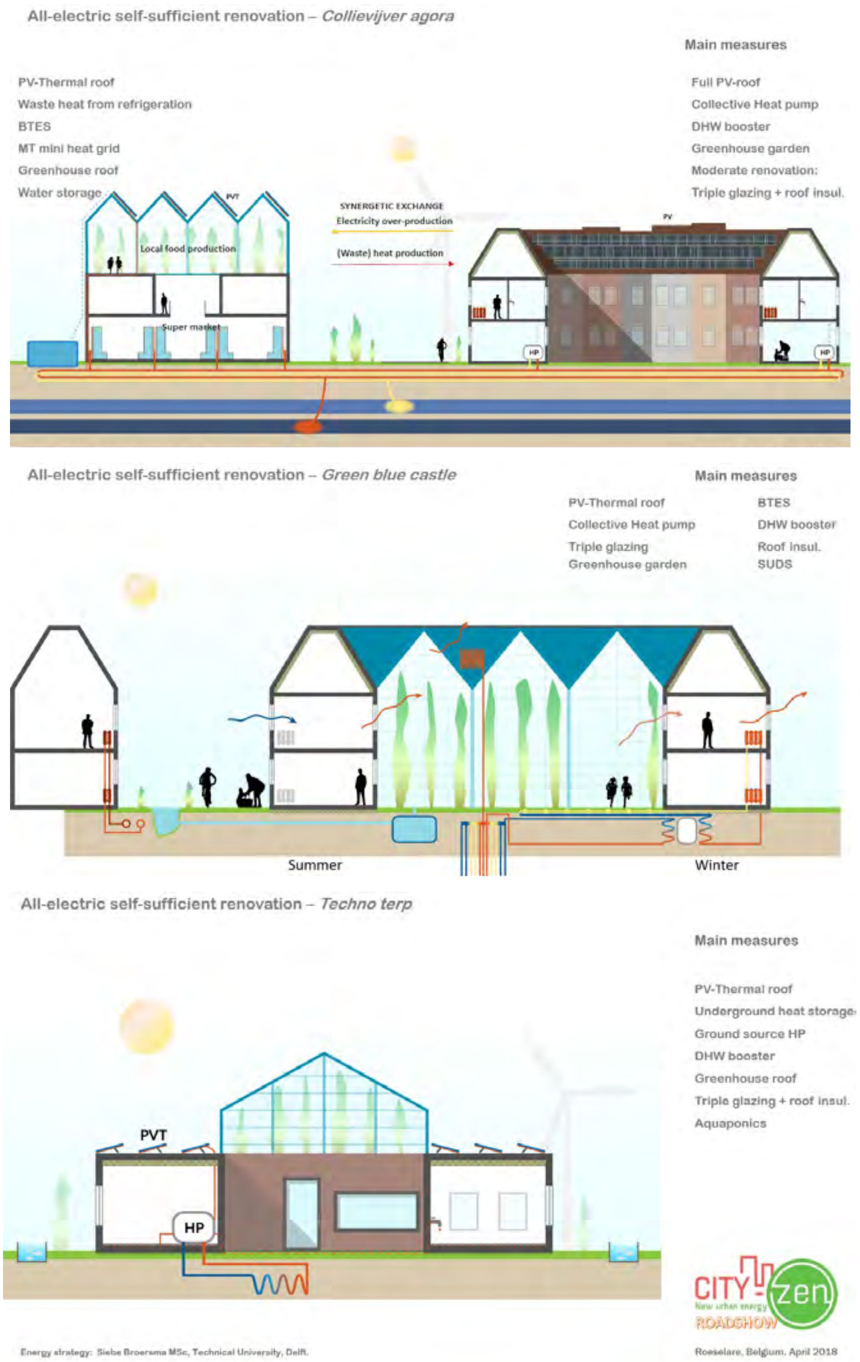

Fig 24. Energy design schemes for retrofitted buildings in the Collievijver-beek neighbourhood.

2.2.7. Carbon accounting of the energy transition

Out of the energy design and urban design sessions, the transition plan for Roeselare has finally identified a sequence of 14 measures that constitutes a potential scenario for carbon neutrality by 2050. Planned actions have been hypothesised based on energy potentials and the urban context, aiming at pursuing the objectives. Table 4 shows the estimated size of interventions and their effects in terms of Carbon Footprint mitigation.

		Sector	HOUSING		TERTIARY		INDUSTRY		PUBLIC LIGHTS	AGRICULTURE		MOBILITY		PUBLIC TRANSPORT		WASTE	WATER	CF total	CF %
		Source	electricity	fuel mix	electricity	fuel mix	electricity	fuel mix	electricity	electricity	fuel mix	electricity	fuel mix	electricity	fuel mix				
		unit	MWh_e	MWh	MWh_e	MWh	MWh_e	MWh	MWh_e	MWh_e	MWh	MWh_e	MWh	MWh_e	MWh	t	m3	t CO2-eq	%
0	**CURRENT STATE**	data	**93,402**	**321,820**	**176,876**	**265,771**	**215,918**	**100,000**	**5,546**	**3,419**	**24,973**	**63**	**284,554**	**0**	**6,122**	**28,345**	**2,521,692**	**351,842**	**100%**
		t CO2-eq	**91,118**		**99,898**		**64,161**		**1,002**	**7,346**		**77,893**		**1,689**		**7,260**	**1,476**		
1	**ENERGY SAVING**	data	-14,010	-80,455	-26,531	-53,154	-21,592	-10,000	-2,773	-342	-4,995							**-47,800**	**-14%**
		t CO2-eq	-21,093		-18,383		-6,416		-501	-1,408									
G	**GROWTH 2050 forecast**	data	19,848		15,034		38,865						28,455		306	2,834	252,169	**22,064**	**6%**
		t CO2-eq	3,584		2,715		7,019					7,788		84		726	148		
2	**DHN – biomass**	data						-35,000										**-8,809**	**-3%**
		t CO2-eq					-8,809												
3	**DHN - waste incineration**	data	-12,000	-25,000	-20,000	-20,000		-10,000										**-17,011**	**-5%**
		t CO2-eq	-7,935		-6,559		-2,517												
4	**DHN - solar collectors & HT storage**	data		-30,000		-25,000												**-13,314**	**-4%**
		t CO2-eq	-6,922		-6,392														
5	**DHN - HT industrial waste**	data		-30,000		-25,000		0										**-13,314**	**-4%**
		t CO2-eq	-6,922		-6,392		0												
6	**MHG - Solar collector & MT storage**	data		-60,000		-60,000		-45,000										**-40,511**	**-12%**
		t CO2-eq	-13,843		-15,342		-11,326												
7	**PV Thermal on house blocks**	data	-1891	-75,000														**-19,195**	**-5%**
		t CO2-eq	-19,195																
8	**MHG & LT ATES**	data		-21,365		-82,617					-19,978							**-31,437**	**-9%**
		t CO2-eq	-4,929		-21,125					-5,383									
9	**PV roofs / non roofs**	data	-76,771		-118,034		-139,915											**-60,446**	**-17%**
		t CO2-eq	-13,864		-21,315		-25,267												
10	**WIND FARM**	data			-39,345		-93,277		-2,773	-3,077								**-25,006**	**-7%**
		t CO2-eq			-7,105		-16,844		-501	-556									
11	**SUSTAINABLE MOBILITY**	data											-125,204					**-34,268**	**-10%**
		t CO2-eq										-34,268							
12	**ELECTRIC MOBILITY**	data										61,976	-187,805	2,121	-6,428			**-41,600**	**-12%**
		t CO2-eq										-40,210		-1,390					
13	**WIND FARM**	data										-62,039		-2,121				**-11,587**	**-3%**
		t CO2-eq										-11,203		-383					
14	**WASTE recycling & WATER harvesting**	data														-17,007	-756,508	**-4,799**	**-1%**
		t CO2-eq														-4,356	-443		
15	**CARBON UPTAKE**	**Required forestland for compensation: 356 ha**																**-4,810**	**-1%**

Table 4. Sequence of selected Carbon Footprint mitigation measures for the Municipality of Roeselare towards the 2050 objective of carbon neutrality.

The CF of Roeselare is 351,842 tonne CO_2-eq (0 in the table) depending on different sources, including a total demand of 495 GWh electricity, 712 GWh from a fuel mix for space and water heating, 290 GWh for mobility, 28,000 tonnes of waste treated and 2.5 million m^3 of water used. This marks the starting-point of any transformation process forward.

Next, the different mitigation measures are assessed on their single contribution to the reduction of the CF, whereas in reality, the different measures will all contribute gradually over time towards the final vision for 2050.

Consistent reduction of energy demand can be achieved by building retrofitting and improved insulation. *Energy savings* (1) have been hypothesised as follows: -15% electricity and -25%

fuel demand for housing; -15% electricity and -20% fuel in tertiary; -10% electricity and -10% fuel in industry; -10% electricity and -20% fuel in farms; -50% electricity demand for public lighting through light replacement with LED lamps. This action brings the CF down by 14%.

Together with potential energy savings, a certain *growth* (G) of population and energy demand has been forecasted by 2050 due to both population increase and economic growth: 25%, 10% and 20% electricity for housing, tertiary and industry, respectively; 10% and 5% fuel demand for private and public transport, respectively; 10% increase of domestic waste and water use. The expected increase of the CF in Roeselare is 6%.

The heating supply can be achieved by a smart combination of HT, MT and LT systems. In particular, HT systems would refer to an urban DHN supplied by a combination of different sources; the hypothesised scenario includes 35 GWh supplied by industrial use of biomass (2), 55 GWh by waste incineration (3), 55 GWh by solar collectors connected to a MT underground storage (4), and 55 GWh by industrial heat waste (5). The avoided use of fuels would correspond to 15% CF reduction. Moreover, a combination of solar collectors with MT storage can potentially supply 165 GWh through MHG in given locations (6) with a corresponding CF reduction of 12%. Similarly, LT MHG's can combine PV-thermal systems installed on roofs of single houses or housing blocks and LT Aquifer Thermal Energy Storages (7).

The electricity demand can also be supplied by local renewable sources. The selected scenario realistically forecasts 12 GWh_e provided by waste incineration (3), 345 GWh_e by PV installed both on roofs and other horizontal or vertical surfaces (9), 138 GWh_e by wind turbines (10). The latter will be further enlarged to 203 GWh_e (13) to cover the additional demand of next measures.

Sustainable mobility is among the desirable measures to be implemented. The increased use of bicycles and public transport (11) would avoid the use of 125 GWh of fuels for private cars, corresponding to a CF reduction of 10%. Moreover, a full transition to electric mobility (12) can be forecasted in the long run, providing an avoided use of 194 GWh of fuels with an additional electricity demand of around 64 GWh_e to be potentially supplied by wind farms (13).

CF mitigation measures also concern waste recycling, with a drastically decrease of landfilled waste, and a consistent reduction of water use by behavioural changes and water harvesting systems for different uses (14).

The combination of designed measures above is supposed to bring the initial CF to a much lower value, i.e. 4810 tonne CO_2-eq (just over 1% of the initial CF). This residual CF, that cannot be avoided due to physical rules (it is a form of entropy) and can be compensated by 356 ha of urban forestry (15).

The sequence of measures above composes one possible scenario, among others, for a future energy and carbon neutral Roeselare.

2.2.8. Conclusion & Discussion

Carbon accounting, combined with energy transition design and urban design, is a crucial aspect of the iterative methodology of the roadshows. Solutions for energy transition and climate-neutral cities can be designed considering different scales for interventions, both spatial (from the single household to the neighbourhood, to the city scale) and temporal (short-, medium-, or long-term implementation period). Moreover, they can include different strategies, referring to new technologies in buildings and infrastructures in the built environment, or even to behavioural changes, through specific campaigns for raising awareness (the Roadshow itself is part of these), involving citizens and communities. In this regard, communication plays a crucial and relevant role. In order to make the challenges, design steps and Roadshow proposals more easily understandable by stakeholders whose background is likely not one from environmental design or analysis, the visualisation of a city's CF, and indeed new technological and spatial infrastructures can be an effective tool to motivate and foster climate action.

Roeselare's CF has been represented graphically with an area of forestland needed to compensate greenhouse gas emission through carbon uptake. Figure 25 shows that the CF of Roeselare (26,062 hectares) is five times the area of the city itself (5,979 hectares). This schematic representation comprised on 1 km^2 squares of forest, empathises the influence of different emission sources through colours, allowing local stakeholders to become conscious of the initial challenge to be faced.

Similarly, the impact of any single household has been spatially visualised; the emission of 6.7 tonne CO_2eq/year per household in Roeselare corresponds to 0.5 hectares forest, the size of a football pitch. Compared to the European average, i.e. 6.9 tonne CO_2eq/year per household, citizens in Roeselare provide lower impacts but this modest result is mostly due to the low emission of the national electricity mix (52% nuclear, 18% renewables), not just on lower consumption or virtuous behaviours.

The schematic representation of proposed or required energy measures for energy and carbon neutrality over time, their visualisation in city maps and schematic sections and potential 3D visualisation of solutions at the building scale also contribute to the comprehension of what a full energy transition implies.

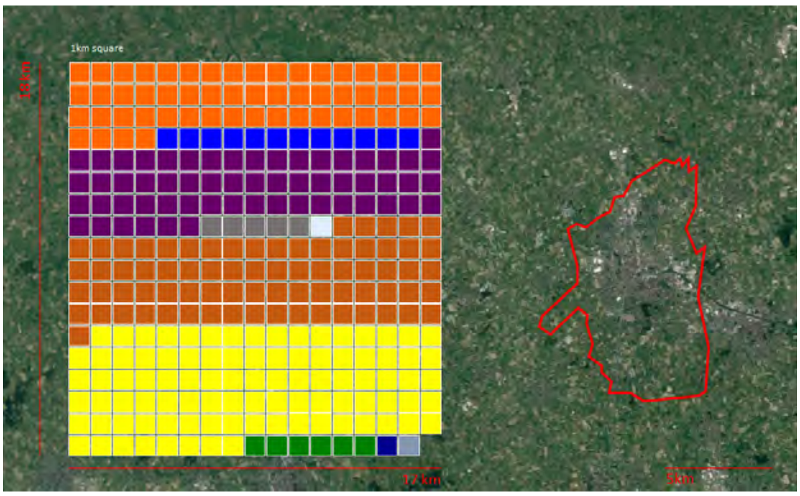

Fig 25. Visualisation of the current Carbon Footprint of the Municipality of Roeselare in terms of virtual forestland (each square is 1 km^2).

The starting-point in Roeselare, as in most of EU cities, is very challenging and the goal of decarbonisation is ambitious enough. Nevertheless, the sequence of solutions selected in the 2050 decarbonisation scenario above clearly shows that paths have been set out. In order to be more effective in engaging local stakeholders, the CF mitigation effect of each measure has been represented in terms of avoided emission and corresponding forestland. In particular, each of the actions has been represented in the sequence in Figure 26, including the current state (0), the expected growth by 2050 (G) and the residual emission (14) that requires final compensation by urban forestry. During a Roadshow this sequence is shown dynamically and, in order to highlight any step in the series, the yellow hero of the Pacman game is represented in the figures, crunching forest squares, to animate the sequence. Rather than dumbing down challenges, the Pacman contributes to attract the attention and let every stakeholder in the audience start their own personal transition process.

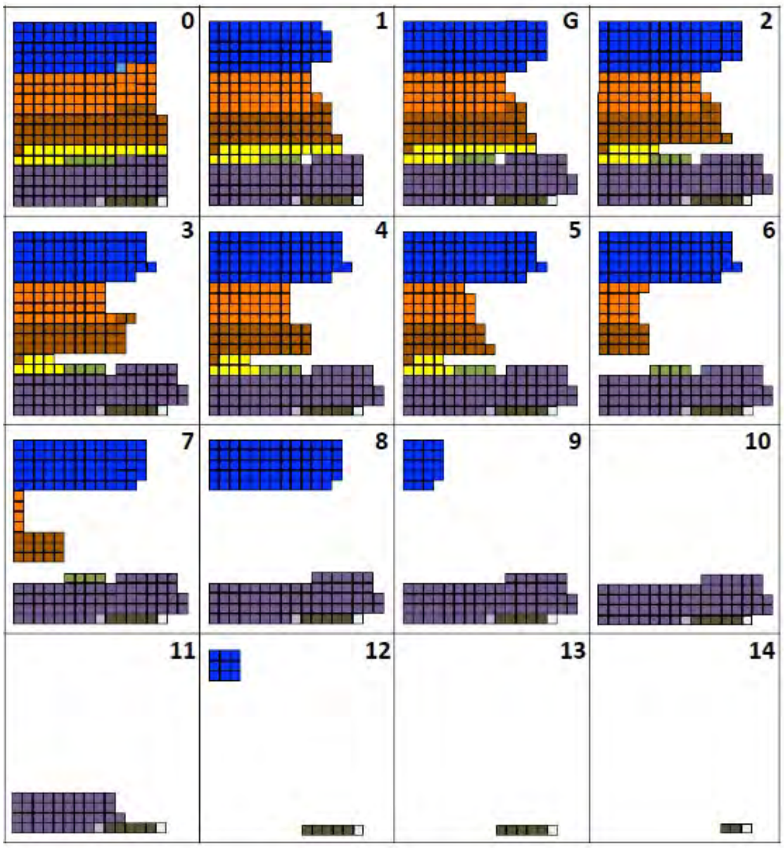

Fig 26. Visualisation of the sequence of Carbon Footprint mitigation measures by forestland crunching.

Most of the CF mitigation is clearly related to solutions planned through energy measures. The effects of both behavioural and technological solutions have been accounted and contribute to the CF crunching. The urban design approach is indirectly considered in numerical terms; it operates mostly on a qualitative sphere. The design of urban spaces, organisations and communities is nevertheless essential for the success of the initiative, particularly stressing the concept that more sustainable cities do not foresee any loss but, on the contrary, they imply gains for citizens from any social class, by improving welfare, investments and business opportunities. Urban design contributes to highlight social, economic and environmental benefits of the transition to carbon-neutral cities that end to look more desirable and appealing than they currently are.

CHAPTER 3 – SUSTAINABLE CITY VISION

3.1. FINAL DAY PRESENTATION AT THE HUIS VAN DE VOEDING

The final day of the Roeselare Roadshow took place in the Huis van de Voeding on the 27th April 2018. The final 'Sustainable City Vision' was presented to an audience comprising the city's Municipality leader's, members of the Klimaatswitch team, professionals, students and citizens. The Mayor of Roeselare (Kris Declercq) and the alderman for energy and climate (Michèle Hostekint) introduced the Roadshow team to the audience. The many that attended joining with over 300 citizens that had participated over the course of the week.

(a)

(b)

(c)

Fig. 27. (a) A scene from the final presentation (Day 5) of the City-zen Roeselare Roadshow hosted by the Municipality of Roeselare. As the international team presented in English, the audience had the option to use earphones where they could hear instant interpretation. (b) Final team photo of TU Delft's Roeselare SWAT Studio, a Masters student design studio that began the Roadshow methodology in February 2018. It's aim being to combine stakeholders and sustainability experts with the aim of co-creating solutions for healthier, happier lifestyles in a non-fossil fuelled urban future. (c) Roeselare Roadshow Team photo (April 2018).

The final day of the Roeselare Roadshow took the form of several integrated presentations. The first briefly outlined the overall objectives, ambitions, format and activities completed during the week. The second and third components composed the major body of the 'City Vision'. These being the 'Energy' workshop presentation, a complementary quantitative approach focussed on energy strategies, scenarios and carbon offsetting measures at overlapping scales. The 'Future Neighbourhoods' workshop, more qualitative in nature, including urban planning intervention proposals at the façade, building and neighbourhood and city scale, together with spatial, social and guidelines. These elements would be brought together by urban observations instigated by the walking event and in-depth Carbon investigations that graphically demonstrated how the city would reach zero-carbon by implementing the variously scaled interventions outlined earlier in the presentation.

The Roadshow continues to build upon previous experiences and looks forward to future visits to Preston (United Kingdom), Nicosia (Cyprus) and Amersfoort (The Netherlands). Further additions to the budget now allows Building Technology students from TU Delft to be invited to the Roadshow as 'Workshop Facilitators'. A move giving our young professionals a unique opportunity to experience live city design challenges and to develop the skills necessary to respond to them.

The key to success has been to identify, reach and gain the trust of city inhabitants and 'decision makers'. To achieve this, an exchange of knowledge, experience and commitment continues to be crucial. The Roadshow will continue to develop and implement innovative methods that increase city engagement, awareness and understanding of the solutions needed to counter climate change, become carbon neutral and make cities happier and healthier places to live.

3.2. THE PRESENTATION

The following Sustainable 'City Vision' presentation (Roadshow outcomes) was presented at the Huis van de Voeding on the 27th April 2018:

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 0

'Co-creation' & 'Synergy of Solutions'

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 1

What went on …

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 2

What went on …

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

Roeselare, Belgium. April 2018 3

What went on …

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

CITY-zen
New urban energy
ROADSHOW

What went on …

Dinsdag 24 april |
Toekomstbeelden
Fun-shops 'Buurten
van de Toekomst' &
'Energie'

CITY-zen
New urban energy
ROADSHOW

What went on …

Donderdag 25 april |
Evalueren
Fun-shops 'Buurten van de Toekomst' & 'Energie'

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

Roeselare, Belgium. April 2018 [6]

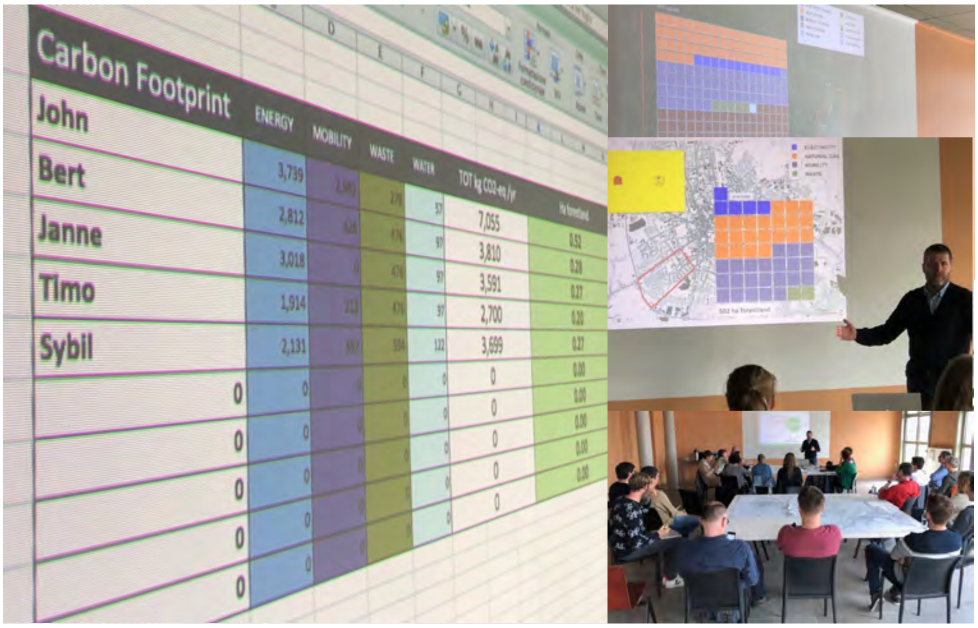
What went on …

Woensdag 25 april |
Design
9 u. - 12.30 u.:
Serious Game 'Go2Zero'

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

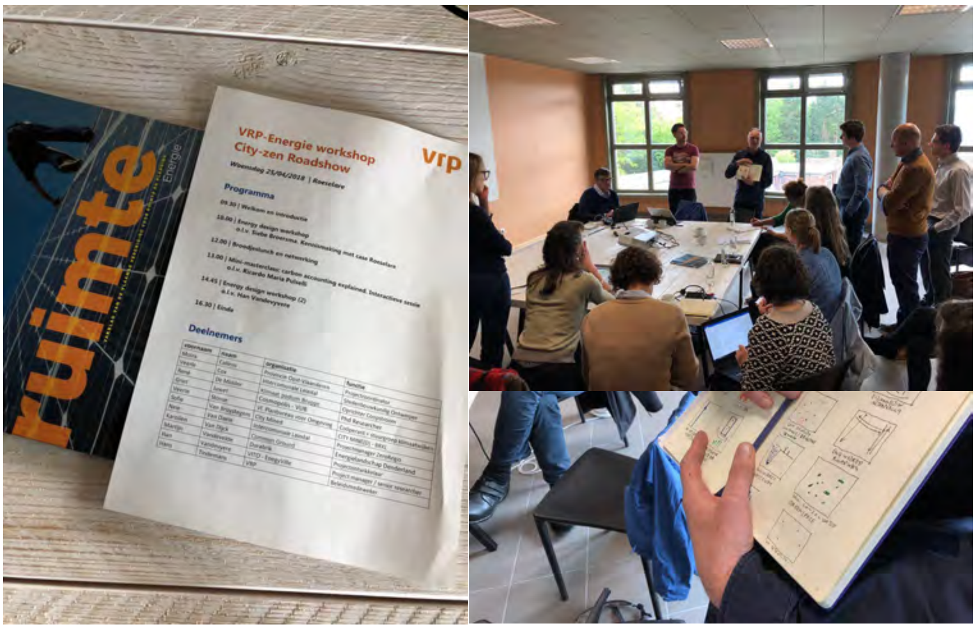
Roeselare, Belgium. April 2018 [7]

What went on …



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

What went on …

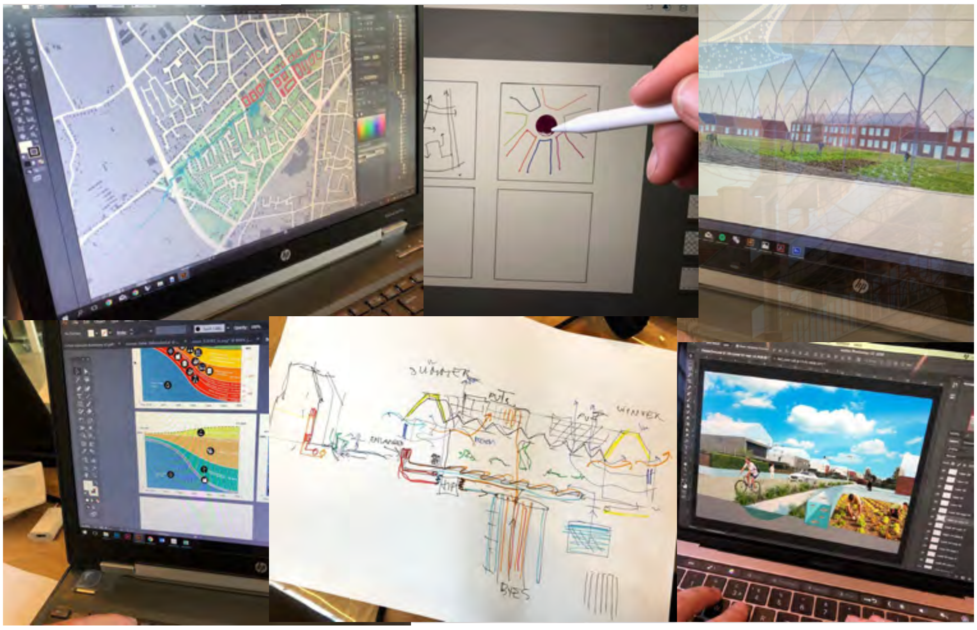


Woensdag 25 april | Design
14.30 u – 17.00.: VRP Urban Design Session - Vlaamse Vereniging voor Ruimte en Planning: VRP

What went on …

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

What went on …



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

Now …

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 EXPLANED

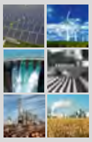
CO_2-eq

UNIT kg CO_2-eq

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

EMISSION FACTOR

Emission Factor of Electricity Grid Mix in Belgium



BELGIUM 2016	LCA based EF	DATA	%	GHG EMISSION
GENERAL DATA	kgCO2/kWh	kWh	%	kt CO2-eq/yr
ELECTRICITY DEMAND	_	8.35E+10		
ELECTRICITY PRODUCTION	_	7.98E+10		
INPORT	0.46	3.65E+09	4.4%	1.68E+09
TERMO-ELECTRICITY		2.31E+10	29.0%	1.03E+10
natural gas	0.443	2.31E+10	29.0%	1.03E+10
petrolium products	0.778			0.00E+00
coal	1.050			0.00E+00
RENEWABLES		1.43E+10	17.9%	2.14E+08
solar thermal				
Solar PV	0.032	2.95E+09	3.7%	9.45E+07
wind	0.010	5.11E+09	6.4%	5.11E+07
hydro	0.012	3.19E+08	0.4%	3.83E+06
geothermal				
biomass				
biogas	0.011	5.91E+09	7.4%	6.50E+07
hydrogen				
NUCLEAR		4.13E+10	51.7%	2.72E+09
nuclear	0.066	4.13E+10	51.7%	2.72E+09
TOTAL	0.181	8.23E+10		1.49E+10

Electricity EF (LCA based)

0.181 kg CO_2eq/kWh

0.460 kg CO_2eq/kWh

HOUSEHOLD PROFILING

ROESELARE CITY (BELGIUM)
TYPICAL HOUSEHOLD PROFILING

ROESELARE		HOUSEHOLD PROFILE			
Emission sources	unit	rawdata	%	kg CO2-eq	%
ENERGY	**kWh**	**15840**	_	**3476**	**51.3%**
LIGHTING&APPLIANC.	**kWh_e**	**3563**	100%	643	9.5%
electricity	Kwh_e	3563	100%	643	9.5%
HEAT+DHW+cooking	**kWh_h**	**12277**	100%	2833	41.8%
Nat gas	kWh_h	10021	82%	2522	37.2%
LGP	kWh_h	460	4%	121	1.8%
Biomass	kWh_h	1662	14%	189	2.8%
Solar thermal	kWh_h	43	0.3%	0	0.0%
Geothermal	kWh_h	91	1%	0	0.0%
MOBILITY	**kWh**	**10858**	100%	**2972**	**43.8%**
Electric car	kWh	2	0.0%	0	0.0%
LGP+Gas	kWh	28	0.3%	7	0.1%
Diesel	kWh	8945	82%	2550	37.6%
Gosoline	kWh	1554	14%	414	6.1%
Bio-fuel	kWh	328	3%	0	0.0%
WASTE	**kg**	**1076**	100%	**276**	**4.1%**
% waste-to-energy	kg	312	29%	204	3.0%
% organic	kg	230	21%	21	0.3%
% landfill	kg	44	4%	51	0.8%
% recycling	kg	490	46%	0	0.0%
WATER	**m^3**	**96**	100%	**56**	**0.8%**
m3 per yr (house)	m^3/ y	**96**	100%	56	0.8%
TOTAL				**6779**	**100%**

HOUSEHOLD profile

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

HOUSEHOLD PROFILING

ROESELARE CITY (BELGIUM)
TYPICAL HOUSEHOLD PROFILING

ROESELARE

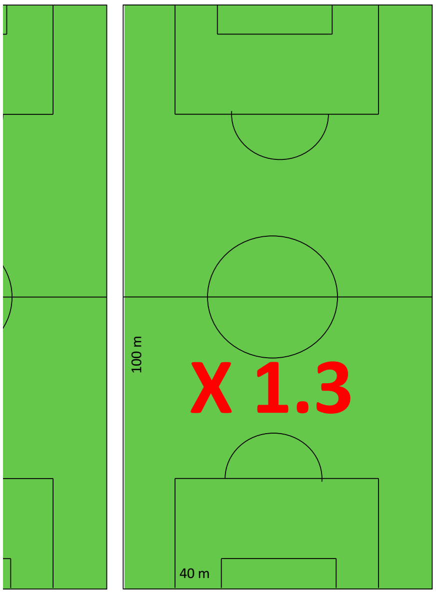
HOUSEHOLD IN ROESELARE

CARBON FOOTPRINT

6.78 t CO_2eq/yr

7.72 t CO_2eq/yr

Carbon Footprint Offset
per household
0.50 ha forestland



HOUSEHOLD profile

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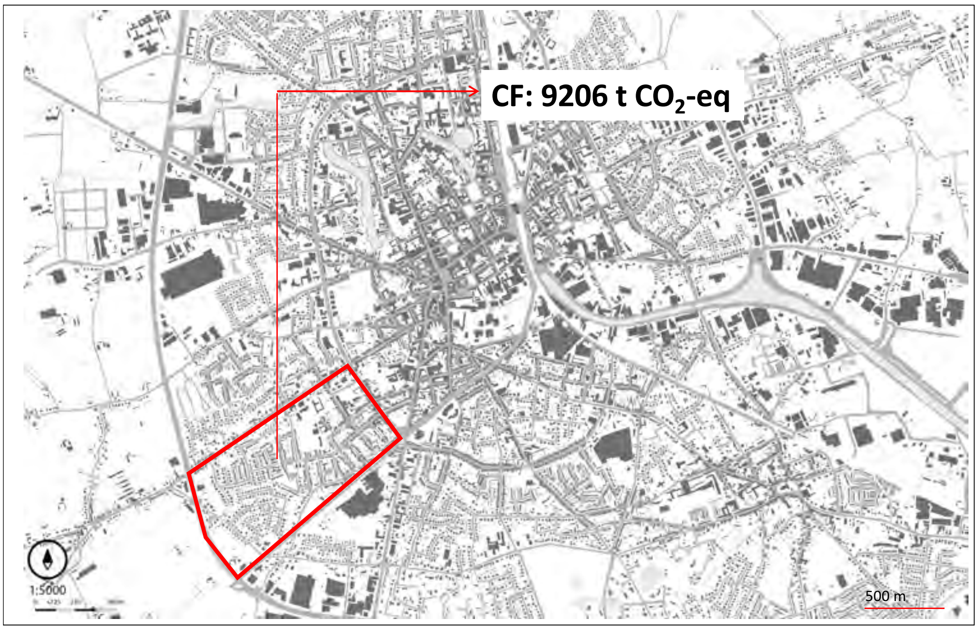
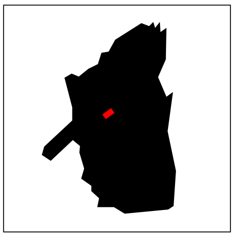
Waste: 467 kg/cap yr
Water: 114 L/cap day

CITY-zen New urban energy ROADSHOW

COLLIEVIJVER NEIGHBOURHOOD



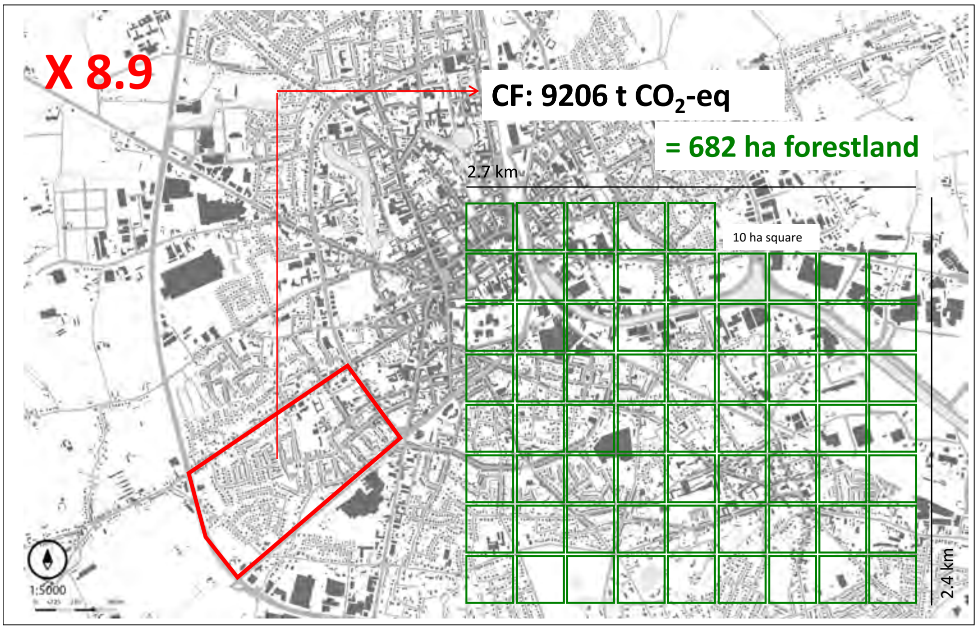


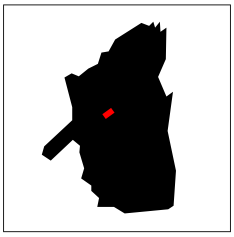
COLLIEVIJVER NEIGHBOURHOOD

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

CITY-zen New urban energy ROADSHOW

COLLIEVIJVER NEIGHBOURHOOD





COLLIEVIJVER NEIGHBOURHOOD

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

Carbon Accounting: Riccardo M. Pulselli, University of Siena

Roeselare, Belgium. April 2018

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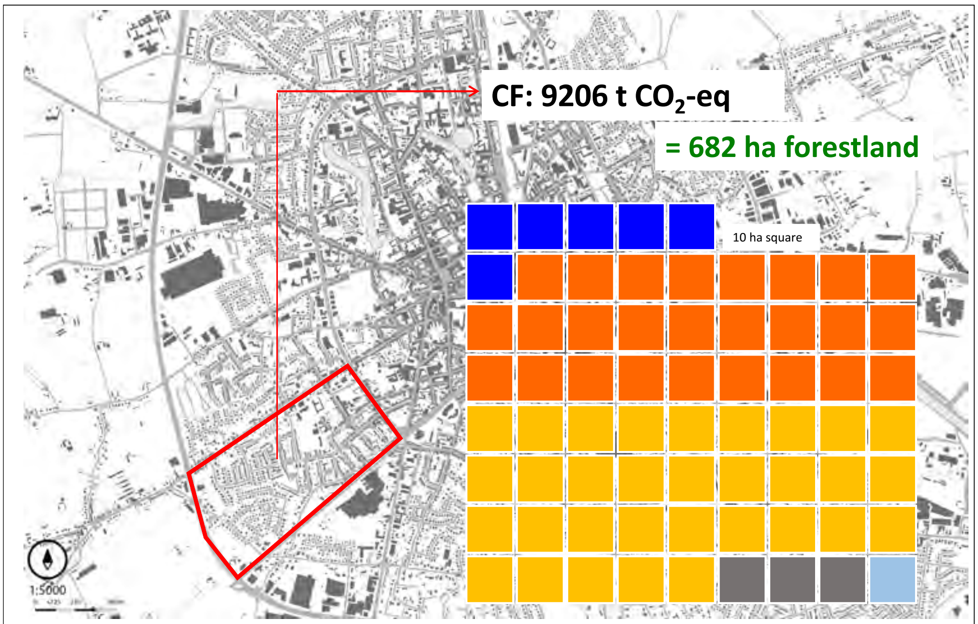
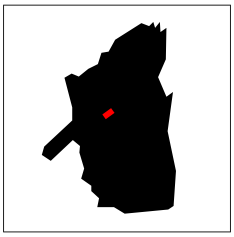
COLLIEVIJVER NEIGHBOURHOOD





COLLIEVIJVER NEIGHBOURHOOD

- ELECTRICITY
- NATURAL GAS
- MOBILITY
- WASTE

Carbon Accounting: Riccardo M. Pulselli, University of Siena

Roeselare, Belgium. April 2018

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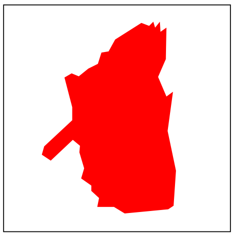
CARBON FOOTPRINT OF ROESELARE CITY

ROESELARE		MUNICIPALITY			
Emission sources	unit	rawdata	%	t CO2-eq	%
ENERGY	**MWh**	**415222**	_	**91,118**	**22.1%**
LIGHTING&APPLIANC.	**MWh**	**93402**	100%	16,867	4.1%
electricity	MWh	93402	100%	16,867	4.1%
HEAT+DHW+cooking	**MWh**	**321820**	100%	74,251	18.0%
Nat gas	MWh	262681	82%	66,115	16.0%
LGP	MWh	12071	4%	3,171	0.8%
Biomass	MWh	43560	14%	4,965	1.2%
Solar thermal	MWh	1124	0%	0	0.0%
Geothermal	MWh	2383	1%	0	0.0%
MOBILITY	**MWh**	**284617**	100%	**77,894**	**18.9%**
Electric car	MWh	63	0.0%	11	0.0%
LGP+Gas	MWh	731	0.3%	192	0.0%
Diesel	MWh	234482	82.4%	66,836	16.2%
Gosoline	MWh	40733	14.3%	10,855	2.6%
Bio-fuel	MWh	8608	3.0%	0	0.0%
WASTE	**t**	**28345**	100%	**7,260**	**1.8%**
% waste-to-energy	t	8231	29%	5,367	1.3%
% organic	t	6049	21%	548	0.1%
% landfill	t	1159	4%	1,345	0.3%
% recycling	t	12919	46%	0	0.0%
WATER	**m^3**	**2521692**	100%	**1,476**	**0.4%**
m3 per yr (house)	m^3/ yr	**2521692**	100%	1,476	0.4%
RESIDENTIAL				**177,748**	**43%**
TERTIARY (private + public)	MWh	442647	_	99,898	24.2%
AGRICULTURE	MWh	28392	_	7,666	1.9%
INDUSTRY	MWh	639487	_	124,644	30.2%
public transport	MWh	5270	_	1,439	0.3%
public lighting	MWh	5546	_	1,002	0.2%
TOTAL				**412,396**	**100%**

ROESELARE

CARBON FOOTPRINT

412 kt CO_2eq/yr



Roeselare City

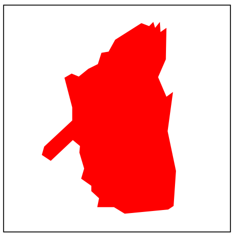
61,657 inhabitants

26,349 households

5979 ha area

CITY-zen New urban energy ROADSHOW

CARBON FOOTPRINT OF ROESELARE CITY



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CITY-zen New urban energy ROADSHOW

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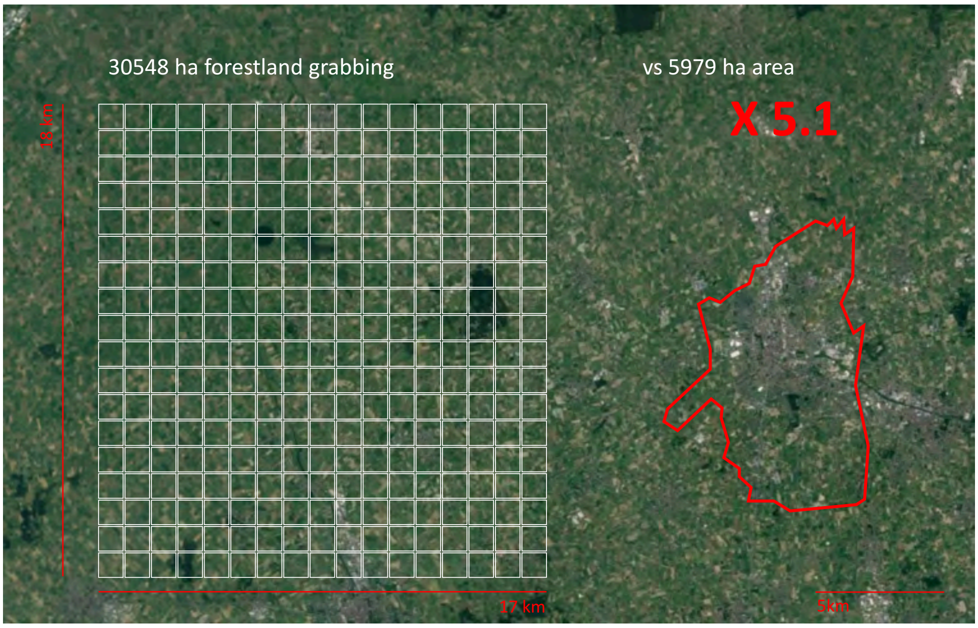
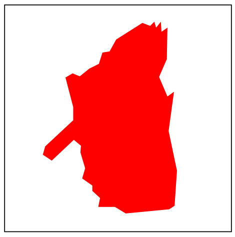




Roeselare City

CARBON FOOTPRINT

412,000 t CO2 eq

FORESTLAND GRABBING

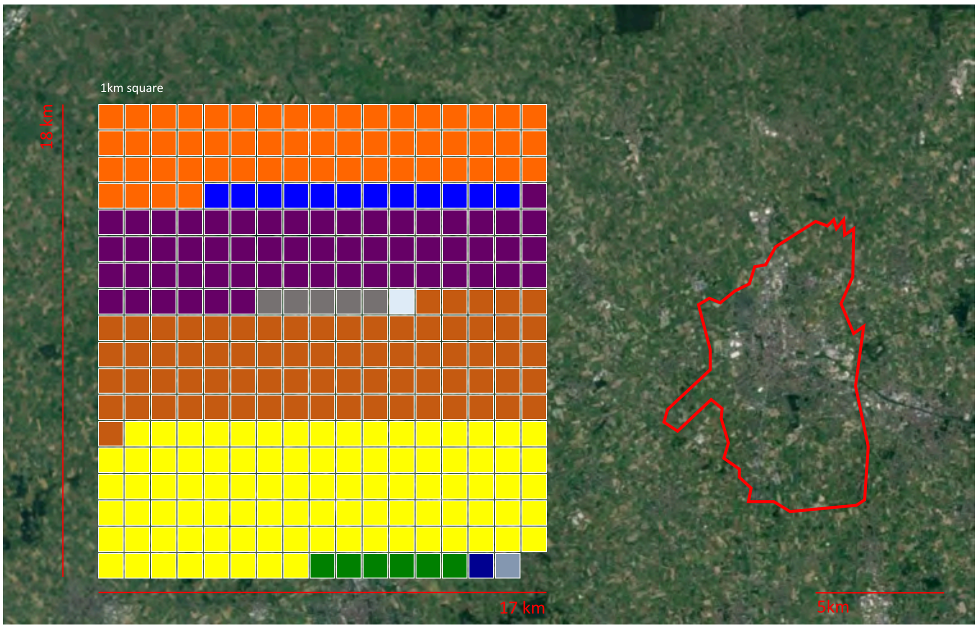
30,548 ha

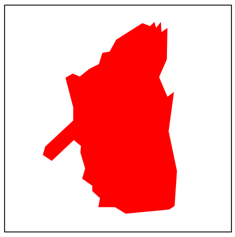
CITY-zen New urban energy ROADSHOW

Carbon Accounting: Riccardo M. Pulselli, University of Siena

Roeselare, Belgium. April 2018 22

CARBON FOOTPRINT OF ROESELARE CITY





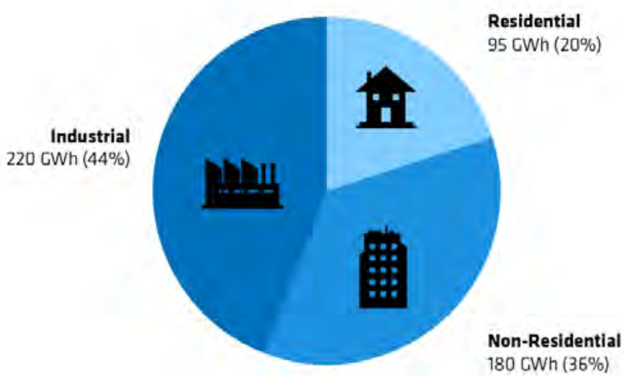
- ELECTRICITY (HOUSING)
- HEAT (HOUSING)
- MOBILITY (PRIVATE CARS)
- WASTE (URBAN)
- WATER USE (HOUSING)
- TERTIARY
- INDUSTRY
- AGRICULTURE
- Public transport
- Public lighting

CITY-zen New urban energy ROADSHOW

Carbon Accounting: Riccardo M. Pulselli, University of Siena

Roeselare, Belgium. April 2018 23

Electricity demand Roeselare 2015 (GWh)



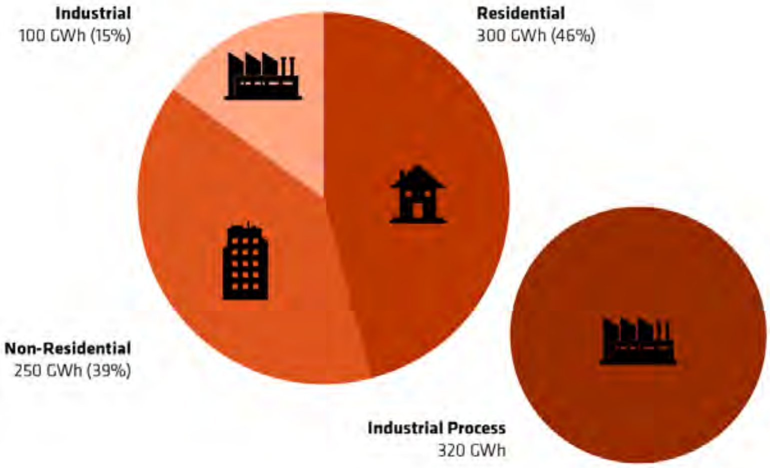
Current Electricity Demand

495 GWh-e in 2015

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

Roeselare, Belgium. April 2018 24

Heat demand Roeselare 2015 (GWh)



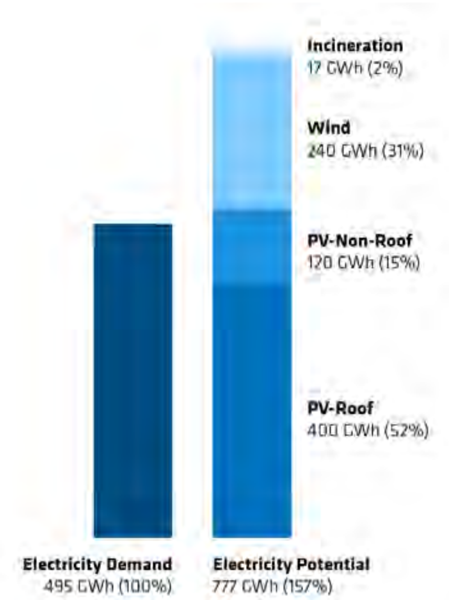
Current Heat Demand

620 GWh-th in 2015
+
320 GWh-pr

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

Roeselare, Belgium. April 2018 25

Electricity potentials in Roeselare



Space for production

40 Wind turbines

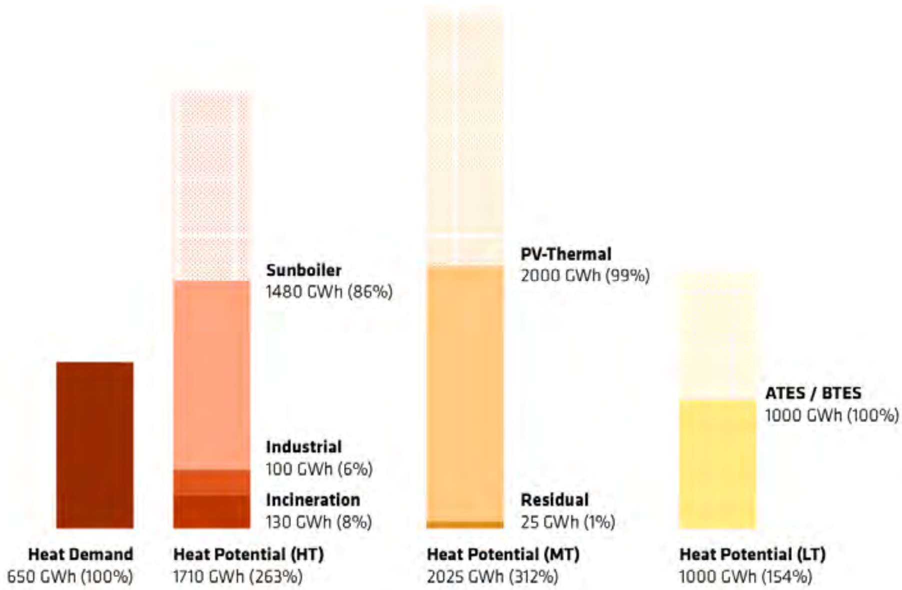
50% of all roofs (235 ha)

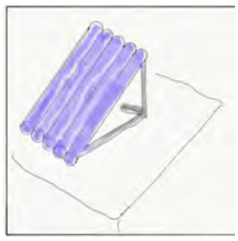
80 ha non-roof

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

Roeselare, Belgium, April 2018 26

Heat potentials in Roeselare





Temperature levels

High-T for district heat network (DHN)

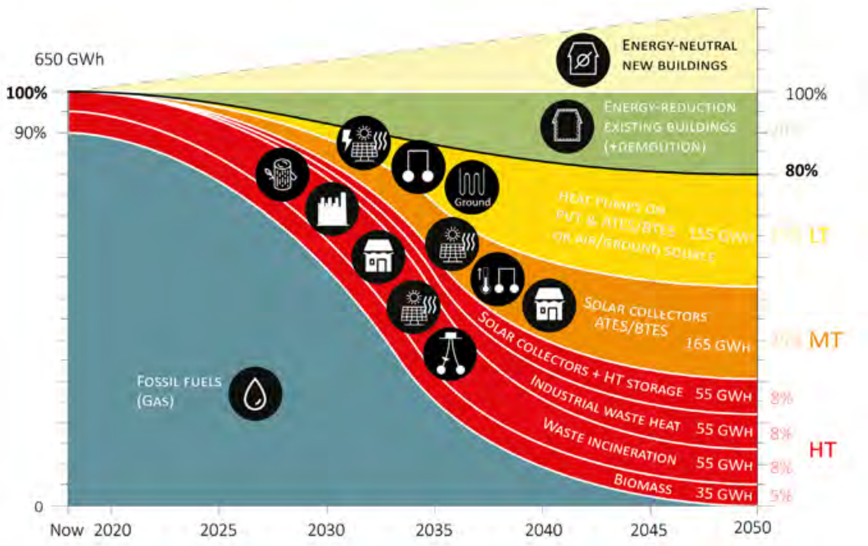
Mid-T needs energy renovation

Low-T needs heat pumps and energy renovation

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

Roeselare, Belgium, April 2018 27

Heat Balance towards 2050



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

Temperature levels

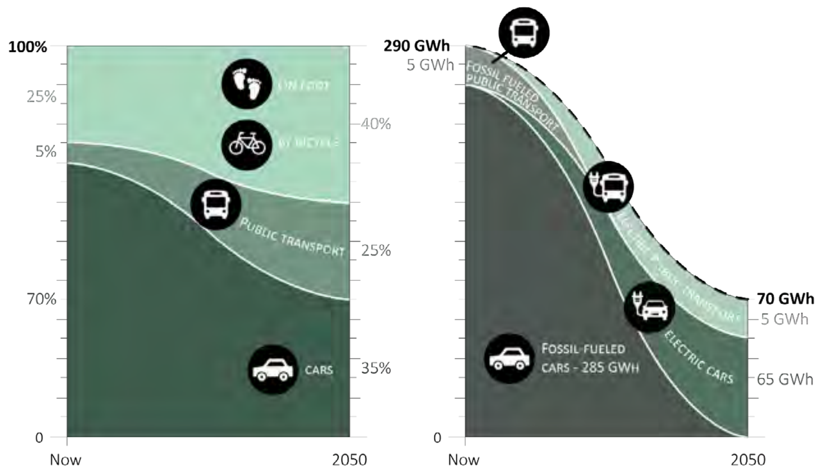
30% High-T for DHN

25% Mid-T

25% Low-T

20% reduction

Sustainable transport scenario



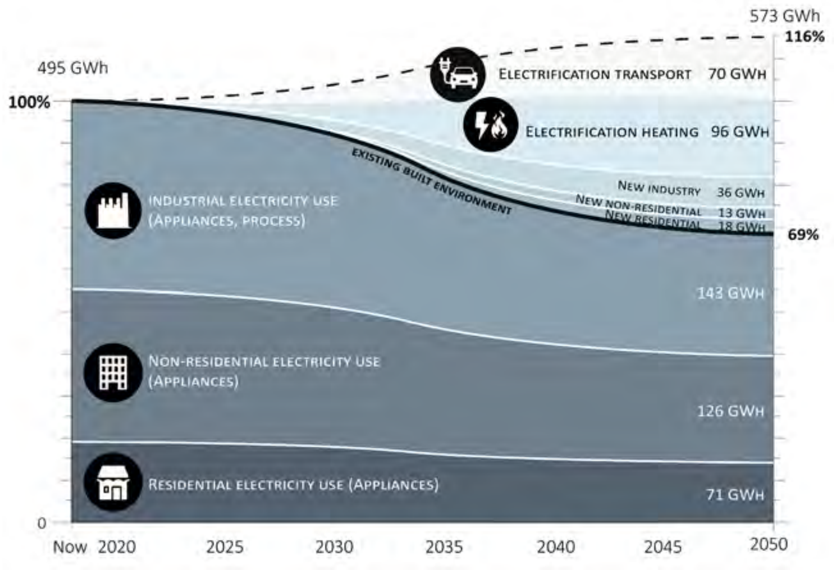
Energy strategy: Siebe Broersma MSc, Technical University, Delft.

Main directions

Modal shift

Electrification

Electricity demand scenario towards 2050



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

Assumptions

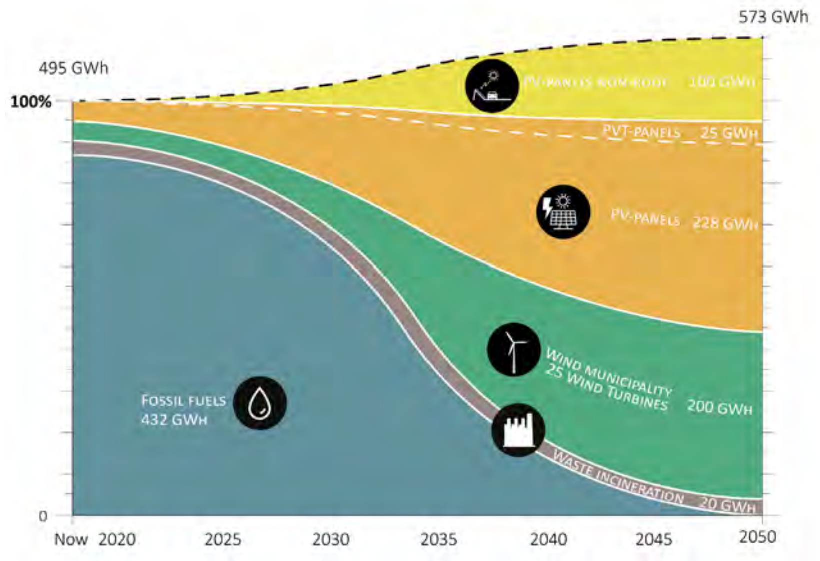
30% reduction of current demand for appliances

15% total increase due to Electrification of

Heating + transport

Roeselare, Belgium. April 2018 30

Electricity Balance towards 2050



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

Main measures

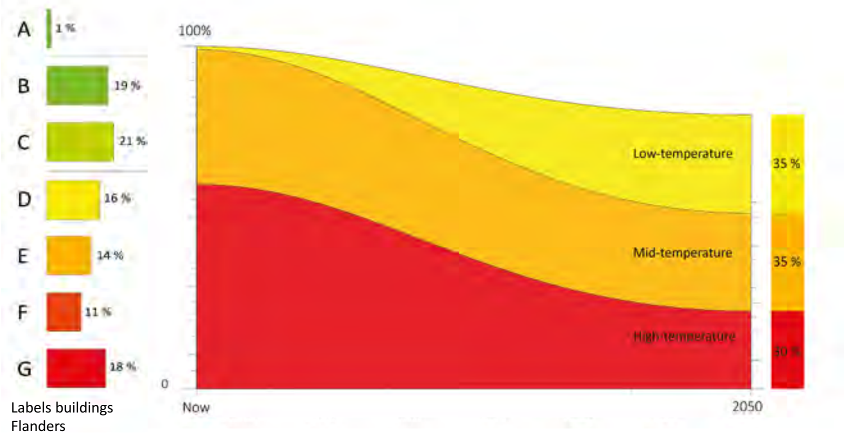
25 Wind Turbines

240 ha PV panels

Co-generation of waste incineration

Roeselare, Belgium. April 2018 31

Temperature levels for heating of buildings towards 2050



Required temperatures

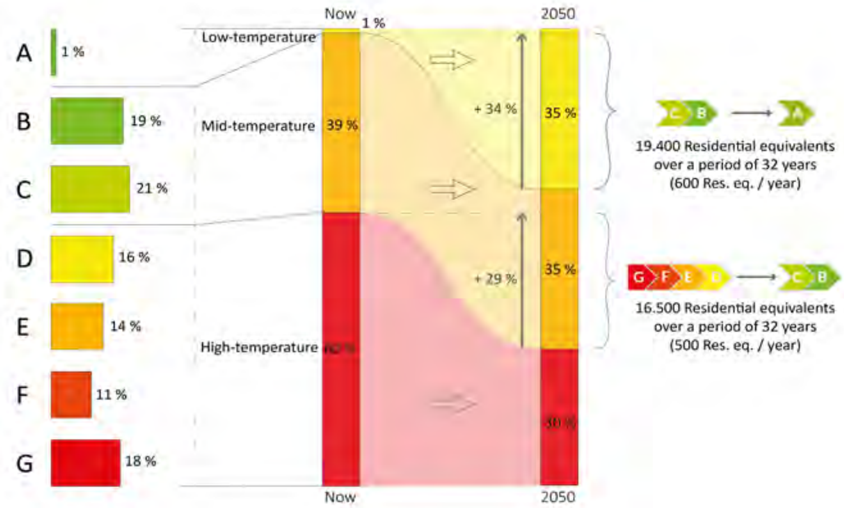
HT = > 65°C

MT = 40°C - 65°C

LT = < 45°C

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

Required energy renovations of building stock towards 2050



Building stock

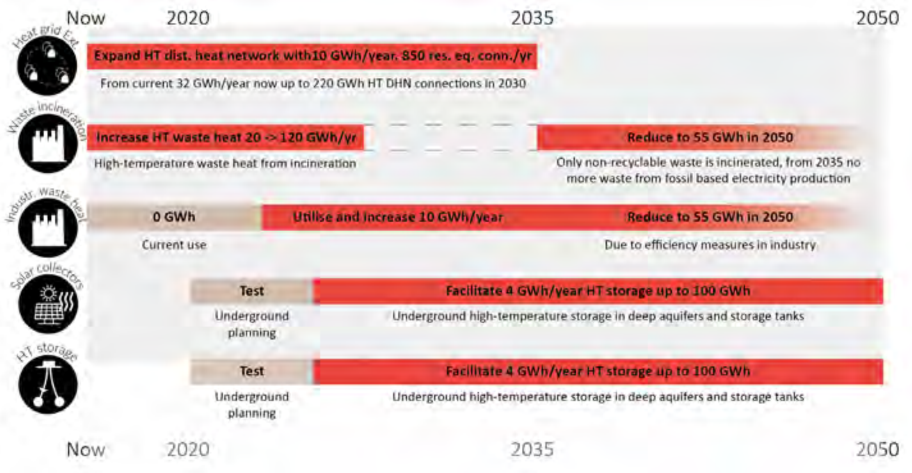
57000 residential unit equivalents of which:

26000 residential

31000 non-residential

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

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



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

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

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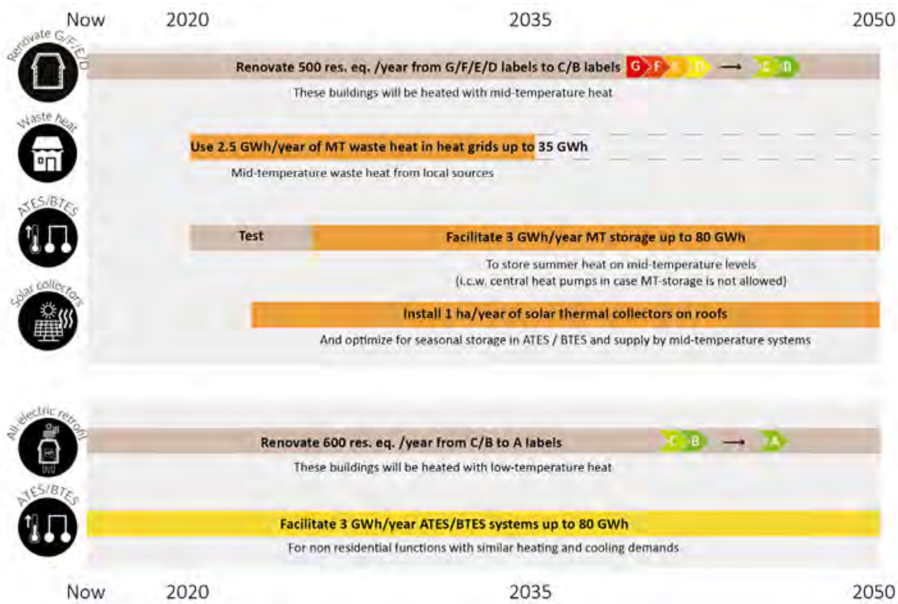
Roadmap for sustainable heating (MT + LT) of Roeselare's current building stock



Main measures

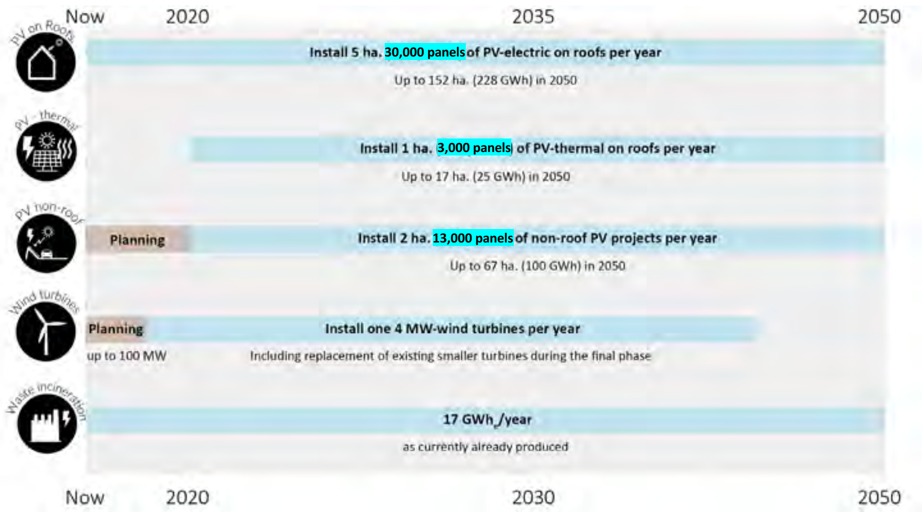
60% of building stock moderately renovated by 2050

Solar collectors and MT-storage in underground

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

Roeselare, Belgium. April 2018 25

Roadmap for sustainable electricity production in Roeselare



Main measures

235 ha PV panels

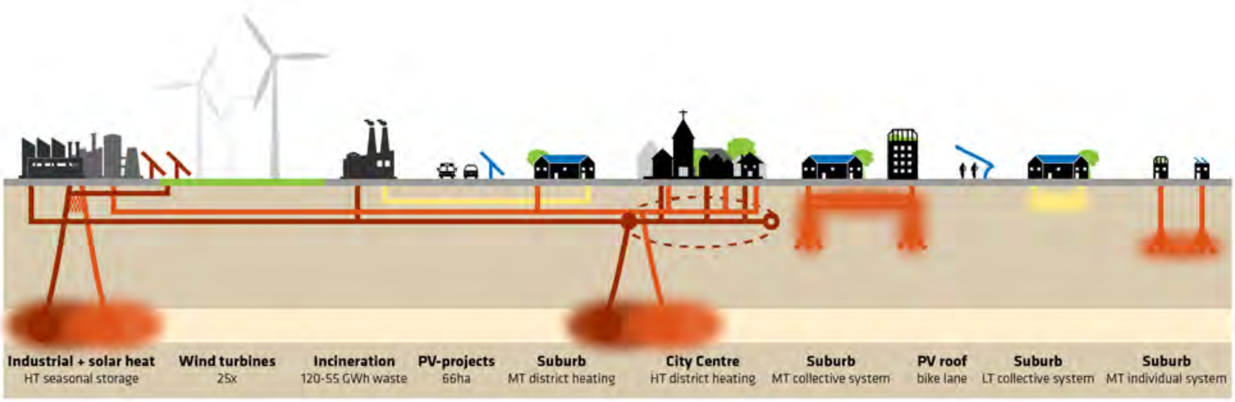
25 4MW Wind Turbines

17 GWh-e from Waste Incineration

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

Roeselare, Belgium. April 2018 36

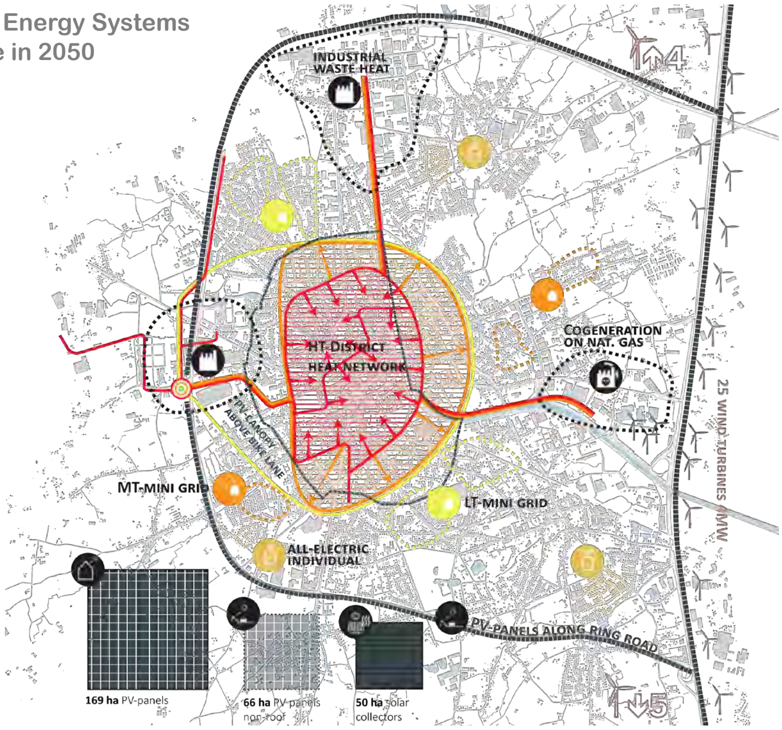
Schematic section of Roeselare's sustainable energy systems in 2050



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

Roeselare, Belgium. April 2018 37

Sustainable Energy Systems in Roeselare in 2050



Main directions

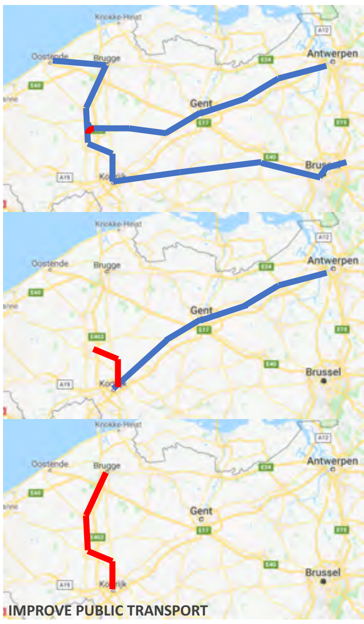
Central HT-DHN Cascaded to

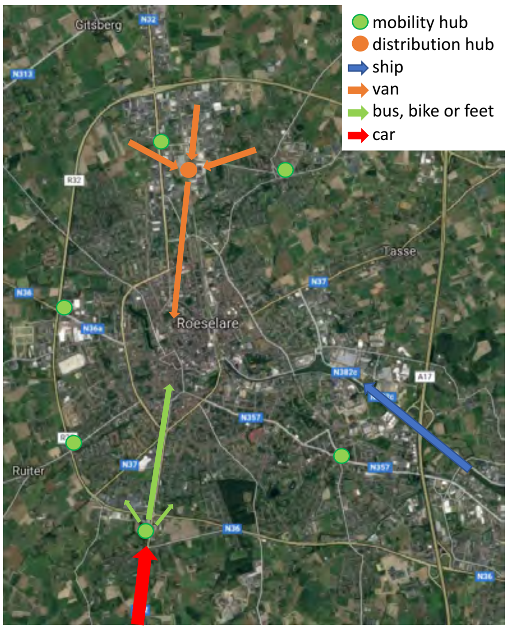
235 ha PV panels

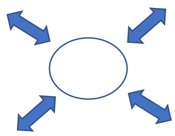
25 4MW Wind Turbines

17 GWh-e from Waste Incineration

Sustainable transport and mobility







Regional connectivity

People

Packages

Heavy materials

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

Urban Analysis

Urban disconnection

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

Roeselare, Belgium. April 2018 40

Urban Analysis

Neighbourhood disconnection

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

Roeselare, Belgium. April 2018 41

Urban Analysis

Low Density

1300 Houses

85 Hectares

15 Homes/Ha

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

Roeselare, Belgium 42 April 2018

Urban Analysis

Low Intensity

No bars

No cafes

No civic functions

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

Roeselare, Belgium 43 April 2018

Urban Analysis

Over-engineered Roads

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

Roeselare, Belgium. April 2018

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Urban Analysis

Over-engineered water ways

Flooding an issue

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

Roeselare, Belgium. April 2018

45

Urban Analysis

Empty but full

75 Homes/Ha

17 Hectares

68 Hectares empty

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

Urban Analysis

Small green spaces

Indvidual gardens

Grass verges

Road infrastructure

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

Urban Analysis

Over-engineered water ways

Flooding issues

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

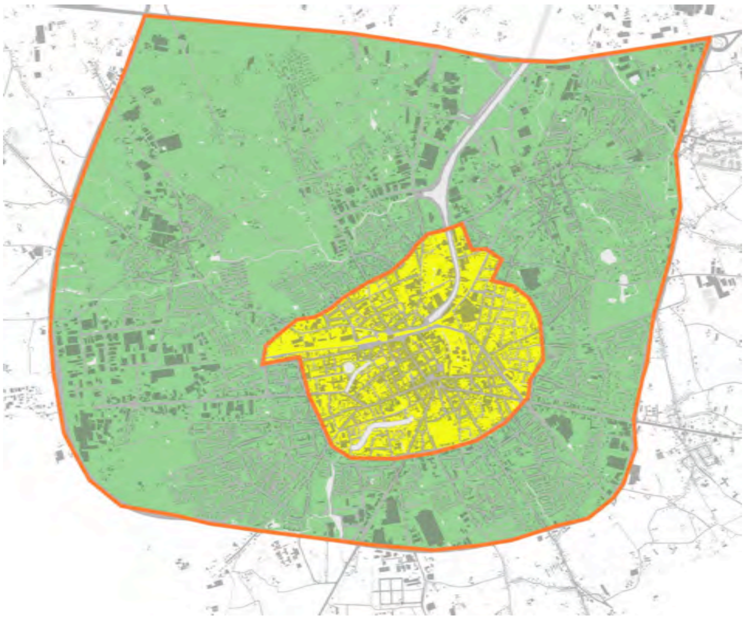
Urban Analysis

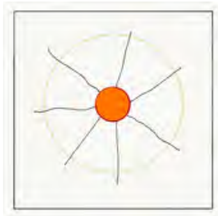
Car-orientated

Highest mobility impact

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

Urban Analysis





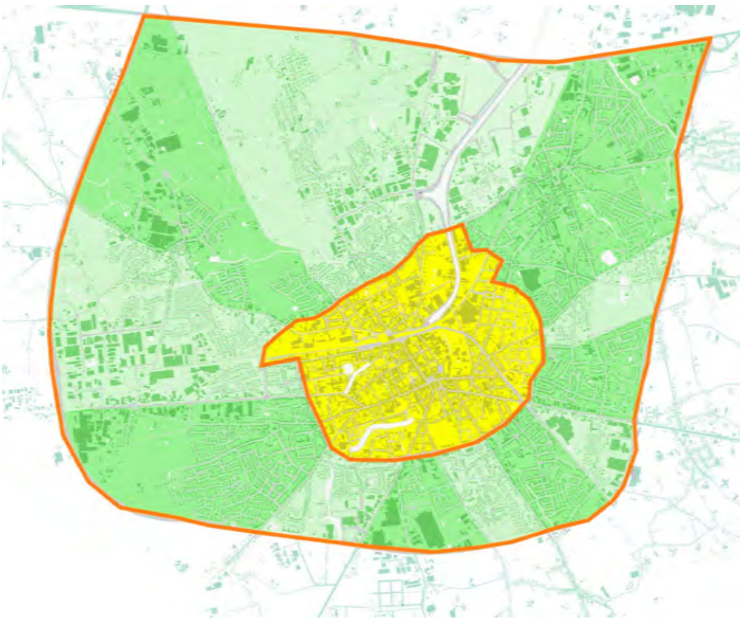
Egg-like structure

Neighbourhood is isolated, both from city and nature

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

Roeselare, Belgium. April 2018 50

Urban Analysis



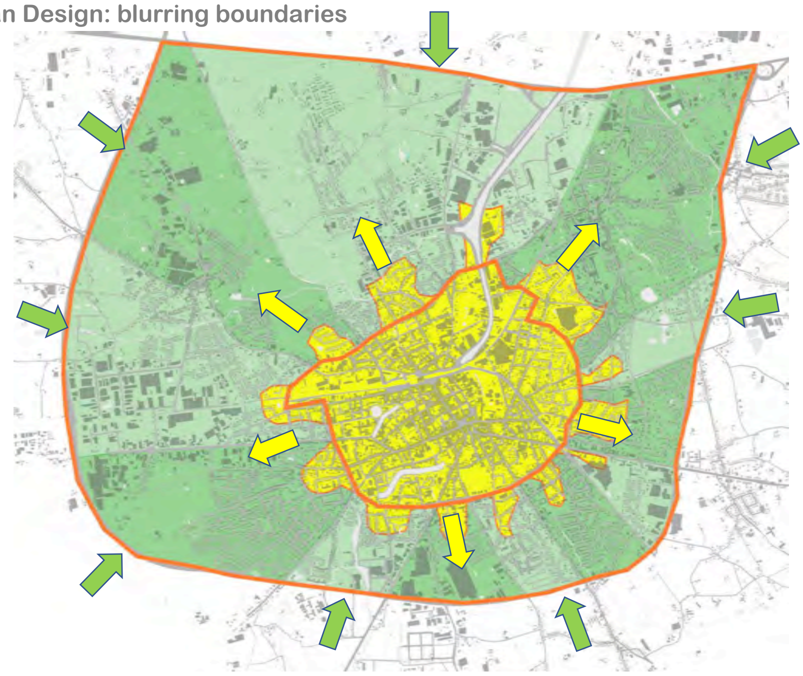
City of bits

Very little contact between neighbourhoods

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

Roeselare, Belgium. April 2018 51

Urban Design: blurring boundaries

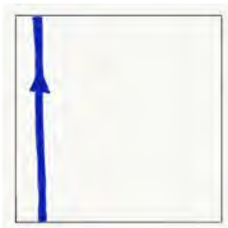


Star-city

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

Roeselare, Belgium: April 2018 52

Urban Analysis

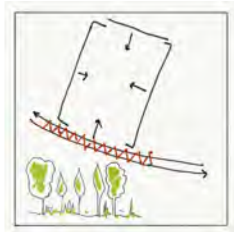


No nature

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

Roeselare, Belgium: April 2018 53

Urban Analysis

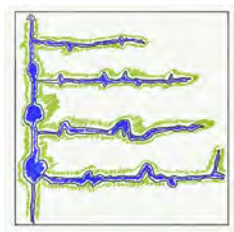


Isolated from nature

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

Roeselare, Belgium: April 2018 54

Urban Design: flood proofing naturally



Sustainable urban drainage

- Cheap
- Easy
- Bio-diverse

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

Roeselare, Belgium: April 2018 55

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.

Roeselare, Belgium. April 2018 56

Urban Design

Community Agora

- Food focussed neighbourhood
- Community food trading
- Paddy field

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

Roeselare, Belgium. April 2018 57

Urban Design

Blurred boundaries

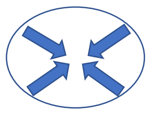
- Bring city to neighbourhood
- Bring neighbourhood to city
- Increase density

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

Roeselare, Belgium: April 2018 58

Modal shift provides urban space

Source: www.verkehrswende-ev.de



Neighbourhood connectivity

- Social
- Safe
- Healthy

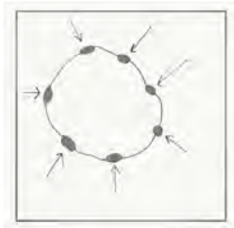
Source: www.wegcode.be

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

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

Roeselare, Belgium: April 2018 59

Urban Analysis



No need to visit

Very generic

No difference

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

Roeselare, Belgium. April 2018 60

Urban Design: New green ring of exciting neighbourhoods

New green ring

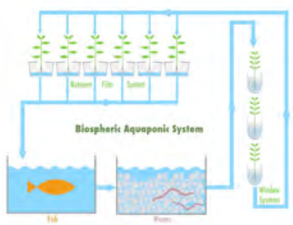
Lots of reasons to visit!

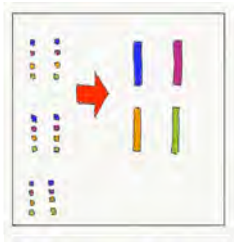
Each neighbourhood is individual and productive!

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

Roeselare, Belgium. April 2018 61

Urban Proposal Super sharing, low impact, urban agriculture neighbourhood





Shared surface

Productive

Flood proof

Community focussed

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

Roeselare, Belgium. April 2018

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Urban agriculture: low impact with technical food systems

Productive Landscapes

Urban Castles

Productive street systems

Techno terps

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

Roeselare, Belgium. April 2018

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Urban Design. Aquaponic people first highways

Urban Agriculture everywhere

Aquaponic cycleway

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

Urban Design - Blue Green castles

Consolidation of green space

Energy renovation

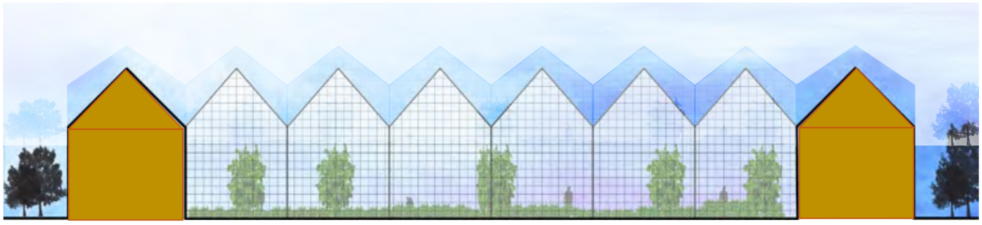
Urban Agriculture

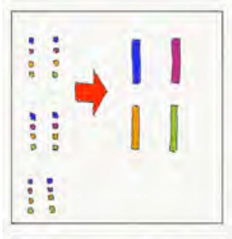
Community focussed

Sharing

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

Urban Design - Blue Green castles





Sharing

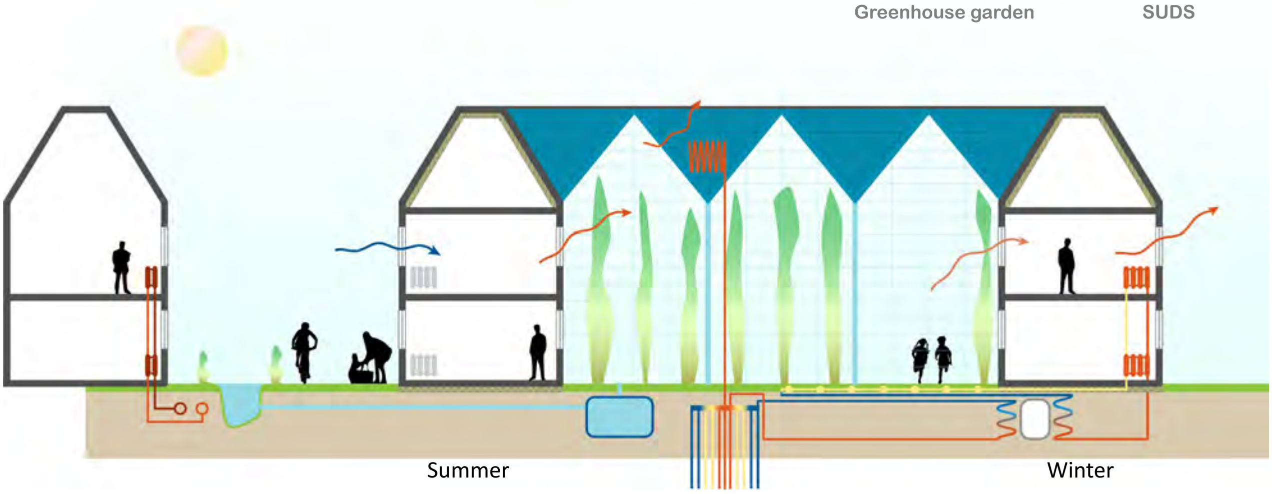
- Energy
- Food
- Community

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

All-electric self-sufficient renovation – *Green blue castle*

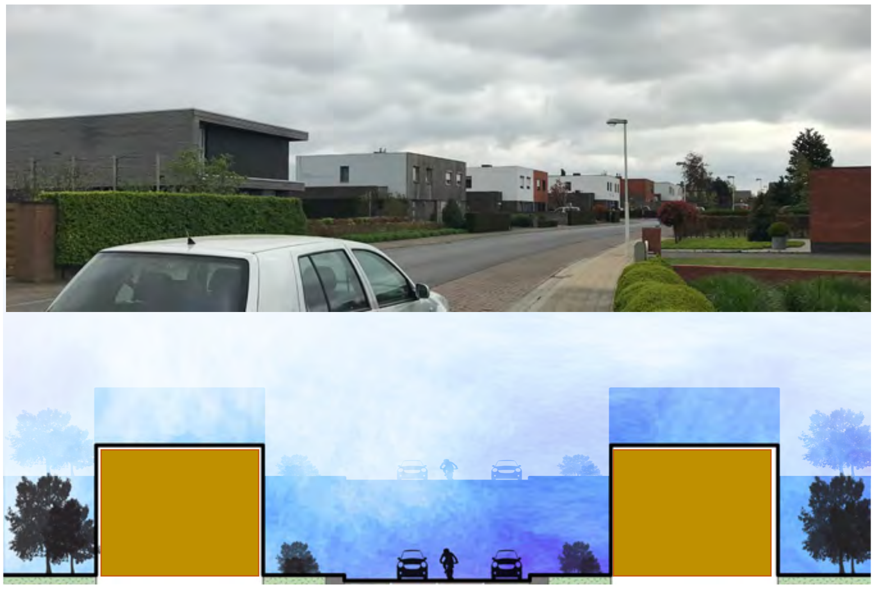
Main measures

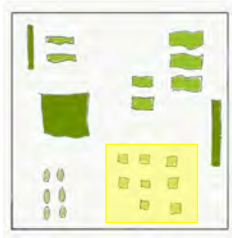
PV-Thermal roof	BTES
Collective Heat pump	DHW booster
Triple glazing	Roof insul.
Greenhouse garden	SUDS



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

All-electric self-sufficient renovation – *Techno terp*



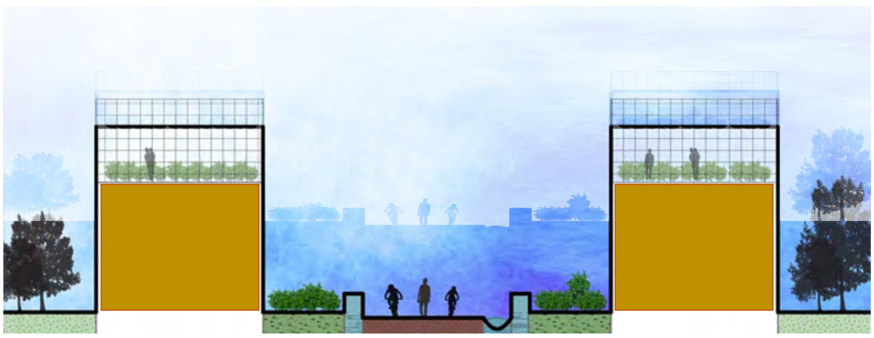


Consolidation of green space

- List 1
- List 2
- List 3

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

All-electric self-sufficient renovation – *Techno terp*



Techno terps

- Technical food system with aquaponics
- Fishtanks provide flood protection
- Bio-swales in street

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

All-electric self-sufficient renovation – *Techno terp*

Techno terp

- Independent energy
- Aquaponic greenhouse
- Fish-tank flood barrier
- SUDS

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

Roeselare, Belgium. April 2018

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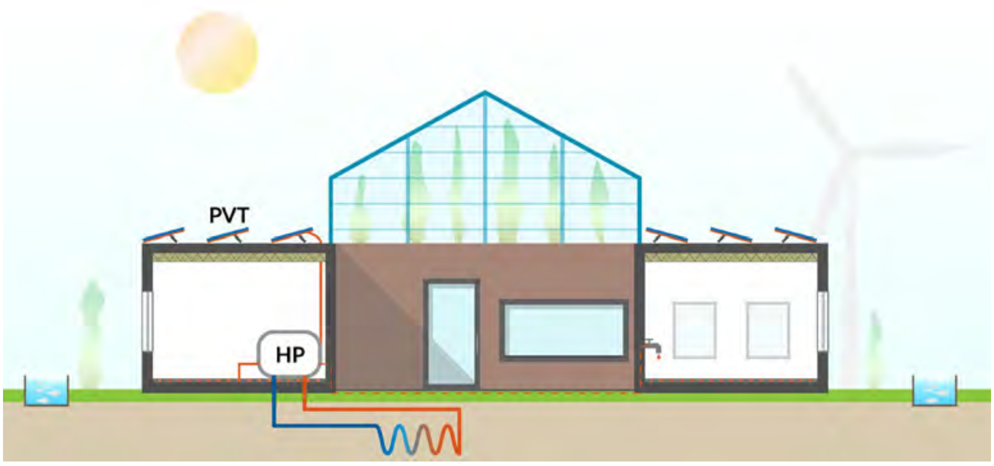
All-electric self-sufficient renovation – *Techno terp*



Main measures

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

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

Roeselare, Belgium. April 2018

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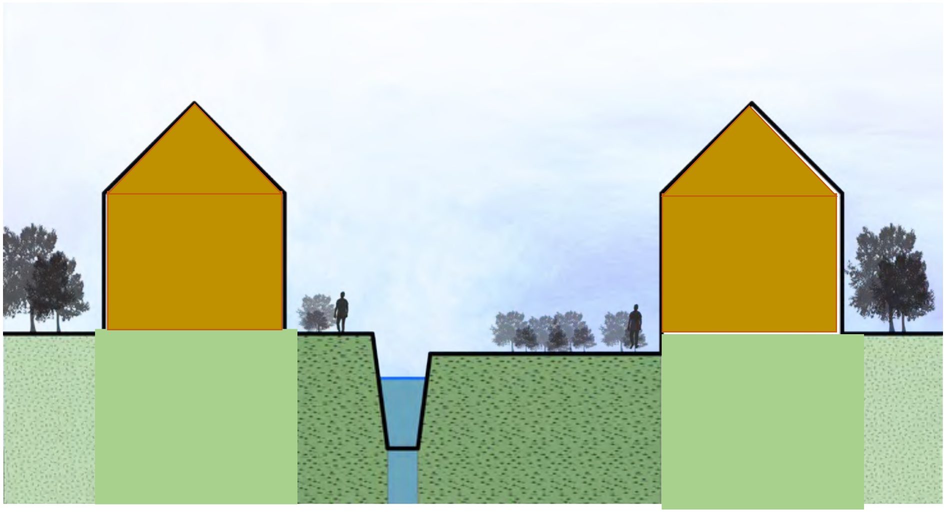
Urban Design

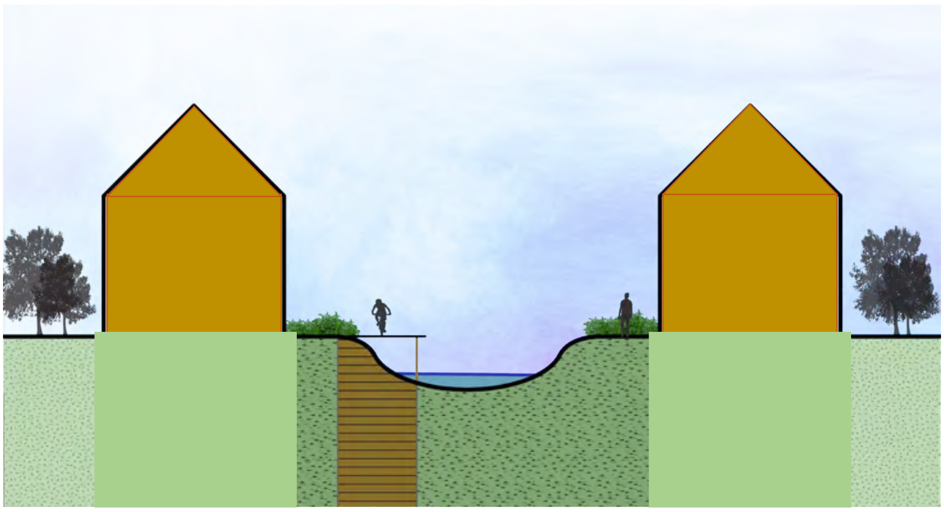


Unsafe and unnatural

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

Roeselare, Belgium. April 2018

Urban Design

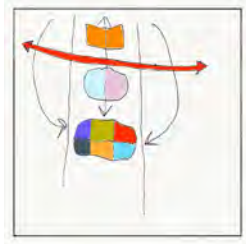


Safe and Natural

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

Roeselare, Belgium. April 2018

Urban Design



Unpacking the city into the neighbourhood

- Increased intensity
- Community services
- Increased density
- Reason to visit

CITY-zen New urban energy ROADSHOW

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

Roeselare, Belgium. April 2018 74

Food-LETTS Agora

Community Agora

- Food focussed neighbourhood
- Community food trading
- Paddy fiels

CITY-zen New urban energy ROADSHOW

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

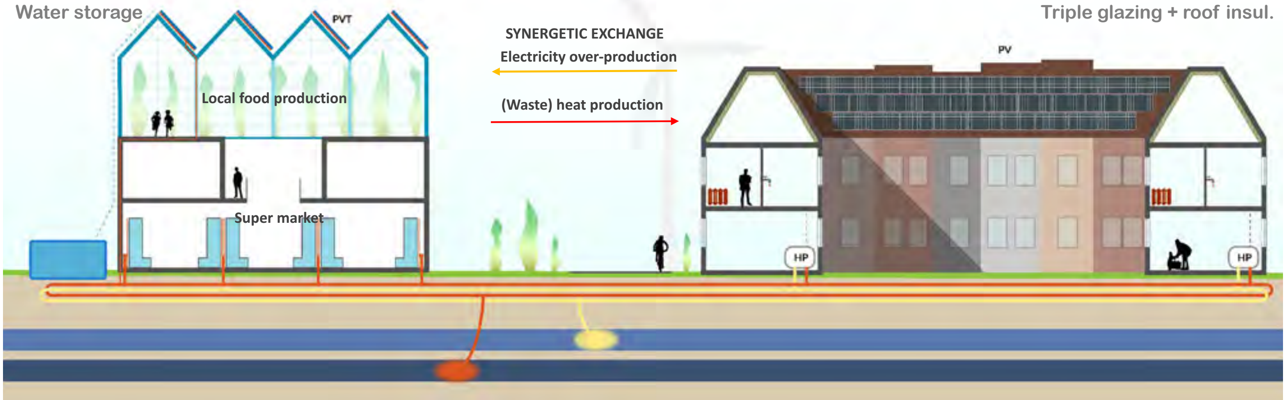
Roeselare, Belgium. April 2018 75

All-electric self-sufficient renovation – *Collievijver agora*

Main measures

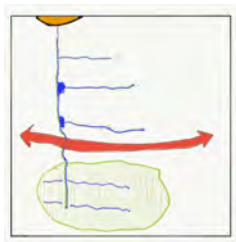
PV-Thermal roof
Waste heat from refrigeration
BTES
MT mini heat grid
Greenhouse roof
Water storage

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



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

Urban Design: nature reconnection



Enjoy the environmental tax!

Short coppice willow provides carbon sink

Amenity space

bio-diversity

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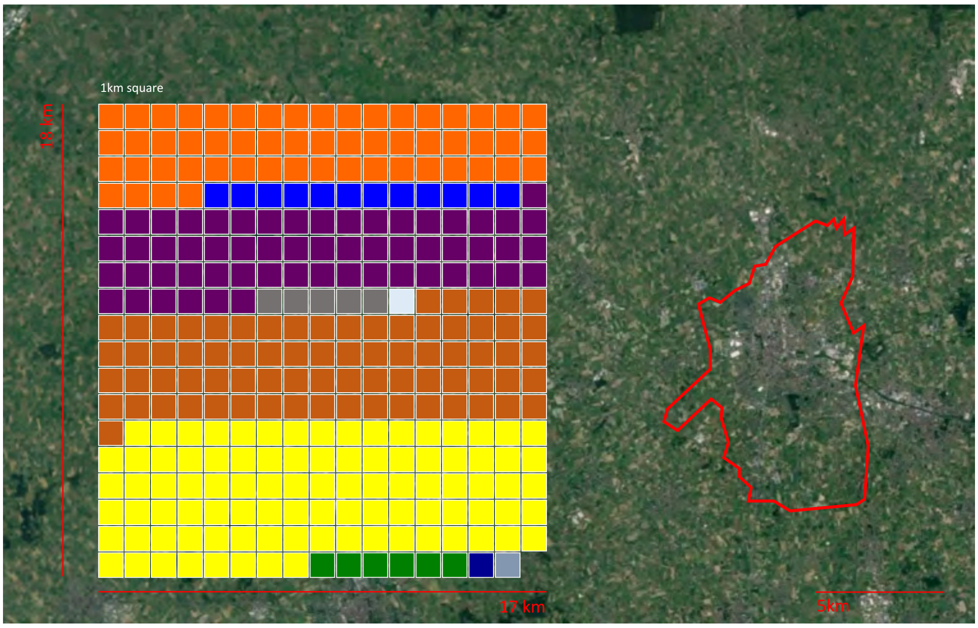
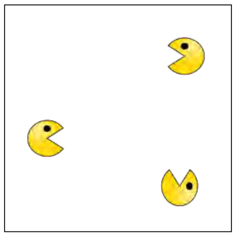
Urban design strategy: Prof Greg Keeffe, Queens University, Belfast.

CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE





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

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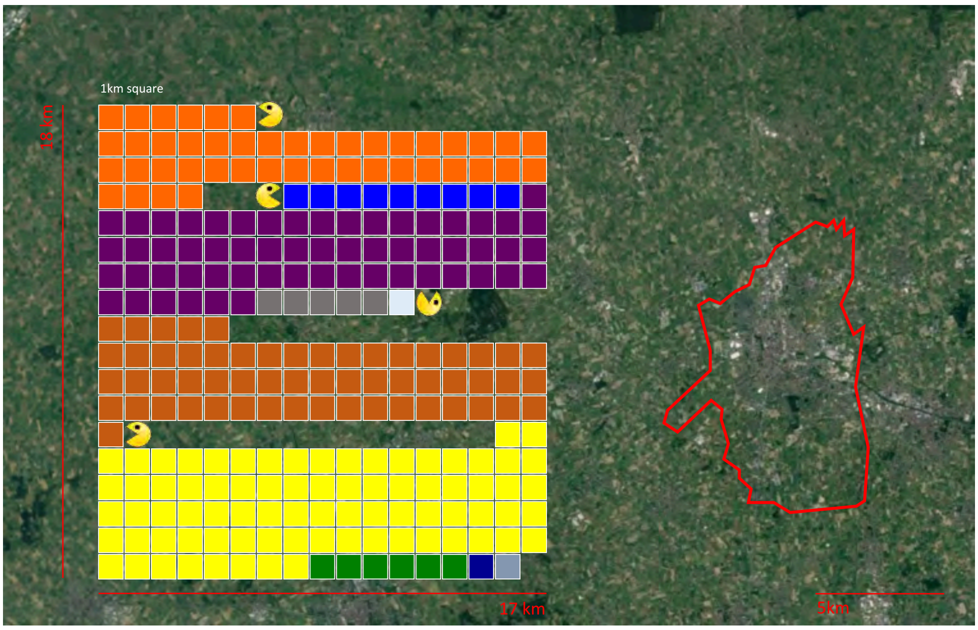

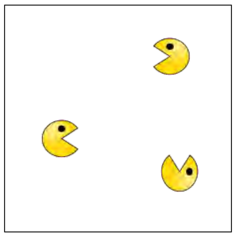

MEASURE #1
ENERGY SAVING
Building energy retrofitting

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

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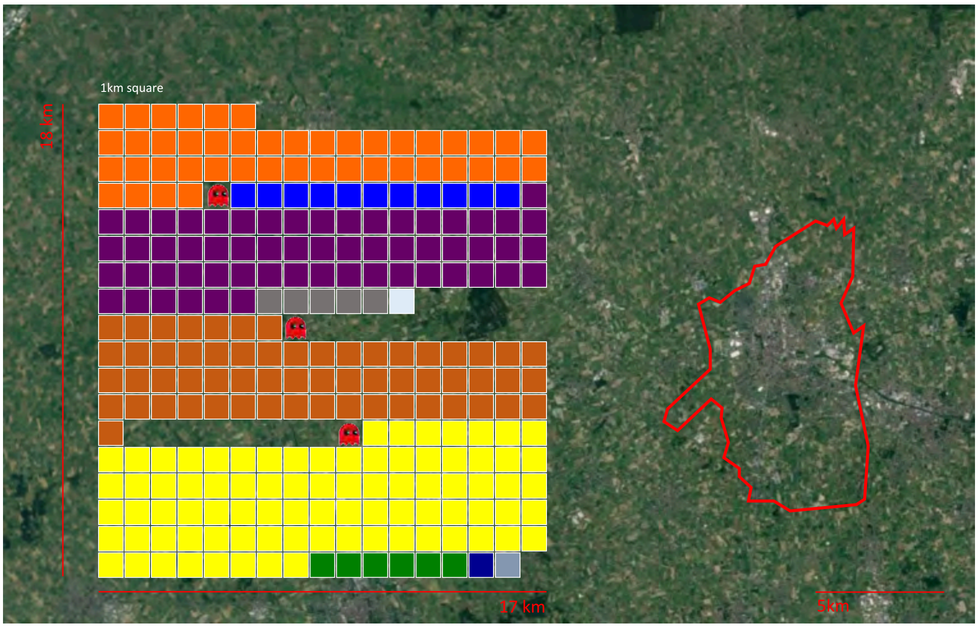

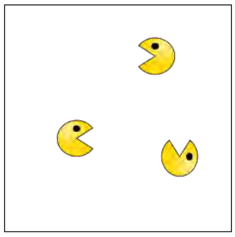

GROWTH
2050 forecast

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

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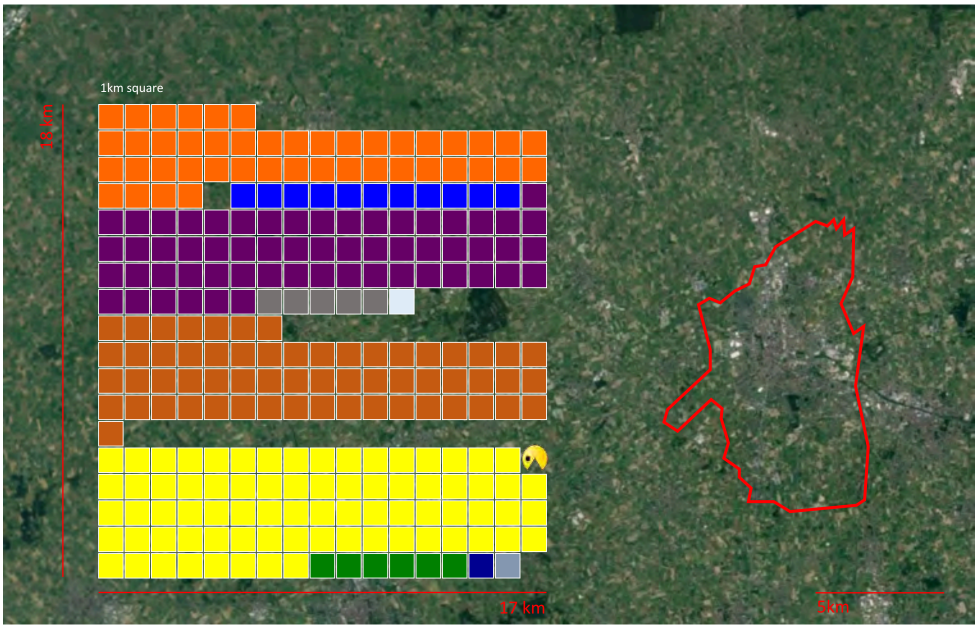

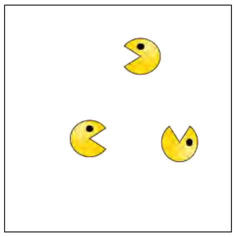

MEASURE #2
BIOMASS
Industrial use

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

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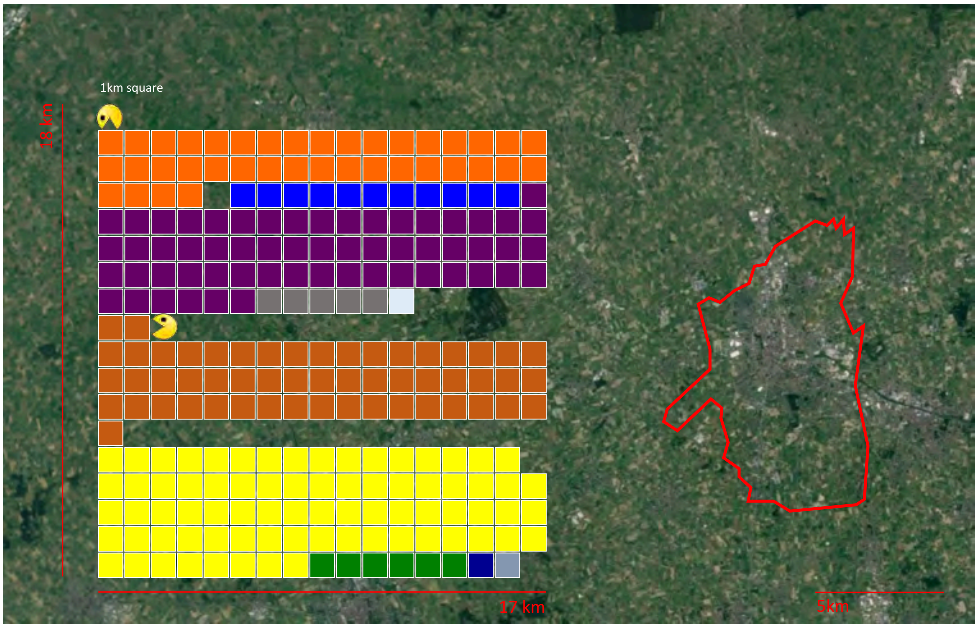

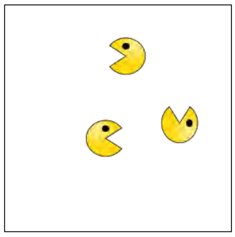

MEASURE #3
DISTRICT HEATING NETWORK
Waste incineration

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

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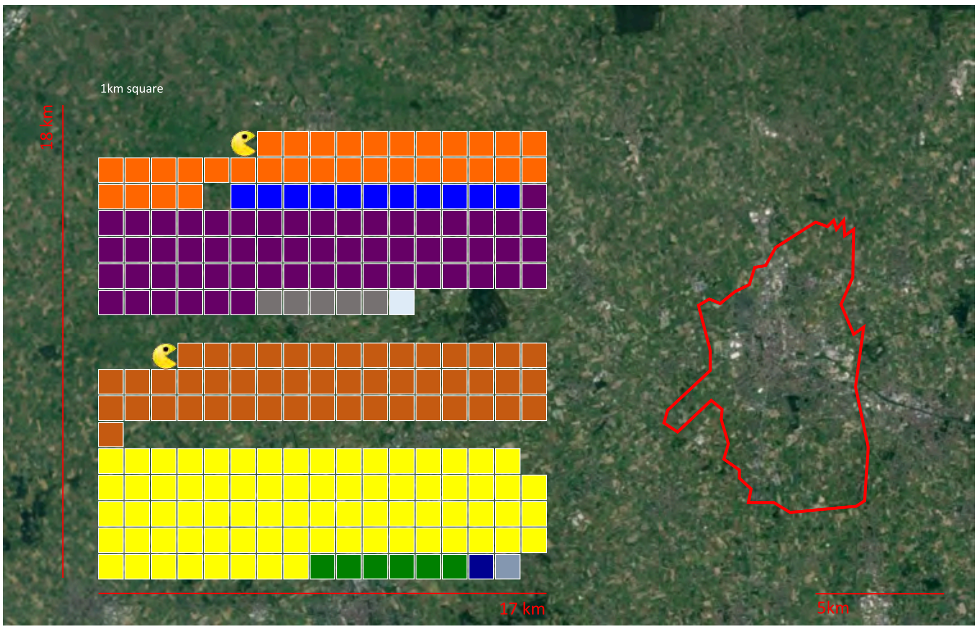

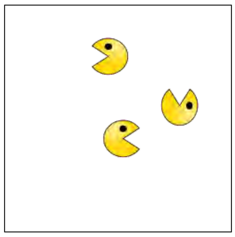

MEASURE #4
DISTRICT HEATING NETWORK
Solar collectors + HT storage

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

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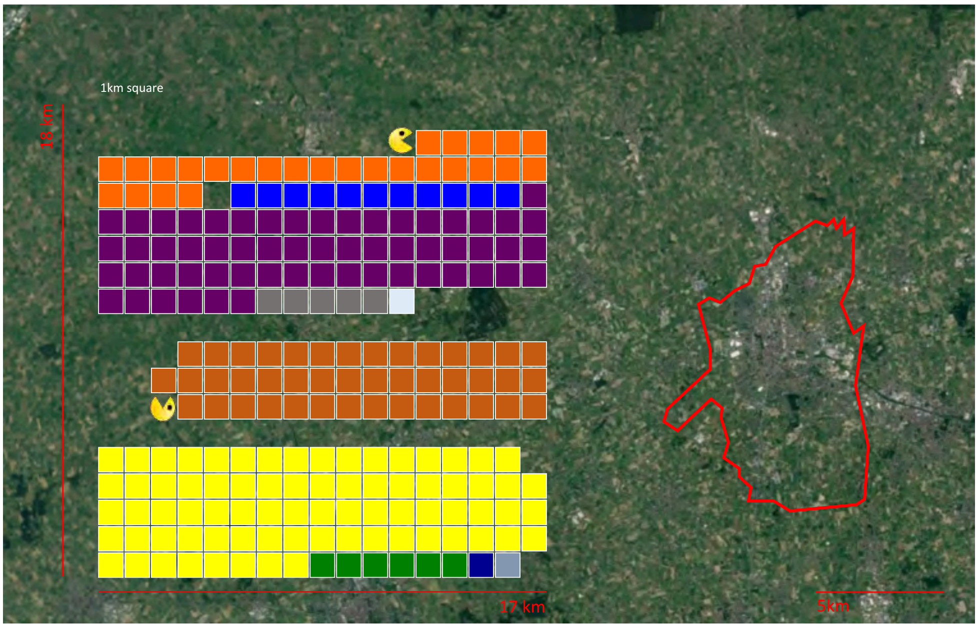
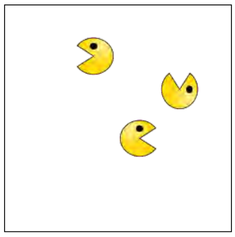
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE





MEASURE #5
DISTRICT HEATING NETWORK
HT industrial waste

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

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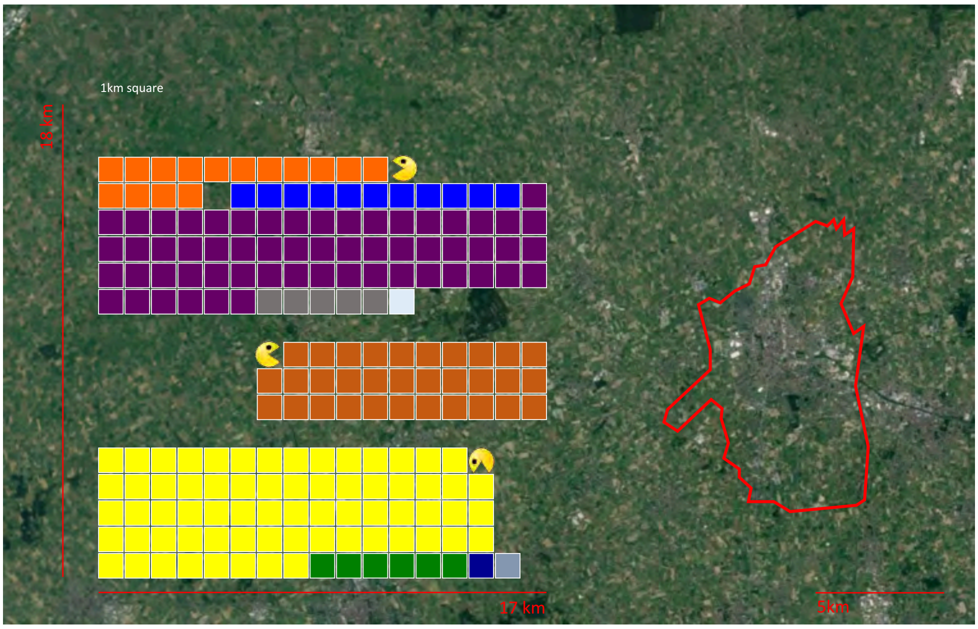

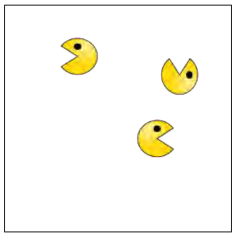

MEASURE #6
MINI HEAT GRIDS
Solar collectors + MT storage

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

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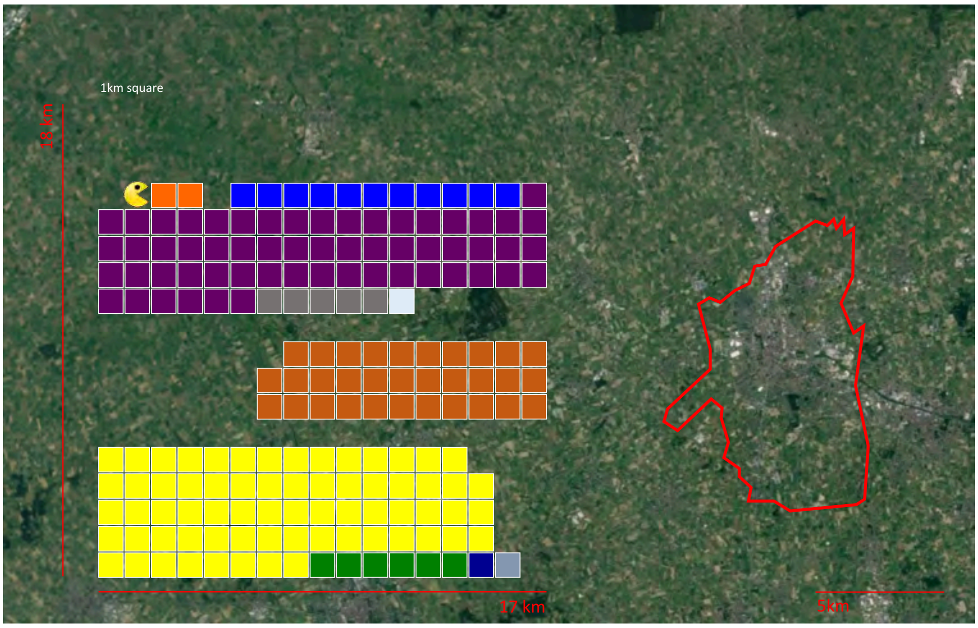
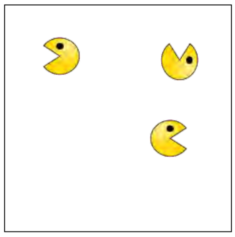
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE





MEASURE #7
PV THERMAL
Individual or blocks

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

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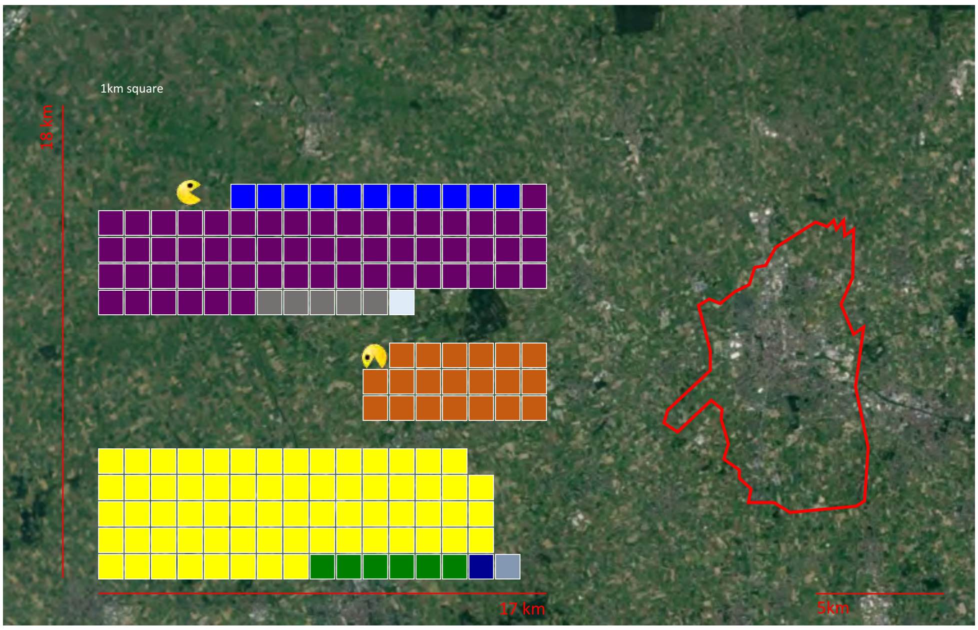
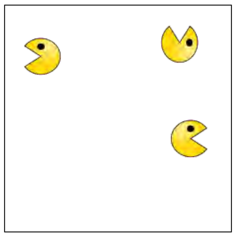
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE





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

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

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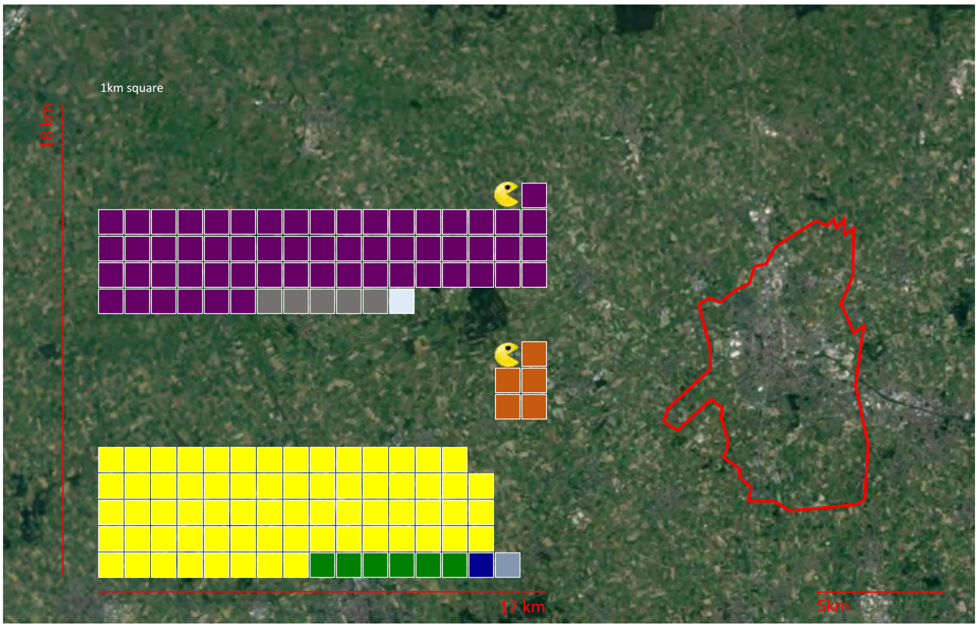
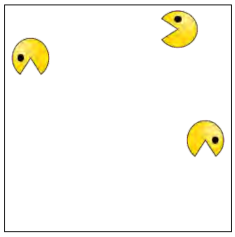
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE





MEASURE #9
PV on ROOF

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

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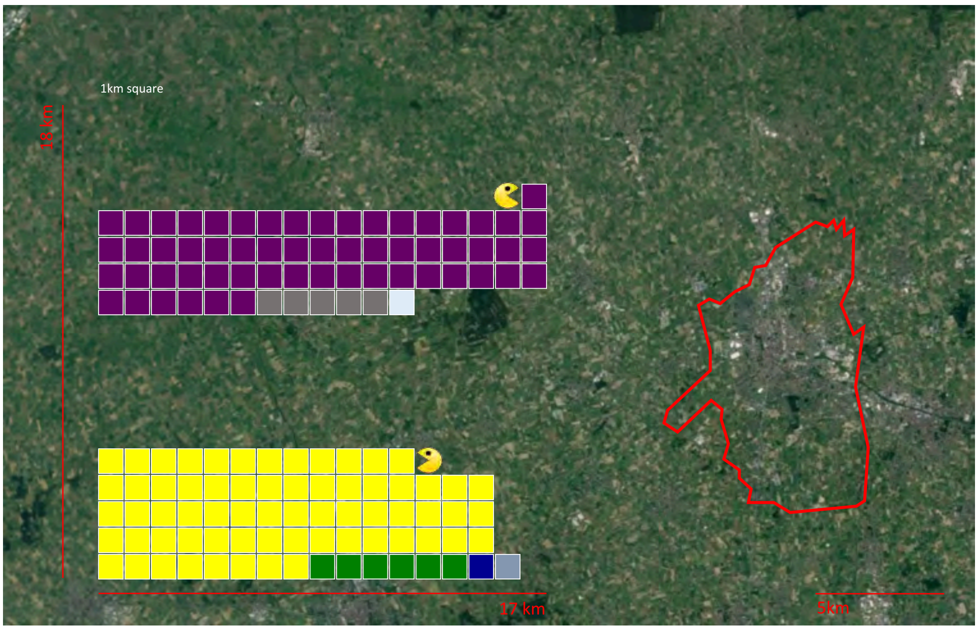
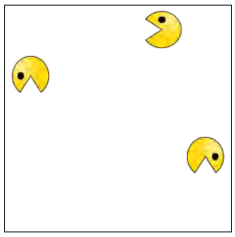
CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE





MEASURE #9
PV non ROOF

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

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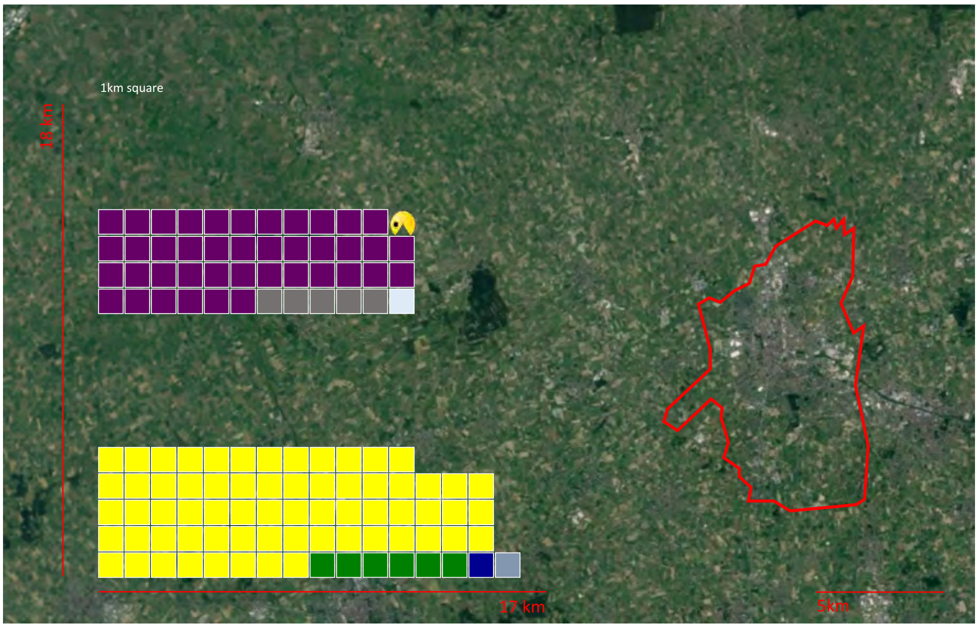
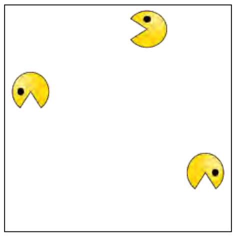
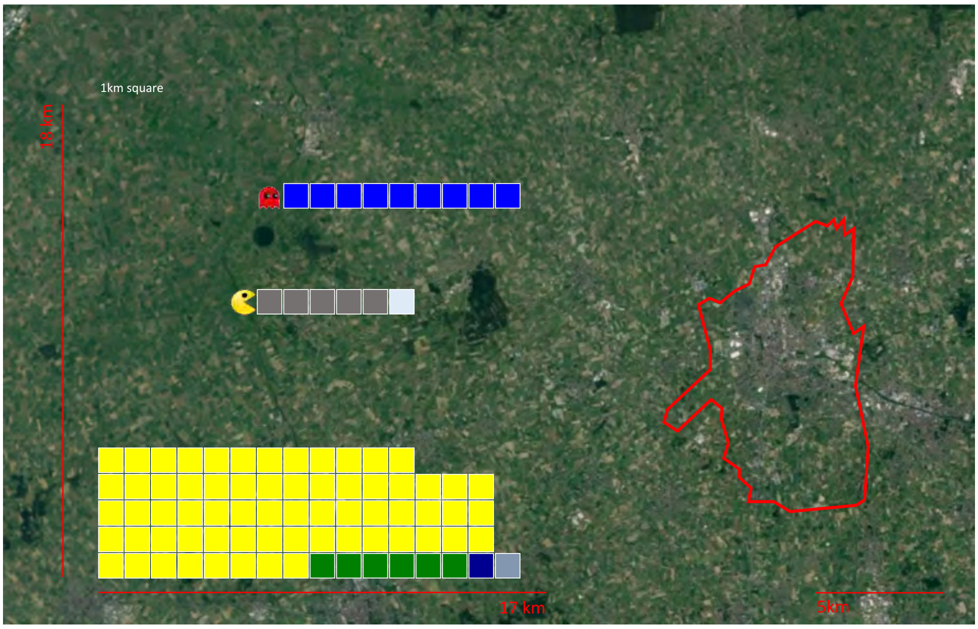


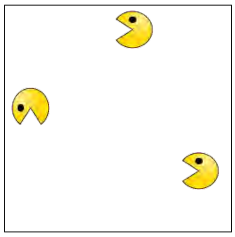


MEASURE #10 SUSTAINABLE MOBILITY
Cycling roads, electric public/sharing

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

CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE

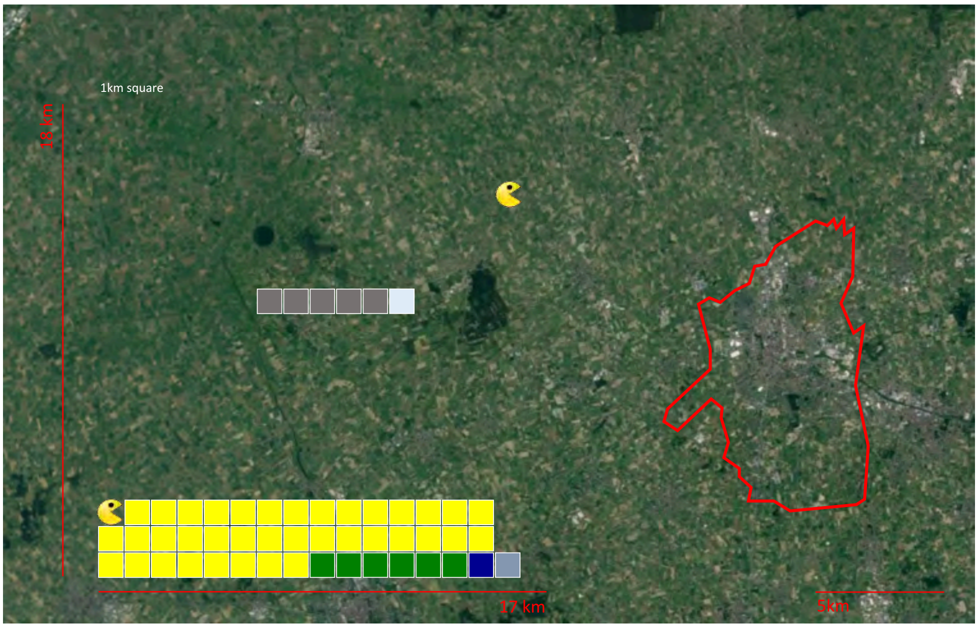


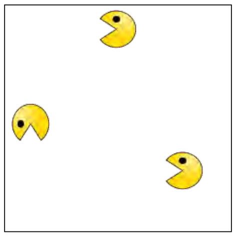


MEASURE #11 TRANSITION TO ELECTRIC MOBILITY

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

CARBON FOOTPRINT MITIGATION SCENARIO FOR ROESELARE





MEASURE #12
WIND FARM

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

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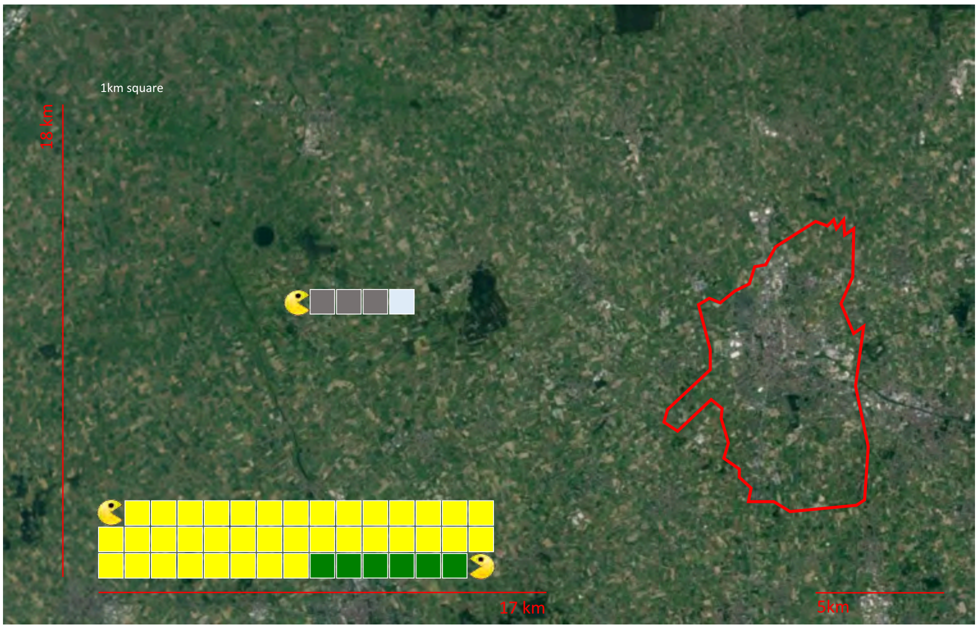

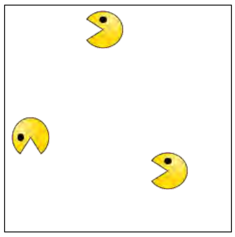

MEASURE #13
Waste recycling %
LED public lights
Electric public transport

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

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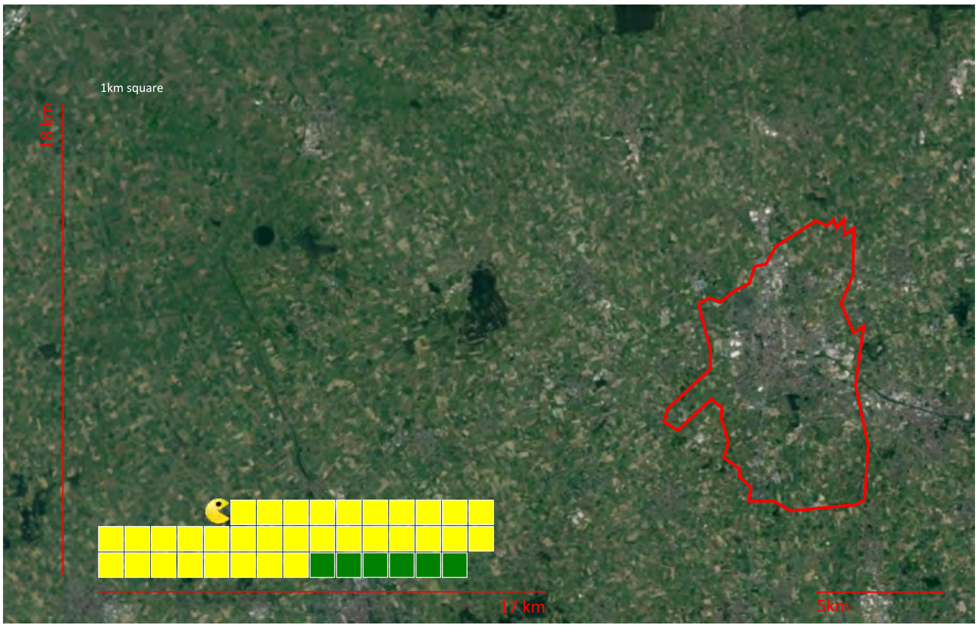

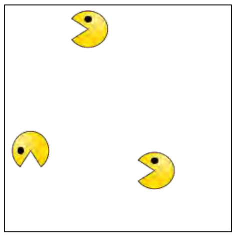

MEASURE #14
URBAN FORESTRY

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

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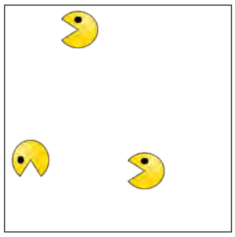

MEASURE #15
NEW FOREST

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

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Future …

Nu is't aan junder, veel succes!

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Contact: c.l.martin@tudelft.nl

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