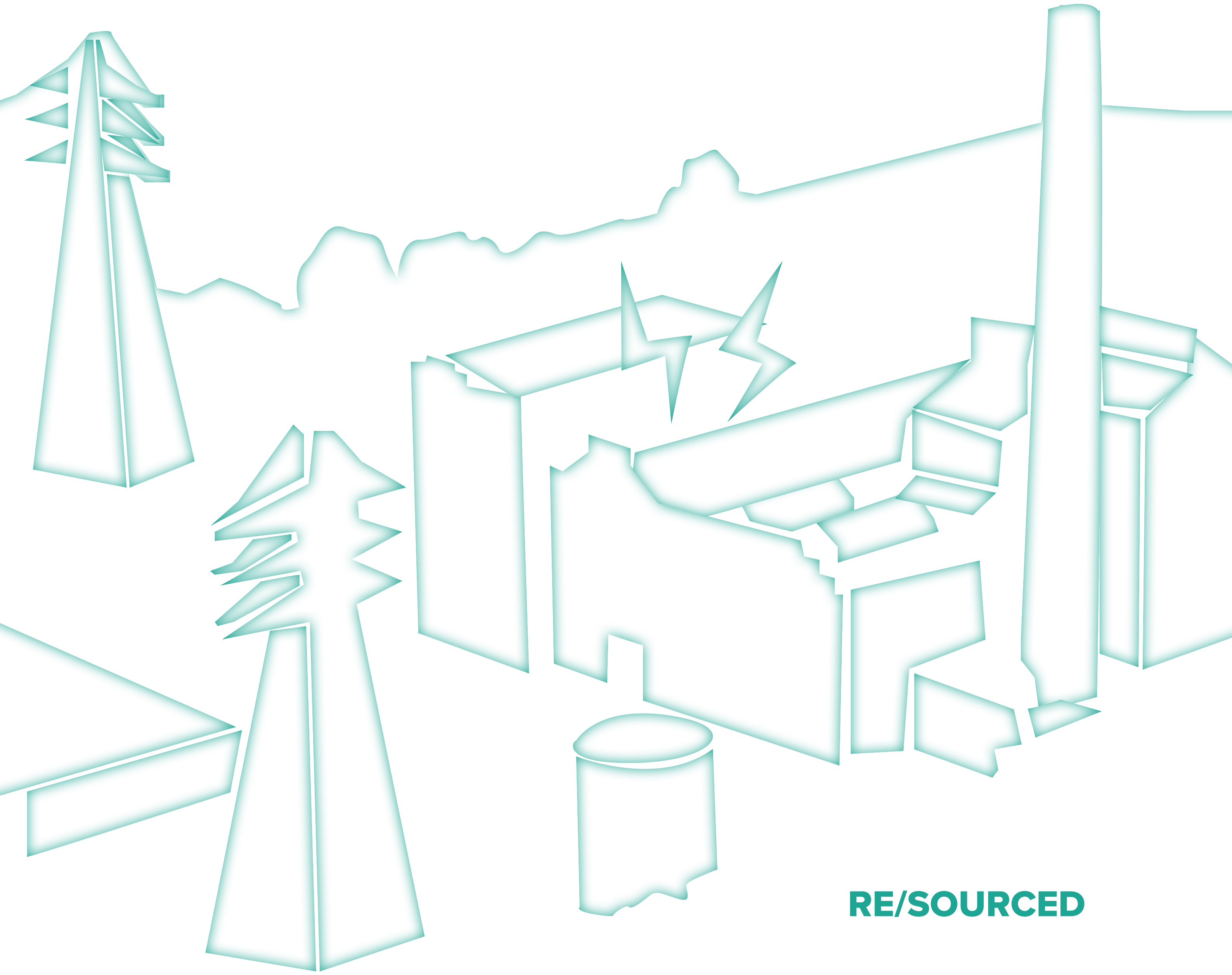
A cobbled road to an electrifying future



RE/SOURCED

A cobbled road to an electrifying future

RE/SOURCED

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Editorial
Cleo Bouttens
Brecht Caers
Jan Desmet
Jordy Forrier
Merel Goossens
Tine Ketelaars
Frederik Loeckx
Tom Nijsen
Tom Rommens
Dominiek Vandewiele
Stijn Vannieuwenborg
Wim Van Opstal
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Ward Ysebie

Editors
Tom Kesteloot
Jakob Vermandere

Graphic design
Lisa Van Speybroeck

Responsible publisher
Filip Vanhaverbeke
General Director Leiedal

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EXECUTIVE SUMMARY

This document summarises the lessons learnt by the consortium of project partners who led the implementation of the RE/SOURCED project. RE/SOURCED stands for “Renewable Energy SOlutions for URban communities based on Circular Economy policies and DC backbones”. The document is designed to be read by those interested in circularity, renewable energy, community engagement in energy and especially those who are interested in combining all three of these topics.

RE/SOURCED is an Urban Innovative Actions project, supported in the 5th round of UIA project funding, that aimed to create a renewable energy smart microgrid on the site of a former (heritage) coal-fired power station site that is being redeveloped. The redevelopment comprises offices, a range of social amenities and residential housing. The core energy generation assets have been retained for heritage and educational purposes.

The project partnership comprises seven discrete but complementary partners:

- 2 local/regional public authorities: Leiedal Intermunicipal Organisation and Zwevegem municipality.
- 1 university: Ghent University.
- 1 regional public authority: province of West Flanders.
- 2 business support organisations: Flux50, REScoop.eu.
- 1 research organisation: Flemish Institute for Technological Research (VITO).

The project was structured around five topics:

- energy transition
- energy efficiency
- energy system design
- the (heritage) listed Transfo site
- the educational infrastructure

Commenced in 2019, the project encountered the full impact of the COVID-19 pandemic at the critical midstage of its implementation. This had a direct and notable impact on the procurement of key technologies at a critical stage

of the project's delivery as providers were either not available or chose not to respond. The impact of COVID-19 also significantly elongated the procurement process and the project was granted an additional 12-month term by UIA to enable it to complete its delivery.

Initial implementation was slow. The project anticipated being able to utilise a regulatory sandbox (in Flemish law) to create its renewable energy living lab, but found that this route was not supported by key energy industry stakeholders. In attempting to find a solution, the Flemish Energy Agency (VEKA), the Flanders Energy Regulator (VREG) and Distribution System Operator (DSO – Fluvius) each put forward different proposals as solutions, but none agreed with the other. In an attempt to break the deadlock, the lead partner posed an interpretative question to DG Energy asking it to provide a legally binding decision. In its reply, DG Energy said the decision fell within the competence of the VREG energy regulator so it would not be appropriate for them to provide an opinion.

This challenge was overcome through the project team negotiating a solution with the DSO, Fluvius, whereby it would construct the network and use it as a test bed for DC circuits. It will be responsible for the maintenance of the network in the future.

An aim of RE/SOURCED was that renewable energy produced on site would be offered to local active users first, with any unused energy being injected in the public grid. This goal proved challenging to deliver due to:

- Legislation at the Flanders level that prevented groups from being classified as active users (only individuals could be active users).
- The small number of potential energy community members already available on site, which made the energy community financially non-viable.

The project team is still trying to overcome these challenges by providing the renewably generated electricity directly to a single end-user (EV chargers) with the revenue going to an existing energy cooperative. In the meantime, the lead partner (Leiedal) stays owner of the assets and will operate the smart grid for at least the next five years.

Legislation also applied to the heritage aspects of the project. These were addressed through close working with the Flemish heritage agency, very regular communication and frequent site visits.

As might be expected given its novelty and stretching goals, the project encountered technical challenges. These were competently addressed through engaging and utilising the expertise of the partnership: Leiedal Intermunicipal Association and Zwevegem municipality (local/regional public authorities), Ghent University, province of West Flanders, Flux50, REScoop.eu (business support organisations) and the Flemish Institute for Technological Research (VITO).

The challenges were not all technical – to be successful, the project had to marry the requirements of circular economy with those of constructing a renewable energy smart grid and finding a way to engage the community of users effectively. The document provides a detailed summary of issues around the five topic themes, but key points worth noting include:

- While the energy community could have been created, there was a challenge to find a model that would be financially sustainable, so an existing energy cooperative was engaged for this purpose.
- Energy generation will be from solar PV panels and a combined heat and power plant (CHP) with electricity storage achieved through end-of-life EV batteries.
- Some planned generation technologies proved technically unfeasible:
  - Pumped storage using the Transfo water tower was not used due to insufficient height to make the system viable combined with an absence of tenders through procurement (conducted during COVID-19 lockdown).
  - Wind turbine on site – national regulations changed, rendering the Transfo site too close to high-voltage power lines, so the turbine was not installed.
  - Reuse of PV panels proved impossible as no supplier was making these units available yet, so new panels had to be procured.
- One of the storage technologies proved a challenge – the use of a flywheel to store energy was not pursued for lack of providers in the marketplace who could provide this technology.
- The educational aspects were challenging to deliver as they had to "fit in" with the construction programme, and this necessitated very good communication between the construction contractors and those delivering the educational assets.

- Some educational elements could not be accommodated as planned while others had to be adapted – experience highlights the importance of ensuring that exhibits that access privately owned data via APIs agree to future access and provision contractually with the provider.
- A further project goal was to reuse materials and it was planned to reuse a steel structure for a new car park on which a large solar PV array would be mounted. This steel structure was located within a local industrial building that was about to be demolished. However, the contractor could not extract it without damaging it to the extent that made it unusable, so a new steel structure was procured yet designed for disassembly in the future.

The project has constructed a renewable energy DC smart microgrid using circular principles. It has included key renewable energy technologies (for generation and storage). It has found a workaround to the challenge of creating a financially viable energy community for a small group by engaging an existing energy cooperative to fulfil this role.

As could be expected, challenges were encountered, but through the pragmatic leadership of the project team, successful and viable solutions were found.

About RE/SOURCED

This document summarises the lessons learnt by the consortium of project partners who led the implementation of the RE/SOURCED project. It is designed to be read by those interested in circularity, renewable energy, community engagement in energy and especially those who are interested in combining all three of these areas.

It is structured around five project topics:

- energy transition
- energy efficiency
- energy system design
- the (heritage) listed Transfo site
- the educational infrastructure

Each chapter has four principal sections:

- context, key definitions and terms
- what we tried to do
- challenges and solutions
- tips and tricks

While we maintain this structure throughout, the balance of material within each section varies significantly from topic to topic – this reflects both the thinking that had to be invested in implementing the topic area, including the challenges that were encountered and solutions that had to be found. Some topic areas are highly technical while others are more reflective in style. This reflects the RE/SOURCED DNA!

AIM OF PROJECT

Scope of project

The aim of RE/SOURCED was to design and demonstrate a circular smart microgrid in a delimited urban environment, linked with an energy community.

The scale of the project site (10 ha) and the complementary energy consumption profiles of the different users (offices, sporting facilities, event halls, a brewery, etc.) offered the perfect setting for an energy community living lab.

The backbone of the system is a DC (direct current) power grid, envisioned to link a set of distributed renewable energy production sources (PV, mid-sized wind turbine and combined heat and power supplied with biofuels) and energy storage (second-life batteries and pumped storage in existing structures).

The proposed smart grid incorporates circular economy strategies based on shared use, refurbishment, repurposing, and higher efficiency of used materials.

The DC backbone offers efficiencies both in terms of energy savings (fewer power losses due to a more efficient conversion from DC to AC) and material use (due to fewer components in a DC/DC converter and same cables as in AC, but exploited at higher voltages, leading to less material for same power distribution). Sharing of production and storage capacity, deployed at distributed locations, increases the self-consumption of renewable energy with fewer components.

The circular approach anticipated using recycled solar PV panels was, front and foremost, a criterion in the circular procurement procedures. The energy storage capacity would be utilising second-life EV batteries and pumped water storage in a former water tank heritage structure and vehicle-to-grid solutions.

It was planned to create an energy community in which all site users would be members, able to participate to become active customers and manage the smart grid infrastructure, generation capacity and storage assets while also stimulating cooperation and engagement within the local user community.

It was anticipated that sharing energy production and storage facilities would enable the community to obtain the same level of self-sufficiency with far fewer materials than a newly built system, including the opportunities to enable local balancing through demand-side management.

Innovation

Surprisingly, at the time the project was designed, there were no examples of circular economy professionals and energy transition professionals working together to pursue bridging the two conflicting yet complementary challenges: energy transition versus closing material loops. There was a notable lack of integrated approaches for circular energy systems (materials - energy efficiency - renewables - shared economy) deployed in real-life urban contexts (TRL 7/8).

RE/SOURCED would build on the findings and experiences of existing projects in the circular and renewable energy disciplines. It combined experiences in energy storage, energy co-operatives, smart grids, etc. Critically, it added one important layer: a circular economy approach.

The elements of the project that were new and truly innovative included:

- The introduction of circular procurement for the different parts of the system at a system, supplier and product level.
- The integration of second-life batteries within the collective self-consumption smart grid, such as end-of-life EV batteries.
- The adaptive reuse of built environment and heritage to facilitate decentralised urban smart grids.
- The integration of a DC backbone in a real-life urban context.
- The addition of a plug-and-play DC docking station to link and test new technologies of all kinds of SDGE (Stochastic Distributed Grid Exchangers).

Partnership

The project partnership comprises seven discrete but complementary partners:

- 2 local/regional public authorities: Leiedal Inter-municipal Organisation and Zwevegem municipality.
- 1 university: Ghent University.
- 1 regional public authority: Province of West Flanders.
- 2 business support organisations: Flux50, REScoop.eu.
- 1 research organisation: Flemish Institute for Technological Research (VITO).

Each of the three knowledge and research partners covers the challenge addressed:

- UGent works on energy efficiency, the development and roll-out of a DC grid.
- VITO on material efficiency.
- REScoop.eu on the sharing concept.

At the crossroads of these dimensions sits the circular ethos of RE/SOURCED which guides the inputs of all partners.

Flux50 and VITO make the link with industry: Flux50 represents 160 companies creating new technologies for energy efficiency and transition, VITO is a renowned research institute focussing on the industry, SMEs, start-ups and policymakers.

Within the RE/SOURCED project, Ghent University is responsible for the development design and roll-out of the DC grid and the EMS system, while VITO, as the Flemish recognised technological institute, maintains strong connections with universities.

REScoop.eu, as the European federation of citizen energy cooperatives, directly or indirectly represents about 2450 energy cooperatives across Europe through national or regional federations.

Partners Leiedal and the Province have a strong network within local, regional and national authorities to get things moving. REScoop.eu and VITO also have a strong tradition of working with/for local, regional, national and international public authorities.

Last but not least, the municipality of Zwevegem secures the local anchoring.

THE REALISED OUTPUTS & RESULTS

The project has constructed a renewable energy DC smart microgrid using circular principles. It has included key renewable energy technologies (for generation and storage). It has found a workaround to the challenge of creating a financially viable energy community for a small group by engaging an existing energy cooperative to fulfil this role.

RE/SOURCED has shown how to construct a DC smart microgrid and to incorporate circular economy principles when doing so. It has contributed genuine learning as to which technologies may work and has managed to engage the DSO not only to be supportive of the project but also to be engaged in its development and building.

This will allow the DSO to use the project as a living lab and DC grid testbed, thereby enhancing its knowledge of a format that offers the potential to be significantly more efficient while also reducing carbon emissions.

1 Combined Heat and Power (CHP)
40 kWe + 78 kWth

2 New Transfo building, PV - *22,1 kWp*

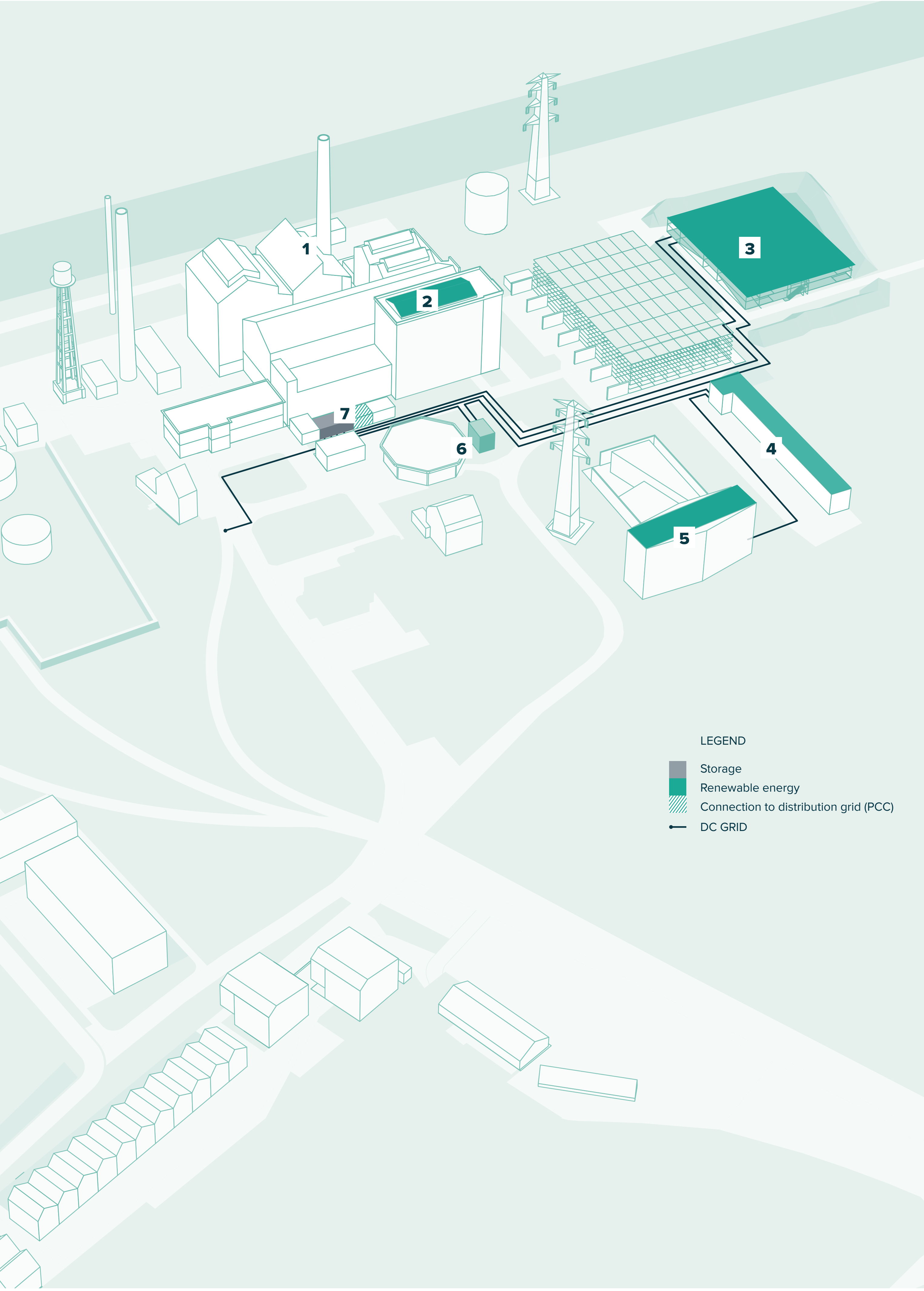
3 Solar car park, PV - *360 kWp*

4 Elia building, PV - *30,6 kWp*

5 Climbing hall, PV

6 DC docking station, *80 kW*

7 Point of Common Coupling (PCC)
+ central inverters, *500 kVA*
+ Battery Energy Storage System (BESS), *306 kWh - 160 kW*



1
2
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7
LEGEND
Storage
Renewable energy
Connection to distribution grid (PCC)
DC GRID

Topic 1

RE/ SOURCED

Energy transition

Context, key definitions & terms

CLIMATE AMBITIONS

The climate challenges force us to urgently make a major shift on a global scale to a carbon-free energy system. Our approaches to generating electricity, providing heating and cooling, commuting, transporting goods and powering manufacturing companies all need to change. And fast! The ambition in the EU's *Fit for 55 plan* is to reduce CO_2 emissions within the European Union by 55% by 2030 and to be completely climate neutral by 2050, having far-reaching implications for all businesses and citizens. Moreover, the EU needs to reduce its energy dependency on external countries and regimes such as Russia, as demonstrated by the impact of the 2021-2023 energy price crisis. Renewable energy should and will be an important game changer in the future. Solar and wind power are perfectly suited to increase our energy independence.


BINNENDIENST
TRANSFO. V

ELECTRIFICATION OF THE ENERGY SYSTEM

The use of renewable energy sources is increasing very fast, including the integration of storage systems and electrical mobility. For many applications, electricity is envisaged to become the most feasible solution for a greenhouse gas-free future energy source of the future. The transition to electric cars is a prominent example.

Although it is a growing economy, the total energy consumption in Belgium should significantly decrease from 360 TWh in 2020 to 230 TWh in 2050 through energy efficiency but will also see an increase in electricity consumption from 84 TWh in 2020 to around 185TWh in 2050, equating to 80% of the total (i.e the share of electricity is projected to rise from ~18% to 80%).

The production of renewable electricity has tripled in Belgium over the past decade from 7 to 21 TWh. However, further acceleration is needed in terms of solar and wind (on land and offshore).

The market demand for electricity, from businesses and households, is highly variable and does not fit the renewable energy production profile of solar and wind. The storage capacity is limited. Presently, the matching of supply to demand is achieved via pricing incentives. Historically, consumption variability was managed by flexible, fossil-based production facilities such as gas-fired plants. In a future electricity system without greenhouse gas emissions, new ways of coping with this variability in production will need to be introduced. The EU aims to better interconnect national grids, ease the transfer of energy surpluses and balance an EU-wide grid.

Battery storage is mostly used for grid balancing and is increasingly used for distribution and transport grid flexibility. Battery units are distributed across the grid and can be located stand-alone (e.g. Ruien, Kinrooi) at factories and domestic dwellings etc. Pumped hydro storage is also used, yet from a geographical and space perspective is not viable in Belgium.

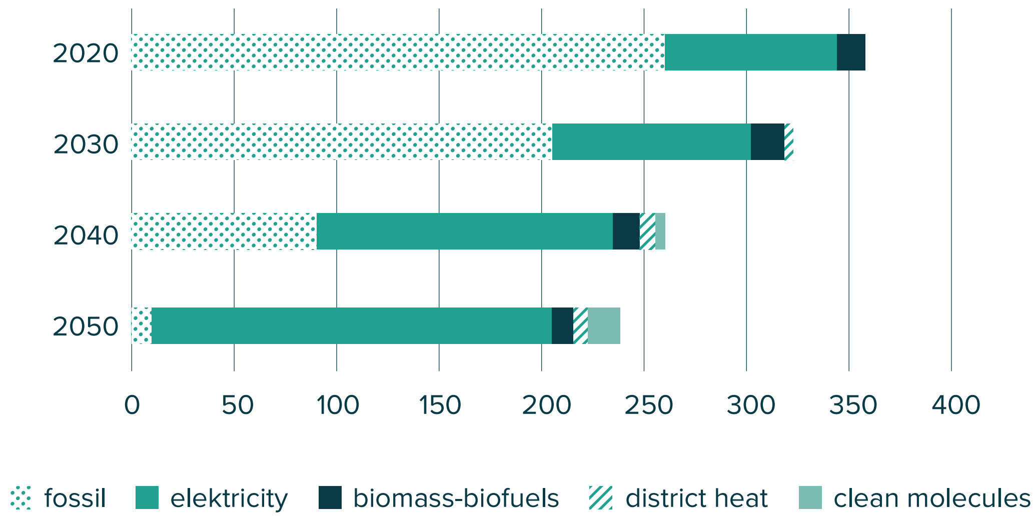
Presently, there is rapid technology evolution and scaling up of both renewable energy production and storage which can increase the efficiency and reduce the cost of these systems.

The electricity system needs to be adapted to accommodate changing consumption patterns due to the electrification (electric vehicles, heat pumps) and almost variable production of renewable energy sources. Consequently, all electrical networks (in neighbourhoods, regions, countries and transnational) have to move to higher levels of electrification, more precisely increasing the hosting capacity of the decentralised energy production. Real-time self-consumption of locally produced energy is promoted as part of the solution since it can reduce power demand of the grid.

Renewable energy technologies create new opportunities for citizens to actively contribute to the energy transition, especially when they become energy producers themselves (i.e. become active customers or “prosumers”). They can act individually or jointly.

Organising customers and prosumers within a cooperation model that allows them to invest jointly in renewable energy, share the energy between each other and optimise the real-time self-consumption, is an interesting option to reach the electrification targets while simultaneously minimising the need for additional grid capacity, thus avoid additional grid investments.

FINAL ENERGY DEMAND (TWH)



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ENERGY COMMUNITIES

To empower citizens in the energy transition, the EU has shifted its outlook on the role of the citizen in the energy system. Besides acting as an energy consumer simply buying electricity and gas from a supplier, a citizen may now become an active customer (acting individually or collectively), or participate in an energy community.

The Clean Energy for All Europeans Package recognised, for the first time within EU law, the rights of citizens and communities to engage directly in the energy sector. This legislation also introduced the role of the prosumer and collective forms of energy users and generators. The Clean Energy for All Europeans Package uses two separate directives to define energy communities: Citizen Energy Communities (introduced in the revised Internal Electricity Market Directive) and Renewable Energy Communities (introduced in the revised Renewable Energy Directive).

These two directives frame energy communities in slightly different ways but the goal of engaging citizens and communities in the energy sector is at their core.

However, the adoption of the energy directives by member states has been diverse. Each member state has interpreted the directives within the context of their existing legislation and their approach to energy market operation. Thus, each situation is different with some interpretations being quite restrictive and others more liberal.

Some member states have not differentiated between citizen energy communities and renewable energy communities in their national legislation – rather, they have simply referred to the creation of "energy communities". This is the case in Flanders.

Both definitions were transposed into a Flemish decree and approved on 31 March 2021. Overall, the legal approach adopted in Flanders is not particularly supportive of those wishing to establish or join energy communities.

The introduction of the legislation on energy communities should go hand in hand with new obligations, privileges and adapted procedures to facilitate their targeted activities (production, self-consumption, storage, participation in flexibility, charging services for EVs, energy sharing…). However, in Flanders, the only new activity facilitated is energy sharing. As a result, being organised according to the requirements of an energy community does not bring any additional value besides the option of energy sharing within an energy community.

ENERGY SHARING WITHIN AN ENERGY COMMUNITY

The new option of energy sharing is introduced to all active customers and may be done without an energy community (peer-to-peer, as a group of active consumers in one building e.g. multi-apartment building), or within an energy community. Energy sharing via an energy community has been the least successful option since its introduction.

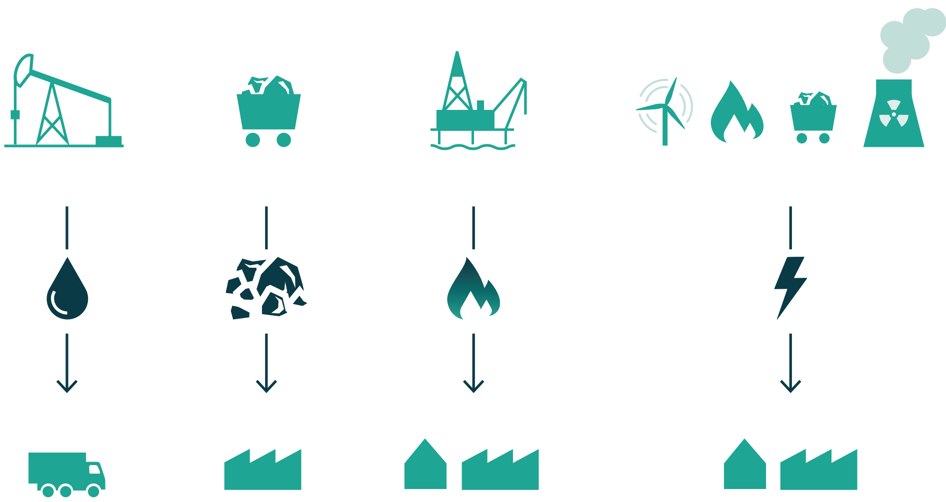
Anyone engaging in energy sharing is defined in law as "a participant". Participants can send energy to other participants (energy producer) and/or take energy from another participant in the community (energy receiver). The (energy) community is the set of participants who share green energy among themselves. All parties must be in Flanders, and both need to have a digital meter.

The approach to energy sharing in Flanders' legislation means that energy communities are liable for full grid fees, independent of the geographic scope of the energy sharing. Unlike other EU countries and regions as France and Brussels, the Flemish government opted to create no differentiation between sharing between citizens within the own site (e.g. a multi-apartment building) and sharing over long distances (e.g. 200 km away). Energy sharing has no impact on the cost of grid access, levies and taxes on the electricity bill. In other words, the regulator did not adopt the vision that an energy community can be financially compensated via tariffs if helping to avoid investments in extra grid capacity.

Moreover, their energy must be shared free of charge: it is not allowed to agree on a price per kWh shared. So, in practice, there is a financial disincentive if you share your electricity rather than sell it to the public grid. This makes the business case for creating or joining an energy community far from compelling.

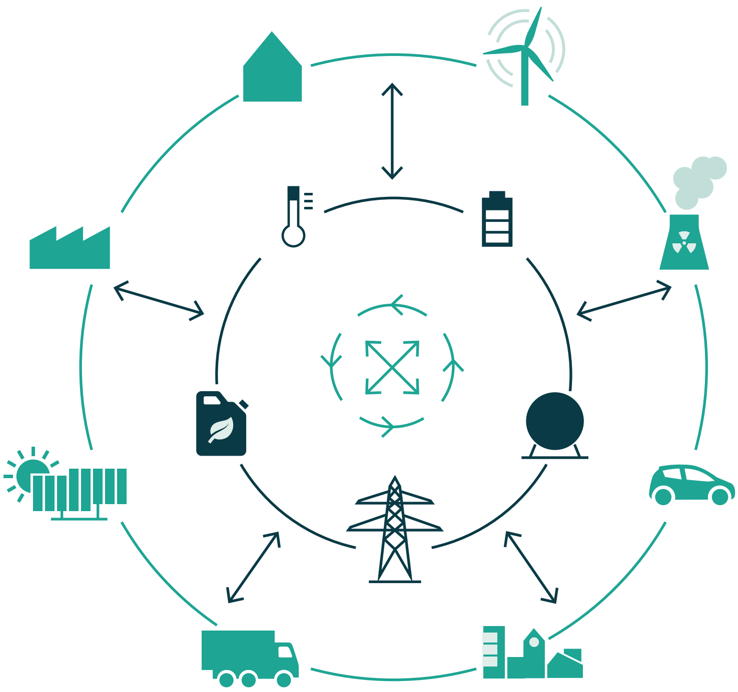
THE ENERGY SYSTEM TODAY

Linear and wasteful flows of energy, in one direction only



FUTURE EU INTEGRATED ENERGY SYSTEM

Energy flows between users and producers, reducing wasted resources and money



What we tried to do

The vision for RE/SOURCED was to create a model where more renewable energy is jointly and locally produced, stored, distributed and used collectively within one single urban neighbourhood, the Transfo site. At the same time, the smart microgrid of the neighbourhood allows local balancing reducing the interaction with the higher distribution grid in terms of capacity (kW) and flows (kWh). This would be more efficient for both the users of the site as the same energy could be shared but with less infrastructure, and for the wider society since less grid capacity investments are needed.

One central question was whether the newly implemented legislation on energy communities could be a tool to deliver the RE/SOURCED vision. The RE/SOURCED project started with the EU directives as a basis, since the transposition in Flemish legislation was ongoing during the execution of RE/SOURCED.

The smart microgrid is conceived to be a system that continuously aligns the production, consumption and storage of energy within the limited geographical demarcation of the Transfo site (which is also the boundary of the energy community).

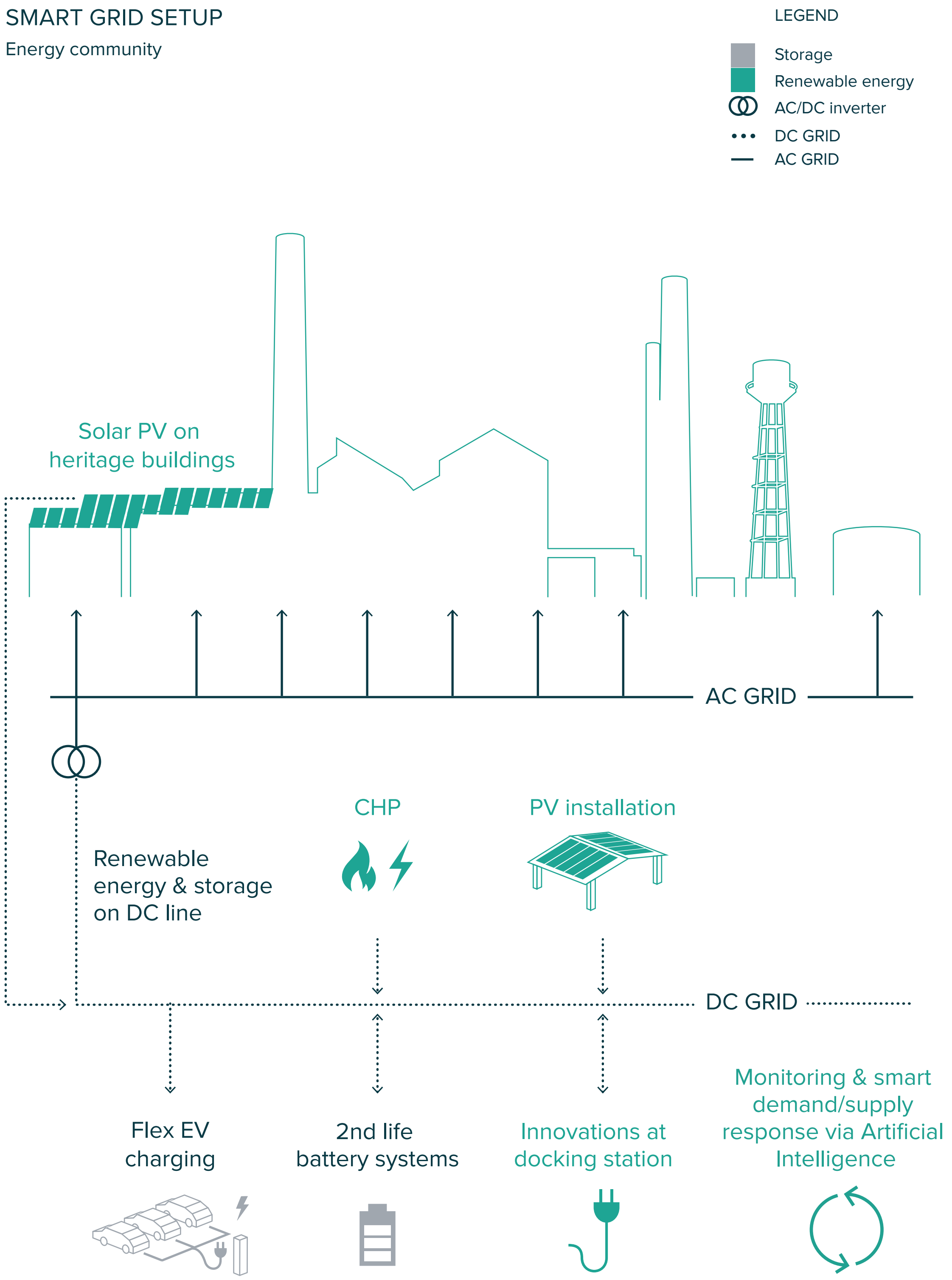
The vision was that all users at Transfo should become members or shareholders of a *Transfo energy cooperative* and that said cooperative should be the owner of the installations for production, storage, distribution, consumption and balancing of energy. In line with the EU directives (on the Energy Market and Renewable Energy), the Transfo energy community planned to carry out the following activities, limited to the site of the energy community:

- Production of renewable energy
- Distribution of energy
- Supply of energy to the energy community members
- Energy consumption by the installations owned by the energy community
- Storage of energy
- Offering electric vehicle charging services to members of the energy community
- Offering energy management services to members

At the start of RE/SOURCED, it was also expected that a level playing field between individual active users (prosumers) and collective active users (energy communities) would be created. When the Transfo smart grid was first envisaged, it was anticipated that the energy community would be allowed to operate a smart microgrid with *one* connection to the public distribution grid and would therefore be considered as *a single* collective active consumer.

SMART GRID SETUP

Energy community



Challenges & solutions

There were obstacles when implementing the Transfo Energy Community, the most significant of these being non-technical in nature. The two key challenges were: meeting the legal and regulatory framework in Flanders and designing an operating model that would be commercially viable (sustainable).

To overcome these challenges, the following major adaptations were carried out:

- Changes to the concept of the energy community
- Reduction of the geographical scope of the circular smart grid
- Subsequently, changes to the technical concept to make it economically viable within the legislative and regulatory framework

OVERCOMING LEGAL AND REGULATORY REQUIREMENTS

The biggest tension we encountered was around the legal and regulatory requirements. Our concept, which was informed by the European regulations around energy communities, turned out not to be viable (within Flanders) when attempted in practice. There were two main reasons:

- The EU directives on the Energy Market and Renewable Energy are not fully consistent with the newly introduced concepts of citizen energy communities and renewable energy communities. The option for horizontal integration of activities within energy communities, for instance, is not fully developed and creates conflicts with the unbundling principle.
- The Flemish Region's adoption of the directives into its current regulatory framework, specifically the lack of alignment between existing regulations and the new regulations relating to energy communities, meant that energy communities cannot access all electricity markets in a non-discriminatory manner (Art. 16 of the Energy Markets Directive), for example:
    - There is no accommodation within the Flanders' legislation that supports the supply of energy to members of the energy community. An energy community is treated in law like another provider and would need a full supply license which would require it to be a large-scale energy provider, which in turn would conflict with its founding principles as an energy community.
    - The distribution tariff structure is not adapted to the concept of a smart microgrid on a private site. Legislation does not incentivise producers to come together to reduce peak demand within the own site – rather, the incentives are framed around individual producers. Moreover, in Flanders, the costs for individual active consumers are lower than those for collective active consumers via the ODV's (public service obligations), placing groups at a further disadvantage.

HOW TO FACILITATE THE TRANSFO ENERGY COMMUNITY MANAGING ITS SMART GRID

A key problem for the RE/SOURCED project was the inability of the Transfo Energy Community to manage the energy distribution on its own site, thereby preventing the energy community from operating it as a smart grid. Several solutions were considered.

Become a Distribution System Operator

The first legal option considered Transfo becoming a distribution system operator. EU Directive 2019/944 *"empowers member states to allow citizen energy communities to become distribution system operators either under the general regime or as 'closed distribution system operators'"*. However, this option was not transposed in the Flemish Energy Decree making it impossible for the energy community to become a distribution system operator. The Decree requires a minimum of 200,000 connections which indicates the scale anticipated for these types of proposals – clearly on this scale, Transfo was not eligible.

Direct line provision

The second legal option that was considered was to use the legislation around "direct line" provision. This allows a producer to have a single connection to a consumer on an adjacent site – this proved also unhelpful as it only connects production to one user which is clearly totally impractical for Transfo.

Closed Distribution System

The third legal option considered was a closed distribution system (CDS). This would require the exclusion of residential Transfo site users from the energy cooperative's sharing model. If adopted, this change would have greatly weakened the original vision of RE/SOURCED. The Flemish Energy Regulator VREG was responsible for the approval of the CDS. Whereas the Flemish Energy and Climate Agency, as a policymaker, believed that the Transfo concept would fit the concept of the CDS in the Flemish Energy Decree (and EU directive), the Flemish Energy Regulator did not. The regulator referred to the EU directive and accompanying interpretations dating from before the introduction of the concept of energy communities in the directives. To break this stalemate, the RE/SOURCED project raised an interpretative question directly to the European Commission, DG ENER: *"Does the proposed concept for a Closed Distribution System (CDS) at the Transfo site in Zwevegem meet the conditions to be recognised as a CDS conform the definition of Article 38 of the directive (EU) 2019/944?"*. The EC responded that it is the competence of the Flemish regulator to decide on this and chose not to make interpretations of Article 38 based on the RE/SOURCED case.

Regulatory sandbox

Meanwhile, the RE/SOURCED partnership prepared a request for a regulatory sandbox to facilitate dealing with other legislative hurdles. In 2018, the Flemish government introduced the possibility of creating regulatory sandboxes as a tool to stimulate the energy transition via living labs. These would allow legal exemptions with the aim to test a new idea or concept. The idea of using a regulatory sandbox was at the heart of the original UIA project proposal. Despite extensive and thorough preparation, the RE/SOURCED project did not succeed in obtaining a legal sandbox status. By 2023, there was no political support from the Flemish government to allow regulatory sandboxes. Only one (limited) regulatory sandbox was approved in Flanders. This route was closed.

A FUNDAMENTAL RETHINK WAS REQUIRED

As a result of these challenges, two adaptations were made to the circular smart microgrid concept.

Firstly, the geographical scope of the Transfo site was adapted. Secondly, the design was technically adapted: one energy user (EV charging station) connected via DC grid with PV, battery and CHP and steered by an EMS. This concept is supported by DSO Fluvius, who was engaged to build and operate the DC grid as a living lab.

Overcoming the challenge of financial viability

The vision was always that the assets comprising the Transfo generation and distribution system be transferred to the energy community once the RE/SOURCED project had been delivered. However, the adaptations described above impacted upon the energy community's financial sustainability and made it difficult to build a solid business case for the RE/SOURCED concept. The regulatory framework and tariff structure reduce the cooperative's ability to generate revenue while also adding additional expense. For example, it is not possible to sell the jointly-produced energy directly to members of the energy cooperative as an intermediary party must be engaged for this task and this adds additional costs - and full grid charges, other taxes and charges still have to be paid. There is no incentive, therefore, to share energy within our own site, although this was a key goal of the project.

The Transfo energy concept is innovative, serves as a living lab and can act as an exemplar to others. As such, the economic dimension was not dominant in decisions around technical design. In addition, non-standard technical solutions such as the DC grid increased the project cost. This was compensated by the financial support of UIA but in the long term and once the UIA project has been delivered, the concept faces more financial risks since the technology and design used are novel and less standard.

From a societal viewpoint, the challenge of creating an energy community is characterised by the complexity of dealing with multiple and as-yet-unknown users, such as residents who were on-site at the beginning and office owners who are only now in place. Accurate consumption profiles were not available and estimations had to be changed as both existing users altered their demand profiles and new users came on board. This situation is not unique to the Transfo site.

Considering the size of the site and the relatively small number of users (and therefore potential members) requiring limited volumes of energy, the creation of a dedicated energy cooperative would lead to a substantial cost and staffing overhead. Energy community members usually contribute financially to the operation of their group – if the membership numbers are low, this income stream is also low.

Therefore, an alternative approach was required. This was achieved through cooperating with an existing regional energy cooperative, Vlaskracht, who will be responsible for operating the Transfo energy system. It is important to remember that cooperatives (and energy communities in general) are businesses and have to manage their commercial risk. Creating a commercially sound business case for the Transfo system was a challenge.

Through the arrangement with Vlaskracht, all Transfo site users may become members of Vlaskracht and will be able to buy sustainable energy from the cooperative via the linked cooperative energy supplier Ecopower with whom Vlaskracht has an established relationship.

LESSONS LEARNT

RE/SOURCED is an innovative and multidimensional project. Incorporating an energy community was one of these innovations. The combination of its regulatory and technological innovations was one of the complexities of the RE/SOURCED project. More precisely, the EU directives introducing the concept of energy communities seemed to open the path to a genuinely new approach to energy production and consumption and were needed to speed up the energy transition.

However, the initial optimism of RE/SOURCED was blocked by the rigid regulatory framework and a lack of alignment between the concept of energy communities (at an EU level) and the existing regulation in the Flemish Energy Decree. In Flanders, being recognised as an energy community does not create any new possibilities apart from energy sharing. Moreover, it is disadvantageous being a group of collective active users or an energy community.

Projects such as RE/SOURCED need to be embedded in a culture of innovation and experiment. In general, Flemish energy policy and key stakeholders lack strategies to facilitate innovation and to experiment within living labs. This is illustrated by the limited options of the regulatory framework on regulatory sandboxes in Flanders. The restraint of DG ENER when answering the interpretative question did not help the project. With key stakeholders, the fear of a precedent seemed to dominate over the goal of helping to find new models for energy transition. Moreover, believers in energy communities as a viable mechanism for energy production and energy sharing are obstructed by non-believers. It should be noted that the energy sector sees little benefit for them through engaging in the delivery of energy communities – but they were introduced to benefit citizens, not existing energy players.

The creation of an energy living lab is challenging, not just from a legal viewpoint but also as the economic model underpinning its operation is fragile. An energy community must be operated with a sound business model.

Tips & tricks

ADOPTION EUROPEAN DIRECTIVES BY MEMBER STATE

Check whether and how the Internal Electricity Market Directive and the updated Renewable Energy Directive RED-II have been adopted into member state legislation. Look specifically at how rules governing energy communities have been defined and how key stakeholders such as the energy regulator, the energy agency and the DSO interpret these rules.

THINK CAREFULLY ABOUT THE MOST SUITABLE MODEL

Think carefully about what you are trying to achieve with your project and what it will do that is new. Then think about whether an energy community is best suited to it (which strengths does it bring?) or whether a different model might be better. While some member state legislation delivers tangible benefits for members of energy communities, for others (like Flanders) the benefits are minimal and it may be more appropriate to create a group of interested parties that is not defined as an energy community. Regardless, the business case must be sound.

ENGAGING AN ESTABLISHED ORGANISATION

As with RE/SOURCED, think about whether an existing/ established organisation might be engaged – this reduces risk as it will have established procedures and operating experience.

CHECK WITH KEY STAKEHOLDERS

If attempting to deliver a model that is outside conventional thinking, check with key stakeholders (DSO, Energy Regulator etc) whether and how it might be tested. Even if they say no, try to find workarounds that allow you to proceed in a way that is as close as possible to your original idea or plan.

COMMERCIALLY SUSTAINABLE

Make sure that the commercial model for energy communities is commercially sustainable. This is important as should the community fail, it will be much harder to get the members to re-engage in another initiative of this kind.

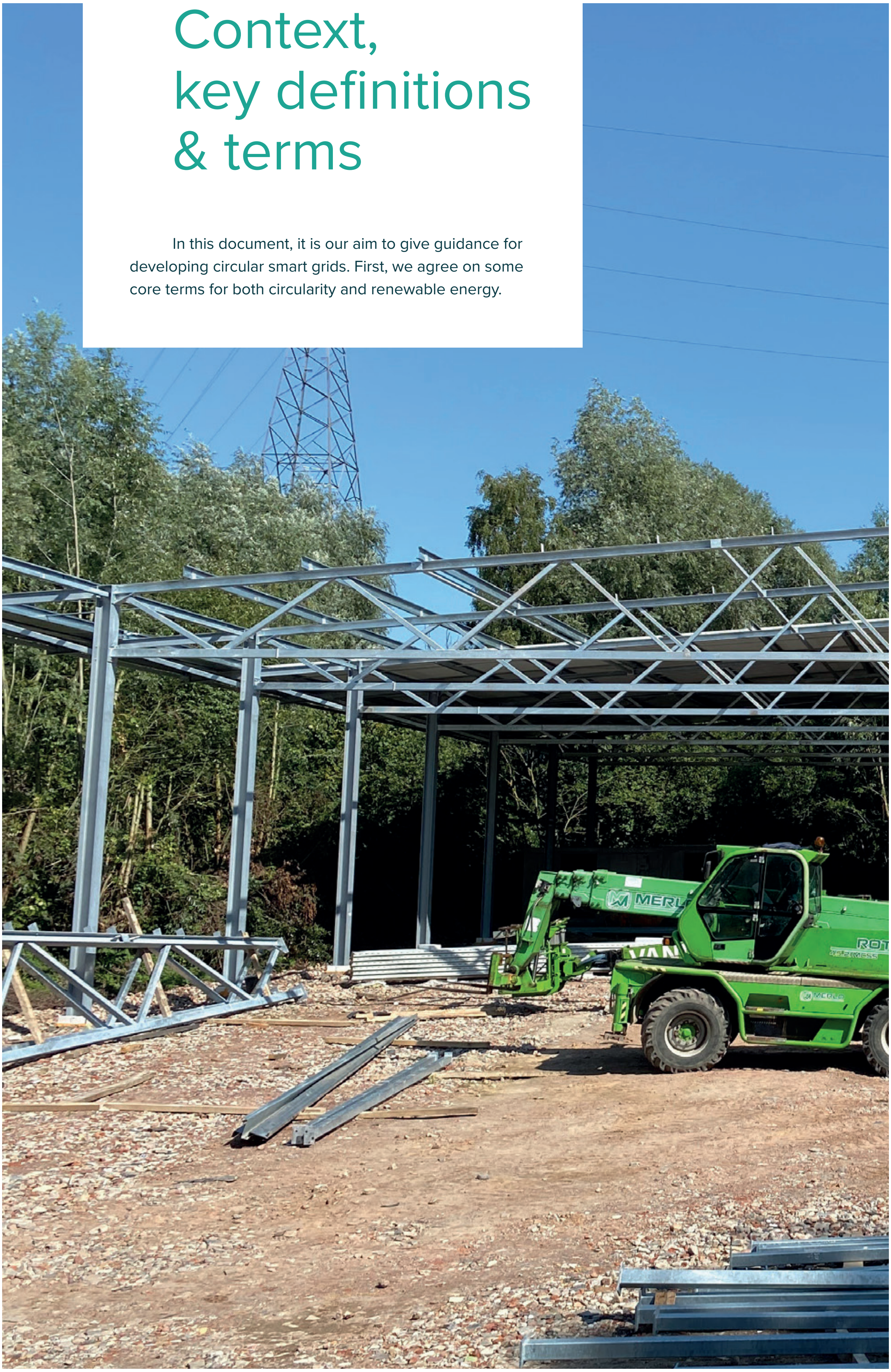
Topic 2

RE/SOURCED

Resource efficiency

Context, key definitions & terms

In this document, it is our aim to give guidance for developing circular smart grids. First, we agree on some core terms for both circularity and renewable energy.



RENEWABLE ENERGY VERSUS CIRCULARITY

A circular economy is "an economic system that replaces the 'end-of-life' concept with reducing, reusing, recycling and recovering materials in production/distribution and consumption processes"1. For policy purposes, the European Parliament defines the circular economy as a "model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible". In this way, the lifecycle of products is extended2.

Circularity is becoming a leading principle in EU policy plans. Important objectives in the EU Green Deal include, for example, maximising the energy self-sufficiency of local communities, while at the same time introducing circular economy strategies in renewable energy systems design. Indeed, an important challenge of the energy transition is to make the deployment of renewable energy technologies sustainable: adding as much renewable energy generation capacity while using as few natural resources as possible.

Circular economy principles provide a useful framework in this respect. Yet, for project developers and engineers developing energy grids, it is difficult to translate these principles into a practical framework which would allow them to optimise the circularity of their conceptual or detailed designs. Energy efficiency has been leading in the development of smart grids so far, while circularity aspects have been underexplored.

R1	REFUSE	Make a product redundant by abandoning its function or by offering the same function by a radically different (e.g., digital) product or service. *Example: refusal of carbon-based fuels by focusing on renewables.*
R2	RETHINK	Make product use more intensive (e.g., through product-as-a-service, reuse, and sharing models or by putting multi-functional products on the market). *Example: smart demand control for peak-shaving and improved resource efficiency.*
R3	REDUCE	Increase efficiency in product manufacture or use by consuming fewer natural resources and materials. *Example: using a DC backbone to reduce the number of small-scale inverters in the smart grid.*
R4	RE-USE	Re-use of a product which is still in good condition and fulfils its original function (and is not waste) for the same purpose for which it was conceived. *Example: re-use of solar PV panels that have been decommissioned before their end-of-life.*
R5	REPAIR	Repair and maintenance of a defective product so it can be used with its original function. *Example: proactive repair and maintenance of solar PV panels and inverters to optimize product lifetime*
R6	REFURBISH	Restore an old product and bring it up to date (to specified quality level). *Example: refurbishment of solar PV panels and EV chargers.*
R7	REMANUFAC-TURE	Use parts of a discarded product in a new product with the same function (and as-new-condition). *Example: remanufacturing battery cells from EV batteries into stationary batteries.*
R8	REPURPOSE	Use a redundant product or its parts in a new product with a different function. *Example: repurposing EV batteries into a stationary battery, or a water tower into pumped hydro energy storage*
R9	RECYCLE	Recover materials from waste to be reprocessed into new products, materials, or substances whether for the original or other purposes. *Example: proper decommissioning, collection, and sorting of solar PV panels to optimize recycling processes.*

Source: Potting, J., Hekkert, M., Worrell, E., Hanemaaijer, A., 2017. Circular economy: Measuring innovation in the product chain. PBL Netherlands Environmental Assessment Agency, The Hague.

RESOURCE EFFICIENCY

Resource efficiency can be defined as a result of actions that (1) reduce consumption of resources and (2) enable greater value retention and/or value recovery throughout value chains through reuse, repair, refurbishment, remanufacturing, repurposing or recycling activities. Therefore, resource efficiency is a key contributor to a circular economy.

Circularity is one of the guiding principles of sustainable development. In many cases, it helps to reduce the environmental impact of products or activities. In circular systems, material and product cycles are closed, narrowed or slowed down. Therefore, a truly sustainable smart grid not only uses renewable energy, ideally, it is also circular!

Challenges & solutions

TECHNICAL

Circular design

Various constraints in the design phase resulted in the need to find a compromise between sustainability ambitions and technically/financially feasible solutions. As an example, the energy efficiency of repurposing the water tower into pumped storage proved to be too low from a technical and financial perspective. So although the concept was a very good fit with Transfo's principles, it would not have been practical or cost-effective to proceed with this element.

Example 2.1
Circular procurement
Suppliers are not always able to inform customers about resource efficiency, particularly in the energy sector. Sustainability strategies in this field primarily emphasise the deployment of renewable energy components, rather than addressing resource efficiency concerns. Moreover, suppliers depend on the information provided by manufacturers, who themselves tend to prioritise the energy efficiency of their products. Importantly, this information is not identified, gathered or shared because suppliers are not used to receiving requests to do so.

Example 2.2
Challenges reusing construction materials
There is a significant solar PV installation on site, on the roof of a newly constructed car park. As part of the circular strategy, it was proposed that the steel structure from a derelict building in the region of South West Flanders would be extracted and reused as the supporting structure for the solar PV installation on the car park's roof.

The building from which this steel structure was to be extracted was inspected when designing the project and the structure was deemed to be suitable.

However, there were problems when it came to demolishing the building, and in particular extracting the steel superstructure. Specifically, the structure (over 100 years old) was constructed in a way that was not designed to be removed, let alone dismantled - it was not designed with circularity in mind. Consequently, attempts to remove it without damage proved impossible and further investigations indicated that it could not be removed without causing substantial damage to the structure (thereby rendering it unusable at Transfo).

As project managers, we had to be pragmatic. It was decided to purchase a new steel structure for the car park, but one that would be designed for disassembly and reuse should that be required in the future. This was also cheaper than reusing the existing superstructure – reusing components is not always the cheapest route financially.

Circular value retention: What measures could be taken to give used components and materials a second life in the future? Conversely, could we use second-life structures or technical installations in our new smart grid? Historic and heritage industrial buildings and installations were not "designed for disassembly", as seen above with the example of the steel supporting structure for the car park's roof. Dismantling existing structures or installations for reuse can be technically challenging, expensive and/or simply impossible. Therefore, initial reuse targets might prove to be too ambitious and need to be adjusted. You need to be pragmatic!

LEGAL

<u>Energy versus materials</u>

At an EU level and therefore at national levels, energy efficiency and resource efficiency tend to be addressed in separate legislative frameworks. As they are separate, they tend to be poorly linked. Energy efficiency is seen as a strategy for reducing energy use and/or reducing emissions (climate challenge) - the material impact is usually not considered. Thus, from a market perspective, there is no “legislative driver” that is driving businesses to change their current approach to product development and supply. This results, amongst other things, in a lack of readily available public procurement frameworks that could incentivise suppliers to propose circular solutions. Nevertheless, upcoming regulatory frameworks, e.g. on repair, should encourage suppliers to invest in circular strategies.

<u>Categorisation of innovative smart grid designs</u>

From a technical perspective, the Transfo microgrid design needed adjustments in order to comply with existing legal frameworks, which themselves have not (yet) been tailored to accommodate new smart grid configurations. For example, regulatory frameworks to construct a DC grid appear to be underdeveloped as these configurations are not prevalent in the market. With the growing adoption of renewable technologies globally, especially solar PV, this is likely to change.

ECONOMIC

<u>Incomplete markets</u>

Markets for reused and repurposed applications and components are few in number and tend to be specialised. Those that do exist are meeting a specific (niche) market demand but, overall, the market for reused and repurposed products is embryonic. This results in large search and transaction costs, underdeveloped regulatory frameworks, insurance, warranties, product passports and testing protocols. In general, a lack of comprehensive regulatory frameworks and experience among market participants leads to perceived higher risk and lock-in to linear make-use-dispose systems, even though circular alternatives could be more efficient once a learning curve is overcome and broader adoption occurs.

<u>Costs of dismantling</u>

The (labour) costs of dismantling, testing and reinstalling installations often outweigh the benefit of reusing or repurposing applications or make doing so prohibitively expensive. This particularly holds for applications whose prices have been decreasing or whose technological efficiency has improved at a rapid pace, which is clearly the case for solar PV as seen below.

Example 2.3
Procuring second-hand solar panels
No response from the market and not practical due to the low efficiency of second-hand solar PV panels.
RE/SOURCED initially considered procuring second-life PV panels but encountered some issues. Specifically, no providers of second-life panels could be found. Unlike second-life batteries, this supply capacity is absent for solar PV.

There are four likely reasons for this:

- Global supply volumes of new solar PV units have grown substantially over the past five years leading to much lower unit costs.
- The operating efficiency of solar panels degrades with time so the realistic achievable output will be notably below their stated specification for older units.
- Technology improvements have resulted in modern panels producing much more electricity than those produced 15-20 years ago. In 2004, the typical efficiency was around 12,5%. By 2012, it had risen to 15,5% while currently, it is around 23%.
- The cost of removing and testing second-life panels adds to their unit cost.

The efficiency of solar PV is particularly relevant at Transfo as the buildings have a “heritage listing” status so there are constraints on how the site may be developed and in particular what the modifications could be to accommodate solar PV on roof spaces. There is relatively limited space available so the project needs panels with the highest possible efficiency.

GOVERNANCE

Circular use

There is a lack of guidance regarding the integration of circularity principles into long-term operations. Circular strategies extend beyond the initial building phase, encompassing maintenance, repair, remanufacturing and recycling. Circular business models, including lease models, product sharing and product-as-a-service schemes may align incentives to apply circular principles throughout the use phase. However, circular procurement rules are often not designed to engage this kind of business model.

Embedding circularity within governance

To safeguard circular economy principles within the design, make, use and decommissioning phases, the principles must be embedded in the governance of the smart grid. If not, these principles may be put aside early in implementation because linear alternatives to use and replace materials are often cheaper and more easily available in the short run. This can be prevented by incorporating circular economy principles in procurement (i.e. included within tender specifications) with suppliers and service providers and embedding circularity in the strategic governance of the smart grid once it is operational.

CIRCULAR DESIGN

For energy systems in general, higher yields result in a lower impact per kWh produced. From a circularity perspective, the yield of a PV system is therefore an important factor the design should aim for towards an efficient system. In this regard, the rule of thumb for wind turbines is that larger blade diameters correspond to improved yield and a reduced carbon footprint per kilowatt-hour produced. For stationary batteries, it also matters what type of electricity is stored and – more importantly – lost during charging and discharging cycles. If that lost energy is not sourced from renewables, it adversely affects the environmental impact of the battery. Production of the battery itself constitutes only a minor portion of its carbon footprint. Installing repurposed stationary batteries to store renewably generated energy (solar) therefore results in environmental gains on many levels.

Renewable energy generated by solar PV panels is in any case vastly more environmentally friendly than energy from fossil sources. Producing a kilowatt-hour of electricity in a gas-fired power plant emits at least 10 times more greenhouse gases than a kilowatt-hour generated by any type of solar panel. Electricity from a conventional coal-fired power plant is even higher with a carbon footprint that is 20 to 30 times that of solar PV.

While it may not always be feasible to procure reused, repurposed or refurbished products, an important design aspect entails ensuring new product designs to allow for circular strategies, including repair, refurbishing and high-quality recycling. For example, this may include the use of de-bondable adhesives that may enable refurbishment or disassembly at a later stage. Likewise, keeping track of the use of materials in construction and commissioning may enable future circular strategies that we may not consider or envisage today.

Tips & tricks

SYSTEM DESIGN

"Design-in" circularity explicitly within project blueprint designs and procurement specifications.

Where suppliers cannot provide circular information due to manufacturing not making it available, lobby manufacturers and inform your national policymakers to encourage them to consider including circular information in future product type specification legislation.

CIRCULAR PROCUREMENT

Reduce the overall quantity of materials used in a project. Is purchasing the product really necessary? Could sharing, renting, reusing (2nd-life product) or reducing the scale of the design be viable options?

Reduce the use of non-renewable primary resources. Understand the share of recycled, bio-based and primary materials in products. Aim for an increased share of recycled materials in products.

Make circularity part of the tendering criteria: ask for information regarding material use (recycled content, reused components…), responsible sourcing policies, repairability and flexibility of equipment, waste treatment or take-back schemes, environmental labels and certificates.

Adopt flexibility in procurement rules to enable circular business models, such as as-a-service and sharing models.

CIRCULAR VALUE RETENTION

Extend the useful life of products. Ask for extended warranty periods. Ensure contractual agreements for maintenance and repair. Prioritise products that can be easily repaired, maintained and upgraded.

Modular or flexible designs are in this respect advantageous. Consult suppliers for guidance on optimising product utilisation.

CIRCULAR USE

Maximise the potential for future product or component reuse. Understand the importance of how installations are composed and connected. Likewise, it is important to log the installation and maintenance history of installations.

Maximise future material recycling opportunities, for example by avoiding toxic products or components, and choosing biodegradable/compostable materials whenever feasible. Consider implementing contractual agreements for product take-back and recycling services.

Keep a record of the materials and construction processes used so that, as the market evolves and new circular decommissioning processes are developed, project practitioners have the information available to decide whether new techniques might be used.

LOCAL MARKET OPPORTUNITY

When implementing your project, if you encounter a challenge procuring second-life components, consider whether there is an opportunity to facilitate local companies to enter the market to make them available. This could include product testing, validation, component replacement and remanufacturing through warranty service provisions (insurance). Such activity could also be linked to local employment and training programmes (technical).

Topic 3

RE/SOURCED

Energy system design

Context, key definitions & terms

WHAT IS A DC BACKBONE AND WHY IS IT A GOOD IDEA?

Transfo's energy system consists of a DC backbone which connects all production and storage technologies as well as certain consumers on site. The biggest advantage of a DC grid is the reduction of conversion losses of DC/DC converters compared to AC/DC converters, which increases the whole system's energy efficiency. There are additional benefits too in that a DC system:

- Increases the energy efficiency of the whole system
- Reduces conversion losses
- Increases the global self-consumption of the system
- Allows more power to be transported through the same cable (higher voltages can be used than in the traditional AC grid)
- No reactive power control needed (material dimensioning always for the real power)
- Reduction of power quality problems
- Allows optimised dimensioning of BESS and PV systems
- Allows a single point of connection via central inverters to the AC grid leading to
  - flexible control
  - avoiding congestion
  - increasing hosting capacity

For these reasons, DC was chosen for the grid at Transfo.

What we tried to do

The goal was to create a DC smart grid covering the Transfo site that would host renewable electricity generation and storage. We focused on DC to minimise conversion losses from DC to AC and vice versa.

This goal meant that we had to develop a grid design that would be good for the users at Transfo while also meeting the working parameters of the public (AC) grid operator, Fluvius. It will be seen below that designing a DC grid requires a very different approach to an AC grid and will lead to extra challenges.

IDEAS WE DROPPED

Before looking at what we did, there were several emerging technologies that we anticipated might work well at Transfo but which we dropped due to their being impractical.

Mid-sized wind turbine

It was proposed to erect a mid-sized wind turbine on a corner of the Transfo site (out of the protected area). This was located in a wooded area that had returned to nature following the decommissioning of the plant in the '80s. One of Transfo's strengths in being a former power station is that it is located very close to Flanders' electricity grid. However, this proximity also proved to be a weakness.

When the UIA funding application was submitted in 2019, locating a wind turbine on the site made sense and could be accommodated within the permitted activities. However, just before the permit was about to be submitted (2023), regulations changed on the minimum distance of wind turbines from critical grid infrastructure. Grid operators were now required to have a much greater distance between the turbine and nearby power lines. Historically, Transfo was close to the intersection of two key distribution lines (as it supplied electricity to the region). The requirement for the increased distance rendered the erection of a wind turbine anywhere at the Transfo site impossible.

Pumped storage

For pumped storage, the project aimed to use the water tower at Transfo that served the former power station site. The idea was to pump water up the storage tank and then use this stored resource for short-term electricity production at peak times. Despite repeated tendering (during the COVID-19 pandemic), we found it impossible to attract any successful and financially feasible bids to deliver. The relationship between the amount of energy production and the cost of repurposing the water tower was no longer in balance. For this reason, and given the impending completion date for the project, the steering group decided to exclude the pumped hydro storage from the project.

Three other technologies were reviewed but not pursued:

TECHNOLOGY	REASON FOR NOT PROCEEDING
DC/DC EV chargers to minimise the conversion losses from DC to AC (at charger)	Although it was anticipated that DC/DC chargers would be available by the time the project was implemented none were ready to be procured in practice (their commercial development was likely slowed down by the COVID-19 pandemic).
Flywheel storage	This was a particularly novel proposal. Unfortunately there was limited technical and/or commercial support available to implement and procure this technology
Micro wind turbine (on building/in chimney)	Apart from the potential visual impact issue these units did not produce enough energy to make them viable for practical application.

These decisions explain why the smart grid uses a set of established technologies for generation and storage.

Challenges & solutions

NETWORK DESIGN PARAMETERS

From an energy system design viewpoint, the Transfo site is relatively complex but also offers very interesting opportunities. The mix of consumer types located within Transfo's relatively confined geographic area creates a challenge when trying to estimate aggregated demand. The site has a core set of available (and mostly unused) heritage buildings that provide options for how the energy system is configured. However, the task of designing an appropriate energy system is made more complex given the age of the physical infrastructure and the lack of reliable stability data. Separately (and significantly), there are architectural, heritage and planning constraints on most of the buildings that limit how they can be redeveloped. Thus, it was not a straightforward location to develop a contemporary energy system design, especially where that system is DC.

At Transfo, the radial DC grid is connected to the public AC grid at its centre via an AC/DC converter (inverter). Energy is produced via multiple PV installations and a Combined Heat and Power plant. A stationary battery is used for storage. Direct consumption on the DC grid was planned to be used by the EV charging stations (although this did not work as planned – explained below) while the rest of the energy will meet part of the demand from on-site consumers and/or will be injected into the public AC grid. All energy flows are metered and managed by an energy management system (EMS).

CHOOSING AND SIZING THE ASSETS
CONNECTED TO THE DC BACKBONE

Challenge
Developing the operating parameters
of the DC backbone

For a DC grid, both the amount of renewable energy that needs to be produced and the amount to be stored, have to be calculated using projected consumption levels at the site. It was necessary to analyse the performance of different technologies when matching renewable energy consumption and production profiles. Only then did we consider the optimum physical locations of the assets. These initial steps uncovered several challenges that had to be addressed for the design to be robust and the implementation successful.

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Challenge
Establishing the consumption profile

The design of the smart grid had to be completed relatively early (at the outset) of the Transfo development project – in fact, grid design will always be one of the first tasks in a project of this kind. Few buildings on the site had detailed end uses assigned to them, so it was difficult to estimate likely consumption levels. Consumption levels are a function of the size of the units and the nature of the activity that will be undertaken within them. The challenge therefore was to draw up meaningful use profiles for the buildings even though we were not sure of what would be taking place within them. This was achieved initially through making assumptions and using computer simulation tools to develop demand projections. Subsequently, when the nature of the site's activities was starting to take shape, we undertook a more detailed analysis and calculated more accurate operational parameters (and size) for the renewable energy production, storage capacity and charging infrastructure on the site.

Challenge
heritage-related constraints

Heritage regulations limited the scale of renewable energy systems that could be created at Transfo. Specifically, photovoltaic (PV) installations were restricted to rooftops where they remained obscured from view at ground level. This limited both the quantity of PV panels and their optimal tilt angle.

Transfo's energy customer mix
Today, Transfo consists of a microbrewery, a camping ground, a pub and bar, event spaces and leisure facilities such as a climbing hall, a diving centre and outdoor sporting amenities. Almost half of the existing buildings now have new uses while the remainder of buildings should find a new use in the coming 2 to 3 years. The site will, amongst others, welcome other micro and small companies, a restaurant, offices, tourism businesses and an educational experience centre on renewable energy technology. Clearly, these types of businesses will each have a very different energy demand profile. This had to be estimated on a case-by-case basis.

What we found
Because the Transfo site is a protected heritage site, all decisions impacting the buildings and the appearance of the site had to be discussed with the Flemish Agency of Immovable Heritage. For the solar PV installations, we agreed with the agency on six locations where solar PV panels could be located. The supplier only installed PV panels at four of the six locations, as external factors such as rust formation on the old transformer post made them impractical. Other options such as the on-site diving tank which would have been feasible on a technical level, were rejected by the agency because of the visibility (and in their view sight pollution) of the solar PV installations.

Numerous parameters that are comprehensively covered by standards for AC networks lack agreed specifications for DC networks. Basic queries regarding voltage levels and cable types are not easily addressed in the context of DC grids. Both the AREI regulation and the Dutch NPR 9090 standard offer some guidance for DC applications with the latter providing marginally more information than the former. However, neither source offers sufficient information to allow the design and operation of a DC grid to be comprehensively undertaken. Consequently, we relied heavily on three information sources: technical reports from the International Electrotechnical Commission (IEC), information provided by the Distribution System Operator (DSO) and academic (technical) expertise available through our University of Ghent partner.

The rest of this section is quite technical. Please refer to the Blueprint for in-depth technical descriptions of the grid componentry design and selection.

Challenge
Setting the correct voltage level

In DC systems, there isn't a standard fixed voltage equivalent to the typical 3x400+N configuration in AC systems. So, we had to look for a suitable voltage level ourselves - too low a voltage would lead to high currents, which in turn create additional losses and oversizing of the cable. But if we chose high voltages, we would fall outside the AREI low voltage regulations (<1500 Vdc). On top of that, all electrical equipment would have to be rated for much higher voltages, making it much more expensive.

In DC grids, an additional decision arises regarding the operational mode, as there are two options: unipolar and bipolar. In the unipolar configuration, there are two conductors with a single voltage level. Conversely, the bipolar setup consists of three conductors - L+, L-, and 0 - enabling the utilisation of two Although a two core cable could have been used, the "standard" four core (EAXVB 4G 150 ALU) cable was used. The main reason for that is that the DNO Fluvius has installed the complete network, using their standard cable. Consequently, all assets needed to build an operational network were available. This led us to the dimensioning of a bipolar system.voltage levels. However, this approach necessitates an additional conductor, which is a notable drawback as it leads to additional cost, additional infrastructure being required as well as a new circuit design.

There are several possible solutions to the problem, some of which are mentioned in the IEC TR 63282. Based on the technical report and the availability of the required components on the market, we have chosen to operate our grid unipolar at 700 V nominal voltage.

Challenge
Cable sizing and selection

Once we had established the voltage level and the range, type and specification of connected assets on the DC grid, the next step was to determine the current flows within the grid. This was achieved through undertaking a power flow analysis. This was a critical assessment as the current levels set at this point act as the foundation for dimensioning cable sizes within the system as a whole.

Although a two-core cable could have been used, the "standard" four-core (EAXVB 4G 150 ALU) cable was used. The main reason being that the DSO Fluvius installed the complete network using their standard cable. Consequently, all assets needed to build an operational network were available. This led us to the dimensioning of a bipolar system.

Using DC at 700V also led to the advantage that more power could be transported than with the regular 3*400V in AC.

NETWORK SAFETY AND CIRCUIT BREAKERS

Effective circuit protection is essential for protecting the well-being of equipment and people – it is a critical safety component. While the DC grid boasts numerous efficiency-related advantages, its differences from AC systems introduce some unique challenges concerning circuit protection.

The most significant issue lies in the absence of what is called zero crossing in DC current. AC circuit breakers are designed to interrupt the flow of electricity when a fault is detected, such as an overload or short circuit. The design of an AC circuit breaker takes advantage of the fact that the AC current waveform naturally crosses zero volts every 1⁄50th second for a 50 Hz supply. At this zero crossing, the arc that is produced within the breaker when interrupting a current flow will naturally extinguish at that point, allowing the breaker to activate, thereby safely isolating the fault.

However, unlike AC, DC current does not pass through a zero point, which makes it more difficult to interrupt the supply and extinguish the arc when there is a problem. Therefore, you cannot use standard (widely available) AC circuit breakers on DC circuits and, as there is no zero crossing, their design is more complex to ensure the arc is effectively extinguished. This must be carefully considered when designing circuit protection measures. To complicate matters, there are far fewer regulations in place for DC equipment so there are fewer accredited circuit breaker products available on the market. There is also a shortage of adequately skilled personnel to install and manage DC systems.

Effective circuit protection can be addressed by employing power electronics, such as Solid State Circuit Breakers (SSCBs), for switching purposes. At the time of the tender, we did not find a supplier who could supply us with the SSCB for our current and voltage range. So we used the “old school” method and combined fuses and switch disconnectors to protect against overcurrent. As we were aware that SSCBs would likely be offered to the market imminently, we constructed our electrical cabinets to be large enough to accommodate these devices when they become available in the future.

Challenge
Residual Current Device (RCD)

An RCD is an electrical safety device that interrupts an electrical circuit when the current passing through a conductor is not equal and opposite in both directions, therefore indicating an improper flow of current such as leakage current to ground or current flowing to another powered conductor. The device’s purpose is to reduce the severity of injury caused by an electric shock. Due to its operating principle, it cannot simply be used with DC currents. As the RCD measures the flux difference, it will become saturated by DC components and therefore no longer work correctly. To guarantee safe operation here, we must work with a special type of RCD that can also detect and intercept pulsating and direct currents. This kind of RCD is called a type B RCD.


CE+T
POWER
CE+T
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CE+T
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CE+T
POWER

EARTHING AND PROTECTION OF A DC GRID

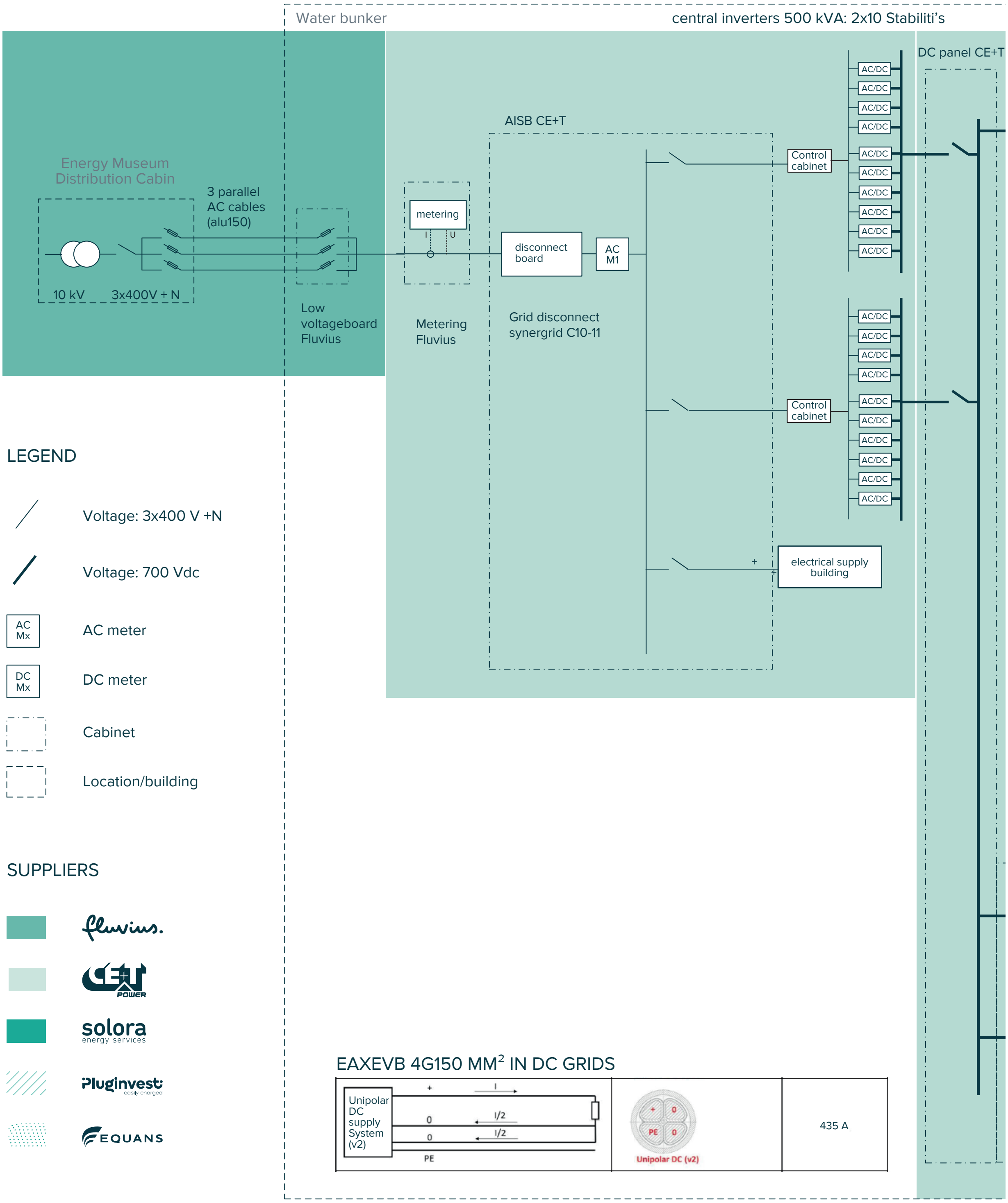
Challenge
earthing topology

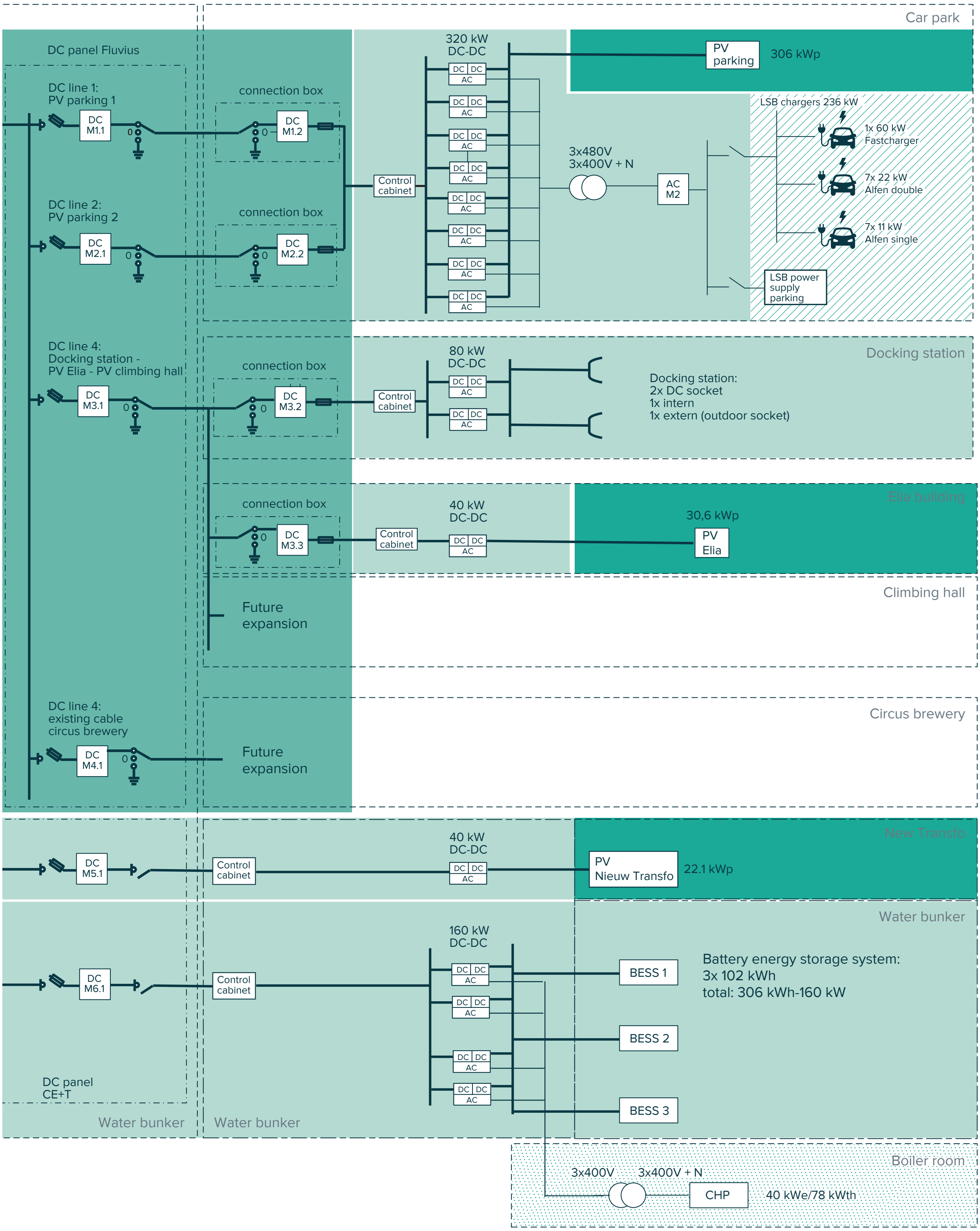
There are two established configurations for electricity circuit earthing: TN is where the electrical supply is earthed and the customer loads are earthed via the neutral, and TT is where the electrical supply and the customer loads are separately earthed. The TT configuration is the predominant earthing system within typical AC distribution networks. However, it is not well suited to DC network applications as stray DC currents (which can occur on DC networks) can cause corrosive effects on metal components when this configuration is used. Therefore, we chose the TN configuration to minimise the potential corrosive effects of DC stray currents on metal components (a problem unique to DC circuits).

Challenge
remaining capacity of the DC grid & converters

The chosen inverters contain a large capacitor that can continue to hold its charge after disconnection from the grid – this is a potential safety risk. The DC grid itself can also behave capacitively. In order to be able to work safely on the grid, it must be possible to discharge this capacity to earth at any time. For an AC circuit, we could use standard switch disconnectors but for the DC circuit, we had to use grounded switch disconnectors. These allow us to discharge the capacity of each inverter and cable to the ground, allowing safe working on the installations and lines at any time.

SLD RE/SOURCED @TRANSFO (ZWEVEGEM), AC & DC UGENT




Car park
DC panel Fluvius
DC line 1:
PV parking 1
DC M1.1
connection box
DC M1.2
DC line 2:
PV parking 2
DC M2.1
connection box
DC M2.2
320 kW
DC-DC
DC DC AC
Control cabinet
PV parking
306 kWp
LSB chargers 236 kW
1x 60 kW
Fastcharger
7x 22 kW
Alfen double
7x 11 kW
Alfen single
LSB power supply parking
3x480V
3x400V + N
AC M2
Docking station
DC line 4:
Docking station -
PV Elia - PV climbing hall
DC M3.1
connection box
DC M3.2
80 kW
DC-DC
Control cabinet
Docking station:
2x DC socket
1x intern
1x extern (outdoor socket)
connection box
DC M3.3
Control cabinet
40 kW
DC-DC
Elia building
30,6 kWp
PV
Elia
Climbing hall
Future
expansion
Circus brewery
DC line 4:
existing cable
circus brewery
DC M4.1
Future
expansion
DC M5.1
Control cabinet
40 kW
DC-DC
New Transfo
PV
Nieuw Transfo
22.1 kWp
Water bunker
DC M6.1
Control cabinet
160 kW
DC-DC
BESS 1
BESS 2
BESS 3
Battery energy storage system:
3x 102 kWh
total: 306 kWh-160 kW
DC panel
CE+T
Water bunker
Water bunker
Boiler room
3x400V
3x400V + N
CHP
40 kWe/78 kWth

Tips & tricks

INVOLVEMENT DSO	Start discussions with your DSO early – and certainly once you have a good idea of what your grid design parameters will look like.
4-CORE CABLE	Use standard 4-core cable for DC circuits even though it may be possible to use only 2-core.
BE CREATIVE	Do not be afraid of combining “old school” fuses and switch connectors, at least until more sophisticated circuit production devices are available on the market.
EARLY INVOLVEMENT OF LOCAL AND REGIONAL AUTHORITIES	Check in with heritage agencies and local planning authorities early and try to get them on board and provide constructive input.

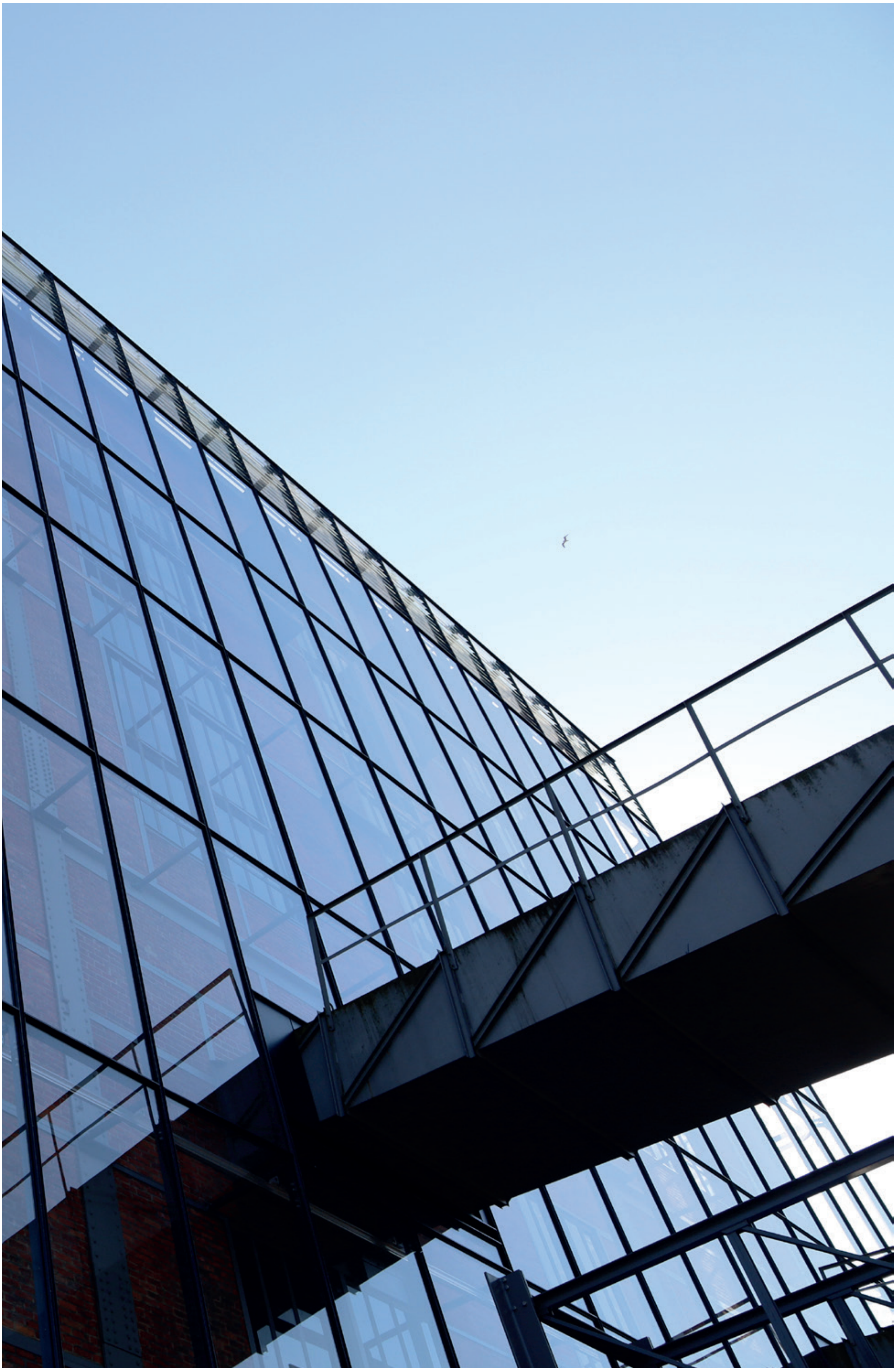
Topic 4

RE/ SOURCED

The listed Transfo site

Context, key definitions & terms

Transfo, situated in Zwevegem, a town with a population of 25,000 on the western side of Belgium and part of the Kortrijk region, boasts a unique character in terms of industrial heritage. Dating back to 1912, Transfo is a heritage listed power plant comprising boiler rooms, a turbine hall, a power distribution building and various additional buildings and machinery.



Electricity production at the Transfo power plant ceased in 1985, while steam production continued until 2001, after which the plant was decommissioned. Prior to the closure of the power plant, there were plans to demolish it and redevelop the site into a residential project. However, the site was listed in 1999, preventing its demolition.

In 2004, the Zwevegem council and intermunicipal organisation Leiedal purchased the power plant, recognising its significant value as an industrial heritage asset. The acquisition presented a significant challenge for the new owners: the listed and abandoned industrial site held strategic importance for Zwevegem and the wider region, but reusing it thoughtfully and sustainably proved to be exceedingly difficult.

After more than 20 years of investment and hard work by the municipality of Zwevegem, the intermunicipal organisation for regional development Leiedal, the province of West Flanders and the Flemish government, Transfo is gaining momentum. The site is now witnessing a growing number of initiatives and changes, which is undoubtedly positive. Several initiatives and projects are currently in full development.

Presently, Transfo features a microbrewery, offices, a pub and bar, housing, event spaces and leisure facilities such as a diving centre and outdoor sporting amenities. Nearly half of the existing buildings have been repurposed, with plans underway to allocate new purposes to the remaining structures within the next two to three years.

Among other additions, the site will welcome other micro and small companies, a climbing hall, a restaurant and other tourism-related services.

Large heritage sites like Transfo are a challenge to redevelop but also offer unique advantages. They often host mixed-use projects, creating vibrant communities within themselves. This scale and diversity provide a fertile ground for decentralised and shared energy systems. The size allows for the collective use of these systems, resulting in mutual benefits. Additionally, the diverse energy profiles within the site often complement each other, enhancing overall energy efficiency as will be seen below.

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What we tried to do

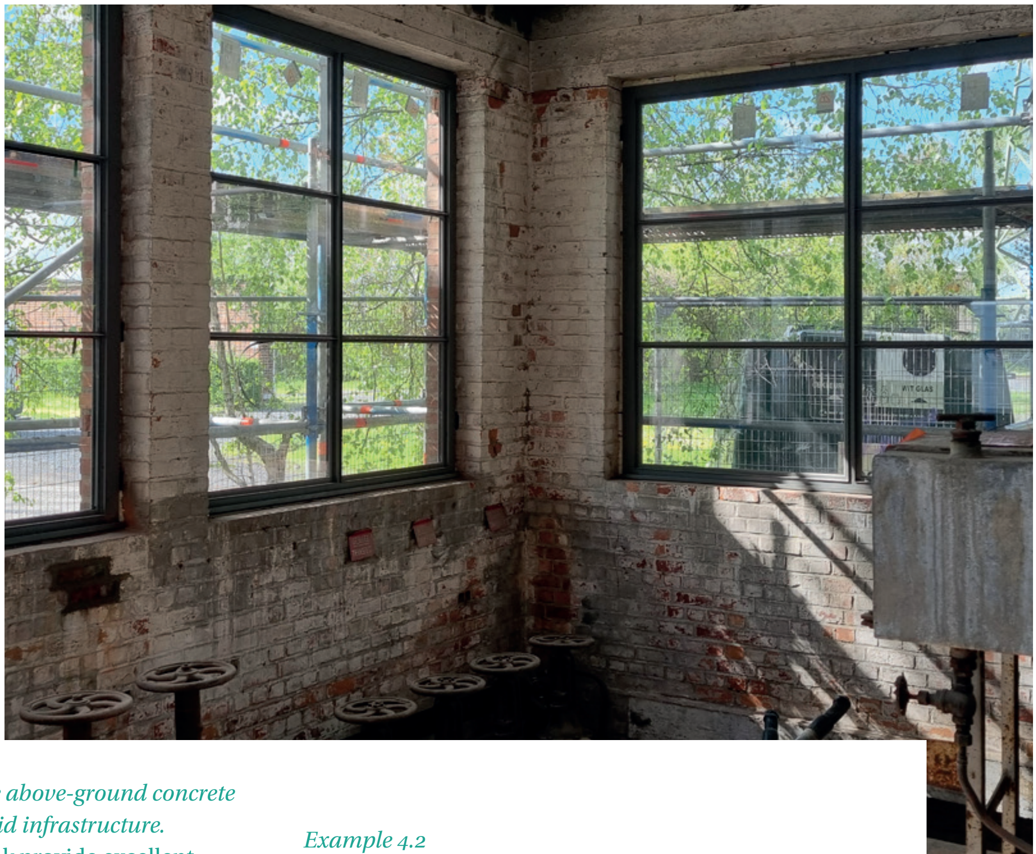
The interaction between built heritage reconversion and circularity represented a dynamic approach to urban development, blending the preservation of cultural and historical value with the principles of resource efficiency and sustainability. By repurposing existing structures with historical or cultural significance, this approach aimed to breathe new life into these assets while minimising waste and environmental impact.

Central to this interaction was the preservation of the unique character of Transfo as a heritage site, ensuring that its identity and historical significance be retained even as it was transformed to meet modern needs. This often involved adaptive reuse, where buildings were creatively repurposed to accommodate different functions or uses over time.

Leveraging the adaptability and flexibility of heritage structures allowed us to create spaces that can evolve with changing urban dynamics while preserving their intrinsic value.

Challenges & solutions

At Transfo, the conversion of an above-ground concrete water tank into smart grid infrastructure provided numerous benefits (see Example 4.1). Similarly, a previous fire hydrant valve building would have remained unused (and unusable in its original form) but has now been repurposed as a DC docking station (see Example 4.2).



Example 4.1
The advantages of repurposing the above-ground concrete water tank at Transfo for smart grid infrastructure.
The thick concrete walls of the tank provide excellent insulation, helping to maintain a stable temperature inside the structure. This is particularly important for housing batteries and inverters, as they perform optimally within a certain temperature range. By utilising the thermal properties of the concrete, the need for additional cooling systems is reduced, contributing to energy efficiency.

The lack of window openings in this structure enhances security and safety. Without windows, there are fewer points of entry for unauthorised access, reducing the risk of theft or vandalism. Additionally, in the event of a fire or explosion, the enclosed nature of the tank helps to contain the damage and prevent it from spreading to other areas of the smart grid infrastructure.

Example 4.2
Repurposing a structure formerly used for operating fire hydrants into a DC docking station.
This structure, situated at the heart of the Transfo site, originally housed various valves for controlling hydrants. It now serves as a DC docking station, providing testing facilities for universities, research institutions and innovative firms to explore new energy technologies within the framework of the DC smart grid. With ample space and natural illumination, the building offers an ideal environment for conducting tests. Its central location and large windows make it a perfect spot for creating an educational attraction where visitors, including schools and families, may observe and learn about the testing processes.

Resource efficiency

Resource efficiency is another key aspect of built heritage reconversion within a circular framework. The challenge was to identify how to retain existing structures, materials and features wherever possible, while also creating an asset fit for contemporary and future uses.

Our approach to delivering the project minimised the need for new resource extraction and construction materials, reducing both its costs and environmental footprint. This emphasis on sustainability extended to the longevity and durability of the heritage buildings, which were constructed using high-quality materials and craftsmanship built to last. At Transfo, the original emphasis was on industrial functionality, which prioritised strength and durability. It would have been a missed opportunity not to capitalise on these qualities – the challenge was how to retain them.

Despite their sturdy appearance, the heritage buildings at Transfo can also be fragile. Repurposing them to meet modern energy standards while preserving integrity was essential. We achieved success through careful planning, often involving interventions like improving insulation. Sustainable materials like lime hemp, offering thermal performance, breathability and moisture regulation, were used to insulate without causing issues like dampness or mould. This approach ensured energy efficiency, comfort and preservation of architectural heritage while promoting sustainability and circularity in the built environment.

Built heritage conservation and renewable energy

The Flemish Heritage Agency, overseeing architectural, archaeological, landscape and waterway heritage, has established guidelines for integrating renewable energy infrastructure. These guidelines are clear and practical where necessary, aiming to ensure responsible and consistent (re)development of heritage assets - they therefore applied to Transfo. Implementing these guidelines correctly and effectively required extensive discussion to agree on decisions regarding the choice of materials, selection of locations for energy infrastructure and the preservation of significant heritage features. Through close collaboration among project partners, heritage experts and (sub)contractors, the RE/SOURCED project was able to navigate potential challenges and ensure that the integration of renewable energy infrastructure was done thoughtfully and responsibly.

Tips & tricks

UTILISE CREATIVE THINKING AND FLEXIBILITY TO TAILOR THE SYSTEM DESIGN TO THE SPECIFIC CHARACTERISTICS OF THE SITE

Incorporate existing buildings and structures wherever possible, ensuring that their heritage value is preserved. Strike a balance between project aspirations, heritage preservation guidelines, practical constraints and functional needs. Remain flexible and responsive to unforeseen constraints that come with restoring built heritage, adjusting the system layout accordingly (see ‘nasty surprises’ below). Show profound respect for the built heritage, represented by sites like Transfo, by seamlessly integrating modern elements with historical features to enhance both functionality and preservation efforts.

PREPARE FOR UNEXPECTED CHALLENGES

Heritage sites frequently conceal unpleasant surprises, like previously unknown subterranean structures that emerge, necessitating additional work and expenses (such as soil contamination, as encountered at Transfo, and historic electric cables). Be prepared for extra tasks (and spend!) to support interventions in buildings due to the preservation of historical elements, even if they offer no functional benefits.

IF YOU CAN SUCCEED HERE, YOU CAN SUCCEED ANYWHERE

Heritage sites pose unique challenges due to stringent regulations and unexpected issues stemming from their past use. Despite these challenges, RE/SOURCED was successfully implemented in this complex environment, making it feasible to replicate aspects or the entire project in other locations or contexts with greater ease.

STORYTELLING PLAYS A CRUCIAL ROLE AT TRANSFO

Where the project seamlessly intertwined its contemporary renewable energy focus with the site’s historical roots as a coal, fuel and gas-powered plant, by weaving the story of RE/SOURCED into the fabric of the site’s past, it created a meaningful connection between bygone eras and present-day initiatives, offering a unique opportunity for reflection and engagement.

RE/SOURCED SERVES AS A KEY ATTRACTION FOR DRAWING CROWDS

Major heritage sites rely on a few key crowd-pleasers to maintain a steady stream of visitors and foster a lively atmosphere. Through the RE/SOURCED initiative, a flagship renewable energy project has been established, complemented by educational facilities. This development is anticipated to draw an increased number of visitors to Transfo. This initiative provides a catalyst for the successful tourist development of the heritage site.

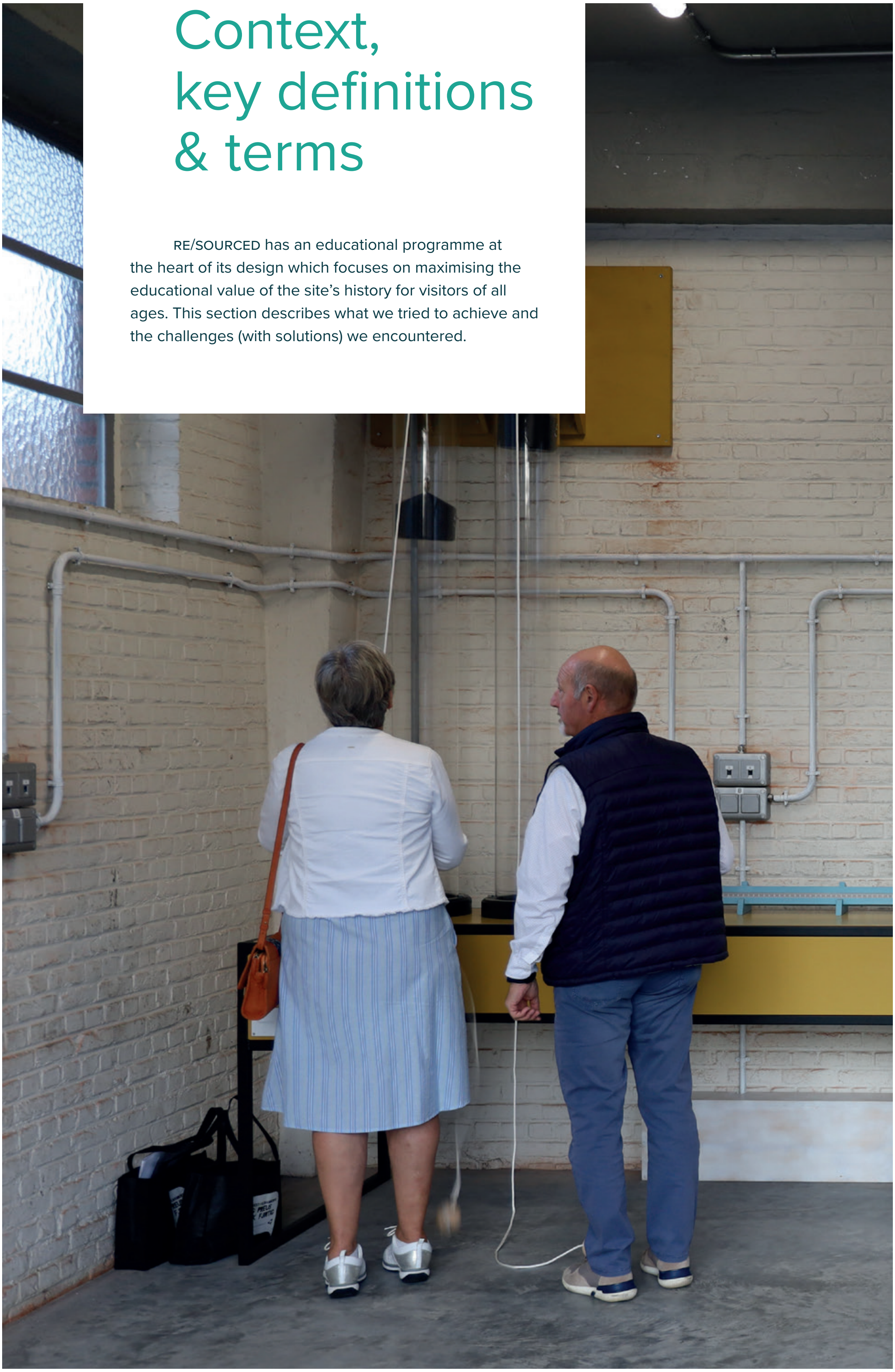
Topic 5

RE/ SOURCED

Educa-tional infrastruc-ture

Context, key definitions & terms

RE/SOURCED has an educational programme at the heart of its design which focuses on maximising the educational value of the site's history for visitors of all ages. This section describes what we tried to achieve and the challenges (with solutions) we encountered.




WATT
TOTAAL WATT
KILOWATT

What we tried to do

The original educational element of RE/SOURCED comprised a mix of indoor and outdoor points of interest. At the design stage, it was hoped to have four of these, the indoor points of interest consisting of:

- 3 interpretative tables
- 1 wall display

The outdoor points of interest being:

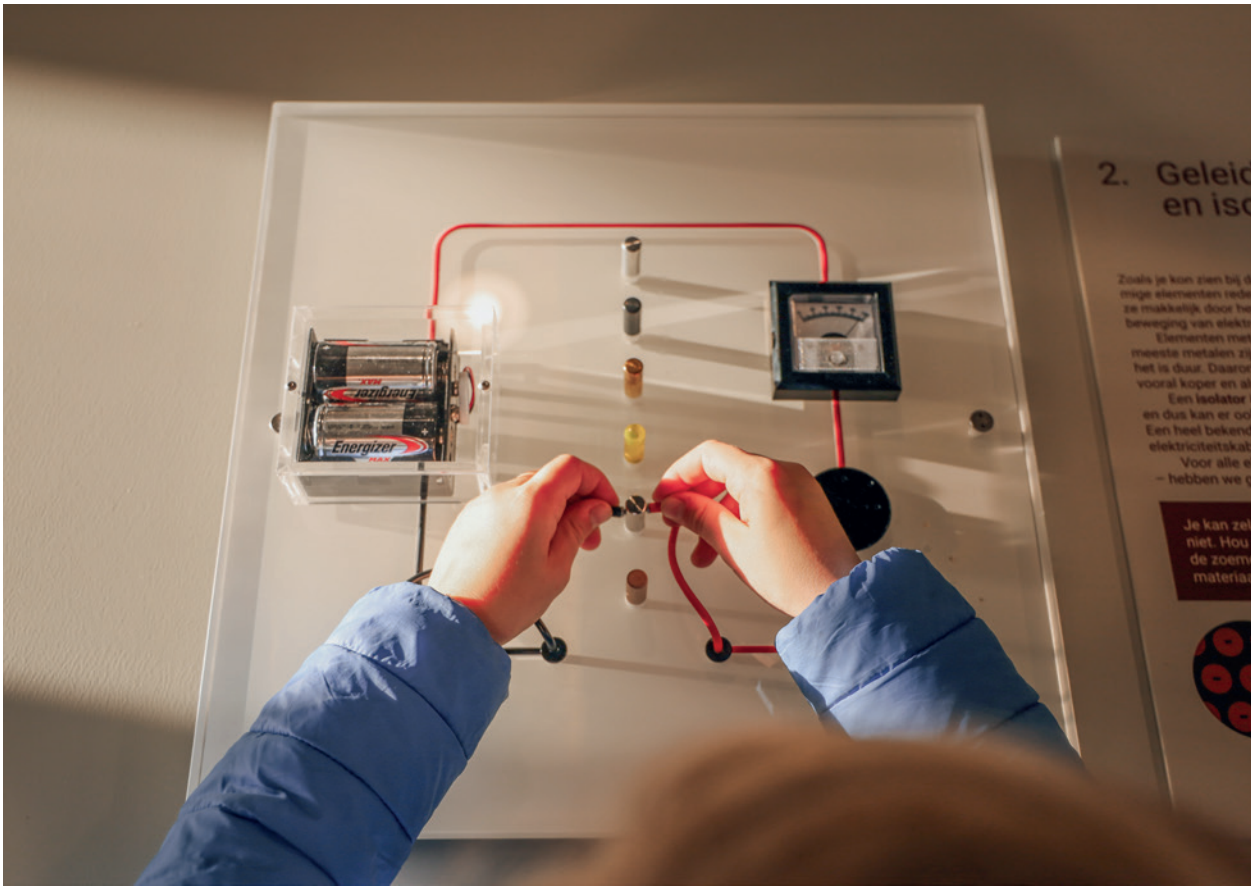
- an electric swing
- a gravity light
- an energy floor
- an energy bike
- a scale version of the Transfo site
- an X-ray viewer

As with the other aspects of RE/SOURCED, the educational element has a notable innovation slant to its design and delivery. The team used the expertise of the project's Advisory Board including representation from Technopolis - Technopolis is based in Mechelen (Belgium) and is recognised as a leader in STEM engagement.

The educational journey begins at the Transfo Energiek visitors' centre which serves as a gateway for visitors to explore topics related to electricity, energy and the energy transition. Comprising both an indoor facility and five outdoor points of interest (POIs), Transfo Energiek aims to spark curiosity and wonder, fostering a deeper engagement with the energy-related information that is provided.

Accessible to both individual visitors and organised (class) groups, Transfo Energiek offers an immersive experience for all. The most impactful aspect of energy education is achieved through using different educational packages. Throughout the project's duration, we have developed educational materials for students aged 15 and 16, along with an engaging audio tour designed for a broader audience. Plans for the future include the creation of additional educational packages to further enrich the learning experience and keep the programme fresh.

The sustained success and ongoing energy education initiatives of Transfo Energiek are ensured through the approval of a business plan, which allocates budgets to maintain the existing exhibits and to develop new ones. In addition, the Province of West-Flanders has committed to employing a full-time equivalent (FTE) position to support the project, further cementing the project's commitment to education and long-term impact.


Energizer

Challenges & solutions

TECHNICAL

Sequentiality

Educational packages could only be developed after the infrastructure had been fully installed. Similarly, the installation process encompassed screen content, audio tour materials, information boards and more. Given the intricate nature of the project, which was both innovative and experimental, the constantly evolving context presented numerous challenges that were not easily addressed. Continuous management input and progress review were essential for progress.

Midway through the project, the focus of the visitors' trail shifted towards providing information about energy and energy transition in general, rather than solely emphasizing the DC smart grid that is unique to RE/SOURCED.

Restoration and infrastructure works
Implementation of points of interest (POIs) on a site undergoing full restoration posed unique challenges, such as:

- Energy Floor: Wall restoration occurred late in the project timeline, leaving no option but to proceed with the installation of the floor without delay. While the electricity supply is currently temporary, a permanent solution is planned in the restoration programme for the locomotive building. The contractor went bankrupt during the project which made further technical support impossible. Consequently, the planned educational valorisation, involving collaboration with colleges for the development of new floor games to use in educational packages, cannot proceed as intended.
- XR viewers: The postponement of the smart grid installation rendered the installation of XR viewers unfeasible. Alternative locations were considered, but they were unsuitable due to content concerns (the site filming not being adequately linked to the RE/SOURCED project) and uncertainties regarding timing. Due to the postponement, we could no longer guarantee the full installation within the project's lifetime.
- Maquette: Integrating the maquette with the outdoor master plan posed a challenge – it was to find an optimal location. The original location was deemed impractical due to dimensions, forcing us to reconsider placement options. Placing it on the cycle path was not viable due to orientation issues and obstruction by other elements at the site, so we discussed all other feasible options with the stakeholders and came up with an alternative location.
- Contractors: As this was a particularly novel installation (definitely not an 'off-the-shelf' product), there were numerous contractors involved in the creation of the indoor visitors' centre. Given the multifaceted nature of the development, each element required an independent procurement procedure. Coordinating the collaboration across these different parties required extensive consultation, risk assessment, adaptation and a high degree of flexibility. It also required a lot of management time. When procuring the outdoor POIs, we included specific criteria such as providing a memorable experience, suitability for outdoor conditions, compliance with legal safety standards for outdoor play equipment, resilience against vandalism and the use of sustainable materials for long-term use. Few contractors could comply with these procurement conditions.

LEGAL

- Collaboration and communication with the heritage department was good, but the extensive coordination required with the department on heritage issues was a delaying factor. We needed extra budget and time to align the installations and POIs with heritage requirements.
- Establishing an energy cooperative in conjunction with the municipality was not legally feasible. This is covered separately (Topic 2 earlier).
- Real-time energy data at the provincial level that were to be used for several of the interpretative exhibits, proved impractical due to the number of sources that were required to be accessed. The data are dispersed across multiple sources, each with its own access controls and requirements. While it was feasible to reprogramme the software, the process would have required 66 working days. This was not feasible financially.

BUSINESS CASE

- To ensure the long-term success and impact of the RE/SOURCED project, we needed to prioritise energy education. This included allocating resources for a full-time energy educator, budgeting for content updates, establishing and sustaining guided tours and creating new educational materials. The province has allocated approximately €130,000 annually for these initiatives.
- We depended on a commercial company, Electricity Maps, for the reliable flow of real-time energy data. Unfortunately, they changed their business model making access to these essential data a lot more expensive. This proved to be a serious challenge since our entire interface was customised around the APIs they provided. We resolved this matter through consultation with the company.
- We encountered challenges with the reliability of data available from some countries that were used for our exhibits. This inconsistency distorted the overview map. Despite investing significant time and effort into trying to programme a solution, it ultimately proved unattainable. As a result, we have removed data relating to the affected countries to prevent visitors from being misinformed about those countries' energy performance.

SOCIAL

- There was a complex and fragmented decision-making process at Transfo due to the multifaceted nature of the project, the multiple contractors on site, the intensity of the physical redevelopment programme and changes that had to be made to the masterplan to accommodate unforeseen construction issues that emerged. This occasionally led to delayed decision-making on the construction activities which in turn caused knock-on delays that slowed down our contractors.
- In addition, the shared use of the outdoor space introduced a challenge. The educational elements had to be located so as to avoid interfering with other users and activities, for example, outdoor adventure sports and the various renovation works.
- Furthermore, unforeseen events may occur regardless of the amount of planning you do and these can create significant challenges. For example, the location of one POI was closed off temporarily following a tragic accident.

Tips & tricks

MINIMISE SEQUENTIALITY WITHIN WORK PACKAGES

Throughout project development, strive to eliminate interdependencies or effectively mitigate associated risks. One strategy is to avoid running work packages in parallel. Ensure that each work package generates sufficient output that can be accomplished independently of others.

ENSURE ADEQUATE ATTENTION TO PROJECT PREPARATION, FOLLOW-UP AND AFTERCARE

It is crucial to allocate sufficient resources for preparation and aftercare. Thorough preparation is invaluable, as time invested upfront leads to significant time savings later on. Personnel should be allocated to tasks, including risk analysis, establishing provincial support structures, engaging stakeholders, conducting market research, obtaining permits and developing a comprehensive business plan to understand long-term commitments and financial implications.

BE REALISTIC IN THE INVESTMENT AFTER THE PROJECT'S LIFETIME IN TERMS OF TIME AND MONEY

Make a realistic business plan and do not be naive: a visitors' trail that is not continuously updated will quickly lose its relevance.

FOR PROJECTS SITUATED IN PROTECTED HERITAGE LOCATIONS

If you have a heritage project, allocate additional time to coordinate inputs from your heritage agency and for the approval or adjustment of design elements, colour choices, location and other specifications. It is also essential to allocate an extra budget to ensure compliance with the necessary heritage development requirements.

BE CAREFUL WHEN USING CORE INFORMATION THAT IS PROVIDED BY OTHERS

This is for example when you use organisations' APIs, especially when the providers are commercial organisations. Double-check their business models to see if you can get a long-term contractual commitment to continue to provide access. If they do change their terms, try to negotiate favourable terms with them as we did. Do not underestimate the impact such a change may have. Expect the unexpected.

Topic 6

Project set-up & manage-ment

Context, key definitions & terms

The project set-up, partnership and project management are largely steered by the UIA programme context and guidelines. Within this framework, Leiedal and its partners elaborated a project proposal with a specific set-up, timeline, project organisation and management structure and a set of outputs, deliverables and milestones.

What we tried to do

The initial phase of the project involved forming a robust partnership comprising entities with diverse expertise relevant to the RE/SOURCED project's objectives. Drawing on the unique strengths and backgrounds of each partner, the project was collaboratively developed. The parameters for this collaboration were set by the UIA programme, defining key aspects like project duration, thematic work packages and budget allocation.

Within this framework, partners worked together to delve into the substantive aspects of the project, shaping its direction and objectives. They also focused on refining the project's organisational structure and approach to ensure effective implementation. Each partner brought their in-house expertise to the table, providing valuable insights and resources.

Moreover, the partnership benefited from the involvement of external service providers who contributed specialised knowledge and support. Notably, service provider CE+T played a crucial role by leveraging its expertise to act as the system integrator, coordinating various aspects of the project to ensure seamless integration and functionality.


HOUR
DAY
SEASON

Challenges & solutions

Challenge
composing the right partnership

Creating the right partnership based on a conceptual project idea is a challenge. It involves finding the right expertise and partners and securing their commitment. Their engagement depends not only on the project's value and learning potential but also on the substantial budget available to finance their expertise and availability. Given the project's non-negotiable nature, partner engagement cannot be casual.

In hindsight, it would have been advisable to involve DSO Fluvius and the regional citizen cooperative for renewable energy, Vlaskracht, as partners in the project from the outset. Both entities play crucial roles in project implementation, and their early engagement would have been beneficial. Regarding Fluvius, its value as a partner is evident: as a DSO, it holds a pivotal position in the energy landscape, particularly in innovative pilot projects like RE/SOURCED. Therefore, the commitment and constructive attitude of the DSO are paramount.

Although RE/SOURCED partners and the DSO eventually found common ground as the project progressed, the DSO initially took time to see the project's benefits. Nonetheless, early involvement would have been advantageous.

The same applies to the regional citizen cooperative for renewable energy. Initially, the intention was to establish a dedicated energy cooperative for the Transfo site. However, it became evident later on that this approach was not practical. The workload needed to manage an energy cooperative was disproportionate compared to the scale of the project, partly due to the requirements of Flemish legislation. In simpler terms, the project's scope was not large enough to support its own cooperative. Recognising this aspect earlier would have been beneficial from the project's outset.

Challenge
system integration

RE/SOURCED is a complex project that required considerable time to refine the design parameters and system design. This was partly due to difficulties in delineating the legal landscape, which was crucial for the project's layout. Concurrently, the partnership began appointing service providers and suppliers for various project components (batteries, PV installations, charging infrastructure, cabling, inverters, CHP, data connections, various constructions, regular technical elements, etc.). This resulted in around twelve service providers and suppliers collaborating to fine-tune the project design and implementation. It necessitated extensive coordination and alignment throughout the design and implementation phases. The risk here lies in potential miscommunication among different components, loose ends emerging, duplication of work or overlooking certain aspects.

Within RE/SOURCED, all of this ultimately went quite smoothly for two important reasons. The first reason is that the partners placed the right people on the project. Especially the tandem of dedicated employees from Leiedal and Ghent University worked well in both the design and implementation phases. Their pragmatism, knowledge of the physical context and technology, and their decisiveness ensured efficient and effective implementation. The second reason is somewhat the result of coincidence: after the necessary procurement procedures, CE+T was appointed as a supplier and service provider for various components (batteries, inverters, control panels, etc.). CE+T also took on the role of system integrator. A crucial role, but one that was not delineated at the outset.

Challenge
project management

RE/SOURCED was a significant undertaking characterised by its ambitious scope, multifaceted challenges and stringent timelines. As a large-scale initiative, it encompassed a wide array of tasks ranging from technological implementations to stakeholder engagement efforts.

Given the project's complexity and scale, the workload associated with it was substantial. There were numerous tasks to be completed, such as designing and implementing renewable energy infrastructure, coordinating community involvement initiatives, managing procurement processes and ensuring regulatory compliance. Additionally, the project operated within tight deadlines, adding further pressure to deliver results efficiently and effectively.

The project faced additional challenges due to COVID-19 restrictions, which made coordination and implementation more complicated. Furthermore, post-COVID price inflation and disturbed supply chains added to the complexity, requiring the team to adapt and find creative solutions to procurement and logistics challenges.

The success of RE/SOURCED hinged on a high level of collaboration among its partners and stakeholders. Effective communication, cooperation and coordination were essential to ensure that different components of the project aligned seamlessly and progressed towards common objectives. Moreover, the project demanded a spirit of innovation, as it involved exploring innovative approaches to address sustainability challenges.

Decision-making agility was another critical aspect of the project. Given the dynamic nature of the renewable energy sector and the evolving needs of the community, the project team had to be responsive and adaptable. Rapid decision-making was necessary to address emerging issues, capitalise on opportunities and overcome obstacles encountered during implementation.

In the context of the RE/SOURCED project, a core management team was introduced at the level of lead partner Leiedal, supported by a project management team that included the different partners. Having a small management team meant sharing responsibilities and workload evenly among a select group of individuals. This approach made decision-making faster and more agile, as multiple team members could contribute to the process. It was similar to having a backup plan - if one person was unavailable, someone else from the team could seamlessly step in to address the issue.

The members of the management team worked closely together, collaborating and bouncing ideas off each other to arrive at better solutions. Each team member brought their own expertise to the table, whether it was in civil or electric engineering, financial management or community engagement. This diversity of skills and perspectives ensured that decisions were more well-rounded and considerate of various factors.

By leveraging the strengths of each team member and allowing them to focus on what they were good at, the management team could accomplish tasks more efficiently and effectively. This streamlined approach enabled the RE/SOURCED project to navigate its complexities and achieve its goals with greater success.

Moreover, the project partners carefully selected suppliers and contractors through thorough procurement processes. This helped the management team to tap into their expertise and professionalism, ensuring better results and a smoother project execution.

Tips & tricks

EARLY ENGAGEMENT OF KEY PARTNERS AND CRUCIAL STAKEHOLDERS

Ensure early engagement of key partners in your project to streamline implementation and maximise benefits. Identify and engage crucial stakeholders like DSOs and regional energy cooperatives from the beginning and involve them from the conceptual stage.

THE RIGHT INDIVIDUALS FOR YOUR TEAM

Selecting the right individuals for your project team is crucial for success. Consider pairing dedicated personnel who bring a practical approach, a deep understanding of the project context and technology and decisive decision-making skills.

SMALL MANAGEMENT TEAM FOR FAST DECISION-MAKING

Implement a small management team to have faster decision-making and enhanced agility. Distribute responsibilities evenly among a select group. This approach allows for quick adjustments and ensures continuity in case of absence. Leverage diverse expertise within the team to generate well-rounded solutions, benefiting from various perspectives.

MAXIMISING INNOVATION BY EXPLORING ALL OPTIONS

Maximise innovation within the legal framework by exploring all options. Expect obstacles, proactively seek workarounds and anticipate challenges. Build resilience through a diverse management team and embrace uncertainty as part of the process.

APPOINT A SYSTEM INTEGRATOR

Be sure to appoint a service provider who can act as a system integrator. Avoid relying on chance or the assumption that things will fall into place on their own. Managing and coordinating the various procurement procedures and roles of each contractor or service provider is a demanding and vital task.

LIMIT THE NUMBER OF SERVICE PROVIDERS AND CONTRACTORS

Streamline your project by limiting the number of service providers and contractors. This simplifies management, ensures clear accountability and streamlines communication and coordination. Consistency in quality and potential cost savings are additional benefits of this approach.

DESIGN-IN CIRCULARITY FROM THE OUTSET

When implementing circular projects, design-in circularity from the outset and do not view it as an add-on.

UNDERSTANDING THE NUANCES OF THE PROJECT

When selecting service providers and contractors, prioritise those who understand the nuances of the project and demonstrate adaptability. Look for partners who are willing to collaborate and show flexibility in their approach.

DEDICATED EXTERNAL EXPERT

Utilise a dedicated external expert to enhance the project's value. This expert offers fresh perspectives periodically, examining the project from an outsider's viewpoint and providing a valuable second opinion.

COMMERCIALLY SOUND BASIS

Energy communities must be operated on a commercially sound basis through adopting a viable business model. Put simply, sources of income must exceed operating costs. For RE/SOURCED, the aim was to transfer assets from the project to the energy community. In practice, this was not possible as it would have placed a liability (debt) on the community's operating model that it could not service. Income is a function of the number of users in the community.

RE/SOURCED had a small number of users and therefore had limited ability to generate income. It therefore had to look at a different model. The partners identified Vlaskracht , a local energy cooperative, as being a potential delivery partner.

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