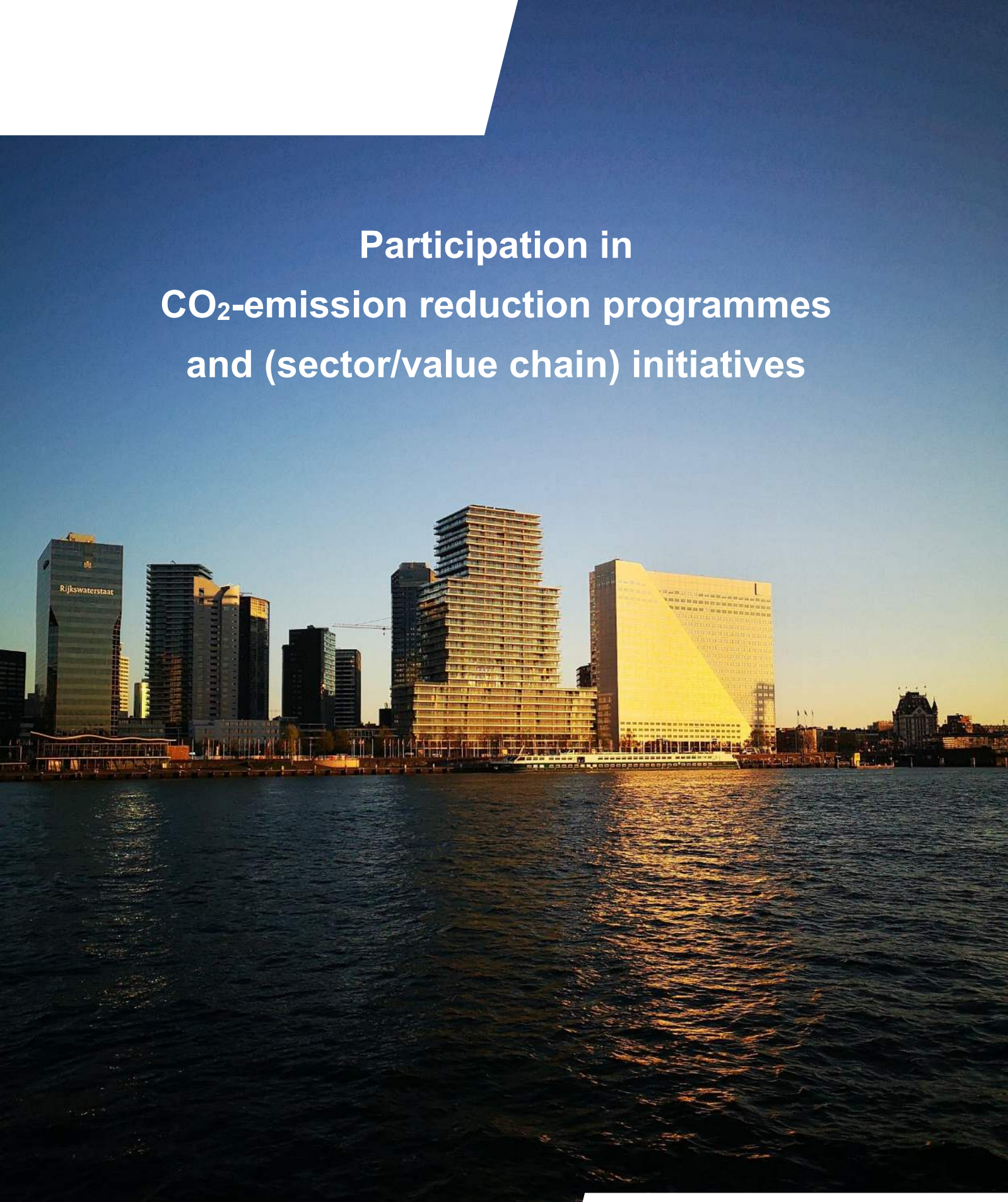
Participation in CO_2-emission reduction programmes and (sector/value chain) initiatives



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BESIX Group

Title: Participation in CO_2 reduction programs and (sector and/or value chain) initiatives

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Revision	Date	Description
0	22/02/2022	First version
1	01/04/2022	Review related to name change of Van den Berg and Agidens Infra Automation into BESIX Unitec
2	15/03/2023	2023 Update
3	15/03/2024	2024 Update

Content table

1. Introduction

BESIX is a multi-disciplinary construction company specialized in construction, infrastructure and marine works, often in contracts with a high level of complexity. In Benelux and France, the Group's regional affiliates BESIX Infra, Jacques Delens, Vanhout, Wust and Lux TP ensure a strong presence and a local approach. With Franki Foundations, Socogetra, BESIX Environment and BESIX Unitec, the Group offers specialist niche solutions for the building market like deep foundations, geo-engineering, road construction, water treatment and cable and pipeline construction.

As an active member of the United Nations Global Compact since 2016, BESIX Group supports the 10 United Nations principles relating to the respect of Human Rights, international labour standards, the environment and the fight against corruption. BESIX Group is also an active member of The Shift. The Shift helps BESIX Group to make use of the global framework of the UN Sustainable Development Goals to map its societal ambitions.

In 2016, BESIX Group signed the Belgian SDG Charter for Development with the objective to promote the Sustainable Development Goals (SDGs), to implement them in the framework of development cooperation and to raise awareness of the international development agenda in the Belgian private sector.

The Belgian SDG Charter for Development is based on the 5 Ps of the SDGs: People, Planet, Profit, Peace and Partnerships. The Shift, the Belgian sustainable development network, guides the whole process. BESIX is one of the signatories of the Charter.

BESIX, as part of BESIX Group, supports the Sustainable Development Goals (SDGs), with a particular focus on SDG 13 related to climate change. Our group indeed recognizes the urgency of the climate challenge and addresses it as one of the main challenges of the construction sector.

Mid-2022, BESIX extended the CO_2 performance ladder level 5 certification for her activities in the Netherlands to the BU Europe.

The purpose of this document is to give a clear overview of the public CO_2-emission reduction programmes to which BESIX Group commits (requirement 5.C.1) and the (sector and/or value chain) initiatives in which BESIX Group participates (requirement 3.D.1).

2. Government or NGO CO_2-emission reduction program commitment *(5.C.1)*

2.1. Belgian Alliance for Climate Action – SBTi (BESIX Group)

BESIX Group is since October 2020 a signatory of the Belgian Alliance for Climate Action, launched by the non-governmental organizations **The Shift** and **WWF Belgium**. The Belgian Alliance for Climate Action (BACA) is a national initiative that invites the private sector and academic institutions to take the lead on climate action and to align their activities with the objective of the Paris Agreement, i.e. to limit the rise in global temperature to a maximum of 1,5°C.

Signatories of the Alliance express their intention to commit themselves to the Science Based Targets (SBTi) initiative and to develop and submit greenhouse gas science-based reduction targets. More information on SBTi can be found on www.sciencebasedtargets.org.

Through debates, workshops and webinars BACA aims to increase knowledge about Science Based Targets amongst the members in order to build their business case for the adoption of science-based targets, define specific targets and develop a roadmap for their implementation.

Through the Belgian Alliance for Climate Action and The Shift, BESIX has introduced to SBTi a request to develop a more sophisticated, nuanced pathway for setting targets within the construction industry.

More information can be found on www.belgianallianceforclimateaction.org

2.2. Concrete Agreement Netherlands – Betonakkoord Nederland (BESIX)

In 2016, the at that time Ministry of Infrastructure & Environment and MVO Nederland (= a network of innovating companies with the aim to create a futureproof economy) took the initiative to use the Concrete Agreement to flesh out the earlier plans of the Green Deal 'Sustainable Concrete', which was concluded in early 2016. The objective of the Green Deal was to define a widely supported and independent definition of 'sustainable concrete'.

The Concrete Agreement wants to takes this further and wants to make it more tangible to the value chain partners. In July 2018 at the moment of the launch of the Concrete Agreement, Rijkswaterstaat has taken over the role of facilitator from the MVO Netwerk Beton.

The "Concrete Agreement" is committed to increase the sustainability of concrete within the sector and value chain. The agreement focuses on four themes: CO_2 reduction, circular economy, innovation & education and natural capital. Within these four themes, the signatories to the agreement aims to improve competitiveness, increase employment, increase exports without making concessions to the quality, safety and life span of concrete.

The "Concrete Agreement" gives substance to the objectives and ambitions for the concrete related value chain. Here are a few examples: 30% CO_2 reduction by 2030 compared to 1990 with an ambition of 49% reduction in the value chain, 100% high-quality reuse of waste concrete by 2030 and, with immediate effect, replacing at least 5% of the total volume of aggregates with concrete residual flows.

BESIX is since 2020 a signatory of the Concrete Agreement. See www.betonakkoord.nl/ondertekenaars.

More information can be found on www.betonakkoord.nl

2.3. Circulair Betonakkoord Vlaanderen (BESIX, BESIX Infra)

The 'Circular Betonakkoord Vlaanderen' initiative, launched on 18/12/2020 is part of Flanders Circular and supported by the project partners Groen Beton Vert (GBV), the Flemish Construction Federation, Buildwise, the Federation of Producers of Recycled Granulates (FPRG), the Confederation of demolition & dismantling contractors (CASO) and Fedbeton is the follow-up of the Circular Concrete initiative which ended end 2020.

It is technically possible to use recycled aggregates in new concrete, alternative binders are becoming market-ready and there is potentially a sufficient supply of high-quality secondary raw materials. Despite the rising demand for "circular concrete" and the increasing number of companies that offer innovative "green" concrete, the big wave of circular concrete projects is still not happening. Project ambitions are diluted or face practical problems and the pilot projects do not appear to be easily scaled up. The use of circular concrete is not self-evident and the chain is not optimally organized.

By opting for a "top-down" systemic approach the partnership aims on a broad commitment on a Flemish scale from all relevant parties (policymakers, clients - public and private, designers, construction companies, producers - precast concrete/landfill concrete, demolishers, recycling companies and crushers). By analogy with the Dutch Concrete Agreement, a joint ambitious path towards the future is set.

In co-creation with all stakeholders, an answers to the most important system bottlenecks such as integration of sustainable solutions in tenders, lack of trust and good value chain cooperation and shortage of high-quality aggregates has been formulated. Instruments to translate this commitment into concrete results will be developed at the technical (standard texts for demolition and concrete works, new market forms) and policy levels (incentives, obligations, steering of material flows).

At the end of the project period (dd. 17/12/2022), the participants endorsed the ambitions of the elaborated path in a Flemish concrete agreement.

BESIX Infra, as chairman of the FPRG, is represented in Project Group. BESIX is a member of the Steering Committee and the Transition Group. For a full list of participants – please refer to PowerPoint Presentation (circular-concrete.be).

2.4. Het Nieuwe Normaal (BESIX)

Het Nieuwe Normaal (HNN) is the new, supported standard for circular construction with achievable and ambitious performance for buildings, infra and area.

HNN is a framework aimed at the materials transition: it makes circular construction unambiguous and concrete. It also takes into account the sustainable context of a circular project, such as energy, water and nitrogen. In addition, accelerators are visualised. And because circular building is about a new way of working, experiences are shared about collaboration in teams and within the organisation. Thus, the relationship is made with social themes such as reintegration and participation.

The HNN framework covers 3 themes. These themes have been developed into indicators that can be used to determine the circularity of a project.

1. Environmental impact including CO2 emissions and CO2 storage of materials.

2. Use of materials looking at the origin of materials, the proportion of healthy materials and the handling of residual materials during construction.
3. Value retention which looks at adaptive capacity, detachability and reuse potential.

More information can be found on: Het Nieuwe Normaal | Cirkelstad

3. Active participation in sector and/or value chain initiatives *(3.D.1)*

The companies belonging to the Organizational Boundary participate both actively in a wide number of (sector or value chain) initiatives.

3.1. CO_2-Projectplan (BESIX)

The CO_2 Projectplan initiative, originally launched by CFE Nederland and Geka Bouw in 2015, is a sector initiative that since 2017 is led by BESIX, TBI Infra BV and Van Gelder Group BV gathering various large Dutch construction companies (for a full list of participating companies - see https://www.co2projectplan.nl/ledenlijst/bedrijven). The initiative is supported by knowledge institute KWA Bedrijfsadviseurs.

The initial purpose of this development project was to facilitate a simple and unambiguous measurement and reporting of the most material scope 1, 2 and 3 emissions. During the development project, a project CO_2 monitoring and reporting tool was developed, first in Excel which has been digitalized during a second phase into the application 'Smarttrackers'.

The CO_2 project plan is used mainly on CO_2 awarded projects to define and analyze the expected project carbon emissions (including scope 3) and to take measures to reduce these carbon emissions by, for example, application of saving energy measures, use of sustainable energy, design optimization, use of more sustainable materials and optimization of execution and transport methodologies.

Experiences by the members of the initiative are shared during active quarterly meetings and form a basis for dialogue on sustainability. By publicly sharing experiences and inspiring each other, the members of the initiative strive for a joint carbon reduction within the construction sector and its supply chain in line with the Dutch National target of 49% CO_2 reduction by 2030 compared to 1990.

Each member commits itself to publish (at least twice a year) their projects with a CO_2 awarded advantage on the CO_2-Projectplan website mentioning project reduction objectives, foreseen and implemented reduction measures and obtained carbon reduction results.

BESIX monitors all Dutch projects with a CO_2 related advantage with this tool. More information can be found on www.CO2projectplan.nl

3.2. Belgian Alliance for Sustainable Construction (BESIX)

The alliance is a network for partners throughout the value chain of the construction sector in Belgium. It was founded with the following mission:

- Integrate and stimulate sustainable development at micro and macro level in the Belgian construction sector between the various chain partners in a concrete and pragmatic way. This with a common agenda at federal level and in the three regions to make the transition to high- quality, sustainable, future-oriented and climate-proof construction and renovation.
- Increase the positive impact and image of the sector based on a common and holistic vision of innovation, sustainability and quality, while also guaranteeing the affordability of new construction and high-quality renovation.
- Accelerating the sector's transition towards the European Green Deal agenda, its elaboration in the New European Bauhaus and the global Sustainable Development Goals.

The alliance wishes to develop activities around the following topics, all of which we consider important for our ambition:

1. Limit the entire environmental impact of buildings, structures and infrastructure over their entire lifetime while paying attention to environmental aspects
2. Construction industrialization and standardization
3. Digitization, new methodologies and techniques
4. Site logistics
5. Value chain cooperation

BESIX is a member of the steerco of this Alliance and an active member of the 'scope 3' workgroup which has a primary focus on the building materials cement, ready-mix concrete and steel (rebar, (sheet)piles, structural steel,...). More information can be found on www.ba4sc.be.

3.3. ADEB-VBA (BESIX, BESIX Infra, Franki Foundations)

ADEB-VBA is the branch organization of the large construction companies in Belgium and is part of the Belgian Construction Federation. As a member, BESIX, BESIX Infra and Franki Foundations participates in the Green Board and a number of sustainability related workgroups.

These workgroups have as purpose not only to exchange knowledge and experiences amongst the members but also to define common environmental and/or sustainability standards to drive the Belgian construction sector to a higher level.

In 2021 and 2022, together with CFE and Denys, BESIX played an active role in defining the sustainability strategy of ADEB-VBA.

More information can be found on www.adeb-vba.be

3.4. BouwCirculair Betonketen Limburg (BESIX, BESIX Infra NL)

BouwCirculair is a knowledge sharing network that aims for the use of sustainable products in the construction sector, to reduce carbon emissions and to stimulate the use of circular raw materials. BouwCirculair connects all the links in the value chain and organizes meetings, provides courses, initiates projects and develops practical instruments. In addition, BouwCirculair is committed to realize innovations by connecting parties in the value chain, setting up pilot projects and involving schools and students in projects.

BESIX and BESIX Infra Nederland participates in the workgroup 'Betonketen Limburg'.

For more information: https://bouwcirculair.nl

3.5. Ode Warmtenetwerk (BESIX Unitec)

Ode is the sector organization for sustainable energy in Flanders. Through consultation and political work, ODE is working on a 100% renewable energy system.

Warmtenetwerk Vlaanderen (WNVL), the technology platform for heat networks of ODE, was founded in 2012 with the support of the Dutch Foundation 'Warmtenetwerk' and has 82 members in Flanders. The objective is to stimulate a supported development of sustainable heat and cold networks.

BESIX Unitec is a member of the Ode-Warmtenetwerk.

More information can be found on www.warmtenet.ode.be

3.6. Belgian Hydrogen Council (BESIX Environment)

In September 2022 TWEED (Wallonia) and WaterstofNet (Flanders) clusters have joined forces and established the Belgian Hydrogen Council. To facilitate the cooperation between the industry and the various governments on hydrogen, WaterstofNet and Cluster Tweed will work together intensively under the flag of a 'Belgian Hydrogen Council' which comprises Flemish members of WIC (Waterstof industrie Cluster) and French members of H2Hub.

This Belgian Hydrogen Council will advise the various authorities on specific themes in which cooperation is necessary. In addition to the companies that are part of the Council through the two cluster organizations, experts from the academic world and sector federations will also be involved in its functioning.

Objectives of the Belgian Hydrogen Council are:

- Profiling & promotion of the Belgian Hydrogen Industry
- Acting as a spokesperson for Belgian hydrogen ecosystem equivalent to National H2 organisations in neighbouring countries
- Advising our policy makers on roll-out of Regional & federal hydrogen strategies
- Fostering a coordinated approach of cross-regional topics
- Connecting existing industrial ecosystems on H2 in Flanders & Wallonia

BESIX Environment is a member of the Belgian Hydrogen Council and wants to play an important role in the National Council.

3.7. Buildwise – Technical Comittee Smart & Sustainable Constructions (BESIX)

The Technical Committee (TC), launched in 2018 and since 2020 presided by BESIX, focuses on the following themes within the Horizon Europe framework:

- New business models, based on SMART technologies and circular principles. Amongst others via a 'SMART Maintenance' project for which an innovation paper on this theme will be developed to help large and small contractors on the right track.
- The working group 'Relationship building – environment' to make it possible to better define the role of the contractor in the energy systems of the future (energy flexibility, district grids, temporary storage, etc.) and to start up new research projects.
- The development of insights, instruments and innovations in the field of the environmental impact of buildings and construction materials through various R&D projects, the development of standard methodologies, tools and benchmarks towards future regulations.
- The translation of circular solutions into usable information for the contractor via e.g. BuildCircular.brussels, the Green Deal and/or Innovation yard Circulair Construction.

Within the TC three workgroups have been initiated:

- Workgroup 'Environmental impact (& life cycle costs)'
- Workgroup 'SMART & data driven maintenance (& operation)'
- Workgroup 'Interaction building-environment (for sustainable residential areas & cities)
- Workgroup 'Circular economy'

More information can be found on Smart & Sustainable Constructions (buildwise.be)

3.8. lifeMACS – **life** cycle **M**ethodology for the **A**ssessment of existing **C**oncrete **S**tructures (BESIX)

The lifeMACS project is unique in a way that it combines the strengths of Ghent University, KU Leuven and WTCB. Together with the expertise of the industry partners in the advisory board, this multidisciplinary research will surpass the innovation capacity of the individual stakeholders, arriving at an integrated assessment, repair and management of existing concrete structures. Moreover, the results will ensure further ground-breaking industrial developments in the construction industry.

Refurbishment and retrofitting of existing structures in industrialized countries are currently gaining in importance while new construction rates stagnate. This is due to the ageing patrimony of many developed countries. In Flanders for example, 69% of the building stock was constructed before 1981 and 28% even before 1945. Currently, the biggest challenge lies in the assessment and management of these ageing structures considering costs for inspections, repair and upgrading, while also keeping in mind human safety. Therefore, the development of an adequate framework for an efficient through-life analysis of structures on the basis of quantitative date is highly desired.

In order to fill this gap in the current state-of-the-art, lifeMACS will focus on developing a life-cycle methodology for the assessment of existing concrete structures. In order to accomplish that, several frameworks are developed, such as the condition assessment and modelling of damage (WP1), the

prediction of the structural performance (WP2), the assessment and optimization of combined inspections and monitoring strategies (WP3), and the optimization of maintenance strategies and repair or strengthening interventions (WP5). In these frameworks, time-dependent degradation, spatial variability and updated information based on results from investigations, monitoring and degradation modelling will be incorporated. In order to do this, a multi-layered Bayesian approach will be used. Furthermore, a novel integrated BIM-environment for life-cycle management will be developed (WP6), allowing for a more efficient interaction between the stakeholders and a continuous data management over the lifetime of the structure. The combination of these frameworks will allow to perform a coherent through-life performance quantification, life-cycle management and decision making for existing concrete structures, considering all available information from inspections, monitoring and structural modelling. To validate the developed methodologies, an experimental test program will be set up (WP4) and the methodologies will be applied to several benchmark case studies.

The results from the lifeMACS project will create important opportunities for several industry sectors, such as companies offering damage diagnostics and monitoring, engineering design offices, control and certification bodies, contractors, material suppliers, construction software providers, owners and asset management firms. It will furthermore significantly improve durability and sustainability, by facilitating high-level service-life management, promoting longer lifespans. This proves the relevance and importance of the lifeMACS project, as it will create potential for many industries, contribute to a longer and safer lifetime of existing concrete structures and improve durability and sustainability.

BESIX role in the lifeMACS project is to identify potential structures affected by durability issues and facilitate the contacts and networking between the lifeMACS Research team members and structure owners (private or public authorities).

More information can be found on the project website: http://www.lifemacs.be

3.9. Industrial advisor on external R&D projects (BESIX, BESIX Infra)

BESIX and BESIX Infra advise a number of external R&D projects in facilitating the usage of sustainable materials and the reduction of construction waste.

- 3DCP as lost formwork

  BESIX is participating in the work group of the research studies by UGent on 3D concrete printing lost formwork as an industrial advisor. The objective is to avoid using the conventional timber or steel formwork by replacing them with stay-in 3D printed concrete skins and save the consequent construction waste.

- Feasibility of 3D printing infra elements

  BESIX Infra is collaborating with UHasselt by co-advising a master's thesis work on feasibility study of 3D printing infra elements. The scope of work is not limited to using concrete, but rather broad search of the best solutions in producing infra elements. Alternative binder materials such as sulfur concrete, which is 100% recyclable, are also being investigated.

3.10. The Lightness project (BESIX, i.LECO)

LIGHTNESS is a Horizon 2020 EU funded project carried out by 13 partners from across Europe that aim to increase the penetration of Renewable Energy Sources, to achieve the EU target for 2030 of at least 32% of final energy consumption. All that by supporting the market uptake of Citizen Energy Communities through a low-cost turnkey social engagement, regulatory roadmap and technological package to unlock their full flexibility potential, reduce the final energy consumption and CO2 emissions and bring economic, social and environmental benefits to the communities and across the energy value chain.

The power of this project lays in its holistic approach. User engagement, regulatory assessment, technology evolution, simulation and assessment, case study deployment, demonstration & replicability all are aspects of the project grouped in work packages. i.LECO actively takes part in all work packages and additionally leads work package 4 – "Evolution and integration of the CEC platform" (CEC – Citizen Energy Communities).

LIGHTNESS has started in December 2020 and will take 36 months to complete. First 24 months focus will be brought to life energy communities in 5 European countries: the Netherlands, France, Italy, Spain and Poland. That includes a lot of activities as at first it has to be checked what are legal limitations and inhibitors, create business models, engage people and of course prepare a platform, which supports scenarios for all cases. More information can be found on https://www.lightness-project.eu/

3.11. The Hestia project (BESIX, i.LECO)

HESTIA is an EU funded Horizon 2020 project developing a cost-effective solution for the next-generation demand-side response services by encouraging residential consumers to engage in flexibility sharing and grid balancing. User-personalized services will help lay the foundation for an open marketplace and a new grid reality.

The HESTIA consortium is composed of 19 partners from 9 countries (Italy, France, Austria, Belgium, Netherlands, Spain, Ireland, Denmark and Serbia), gathering energy service providers, pilot sites, R&D institutions, and public authorities, as well as industrial, technological, consulting, and investment companies. i.LECO will deliver the blockchain-based LES platform that will set the foundation for an open marketplace with potential for "community trading" and flexibility sharing on all pilot sites. i.LECO is also developing the designated user visualization and communication interfaces for consumer engagement.

HESTIA started in December 2020 and will take 36 months to complete. During this period, 3 energy communities will be established in the Netherlands, France, and Italy. These pilots will provide a wide diversity of demonstration opportunities in terms of population densities, consumer categories, geographical locations, and climates.

More information can be found on https://hestia-eu.com/

4. Passive participation in sector and/or value chain initiatives *(2.D.)*

Both BESIX, BESIX Infra and BESIX Unitec participates passively in the following sector and/or value chain initiatives:

- Waterstof Industrie Cluster (www.waterstofnet.eu) (BESIX Environment)
- Tweed Cluster (https://clusters.wallonie.be/tweed/en) (BESIX Environment)
- VCB Commissie Leefmilieu (BESIX, BESIX Infra)
- Sustainability workgroup and workgroup 'Carbon calculator' within the European Federation of Foundation Contractors (Franki Foundations)
- Bouwend Nederland - initiatives 'De Groene Koers' (Home • De Groene Koers) and 'Klimaatadaptief Bouwen met de natuur' (www.kanbouwen.nl) (BESIX Nederland)
- Centrum Ondergronds Bouwen – platform sustainability (Platform Duurzaamheid - COB)
- Bouwcampus – transition trajectory 'Verduurzaming Gebouwen en Omgeving' (Trajecten (debouwcampus.nl))

5. Finalized sector and/or value chain initiatives (3.D.1)

5.1. 3D2BGreen – Sustainable concrete mixtures for 3D printing of breakwater units (BESIX, Six Construct; 2019-2023)

Supported by VLAIO and SIM, 3D2BGreen is a three-year 3D concrete printing research project, set up in 2019 by construction company BESIX, start-up ResourceFull, engineering company Witteveen+Bos and research institution Ghent University. The research focuses on developing sustainable concrete mixtures suitable for the 3D printing of breakwater units. The combined expertise of the project partners will result in new, innovative and more sustainable solutions in hydraulic engineering.

Standing in the last year of the research project, the partners are making promising progress according to the project objectives and planning. The strategy of combining 3D printed concrete for the shell and conventionally cast sustainable concrete as infill is being explored. ResourceFull and UGent have developed affordable concrete mixtures suitable for 3D printing and resistant to the marine environment. Within both the 3D printed and the infill concrete mixtures, the main ingredient of cement is replaced by sustainable alternative binders with the goal to reduce carbon footprints. UGent and ResourceFull performed extensive testing on the new concrete mixes to optimize for 3D printing extrudability, buildability, mechanical strengths and durability capacities. They are also exploring the possibility of 3D printing marine elements under water in order to eliminate the need of heavy transport.

Except for the material characterization, the team is also investigating in the practical aspects on the structural scale. Witteveen+Bos is in the process of optimizing a breakwater element shape based on existing products, of which the geometry needs to be feasible for 3D printing and initial stability assessment. Parametric design and advanced analysis methods are utilized in the optimization processes. As a partner in the construction industry, BESIX is facilitating the research from a practical point of view by sharing experience and knowledge from industrial marine projects. On top of the technical soundness, the BESIX innovation division compares the environmental, economic, and constructability aspects of the developed method for 3D printing breakwater elements. Trial printing with the sustainable concrete material is being carried out in the BESIX 3D printing studio in Dubai. Through in-depth collaborative work and studies, the partners look forward to fruitful outcomes.

More information can be found on https://www.sim-flanders.be/projects/3d2bgreen/

5.2. BouwCirculair – Ownership Infrastructure (BESIX, BESIX Infra NL; 2018-2023)

BouwCirculair is a knowledge sharing network that aims for the use of sustainable products in the construction sector, to reduce carbon emissions and to stimulate the use of circular raw materials. BouwCirculair connects all the links in the value chain and organizes meetings, provides courses, initiates projects and develops practical instruments. In addition, BouwCirculair is committed to realize innovations by connecting parties in the value chain, setting up pilot projects and involving schools and students in projects.

End 2018 the 5-year 'Uitvoeringsprogramma Circulaire Bouweconomie", a collaboration between government and the industry, has been launched which must result in 2023 in the "basecamp", a number of instruments, supporting material and conditions to facilitate the next steps into the transition to a circular economy. Within the program, BouwCirculair works on 27 themes which will be presented at the end of 2022 during the BouwCirculair Congress 'De Circulaire Spurt'. (Spurt2023 - Bouwcirculair)

BESIX actively participates in the workgroup 'Ownership Infrasructure' , a workgroup to promote circularity by giving ownership to materials/projects. The working group lists the advantages and disadvantages of ownership. This listing offers a guideline for projects based on ownership. The working group is developing a proposal for implementing 'ownership' projects.

More information and members of this workgroup, please refer to https://bouwcirculair.nl/nieuws/10-eigenaarschap-infrastructuur/

5.3. SMARTINCS – **S**elf-healing, **M**ulti-functional, **A**dvanced **R**epair **T**echnologies **IN** **C**ementitious **S**ystems (BESIX; 2024)

The SMARTINCS consortium was born from the SARCOS COST action CA15202 on self-healing and preventive repair of concrete structures. This project has received funding from the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement SMARTINCS No 860006.

SMARTINCS will implement new life-cycle thinking and durability-based approaches to the concept and design of concrete structures, with self-healing concrete, repair mortars and grouts as key enabling technologies. This will create a breakthrough in the current practice of the construction industry, which is characterized by huge economic costs related to inspection, maintenance, repair and eventually demolition activities and additional indirect costs caused by traffic congestions during maintenance and environmental effects.

SMARTINCS will train a new generation of creative and entrepreneurial early-stage researchers in prevention of deterioration of

- new concrete infrastructure by innovative, multifunctional self-healing strategies and
- existing concrete infrastructure by advanced repair technologies.

The project brings together the complementary expertise of research institutes pioneering in smart cementitious materials, strengthened by leading companies along the SMARTINCS value chain, as well as certification and pre-standardization agencies. They will intensively **train 15 early stage researchers** to respond to the clear demand to implement new life-cycle thinking and durability-based approaches to the concept and design of concrete structures, minimizing both the use of resources and production of waste in line with Europe's Circular Economy strategy. The new generation of researchers will be immediately employable to support the introduction of the novel technologies.

BESIX is the industrial partner in the Smartincs project and responsible for building a series of concrete walls as demonstrators, assessing the potential of a self-healing agent to repair cracks of a such concrete structures. The cracks will be induced by early age shrinkage, autogenous shrinkage or other unfavorable building conditions (restrained shrinkage on existing slab). This demonstrator has to be built in real jobsite execution conditions during Q1-Q2 2023 on a BESIX project location at Zaventem (B), then self-healing agent effects and benefits will be monitored and tested during Q2-Q3 2023.

More information can be found on the project website: www.smartincs.eu

5.4. Green Deal on Circular Construction (BESIX, Vanhout, BuildUp (former Be.Steel); 2019-2023)

The Green Deal on Circular Construction was launched in the spring of 2019 by Circular Flanders and OVAM (Public Waste Agency of Flanders) and ended in February 2022 with a slot event. BESIX was one of the 320 signatories.

The participants experimented on new tools, methodologies and new ways of value chain cooperation and bring their accumulated knowledge and experience together in a learning network.

In addition, a research group was initiated to develop in a concerted effort the so-called preconditions to a circular economy, i.e. the legal, economic and other barriers to be faced and tackled along the way. Data and experiences from the experiments feed into this research and together solutions were formulated.

About four times a year, participants of the Green Deal gathered to provide inspiration via presentations on Flemish and foreign cases. During this event, workshops were organized to work on concrete issues that the participants table, such as tools and measuring instruments.

The members commitment in the Green Deal had:

- to carry out at least one pilot project during the term of the Green Deal (possibilities: carry out a construction project, offer a site, carry out research, offer circular products or services, develop circular materials, facilitate circular building processes...) and to put all relevant data, results and lessons from the pilot project to the researchers of the living lab Circular Building.
- to actively participate in the learning network where you exchange knowledge and experiences with the other participants. BESIX actively participated in the Communities of Practice and workshops, specifically the ones on 'Material and Business passport' (in collaboration and prepared with OVAM and TEN), 'circular business models' and 'demolition inventories as a starting point for urban mining'
- to take the necessary steps to structurally embed the principles of circular construction in their own organization.

More information can be found on Green Deal on Circular Construction - Circular Construction - Circular Flanders (vlaanderen-circulair.be). The end report can be found on Eindrapport Green Deal Circulair Bouwen - Detail - Vlaanderen Circulair Bouwen (vlaanderen-circulair.be)

5.5. RejuveBit (BESIX Infra, Belasco; 2018-2021)

BESIX Infra and Belasco, in collaboration with the University of Antwerp, the Belgian Road Research Centre (BBRC) and the Administration Roads & Traffics (AWV), participated in the TETRA-project REjuveBIT which was initiated in 2018.

The overall aim of the project was to assess the application of rejuvenating agents in the asphalt sector so that their innovative use leads to an increase in the recycling percentage of reclaimed asphalt. This assessment includes a technical, economic and environmental part. The innovative character is demonstrated for the sector by means of test tracks with new applications (surface courses) and increased recycling percentages (base courses).

To conclude the project, a study day was organized on January 28th, 2021. You can find the presentation of the study day here (PowerPoint-presentatie (uantwerpen.be)).

More information can be found on REjuveBIT | Energy and Materials in Infrastructure and Buildings | University of Antwerp (uantwerpen.be).

5.6. Strategic Business Innovation Research (SBIR) Circular viaducts (BESIX)

As from 2030, Rijkswaterstaat wants to work climate neutral and circular which also apply for the construction, replacing and renovation of bridges and viaducts.

With the Strategic Business Innovation Research (SBIR) Circular Viaducts, Rijkswaterstaat wanted to develop useful innovations for circular viaducts which it can then apply as a launching customer.

The Open Learning Environment Circular Viaducts & Bridges was an initiative of De Bouwcampus and Rijkswaterstaat in response to the first circular viaduct at the Reevesluis. With 60 participants from the private sector, governments and knowledge institutions, knowledge and experience about the circular construction of viaducts and bridges was exchanged.

With the SBIR, initiated in October 2020, several solutions were developed simultaneously by different parties. This started in the area of modular, detachable solutions, solutions with high-quality reuse and solutions made of renewable materials.

Out of more than 30 candidacies, the BESIX and Ney & Partners consortium was selected, with nine other companies, to further develop their concept of a Circular Arc Viaduct with a feasibility study. For the last phase of the SBIR three concepts were selected in March 2021 to proceed to the development of a prototype. Unfortunately the concept of BESIX and Ney & Partners was not selected for this last phase.

The BESIX and Ney & Partners concept of the Circular Arc Viaduct consisted of a dismountable viaduct made up of arch elements consisting of Ultra High Strength Fibre Reinforced Concrete (UHSVB) and a substructure of circular geopolymer concrete with 100% recycled building materials and renewable pile foundations.

The strength of the Circular Arc Viaduct lied in the following core themes:

- substantial material reduction through application of UHSVB
- a modular, demountable and reusable design
- application of renewable and low environmental impact materials in substructure and foundation.

By means of form finding, a design has been developed for the Circular Arc Viaduct which is technically feasible, with a reduction of the MKI value by up to 52% and a reduction of the TCO (Total Cost of Ownership) by 15%.

This feasibility study was carried out with our cooperation partners VITO, Haitsma, ResourceFull, Franki Grondtechnieken, Maurer and Université Libre de Bruxelles.

More information can be found on Home - circulaireviaducten.nl and Circulair Boogviaduct - BESIX.

5.7. Stichting Nederland CO_2 Neutraal (BESIX Unitec Nederland BV; 2016-2021)

Network of more than 200 companies and government organizations with the objective to exchange information during events and workshops on nitrogen, hydrogen, mobility, circularity and energy.

BESIX Unitec Nederland BV participated from 2016 till end 2021 actively in a number of workgroups (Mobility, Gas & Elektra). Membership has been ended in 2022 due to the integration of BESIX Unitec Nederland BV (former Agidens Infra Automation BV) into BESIX Group.

More information can be found on www.nlCO2neutraal.nl.

5.8. Circular concrete (BESIX; 2018-2021)

The 'Circular Concrete' Project, supported by Buildwise, ran from 2018 till end 2020 and aimed to generate innovation in products & technologies and to further stimulate the use of existing innovations by users.

The project consisted of 4 major work packages:

- overview and evaluation of existing technologies
- validation in lab conditions of 5 promising technologies
- application and follow-up of interesting solutions in 10 pilot projects
- chain analysis (costs, LCA,...) to support the actual added value for the economy and the environment

The information and knowledge gathered during the project has been transferred to the construction sector by means of publications, information sessions and network events.

A closing event took place on 29/04/2021. A video on the closing event as the presentations can be downloaded from Slotevent - 29/04/2021 - Online - Circular Concrete (circular-concrete.be).

More information can be found on Circular Concrete : Beton in de circulaire economie (circular-concrete.be)

5.9. Internet of Energy (IoE) - Enleash (BESIX; 2019-2020)

The IoE Ecosystem is an open innovation ecosystem with the objective not only to share knowledge and boost innovation in the energy world but also to create the environment to build, test and learn from new energy applications for consumers and new digital tools for a more efficient system operation. It is an ecosystem built and facilitated by system operators for market parties to develop the energy services of tomorrow. These services, the consequent digital tools and market design elements are developed in an iterative and progressive approach from ideation to sandboxing, through demonstration towards industrialization.

Enleash (from 2019 till 2020) was a journey initiated by driven and complementary partners from different industries and sizes. The common starting point of this journey is the partners' shared acknowledgement of the importance of comfort levels in buildings and of the energy efficiency potential of those buildings. By combining these two elements, Enleash creates cross-sector value for various stakeholders, while ensuring the consumer is at the center of the future electrical system.

While consumers are more and more concerned about their comfort, personal data and willing to be empowered, worldwide, we see major trends affecting our societies; 3 D's, Digitalization, Decarbonization

and Decentralization. As a consequence, more renewable energy sources are developed, which, due to their inherent intermittent character, will require electrical system to become more flexible.

On the other hand, there is a huge potential for energy efficiency with buildings. According to some sources between 40 and 60% of energy is consumed by large buildings. Nevertheless, business owners are more concerned about the comfort and productivity of their employees than of the efficiency. This has a larger impact on their day-to-day operations and profits.

The current evolution in technology will be key in the successful evolution of our economies in the energy transition. Smart buildings, and in a larger perspective, smart cities are already being developed to ensure advanced comfort and efficiency. However, the contribution of these smart buildings to the system and market needs is still at its embryo stage.

With that challenges and opportunity in mind, Fluvius, BESIX, Proximus, byNubian and Elia brought their strengths together within the IO.Energy Ecosystem to answer one question: **How might unlock and valorize the energy potential in large commercial real estate while preserving employees comfort and productivity?**

The result of this project and much more information can be found on IO.Energy Ecosystem co-creating a consumer-centric system