Quantification of impact for Leuven's climate action portfolio

NZC-PCP1-018-Leuven (Co-benefits)

SWECO

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1 Introduction & Context

This report details the development and operational principles of the Leuven Impact Framework, designed to evaluate societal co-benefits generated by projects within the Leuven Climate Portfolio.

Efforts to secure financing for the Leuven Climate Portfolio revealed that, while these projects are deemed highly valuable for the climate transition, their direct financial returns are low, even by impact investment standards. Consequently, feedback from the financial sector suggested that providing more quantified insights into the co-benefits would be beneficial for attracting impact capital.

Although these projects might not directly benefit investors financially, they offer substantial indirect societal benefits. To attract impact investors interested in such projects, these societal co-benefits must be clarified and quantified wherever possible, including assigning monetary values to the co-benefits, even if they do not result in direct investor gains.

The first iteration of a framework to answer this need was developed at the end of 2024 as a proof of concept. While it did not provide a full calculated set of indicators yet, feedback from the financial sector indicated that the initiative was on the right path. This report describes the second phase of framework development, resulting in a more comprehensive version with additional indicators and improved calculation methodologies. The resulting version of the impact framework is considered a sufficiently robust version 1.0 that can be used reliably.

A more detailed account of the expanded framework and the methodologies used for calculating co-impacts follows below.

2 Impact Framework: General Structure

The impact framework is based on the same structure that also determines the climate portfolio of the Leuven Climate City Contract. This structure contains five emission domains, each comprising several levers considered key to the Leuven climate transition. Within each lever, a few interventions are defined. Any given project can be classified into one or more interventions using the framework. This classification forms the starting point of the analysis. The framework structure is demonstrated in Figure 1.

For each intervention, a set of co-impacts is defined within four categories: Economic, Health, Social Justice, and Ecologic. These co-impacts were defined through internal expert interviews within Sweco, as well as interviews with city experts and extensive literature reviews. The exploration of both the general structure of the framework and the concrete co-impacts for each intervention was facilitated using Mural. This allowed for an interactive working method, easily retaining previous versions and noting down the thought process behind certain choices. This is illustrated in Figure 2.

Each co-benefit is quantified using an indicator value and, where possible, a corresponding (indirect) monetary value. For example, productivity gains for office workers can be defined as a yearly FTE gain and translated into a monetary benefit. Thus, each intervention corresponds to a set of co-impacts with corresponding indicators. For every indicator, a calculation method is constructed based on two simple project KPIs and, in some cases, a few additional inputs.

The framework's ultimate goal is to calculate all co-impacts based on these simple inputs, provided by the project owners. Using benchmarks and literature-based calculation methods, this calculation is automated to the extent possible. This ease of use poses some challenges when it comes to constructing sufficiently robust calculation methods. However, this is a key characteristic of this impact framework that differentiates it from other, existing frameworks. This approach allows for rapid calculation of a large project portfolio, providing first benchmarks for discussions with possible investors.

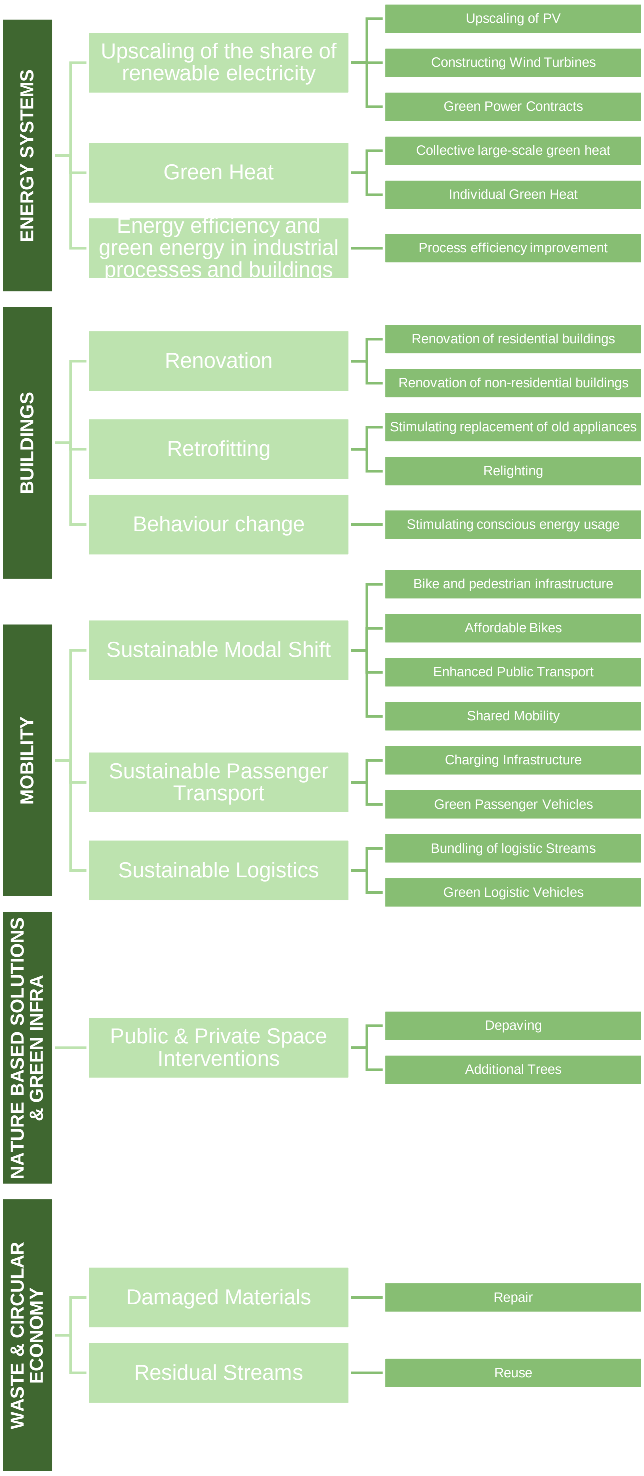

Figure 1: Impact framework structure, based on the climate portfolio of the Leuven Climate City Contract.

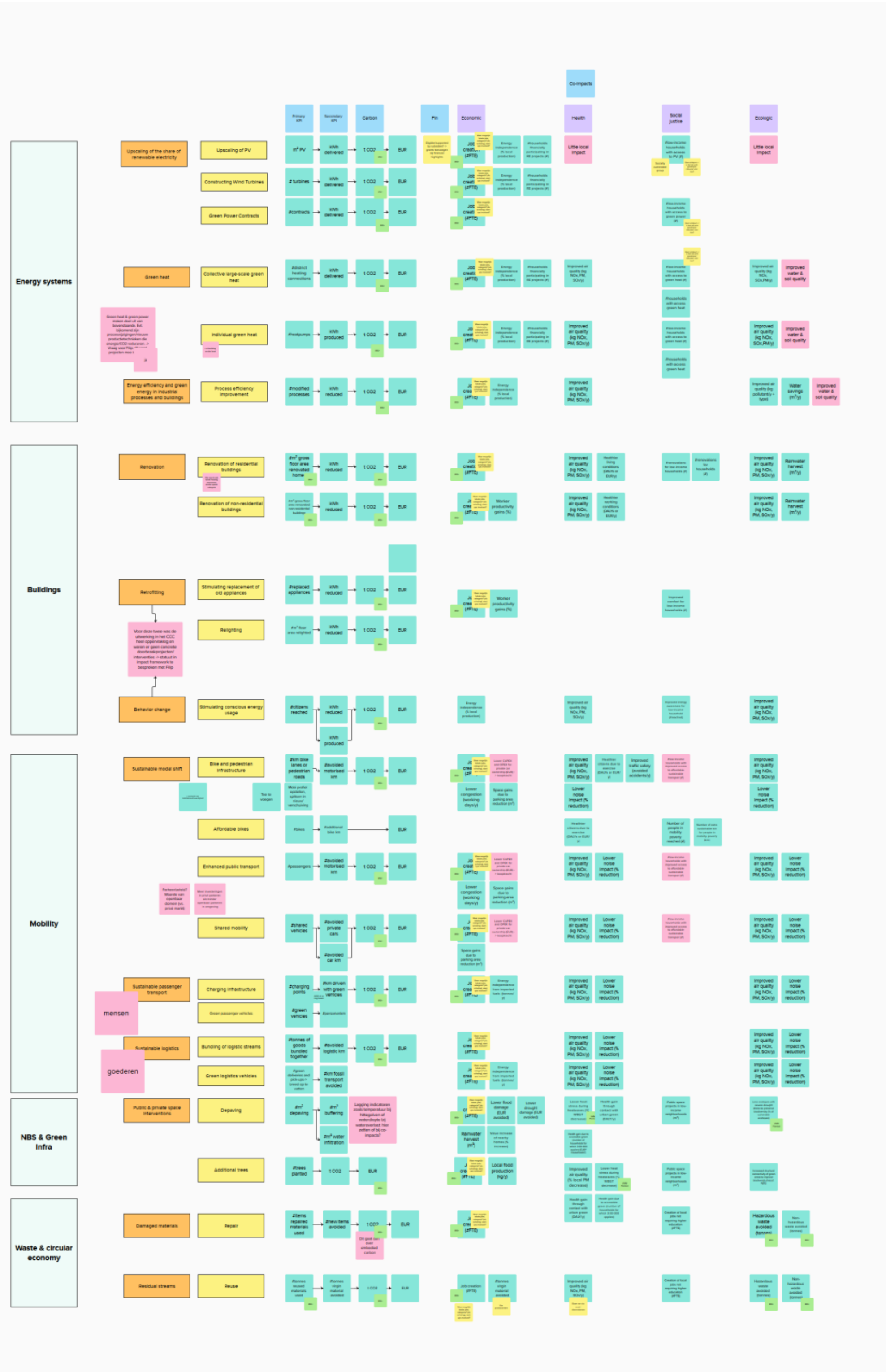

Figure 2: Illustration of the Mural workspace that was used to co-create the framework, together with Sweco and city experts

3 Indicator sets & calculation methods

In the first 'proof of concept' version, only relatively few indicator calculation methods were in place, and these methods had not yet been thoroughly validated by experts. In this continuation of the work, a validation step was executed, and five additional breakthrough projects were calculated. These projects encompassed more than five different interventions for which the indicators had not yet been calculated.

3.1 Validation of existing calculation methods

In the first version of the framework, a lot of attention had been given to interventions within Energy Systems and Built Environment, as there were some test projects readily available within these domains. Some calculation methods for indicators in Nature-Based Solutions where also in place and were reviewed as part of this work. The approach for Nature-Based Solutions, however, was drastically changed in this version of the impact framework. This is further discussed in 3.2.3.1.

A review of the indicators within Energy Systems and Built Environment was performed by two Sweco experts, focusing on three checks:

1. Possible missing co-benefits
2. Conceptual structure of the calculation methods: data sources, assumptions, steps in the calculation process
3. Due diligence of concrete assumptions, tracking possible updates of some of the used benchmarks, and checking calculations for errors

The first two checks were done by comparing the indicator list with literature and, more specifically, with the MICATool (Multiple Impacts Calculation Tool). [1]

The general goal and structure of the MICATool are fairly similar to the Leuven Impact Framework. In the MICATool, projects are classified as a combination of actions and (sub)sectors, which determine the relevant co-benefits.

In general, the choice of indicators in the MICATool is very similar to the indicator sets already present within the framework. Some relevant (future) additions include:

- *Increased asset value of buildings after renovation* was added within the interventions on renovation of residential buildings. For non-residential buildings, this is not estimated due to the enormous variety within this category of buildings.
- *Number of households lifted out of energy poverty*, following the definition of energy poverty used by the MICATool:
    - The M/2 metric: Households are considered energy-poor when they spend less than half of the median energy expenditures compared to the general population, indicating insufficient resources to adequately heat their homes.
    - The 2M metric: Households are considered energy-poor when they spend at least twice as much on energy compared to the median expenditures, often indicating poorly insulated homes.
- *Avoided investments in additional grid capacity* should be added to the framework in the future, particularly as Battery Energy Storage (BES) projects enter the Leuven climate portfolio. For now, these are not yet present. In the future, a new intervention 'Flexibility & Storage' could be added to the framework to accommodate these projects.

The MICATool can be used at a European or national level, employing different datasets. An assessment at a local level is also possible but is done through scaling the national results based on the number of inhabitants of the local community.

As the Leuven Impact Framework targets mainly interventions in the local context of Leuven itself, the conceptual calculation steps are often very similar, but the data is in some cases more locally sourced.

For instance, calculations of *health benefits due to lower air pollution* in the MICATool are based on general emission factors, WHO benchmarks, and data from the International Institute for Applied Systems Analysis (IIASA), whereas in the Leuven Impact Framework, values are based on a study conducted specifically for Flanders by the Flemish Government, providing well-backed, local benchmarks. [2]

The comparison with the MICATool provided valuable insights and confirmed that the current state of the framework is on the right track. Further detailed verification of benchmarks and assumptions led to some minor adjustments in some values, such as the yearly assumed heat demand of a typical household and the assumed reduction in heat demand after renovation.

All calculation methods are described within the Excel tool and are therefore not fully repeated in this report.

3.2 Expansion of calculation methods for five new breakthrough projects

In this section, the results of the impact calculations for the five selected projects are discussed. These results were used to provide formulas and benchmarks for future indicator calculations for similar projects.
The new set of projects to be analyzed, was determined together with experts from Leuven 2030 and the city of Leuven. The following projects were selected:

- Energy Systems & Built Environment: Hanengang

* Mobility & Transport: Iedereen Mobiel
* Nature-based solutions: Meunierstraat & Spaanse Kroon
* Circular Economy: Materialenbank

The classification of these projects is given in Table 1. Some projects entail multiple interventions.

Table 1: Classification of the set of five breakthrough projects that was analyzed.

Project	Emission Domain	Lever	Intervention
Hanengang	Energy Systems	Upscaling the share of renewable electricity	Upscaling of PV
		Green heat	Individual green heat
	Built Environment	Renovation	Renovation of non-residential buildings
		Retrofitting	Relighting
Iedereen Mobiel	Mobility & Transport	Sustainable modal shift	Affordable bikes
Meunierstraat	Nature-based Solutions	Public & private space interventions	Additional trees
			Depaving & greening
Spaanse Kroon	Nature-based Solutions	Public & private space interventions	Additional trees
			Depaving & greening
Materialenbank	Waste & Circular economy	Residual streams	Reuse

The main assumptions to determine the project KPI's and additional inputs are described below. Furthermore, calculation results for co-benefits of these projects are discussed. The actual calculation methods for every indicator are reported in the indicator list within the Excel-tool and are not repeated below.

3.2.1 Project 1: Hanengang

3.2.1.1 Project scope

Hanengang is the name of a street near the city center of Leuven. The city has bought an old garage building and is planning on renovating this building to be used as a storage facility for the nearby museum. Both the museum and this new building will receive heating and cooling from a new geothermal BTES system ('Borehole Thermal Energy Storage'). Furthermore, installation of PV on top of the renovated building and a relighting campaign are investigated.

Some of these interventions are still to be validated, so some assumptions were made based on input provided by the city.

3.2.1.2 Intervention 1: Upscaling of PV

From input provided by the city, it is estimated that 855 m² of PV will be installed (KPI1), producing 123.196 kWh of electricity yearly (KPI2). These values serve as the inputs for this intervention. The results from the tool are shown in Table 2.

Table 2: Results of the co-impact calculation, using the Leuven Impact Framework.

Co-impacts				
Economic	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Job creation - single	1,14	FTE	57.228,00	EUR
Job creation - permanent	0,02	FTE	855,00	EUR/y
Energy independence	0,02	%	NA	EUR/y
Households financially participating in RE projects	NA		NA	
Social justice	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Low-income households with access to green power	NA	#households	NA	EUR
Households lifted out of energy poverty	NA	#households	NA	EUR

The CO_2-reduction was manually calculated. It is estimated to amount to 24,02 t CO_2/year.

3.2.1.3 Intervention 2: Individual green heat

A geothermal system for green heating and cooling is put in place. As this is a site-level heating system, it falls in the intervention of 'Individual green heat'. From input provided by city of Leuven, assumptions for the KPI's are derived. It is assumed that two heat pumps will be installed (KPI1), delivering a total of 507.076 kWh of heat per year. The resulting co-benefits are shown in Table 3.

Table 3: Results of the co-impact calculation, using the Leuven Impact Framework.

Co-impacts				
Economic	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Job creation - single	0,03	FTE	1.598,34	EUR
Job creation - permanent	0,01	FTE	360,00	EUR/y
Energy independence	0,04	% of residential and tertiary heat demand for Leuven	NA	EUR
Households financially participating in RE projects	Provided by project owner	#households	NA	EUR/y
Health	**Benchmark based on KPI**			

Indicator	Indicator value	Unit	Monetary value	Unit
Improved air quality	cf. ecologic	kg NOx/y	cf. ecologic	EUR/y
Improved air quality	1,74	kg PM10/y	320,46	EUR/y
Improved air quality	2,20	kg PM2.5/y	492,45	EUR/y
Improved air quality	52,55	kg SOx/y	1098,33	EUR/y
Social justice	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Low-income households with acces to green heat (#)	NA		NA	EUR/y
Households with acces to green heat (#)	NA		NA	
Households lifted out of energy poverty	NA		NA	EUR
Ecologic	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Improved air quality	23,85	kg NOx/y	1.299,54	EUR/y
Improved air quality	cf. health	kg PM10/y	cf. health	EUR/y
Improved air quality	cf. health	kg PM2.5/y	cf. health	EUR/y
Improved air quality	cf. health	kg SOx/y	cf. health	EUR/y

The CO_2-reduction of this intervention is manually calculated to be 102,43 t CO_2/y.

3.2.1.4 Intervention 3: Renovation of non-residential buildings

Only the garage building with a gross floor area of ca. 855 m² (KPI1) is assumed to be energetically renovated. This building is currently not (or very little) climatized, therefore the reduction in heat demand is set to 0 kWh/y (KPI2), which causes some of the co-benefits to be set at zero. Similarly, no CO_2-reduction is expected. An increase in (scope 1 and 2) CO_2-emissions is avoided if the new heating system is fossil free and is powered by green electricity, which is assumed to be the case. The resulting co-benefits are shown in Table 4.

Table 4: Results of the co-impact calculation, using the Leuven Impact Framework.

Co-impacts				
Economic	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Job creation - single	5,10	FTE	255.150,00	EUR
Worker productivity gains	NA		NA	
Rainwater harvest	129,28	m³/y	608,99	EUR/y
Health	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**

Improved air quality	cf. ecologic	kg NOx/y	cf. ecologic	EUR/y
Improved air quality	0,00	kg PM10/y	0,00	EUR/y
Improved air quality	0,00	kg PM2.5/y	0,00	EUR/y
Improved air quality	0,00	kg SOx/y	0,00	EUR/y
Improved health through better working or learning conditions	NA		NA	
Ecologic	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Improved air quality	0,00	kg NOx/y	0,00	EUR/y
Improved air quality	cf. health	kg PM10/y	cf. health	EUR/y
Improved air quality	cf. health	kg PM2.5/y	cf. health	EUR/y
Improved air quality	cf. health	kg SOx/y	cf. health	EUR/y

3.2.1.5 Intervention 4: Relighting

A relighting of the museum is under investigation. The total gross floor area that is subject to relighting is (roughly) estimated to be 5.000 m². (KPI1) This number can be refined easily in the tool when more information becomes available. Currently, only two indicators are calculated for this intervention. Benchmarks for worker productivity gains that are by default used in the tool are applicable only for office buildings. Actual productivity gains in a museum context are expected to be very small in comparison. A 95%-reduction was used. These results are shown in Table 5.

Table 5: Results of the co-impact calculation, using the Leuven Impact Framework.

Co-impacts				
Economic	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Job creation - single	6,46	FTE	322.917,31	EUR
Worker productivity gains	0,89	FTE/y	44.642,86	EUR/y

3.2.2 Project 2: Iedereen Mobiel

3.2.2.1 Project scope

The City of Leuven is considering providing bicycles at a discounted rate to vulnerable groups, aiming to encourage cycling and thereby address mobility poverty.

3.2.2.2 Intervention 1: Affordable bikes

In 2029, this initiative could reach 189 users (KPI1), of whom 90% would be part of a vulnerable group, experiencing mobility poverty. Based on this input, the co-benefits are given in Table 6. Generally, this initiative is expected to mobilize people who are currently not very mobile. Therefore, no avoided motorized km are assumed, implicating no impact of this intervention on air quality and CO_2 emissions. This is a conservative assumption.

Table 6: Results of the co-impact calculation, using the Leuven Impact Framework.

Co-impacts				
Health	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Mental & Physical health gain due to extra exercise	174.059,55	EUR/y	174.059,55	EUR/y
Social justice	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Number of people in mobility poverty reached	170,10	People	NA	EUR
Number of additional sustainable km by people in mobility poverty	96.106,50	km/y	NA	EUR/y

3.2.3 Projects 3 & 4: Meunierstraat & Spaanse Kroon

3.2.3.1 A new calculation approach for Nature-based solutions

In the initial version of the impact framework, several publicly available tools were explored to calculate co-benefits related to nature-based solutions, such as the ‘Nature Value Explorer’ developed by VITO. [3] Although documentation on the use of these tools was prepared, the calculations were not integrated within the framework itself. Consequently, automatic calculation of co-benefits for projects involving nature-based solutions was not possible.

This work aimed to incorporate the calculation of co-benefits within the Excel tool wherever possible. However, the previous methodology, which utilized only one KPI per project and no other inputs, lacked the necessary flexibility to internalize these complex external tools. For example, in the intervention "Additional Trees," simply specifying the number of trees would be inadequate. External tools indicated that tree size is also a crucial input. Therefore, the Excel tool was revised to include two KPIs per project and additional inputs for certain interventions:

- For the intervention ‘Additional Trees,’ the KPI is the number of trees, and tree size has been added as an additional input (three options: small, medium, large, with indications of the corresponding crown sizes).
- For the intervention ‘Depaving and Greening,’ the KPI is the area, and a type of green input has been added (low, medium, high quality, with descriptions of the vegetation in each category).

These additional inputs are optional, but provide greater depth to the calculations. Implementing this approach necessitated substantial modifications to the Excel tool, transitioning it from a formula-based operation to one utilizing macros.

Following the required structural changes to the Excel tool, empirical formulas were constructed for as many indicators as possible, based on benchmark results from two case studies: Meunierstraat and Spaanse Kroon. These formulas where thereafter incorporated in the Excel to automate the following indicators:

- Intervention 'Depaving & greening':
    - Additional water infiltration and rainwater buffering (m^3/y) – including monetary value
        - Note: this indicator also reflects avoided costs due to flooding and drought
    - Improved local air quality (kg PM10/y) – including monetary value
    - Mental & physical health gain due to contact with green – including monetary value
        - This indicator was not automated through empirical formulas, but based on literature. The methodology is described in the indicator list in the Excel-tool.
    - Improvements in the Shannon-Weaver index – no monetary value
        - Any value higher than zero reflects an improvement when compared to a situation without urban green.
- Intervention 'Additional trees':
    - Additional water infiltration and rainwater buffering (m^3/y) – including monetary value
        - Note: this indicator also reflects avoided costs due to flooding and drought
    - Improved local air quality (kg PM10/y) – including monetary value
    - Lower heat stress during heat waves (°C) – including monetary value

Following indicators could not (yet) be automated, due to various reasons:

- Intervention 'Depaving & greening':
    - Value increase of nearby homes (EUR) – results between both external tools (Nature Value Explorer [3] and EcoPlan QuickScan Tool [4]) differed widely, so no reliable benchmarks could be derived
- Intervention 'Additional trees':
    - Local food production (kg/y) – some benchmarks for different types of vegetation or land use are available and listed in the tool. This indicator was not relevant in the two cases that were investigated. Therefore no general automated calculation method has been constructed. Making this fully automatic is expected to be complicated, requiring multiple additional inputs.

For these indicators within Nature-based solutions, numbers must be provided by project owners.

The cases and results are detailed below.

3.2.3.2 Projects scope

Both Meunierstraat and Spaanse Kroon are projects where a significant section of public domain in the urban center of Leuven is renewed, including substantial depaving and planting of additional trees. By calculating depaving and additional trees separately, some additional insight is provided on the effectivity of both interventions.

3.2.3.3 Intervention 1: Depaving & greening

The co-benefits of depaving and greening for Meunierstraat and Spaanse Kroon are presented in Table 7 and Table 8 respectively.

Table 7: Results of the co-impact calculation for Meunierstraat (depaving), using the Leuven Impact Framework.

Co-impacts				
Economic	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Job creation - single	Provided by project owner	FTE	Provided by project owner	EUR
Job creation - permanent	Provided by project owner	FTE	Provided by project owner	EUR/y
Additional water infiltration and rainwater buffering	2.037,45	m³/y	1.083,92	EUR/y
Improved local air quality	4,62	kg PM10/y	412,73	EUR/y
Value increase of nearby homes	Provided by project owner	% increase	Provided by project owner	EUR
Health	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Mental & Physical health gain due to contact with green	0,17	DALY/y	17.848,90	EUR/y
Additional households for which 3-30-300 rule applies	Provided by project owner	#households	Provided by project owner	EUR
Social justice	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Public space projects in low-income neighbourhoods	Provided by project owner	m²	NA	EUR
Ecologic	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Improvements in the Shannon-Weaver Index for biodiversity	1,06		NA	EUR/y

Table 8: Results of the co-impact calculation for Spaanse Kroon (depaving), using the Leuven Impact Framework.

Co-impacts				
Economic	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Job creation - single	Provided by project owner	FTE	Provided by project owner	EUR
Job creation - permanent	Provided by project owner	FTE	Provided by project owner	EUR/y

Additional water infiltration and rainwater buffering	3.489,75	m³/y	1.856,55	EUR/y
Improved local air quality	3,82	kg PM10/y	341,87	EUR/y
Value increase of nearby homes	Provided by project owner	% increase	Provided by project owner	EUR
Health	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Improved local air quality	7,90	kg PM10/y	706,17	EUR/y
Mental & Physical health gain due to contact with green	0,27	DALY/y	27.621,95	EUR/y
Additional households for which 3-30-300 rule applies	Provided by project owner	#households	Provided by project owner	EUR
Social justice	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Public space projects in low-income neighbourhoods	Provided by project owner	m²	NA	EUR
Ecologic	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Improvements in the Shannon-Weaver Index for biodiversity	0,52		NA	EUR/y

3.2.3.4 Intervention 2: Additional trees

The co-benefits of the additional trees for Meunierstraat and Spaanse Kroon are presented in Table 9 and Table 10 respectively.

Table 9: Results of the co-impact calculation for Meunierstraat (additional trees), using the Leuven Impact Framework.

Co-impacts				
Economic	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Job creation - single	0,48	FTE	24.200,00	EUR
Job creation - permanent	0,11	FTE	5.397,73	EUR/y
Local food production	Provided by project owner	kg/y	Provided by project owner	EUR/y
Additional water infiltration and rainwater buffering	1.097,80	m³/y	584,03	EUR/y
Health	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Improved local air quality	3,13	kg PM10/y	279,96	EUR/y
Lower heat stress during heatwaves	0,76	°C decrease	5.444,24	EUR/y

Additional households for which 3-30-300 rule applies	Provided by project owner	#households	Provided by project owner	EUR
Social justice	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Public space projects in low-income neighbourhoods	Provided by project owner	m²	NA	EUR

Table 10: Results of the co-impact calculation for Spaanse Kroon (additional trees), using the Leuven Impact Framework.

Co-impacts				
Economic	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Job creation - single	0,92	FTE	46.200,00	EUR
Job creation - permanent	0,15	FTE	7.670,45	EUR/y
Local food production	Provided by project owner	kg/y	Provided by project owner	EUR/y
Additional water infiltration and rainwater buffering	1.646,70	m³/y	876,04	EUR/y
Health	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Improved local air quality	4,04	kg PM10/y	360,86	EUR/y
Lower heat stress during heatwaves	0,58	°C decrease	4.140,16	EUR/y
Additional households for which 3-30-300 rule applies	Provided by project owner	#households	Provided by project owner	EUR
Social justice	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Public space projects in low-income neighbourhoods	Provided by project owner	m²	NA	EUR

3.2.4 Project 5: Materialenbank

3.2.4.1 Project scope

Materialenbank is a successful reuse hub, promoting the circular economy in Leuven. Currently specializing in building materials, Materialenbank is in the scale-up phase to achieve higher annual volumes.

3.2.4.2 Intervention 1: Reuse

In the future an annual throughput of 5.000 tonnes of construction materials is envisioned. This is the value that is used for KPI1. Results are shown in Table 11.

Table 11: Results of the co-impact calculation, using the Leuven Impact Framework.

Co-impacts				
Economic	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Job creation - permanent	22,50	FTE	1.125.000,00	EUR/y
Social justice	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Local jobs without higher education - permanent	10,38	FTE	NA	EUR/y
Ecologic	**Benchmark based on KPI**			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Hazardous waste avoided	-	Tonnes/y	-	EUR/y
Non-hazardous waste avoided	3.048,65	Tonnes/y	NA	EUR/y
Improved air quality	14.125,82	kg NOx/y	110.549,88	EUR/y
Improved air quality	3.262,53	kg PM2,5/y	244,18	EUR/y
Improved air quality	8.326,05	kg SOx/y	33.304,21	EUR/y

4 Implementation of results in the Impact Framework

During the calculation process of the above co-benefits, new calculation methods were developed and implemented in the Excel-tool. The structural changes to encompass two KPI's and some additional inputs were also made. In this section, a brief overview of the two main sections of the tool are given, i.e. the project template and the indicator list.

4.1 Project template

The project template that is used to calculate the co-benefits of a climate project, is illustrated in Figure 3. First, a project title can be filled in. Below, the classification is done, using three dropdown menus for Emission domains, Levers and Interventions. Some financial highlights can be filled in, but this is for dashboarding purposes only, they are (currently) not used in the calculations. Below the financial highlights, the primary and secondary KPI are prompted. The primary KPI is always mandatory, the secondary KPI is only mandatory for projects within Mobility & Transport. When additional inputs can be used in the calculation, they are prompted in the section below the KPI's. These are not mandatory.

Currently, the CO_2-reduction must be filled in manually, as this is not the focus of the framework. However, making this calculation automatic is well feasible and a valuable next step (see below).

Finally, the co-benefits are calculated. In the first section, the automatic benchmarks and the corresponding monetary value are shown where available. They are subdivided per category of co-benefits. In some cases, the value cannot be calculated automatically and must be provided by the project owner.

In case better values are available, based on more detailed calculations, there is room for benchmark overrides in the yellow cells to the right.

The final four columns allow to report actual ex post values based on monitoring when the project is executed. This may be valuable to check against the first benchmarks. This section can be copied and pasted horizontally to report values of multiple years.

Project title		
Project classification		
Emission domain	Energy systems	
Lever	Green heat	
Intervention	Collective large-scale green heat	
Financial highlights		
CAPEX		EUR
OPEX		EUR/y
Direct returns		EUR/y
Primary KPI		
#district heating connections	50,00	
Secondary KPI		
kWh delivered	500.000,00	*Indien niet gekend: 0 invullen*
Additional inputs		
Project impact		
CO2-reduction		
	t CO2/y	

Co-impacts

Economic	Benchmark based on KPI				Provided prognosis by project owner/Manual calculation (Benchmark override)					Reported data - year x			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**	**Indicator value**	**Unit**	**Monetary value**	**Unit**	**Remarks/Methodology**	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Job creation - single	0,49	FTE	24.428,57	EUR									
Job creation - permanent	0,11	FTE	5.267,86	EUR/y									
Energy independence	37,59	% of residential	NA	EUR									
Households financially participating in RE projects	Provided by project owner	#households	NA	EUR									
Health	Benchmark based on KPI				Provided projected value/Manual calculation (Benchmark override)					Reported data - year x			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**	**Indicator value**	**Unit**	**Monetary value**	**Unit**	**Remarks/Methodology**	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Improved air quality	cf. ecologic	kg NOx/y	cf. ecologic	EUR/y									
Improved air quality	1,54	kg PM10/y	284,09	EUR/y									
Improved air quality	2,15	kg PM2.5/y	454,00	EUR/y									
Improved air quality	48,07	kg SOx/y	1.004,60	EUR/y									
Social justice	Benchmark based on KPI				Provided projected value/Manual calculation (Benchmark override)					Reported data - year x			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**	**Indicator value**	**Unit**	**Monetary value**	**Unit**	**Remarks/Methodology**	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Low-income households with acces to green heat (#)	Provided by project owner		NA	EUR									
Households with acces to green heat (#)	50,00	#households	NA	EUR									
Ecologic	Benchmark based on KPI				Provided projected value/Manual calculation (Benchmark override)					Reported data - year x			
Indicator	**Indicator value**	**Unit**	**Monetary value**	**Unit**	**Indicator value**	**Unit**	**Monetary value**	**Unit**	**Remarks/Methodology**	**Indicator value**	**Unit**	**Monetary value**	**Unit**
Improved air quality	28,60	kg NOx/y	1.272,28	EUR/y									
Improved air quality	cf. health	kg PM10/y	cf. health	EUR/y									
Improved air quality	cf. health	kg PM2.5/y	cf. health	EUR/y									
Improved air quality	cf. health	kg SOx/y	cf. health	EUR/y									

Figure 3: Project Template in the Leuven Impact Framework

4.2 Indicator list

The indicator list contains the classification information for every indicator, as well as the units and all necessary information to calculate the value based on the KPIs and additional inputs. This is represented by the two formula columns 'Formula1' (indicator value) and 'Formula2' (monetary value). At the end of each row, the calculation method is explained with sufficient detail, including all used sources and assumptions.

The current structure of the tool allows the user to add or remove indicators in this list, as long as the same structure is followed.

Emission domain	Lever	Intervention	Primary KPI	Secondary KPI	Impact category	Indicator	Unit	Benchmark calculation type	Formule 1	Formule 2	Yearly/one time	Calculation Method based on KPI	Sources & assumptions
Energy systems	Upscaling the share of renewable electrici	Upscaling of PV	m² PV	kWh produced year	Economic	Job creation - single	FTE	Direct calculation	KPI1*1.004/750	KPI1*1.004/750*50000	One time	750 m² PV creates jobs equal to 1,004 FTE (according to Sovacool et al.) calculation with 50.000 EUR/FTE (4076 Gross salary per month in BE - statbel) 92% could be locally when the deployment of solar PV is done by a local company	1. Sovacool, B. K., Evensen, D., Kwan, T. A., & Petit, V. (2023). Building a green future: Examining the job creation potential of electricity, heating, and storage in low-carbon buildings. The Electricity Journal, 36(5), 107274. 2. EU Solar Jobs Report 2023 3. https://statbel.fgov.be/en/themes/work-training/wages-and-labourcost/overview-belgian-wages-and-salaries#:~:text=The%20average%20gross%20monthly%20salary%20is%204%2C076%20euros&text=In%202022%2C%20full%2Dtime%20employees,among%20more%20than%20184%2C000%20employees.
Energy systems	Upscaling the share of renewable electrici	Upscaling of PV	m² PV	kWh produced year	Economic	Job creation - permane	FTE	Direct calculation	KPI1*1/50000	KPI1*1/50000*50000	Yearly	PV maintenance is strongly limited. A technical review and cleaning service of the installation every 2 years is assumed. The incremental cost of clean-up per solar panel is reported to be 2 to 5 EUR excl. VAT. Assuming a large scale, a cost of 2 EUR per panel or 1 EUR per m² is used. This corresponds almost exclusively to the salary cost of the maintenance. Assuming a FTE cost of 50.000 EUR, 50.000 m² of PV induces 1 permanent FTE.	1. https://www.zonne-paneel.net/onderhoud-zonnepanelen/
Energy systems	Upscaling the share of renewable electrici	Upscaling of PV	m² PV	kWh produced year	Economic	Energy independence	%	Direct calculation	IF(KPI2<>0,KPI2*1/7	NA	Yearly	According to the Vito Emissie-inventaris for 2022, electricity usage on Leuven territory amounted to 742,040 MWh/y. A well-oriented PV-panel produces around 170 kWh/m².	1. Vito Emissie-inventaris: https://www.vlaanderen.be/lokaal-energie-en-klimaatbeleid/burgemeestersconvenant/co2-inventarissen/co2-inventarissen-2022 2. General numbers on PV performance (Sweco)
Energy systems	Upscaling the share of renewable electrici	Upscaling of PV	m² PV	kWh produced year	Economic	Households financially	#households	Relevance check	KPI1*0.0809	NA	One time	Possible methodology via ECoOB numbers for 2023: 1133 shareholders invested on average 2440 EUR each. The funds where used to finance installations for a total yearly production of 2400 MWh. Using a production of 170 kWh/m² as an average for well-oriented PV-panels, this indicates an installation of ca. 14.000 m². Therefore, 1 m² implies 0,0809 shareholders to participate financially. It is assumed that 1 shareholder represents one household.	1. https://www.ecoob.be/_files/ugd/798c7e_d5976e94317f4782bf839f818812dd2f.pdf 2. General numbers on PV performance (Sweco)
Energy systems	Upscaling the share of renewable electrici	Upscaling of PV	m² PV	kWh produced year	Social justice	Low-income househol	#households	Provided by project owner	Provided by project	NA	One time		
Energy systems	Upscaling the share of renewable electrici	Constructing Wind Turbines	#turbines	kWh produced year	Economic	Job creation - single	FTE	Direct calculation			One time		
Energy systems	Upscaling the share of renewable electrici	Constructing Wind Turbines	#turbines	kWh produced year	Economic	Job creation - permane	FTE	Direct calculation			Yearly		
Energy systems	Upscaling the share of renewable electrici	Constructing Wind Turbines	#turbines	kWh produced year	Economic	Energy independence	%	Direct calculation			Yearly		
Energy systems	Upscaling the share of renewable electrici	Constructing Wind Turbines	#turbines	kWh produced year	Economic	Households financially	#households	Provided by project owner	Provided by project	NA	One time		
Energy systems	Upscaling the share of renewable electrici	Constructing Wind Turbines	#turbines	kWh produced year	Social justice	Low-income househol	#households	Provided by project owner	Provided by project	NA	One time		
Energy systems	Upscaling the share of renewable electrici	Green Power Contracts	#contracts	kWh delivered year	Economic	Job creation - single	FTE	Direct calculation			Yearly		
Energy systems	Upscaling the share of renewable electrici	Green Power Contracts	#contracts	kWh delivered year	Economic	Job creation - permane	FTE	Direct calculation			One time		
Energy systems	Upscaling the share of renewable electrici	Green Power Contracts	#contracts	kWh delivered year	Social justice	Low-income househol	#households	Provided by project owner	Provided by project	NA	One time		
Energy systems	Green heat	Collective large-scale green heat	#district heating cor	kWh delivered year	Economic	Job creation - single	FTE	Direct calculation	KPI1*855*8/700000	KPI1*855*8/700000*50000	One time	According to a Dutch study, an estimated 670 to 1040 FTE's will be needed between 2022 and 2030 for business development and realisation of 700k connections. Using the middle value of 855 FTE's during a period of 8 years, this amounts to 0,0098 FTE/connection.	1. https://www.netbeheernederland.nl/sites/default/files/2024-03/nbnlanalyseswetcollectievewarmtevoorziening.pdf
Energy systems	Green heat	Collective large-scale green heat	#district heating cor	kWh delivered year	Economic	Job creation - permane	FTE	Direct calculation	KPI1*1475/700000	KPI1*1475/700000*50000	Yearly	According to a Dutch study, an estimated 1250 to 1700 FTE's will be needed for overhead and maintenance of 700k connections. Using the middle value of 1475 FTE's, this amounts to 0,0021 FTE/connection.	1. https://www.netbeheernederland.nl/sites/default/files/2024-03/nbnlanalyseswetcollectievewarmtevoorziening.pdf
Energy systems	Green heat	Collective large-scale green heat	#district heating cor	kWh delivered year	Economic	Energy independence	% of resident	Direct calculation	IF(KPI2<>0,KPI2*1*0	NA	One time	Based on numbers by VREG, a current average household consumes 17 MWh/y of gas. (1) Assuming 90% gas boiler efficiency, a total final heat demand of 15,3 MWh/y is assumed. To avoid double counting, it is also assumed that all households have already gone through renovation. Based on the Flemish energy score (2) a procentual reduction in energy demand is calculated, corrected for a rebound effect of 32% (3). The resulting reduction in energy demand is 28,58%. This leads to a final heat demand after renovation of 10,9 MWh/y that will be covered by the district heating network. In a calculation from 2023 where the Vito Emissie-inventaris was used as a basis, a total final heat demand for households was estimated to be 753 GWh/y and tertiary heat demand (for room heating) to be 444 GWh/y. The total final heat demand for Leuven (excl. activities categorized as industrial) is therefore assumed to be ca. 1.197 GWh/y. (4)	1.VNR: https://www.vlaamsenutsregulator.be/nl/energieverbruik#:~:text=Aardgasverbruik,op%20jaarbasis%2011.094%20kWh%20aardgas. 2. https://www.vlaanderen.be/statistiek-vlaanderen/energie/energiescore-van-bestaande-woningen 3. Rebound effect: https://maastrichtrealestate.com/upload/researches/Aydin-et-al_Energy-Efficiency-and-Household-Behavior.pdf 4. Calculation performed in support of the Climate City Contract based on the Vito Emissie-inventaris for Leuven for 2018, internally available within the city administration.
Energy systems	Green heat	Collective large-scale green heat	#district heating cor	kWh delivered year	Economic	Households financially	#households	Provided by project owner	Provided by project	NA	One time		
Energy systems	Green heat	Collective large-scale green heat	#district heating cor	kWh delivered year	Health	Improved air quality	kg NOx/y	cf. ecologic	cf. ecologic	cf. ecologic	Yearly	Based on numbers by VREG, a current average household consumes 17 MWh/y of gas. (1) Assuming 90% gas boiler efficiency, a total final heat demand of 15,3 MWh/y is assumed. To avoid double counting, it is also assumed that all households have already gone through renovation. Based on the Flemish energy score (2) a procentual reduction in energy demand is calculated, corrected for a rebound effect of 32% (3). The resulting reduction in energy demand is 28,58%. This leads to a final heat demand after renovation of 10,9 MWh/y that will be covered by the district heating network. This often requires a heat pump for central or decentral heat production. A SCOP of 4 is assumed. Emissions (direct and indirect) for both gas and electricity are taken into account, based on a study by Dep. Omgeving. This study also reports the equivalent environmental and health costs of these emissions. For the avoided emission due to reduced use of gas, the monetary value for a city environment is used. For the additional electricity consumption, the monetary value for a rural environment is used, assuming electricity production mainly outside of the city. (4)	1.VNR: https://www.vlaamsenutsregulator.be/nl/energieverbruik#:~:text=Aardgasverbruik,op%20jaarbasis%2011.094%20kWh%20aardgas. 2. https://www.vlaanderen.be/statistiek-vlaanderen/energie/energiescore-van-bestaande-woningen 3. Rebound effect: https://maastrichtrealestate.com/upload/researches/Aydin-et-al_Energy-Efficiency-and-Household-Behavior.pdf 4. https://omgeving.vlaanderen.be/sites/default/files/2021-11/2019-Milieuschadekosten-woningverwarming.pdf
Energy systems	Green heat	Collective large-scale green heat	#district heating cor	kWh delivered year	Health	Improved air quality	kg PM10/y	Direct calculation	IF(KPI2<>0,KPI2*((8	IF(KPI2<>0,KPI2*((866/277780	Yearly	Based on numbers by VREG, a current average household consumes 17 MWh/y of gas. (1) Assuming 90% gas boiler efficiency, a total final heat demand of 15,3 MWh/y is assumed. To avoid double counting, it is also assumed that all households have already gone through renovation. Based on the Flemish energy score (2) a procentual reduction in energy demand is calculated, corrected for a rebound effect of 32% (3). The resulting reduction in energy demand is 28,58%. This leads to a final heat demand after renovation of 10,9 MWh/y that will be covered by the district heating network. This often requires a heat pump for central or decentral heat production. A SCOP of 4 is assumed. Emissions (direct and indirect) for both gas and electricity are taken into account, based on a study by Dep. Omgeving. This study also reports the equivalent environmental and health costs of these emissions. For the avoided emission due to reduced use of gas, the monetary value for a city environment is used. For the additional electricity consumption, the monetary value for a rural environment is used, assuming electricity production mainly outside of the city. (4)	1.VNR: https://www.vlaamsenutsregulator.be/nl/energieverbruik#:~:text=Aardgasverbruik,op%20jaarbasis%2011.094%20kWh%20aardgas. 2. https://www.vlaanderen.be/statistiek-vlaanderen/energie/energiescore-van-bestaande-woningen 3. Rebound effect: https://maastrichtrealestate.com/upload/researches/Aydin-et-al_Energy-Efficiency-and-Household-Behavior.pdf 4. https://omgeving.vlaanderen.be/sites/default/files/2021-11/2019-Milieuschadekosten-woningverwarming.pdf

5 Conclusion & Next steps

In this work, the Leuven Impact Framework was developed from an early stage version to a solid version 1.0, which can be used reliably to benchmark co-impacts of climate projects in Leuven.

Through five practical cases, the Leuven Impact Framework was elaborated to encompass calculation methods for co-benefits within 8 different interventions, spanning all five emission domains. This approach ensures that the calculation methods are grounded in realistic cases and are usable via very simple and easily attainable project KPI's and inputs. The developed template allows for quick benchmarking, while the comprehensive indicator list transparently reports on calculation methods and can be used as a starting point for more in-depth analyses.

This work continued to expand on the first version that was built in 2024. Some very interesting next steps are identified to further elaborate the impact framework, and make it more robust and user-friendly:

1. Filling the gaps in the indicator list: some indicators still lack calculation methods, as they were not present in the five analyzed breakthrough projects. These gaps can be gradually filled in future work.
2. Identifying additional co-benefits, especially within *social justice*, will provide a more comprehensive overview of co-benefits that come along with the climate transition.
3. Automation of the CO_2-calculations based on the KPI's seems feasible, as benchmarks are readily available. As the focus currently lies on *co*-benefits of climate project, whereas CO_2-reduction is considered the main goal, this automation is not yet in place.
4. By using the same project template for every project, dashboarding is possible in external tools like Power BI. A dashboard in Excel itself is also a valid option as a first step. The dashboard can be used to quickly show the full societal impact of (a selection of projects from) the climate portfolio.
5. Currently, when a project entails multiple interventions, one Excel tab per intervention is used. In a future version of the framework, this could be done more elegantly in one template per project, even when it covers multiple interventions. This, however, may require a more extensive reworking of the current template.
6. The use of "Additional inputs" on top of the primary and secondary project KPI's, allows for much more flexibility and detail in the calculations. For instance, in the calculations for renovation, an additional input could be the renovation level, allowing to differentiate the benchmarks

accordingly. Using this new feature in other emission domains than just nature-based solutions, is an interesting next step.

Concerning the *governance* of the Impact Framework, it is crucial to identify a clear responsible within Leuven 2030 who can coordinate future updates, gathering and benchmarking of projects, dashboarding efforts,… This person should have sufficient time and resources to get well acquainted with the framework, as such ensuring correct use (e.g. avoiding double counting). To allow for more efficient use, it is possible to organize the process in, for instance, yearly routines of gathering projects, performing the calculations, evaluating the results to assess possible gaps or improvements in the framework and to allow for targeted reworkings.

6 Bibliography

[1] Fraunhofer-Gesellschaft, „Welcome to MICAT's documentation!," 1 May 2025. [Online]. Available: https://doc.micatool.eu/.

[2] MIRA, „Milieuschadekosten van verschillende technologieën voor woningverwarming," Departmenent Omgeving, Vlaamse Overheid, Brussels, 2019.

[3] VITO, „Nature Value Explorer," [Online]. Available: https://www.natuurwaardeverkenner.be/. [Geopend May 1 2025].

[4] U. o. Antwerp, „ECOPLAN quickscan (finaal)," [Online]. Available: https://www.uantwerpen.be/nl/onderzoeksgroep/ecoplan/ecoplan-tools/ecoplan-quickscan--f/. [Geopend 1 May 2025].

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