

# Specific Environmentally-conscious Targets for Urban Planning (SETUP)

## A method for informing the decision-making process

Emilie Nault<sup>1\*</sup>, Thomas Jusselme<sup>1</sup>

### CONTEXT, MOTIVATION, OBJECTIVES

Early design phase



With increasing awareness around climate change and humans' ecological impact, further improvements are necessary to **minimize the environmental footprint our buildings have over their whole life**, from the construction to the operational phase and beyond.

In this context, various **building labels and norms** are setting evermore-ambitious **primary energy and greenhouse gas emissions targets**. In parallel, a growing number of **digital performance evaluation tools** integrate a **life-cycle assessment** and allow verifying if a project, based on its description, reaches these targets. However, such instruments are still largely left out of the **urban planning and design stages**, characterized by the ill-defined status of the project and the exploration and comparative assessment of multiple possible solutions.

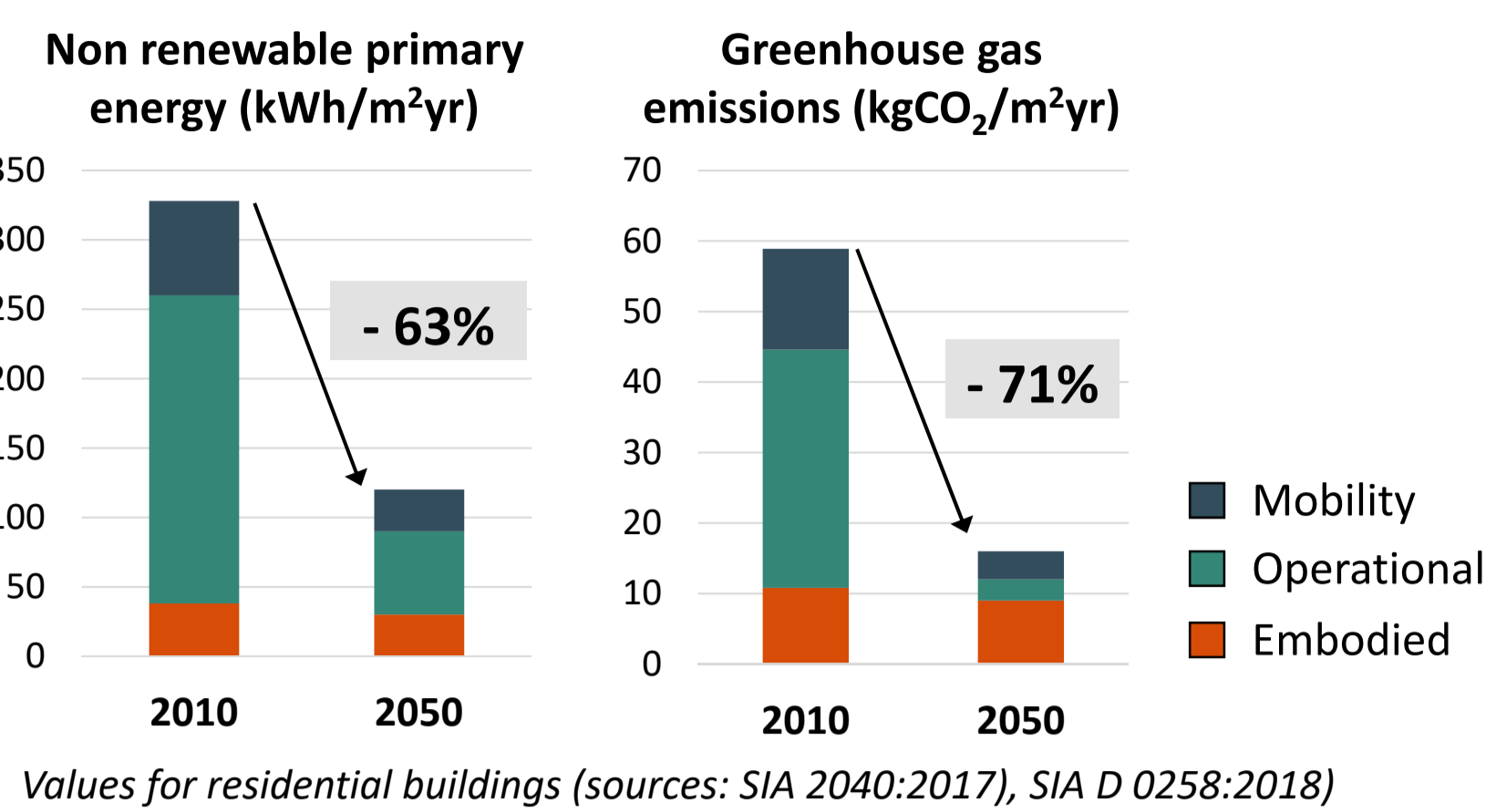
Confronted to those conditions, existing tools often fall short given their **limited guidance and inadequacy** in dealing with the **scarce amount of available information**. We specifically observe a **lack of tools** that can allow **converting a performance objective set at the urban level** (e.g. 2000W society targets) into **specific sublevel targets** (e.g. per building or component), while taking into account the **site's characteristics** (e.g. climatic context).

*"[...] target values cannot be reached for each building. Some initial situations exclude or greatly complicate the achievement of the objectives."* (SIA D 0236:2011)

Absence of detailed project information

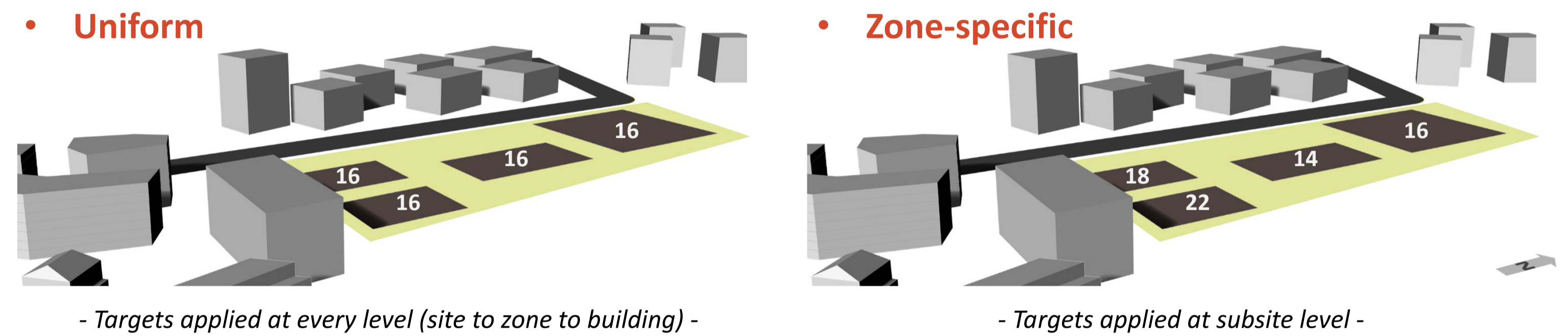
Diversity of possible scenarios and performance levels

The **SETUP project** aims to address these issues within the Swiss context through **collaboration with practitioners** having complementary roles in a district project aiming to be low-carbon. The goal is to elaborate a **novel method for enabling decision-makers to integrate environmental performance considerations from the masterplanning stage**, and to implement it into a **prototype decision-support tool** tailored to the site under study (blueFactory, Fribourg).



*"There are labels and objectives, but nothing that says **how to achieve them before the end of the project's realization phase**. I see the utility of a tool at the **very beginning** of the project, to figure out how to design my project so that it can fulfil a given label."* (project industrial partner)

**Towards a zone-specific (contextualised) approach to defining performance objectives**  
- given a performance objective set at **site level** of 16 kgCO<sub>2</sub>/m²·yr (SIA 2040:2017) -



### METHOD, WORKFLOW

#### 1 Division of site in zones presenting different conditions

- Solar exposure level
- Limit in constructible building height
- Factors affecting mobility impact (SIA 2039:2016)
- ...

#### 2 Definition of variable and fixed parameters

- Variable parameters: building shape, depth, height; built context, glazing ratio and type, U-value, PV roof ratio, HVAC system, insulation material, ...

#### 3 Documentation of impacts and simulation hypotheses

- Factors related to embodied, operational, and mobility impacts (sources: KBOB database:2016, SIA 2032:2010)

#### 4 Definition of scenarios

- Sobol sampling method for defining scenarios to evaluate (combination of variable parameter values)

#### 5 Application to each zone

- Parametric modeling and dynamic energy simulation
- Evaluation of performance: (non-renewable) primary energy and greenhouse gas emissions

#### 6 Data processing and analyses

- Differentiated impact targets at different sub-levels (e.g. per zone, per component)
- Sensitivity of performance indicators to different variable design parameters
- Feasibility of achieving given performance targets
- Impact of design parameters on performance indicators

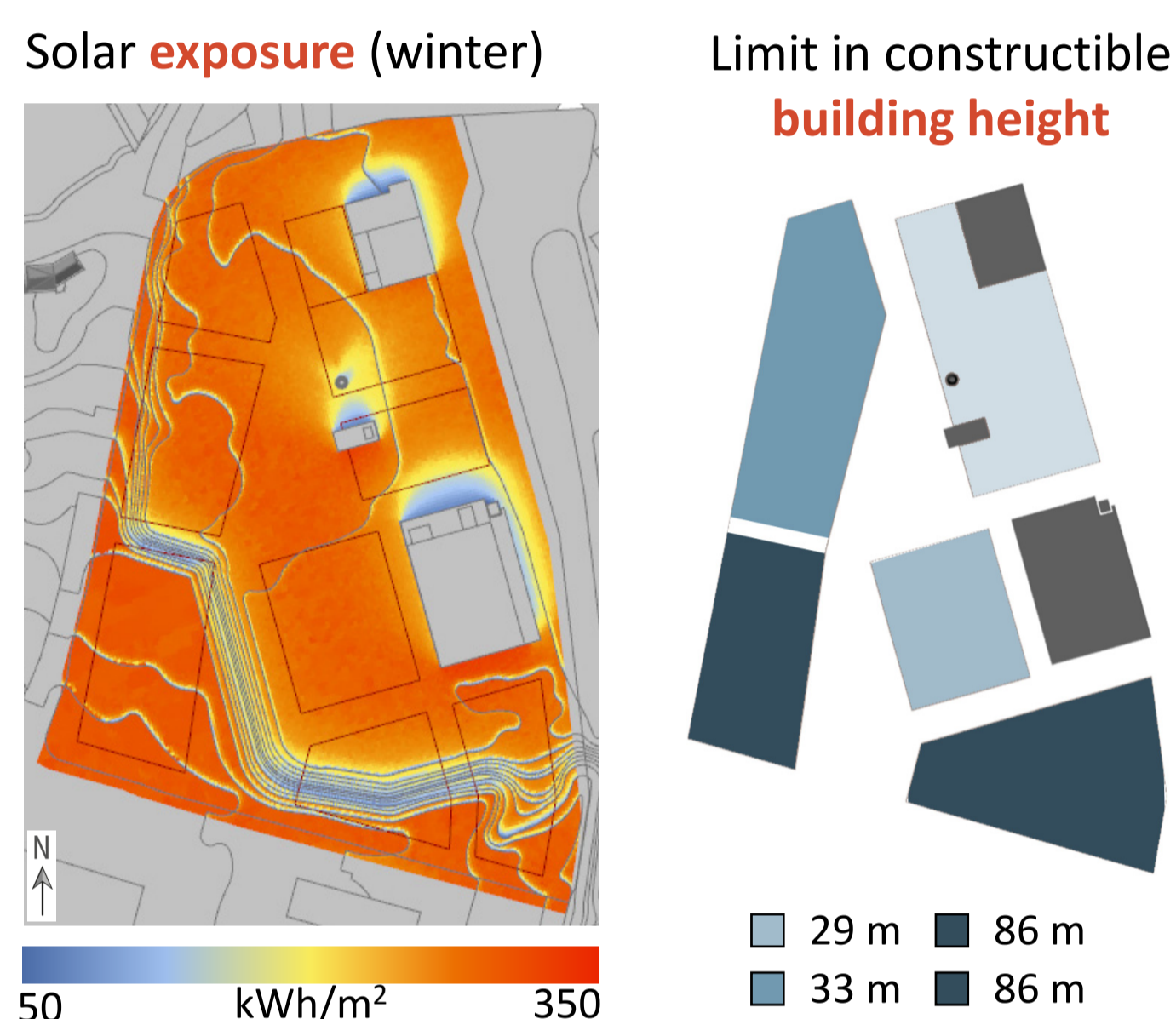
### MAIN OUTCOMES

By interacting with the databases of scenarios and exploring the results of the various analyses through an Excel-based interface and dedicated web-based viewer, practitioners can identify the **most influential parameters** for each zone of the site, and anticipate the share that a given design choice might take up in the total carbon budget set for each zone. A feasibility assessment will indicate the difficulty in reaching a given site- or zone-level target. Such information can guide them toward **choices that do not constrain the design freedom for downstream parameters, or compromise the potential of the district for reaching its objectives**.

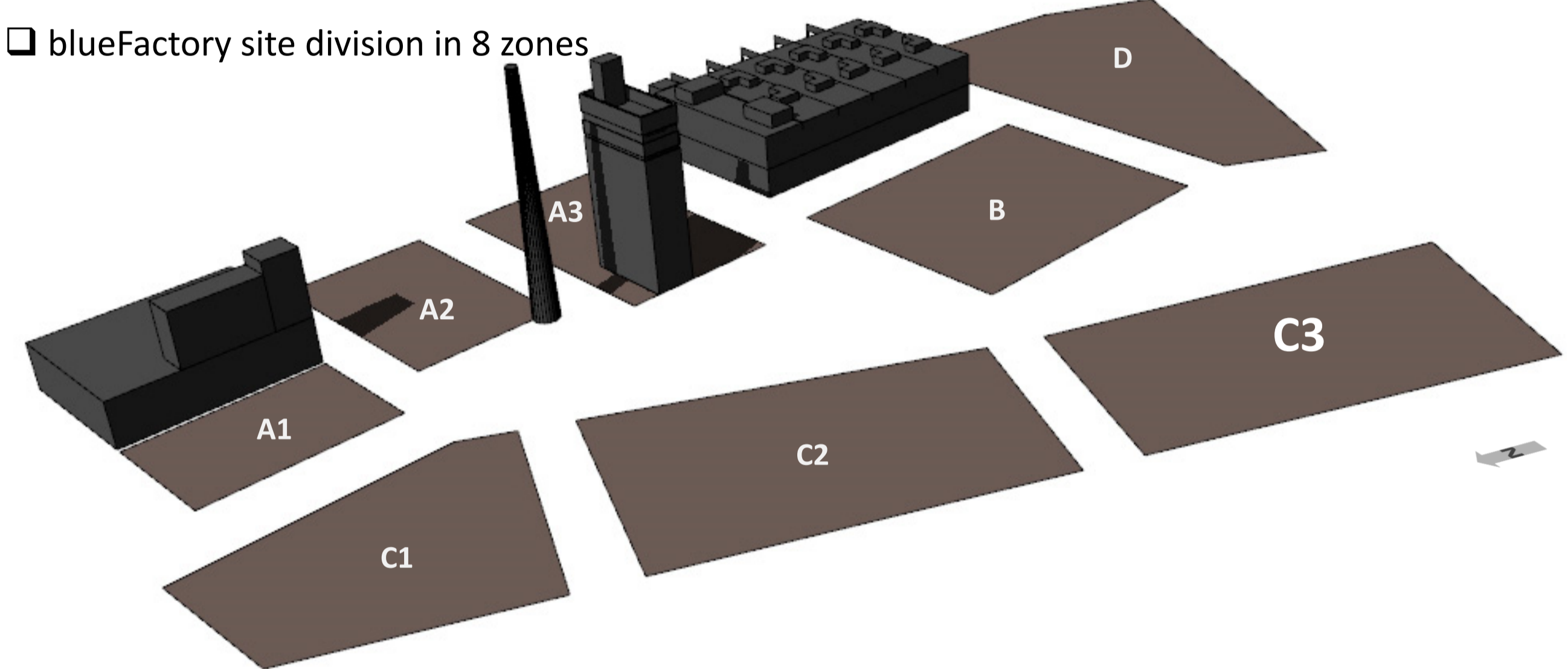
This research and development project highlights how the use of digital tools to produce, analyse and visualise data can contribute to informing decision-making and fostering **collaboration and communication** among complementary key stakeholders.

### CASE STUDY APPLICATION, RESULTS

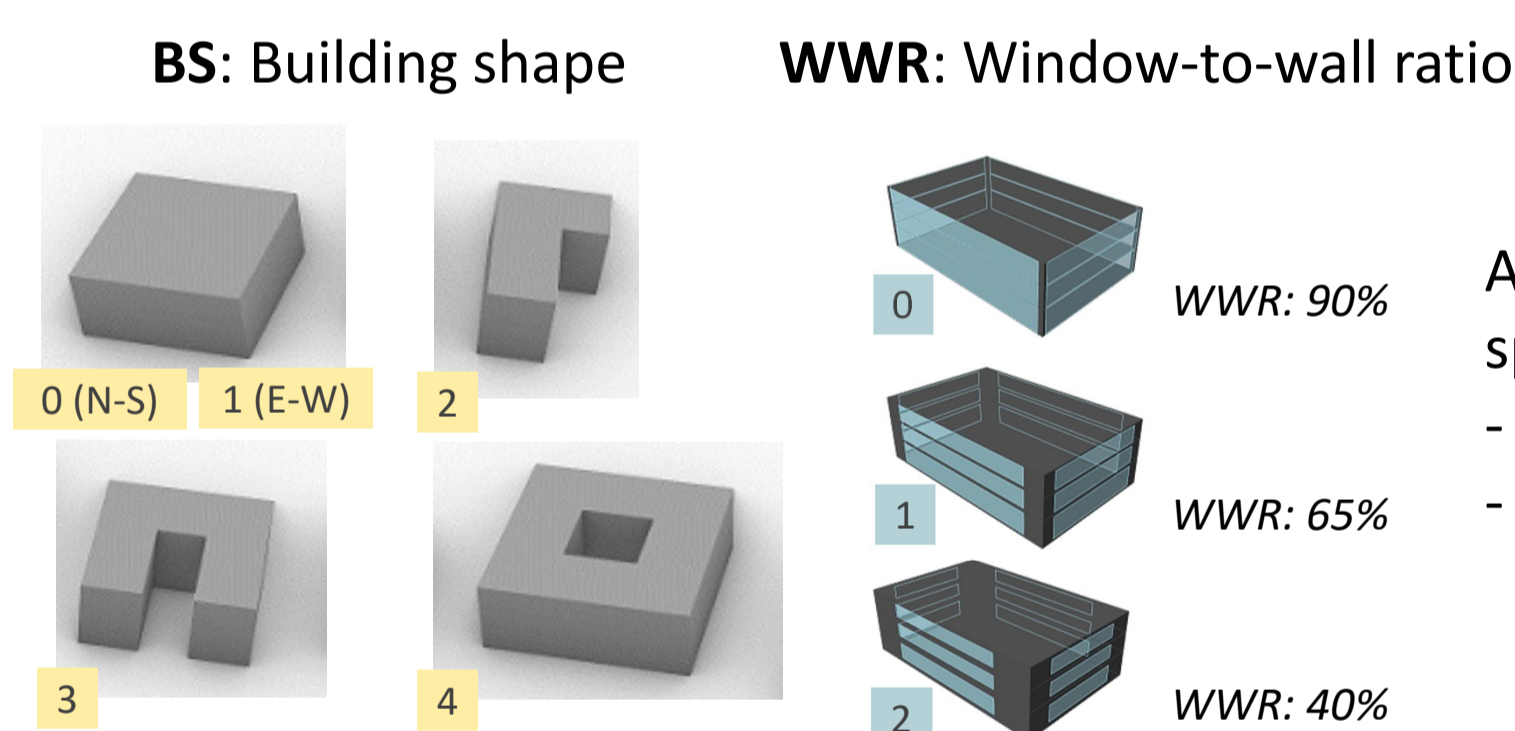
Analysis of the **different conditions** over the site



blueFactory site division in 8 zones



Example of predefined **values per parameter**



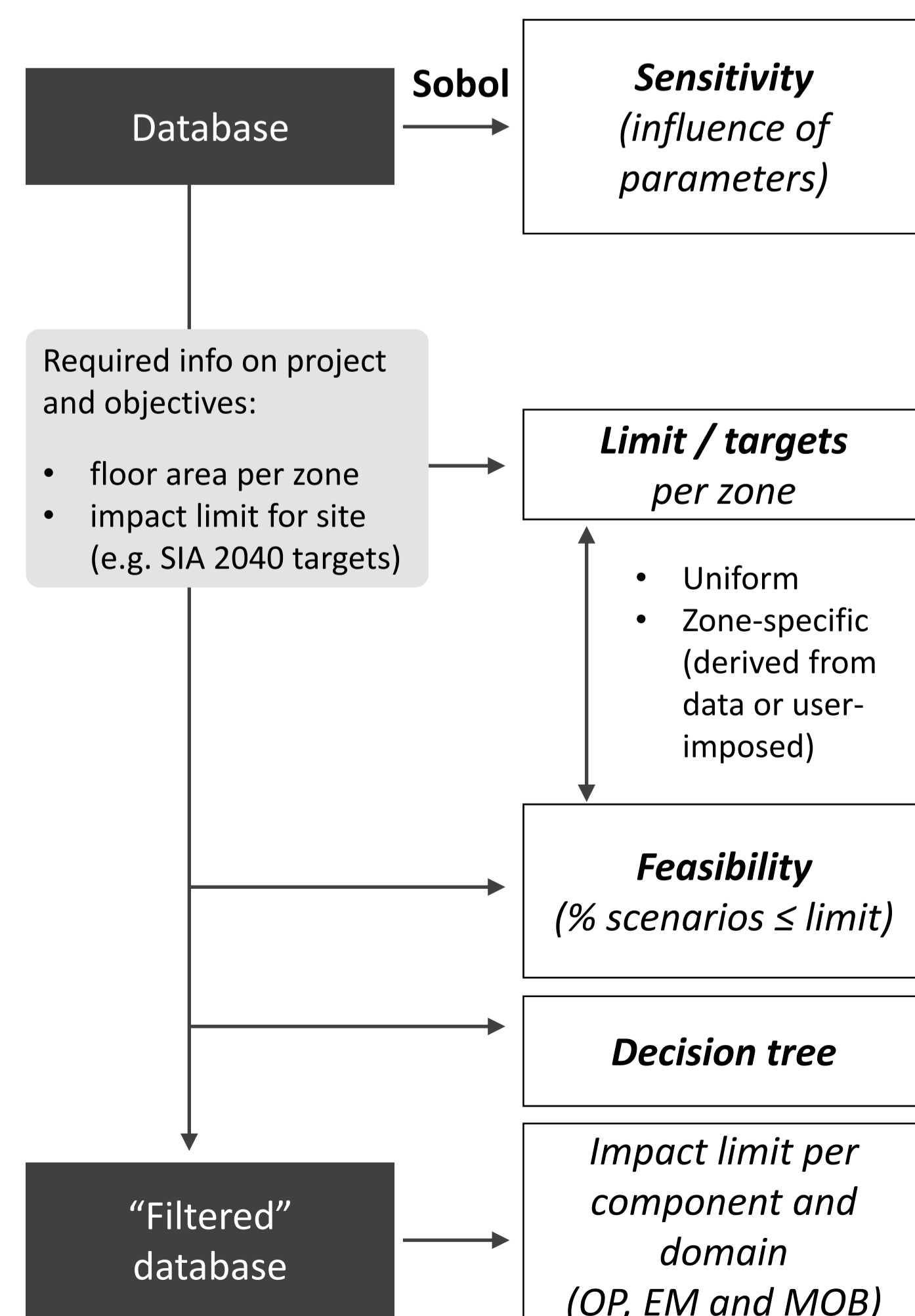
Application to specific case study - blueFactory site - Zone C3

"n" possible scenarios based on **Sobol matrix combination** according to predefined range of values per parameter

ID	BS	BD	BH	CONT	WWR	WIN	FRA	U	PV	HVAC	VENT	HOREL	VEREL	INS	COVS	COVW	BAL
1	1	0	1	1	1	2	0	2	2	0	0	1	1	2	1	0	0
2	3	0	1	1	2	2	0	2	2	0	0	1	1	2	1	0	0
3	1	1	1	1	1	2	0	2	2	0	0	1	1	2	1	0	0
...	...																
n	...																

- BS: Building shape
- BD: Building depth
- BH: Building height
- CONT: Built context
- WWR: Window-to-wall ratio
- WIN: Glazing type
- FRA: Frame type
- U: Thermal transmittance
- PV: PV roof ratio
- HVAC: Heating system
- VENT: Ventilation type
- HOREL: Construction horizontal elements
- VEREL: Construction vertical elements
- INS: Insulation type
- COVS: Covering material slab
- COVW: Covering material walls
- BAL: Balcony

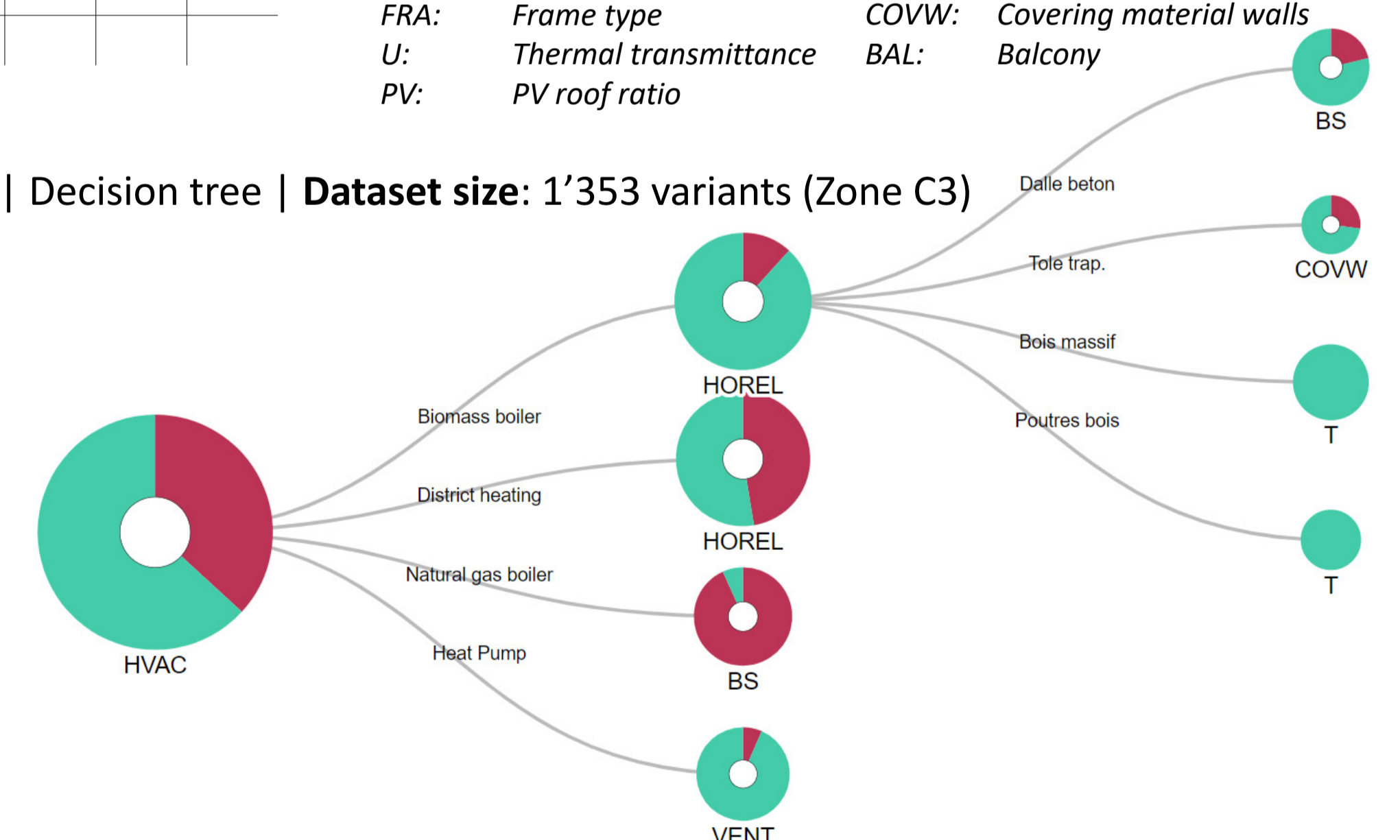
Analysis workflow



Results exploration | Decision tree | Dataset size: 1'353 variants (Zone C3)

Target method: **Uniform**

Target Feasibility:  
True (T): 63%  
False (F): 37%



Global Warming Potential (GWP) impact limit per component to achieve 2'000-watt society target

