Deliverable D3.1: Step-WISE Toolkit

Public Document

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Contents

Acronyms

CETP	Clean Energy Transition Plan
SEAP	Sustainable Energy Action Plan
SECAP	Sustainable Energy and Climate Action Plan
NECP	National Energy and Climate Plan
LRA	Local and Regional Authority
iCD	intelligent Community Design - A Sketch-up plug-in tool by IES for energy and carbon assessments for portfolios, campuses and cities
iCIM	intelligent Community Information Model - An online 3D Collaboration and Visualization Platform by IES
iVN	intelligent Virtual Network - A Network Modelling desktop tool by IES
iSCAN	An online data management platform by IES
VE	Virtual Environment - IES' key software using advanced building-physics based engine to model and simulate building performance
PV	Photovoltaic
EV	Electrical Vehicle
U-Value	Thermal transmittance for a building fabric
BMS	Building Management Systems
OSM	Open Street Maps
GIS	A GIS (file) is a digital file used to store geographic information system (GIS) data, which includes spatial and attribute data for mapping and spatial analysis
SHP	Shapefiles

Executive Summary

The Step-WISE project aims to advance decarbonization efforts through its comprehensive capacity-building program. A key component of this initiative is the development of a technical toolkit designed to support the creation of effective Clean Energy Transition (CET) plans, such as Sustainable Energy and Climate Action Plans (SECAPs).

The comprehensive Step-WISE toolkit consists of the knowledge sharing platform, the training materials developed as part of the Step-WISE program, and the set of technological tools, referred as the **Step-WISE technical toolkit**. The present public deliverable **D3.1 Step-WISE Toolkit** presents the technical toolkit, and the findings from recent workshops and the resulting refinements to the Technical Toolkit. The primary objective of the workshops was to understand the needs of CET planners and to refine the toolkit to better address these needs. Through detailed discussions with partners involved in CET planning, the workshops explored the user journey of CET planners, identifying specific pain points and requirements. This involved mapping the CET planning process against the capabilities of the toolkit to ensure it meets user expectations effectively.

Key findings:

- Data Baseline Challenges: Establishing a comprehensive baseline of energy use and emissions remains a significant challenge due to incomplete or unavailable data. The toolkit addresses this by providing pre-filled data templates and physics-based simulations to create accurate baselines.
- Target Setting and Scenario Modelling: Setting clear emission reduction targets and modelling different scenarios are crucial for effective planning. The toolkit allows users to create and analyse multiple scenarios to determine the most impactful interventions.
- Sector-specific Emissions: Understanding emissions by sector is vital for targeted interventions. The toolkit facilitates the categorization of emissions across various sectors and helps visualize their impact.
- Climate Adaptation Measures: Besides mitigation, climate adaptation measures are essential. The toolkit supports the analysis of both mitigation and some adaptation strategies.
- Visualization and Monitoring: Effective communication with stakeholders and ongoing monitoring are critical. The toolkit includes visualization tools and dashboards to track progress and engage with municipal authorities and other stakeholders.

Toolkit Enhancements:

Refinements were made to the iCD tool, the primary modelling platform in CET planning. These improvements include enhanced error reporting, streamlined simulation controls, simplified CSV import, and a more intuitive user interface for tracking simulations. Overall, these updates are designed to enhance the user experience, which was identified as a key barrier to increasing the capacity of local and regional authorities, thereby advancing the Step-WISE objectives.

Components of the Toolkit:

- iCD (Integrated Design and Analysis): A 3D masterplanning modelling tool that assists in creating baseline and intervention models at urban level.
- iCIM (Collaboration and Visualization Platform): Provides 3D visualization and stakeholder engagement features.
- iVN (Network Modelling Tool): Enables advanced analysis of local energy systems, including district heating and storage.
- Power BI Dashboards: Customizable dashboards for monitoring and visualizing progress.

- iSCAN (Building Data Analysis): Collects and visualises building performance data to optimize operations.

The refined Step-WISE Technical Toolkit offers a solution for CET planning, addressing key challenges identified by users. With its comprehensive features and user-friendly enhancements, the toolkit is well-positioned to support local and regional authorities in achieving their decarbonization goals. The ongoing refinement and development of training modules will further enhance the toolkit's effectiveness, ensuring that it is a valuable asset for energy transition planning and supports capacity building objectives.

1 Introduction

The transition towards a low-carbon energy system is critical in mitigating climate change and fostering sustainable development. Effective planning and implementation of energy strategies are essential to achieve these goals. The Step-WISE capacity building program, with IES as its technology partner, provides an advanced suite of tools to support this transition. The primary focus of this program is to offer a toolkit designed to facilitate the creation and management of energy plans.

To tailor these tools to the needs of energy planners, a series of workshops were conducted with dissemination partners. These sessions aimed to map the user journey of a CET planner, identify the challenges encountered during the energy planning process, and assess how the Step-WISE toolkit could address these needs. By engaging directly with users who are actively involved in CET planning (especially in SECAPs), the workshops provided critical insights into the practical difficulties faced and how the toolkit could be refined to offer more effective solutions.

The CET planning process generally involves several key stages: initiation, planning, implementation, and monitoring. Each stage requires specific tasks, such as baseline data collection, setting emission targets, strategy development, and continuous performance tracking. The workshops revealed several pain points in this process, including difficulties in establishing accurate baselines, setting achievable targets, categorizing emissions, and visualizing energy impacts.

The Step-WISE Capacity Building Programme encompasses three key components as integral parts of the Step-WISE toolkit(See Figure 1.), explained in further detail in **D2.2 Use Cases identification and characterization and Step-WISE toolkit requirements** definition :

1. The **Technical toolkit:** This consists of **IES's decarbonisation tools** for modelling and simulation of scenarios that provide the municipalities with the technical functionalities that make the process for the municipalities as easy as possible. The current deliverable D3.1 focusses on this technological part of the toolkit.
2. The **knowledge sharing platform**: Potentially using the **Virtual Knowledge Offices** in the Step-WISE project, the platforms' purpose is to bring together per use case, a collection of resources that will support the development of the CET plans in each use case. These will be tailored specifically to each use case in terms of the exact requirements. The creation of the VKO itself, and integrating its other features is developed as part of WP6 T6.3.
3. The **Training material** produced in Capacity Building Programme: A significant part of the capacity building programme is the training provided to the LRAs themselves by the experts in the field within the Step-WISE consortium, and the **training material** thus created to allow the future adopters to continue increasing capacity in each use cases. This component is crucial in also addressing several of the key non-technical requirements highlighted in previous research. The constitution of the training programme will be developed further as part of WP3 (Tasks 3.2 – 3.4).

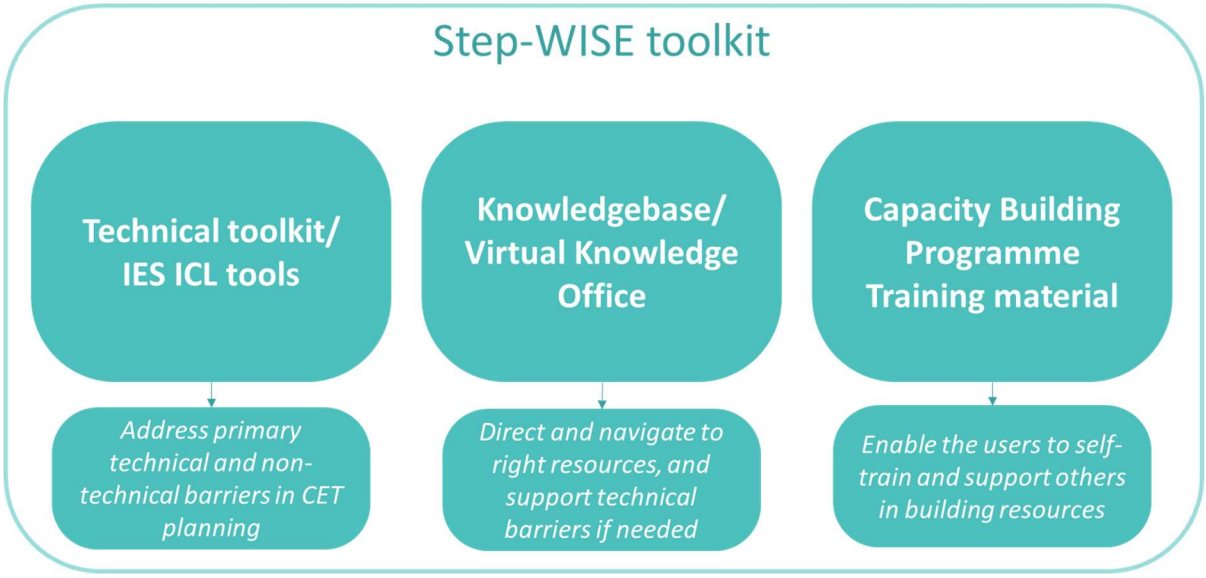

Figure 1. Components of the Step-WISE toolkit (D2.2)[1]

The Step-WISE technical toolkit, developed by IES, is designed to address these challenges through its suite of technical tools. The toolkit includes components such as iCD for scalable analysis, iCIM for collaborative 3D visualization, iVN for network modelling, and PowerBI for customized dashboards. These tools work together to support planners in creating detailed baseline models, simulating intervention scenarios, and visualizing energy and carbon metrics. By leveraging these tools, users can enhance the accuracy of their energy plans, improve stakeholder engagement, and streamline the monitoring and revision processes.

This report delves particularly in the technical toolkit and into the specifics of the CET planning journey, the functionalities of the Step-WISE technical toolkit, and the refinements made to enhance user experience. It also outlines the workflow of the toolkit and presents a demonstration video to showcase its application. The ultimate goal is to provide local and regional authorities with a robust, user-friendly solution to effectively manage their transition to a low-carbon energy system, ensuring that every step of the planning process is supported by advanced technical tools and clear, actionable insights.

[1] IES ICL tools terminology changed since submission of D2.2 to IES Decarbonisation tools

1.1 Step-WISE terminology

This section briefly outlines the key definitions of the terms used in the context of Step-WISE project. The brief description of the terms and the chart in Figure 2 helps the reader understand the context of the project further.

1. **Use cases** in the project refer to 4 distinct regions of focus for the project: Bulgaria, Spain, Cyprus and Mediterranean islands. The goal of the project is to increase the capacity of local and regional authorities to create and implement Clean Energy Transition Plans. The variety of use cases in Europe provide different political, geographical and socio-economic backgrounds for the project to test the applicability of the toolkit, provide case studies and have impacts spread across different European contexts. (See no. 1 in Figure 2)
2. **Wave 1** and **Wave 2** of capacity building in the project refers to two phases of project implementation. In the first wave, the training of the use of a toolkit (Step-WISE toolkit) will be provided to Use Case leaders, who are part of the consortium. In the second phase or second wave of the project, the trained use case leaders extend this training to local and regional authorities within the use case regions. (See no. 2 in Figure 2)

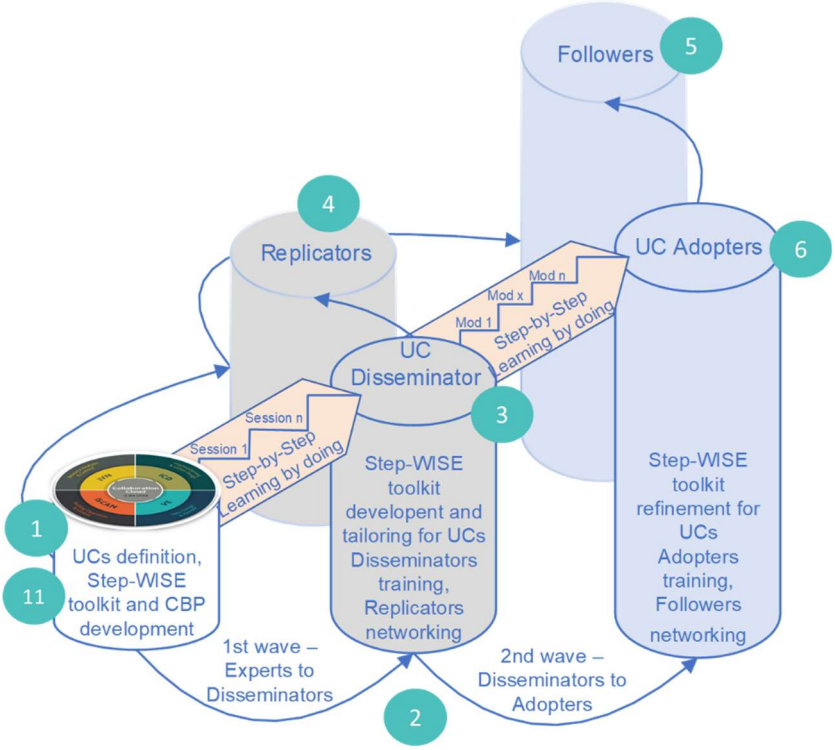

Figure 2. Step-WISE overall concept cross-section explaining main UC based activities, key actors involved, and Step-WISE toolkit use across the process. Numbers added to cross reference from terminology list on the left (From Step-WISE grant agreement)

3. **Disseminators** are the use case leaders in the Step-WISE consortium (See no. 3 in Figure 2). They will receive the training in the Wave 1 of the project action, and provide training to interested local and regional authorities in the Wave 2 of the project (referred as Adopters). The disseminators also engage other entities to replicate their role as trainers of Step-WISE approach (referred as replicators). (SINLOC, EAP, CEA, CERES and linked third party Traza)
4. **Replicators** are the entities outside of the project who are engaged to follow the example of the disseminators and will play the role of replicating the Step-WISE approach and training other local and regional authorities within their regions (LRAs also referred as followers). The replicators can also be seen as future-disseminators, and can be any type of entity. (See no. 4 in Figure 2.
5. **Followers** are the local and regional authorities who are interested in adopting the Step-WISE approach to develop CETPs, or are contacted by Replicators, or Disseminators to engage in creating these after the end of the project (See no. 5 in Figure 2)

6. **Adopters** are the local and regional authorities that are trained by disseminators to use the Step-WISE approach in Wave 2 of the project implementation. They are linked to other local and regional authorities in the use case region, as they can encourage and facilitate these to also adopt the Step-WISE approach as a *follower* after the end of the project. (See no. 6 in Figure 2)
7. **Trainers** or experts are consortium members that are contact points for both the technology provider in the consortium and the use case leaders/ disseminators. These members assist the disseminators to receive and perform the training programme, as well as coordinate with the technology provider with feedback on the toolkit and relevant materials (primarily involved in Wave 1 in Figure 2). (FredU and R2M)
8. **Technology provider** in the project is the member of the consortium that provides the technology that forms the core of the Step-WISE toolkit for CET planning (involved in Wave 1 and Wave 2 in Figure 2) (IES)
9. **Steering group** is a group within the consortium tasked to lead the implementation of the Wave 1 and Wave 2 of the program, and is formed of the disseminator, trainer and technology provider (primarily involved in Wave 1 in Figure 2)
10. **Action plans** are defined as high level plans for the project implementation. These refer to the main items of activities, resources, groups of people – including stakeholders and steering groups in context of Step-WISE, required to execute these activities. These are tailored to each use case, taking into account individual training requirements for the capacity building programmes as well as the local contexts. These activities are mapped against the timeline of the project when the Wave 1 (Training of the trainers/disseminators) and Wave 2 (Training of the adopters) takes place.
11. **Step-WISE toolkit** refers to a digital toolkit that empowers LRAs to develop their own CETPs using a dynamic model, providing key requirements identified through the project to overcome major barriers, facilitating easier and more accurate plan creation. (See no. 11 in Figure 2)
12. **Virtual Knowledge Offices (VKO)** refer to knowledge repositories that will act as amplifiers to increase the sustainability and replicability of the Step-WISE approach across Europe and beyond the identified use case regions.

2 CET planning journey mapping

D2.1 Local CETPs Framework, including stakeholders mapping and skills gap analysis describes Clean Energy Transition Plans (CETPs) as central to the EU's energy transition strategy, serving as essential tools for translating EU-wide goals into practical, region-specific actions. While these local CETPs are created within the broader framework of national and European policies, they are customized to fit the unique contexts, resources, and needs of individual regions and municipalities. These plans are crucial for engaging local stakeholders, capitalizing on regional strengths, and overcoming specific obstacles to clean energy adoption.

Clean Energy Transition (CET) plans can include various strategies, with Sustainable Energy and Climate Action Plans (SECAPs) being the most common type of CETP expected in the Step-WISE project's Use Case areas- Spain, Bulgaria, Cyprus, and the Mediterranean islands. Thus, the project uses SECAPs as a foundational framework for the toolkit's finalisation. This approach allows benchmarking of general requirements of other CETPs, as a level of standardization is necessary for the toolkit. An investigation into the process and needs of the SECAP helped the consortium to identify common needs that can be translated into broader CETP requirements.

IES is the technology provider in the Step-WISE capacity building programme. IES offers several tools at different levels of complexity to drive decarbonisation. In order to understand the exact requirements of the user of the technical part of the toolkit, who would use it to create an energy plan, workshops were organised with the disseminators. These workshops aimed to explore the user journey of a CET planner in more detail. These mapped the needs identified by the partners, who are regularly involved in the CET planning process, and review how the Step-WISE toolkit, particularly the digital tools by IES for decarbonization, can address these needs. The identified needs and challenges were then mapped against the capabilities of the Toolkit to determine how it can provide effective solutions.

In general, the workshops addressed the following:

- **Mapping User Needs**: Identifying the specific requirements and challenges faced by a user in an energy planning process.
- **Toolkit Alignment**: Demonstrating how the Step-WISE toolkit, comprising both technical and non-technical components, can address these needs.
- **Feedback Collection**: Gathering feedback from participants to refine how the toolkit is presented and ensure it meets user expectations.

The general process of a CET planning process is assumed to follow a SECAP planning journey [2]. This is summarised in the Figure 3:

[2] https://eu-mayors.ec.europa.eu/en/resources/reporting

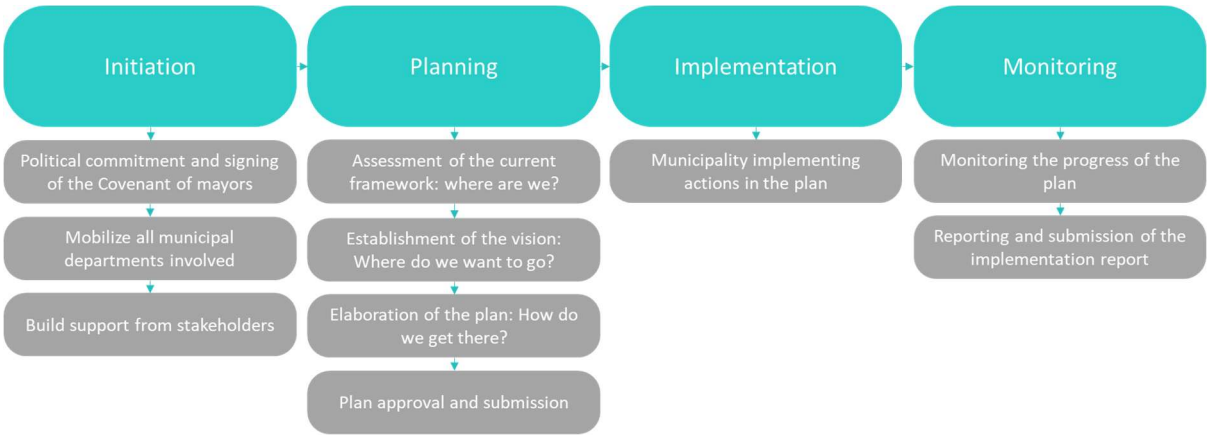

Figure 3. SECAP planning process

The workshops were vital in identifying the key issues that a planner faces in the creation of a SECAP process, and how the technical Step-WISE toolkit can support in the process.

Key Workshop Outcomes- pain points

The workshops revealed the following about the main pain points where the technical toolkit could support:

- **Establishing a baseline** is the first crucial step in the process, as it involves gathering data on current energy use and emissions. However, this step can be challenging because sometimes the necessary data is readily available, but in other cases, it might be missing or incomplete. The tools discussed in the workshop help identify and fill in these gaps, ensuring a comprehensive baseline is established, which is essential for accurate planning and analysis.
- **Setting clear and achievable target emission rates** is another critical component. The workshop emphasized the need to aim for a minimum of 55% reduction in emissions by 2030 specifically for a SECAP. To determine the best interventions, different projections may be used: a "business as usual" that assumes no changes, and at least two projections on the baselines are investigated.

Categorizing baseline emissions by different sectors, such as residential, commercial, and transportation, is also crucial. This step helps identify which sectors contribute the most to emissions and where interventions can be most effective. By understanding the distribution of emissions, planners can target their efforts more precisely and achieve better results. Within SECAP,

Table 1 shows the key sectors that were identified.

Table 1. Sectors evaluated in SECAP plans

Macro-Sector	Activity Sector	Description
Buildings	Municipal Buildings	Final energy use and GHG emissions in local government-owned buildings and facilities.(e.g., government offices, schools, police stations, hospitals)
	Tertiary Buildings	Final energy use and GHG emissions in private sector buildings (e.g., offices, retail).
	Residential Buildings	Final energy use and GHG emissions in residential buildings, including social housing.
Public Lighting		Final energy use for public street lighting and traffic lights managed by the local authority.
Industry	Non-ETS Industries	Final energy consumption and GHG emissions from non-EU-ETS manufacturing and construction industries with up to 20 MW thermal input if mitigation measures are planned. Energy generation industries should be reported under "Energy Supply," and ETS-covered industries over 20 MW should only be included if previously documented.
	ETS or similar industries	
Agriculture, Forestry, Fisheries		Energy use and GHG emissions in primary sector activities (e.g., farm machinery).
Transport	Municipal Fleet	Energy use and GHG emissions from transportation managed by the local authority.
	Public Transport	Energy use and GHG emissions in public transport not directly managed by the local authority.
	Private and Commercial Transport	Energy use and GHG emissions from private and commercial vehicles

- The **feasibility analysis** involves carefully assessing various factors to determine whether the proposed interventions are practical and achievable. For example, when considering the installation of photovoltaic (PV) systems, it's important assess the level of energy poverty in the area helps determine if the intervention can effectively address local energy needs. Evaluating the solar potential is also crucial to ensure that the site receives enough sunlight for the PV systems to generate sufficient renewable energy. These factors are all essential for determining the viability of renewable energy scenarios.
  - **Climate adaptation measures** are also investigated in energy plans in addition to climate mitigation measures. These measures focus on adapting to climate change rather than just mitigating it. The guidance on these is more qualitative compared to climate mitigation measures. Climate adaptation measures could include planting trees to provide shade and reduce heat island effect, or increase ground surface permeability to reduce flooding risk.

    Scenario modelling and energy savings calculations are integral parts of the planning process. Here, a scenario is defined as a set of measures applied in across an area of interest. In the context of SECAP development, these are referred as 'projections' and must align with the targets set in the National Energy and Climate Plans (NECP). Additionally, more ambitious targets should be considered. Essentially, when planners create future projections, they evaluate three scenarios: (i) a business-as-usual scenario, (ii) a scenario designed to meet the targets (which may or may not be ambitious), and (iii) an ambitious scenario that exceeds the targets by incorporating advanced energy actions and measures.

    This could be over a year or a test of different set of measures within the same year. By modelling different scenarios, planners can project energy use and savings under various conditions. Energy savings are calculated using assumed emission factors and improvements in technology or occupant behaviour. This modelling helps planners understand the potential impact of their interventions and make data-driven decisions.

- The SECAP is then **presented to the municipality**. During this step, detailed plans are shown to municipal authorities to obtain their feedback and approval for implementation. This engagement ensures that local governments are on board with the proposed measures and can provide valuable insights and support. In this step, it is necessary that the plan is presented in a simple way, that makes it easy to visualise the short- and long-term actions across a municipality, and is understandable for a non-technical audience.
- After presenting the plan, it may need to be revised based on the municipality's feedback. This **iterative process involves making necessary adjustments** as per the feedback and resubmitting the revised plan for final approval. This step ensures that the plan is robust, realistic, and has the support of local authorities, increasing its chances of successful implementation. This necessitates being able to revise plans and recalculate as needed.
- The final step is to **monitor the implemented measures**. Workshop participants suggested that as information becomes available, such as the potential impact of the implemented measures, it would be helpful to add this to the original energy plan to track the progress of the SECAP and correct course if necessary.

These key steps, as highlighted in the workshop, underline the detailed and iterative process involved in creation of CETPs such as SECAPs.

Following summarises the main pain points from a potential Step-WISE technical toolkit user perspective:

- *I struggle to find all the data pieces needed for the creation of an energy plan's baseline*
- *I would like user friendly digital tools to support with my tasks and analyse future scenarios*
- *I find that playing around with numbers to make the plan is very effort intensive*
- *I struggle to measure climate adaptation measures or complex interventions such as district heating*
- *I would like to visualise the energy/carbon on various sectors such as different building types*
- *I would like a way to monitor results and communicate with municipality more easily/visually*
- *I struggle to bring everyone together to understand and visualise the plan, especially when the key members in the municipality keep changing*

CET planning mapped against Technical Step-WISE toolkit

Based on these pain points and reviewing the decarbonisation tools available by IES, a mapping exercise was done. The main points that the toolkit will address the barriers highlighted through the exercise:

- The toolkit allows for the creation of a baseline model with **pre-filled data**, particularly useful when limited data is available for establishing the energy consumption baseline of a city's residential sector.
- Users can **create multiple scenarios from the baseline** or business-as-usual case and define their target emissions for specific years of interventions
- The toolkit enables users to **test multiple climate mitigation interventions** and **some climate adaptation measures.**
- It provides a **user-friendly interface** for calculating the energy and carbon use of a municipality under various scenarios and interventions.
- The software's building **physics-based simulations** allow for more **informed modelling** of different energy-saving interventions and visualizing their impact across various sectors, increasing the confidence in final results, and potentially minimising the revisions needed.

In specific cases of SECAP planning, it was identified that **district heating or energy storage** could be evaluated within intervention scenarios. The toolkit includes components that can perform specialized

analyses, such as district heating or energy network simulations, to support these evaluations. Figure 4 visualises this mapping exercise.

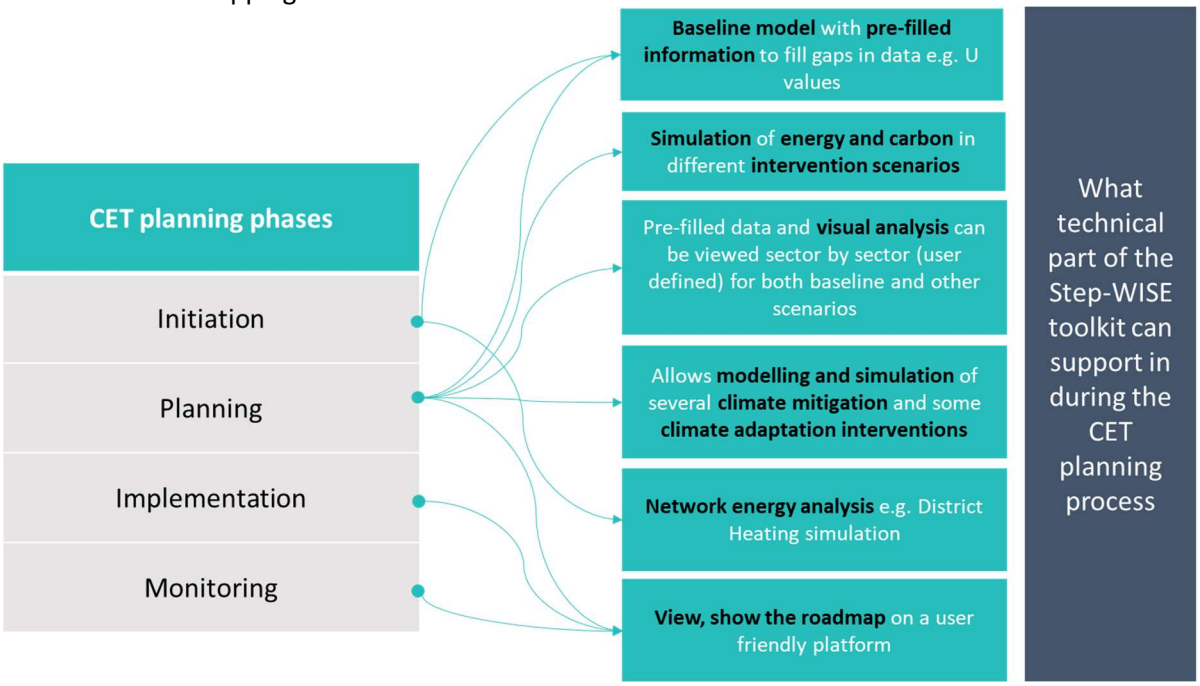

Figure 4. Technical Step-WISE toolkit mapped against the CET planning phases

3 Components of the Technical toolkit

The Step-WISE Technical Toolkit, provided by IES, is a collection of software tools designed to address the need for creating net zero energy plans, particularly for buildings with minimal available data. This toolkit ensures confidence in the results by employing modelling based on building physics principles. It will have 3 main supporting software tools (**iCD,iCIM** and **Microsoft PowerBI Dashboard**).

These interconnected tools will equip local and regional authorities with the technical capability to model their area's baseline scenario, identify cost-effective decarbonization pathways, prioritize interventions over a specified timeframe through socio-economic analysis, and develop a dynamic Clean Energy Transition (CET) plan.

The following summarises and completes the mapping of the Step-WISE technical toolkit, across the CET planning process with its individual components.

Table 2. Technical Toolkit Components for CET planning

Part of the technical toolkit	**Keyword /Component type**	**What is it**	**What to do with it**	**Which part of CET planning to use**	**Pre-requisites**	**Outputs**
iCD	Modelling Platform	A 3D sustainable urban design plug-in tool to SketchUp using IES' Apache engine for performance simulation.	Create baseline and intervention models for municipalities, assess impacts over time	Planning	Access to SketchUp, IES Apache Engine, and basic input building attribute data, a rough plan of interventions	Baseline energy emissions, scenario energy emissions, 3D models
iCIM	3D Collaboration Cloud	A cloud-based 3D model platform for visualizing and managing community data.	Synchronize plans, visualize intervention scenarios, and facilitate engagement with stakeholders.	Planning, Implementation, Monitoring	Plan on what is needed to be visualised; emails of stakeholders	3D visualizations of CETP
iVN	Network Modelling Tool (*Advanced requirement)*	A tool for analysing and designing local energy networks, including district heating and storage	Optimize local energy systems, assess impact of district heating, or storage, and run scenario analyses.	Planning	Integration with iCD data or time-series data from iSCAN	Optimized energy systems, scenario impact analyses
Microsoft PowerBI dashboard	Dashboard Tool	Microsoft Power BI tool for creating customized dashboards and	View and customize the roadmap, monitor ongoing interventions	Implementation, Monitoring	CETP dashboard template (CSV and PowerBI template), ongoing	Customizable roadmap views, performance monitoring dashboards

		visualizing data on a browser			renovation performance data	
iSCAN	Building Data Analysis (*Advanced requirement)*	A cloud-based platform for managing and analyzing building performance data in real-time.	Import and analyze building data, identify performance issues, and optimize building operations.	Planning, Implementation, Monitoring	Integration with BMS, smart meters, IoT sensors, and other data sources	Real-time performance insights, data analysis, and optimization suggestions

The following section describes the main tools of the Step-WISE Technical toolkit in more detail:

iCD for Scalable Analysis

iCD is a 3D sustainable urban design and early stage master-planning tool. It can be used by Urban Planners, Designers, Sustainability Consultants and MEP Engineers to collaborate and exchange ideas quickly and easily through one central tool. It is a desktop software that integrates with the building physics capabilities of IES' Apache engine with Trimble SketchUp (a well-known 3D modelling program used within the AEC industry) to masterplan and assess the performance of a group of buildings anytime in its lifecycle. As such, the iCD can provide the information to help make decisions for the near future or for the longer term, for example, creating a decarbonisation roadmap towards 2050 for a development, city or campus.

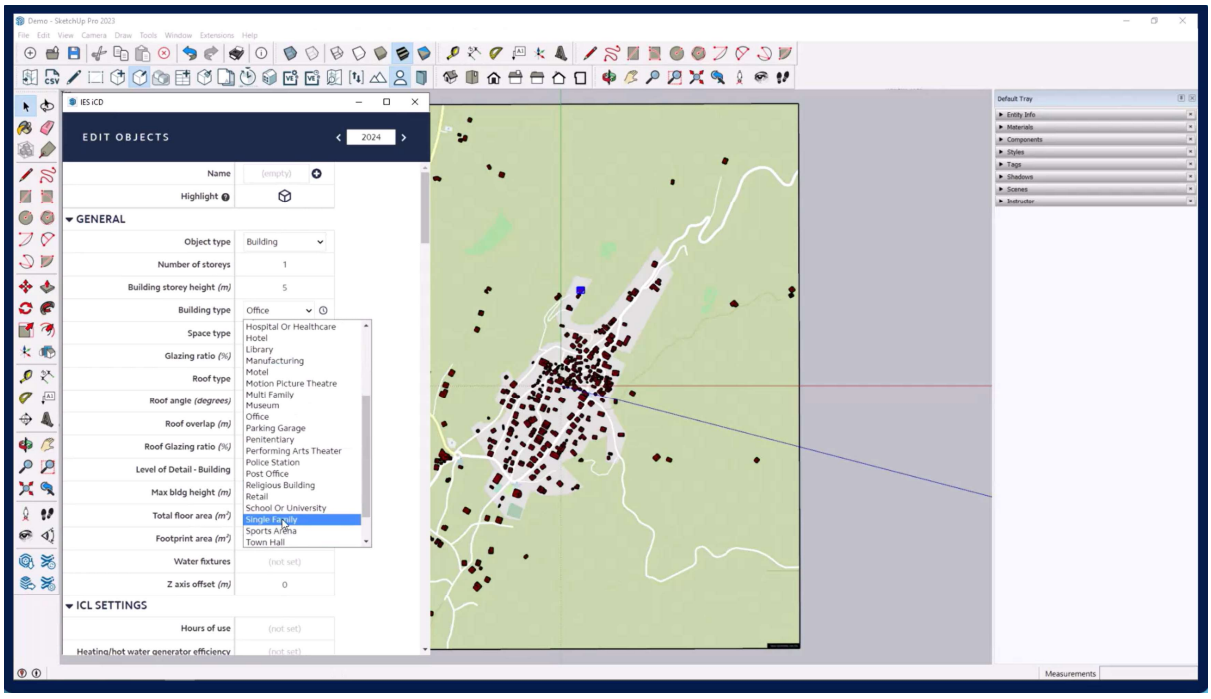

Figure 5. An extract of the ICD tool

In context of Step-WISE, iCD will be used as the main modelling and simulation tool in the technical toolkit. It addresses the key concern pointed out in the workshops - the lack of data to create a baseline. Each building is imported with pre-filled attribute data from templates, based on the type or use of that building. This helps to fill in data gaps such as U-values, to more model energy baselines at

scale, using physics-based simulations. Here are the key features that will be fundamental for the Step-WISE use cases:

- Use of pre-filled attribute data to fill in gaps in input data : Data should initially be imported from Shapefiles (SHP) or GIS files when available. If these sources are not accessible, maps from OpenStreetMap (OSM) should be used. This approach allows the iCD model to address any data gaps by supplementing with information from the ASHRAE database relevant to specific building types.
- Use of physics-based energy simulation engine allows iCD to calculate energy consumption for large-scale models with much greater accuracy than assessment-based methodologies, using simple available inputs
- Solar/PV potential analysis
- Walkability and Accessibility Studies
- Building energy consumption calculations
- Including static socio-economic data into analysis
- EV charging energy consumption
- Modelling future renovation scenarios

iCIM– Collaboration Cloud

iCIM is a cloud-based 3D model that can present any data for a community defined by a geographical boundary, whether that be a campus, community or city. It is a 3D graphical repository of all data resulting from the IES ecosystem of technologies from which it is possible to monitor, manage, visualise and communicate performance. In context of Step-WISE the following key features will be fundamental for the use cases.

Figure 6. An extract of the iCIM tool

- 3D visualisation of the intervention scenarios over years.
- Synchronises the plans created in iCD.
- Allowing access to the cloud model without requiring downloads or understanding of complex tools, facilitating engagement with the workforce, building occupants, or local communities when needed.

iVN – Local Energy Decarbonisation

iVN is a network modelling and design tool that enables the analysis of a community and its resource networks, including heating, cooling, electricity and water. The energy demand from the community buildings can be imported from other IES' tools, whether generated in iCD or the VE, or taken from time-series data from iSCAN. The iVN model can then consider different assets and renewable energy sources (for example, solar PV installations, wind turbines, CHP, battery storage, etc.) which could be added to the network, running analysis on various scenarios to determine their impact. This enables the optimisation of local energy systems, identifying ways to share energy between buildings, meet energy needs using low/zero carbon technology, reduce costs and improve the overall efficiency of the network.

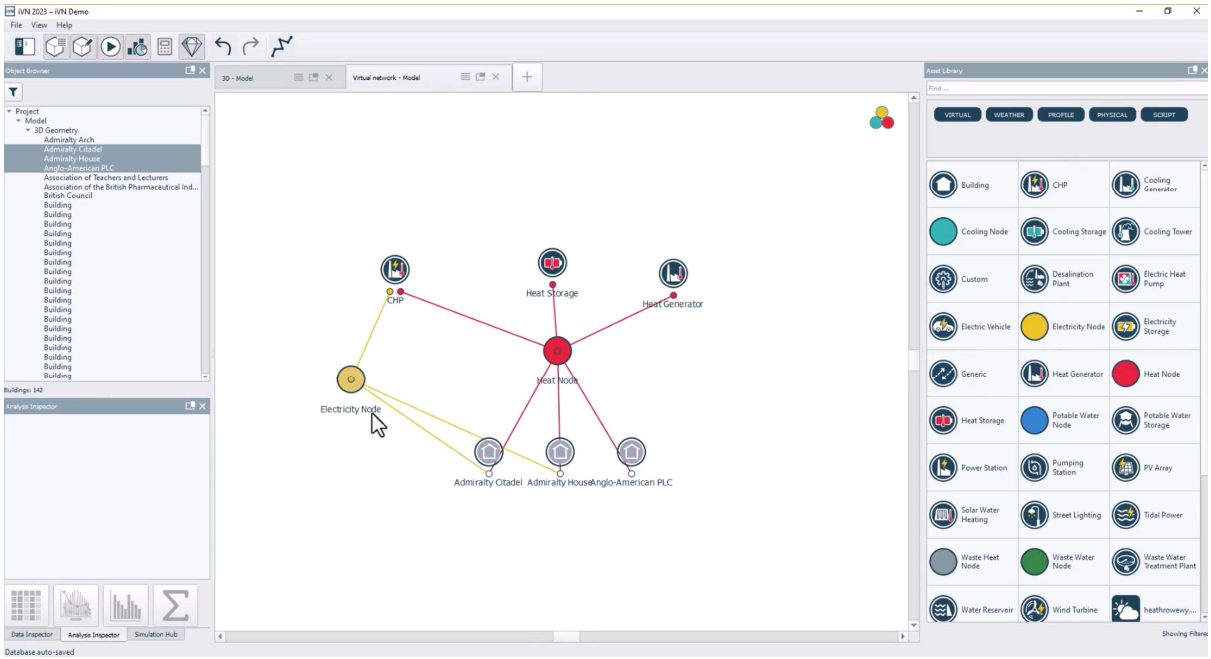

Figure 7. An extract of the iVN tool

In context of Step-WISE, iVN is not expected to be part of the workflow in all cases, but more rather more special cases where a special level of modelling is expected. The key features relevant for the Step-WISE use cases would be the assessment of existing supply and demand from buildings and other community assets such as Energy storage or District heating.

Dashboards using PowerBI

The Step-WISE technical toolkit will utilize Microsoft' Power BI tool to deliver customized dashboards tailored to the needs and requirements of local and regional authorities. The toolkit will include a dashboard template specifically designed for the decarbonization roadmap exercise, which will be provided to the use case leaders and LRAs to be modified according to their individual needs. The following key features of the dashboards are critical for the Step-WISE project.

- Ability to view the complete roadmap in a customisable way on a dashboard.
- Capability to include the performance of ongoing interventions in the plan for monitoring purposes.

Figure 8. An extract of the Step-WISE CETP dashboard template using Microsoft PowerBI

iSCAN – In-use Building Data Analysis

While iCD, iCIM and Power BI dashboards, supported by iVN are anticipated to be the main tools in use for the CET planning, an additional tool is made available as part of the toolkit, called iSCAN.

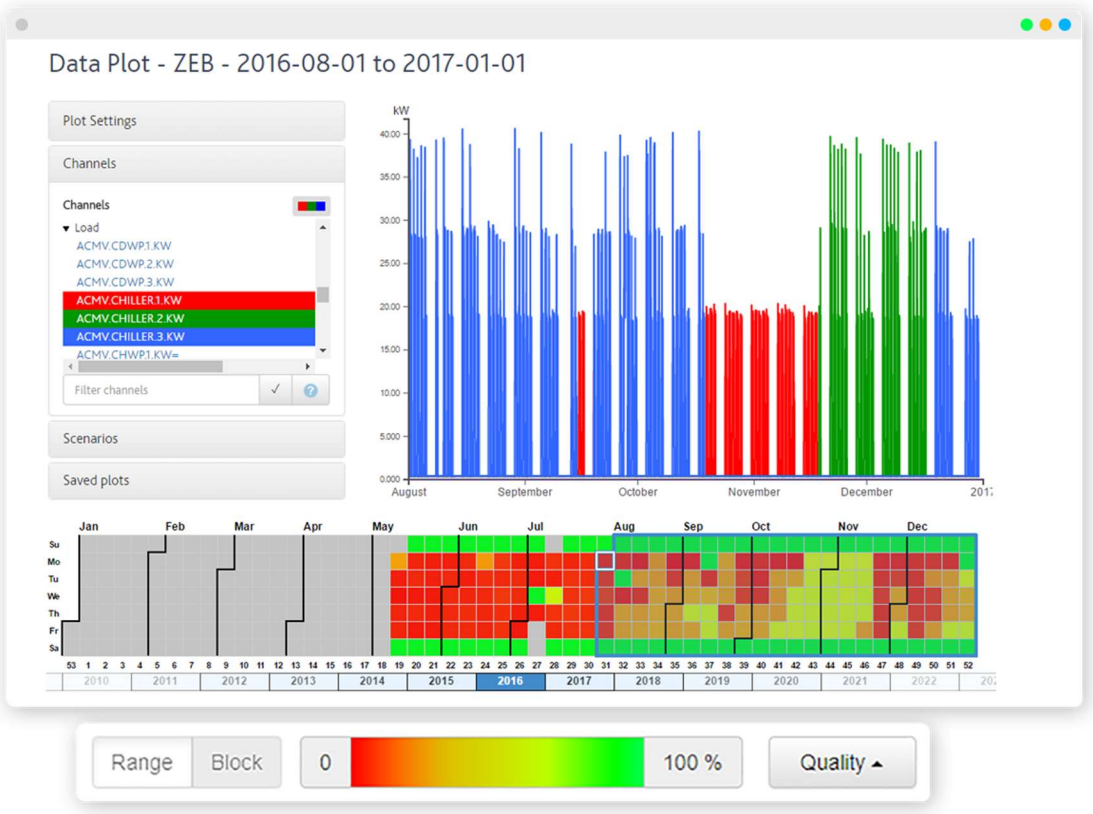

Figure 9. Extract of iSCAN tool

iSCAN is a cloud-based data management and analytics platform that helps optimise the operational performance of buildings. Providing a single pane view for all your building data, it can import time-series data from multiple sources, including building management systems (BMS), smart meters, IoT sensors, energy bills etc. into a single platform. iSCAN has capabilities to interrogate this data to identify how the building is performing in real-time with respect to energy use, indoor environmental quality and running costs. Providing insights and enabling analysis to be performed to identify quick wins, such as identifying faults or easy to implement energy saving measures. The tool's Machine Learning and AI capabilities can be used to fill missing data gaps, make predictions and optimise performance on a minute, hourly or daily basis. In the context of Step-WISE, iSCAN may need to assist iVN if energy modelling design is required.

4 Refinements to the Technical toolkit

D2.1 Local CETPs Framework, including stakeholders mapping and skills gap analysis and **D2.2 Use Cases identification and characterization and Step-WISE toolkit requirements definition** highlighted the key concerns of the Local and Regional Authorities with respect to CET planning. These outlined any measures of refinements which were necessary to the toolkit. The key takeaway from the research, was the need to have a user-friendly experience. Therefore, the technical toolkit underwent some refinements as listed below to enhance and improve the overall toolkit usability, ultimately making it more adaptable to the needs of LRAs. These refinements took place in the iCD tool, which is the main modelling platform in the CET planning workflow.

Updated Simulation Progress Dialog UI

The tool has undergone significant improvements to make it more user-friendly. The updated interface now provides a clear overview of ongoing simulations, upcoming ones, and a comprehensive history of all past simulations, making it easier to track progress. Additionally, a new "Clear Log" button has been added, allowing users to easily remove old logs whenever needed, streamlining the process and enhancing overall usability.

Easier CSV Import

The CSV import process has been simplified and visually updated for ease of use, now accessible directly from the toolbar. This enhances usability by making data integration more intuitive and efficient, relevant in CET planning contexts as different data sets become available and may need to be integrated in the CETP.

More Actions in Simulation Progress Dialog

Enhancements have been made to the simulation dialog box to make the user experience smoother and more intuitive. Users can now easily stop a running simulation or remove it from the queue and log with a click. Additionally, a new feature allows users to select and view all objects involved in a simulation, making it easier to keep track of them. For convenience, simulations can also be re-launched with the same settings, saving time and effort in repeating the process.

Better Error Reporting for Simulations

Using simulation tool for decarbonisation planning, occasionally, simulations may run into issues, and the tool's features were improved to assist in such instances. The tool includes several user-friendly features to streamline troubleshooting when a simulation fails. Users can hover over the "Failed" status to see a brief explanation of the failure, providing immediate insight. Detailed error messages pinpoint issues, such as geometry problems or invalid attribute values. Clicking on the underlined "Failed" status opens a comprehensive report identifying the specific building and space with the issue. Highlighter and magnifying glass icons help users locate and zoom in on the problematic building. Additionally, the report expands to detail which attribute caused the error, offering all necessary information to quickly resolve the issue. These features collectively enhance the user experience by making error diagnosis and resolution straightforward and efficient.

In summary, the minor refinements to the toolkit add significant value to the user, contributing to the Step-WISE's capacity building:

- **Enhanced Usability**: The redesigned CSV import and updated simulation progress dialog make the interface more intuitive and easier to navigate.

- **Improved Efficiency**: Faster query tool performance saves time when working with multiple buildings.
- **Better Error Management**: Detailed and clickable error reports help quickly identify and fix issues, minimizing downtime.
- **Streamlined Simulation Control**: The ability to easily stop, remove, re-launch, and manage simulations provides more control and flexibility.
- **Accurate Data Export**: Scaled simulation results ensure more accurate data representation in iSCAN.

5 Technical toolkit workflow and Demonstration Video

IES' decarbonisation tools have the following 4 key elements as it follows the CET planning process:

Table 3. Main toolkit task in each CET planning phase

CET planning phase	**Technical Toolkit main task**	**Toolkit Component**
Initiation	-	-
Planning	▪ Create a baseline model ▪ Create a Scenario intervention model(s) ▪ Visualise Carbon and Energy metrics	▪ iCD ▪ iCIM ▪ iVN (optional) ▪ iSCAN (optional)
Implementation	▪ Visualise the roadmap	▪ iCD ▪ iCIM ▪ iSCAN (optional) ▪ Microsoft PowerBI dashboard
Monitoring	▪ Visualise the roadmap	▪ iCD ▪ iCIM ▪ iSCAN (optional) ▪ Microsoft PowerBI dashboard

The degree of user involvement in the toolkit varies. Certain aspects are fully defined by the user, such as the location of the study and the specific renovation measures to be implemented, including the year of implementation. However, the toolkit also provides substantial support in other areas where user involvement is optional. For instance, the toolkit automatically generates a 3D visualization, a distribution of building types, thermal characteristics, and the weather file for the selected location.

The toolkit enables various levels of analysis to apply intervention measures and visualize these in a roadmap format. This functionality allows users to review and modify interventions if the expected energy reduction is not achieved, thereby enabling an iterative process to optimize the impact of the measures.

The following Figure 10 aims to cover (not exhaustively) the main features of interest in the toolkit, across the different main tasks.

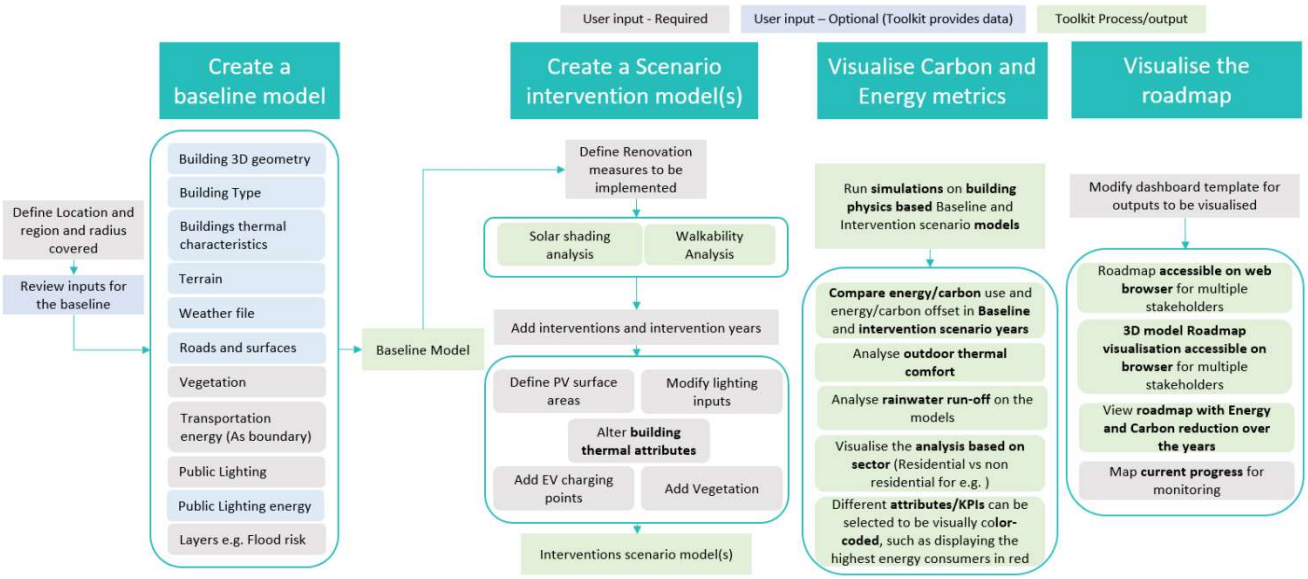

Figure 10.Toolkit workflow in CET planning process[3]

The main output of the current deliverable is to present the technical toolkit in full operation – this includes the digital technology tools as part of the Step-WISE toolkit.

A demonstration video was thus created, that first introduces the viewer to the entire technical toolkit and its individual components, following the operation workflow mentioned above. This is published on the public Step-WISE webpage https://www.iesve.com/step-wise (See Figure 11).

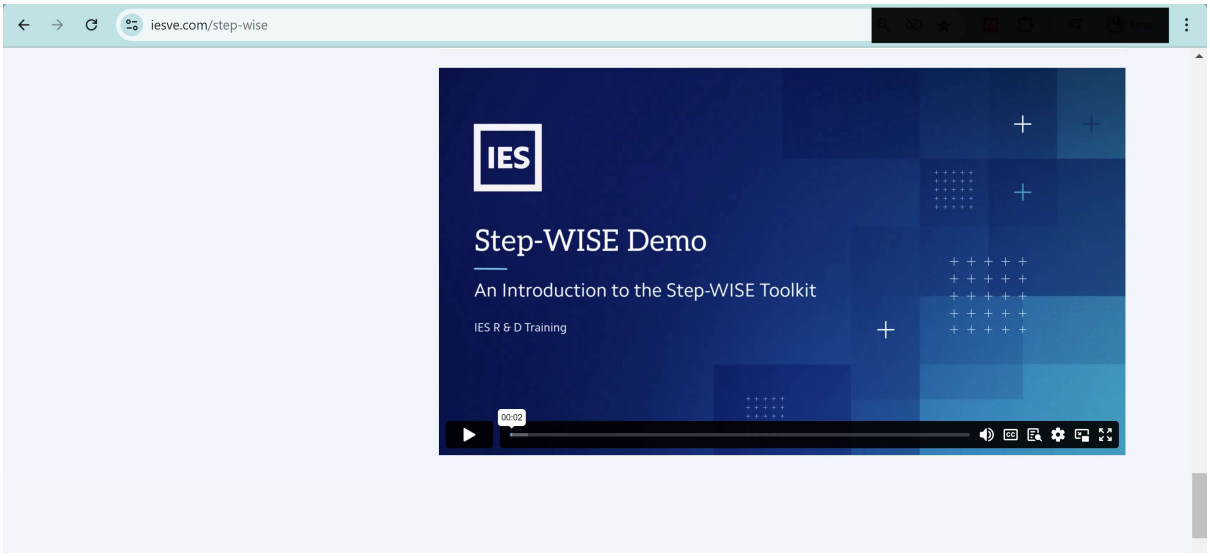

Figure 11. Step-WISE technical toolkit in operation -demonstration video on Step-WISE webpage

It is recognised that the CET planning process is an iterative process, and training is a key aspect of the Step-WISE project. To support the provision of the Step-WISE technical toolkit, specific training materials and modules will support the overall demonstration video, going into more detail on the

[3] *IES' software and tools are constantly developing, and the workflow presented is subject to adaptation in features that can be currently provided in the Step-WISE project*

individual steps involved. These will be developed as part of T3.3. The following sub sections cover these main steps involved in the CET planning using the Step-WISE technical toolkit.

5.1 Create a Baseline Model

The initial step in creating an energy plan, such as a Sustainable Energy and Climate Action Plan (SECAP), involves developing a baseline model. This is accomplished using iCD, a SketchUp plugin designed for large-scale energy and carbon analysis of portfolios, campuses, and cities.

1. Import City Data:
   - Use OpenStreetMap (OSM) import to quickly create a baseline model
   - Search for the city and define the area radius for importing building information.
   - Optionally include additional data such as roads, landscaping, and terrain.
2. Building Data:
   - Each building is imported with pre-filled attribute data from templates, aiding in data gaps like U-values for accurate energy baselines using physics-based simulations.
   - The nearest available weather file is added automatically based on the location.
3. Detailed Information Import:
   - It is possible to import more detailed information, such as GIS files for the municipality if available.
4. Non-Building Elements:
   - Add elements like street lighting, EV chargers, and trees to the baseline model.
5. Carbon Intensity:
   - Manually add the carbon intensity of each fuel type, as it varies by region, market, and year of the baseline.
6. Simulation:
   - Simulate the business-as-usual scenario once all elements are accounted for in the baseline model.
   - Visualize energy simulation results in a ready-made energy report showing carbon emissions and energy use for each year.

5.2 Create Scenario Intervention Models

With the baseline model established, the next step is to create intervention scenarios (or projections) by sector on an annual basis, evaluating potential carbon emission reductions over time.

1. Intervention Proposals:
   - Develop a rough idea of proposed interventions and set the intervention year (e.g., 2020, 2030, etc).
2. Intervention Measures:
   - Apply renovation measures like roof insulation, improved glazing, or changing street lights to LEDs.
   - If the intervention applies to multiple buildings in one sector e.g. residential, apply copy the intervention to the buildings in that sector using the paint feature.
3. Solar Potential:
   - Use iCD's solar assessment feature to calculate solar potential across all building surfaces and add PV panels to roofs with the best potential.
4. Carbon Sequestration:

- Add trees to the model to calculate their impact on carbon sequestration.

5. Carbon Intensity Updates:
   - Update carbon intensity figures to reflect expected values for the scenario year.
6. Simulation and Review:
   - Simulate the impact of carbon interventions at any point in time on a municipal scale.
   - Visualize and review results to adapt and refine the scenario until satisfactory.
   - Set up multiple intervention scenarios as needed.
7. Specialized Modelling:
   - Use iVN and iSCAN for detailed network-related interventions like district heating or community-level thermal storage.
   - Simulate district heating potential and export results to Excel for inclusion in the final roadmap

5.3 Visualize Carbon and Energy Metrics

With baseline and intervention scenarios in place, the next step is to visualize energy and carbon data for decision-making. This involves linking the iCD model to the iCIM for enhanced visualization.

- Synchronize updates from iCD with the collaborative model in iCIM to reflect plan changes.
- iCIM is an online 3D visualization tool for collaboration, communication, and idea exchange with non-technical stakeholders.
- Retain the plan in a 3D model that shows changes over time, making it accessible and visual for multiple stakeholders.
- Use tools in both iCD and iCIM to visualize results in a color-codes based on sector, energy consumption, building height, etc.

5.4 Visualize the Roadmap

The final step involves using PowerBI, a Microsoft tool for interactive data visualization, to create an overall roadmap visualization dashboard for Step-WISE.

- Emission Data calculated in the projections or scenario simulations is held in a template Excel file displayed in PowerBI dashboard templates.
- A link back to the iCIM model makes these dashboards a central online location for communication and visualization of the transition plan.
- Import progress data, such as energy and carbon results, into the PowerBI dashboard to plot against expected performance and monitor implementation of the energy transition plan.

6 Conclusion and next steps

Guided by the requirements outlined in Task 2.4, the Step-WISE technical toolkit presented in this report aims to support stakeholders in developing dynamic CETPs. This set of tools aim to enhance the capacity of local and regional authorities through a comprehensive step-by-step training program (developed in T3.2), which will bolster their capacities. It will enable authorities to assess baseline scenarios, identify cost-effective decarbonization strategies, and prioritize interventions through what-if analysis.

The recent workshops have been instrumental in identifying key challenges and areas for improvement. The technical toolkit offers enhanced functionalities that address common pain points in CET planning, such as data baseline establishment, target setting, scenario modelling, sector-specific emissions analysis, and climate adaptation measures. The inclusion of IES tools like iCD, iCIM, iVN, Power BI Dashboards, and iSCAN ensures that users have access to a suite of user-friendly resources for creating, analysing, and visualizing CETPs.

The technical toolkit's ability to streamline the planning process, combined with its user-friendly interface and improved performance, positions it as a critical asset for local and regional authorities and to build their capacity for energy planning. It not only supports the development of CETs such as Sustainable Energy and Climate Action Plans (SECAPs) but also enhances stakeholder engagement through effective visualization and monitoring tools.

In conclusion, the Step-WISE Technical Toolkit addresses the practical challenges faced by CET planners and incorporate user feedback to drive advancements in the CET planning process. The toolkit is well-equipped to drive significant progress in the energy transition journey. It aims to enhance and facilitate the analytical process, supporting planners in achieve a high level of expertise. Ongoing refinements, training, and support as part of the Step-WISE project will ensure that the toolkit remains relevant and valuable to the Step-WISE objectives.

The next steps involve further development of the non-technical components of the toolkit, including the creation of additional training materials aligned with the capacity building programme (Tasks T3.2 and T3.3) and the knowledge sharing platform (Task T6.3). Additionally, the initial phase of the capacity building programme will use the technical toolkit to train disseminators (Task T4.3). Throughout the project, IES tools will continue to be refined, with updates communicated as part of the ongoing training programme.