

# Interreg



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European Regional Development Fund

*D 1.1.1 – D 1.1.2 – D 1.1.3 Tools and methods for emerging energy communities*

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## Objective of this deliverable

Under the driving force of market liberalisation, favourable renewable energy policy frameworks and the innovation in distributed energy technology, the energy market is gradually transforming from a top-down centralised system to a more low-carbon, smart and combined centralised-decentralised system.

Changes are happening throughout the entire system, with more intermittent renewable energy production at all levels and the integration of flexibility through storage, power-to-gas and more dynamic and responsive behaviour at the level of energy consumption. The decentralisation of technology allows for new actors to enter the market: it allows consumers to become 'active' by taking control over energy-related activities, either individually as active consumers, or collectively in the form of energy communities or through participating in aggregation.

In this deliverable, available tools and methods to support the initiating of energy communities are presented and discussed. It is important to state that the tools are free to utilize, and the results cannot be used to hold the authors accountable. An effective large-scale validation, or an update of the assumption basis, is absent. Additionally, the tight or absent business case requires to do value stacking of all relevant services, such as P2P as well as aggregation, energy saving combined with smart control of thermal electrical devices, demand side management and smart charging. In order to allow for the tools to be effectively useful to design the energy community and bring together all needed aspects to be subsidy independent, the algorithms behind it are complex and need to be linked to maintained databases providing insight on profiles, tariffs, and locally offered aggregation services.

The generic tools do not integrate such complexity and hence the effective use of typical tools is limited to a first exploration of options.

## Overview of tools and guides for Energy Communities

Setting up an energy community starts from an idea and intention but requires several steps until the project is actually launched. Building up a core group comes first, but also outreach to the broader community is necessary to pick up momentum. Different forms of energy communities exist, therefore it is important to determine the governance type, as well as the activity that will be pursued and the technologies that will be used early on. These will depend on the social, political, and economic contexts, the regulatory framework, the local resources and infrastructure, but also the preferences of the members. A technical, regulatory and economic analysis are necessary to determine the feasibility of the idea and to specify necessary technical details. These will be needed in order to develop a business plan and find the necessary funding or financing. Once the energy community has started, management of the people, the technology and legal aspects will be needed to maintain and possibly expand the initiative. Additionally, the arrangements with regards to the dissolution of the initiative are to be included. It is always advisable to take these considerations in mind from the start of the project.

Different types of tools can be employed by those interested to start an energy community to help them in the various aforementioned steps. Some tools aim to help users navigate through the possible steps and learn from best practices, while others focus on specific aspects and provide answers tailored to the case. There are also tools for management of the energy and grid aspects of the energy community, but these are often commercial or very technical for users without sufficient background. This report will focus on open-source tools.

Kazimi et al. have recently reviewed open-source datasets, models and tools that can support energy communities from the technology perspective (Kazmi, et al. 2021). Such models and tools focus on the determination and forecasting of energy demand and production, design and optimisation of production assets and energy storage, estimation of flexibility, energy flow tracking, and generally process and visualise the relevant data. These tools have a clear use in determining the technical and economic feasibility, however they require a certain expertise and would be used at a more advanced stage. Therefore, this type of tools is not part of this analysis.

This section provides an overview of available open-access tools that can be employed by persons without significant technical background at early stages of the process of building an energy community.

## 1. Community Energy – A practical guide to reclaiming power

Friends of the Earth Europe, Energy Cities and REScoop.eu, with the support of the community power coalition, developed a guide to help citizens navigate all stages of setting up and running an energy community. These organisations aim to speed up the development of community energy in Europe and produce various material for this cause. This guide contains practical tips, information and tools related to starting up a community energy initiative. Bringing the group together, selecting a legal form and the kind of project or technology are covered by the guide. Also challenges at the initial phase, finding funding or finance, and getting grid access are briefly discussed.

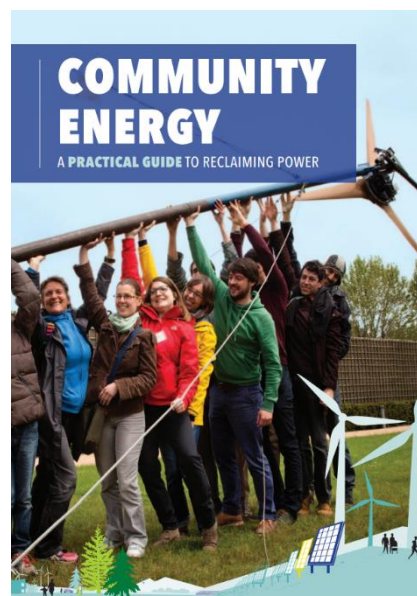


FIGURE 1. COMMUNITY ENERGY PRACTICAL GUIDE FRONT PAGE.

TABLE 1. OVERVIEW OF COMMUNITY ENERGY – A PRACTICAL GUIDE TO RECLAIMING POWER.

<b>Type of tool</b>	One document (guide)
<b>Focus</b>	Stakeholder engagement Legal organisation Technology selection
<b>Aim</b>	Step-by-step guide to initiate community energy projects
<b>Stage of EC development</b>	Initiation
<b>Generic/ tailored</b>	Generic guide
<b>Availability</b>	Publicly available online in 7 languages
<b>Updates &amp; maintenance</b>	One-time document
<b>Part of a project or commercial</b>	Support from European Community Power Coalition (published in Oct 2020)
<b>Limitations</b>	
<b>Link</b>	<a href="https://energy-cities.eu">Community Energy - Energy Cities (energy-cities.eu)</a>

## 2. Community Energy Toolkit

The International Renewable Energy Agency (IRENA) Coalition for Action has as goal to advance the uptake of renewable energy in the global energy mix and accelerate energy transitions. The Coalition's Working Group on Community Energy has put forward a Community Energy Toolkit, in the form of a white paper, presenting case studies of communities actively participating in energy decision making around the world, with the aim to inspire citizens and communities. The paper also provides a checklist and additional resources for energy communities to use in their first steps towards identifying their needs and developing their vision.

This toolkit focuses on distilling key lessons from a number of existing community energy projects. It covers cultural and gender considerations, which are not always considered by energy communities, and also considers cases from around the globe. While these are important issues, and the paper provides some useful considerations for developing a vision for such initiatives, there is less focus on practical aspects.



FIGURE 2. DIMENSIONS OF COMMUNITY ENERGY, ACCORDING TO THE COMMUNITY ENERGY TOOLKIT.  
(SOURCE: [COMMUNITY ENERGY TOOLKIT](#))

TABLE 2. OVERVIEW OF COMMUNITY ENERGY TOOLKIT.

<b>Type of tool</b>	One document (best practice examples and checklist)
<b>Focus</b>	Ownership and governance, socio-economic impacts, technology, policy context, financing, cultural/ gender considerations
<b>Aim</b>	Identifying the needs of the community and developing a vision
<b>Stage of EC development</b>	Vision creation, Initiation
<b>Generic/ tailored</b>	Generic guide
<b>Availability</b>	Publicly available online in English
<b>Updates &amp; maintenance</b>	One-time document
<b>Part of a project or commercial</b>	IRENA Coalition for Action (published in Nov 2021)
<b>Limitations</b>	
<b>Link</b>	<a href="#">Community Energy Toolkit</a>

### 3. COMPILE COOLkit and technical tools

The COMPILE project, funded by the European Union's Horizon 2020 research and innovation programme, has as main aim to show the potential of energy communities in the decarbonisation of the energy system and the creation of environmental and socioeconomic benefits. They intend to foster

the creation of energy communities providing among others the technical tools needed for the integration of energy systems.

## COOLkit

**COOLkit** is COMPILE's web-based knowledge repository that contains information to help you start an energy community. It contains a Stakeholder Engagement guide about how to engage people, a Financing guide describing the various ownership models and how to finance the project, and a Best Practice guide with a collection of experiences of energy communities around Europe. There is also a section describing Technical Tools that the project is developing, which will be described separately in the following section.

The **Stakeholder Engagement guide** provides guidance and tools on how to organise the group, how to develop projects together and how to mobilise others to join the initiative. It describes the possible structure of this energy community, the roles and rights of the members and volunteers, but also how to make the energy community a democratic organisation.

The **Financing guide** explains the basic principles related to financing and ownership for energy communities and gives guidelines for building up a financing plan. Advice is given on the legal forms an energy community may choose to develop its projects. Equity, debt and other forms of finance are discussed with their benefits and disadvantages, and with relevant examples.

The **Best Practice guide** shares experiences accumulated by REScoop.eu since its founding to allow existing or emerging energy communities to draw lessons and get inspired to start their own initiative or experiment with innovative projects and collective schemes. The examples are structured around the type of activities or technology used.



**FIGURE 3. PREVIEW OF THE COMPILE COOLKIT KNOWLEDGE PLATFORM.**

COOLkit can be found on the COMPILE website: <https://www.compile-project.eu/products/coolkit/>. The user can navigate through the different guides via a user interface allowing the selection of different aspects, as shown in Figure 3. The material is also available in the format of reports that can be downloaded for free. An overview of the toolkit's main characteristics can be found in Table 3.

TABLE 3. OVERVIEW OF COMPILE COOLKIT AND TECHNICAL TOOLS

	COOLkit	GridRule, HomeRule, ComPilot, ValueTool, EVrule
<b>Type of tool</b>	Online repository with own material	Technical tools, cloud-based
<b>Focus</b>	Stakeholder engagement Organisation Financing	Grid management Community self-consumption Building level energy management Members management EV charging strategies
<b>Aim</b>	Introduction to tools and methods to provide ideas and inspiration.	Facilitate energy community operation.
<b>Stage of EC development</b>	Initiation	Initiation, Operation
<b>Generic/ tailored</b>	Generic guide	Tailored to each project
<b>Availability</b>	Publicly accessible online, with downloadable reports.	Commercial tools
<b>Updates &amp; maintenance</b>	Ongoing project, no information on maintenance in the future	Will be commercially managed
<b>Part of a project or commercial</b>	COMPILE project (Horizon 2020) Nov 2018- Oct 2022 (Technical tools will be commercialised)	
<b>Limitations</b>		
<b>Link</b>	<a href="https://coolkit-compile-project.eu">COOLkit - Compile Project (compile-project.eu)</a>	<a href="https://technicaltools-compile-project.eu">Technical Tools - Compile Project (compile-project.eu)</a>

## Technical tools

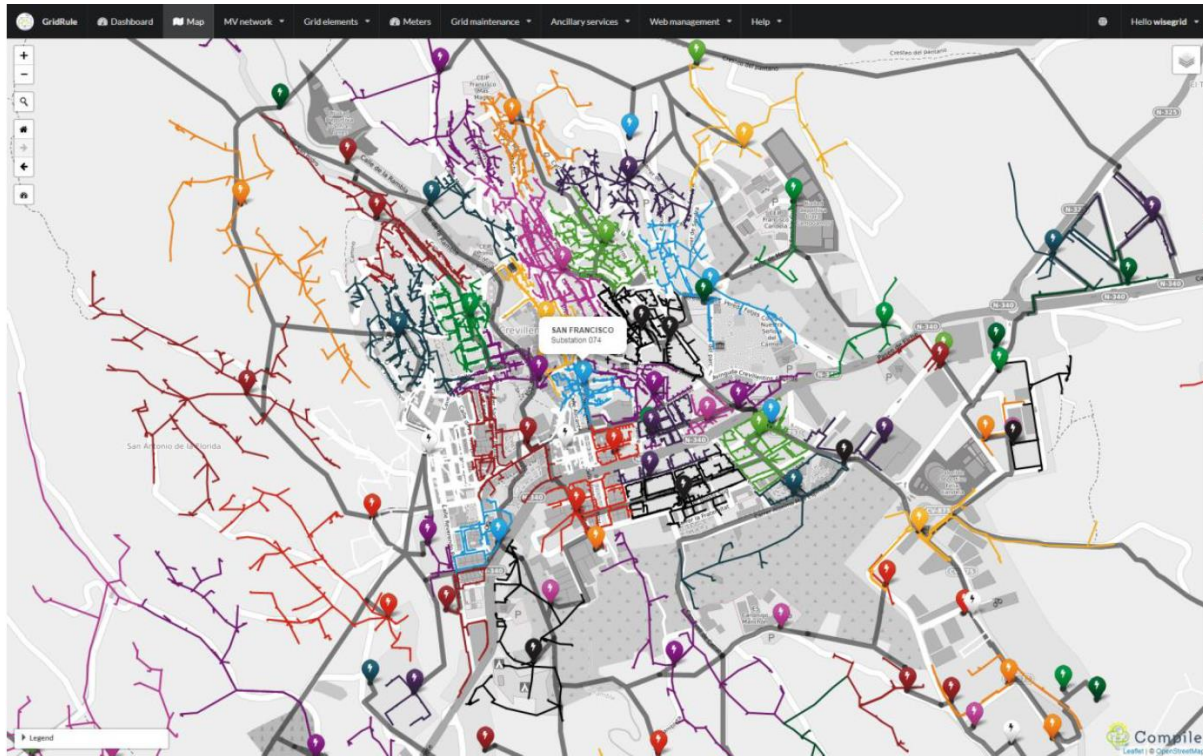
The project partners are also developing various technical tools to help energy communities manage and optimise their energy use. These, however, have a high technology readiness level and will be commercialised. Nevertheless, as they could be potentially very useful for energy communities, we describe them briefly here. The tools share the same architecture and can communicate with each other. They can be deployed on a virtual machine in the cloud and have a graphical user interface (GUI). More details can be found in Deliverable 4.1 of the project.

**GridRule** focuses on the operation, control and management of microgrids, aiming to improve their flexibility, stability and security. It is specifically designed for energy communities, as it allows coordination of individual members to optimize the whole community energy needs while taking into account each member's preferences. Some of the features include community battery management and community self-consumption optimization. The tool includes a dashboard displaying general data on the grid status, an interactive map of the grid, various graphical representations of measurements and power flows, information about all grid elements and meters, a grid maintenance section and tracking of demand response campaigns.

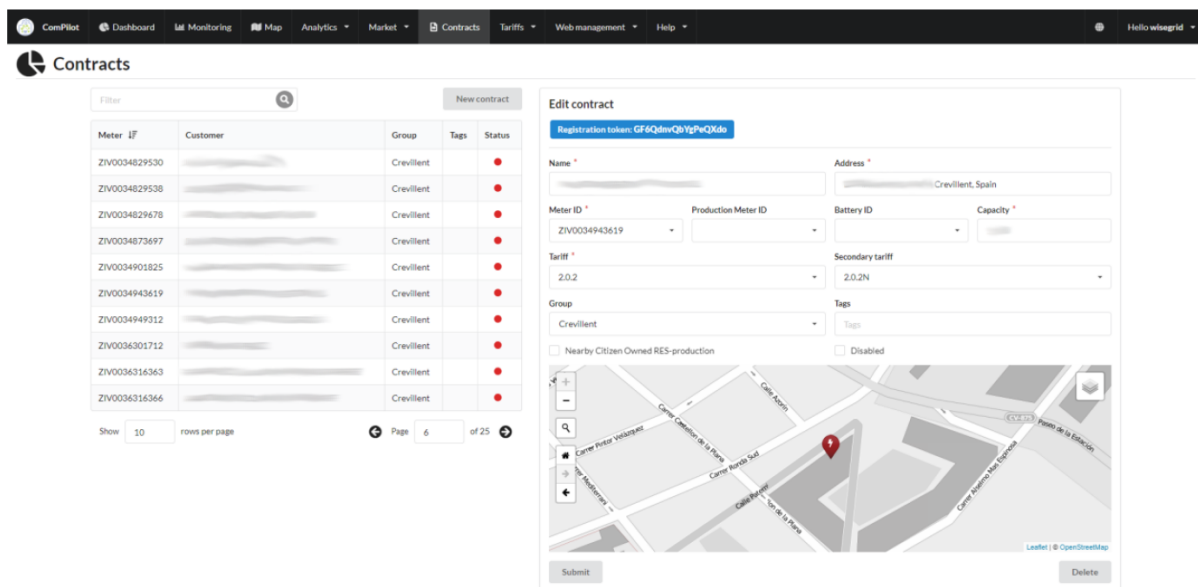
**HomeRule** focuses on energy management at the building level. The application supports the management of PV systems, home batteries and will be expanded to include electric vehicle chargers, heat pumps and other smart devices. Some of the features include voltage support, advanced PV curtailment and economic optimisation. This tool also offers a dashboard, a map and overview with summary data for each building in the portfolio, and it allows to perform tariff optimisation based on the measured consumption.



**ComPilot** focuses on the management of energy community members. This socio-technological digital platform can help an energy community manager to monitor and analyse data from different members and clusters of members, including energy demand, production, CO2 emissions and energy cost. It also allows managing contracts and tariffs.



**FIGURE 4. GRID MAP VIEW EXAMPLE FROM GRIDRULE. (SOURCE: COMPLILE DELIVERABLE 4.1 THE ENERGY COMMUNITY TOOLKIT)**



**FIGURE 5. MANAGING CONTRACTS IN COMPILOT. (SOURCE: COMPLILE DELIVERABLE 4.1 THE ENERGY COMMUNITY TOOLKIT)**

Two other tools will be developed by the project in a later stage. **ValueTool** will help the consumers to obtain the costs and benefits of installing PV panels to their building and simulate the return on investment based on previous electricity bill data. **EVrule** will focus on EV management and will communicate with GridRule. It will include prediction of EV user behaviour and will develop charging algorithms for fair redistribution of power.

#### 4. EMPOWER 2.0 Toolbox

EMPOWER 2.0 is an Interreg North Sea Region project aiming to empower citizens to become active energy citizens. Creating local energy communities is one of the main solutions for citizen energy ownership. To assist citizens, authorities and energy communities in producing their own green energy, the project created an online toolbox with resources relevant to that purpose. The toolbox is a collection of guides, projects, example cases and tools, including calculators, apps, and other platforms, either of local interest for countries participating in the project, or general for Europe. The user can browse these resources while filtering by theme, location or type of tool, or depending on the type of problem they want to solve (see Figure 6). The approach provides resources to address technical, legal and economic challenges, as well as building up the community.

This toolbox focuses strongly on the countries participating in the project, namely Belgium, Denmark, the Netherlands and the UK, however some of the tools and examples also come from or are applicable to other parts of Europe. Instead of a structured step-by-step guide, this tool provides resources more based on the user's needs, however this requires that the user knows what they are looking for.

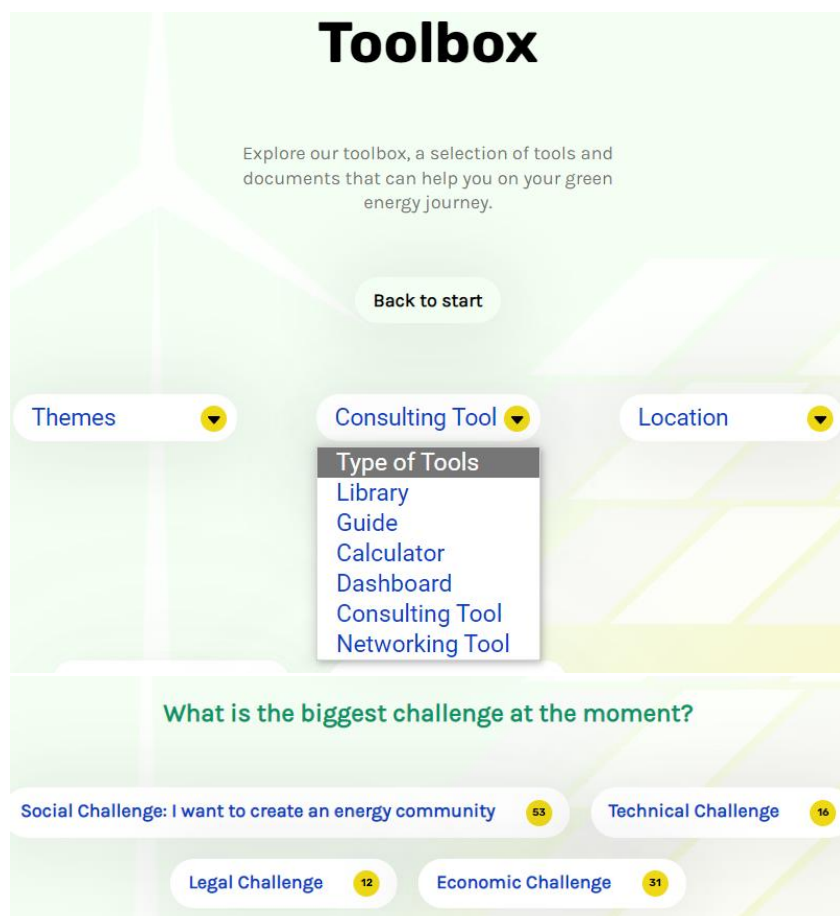


FIGURE 6. PREVIEW OF THE EMPOWER 2.0 TOOLBOX. (SOURCE: [HTTPS://WWW.TOOLBOX.ENERGY/TOOLS](https://www.toolbox.energy/tools))

**TABLE 4. OVERVIEW OF COMMUNITY EMPOWER 2.0 TOOLBOX.**

<b>Type of tool</b>	Online repository linking to other materials and tools
<b>Focus</b>	Renewable energy technologies Technical, legal & economic challenges
<b>Aim</b>	Assist citizens, authorities and energy communities to produce their own energy
<b>Stage of EC development</b>	Initiation mostly
<b>Generic/ tailored</b>	Generic repository, though it allows for targeted search depending on the problem
<b>Availability</b>	Publicly accessible online
<b>Updates &amp; maintenance</b>	Ongoing project, no information on maintenance in the future
<b>Part of a project or commercial</b>	EMPOWER 2.0 project Interreg Netherlands, Belgium, Denmark United Kingdom. 2019 - 2022
<b>Limitations</b>	Many resources focused on 4 participating countries.
<b>Link</b>	<a href="http://www.toolbox.energy/home">http://www.toolbox.energy/home</a>

## 5. EESIP resources database

The European Energy Social Innovation Platform (EESIP) is a platform created by the SocialRES Horizon2020 project, to be the point of reference for social innovation and citizen engagement in the renewable energy sector. The platform gathers resources for different aspects of renewable energy and social innovation, including energy communities. The users can find scientific papers, best practices, trainings and other types of material, which they can browse per topic, such as energy efficiency, renewable energy sources, storage, and social innovation.

The platform could potentially be a source of useful information, even though it has a broader focus than energy communities, however it contains at the moment only few entries. This type of platforms requires more regular maintenance and a large number of contributors to provide accurate and up-to-date information that can serve its purpose.

**TABLE 5. OVERVIEW OF EESIP RESOURCES DATABASE.**

<b>Type of tool</b>	Online repository linking to other materials and tools
<b>Focus</b>	Renewable energy, social innovation and citizen engagement (not specifically energy communities)
<b>Aim</b>	Information and knowledge sharing about the renewable energy sector
<b>Stage of EC development</b>	Not specific
<b>Generic/ tailored</b>	Generic repository
<b>Availability</b>	Publicly accessible online
<b>Updates &amp; maintenance</b>	Ongoing project, no information on maintenance in the future
<b>Part of a project or commercial</b>	SocialRES project (Horizon 2020) May 2019- Aug 2022
<b>Limitations</b>	Very limited content at the moment, energy communities not the primary focus.
<b>Link</b>	<a href="https://www.eesip.eu/resources/">https://www.eesip.eu/resources/</a>

## 6. REScoop.eu toolbox

REScoop.eu is the European federation of citizen energy cooperatives, which was founded in 2011. Its main purpose is to support citizens, businesses and local authorities that want to work on community energy. Among the various services they provide, they also maintain a toolbox, which is a collection of tools, reports and papers produced by the organisation or other sources. The material targets different

audience, such as citizens, local authorities, policy makers as well as researchers. Users can browse based on the type of activity, the project, the intended audience and type of resource.

Unlike other repositories which are project-based and may not be maintained after the duration of the project, this toolbox has been regularly updated by REScoop.eu, who furthermore produce new content on a regular basis. An example of this content is also the aforementioned Community Energy practical guide. REScoop.eu gathers experiences from around Europe to create their material, which is also reflected in the fact that some of the content is presented in multiple languages, making it more accessible.

**TABLE 6. OVERVIEW OF RESCOOP.EU TOOLBOX.**

<b>Type of tool</b>	Online repository linking to own and other materials and tools
<b>Focus</b>	Everything related to renewable energy cooperatives
<b>Aim</b>	Support citizens, local authorities and policy makers with all aspects of community-led renewable energy.
<b>Stage of EC development</b>	Not specific
<b>Generic/ tailored</b>	Generic repository
<b>Availability</b>	Publicly accessible online
<b>Updates &amp; maintenance</b>	The repository and own content are managed and updated on a regular basis by REScoop.eu
<b>Part of a project or commercial</b>	Maintained by REScoop.eu
<b>Limitations</b>	
<b>Link</b>	<a href="https://www.rescoop.eu/toolbox/all/all/all/online-tool">https://www.rescoop.eu/toolbox/all/all/all/online-tool</a>

## 7. BEcoop Toolkit and self-assessment tool

BECoop is a Horizon2020 funded project that focuses on energy communities and cooperatives dealing with bioenergy, mainly in the residential sector and small heating applications. The project aims to unlock the market potential of community bioenergy by providing the necessary conditions and technical as well as business support tools. Part of this project concerns the development of supporting resources and tools for developers and operators of community bioenergy and heating projects. The toolkit, which is a simple to navigate web-based repository of existing open-source tools and other related material, should cover steps of the process from the initiation to the growing stages and operation of a bioenergy community, as well as scaling up.

The toolkit is structured in three main categories of tools: **technical tools** addressing technical issues, **business model tools** concerning financial models and supply chain issues, **community model tools** for community building and management (see Figure 7). These include calculation tools, technical and policy databases, maps, reports and software, such as for example tools for collaborative decision-making. There is also a fourth category which lists **related projects** in the fields of renewable energies, energy communities, energy efficiency or circular economy. Finally, the project is preparing a **self-assessment tool** to evaluate the current status and future market potential of a bioenergy community project, providing recommendations for further development. This tool was planned for the end of 2021 and is described in a project's deliverable but is not yet available online (as of 31/01/2022).

## TOOLKIT

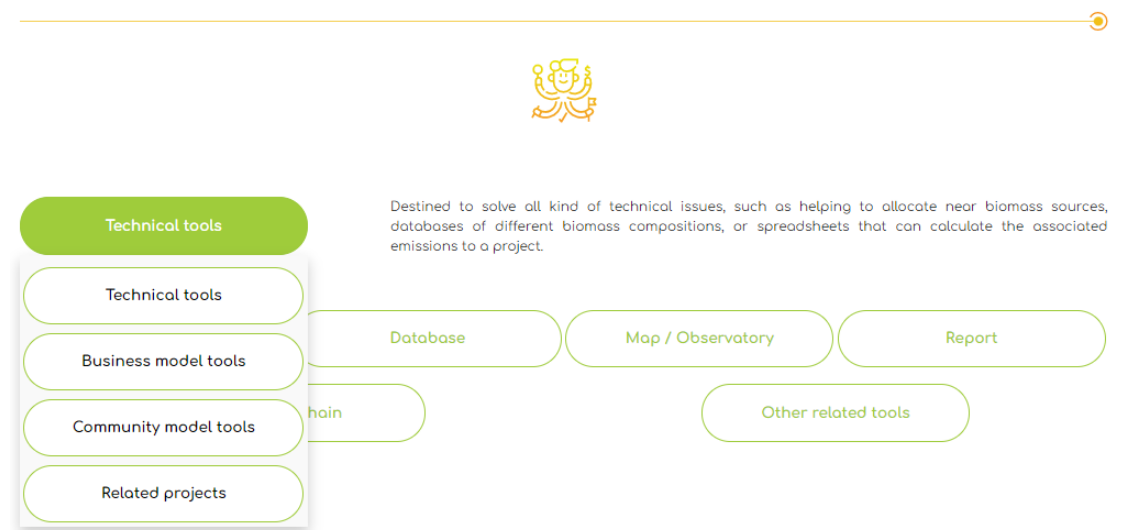


FIGURE 7. PREVIEW OF BECOOP TOOLKIT. (SOURCE: [HTTPS://BECOOP.FCIRCE.ES/TOOLKIT/](https://becoop.fcirce.es/toolkit/))

TABLE 7. OVERVIEW OF BECOOP TOOLKIT AND SELF-ASSESSMENT TOOL.

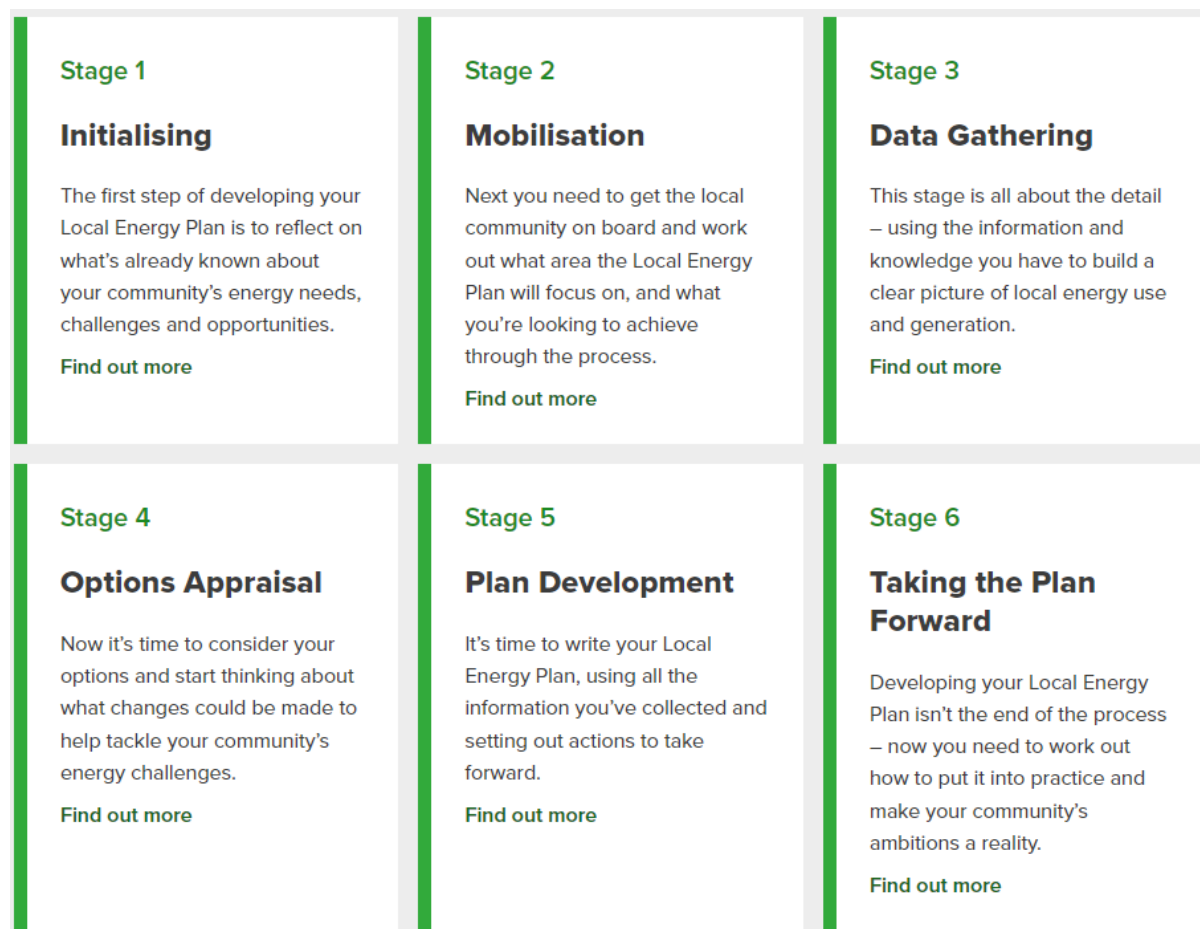
	Toolkit	Self-assessment tool
<b>Type of tool</b>	Online repository linking to other materials and tools	Web-based tool
<b>Focus</b>	Technical aspects Business model Community building and management	Resource assessment Partner assessment Technical aspects Business and financial aspects Social and environmental aspects
<b>Aim</b>	Provide resources and tools to support developers and operators of community bioenergy and heating projects	Assess current status of bioenergy community project and provide recommendations
<b>Stage of EC development</b>	Initiation, operation, scaling up	Initiation, operation
<b>Generic/ tailored</b>	Generic repository	Tailored to the project
<b>Availability</b>	Publicly accessible online	Not yet available, but will be publicly accessible online (potential registration needed)
<b>Updates &amp; maintenance</b>	Ongoing project, no information on maintenance in the future	Not yet available
<b>Part of a project or commercial</b>	BECoop project (Horizon2020) Nov 2020 – Oct 2023	
<b>Limitations</b>	Specific for energy communities dealing with bioenergy	
<b>Link</b>	<a href="https://becoop.fcirce.es">BECOOP TOOLKIT (fcirce.es)</a>	Descriptive report: <a href="#">D2.1 Self-assessment tool-First V1.0.pdf (becoop-project.eu)</a>

## 8. Community and Renewable Energy Scheme (CARES) Toolkit

Local Energy Scotland is a consortium that administers and manages the Scottish Government's Community and Renewable Energy Scheme (CARES), whose purpose is to support the development of locally owned renewable energy projects with wider community benefits. For that purpose, it offers a wide range of guides, resources and tools, covering community energy planning and the development of such projects. All the material is publicly accessible online.

The **community-led local energy plan toolkit** discusses how to engage the community and develop a common local energy plan that takes into consideration the current and future energy requirements of the community, and that evaluates different technological options. The process is described in six stages: initializing, mobilisation, data gathering, options appraisal, plan development and taking the plan forward (see Figure 8).

Further, there are several guides and introductory material for different **technology options**, including solar, wind, heat pumps, biomass, community-owned microgrids and others. The **business planning** section of the CARES toolkit provides information on sources of finance, project finance, shared ownership models, contracts for difference, electricity markets and feed-in-tariffs. The **project development** section provides details on various aspects, from developing the project idea to project planning, site selection, construction,, grid connection and procurement. Finally, the toolkit also discusses how to **establish a community group**, including the different legal forms, the management and governance of the group, and how to develop partnerships and collaborations.



**FIGURE 8. PREVIEW OF COMMUNITY-LED LOCAL ENERGY PLAN TOOLBOX OF CARES TOOLKIT (SOURCE: [COMMUNITY-LED LOCAL ENERGY PLAN TOOLKIT - LOCAL ENERGY SCOTLAND](#)).**



The CARES toolkit is not specific to energy communities. However, it provides various supporting material, such as spreadsheet templates, checklists, methods, and case studies. These tools could be employed by citizens interested to develop an energy community, selecting the parts that are relevant for them. The offered material contains more general advice, which can be widely applicable, as well as templates and examples that are tailored to Scotland and the CARES scheme. Some of the templates, however, could be adapted with minor modifications to other contexts as well.

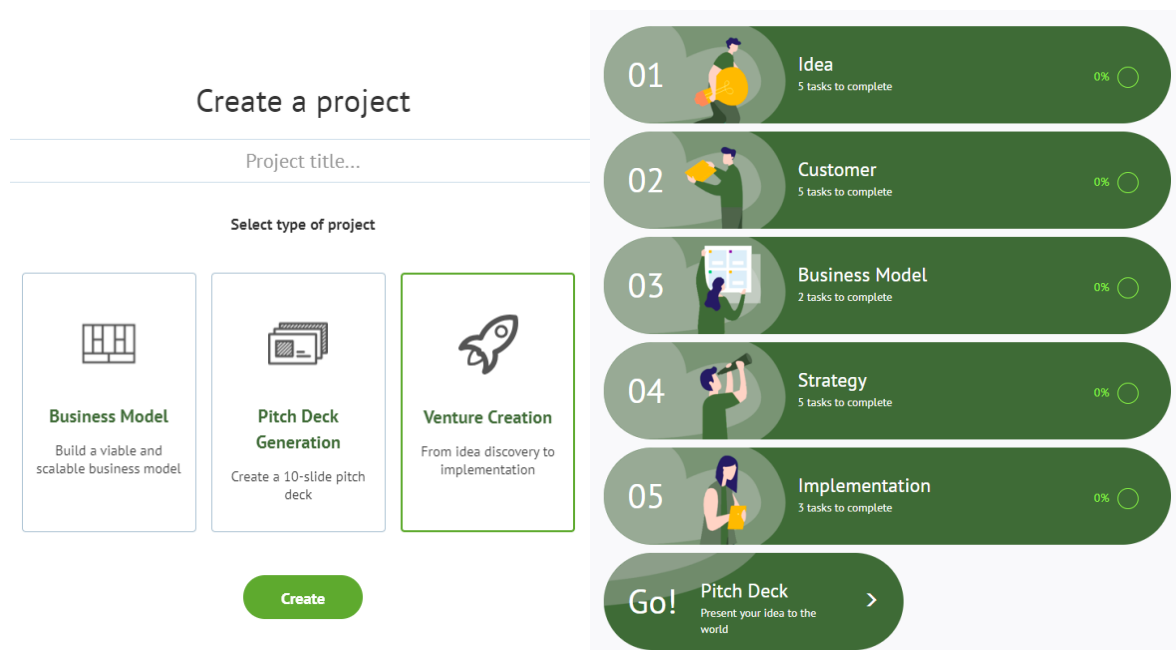
**TABLE 8. OVERVIEW OF THE CARES TOOLKIT.**

<b>Type of tool</b>	Online repository with dedicated material and tools
<b>Focus</b>	Community engagement Community energy planning Technology options review Organisation setup and governance Business models and financing Project planning and development
<b>Aim</b>	Step-by-step guide for the development of a renewable energy project, from goal determination to implementation.
<b>Stage of EC development</b>	Initiation, project development
<b>Generic/ tailored</b>	Generic guides but also tools (templates) that can be used individually. More tailored to CARES program and Scottish regulatory framework.
<b>Availability</b>	Publicly accessible online
<b>Updates &amp; maintenance</b>	The repository and content are managed and updated on a regular basis by Local Energy Scotland
<b>Part of a project or commercial</b>	Managed by Local Energy Scotland
<b>Limitations</b>	Some of the material applies to the Scottish CARES scheme specifically
<b>Link</b>	<a href="#">Resources overview - Local Energy Scotland</a>

## 9. inteGRIDy Business Modelling Tool

In the inteGRIDy Horizon 2020 project, several methods and solutions were explored to optimise the operation of the electricity grid with distributed electricity production and storage. Among other outputs, the project has developed a business modelling tool with the aim to develop business model options for innovative energy solutions, evaluate their market suitability and replicability in other EU countries, and support the refinement of business ideas into business plans. The various modules of the tool were tested in workshops, teaching activities and in the pilot projects. A new Horizon Europe project OMEGA-X will further take up the tool, maintain and develop it further.

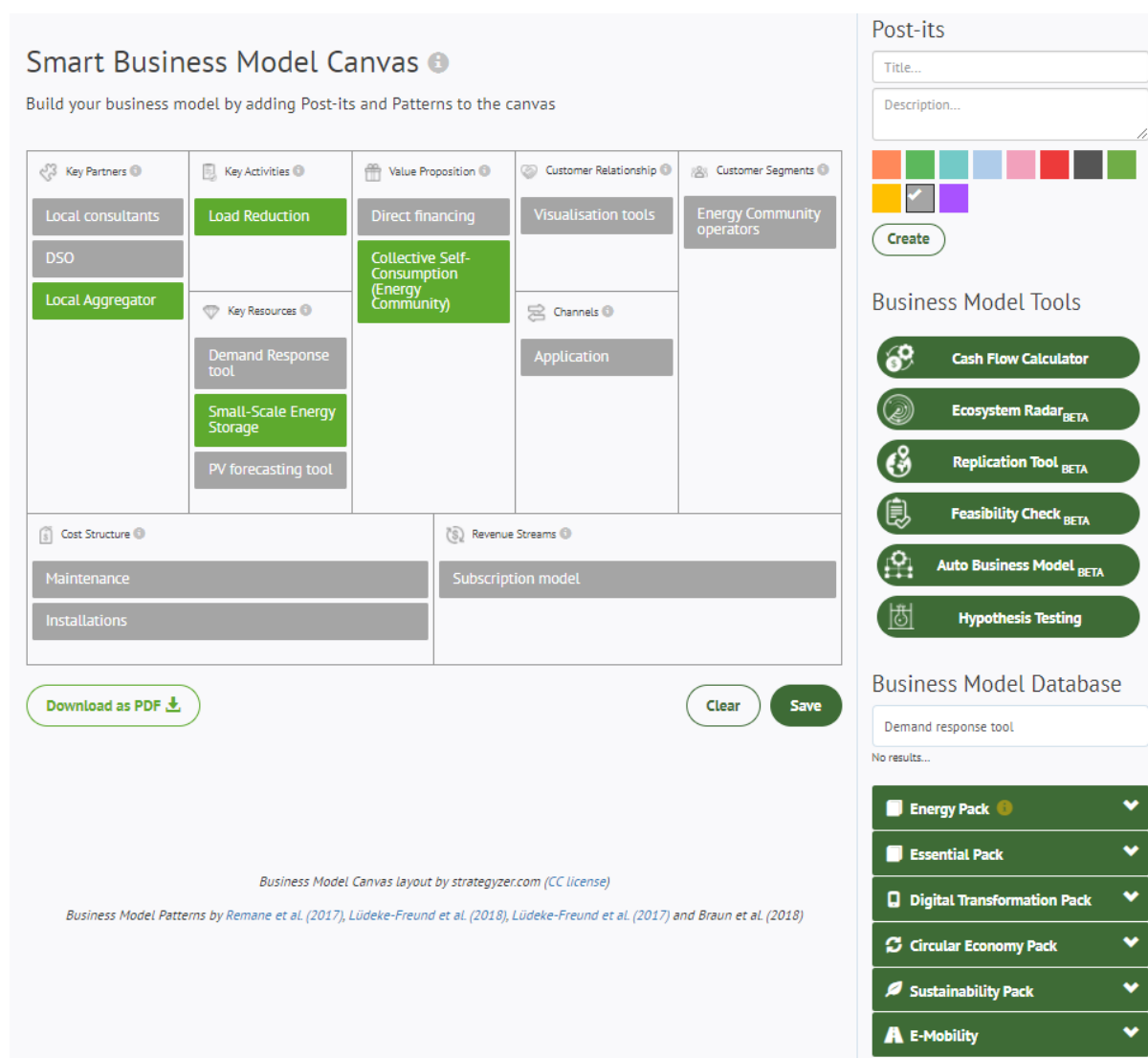
The web-based tool is publicly available but requires the creation of an account to access it. In the tool, the user can create different projects and choose to get step-by-step guidance for creating a new energy venture from scratch. There is also the possibility to only focus on the business model development or generating a pitch deck for the project. The guide provides templates and tools to support the user in completing the different steps.



**FIGURE 9. PREVIEW OF INTEGRIDY BUSINESS MODELLING TOOL. CREATION OF NEW PROJECT AND STEPS IN VENTURE CREATION. (SOURCE: [INTEGRIDY BUSINESS MODELLING TOOL \(VENTURELY.IO\)](https://venturely.io))**

To develop the business model, an interactive business model canvas is available, with a library of generic and more specific business model patterns to choose from. The tools allow the user to perform a cash flow analysis on the basis of inserted values per component of the canvas. Based on the value proposition, the tool can also provide information on similar companies and potential competitors according to a database of more than 3000 companies. Another feature is the feasibility and replicability assessment, which checks whether specific patterns of the business model have favourable conditions in the selected country and other countries for comparison. This only works for a set of pre-determined patterns. It is also unclear whether the information used for this assessment (primarily regulatory aspects) is regularly updated. Some additional features include the Knowledge Hub, where information material is gathered for each step in the business model development process, and the Smart Bot, which provides assistance for all the key functionalities of the tool.





**FIGURE 10. PREVIEW OF INTEGRIDY BUSINESS MODELING TOOL, WHERE A BUSINESS MODEL CANVAS IS DEVELOPED. (SOURCE: [INTEGRIDY BUSINESS MODELLING TOOL \(VENTURELY.IO\)](https://venturely.io/integridy-business-modelling-tool))**

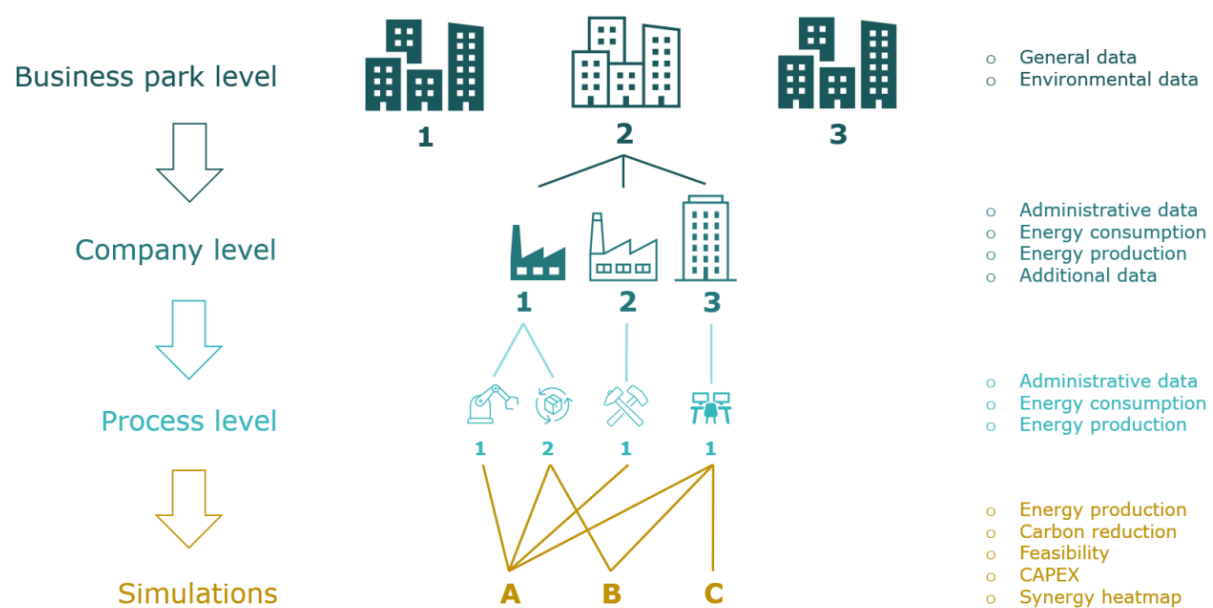
**TABLE 9. OVERVIEW OF INTEGRIDY BUSINESS MODELLING TOOL.**

<b>Type of tool</b>	Web-based tool
<b>Focus</b>	Business model development
<b>Aim</b>	Develop business model and check market suitability and replicability in other countries
<b>Stage of EC development</b>	Initiation
<b>Generic/ tailored</b>	Tailored to the project
<b>Availability</b>	Publicly accessible online, but requires creating an account
<b>Updates &amp; maintenance</b>	Will be further developed and maintained under new Horizon Europe project OMEGA-X (2022-2025)
<b>Part of a project or commercial</b>	integridy project (Horizon 2020) Jan 2017-Jun 2021
<b>Limitations</b>	
<b>Link</b>	<a href="https://www.integridy.eu/content/integridy-business-modelling-tool">https://www.integridy.eu/content/integridy-business-modelling-tool</a> <a href="https://venturely.io/integridy-business-modelling-tool">integridy Business Modelling Tool - integridy Business Modelling Tool (venturely.io)</a>

## 10. Renewable Energy Area Collaboration Tool (REACT)

Goal of the Interreg 2 Seas project BISEPS was reduce the carbon footprint of business clusters by facilitating the deployment of midscale sustainable energy technologies. More specifically, the objective was to cluster the demand of the cluster and reorganising an integrated common energy supply system with low carbon technologies that employs the synergies between businesses. For this purpose, the project developed the open-source Renewable Energy Area Collaboration Tool (REACT), which was based on experience, scientific literature and theoretical insights from other projects, and was tested on-site in the project's living labs.

The tool provides a first assessment of the optimal energy solutions for the companies in a business park, taking into account technical, economic, financial, legal, spatial and organisational parameters. The tool's architecture is shown in Figure 11. Inputs for basic energy data need to be given for each process of every company in the business park. It is possible to determine the daily and weekly shape of energy demand for each process and type of fuel used. REACT then simulates for the selected combination of businesses and processes the energy production, carbon emissions reduction and CAPEX of various possible solutions and estimates their technical feasibility. The result is a high-level advice on the best suited energy solutions for the business park, based on the above results.



**FIGURE 11. SCHEMATIC REPRESENTATION OF THE ARCHITECTURE OF REACT. (SOURCE: [HTTP://WWW.BISEPS.EU/REACT/](http://www.biseps.eu/react/))**

REACT is accompanied by a manual and video tutorials in English, French and Dutch. The manual contains the main assumptions of the simulation, however without providing all details of the model. As this tool is targeting business clusters, it is not straightforward to use it for local energy communities for residential users without more knowledge of the underlying method. In any case, the tool currently is not taking into account grid restrictions, operational costs, network tariffs, or services such as P2P, peak shaving or smart car charging.

**TABLE 10. OVERVIEW OF REACT TOOL.**

<b>Type of tool</b>	Web-based tool
<b>Focus</b>	Energy production Technical feasibility Carbon emission savings Optimal solution
<b>Aim</b>	Determine the optimal low carbon technology solutions for business clusters
<b>Stage of EC development</b>	Initiation
<b>Generic/ tailored</b>	Tailored to the project
<b>Availability</b>	Publicly accessible online, but requires creating an account. Available in English, French and Dutch.
<b>Updates &amp; maintenance</b>	Currently working, no further information available on maintenance
<b>Part of a project or commercial</b>	BISEPS project (Interreg 2 Seas) May 2016 - Apr 2020
<b>Limitations</b>	Focused on business clusters, not residential consumers/prosumers. No grid limitations, operational costs, network tariffs considered.
<b>Link</b>	<a href="#">REACT Tool – Bisepts</a>

## 11. Consumer Stock Ownership Plan (CSOP) calculator

With the aim to include vulnerable groups in renewable energy investments, the Horizon 2020 project SCORE proposes to use the Consumer Stock Ownership Plan (CSOP) as business model. With this model, an intermediary entity invests in a renewable energy asset and operates it on behalf of different co-owners. It allows the co-investment of municipalities, small and medium sized enterprises (SMEs) and other local stakeholders. Employing one bank loan instead of many micro loans, CSOPs reduce transaction costs. This financing method should thus enable individuals, in particular low-income households, to invest in renewable projects and also participate in decision making, as their interests are represented by a trustee in the board of directors.

The project's website provides information and guidance on this financing model, but also includes a simple web-based interactive tool to calculate whether this type of financing would make sense for a group of individuals. This CSOP calculator requires basic inputs, such as the number of households, financial contribution per household, rough technical specifications of the renewable energy plant (PV, wind, CHP), and economic parameters. It then estimates the energy demand and production, the yield, costs and loan repayment, concluding whether the project is feasible and what would be the loan repayment time (See Figure 12).

Information on the assumptions and modelling behind this tool are not immediately accessible on the tool's website, though a handbook is under development (as of 31/01/2022). For the moment, it is unclear under which conditions the results provided by this tool can be employed and with which uncertainty. Furthermore, some important aspects, such as the calculations of the demand and generation can be hardly customised, thus not allowing a more tailored result.

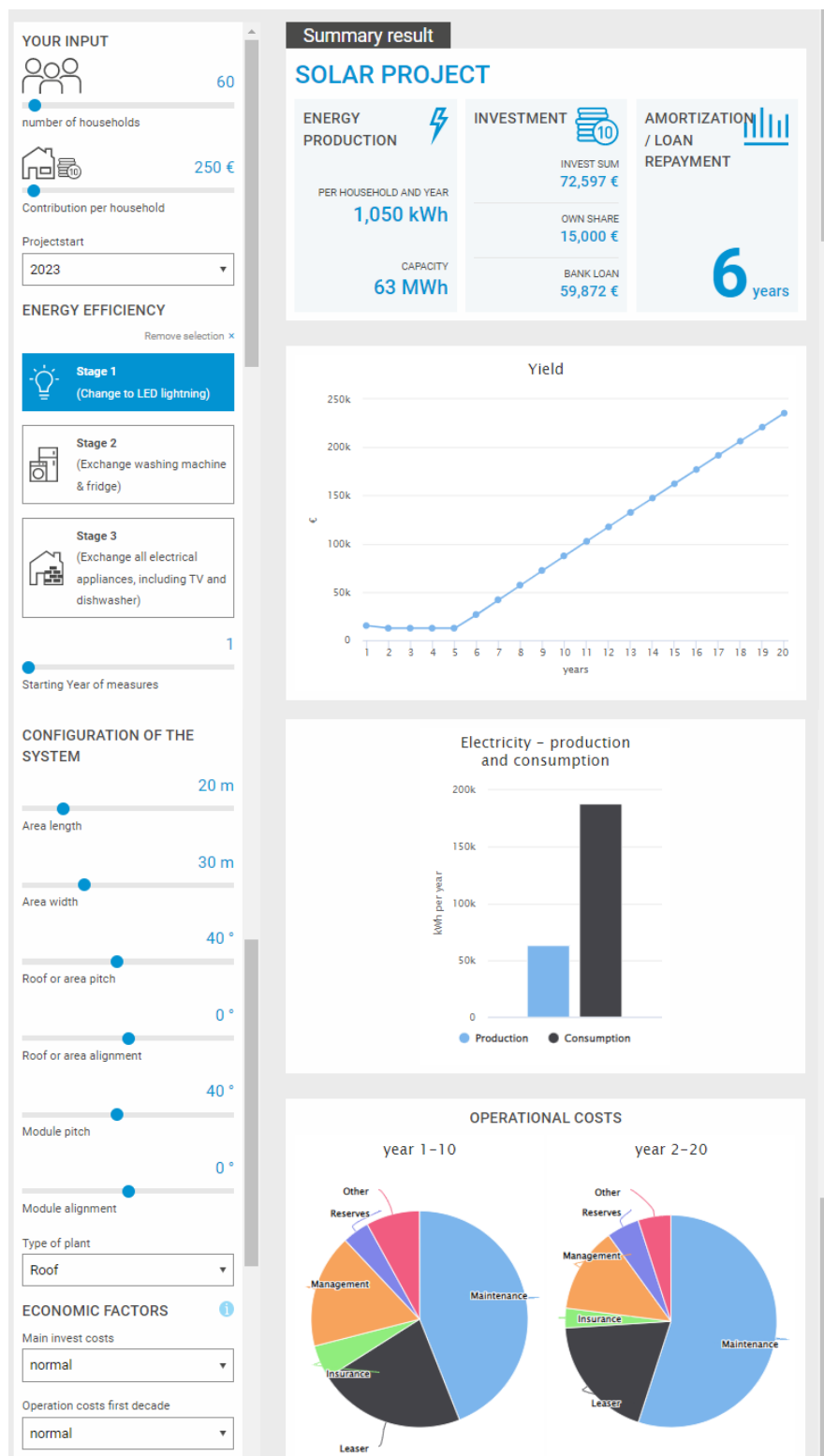


FIGURE 12. PREVIEW OF CSOP CALCULATOR (SOURCE: [CSOP CALCULATOR | SCORE \(SCORE-H2020.EU\)](https://score-h2020.eu/))

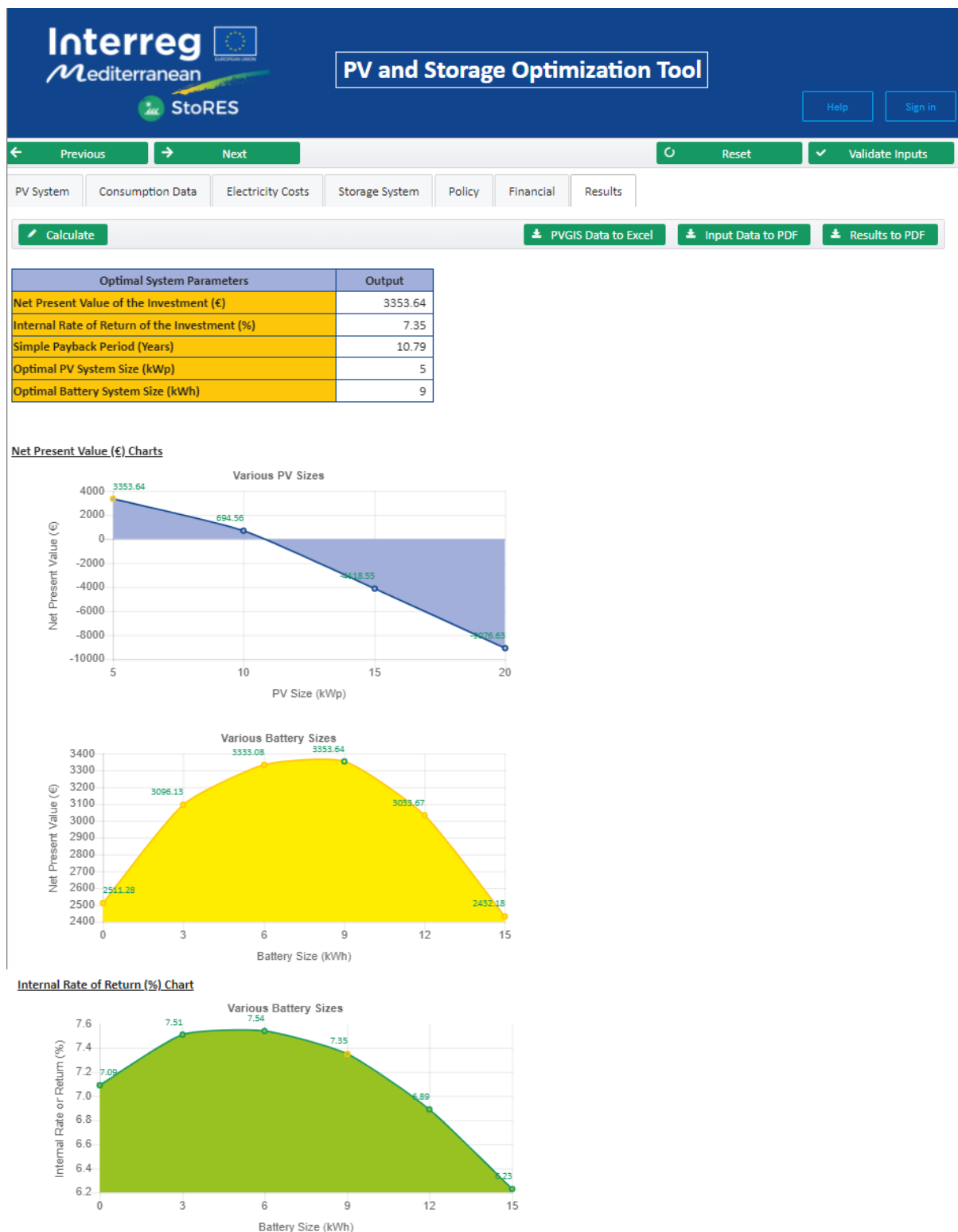
**TABLE 11. OVERVIEW OF CSOP CALCULATOR.**

<b>Type of tool</b>	Web-based tool
<b>Focus</b>	Economic feasibility of the project Operational costs
<b>Aim</b>	Preliminary estimation of the economic feasibility of a renewable energy investment (PV, wind, CHP)
<b>Stage of EC development</b>	Initiation
<b>Generic/ tailored</b>	Tailored to the project (only basic customisation)
<b>Availability</b>	Publicly accessible online
<b>Updates &amp; maintenance</b>	It is currently maintained by European Viadrina University. A handbook is under development.
<b>Part of a project or commercial</b>	SCORE project (Horizon 2020) Apr 2018-Dec 2021
<b>Limitations</b>	Focuses on the CSOP business model specifically The assumptions of the tool are not available
<b>Link</b>	<a href="https://score-h2020.eu">CSOP Calculator   SCORE (score-h2020.eu)</a>

## 12. StoRES PV and Storage Optimization Tool

In the frame of the StoRES Interreg Mediterranean project, a tool was developed to help private consumers and professionals calculate the optimal size for photovoltaics coupled with a storage system. The aim of the project was to increase the integration of renewable energy in islands and rural municipalities, starting in a few Mediterranean selected countries (Cyprus, France, Greece, Italy, Portugal, Slovenia and Spain). The free interactive online tool performs an optimisation of the solar installation and battery size. The required inputs include except for the PV and battery size range, the electricity consumption, the location or solar irradiation, technical parameters, financial parameters, energy policies and electricity costs. Pre-set values are available for most parameters, and when applicable tailored to the selected 7 countries of the project. The tool performs a financial analysis for 20 years, offering as a result the optimal system size, the net present value, internal rate of return on the investment and the simple payback period. The results can be exported after the analysis.

The optimisation tool is accompanied by a manual on the same web page, where instructions are provided for all the steps. Furthermore, the page links to a scientific publication whose method is used for part of the calculations, though the exact assumptions are not mentioned. The tool can be useful for energy communities aiming for a first estimation of the optimal size of small-scale PV systems with batteries for auto-consumption.



**FIGURE 13. PREVIEW OF THE RESULTS OBTAINED FROM THE PV AND STORAGE OPTIMISATION TOOL.**  
(SOURCE: [StoRES TOOL - StoRES App](#))

**TABLE 12. OVERVIEW OF STORES PV AND STORAGE OPTIMIZATION TOOL.**

<b>Type of tool</b>	Web-based tool
<b>Focus</b>	Optimise technology systems
<b>Aim</b>	Calculate optimal combination of solar PV and battery system
<b>Stage of EC development</b>	Initiation of specific technology project
<b>Generic/ tailored</b>	Tailored to your project
<b>Availability</b>	Publicly accessible online
<b>Updates &amp; maintenance</b>	Currently working, no further information available on maintenance
<b>Part of a project or commercial</b>	StoRES project (Interreg Mediterranean) Mar 2017- Mar 2020
<b>Limitations</b>	Included data only for selected countries, though custom data can also be used
<b>Link</b>	<a href="#">StoRES Tool - StoRES App</a>

### 13. Hotmaps

Aim of the Hotmaps Horizon 2020 project was the development of an open-source heating and cooling mapping and planning toolbox that provides data at local and national level for EU28. The toolbox is primarily meant to help public authorities and energy planners develop heating and cooling strategies for a region, by mapping and analysing resources and energy needs. However, the same information could be utilised by an energy community investigating the potential of district heating or other solutions for heating and cooling in a large area.

The GIS-based toolbox consists of a map with EU 28 countries with different layers that provide information on the following:

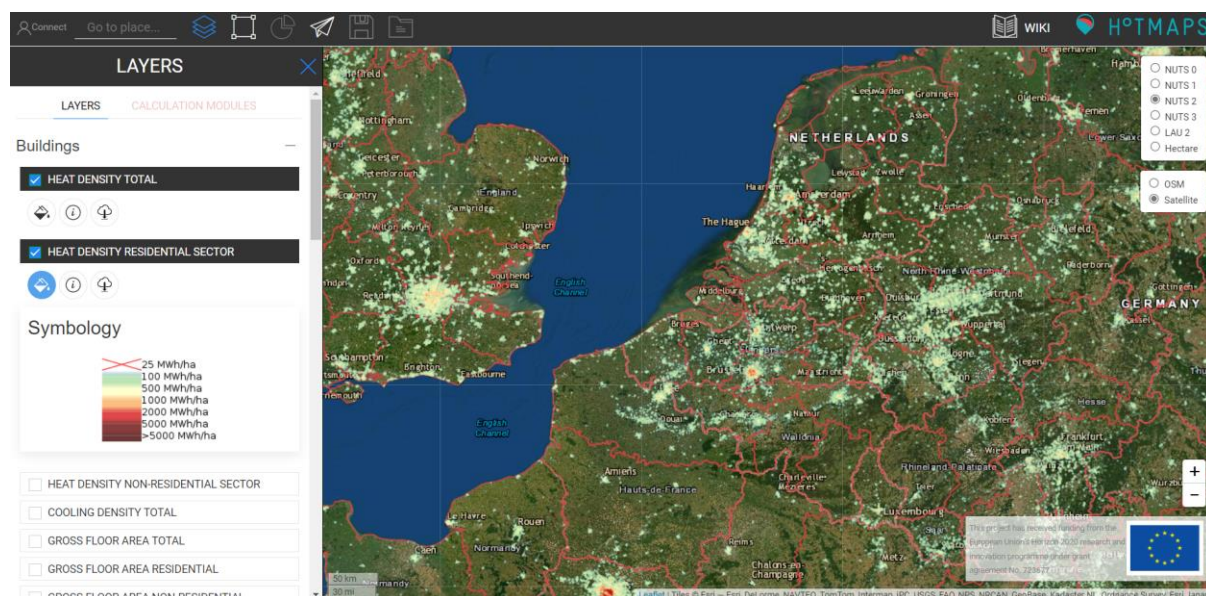
- Current heating and cooling demand density
- Floor area and volumes of buildings
- Industrial sites and their excess heat
- Renewable energy potential for solar, wind, geothermal energy
- Sources of biomass
- Population
- Climate data, such as average temperature, heating/cooling degree days, solar radiation and wind speed

Some of the parameters, such as the heating and cooling demand, and the solar and wind potential, are given with a resolution of 100mx100m.

It is further possible to select specific areas and perform some analyses with the proposed calculation modules, such as:

- Identification of renewable energy potential to supply heating and cooling
- Identification of waste heat potential from industrial facilities
- Estimation of the potential for efficient district heating options
- Estimation and comparison of the costs of individual heating vs. district heating options
- Development of scenarios for decarbonisation pathways of heating and cooling





**FIGURE 14. PREVIEW OF HOTMAPS TOOL SHOWING THE HEAT DENSITY. (SOURCE: [TOOLBOX \(HOTMAPS.EU\)](https://toolbox.hotmaps.eu))**

The tool and related modules run without requiring any other commercial tool or software, nor registration. However, a registered user can save their session and recall it later on. Furthermore, the source code and datasets are available online, while the accompanying Wiki page offers a detailed manual, training material, examples and other guides. The data collection and calculation methods are described in detail in a project deliverable also linked in the Wiki page.

**TABLE 13. OVERVIEW OF HOTMAPS.**

<b>Type of tool</b>	Web-based tool
<b>Focus</b>	Heating and cooling energy demand and supply, Renewable energy potential Waste heat potential District heating options potential and cost
<b>Aim</b>	Map and analyse heating and cooling needs and available resources to develop strategies at local and national level.
<b>Stage of EC development</b>	Initiation of specific technology project
<b>Generic/ tailored</b>	Tailored to the location of interest
<b>Availability</b>	Publicly accessible online, possibility to create an account
<b>Updates &amp; maintenance</b>	Currently working, no further information available on maintenance
<b>Part of a project or commercial</b>	Hotmaps project (Horizon 2020) Oct 2016 – Sep 2020
<b>Limitations</b>	
<b>Link</b>	<a href="https://hotmaps-project.eu">Hotmaps Project - The open source mapping and planning tool for heating and cooling (hotmaps-project.eu)</a> <a href="#">Wiki page</a> <a href="#">Deliverable D2.3 WP2 Report – Open Data Set for the EU28</a>

## 14. POWERPOOR Energy Poverty Mitigation Toolkit

POWERPOOR is a Horizon 2020 project with the goal to support citizens suffering from energy poverty by developing support programmes that are implemented in eight European countries. The project aims to enable citizens in energy poverty to use alternative financing options, including energy cooperatives, to encourage knowledge and experience sharing, and promote small-scale energy efficiency

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interventions and renewable energy source installations. While the project is not directly focused on energy communities, it tries to make energy communities more accessible to citizens suffering from energy poverty.

To support these programmes and facilitate the process, the POWERPOOR toolkit was developed. It includes three different tools that are accessible on the project's website. PowerTarget and PowerAct require the user to create an account and fill-in surveys on their building and energy use, while PowerFund is a separate website with open access information.

**PowerTarget** identifies using a data-driven approach whether the user is suffering from energy poverty based on the answers to a survey of their energy use. It then points to Power Act and PowerFund proposing different actions, such as to apply best practices to decrease energy consumption, to join an energy community as protected member, or to explore programs to improve energy efficiency of the home. **PowerAct** empowers energy poor citizens to understand their energy usage, the benefits associated with implementing energy efficiency interventions and leveraging renewable energy installations. Based on a simple survey on the residence, heating, cooling and electricity use and habits, it provides a score and proposed solutions to reduce energy bills and become more sustainable. Both tools are fairly basic and provide simple tips to individuals that suffer from energy poverty.

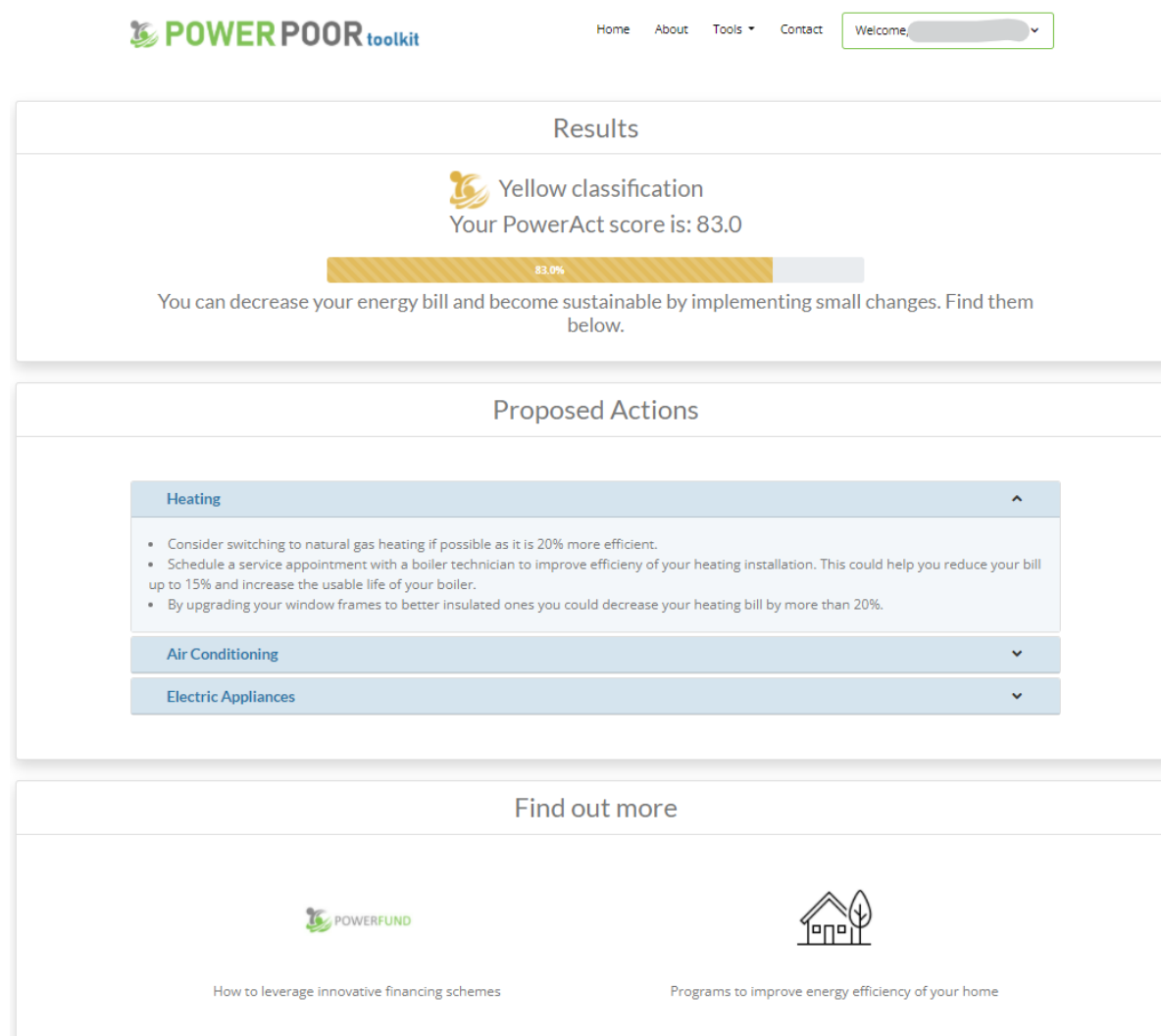


FIGURE 15. EXAMPLE RESULT OF POWERACT SURVEY

**PowerFund** aims to enable citizens suffering from energy poverty to leverage joint energy initiatives across Europe and innovative financing schemes. It is a web-based tool provides an online marketplace for Collective Energy Initiatives, such as energy communities and cooperatives. The tool also contains resources to learn about innovative financial instruments like crowdfunding, and provides guidance for how to start a new community. The information though is rather limited, although there are links to material in other sources.

**TABLE 14. OVERVIEW OF POWERPOOR ENERGY POVERTY MITIGATION TOOLKIT.**

	<b>PowerTarget &amp; PowerAct</b>	<b>PowerFund</b>
<b>Type of tool</b>	web-based tools in form of surveys	Online repository with own material & online marketplace
<b>Focus</b>	Energy poverty identification	Collective finance and collective energy initiatives for energy poor citizens
<b>Aim</b>	Identifying whether energy poverty and propose simple solutions	Help citizens in energy poverty identify and learn about Collective Innovative Actions
<b>Stage of EC development</b>	Identification	Initiation
<b>Generic/ tailored</b>	Somewhat tailored advise based on user input data.	Generic guide
<b>Availability</b>	Accessible online, though an account is required	Publicly accessible online
<b>Updates &amp; maintenance</b>	Ongoing project, no information on maintenance in the future	
<b>Part of a project or commercial</b>	POWERPOOR project (Horizon 2020) Sep 2020 – Aug 2023	
<b>Limitations</b>	Data limited to 8 countries (Bulgaria, Croatia, Estonia, Greece, Hungary, Latvia, Portugal and Spain)	Not many energy communities are part of marketplace (yet)
<b>Link</b>	<a href="https://powerpoor.eu/toolkit">https://powerpoor.eu/toolkit</a>	<a href="https://www.powerfund.eu/">https://www.powerfund.eu/</a>

## Analysis and recommendations of tools and guides for Energy Communities

The below table provides a summarizing overview of the before assessed tools and guidelines. Some important observations can be made:

- Tools often follow the chain of projects of (part of) partnerships, where it is unclear which adaptations have been made and hence what the additional features include.
- The majority of tools are from recent and ongoing EU funded projects so there is not much experience with their use, nor info on what is planned to happen with these tools once the project is finished.
- There are a lot of generic guides, but only few tools that are tailored to specific needs. The latter are generally not very advanced tools, and the effective assumptions, nor aspects of accuracy or risk are included.
- For calculators, it is not always easy to find assumptions, model description and validation. While sometimes manuals are provided, these only guide the user through the different steps, not providing explanation on the methodology and calculations happening behind the screen.
- The tools do not assess the impact of a combination of services (e.g. the impact of combining P2P, peak shaving, and participation in aggregation for smart car charging).
- Aspects with regards to alleviating energy poverty are often not mentioned in the different tools. More general guides may include some discussion and examples, such in the Community Energy practical guide, the COOLkit best practice examples and the REScoop toolbox. However, tackling energy poverty is still presented as a feature of few example energy communities, as also highlighted by a recent study of renewable energy communities (Hanke, Guyet and Feenstra 2021). The POWERPOOR project and its tools are, on the other hand, dedicated to energy poverty.
- Usually no information on updates and maintenance plans is provided on the website. For active projects, it can be assumed that the tools are maintained for the duration of the project at least. However, it is necessary to request additional information regarding updates and maintenance when this is not the case.

The wide range of repositories is very diverse, and there is no clear structure. Similarly guides and handbooks are often tinted and high-level. Aspects such as values for DSO, TSO, and others are not included, nor explained. Dissolvment of the initiatives is not discussed, nor are risks (such as e.g. related to subsidy dependency, size of the initiative, energy market aspects) assessed.

**TABLE 15. OVERVIEW OF ALL TOOLS.**

<b>Tool name</b>	<b>Type of tool</b>	<b>Focus</b>	<b>Aim</b>	<b>Stage of EC development</b>	<b>Generic/ tailored</b>	<b>Availability</b>	<b>Updates &amp; maintenance</b>	<b>Part of a project or commercial</b>	<b>Limitations</b>	<b>Link</b>
<b>Community Energy – A practical guide to reclaiming power</b>	One document (guide)	Stakeholder engagement, Legal organisation, Technology selection	Step-by-step guide to initiate community energy projects	Initiation	Generic guide	Publicly available online in 7 languages	One-time document	Support from European Community Power Coalition (published in Oct 2020)		<a href="https://energy-cities.eu">Community Energy - Energy Cities (energy-cities.eu)</a>
<b>Community Energy Toolkit</b>	One document (best practice examples and checklist)	Ownership and governance, socio-economic impacts, technology, policy context, financing, cultural/ gender considerations	Identifying the needs of the community and developing a vision	Vision creation, Initiation	Generic guide	Publicly available online in English	One-time document	IRENA Coalition for Action (published in Nov 2021)		<a href="#">Community Energy Toolkit</a>
<b>COMPILE COOLkit</b>	Online repository with own material	Stakeholder engagement, Organisation, Financing	Introduction to tools and methods to provide ideas and inspiration.	Initiation	Generic guide	Publicly accessible online, with downloadable reports.	Ongoing project, no information on maintenance in the future	COMPILE project (Horizon 2020) Nov 2018- Oct 2022		<a href="https://compile-project.eu">COOLkit - Compile Project (compile-project.eu)</a>

<b>COMPILE GridRule, HomeRule, ComPilot, ValueTool, Evrule</b>	Technical tools, cloud-based	Grid management, Community self-consumption, Building level energy management, Members management, EV charging strategies	Facilitate energy community operation.	Initiation, operation	Tailored to each project	Commercial tools	Will be commercially managed	(Technical tools will be commercialised)		<a href="http://technicaltools-compileproject.eu">Technical Tools - Compile Project (compile-project.eu)</a>
<b>EMPOWER 2.0</b>	Online repository linking to other materials and tools	Renewable energy technologies, Technical, legal & economic challenges	Assist citizens, authorities and energy communities to produce their own energy	Initiation mostly	Generic repository, though it allows for targeted search depending on the problem	Publicly accessible online	Ongoing project, no information on maintenance in the future	EMPOWER 2.0 project Interreg Netherlands, Belgium, Denmark United Kingdom. 2019 - 2022	Many resources focused on 4 participating countries.	<a href="http://www.toolbox.energy/home">http://www.toolbox.energy/home</a>
<b>EESIP resources database</b>	Online repository linking to other materials and tools	Renewable energy, social innovation and citizen engagement (not specifically energy communities)	Information and knowledge sharing about the renewable energy sector	Not specific	Generic repository	Publicly accessible online	Ongoing project, no information on maintenance in the future	SocialRES project (Horizon 2020) May 2019- Aug 2022	Very limited content at the moment, energy communities not the primary focus.	<a href="https://www.eesip.eu/resources/">https://www.eesip.eu/resources/</a>

<b>REScoop.eu Toolbox</b>	Online repository linking to own and other materials and tools	Everything related to renewable energy cooperatives	Support citizens, local authorities and policy makers with all aspects of community-led renewable energy.	Not specific	Generic repository	Publicly accessible online	The repository and own content are managed and updated on a regular basis by REScoop.eu	Maintained by REScoop.eu		<a href="https://www.rescoop.eu/toolbox/all/all/all/online-tool">https://www.rescoop.eu/toolbox/all/all/all/online-tool</a>
<b>BEcoop Toolkit</b>	Online repository linking to other materials and tools	Technical aspects, Business model, Community building and management	Provide resources and tools to support developers and operators of community bioenergy and heating projects	Initiation, operation, scaling up	Generic repository	Publicly accessible online	Ongoing project, no information on maintenance in the future	BEcoop project (Horizon2020) Nov 2020 – Oct 2023	Specific for energy communities dealing with bioenergy	<a href="https://www.becoop.eu/toolkit">BECOOP TOOLKIT (fcirce.es)</a>
<b>BEcoop Self-assessment tool</b>	Web-based tool	Resource assessment, Partner assessment, Technical aspects, Business and financial aspects, Social and environmental aspects	Assess current status of bioenergy community project and provide recommendations	Initiation, operation	Tailored to the project	Not yet available, but will be publicly accessible online (potential registration needed)	Not yet available			<a href="#">Descriptive report: D2.1 Self-assessment tool- First V1.0.pdf (becoop-project.eu)</a>

<b>CARES toolkit</b>	Online repository with dedicated material and tools	Community engagement, Community energy planning, Technology options review, Organisation setup and governance, Business models and financing, Project planning and development	Step-by-step guide for the development of a renewable energy project, from goal determination to implementation.	Initiation, project development	Generic guides but also tools (templates) that can be used individually. More tailored to CARES program and Scottish regulatory framework.	Publicly accessible online	The repository and content are managed and updated on a regular basis by Local Energy Scotland	Managed by Local Energy Scotland	Some of the material applies to the Scottish CARES scheme specifically	<a href="#">Resources overview - Local Energy Scotland</a>
<b>inteGRIDy Business Modelling Tool</b>	Web-based tool	Business model development	Develop business model and check market suitability and replicability in other countries	Initiation	Tailored to the project	Publicly accessible online, but requires creating an account	Will be further developed and maintained under new Horizon Europe project OMEGA-X (2022-2025)	inteGRIDy project (Horizon2020) Jan 2017-Jun 2021		<a href="https://www.integridy.eu/content/integridy-business-modelling-tool">https://www.integridy.eu/content/integridy-business-modelling-tool</a> <a href="https://energy.venturely.io/">https://energy.venturely.io/</a>
<b>REACT</b>	Web-based tool	Energy production, technical feasibility, carbon emission savings,	Determine the optimal low carbon technology solutions for business clusters	Initiation	Tailored to the project	Publicly accessible online, but requires creating an account. Available in English,	Currently working, no further information available on maintenance	BISEPS project (Interreg 2 Seas) May 2016 - Apr 2020	Focused on business clusters, not residential consumers/prosumers. No grid limitations, operational	<a href="#">REACT Tool – Bisepts</a>

		optimal solution				French and Dutch.			costs, network tariffs considered.	
<b>CSOP calculator</b>	Web-based tool	Economic feasibility of the project, Operational costs	Preliminary estimation of the economic feasibility of a renewable energy investment (PV, wind, CHP)	Initiation	Tailored to the project (only basic customisation )	Publicly accessible online	It is currently maintained by European Viadrina University. A handbook is under development.	SCORE project (Horizon 2020) Apr 2018-Dec 2021	Focuses on the CSOP business model specifically. The assumptions of the tool are not available.	<a href="#">CSOP Calculator   SCORE (score-h2020.eu)</a>
<b>StoRES PV and Storage Optimization Tool</b>	Web-based tool	Optimise technology systems	Calculate optimal combination of solar PV and battery system	Initiation of specific technology project	Tailored to your project	Publicly accessible online	Currently working, no further information available on maintenance	StoRES project (Interreg Mediterranean) Mar 2017-Mar 2020	Included data only for selected countries, though custom data can also be used	<a href="#">StoRES Tool - StoRES App</a>
<b>Hotmaps</b>	Web-based tool	Heating and cooling energy demand and supply, Renewable energy potential, Waste heat potential, District heating options potential and cost	Map and analyse heating and cooling needs and available resources to develop strategies at local and national level.	Initiation of specific technology project	Tailored to the location of interest	Publicly accessible online, possibility to create an account	Currently working, no further information available on maintenance	Hotmaps project (Horizon 2020) Oct 2016 – Sep 2020		<a href="https://www.hotmaps-project.eu/">https://www.hotmaps-project.eu/</a> <a href="#">Wiki page</a> <a href="#">Deliverable D2.3</a>



<b>POWERPOOR PowerTarget &amp; PowerAct</b>	web-based tools in form of surveys	Energy poverty identification	Identifying whether energy poverty and propose simple solutions	Identification	Somewhat tailored advise based on user input data.	Accessible online, though an account is required	Ongoing project, no information on maintenance in the future	POWERPOOR project (Horizon 2020) Sep 2020 – Aug 2023	Data limited to 8 countries (Bulgaria, Croatia, Estonia, Greece, Hungary, Latvia, Portugal and Spain)	<a href="https://powerpoor.eu/toolkit">https://powerpoor.eu/toolkit</a>
<b>POWERPOOR PowerFund</b>	Online repository with own material & online marketplace	Collective finance and collective energy initiatives for energy poor citizens	Help citizens in energy poverty identify and learn about Collective Innovative Actions	Initiation	Generic guide	Publicly accessible online			Not many energy communities are part of marketplace (yet)	<a href="https://www.powerfund.eu/">https://www.powerfund.eu/</a>

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