ARV

CLIMATE POSITIVE CIRCULAR COMMUNITIES

D9.2 ENCYCLOPENERGY: A BUSINESS AND FINANCING MODELS CATALOGUE

WP9 BUSINESS MODELS, FINANCIAL INSTRUMENTS, POLICY, AND EXPLOITATION

Pietro Visetti, GDFA

30.06.2022

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101036723

PROJECT INFORMATION

Project acronym	**ARV[1]**
Project title	Climate Positive Circular Communities
Project number	101036723
Coordinator	Norwegian University of Science and Technology / Inger Andresen
Website	www.greendeal-arv.eu

DOCUMENT INFORMATION

Deliverable Number and Title	**D9.2 Develop catalogue of business and financing models proven in other markets for adaptation in the EU to accelerate the renovation wave.**			
Due Month	Month 6 (June 2022)			
Work Package Number and Title	WP 9. Business models, financial instruments, policy, and exploitation			
Task number and Title	Task 9.2 Map scalable business models and financial instruments adaptable to EU.			
Dissemination Level	PU - Public			
Date of Delivery	30.06.2022			
Lead Author	Pietro Visetti, Green Digital Finance Alliance (GDFA)			
Contributors	ARV WP9 Reference Partners			
Reviewers	Inger Andresen, Norwegian University of Science and Technology (NTNU)			
Status	DRAFT (Pending European Commission approval)			
Revision Log	**Version**	**Author**	**Main changes**	**Date**
	V.01	Pietro Visetti, GDFA	First draft	20.06.22
	V.02	Inger Andresen, NTNU		29.06.22
	V.03	Pietro Visetti, GDFA	Final version	30.06.22

[1] ARV is a Norwegian word meaning "heritage" or "legacy". It reflects the emphasis on circularity, a key aspect in reaching the project's main goal of boosting the building renovation rate in Europe.

ABOUT THE ARV PROJECT

The vision of the ARV project is to contribute to speedy and wide scale implementation of Climate Positive Circular Communities (CPCC) where people can thrive and prosper for generations to come.

The overall aim is to demonstrate and validate attractive, resilient, and affordable solutions for CPCC that will significantly speed up the deep energy renovations and the deployment of energy and climate measures in the construction and energy industries.

To achieve this, the ARV project will employ a novel concept relying on a combination of 3 conceptual pillars, 6 demonstration projects, and 9 thematic focus areas.

The 3 conceptual pillars are integration, circularity, and simplicity. **Integration** in ARV means the coupling of people, buildings, and energy systems, through multi-stakeholder co-creation and use of innovative digital tools. **Circularity** in ARV means a systematic way of addressing circular economy through integrated use of Life Cycle Assessment, digital logbooks, and material banks. **Simplicity** in ARV means to make the solutions easy to understand and use for all stakeholders, from manufacturers to end-users.

The 6 demonstration projects are urban regeneration projects in 6 locations around Europe. They have been carefully selected to represent the different European climates and contexts, and due to their high ambitions in environmental, social, and economic sustainability. Renovation of social housing and public buildings are specifically focused. Together, they will demonstrate more than 50 innovations in more than 150,000 m2 of buildings.

The 9 thematic focus areas are 1) Effective planning and implementation of CPCCs, 2) Enhancing citizen engagement, environment, and well-being, 3) Sustainable building re(design) 4) Resource efficient manufacturing and construction workflows, 5) Smart integration of renewables and storage systems, 6) Effective management of energy and flexibility, 7) Continuous monitoring and evaluation, 8) New business models and financial mechanisms, policy instruments and exploitation, and 9) Effective communication, dissemination, and stakeholder outreach.

The ARV project is an Innovation Action that has received funding under the Green Deal Call LC-GD-4-1-2020 - Building and renovating in an energy and resource efficient way. The project started in January 2022 and has a project period of 4 years, until December 2025. The project is coordinated by the Norwegian University of Science and Technology and involves 35 partners from 8 different European Countries.

EXECUTIVE SUMMARY

We have found ourselves at a crossroads. Buildings energy efficiency is not moving fast enough to meet the Paris Agreement goals. Innovative financial models, business models and regulatory frameworks are urgently needed. We can continue in this direction, or we can explore a new way forward. This deliverable aims at developing a catalogue of business and financing models proven in other markets for adaptation in the EU to accelerate the renovation wave and promote Climate Positive Circular Communities (CPCC).

To achieve this, a crowd-open-source method was utilized. The idea of a static catalogue graduated into the development of a web-based living database that aims to streamline and optimise the way the built environment community shares knowledge. In this spirit, the Encyclopenergy was developed to provide a comprehensive living compendium to support the spread and scale of innovations in financing models, business models, and regulatory frameworks to accelerate the transition to a less carbon-intensive built environment[2].

This deliverable is part of a task that entails mapping the existing market, policy and regulatory practices of real estate linked to Energy Efficient (EE) financing for different real-estate asset classes (social housing, rental and privately owned) and of flexible energy solutions/practices/concepts both within and outside of the EU.

The focus was given to financial and business model practices that have proven abilities to scale in EU or other regions through real world demonstration projects. Overall, in the first 35 days since Encyclopenergy has been live, the web-based tool attracted 153 entries out of which 121 were approved and listed publicly to form the living catalogue.

Encyclopenergy not only aims to create a global compendium of successful models to accelerate the EU renovation wave and CPCCs, but also to engage the built environment community in a process of sharing knowledge, spreading existing innovation globally to catalyse knowledge in one encyclopaedia to offer a free repository for all.

This report offers the link to a live catalogue of financial and business models based on the crowdsourced intelligence gathered via the Encyclopenergy. The list of models offered is in this report is the result of a careful selection among Encyclopenergy entries to provide models that provide transferable practices to the EU.

[2] Encyclopenergy

TABLE OF CONTENTS

1. INTRODUCTION

Buildings are a central part of our daily lives, and we spend a large part of our days in them - at home, at work, or during our spare time. On the other hand, the built environment is the single largest energy consumer in the EU, and one of the largest carbon dioxide emitters. Consequently, the energy and building sectors are vital to Europe's environment and energy policies. In 2018, the built environment was responsible for approximately 40% of the combined EU27 and UK final energy consumption and 36% of their greenhouse gas emissions[3]. In addition, the current energy crisis is calling for immediate and coordinated market and policy actions to reduce the EU's energy dependence on foreign resources. In this context, improving the energy performance of the EU's building stock is an absolute priority. **Massive potential for energy savings lies in renovating the existing building stock.** It is a prerequisite that these buildings are renovated *"deeply"* for the building sector to reduce their greenhouse gas (GHG) emissions and meet global energy reduction objectives.

The EU Green Deal proposes a '*renovation wav*e' of the EU's public and private building stock and requires governments to commit to ambitious climate targets and massive private investment. Over the next decade, large investments are needed to reach the pledges and relative targets. However, a substantial amount of the necessary investment, though profitable on paper, is not being carried out. This issue, which has come to be labelled the "energy efficiency gap", is well-publicised and has been described in numerous research papers and articles.

The main problem with providing more sustainable, low-carbon real estate is that most of the building stock is already in existence. **The majority of the existing buildings were built long before green or low-carbon solutions became available and are therefore not sufficiently energy-efficient.** As a consequence, we are facing the challenge of retrofitting. Retrofitting or conducting a so-called *"deep energy renovation"* means intervening in an existing building to transform it as environmentally sustainable as possible. This involves several possible interventions, from improving thermal insulation to installing solar or photovoltaic panels, water-saving technologies, etc. However, on a large scale, building renovations can be quite tricky due to numerous stakeholders involved, especially tenants who often do not own the building.

Hitherto, a major barrier to renovation is the cost of the intervention itself. **Energy efficiency investments face unique hurdles, such as high up-front costs, long pay-back periods, and small-scale individual investments, all of which contribute to the investment gap needed to reach the climate goals set in the Paris Agreement.** Energy-efficient building renovations can be expensive, and owners (or tenants) may not have the means to finance them. Currently, in Europe, a mix of government subsidies and tax incentives are being used to achieve the decarbonisation targets. Besides the fact that subsidies and tax incentives are usually not harmonised in the Union, part of the challenge remains, as incentives and taxpayer money in the form of subsidies have a limit in terms of financial cap and time to apply for it. Moreover, at a time of war, rising inflation, and post covid recovery, citizens are not in an ideal situation to invest in home renovations.

Nevertheless, besides mainstream instruments such as subsidies and tax incentives, the industry has developed other financial tools such as interest rate reductions on mortgages, energy performance reduction as a service, etc. The scale of investment needed to improve the energy performance of more than 220 million residential dwellings in order to achieve the EU's energy savings targets is huge and cannot be met by the public sector alone. The EU financial sector will therefore play a central role in the transition to a more sustainable economy, reducing energy poverty for households, safeguarding consumer wealth in terms of disposable income and asset value,

supporting economic growth and job creation, and, more relevant today than ever before, helping to support the Joint REPowerEU Action and secure the EU's energy independence.

Encyclopenergy came to be as a web-based tool germinated from the ARV – Climate Positive Circular Communities project which is funded by the European Green Deal initiative as an Innovation Action within the Horizon 2020 Framework Programme (ID: 101036723). The overall objective was to map the existing business and financial model market of practices for real estate linked to EE financing for different real-estate asset classes (social housing, rental and privately owned) and of flexible energy solutions/practices/concepts both in and outside of the EU.

The Encyclopenergy aims to be a contributor-based intelligence repository of worldwide financing solutions, business models, policy and regulatory frameworks which enable, empower, and scale energy efficiency in the real-estate industry to offer a free knowledge network of enablers to support the scaling of decarbonisation pathways for the global built environment.

This report explains how Encyclopenergy came to be and cherry picks from the crowdsourced business and financial models to pave the way for the built environment community to scale solutions as soon as possible to meet the EU climate targets.

2. OBJECTIVES

The objective of this deliverable is to create a list to explain and unpack the best available financial and business models enabling energy efficiency retrofits for replicability and scalability in the European Union. The models presented want to offer solutions for different real estate asset classes – namely: privately owned, rental and social housing.

ENABELING CIRCULARITY IN THE BUILT ENVIRONMENT
There is clear momentum and increasing awareness about the circular economy among stakeholders in the sector, catalysed by the European Green Deal and circular action plans developed by national, regional, and municipal governments. Furthermore, according to the World Economic Forum[4], the built environment is one of the sectors with the highest potential to reach circularity. However, accelerating the implementation of circularity in the built environment requires bringing scalable financing innovation to the forefront and informing new ambitious rules and regulations. With multiple local and international organizations executing and developing parallel efforts to scale the circular economy in the built environment across Europe, there is also a risk of repetition, inefficiencies, and resource loss. A collective network approach can help to bridge the gaps and harmonize the efforts. Hence, the ARV Consortium has focused its effort in creating a knowledge sharing platform which resulted in the Encyclopenergy[5].

To finance the built environment circularity, there is an increasing availability of green financing, innovative funding schemes, and a number of governmental aid schemes[6]. Green investments in the building sector have increased by nearly 40% since 2015 to $180 billion USD in 2020[7]. Currently, in Europe, a mix of government subsidies and tax incentives are being used to achieve the decarbonisation targets. Besides the fact that subsidies and tax incentives are usually not harmonised in the Union, part of the challenge remains as incentives and taxpayer money in the form of subsidies have a limit in terms of financial cap and time to apply for it.

Encyclopenergy intends to map available business and financial models by considering different real estate asset classes and their digital savviness.

In addition, the ARV Consortium will establish an Exploitation Board with the key objective to facilitate a speedy scale-up of the ARV innovations by addressing key policy incentives and regulations, and creating innovative and effective financing mechanisms, and business models. Thus, this report is a starting point for the ARV Exploitation Board for scaling-up the ARV innovations. The Exploitation Board is being formed around solid innovation clusters that will spread the green building and renovation concepts to provide momentum to the 'renovation wave' that will be politically underpinned. The ARV Exploitation Board (AEB) is composed of industry experts selected from among the ARV consortium partners and from influential external companies, to represent the whole value chain of Climate Positive Circular Communities.

Developing novel and sustainable ways of finance mechanisms and investment models for circular construction, transformation, and deconstruction projects is vital. Every geographical context is different. Local impact-driven organizations indicate that it is challenging to replicate solutions in

[4] Built Environment, WEF
[5] Encyclopenergy
[6] UNEP FI, 2022
[7] UNEP, 2020

other places or projects due to the specifics of each context and the lack of shared infrastructure. Another objective of this report and more broadly of Encyclopenergy is to highlight the infrastructures, models and use cases that have been proved successful. In this way, the objective is to spread the knowhow, the dynamics and architecture of projects for scalability.

Creating Climate Positive Circular Communities requires effort from the entire ecosystem value chain and demands new skills, knowledge, and expertise in upcycling, material management, the reuse of construction elements, the development of novel technology, monitoring, and evaluation standards. Designing the bespoke financial and business models to have capital capacity is a crucial factor in driving forward the scalability of implementation of Climate Positive Circular Communities principles in a highly regulated, conservative, risk-averse industry.

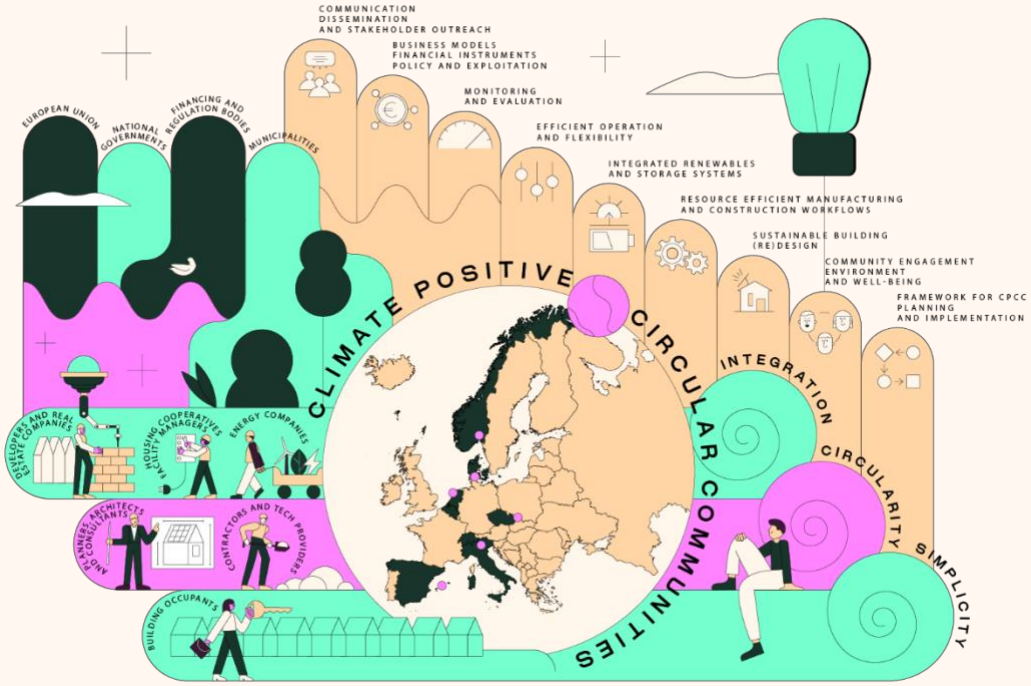

***Figure 1**. ARV systemic approach to create Climate Positive Circular Communities*

As shown in the figure above, business models and financial instruments is one of the foundational blocks to create solid and especially economically viable Climate Positive Circular Communities. This report will conclude with highlighting that bringing circular solutions for buildings to scale requires new policy and regulatory frameworks. Built environment decision-making and goalsetting, however, is typically spread across various public departments, whether on the national or city level. This presents challenges regarding the efficient development of the holistic regulatory frameworks needed to facilitate landing the circular economy in the built environment. In addition, it requires restricting rules and regulations to be terminated.

3. METHODOLOGY, TECHNICAL APPROACH AND FUTURE DEVELOPMENTS

3.1. METHODOLOGY

Crowdsourcing is a phenomenon involving the use of volunteers to accomplish a goal or objective (often work). Individuals, businesses, and government agencies find it possible to harness the participation of volunteers to design products and complete project work. Crowdsourcing provides an opportunity for initiatives to exploit collective knowledge that is located outside or inside the organisation. Given the mandate of this deliverable and the scattered online knowledge hub on the topic leveraging the ARV Consortium partners and the relative network was believed to be an efficient approach. Therefore, the Encyclopenergy was developed with the underlying principle of creating a tool allowing potential contribution from anyone.

In recent years, open innovation (OI) has garnered increasing attention from academics and practitioners alike. A definition of OI is that "*Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation, respectively*"[8]. In light of this, using a web-based online tool to collect the business models and financial models know how to advance energy efficiency globally, seemed to be not only an efficient pathway but also a framework that would provide additional benefits – namely – broadening the collective knowledge, remaining up to date thanks to the continues development, and offering knowledge inclusiveness.

Furthermore, the methodology needed to include different categories of energy efficient enabling business and financial models. Focus was given to collect models that include solutions tailored to social housing, rental and privately owned real estate asset classes. In addition, importance was given to the markets, policies and regulations that created an enabling environment for the models. This framework, together with the ARV pillars of integration, circularity and simplicity, has been the underlying methodological guidance for developing the Encyclopenergy forms to collect inputs (see Figure 2).

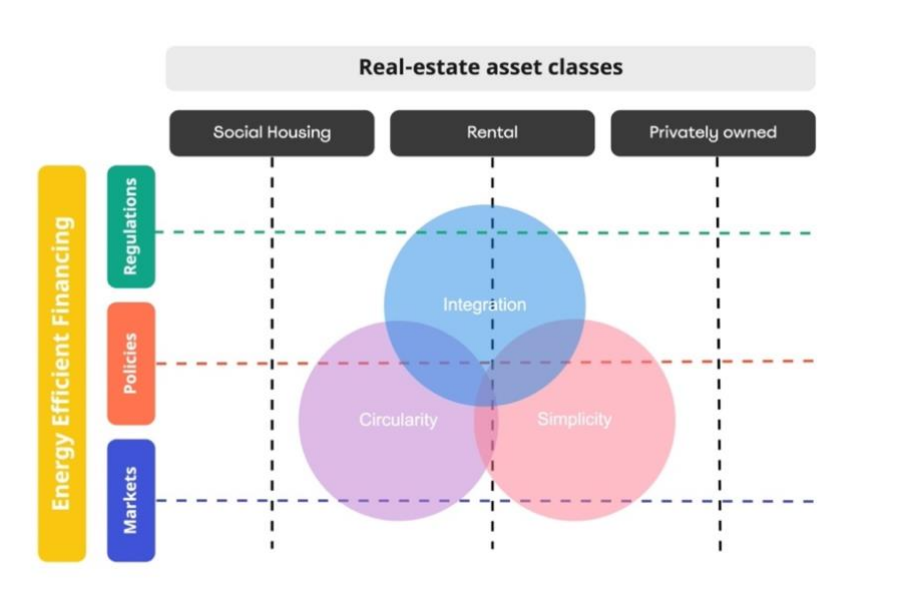

Figure 2. *Systemic approach to map financial and business models*

[8] Chesbrough, H. (2006), "New puzzles and new findings", in Chesbrough, H., Vanhaverbeke, W. and West, J. (Eds.), Open Innovation: Researching a New Paradigm, Oxford University Press, Oxford, pp. 1-12.
p. 1).

3.2. TECHNICAL APPROACH

Encyclopenergy was developed taking inspiration from knowledge crowdsource and open-source initiatives. The interface was designed to be simple with a contribute section to submit models, and a table section where the models are displayed (See figure 3).

***Figure 3**. Home page of Encyclopenergy*

The categories to be captured were decided in coordination with ARV partners. Besides the necessity of capturing financial and business models, it was decided that regulatory frameworks, organisations, and demonstrations would also be important categories given their enabling and foundational connotations. For example, some models would not exist without a certain regulatory framework enabling them, and some other models are successfully implemented thanks to demonstration sites or organisations. For these reasons, and also to make the knowledge repository more appealing to the crowd, these other categories were added.

Finally, to complement the web-based tool, a dictionary section was also included. Definitions abound, new connotations and usage of words in the energy-efficient built environment is not always harmonised. Clarity and harmonisation of the jargon is a foundational step towards speaking the same language and adds crucial layers of clarity, transparency, and accessibility to this sector. Hence, the Encyclopenergy dictionary supports the encyclopedia by unpacking the built environment jargon and provides definitions in a glossary as words' explanations crystallise.

The process to submit entries was designed in a very simple manner. Each category has a contribute section where the user is presented a form with several questions, some mandatory and some optional. The questions include multiple choice and open text to describe solutions.

Additionally, every entry is designed as a post so that if any contributor thinks that a listed word, model, framework, or an organization is wrongly defined, lacks reference, one can simply comment on it in the post page and engage in a discussion to achieve a consensus on shared description. In this way the Encyclopenergy hosts a bult environment community forum that engages when there is the need of improving the description accuracy to harmonise and standardise shared definitions (see figure 4).

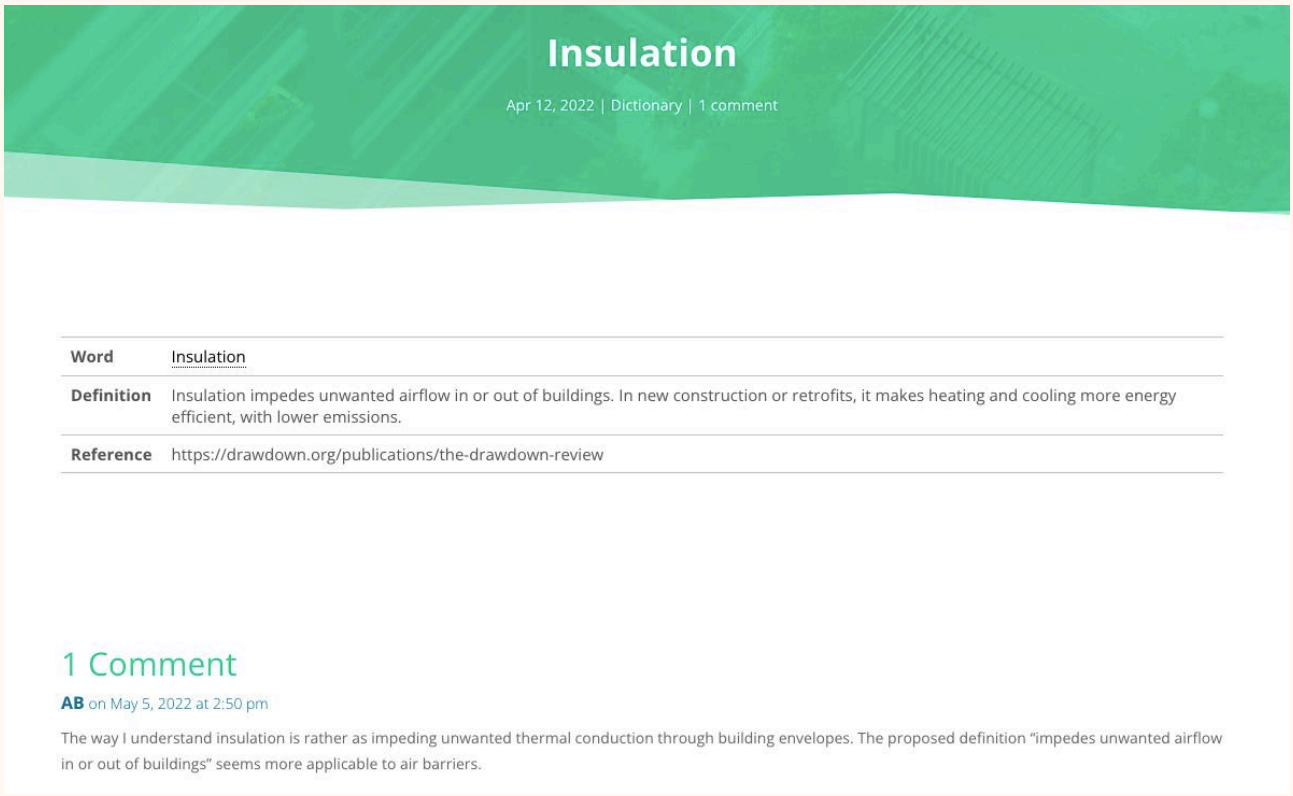

***Figure 4**. Discussion forum below an entry*

From a privacy point of view, all comments and entries are anonymized. All entries had to be approved by the gatekeeper of Encyclopenergy. In this case the team at the Green Digital Finance Alliance was in charge of ensuring security and quality of the entries. The gatekeeping process was designed to ensure a harmless moderation of the crowdsourced material.

In conclusion, the technical development of the web-based tool has gone through several iteration phases. In total, 34 ARV partners have provided inputs via a survey on how the Encyclopenergy could be improved during the prototyping period. These inputs have been crucial to spot bugs on the front end, refined the questions in the forms, and resulted in structural changes that ameliorated the Encyclopenergy as it is today. To align and create synergies, the web domain of Encyclopenergy has been made available as a tab on the ARV official website to complement the library and result activities.

3.3. RESULTS & FUTURE DEVELOPMENTS

In total, Encyclopenergy received more than 160 submissions between the six forms to submit contributions (business models, financial models, regulatory frameworks, organizations, demonstrations, and definitions). After a careful review of the submissions, the gatekeeping activity led to the approval of 120 entries in total (excluding the dictionary). To properly visualize the distribution of the entries and understand the geographical distribution, a dashboard[9] was created to facilitate the user friendliness of the results. The dashboard was created using the interactive data visualization software Tableau Desktop focused on business intelligence. The dashboard is publicly available online both on the Tableau Public server and as part of Encyclopenergy as a website (see Figure 5).

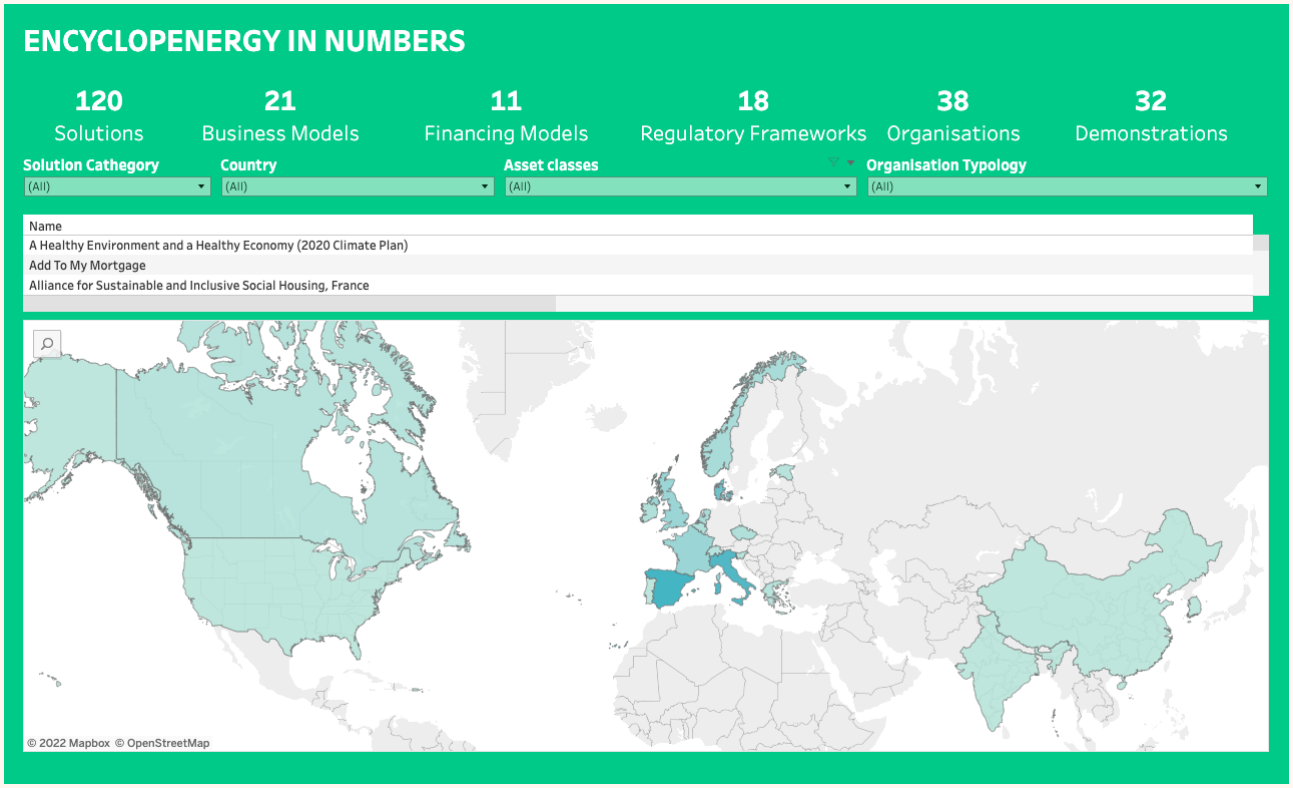

***Figure 5**. Interactive dashboard to display Encyclopenergy results*

For the above screenshotted interactive dashboard, we are using Tableau Software, an American interactive data visualisation software focused on business intelligence. GDFA bought a yearly license at the cost of 980 EUR to ensure the visualisation business continuity throughout the ARV project. The consortium will ensure the renewal each year. As the market-leading choice for modern business intelligence, Tableau is a great tool to display the progress of Encyclopenergy growth in an interactive and user-friendly manner. All approved Encyclopenergy entries will be listed in the dashboard to have a user-friendly manner of visualizing the geographical coverage and also to be able to filter by relevant categories – namely asset classes, solution type and country.

In the future - and especially in the life spam of the ARV project - Encyclopenergy aims at growing the entries based on the consortium network and the ARV governance structures to exploit the knowledge acquired. Moreover, it may be a future development option to share the gatekeeping and approving rights with specific models' expert. For example, either ARV internal or external partners could be interested in taking up the roe of becoming the Encyclopenergy approvers for the business

[9] The Encyclopenergy in numbers dashboards is available here.

models entries. In this case, the Encyclopenergy could be reworked from the backend developer to offer an entry portal option so that approved experts could be empowered to own their section of the encyclopedia. In addition, the main focus of Encyclopenergy in the future will be to expand the demonstration geographical coverage and the regulatory frameworks geographical coverage. The goal is to be as global as possible in order to expand the knowledge base and understand what models work where also based on the different socio-political and development landscapes

4. BUESINESS & FINANCIAL MODELS FOR THE BUILT ENVIRONMENT

This chapter offers a catalogue of the business and financial models that were crowdsourced via the Encyclopenergy. The list is a non-exhaustive knowledge base of the global models available. These models and instruments are established and/or innovative approaches the market has developed to enable energy efficient retrofit projects. The catalogue provides the name of the model, a brief model description, the reference to a source outlining the model and if applicable some of the underlying technologies. In addition, and if applicable, models were labeled by the crowd with a specific or multiple asset classes category. This is in the spirit of the ARV D9.2 deliverable which aimed at investigating models for different asset classes.

4.1. BUSINESS MODELS

The term business model refers to a company's plan for making a profit. In the area of energy flexibility, energy efficiency, and primary energy demand reduction there have been a number of business model archetypes. This list seeks to collect the most successful and mainstream models together with some innovative solutions. The models are explicitly not company linked, but archetypes. Please bear in mind that the catalogue is a living knowledge base and Encyclopenergy keeps on growing and being refined by the community of contributors, hence this is a snapshot of the knowledge gathered to date.

BUSINESS MODEL NAME	BUSINESS MODEL DESCRIPTION	REFERENCE	TECHNOLOGY	ASSET CLASSES
DEMAND RESPONSE (DR)	Demand response (DR) encompasses a large category of technologies and applications. It refers to energy loads that can be adjusted to provide electricity services to the power system. DR can be automatically activated in response to price signals, manually in response to a request from the DR business, or via an alternative dispatch signal. The demand response business model (DRBM) is tool that helps in fostering energy flexibility in a cost-efficient and sustainable manner. The framework of DRBM is outlined by nine elements i.e., flexibility product, flexibility market segment, service attributes, demand response resources, resource availability, demand response mechanism, communication channels, cost structure and revenue model.	https://doi.org/10.1016/j.jclepro.2020.124539		
SMART ENERGY MANAGEMENT SYSTEM PROVIDER	The smart energy management system provider sells, rents, leases smart energy technology for energy management, which includes smart meters, smart thermostats, smart plugs, and energy managers (physical gateways and applications). It focuses on consumption side but can also focus on providing gateways to integrate the energy flows form the households demand and production.	https://doi.org/10.1016/j.jclepro.2020.122083		

SMART MICROGENERATION AND STORAGE PROVIDER	The smart microgeneration and storage provider sells, rents, leases intelligent microgeneration units like photovoltaic systems, combine heat and power, microturbines and storages. It focuses on the production aspect and by providing the consumers with micro generation units it converts the consumer into prosumer.	https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5beef84de&appId=PPGMS
SMART EV CHARGING SYSTEM PROVIDER	The Smart EV Charging System Provider sells, rents, leases mart EV chargers to private households. With the applications and energy management system it offers services like monitoring, controlling the charging, optimizing the consumption and production in the household.	https://pod-point.com/guides/business/ev-charging-business-models
P2P ENERGY PLATFORM OPERATOR	The P2P Energy Platform Operator is a service-oriented archetype which only provides digital service i.e., the operation of an energy community or a marketplace. It advocates prosumers that own a micro-generation unit or storage system and who want to provide their resources to other peers.	http://dx.doi.org/10.20944/preprints202008.0266.v1
SMART ENERGY PLAN PROVIDER	The Smart Energy Plan Provider offers innovative energy supply plans based on the data acquired by the smart energy products. Flexible tariffs in one of the energy plans offered where customers decide to act on their consumption to reduce costs.	https://www2.deloitte.com/us/en/insights/industry/power-and-utilities/smart-energy-management.html
DISTRIBUTED ENERGY RESOURCES (DER) AGGREGATOR	The DER Aggregator provides flexibility services for the grid by designing and offering demand response management programs for private households and selling their energy resources to the energy exchange or grid operators.	https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Feb/IRENA_Innovation_Aggregators_2019.PDF
SMART UTILITY IN A BOX SOLUTION PROVIDER	The provider sells a white label software solution to an energy utility or to an energy firm. The software solution provider profits from the license fess and maybe subscription fees for additional services.	https://doi.org/10.1016/j.jclepro.2020.122083

POWERPLANT OPTIMIZATION	The business model of temporal optimization of large power plant is called as power plant optimization. It investigates volatile power prices of fuels (coal and gas), regulatory constraints, and the technical constraints of power plants such as maximum loads, ramp up speed limits and maintenance needs. Its core is program that determines when to run a power plant and what capacity, thus representing a timing activity.	http://dx.doi.org/10.1016/j.enpol.2016.02.036		
VIRTUAL POWER PLANTS (VPP)	This business model represents the distributed equivalent of centralized power plant optimization. A large amount of small generation units like CHP plants and emergency power supply units together with fluctuating producers (solar and wind) are aggregated and interconnected to achieve sufficient capacity. It can be marketed on wholesale markets, thus allowing utilization of flexibility.	http://dx.doi.org/10.1051/e3sconf/201910801006	Machine learning / Artificial Intelligence, Internet of Things - IoT / Smart metering	
ENERGY-AS-A-SERVICE (EAAS)	Energy-as-a-service (EaaS) is a business model whereby customers pay for an energy service without having to make any upfront capital investment. EaaS models usually take the form of a subscription for electrical devices owned by a service company or management of energy usage to deliver the desired energy service.	https://www.rff.org/publications/issue-briefs/energy-service-business-model-expanding-deployment-low-carbon-technologies/		
SMALL-SCALE DEMAND RESPONSE	This business model control small scale consumers like private household and possess more challenges compared to optimizing the industrial consumers. It focus on exploiting flexibility sources in distribution grids to involve smaller consumers in demand response programs.	https://ideas.repec.org/a/eee/enepol/v92y2016icp348-358.html		
INSTITUT BALEAR DE L'ENERGIA (IBE)	The Institut Balear de l'Energia (IBE) is a public entity from the Balearic Islands (Spain). They are democratizing the renewable energy with affordable prices through PV installations shared between neighbourhood residents and businesses at less than 500 metres around the PV installation prioritizing the vulnerables consumers in the process.	https://www.caib.es/seucaib/es/organigrama/3828756		
RETROFITTING MANAGEMENT ENTITY	This business model is based on aggregated building demand of building owners who want to do energy retrofitting. Also, the retrofitting manager is in charge of finding the financing for the retrofitting costs. Based on that concept, of demand aggregation it is able to get better conditions reducing time and costs.	https://aiguasol.coop/wp-content/uploads/2018/12/Residential_Retrofits.pdf		
PEDRERA - POSITIVE ENERGY DISTRICTS RENOVATION MODEL	PEDRERA project aims to provide an innovative energy renovation model able to accelerate the urban transition towards Positive Energy Districts (PEDs) and to validate	https://www.irec.cat/research/projects/positive-energy-	Digital Tools	Privately Owned

	economic feasibility of the business models, guaranteeing interoperability and replicability at EU scale.	districts-renovation-model/		
HEATING-AS-A-SERVICE	The business model reduces the upfront investment in heat pumps, by offering a subscription model instead. so upfront cost is reduced to approx. 20% of normal cost. At the same time the company operates and maintains and service the installation to optimize usage. This makes it much cheaper for the customer both up front and on a continuous basis, as the heat is utilized as much as possible and often much better that what customers would be able to do themselves.	https://www.bestgreen.dk/	Machine learning / Artificial Intelligence	Social Housing, Privately Owned, Rental
INVOICE DISCOUNT FOR ENERGY RETROFIT OF RESIDENTIAL BUILDINGS.	The italian Superbonus 110% is an incentive measure introduced by the legislative decree "Rilancio" May 19, 2020, n. 34, which aims to make our homes more efficient and safer. The mechanism provides that interventions can also be carried out at almost no cost to the owner. The incentive consists of a tax deduction of 110% that applies to expenses incurred. To benefit from the Superbonus is necessary to make at least one of the so-called "leading" interventions. The leading interventions consist of thermal insulation of the building envelope, which is multi-family or single-family, in the replacement of heating systems with more efficient or centralized ones, in order to improve by at least two classes the energy performance of the building. Once performed at least one of the leading interventions, the beneficiary may decide to carry out also the so-called "driven" interventions, such as the replacement of windows, sunscreens, the installation of photovoltaic systems, storage systems, recharging stations for electric vehicles, building automation systems. he beneficiary may decide to collect a tax credit equal to 110% of the cost of the works (respecting certain ceilings) or opt for the discount on the invoice: the company that carried out the works applies a discount up to 100% of the invoice and the citizen thus carries out the works without any monetary expenditure. The company will then receive a tax credit equal to 110% of the amount of the discount applied, always to be used in annual installments of equal amount (four for expenses incurred in 2022).	https://www.governo.it/it/superbonus#:~:text=Il%20Superbonus%20110%25%20%C3%A8%20una,zero%20per%20tutti%20i%20cittadini.		Social Housing, Privately Owned, Rental
INNOVATIVE FINANCIAL SOLUTIONS	There is a need for cheaper solutions to finance energy retrofitting projects in housing associations compared to the traditional financial solutions. Danish pension companies and funds are interested in investing in green solutions in housing associations because they usually are stable business partners. However, the pension funds normally want to invest in bigger projects, bigger than the normal energy projects in housing associations. Therefore, it is necessary to bundle projects in housing associations to attract investment from pension funds. To solve this issue, there is a need for companies, that can aggregate projects from different housing associations to attract financial involvement from pension funds. It is important to establish Business Development Units in housing associations or combined units among more housing associations. It can include internal staff members or a combination of internal and external experts. These units will be	https://go-happi.dk/happi-d3-1-innovative-third-part-finance-solutions/		Housing associations

	necessary in order to be able to carry out such energy retrofitting projects. One of the important experiences from the HAPPI project is the advantages of cooperation between the participating housing associations, where ideas for new energy retrofitting projects have been exchanged and implemented. Establishing a common Business Development Unit among more housing associations will reduce the barriers to continuing the development of energy projects. The barriers are often lack of time and lack of experience by the internal staff members. Some of the biggest Danish housing associations have established a special task force with obligations to screen all the planned energy retrofitting projects for implementing further energy-saving measures. If not possible to establish common Business Development Units by the housing associations, a start could be to establish a formal ‚ÄúEnergy Retrofitting Network‚Äù with members from each housing associations in a municipality to be supplemented by external experts. An example of a business development process with a focus on energy measures related to a traditional retrofitting plan is described for SAB Department 21 in Sonderborg, Denmark, where the original plan was only to have new roofs for the housing blocks. However, the development process ended with the implementation of a number of energy-saving measures: New ventilation systems, new domestic hot water tanks, new heating automatic equipment, and new solar photovoltaic systems.			
SMART-ENERGY OPERATING-SYSTEMS (SE-OS)	A framework for data-driven demand response using a hierarchy of data-driven digital twins, forecasting and control services. The Smart-Energy OS framework offers an integration with most of the existing flexibility markets.	https://orbit.dtu.dk/en/publications/smart-energy-operating-system-a-framework-for-implementing-flexib	Machine learning / Artificial Intelligence, Internet of Things - IoT / Smart metering	Social Housing, Privately Owned, Other
FROM ENERGY COMMUNITY TO A COOPERATIVE RETAILER	Plus energy neighborhoods or energy communities have the potential to cooperatively decide to become a retailer by pooling all the demand of their buildings. Becoming a retailer allows to directly procure electricity in the wholesale market. This avoids third party transaction costs and potentially lower the energy bill for individual dwellings... The questions are: How can we aggregate the demand at the neighborhood or community level to be able to participate as a retailer in wholesale markets? Does it bring benefits, is there enough automatization and digitalization means to do this?	https://www.sciencedirect.com/science/article/pii/S0378778818330378	Distributed Ledger Technology / Blockchain, Machine learning / Artificial Intelligence, Internet of Things - IoT /	Privately Owned

			Smart metering	
LOCAL ENERGY MARKETS FOR SMART BUILDINGS	The development of plus energy buildings along with the digitalization of power distribution grids (smart grids) is setting the scene to a new paradigm: peer-to-peer electricity trading. The design of the features and rules on how to sell or buy electricity locally, however, is in its early stages for neighborhoods or small communities. Business models on how to setup a fair marketplace to reward and incentivize positive energy buildings (prosumers) trading with their peers (consumers) will bring an overall welfare to various actors.	https://www.sciencedirect.com/science/article/abs/pii/S0306261918311590?via%3Dihub	Distributed Ledger Technology / Blockchain, Machine learning / Artificial Intelligence, Internet of Things - IoT / Smart metering, Other	Social Housing, Privately Owned, Industrial buildings
REWARDING SURPLUS ENERGY BY CREATING INNOVATIVE MARKETPLACES	Plus energy neighborhoods will require new business models that reward surplus energy. For example, community-to-community (C2C) trading is potentially a new, unexplored idea that could become a new business case to obtain a market-based price for surplus energy (in contrast to feed-in tariffs). By introducing trading of surplus energy between communities (or smart neighborhoods), we can create new benefits . This can take advantage of surplus energy that would otherwise be curtailed (or feed-in at a non-market based price) by introducing other players with different load and generation profiles interested on the surplus of a neighborhood. This creates more competitiveness and increase the value of surplus energy in times of high production and low prices.	https://ieeexplore.ieee.org/document/7582518	Distributed Ledger Technology / Blockchain, Machine learning / Artificial Intelligence, Internet of Things - IoT / Smart metering	Social Housing, Privately Owned, Rental
BUILDINGS FLEXIBILITY SERVICES	With more variable renewable sources (wind and solar) in the future, the power grid is facing increasing challenge to manage the real time balance between the supply and demand. With advancements in smart sensing and metering, smart appliances, electric vehicles, and energy storage technologies, demand side management of residential buildings can help the grid to improve stability by optimizing flexible loads. Business models that value building flexibility will incentivize this service for grid operators and aggregators.	https://www.sciencedirect.com/science/article/pii/S2666792421000469	Distributed Ledger Technology / Blockchain, Machine learning / Artificial Intelligence, Internet of Things - IoT / Smart metering	Social Housing, Privately Owned, Rental

SHARED ENERGY ASSETS	Common centralized energy units (battery, district heating, joint thermal storage, solar PV farm) can be shared within a set of buildings or a neighborhood. The community jointly invest in these units and makes a cost-benefit analyses on the value they bring to individual buildings.	https://www.sciencedirect.com/science/article/pii/S0378778821000219	Machine learning / Artificial Intelligence, Internet of Things - IoT / Smart metering

4.2. FINANCIAL MODELS

The list of the financial models offered below gives an overview of models that are not necessarily tied to a business revenue stream. The financial models' archetypes are potentially financial institutions' or intermediaries' products, but also community enabling models. To offer an overview of traditional and innovative financial instruments, a comprehensive literature review was performed to analyze each instrument. This catalogue is the result of the Encyclopenergy crowdsourced work and provides some of the traditional, as well as some innovative models. The financial model archetypes catalogue provides the name of the model, a brief model description, the reference to a source outlining the model, and if applicable some of the underlying technologies. In addition, and if applicable, models were labeled by the crowd with a specific or multiple asset classes category. Please bear in mind that the catalogue is a living knowledge base and Encyclopenergy keeps on growing and being refined by the community of contributors, hence this is a snapshot of the knowledge gathered to date.

FINANCING SOLUTION NAME	DESCRIPTION	REFERENCE	TECHNOLOGIES	ASSET CLASSES
ON-BILL RECOVERY (OBR)	On-Bill Recovery, also known as On-Financing (OBF) , allows customers to repay loans made for energy efficiency improvements on their electricity bills. Typically a customer will apply for a loan for an energy efficiency project, usually one of a defined set of projects that qualify for OBR, and the repayments are then added to the customer,Äôs electricity bills. OBR has a number of advantages for customers and financial institutions.	https://www.lowincomesolar.org/toolbox/on-bill-recovery/		
ENERGY EFFICIENT MORTGAGE (EEM)	A green or Energy Efficient Mortgage (EEM) is one that is used to finance purchase of an energy efficient building or refurbish a building to a higher standard of efficiency. Lower energy bills resulting from high levels of energy efficiency improve the building owner,Äôs cash flow and improve the building's value and therefore should reduce risk of default and potentially allow lenders to offer higher levels of borrowing and Loan to Value and/or lower interest rates. An EEM aims at incentivising borrowers to improve the energy efficiency of their buildings and/or acquire highly energy efficient properties. The incentives for borrowers could be favourable mortgage financing conditions and/or an increased loan amount at origination to finance the energy efficiency improvement of the property and enhance its Energy Performance Certificate (EPC) level. Both aim to reflect the reduced credit risk of EEMs and drive action to improve the energy performance of building stock.	https://energyefficientmortgages.eu/wp-content/uploads/2021/07/EEMI-Definition-14.11.18.pdf		

LEASE-PURCHASE/EQUIPMENT FINANCE	Leasing enables a building owner to use a energy efficiency installation without having to buy it. The installation is owned or invested in by another party, usually a financial institution such as a bank. The building owner pays a periodic lease payment to that party. Leasing is a well established method of financing energy efficiency projects. While the term is virtually interchangeable with equipment finance, the contracts typically cover all materials, labour and soft costs associated with an energy efficiency project. The customer either arranges lease financing through the manufacturer, vendor, or installer of the energy equipment being purchased or, if unavailable, directly with a third-party lessor. The customer and lessor sign a lease agreement once the project terms are agreed upon, and the lessor then provides the capital to purchase the equipment and associated installation services from a contractor. Once installation is complete, the customer begins making regular (typically monthly) fixed payments to the lessor on an agreed-upon schedule. However a critical distinguishing feature of equipment leasing is that the equipment is the collateral for the financing. The possibility that an equipment finance lender would repossess the equipment for non-payment puts the lender in a strong position but in practice it may be difficult to remove energy efficiency equipment that is embedded into a building or process.	https://oneplace.fbk.eu/financing-energy-efficiency/financing-energy-efficiency/transnational-methodological-framework/financing-models-for-energy-efficiency/leasing/
ENERGY PERFORMANCE CONTRACT (EPC)	Energy Performance Contract (EPC) is a form of ‚Äòcreative financing‚Äô for capital improvement which allows funding energy upgrades from cost reductions. Under an EPC arrangement an external organisation (ESCO) implements a project to deliver energy efficiency, or a renewable energy project, and uses the stream of income from the cost savings, or the renewable energy produced, to repay the costs of the project, including the costs of the investment. Essentially the ESCO will not receive its payment unless the project delivers energy savings as expected. In other words, an EPC is a contractual arrangement between the beneficiary and the provider of an energy efficiency improvement measure in which the provider, an Energy Service Company (ESCO), provides a guarantee of performance for the installed measures . The ESCO does not generally provide the required capital but usually works with established lenders to facilitate provision of finance, although the customer can also decide to directly finance the project with its own equity. ESCOs usually operate as the Main Contractor with turnkey responsibility for the energy assessment, project development, technical design, bidding, construction,	https://e3p.jrc.ec.europa.eu/articles/energy-performance-contracting

	commissioning, and provision of a savings guarantee. The ESCO‚Äôs guarantee is meant to ensure that the savings are sufficient to pay debt service. If there is a shortfall, the host, but not the lender, has recourse to the ESCO. The savings guarantee is the critical element that makes a contract an EPC and binds the various pieces together. Lenders require ESCOs with good track records and strong balance sheets that can ensure construction is completed on time and on budget and can support the performance guarantee.	
SPECIALISED ENERGY EFFICIENCY FUNDS	These funds offer a range of equity and debt financing products to energy efficiency projects, often projects implemented using Energy Performance Contracts. The multi-lateral banks, with their long interest in energy efficiency, have established specialised energy efficiency funds in their areas of operations over many years, examples include the World Bank‚Äôs Renewable Resources and Energy Efficiency (R2E2) Fund in the Western Balkans or the Romania Energy Efficiency Fund (FREE) funded by the World Bank and the Global Environment Facility (GEF). Over the last five to ten years a number of specialised energy efficiency funds have been established using private sector and private-public funding. Examples include the European Energy Efficiency Fund, the London Energy Efficiency Fund (LEEF) and the SUSI Energy Efficiency Fund. Another example is the Private Finance for Energy Efficiency (PF4EE) which is a joint initiative between the European Investment Bank and the European Commission. The instrument aims to increase the availability of debt financing for eligible energy efficiency investments and to make energy efficiency lending a more sustainable activity within European financial institutions.	https://www.oecd.org/environment/cc/Green-Investment-Banks-POLICY-PERSPECTIVES-web.pdf
CHAUFFAGE CONTRACTS (ENERGY SUPPLY CONTRACTING)	Under Chauffage, the contractor takes over the provision of an agreed set of energy services, most often heat (hence "chauffage‚Äú) but also potentially light, compressed air etc. The host pays to the contractor some historical average of its energy cost. The contractor then takes responsibility for all elements of energy services, including purchasing fuel for the building and upgrading systems. The developer may choose to discount the historical bill charged to the building owner to ensure savings and incentivise the signing of the contract. The building owner has other motivations, however, typically receiving new equipment and a set of energy services that it might otherwise have to purchase. Chauffage contracts are typically long, 15 to 30 years or more, and are best for	https://lup.lub.lu.se/luur/download?fileOId=4469198&func=downloadFile&recordOId=4468254

	buildings where an owner is comfortable outsourcing all elements of the energy infrastructure, energy purchasing and Operations & Maintenance.			
PAY-FOR-PERFORMANCE (P4P)	In a P4P scheme for financing energy retrofit projects, financial flows between the involved parties are linked to the actual ‚Äì metered ‚Äì and weather-normalised energy savings. This approach encourages long-term investment and transparent cash-flows (pay) in energy-efficient buildings by metering energy savings smart and getting a return on investment (ROI), based on proven and measured savings in the buildings (performance).	https://zenodo.org/record/3887823#.YjMEgBDMJTY	Distributed Ledger Technology / Blockchain, Machine learning / Artificial Intelligence	
PUBLIC-PRIVATE PARTNERSHIP (PPP)	The PPP model is an innovative way of delivering infrastructure, which, when well structured, can occur at a faster pace and at lower expense to the State as it offers recorded off balance sheet for government. Under this contract, the private partner bears significant risks and management responsibilities. The public authority makes performance-based payments to the private partner for the provision of the service or grants the private partner a right to generate revenues from the provision of the service. The first PPP programme for social housing in Europe were signed in Ireland in 2019. The establishment of a PPP can be challenging for an unexperienced local authority, therefore, the European PPP Expertise Centre - part of EIB advisory services- was set up in 2008 to provide adequate support in delivering PPPs.	https://www.housingeurope.eu/resource-1262/the-first-ppp-programme-for-social-housing-in-europe-signed-in-ireland	Other	Social Housing
ONE-STOP-SHOP	One-stop shops aim to address administrative barriers in providing permits, certification and to support households and housing associations with legal, technical (including energy audits) and financial advice. Additional challenges that need to be addressed are the burden of managing the execution, the quality and performance control of the renovation, and knowledge gaps in incorporating resource efficient and circular approaches. To this end, dedicated one-stop-shops in each region can be set up to streamline the administrative processes, to ease access to finance and to enhance the absorption capacity in energy and resource efficiency building renovations. The advantage of the scheme is that it offers a non-institutional space for neighbours and helps increasing the awareness of homeowners for energy efficiency and energy poverty alleviation. The implementation period is estimated to be 18-24 months according to the European Commission.	https://e3p.jrc.ec.europa.eu/publications/one-stop-shops-energy-renovations-buildings	Machine learning / Artificial Intelligence	Social Housing, Privately Owned, Rental

FINANCING MODELS FOR HOUSING ASSOCIATIONS	One of the challenges implementing energy retrofitting measures in housing associations is to get the projects financed. ESCO is financing by private funds provided by private companies, where the realized energy savings in the specific apartments are used to repay the investment. This financing method does not demand increase in the rent in apartments and does not demand financial guaranties from the Municipality. However by this method the tenants do not save energy costs, until the investment is repaid. An example of ESCO financing can be building integrated solar cell projects, which typically have a payback period of 10 years and have a lifetime of 25 years. During the first 10 years the tenants will not get any reduction in their energy costs, but from year 10 to year 25 the tenants will get reduction in energy costs without having an increase in the apartment rent. During the last years the ESCO companies have also started financing energy saving measures with a payback period up to 20 years (insulation works etc). One of the barriers with ESCO financing compared to traditional financing methods is, that the ESCO financing is not very transparent. In traditional projects the housing associations know the specific costs for administration, financing, consulting, implementation. In ESCO projects the financing company takes care of all costs connected to the energy retrofitting, and the housing association has not knowledge to the specifications, as they are used to have.	https://go-happi.dk/happi-d3-2-financing-models-for-housing-associations/		Housing Associations
ON BILL SCHEMES (OBS)	A way of financing energy renovations that utilise utility bills as repayment vehicle (cooperation between energy utilities and financial institutions).	https://www.renonbill.eu/about	Customer segmentation	Residential building market in general

5. CONCLUSIONS

It is widely recognized that new models and sources of finance are necessary to deliver the untapped energy efficiency potential of buildings. As the energy efficient finance market grows, tested concepts will evolve into more well-established schemes, while new ones will develop. Public subsidies provided by EU governments have created an early economic stimulus toward energy renovation projects. Even though they currently form the most popular instrument type provided in the EU, they are unlikely to form a major driver for large-scale investments.

For now, these financial instruments remain an integral part of any comprehensive energy efficiency policy framework due to their ability to incentivize stakeholders, balance risks, and provide direct support to investments that generate significant and long-lasting energy savings. In the future, research must focus on how financial models can be better integrated with new and emerging practices in the field. For instance, 'one-stop-shops', a concept that has gained popularity, offer a single entry to customers which can guide them through all aspects of the complex renovation value chain, including support on how to access finance.

Encyclopenergy was developed to capture the growth and ever-changing models in the built environment field. The next few decades will be key to reverse climate change and the current geopolitical situation suggest that crisis, market challenges and disruptions will continue yet climate change mitigation will have to steadily continue. In this spirit, Encyclopenergy wants to be a lighthouse for the ARV project as well as for the global community when it comes to keep track of innovative and adaptable approaches at a global level. Thanks to the community contribution and the strong impetus the ARV network will create this living deliverable will offer a solid stage to exploit innovative business and financial models to foster energy efficient climate positive circular communities.

6. ACKNOWLEDGEMENTS AND DISCLAIMER

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101036723.

This deliverable contains information that reflects only the authors' views, and the European Commission/CINEA is not responsible for any use that may be made of the information it contains.

This deliverable benefitted from the inputs of all ARV project partners that have contributed to the process of designing, reviewing and populating Encyclopenergy. Special thank you to NTNU, Housing Europe, DTTN and IREC.

7. PARTNER LOGOS

WWW.GREENDEAL-ARV.EU