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Novel business models for solar and geothermal cooling

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A study for innovative and new business models, including Initial-Aid Cashback (IAC) model, Energy service company (ESCO) model and Community Cooling (C-C) Hubs.

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IV. Summary

The Cooling Down project focuses on advancing solar and geothermal cooling technologies to make sustainable and renewable cooling solutions more affordable for consumers and attractive for investors. This initiative is particularly relevant in the EU, where the demand for renewable cooling is growing. This report presents an overview of different stakeholders in the cooling sector, both on the demand and the supply side, and identifies their needs. The project investigates various financing and business models, including the newly developed Initial-Aid Cashback Model, as well as detailed analyses of the ESCO (Energy Service Company) model and Community Cooling Hubs.

The Initial-Aid Cashback Model allows consumers to invest in cooling devices initially and receive discounted energy in return. Operators thereby benefit from reduced risks and by owning the technology without self-financed investments. The ESCO model facilitates energy efficiency projects avoiding investment costs for the consumers. It enables consumers to save energy while the ESCO benefits from the savings. Community Cooling Hubs enable small, private investors to invest and take part on the clean energy transition (CET) and take pressure from municipal energy operators and suppliers.

These models are evaluated using qualitative and quantitative Key Performance Indicators (KPIs) to assess their competitiveness, efficiency, robustness, sustainability, and potential for economic growth. A business model tool was developed to compare these models and to support energy experts in their decision-making process.

A case study of a multi-story office building in Romania demonstrates the practical application of the three considered models. The case study highlights the benefits and challenges of each model. It shows that the Initial-Aid Cashback Model is mostly attractive for operators due to low risk, while Community Cooling Hubs offer high benefits for small, private investors. The ESCO model is mainly applicable and rentable for high energy demand scenarios.

The conclusion shows that the suitability of these models depends on specific use cases and stakeholder objectives. The Initial-Aid Cashback Model and Community Cooling Hubs are effective in integrating citizens and small investors into the clean energy transition, while the ESCO model simplifies the implementation of energy efficiency projects without requiring consumers' technical and administrative expertise. Overall, these models are able to contribute to support the clean energy transition.

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V. Introduction

In the last three decades the market for cooling has been growing and will increase until the middle of the century even more [1], shown in Figure 1. This means that there are many opportunities for new business models, especially for renewable cooling as those technologies shall be used primarily in the EU [2,3].

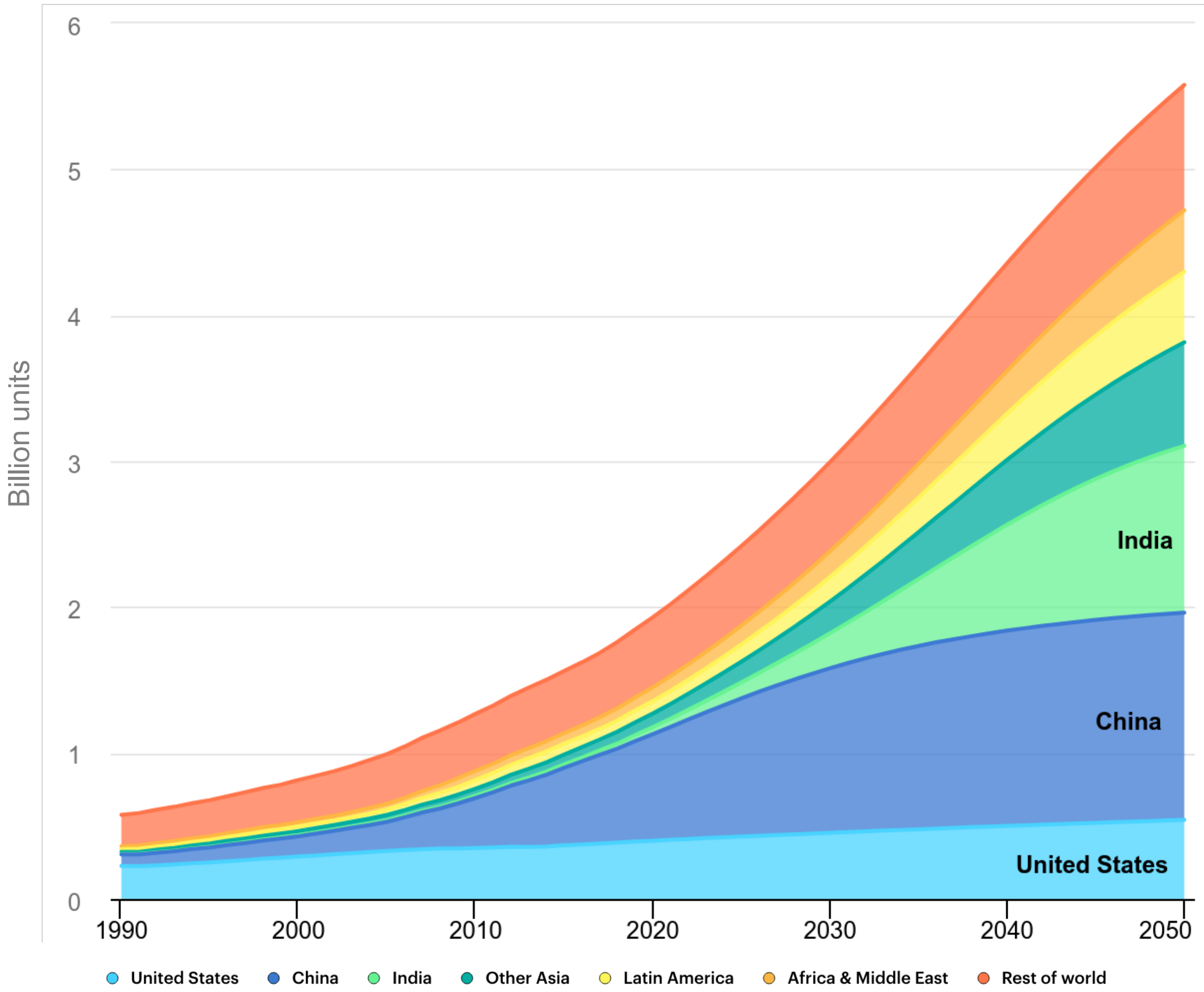

Figure 1: Growth in global air conditioner stock, 1990-2050 [1]

In the Cooling Down project solar and geothermal cooling are the main target fields of research. This report aims to introduce new business models that give advantages for sustainable cooling compared to conventional solutions, as costs are the main driver for the clean energy transition. According to Jakob et. al, the IEA SHC Task 65 focused on promoting solar cooling in the Global South to address growing cooling demands sustainably. Over four years, experts analysed and adapted solar technologies to optimize costs and environmental impact. They developed guidelines, standardized kits, and financing models to support market

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penetration. The task emphasized the importance of policy support and demonstration projects to overcome technical and non-technical barriers. Overall, solar cooling shows potential to reduce emissions and electricity demand in high-need regions [4].

Air conditioners and electric fans consume nearly 20% of global building electricity, straining power systems and increasing emissions. Without policy interventions, cooling demand will continue to rise, but improving equipment efficiency offers a significant opportunity to mitigate this growth sustainably [5].

VI. Methodology of Task 4.2

Task 4.2 and this report tries to answer the question how sustainable and renewable cold can be made affordable for consumers and interesting for investors by reviewing existing financing and business models and creating new ones by adopting and combining the existing models. The new innovative business models shall support the NCAP (National cooling action plans). The overall methodology of this Task is shown in Figure 2.

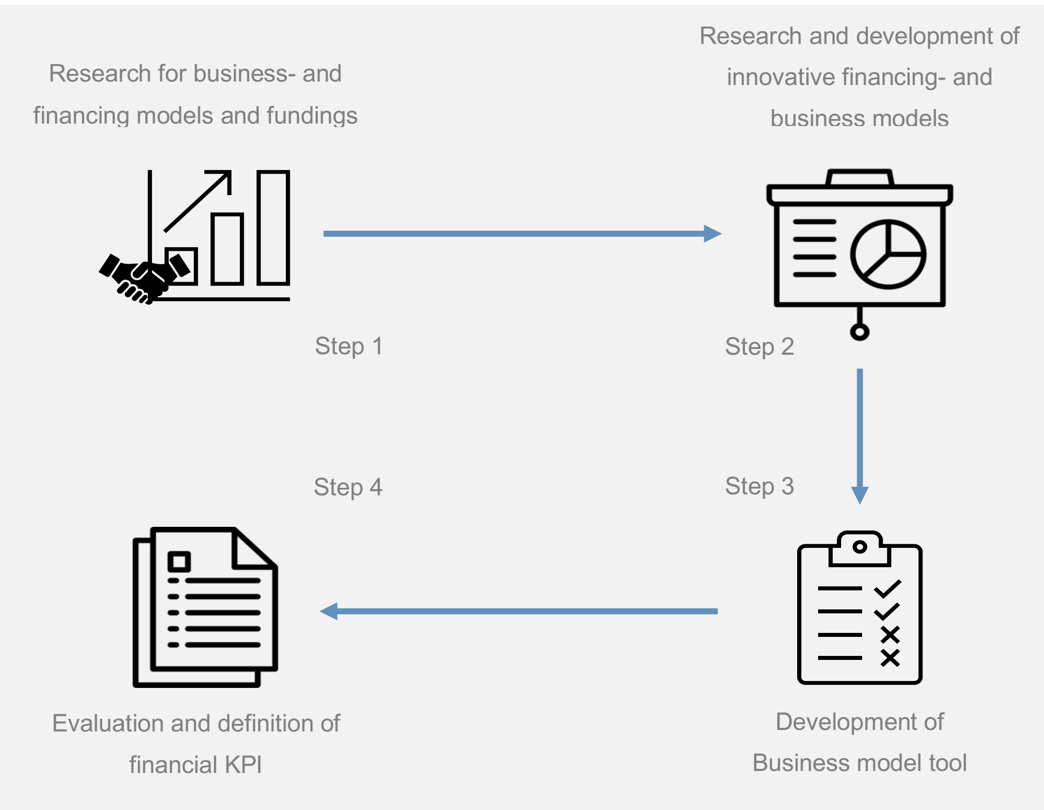

Figure 2: Methodology of the Business modelling development

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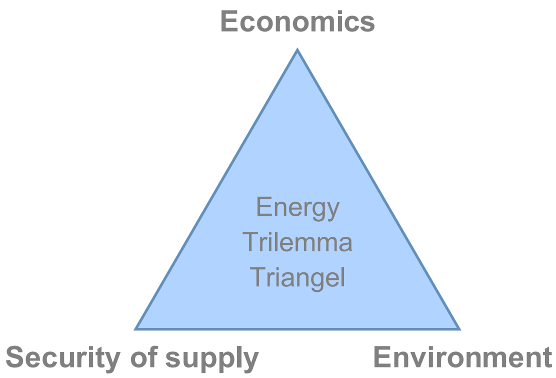
1. Research for business- and financing models and fundings

Following, several options of business models and financing will be shown. These contain well approved systems and models but also new opportunities that came up in the last time. Thereby all four kinds of financing are considered, which contain internal financing, external financing, self-financing and financing with outside capital.
Most models are not tailored specifically on cooling, but the selection was made by having the goal in mind to adopt the models on the cooling market.

1.1. Definition of Target groups

The research and development of innovative and novel financing- and business models was targeted for the client/users of cold, for energy providers and for public bodies.
Following the requirements of the different stakeholders are analysed. Thereby the triangle of the energy trilemma [6] shows the three main aspects of evaluating energy costs:



For each group of stakeholders, those three factors can be prioritised as follows.

Table 1: Stakeholder needs priorisation

Stakeholder	Requirement/ Needs
Private persons	1. Economics 2. Security of supply 3. Environment
Enterprises	1. Economics 2. Environment 3. Security of supply
Energy providers	1. Economics 2. Security of supply 3. Environment

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Public authorities/ municipalities/ administrations	1. Environment 2. Security of supply 3. Economics

One of the main challenges by trading cold are the very diverse needs for different goals of cooling. Within the Cooling Down project, space cooling was in the focus of consideration, regarding different sectors, from private housing in single units and multifamily houses to commercial buildings like offices, hospitals or shopping malls.

Also, funding opportunities are not suitable for every cooling solution which generates a need of different options of business and financing models for renewable and sustainable cooling.

Through different regulations, it can be found that in future times, cooling in Europe will be dominated by devices using natural refrigerants to avoid greenhouse effects by striking cooling devices [7].

1.2. Profit-oriented financing options

Following several options of supporting companies financial are described. All opportunities contain monetary investments by natural or legal persons.

Seed funding

This is also called Early-Stage-Financing and means the support of financing at beginning of start-up [8]. It does not only contain support by cash but also by writing business plans, creating prototypes or commencing [9].

Blended finance

The Bank of America defines blended finance as a kind of financing fund where different kind of private and non-private stakeholders can pay in to take part on projects with different levels of risk [10].

Private Equity

Private Equity means investments in companies that are not quoted. By those investments the company receives money but also knowledge from the investors. In return the investors get interest on the company which will be paid out by time [11].

Crowdfunding

The EU describes crowdfunding as “an emerging source of financing involving open calls to the public, generally via the internet, to finance projects through monetary contributions in exchange for a reward, product preordering, lending, or investment.

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For small businesses, access to this form of finance represents an alternative (or a complement) to more traditional sources of finance like debt finance.” [12]

Bulk procurement

This kind of financing means the procurement of goods above 100,000 US$ [13]. Thereby this kind of financing has several advantages, such as the access to better deals containing lower prices, the quality of the goods will not vary and also the invest of time will shrink.

Cash machine model

This model contains a prepay system which leads purchasers to pay for goods and services in advance. Thereby the provider can use the money to deliver the service that has been paid for [14].

Pay as you go

By this opportunity of financing the company purchasing goods doesn’t need to pay for them in advance nor to make supplementary compensations. Usually, this kind of financing is used in the IT sector for example by renting online storage or server capacities. This means that the company purchasing goods has no preparatory efforts and doesn’t have to count with costs coming up later on after a project’s lifetime [15].

1.3. Profit-oriented business models

Towards the financing options, business models do not only contain financing but also services that are offered in a common package. The business models can contain monetary support but also selling goods or services.

ESCO financing

In this case all installations and services are done by the ESCO company. This leads to lower prices as the whole system comes from one provider. The financing is always coupled with one specific project [16].

Leasing-financing

“An agreement between two parties whereby one party allows the other to use his/her property for a certain period of time in exchange for a periodic fee. The property covered in a lease is usually real estate or equipment such as an automobile or machinery. There are two main kinds of leases. A capital lease is long-term and ownership of the asset transfers to the lessee at the end of the lease. An operating

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lease, on the other hand, is short-term and the lessor retains all rights of ownership at all times.“ [17].

Guaranteed availability

By having the guaranteed availability, consumers pay some extra amount to the provider. By those payments additional installations can be done to renovate the system or create redundancies whereby the delivery of the good or service can be assured [18].

Cooling as a Service

The SET alliance was founded to make "Servitisation" business offers available on a global scale. Servitisation means that not only a product is sold within a contract but also services targeting the net zero goal of the SDG [19]. CaaS is part of this alliance and focusses on sustainable cooling by providing full installation and services of cooling to users [20].

Cooling Bonds

"Bonds are investment securities where an investor lends money to a company or a government for a set period of time, in exchange for regular interest payments. Once the bond reaches maturity, the bond issuer returns the investor's money. Fixed income is a term often used to describe bonds, since your investment earns fixed payments over the life of the bond." The maturity means the date and time when the bond issuer pays back the money to the investor [21].

1.4. Social-oriented business and investment models

There are also opportunities where business and investment models are provided by communities or social facilities.

Citizen Cooperative

The EU defines a cooperative as „an autonomous association of persons united to meet common economic, social, and cultural goals. They achieve their objectives through a jointly owned and democratically controlled enterprise." [22]

Philanthropy

Philanthropic funding for cold-related initiatives involves support and funding of projects that address cooling challenges. These include the expansion of cold chain

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infrastructure for temperature-sensitive goods but also cooling solutions for communities in hot climates or disadvantaged populations. Philanthropic funding supports innovation, research and sustainable cooling solutions to strengthen public health, food security and climate resilience [23].

Community cooling hubs

The goal of Community cooling hubs (CCH) is to provide cold for a group of stakeholders in a sustainable way, according to the Paris Agreement and the UN Sustainable Development Goals [24]. Other than using sectoral divided cooling solutions, cooling hubs can provide cold to several consumers and interdependences can be used in a positive way.

1.5. Funding opportunities for renewable cooling

EU: Social climate fund (SCF)

The EU Social Climate Fund (SCF) as part of the EU Fitfor55 climate package, was established for emissions from fuel combustion in several sectors. Its primary objective is to facilitate a fair transition towards climate neutrality by mitigating the social and economic impacts of the CET. The fund aims to support vulnerable groups, to not being left behind during the green transition. The SCF promotes zero- and low-emission mobility solutions and provides the option for temporary direct income support.

To access SCF funding, Member States are required to draft national Social Climate Plans that outline all planned measures and investments aimed at supporting vulnerable households, transport users, and micro-enterprises. Member States must submit their plans to the European Commission by June 2025.

The SCF will be financed through revenues generated from the auctioning of allowances under the ETS2, as well as 50 million allowances from the existing EU ETS. Additionally, Member States are required to contribute 25% to their Social Climate Plans [25].

National funding programs

There are several funding opportunities in the partner countries of the Cooling Down project. Within the project, the main fundings were collected by the consortium. Table 1 shows the main fundings energy producers and providers can apply for.

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Table 2: Renewable cold fundings in the project countries (no claim for completeness)

Country	Institute	Programm
Germany	BAFA	Förderung von Kälte- und Klimaanlagen
Germany	German ministry for economics and climate action	Richtlinie für die Bundesförderung für effiziente Gebäude – Einzelmaßnahmen (BEG EM)
France	ADEME	Fonds Chaleur Renouvelable
Romania	Environment fund administration	Energy efficiency in public buildings
Romania	Environment fund administration	Program for carrying out works aimed at increasing energy efficiency in single-family homes, beneficiaries being individuals
Romania	Regional Development Agencies	Regional Operational Programmes (ROPs) 2021-2027
Romania	Ministry of European Investments and Projects	Sustainable Development Operational Programme (PODD) 2021-2027
Romania	Ministry of Investments and European Projects	Just Transition Operational Programme (POTJ) 2021-2027
Romania	Ministry of Investments and European Projects	National Recovery and Resilience Plan
Spain	IDAE	Programa de Rehabilitación Energética de Edificios (PREE)
Spain	European Union	Spain's Recovery and Resilience Plan (Next Generation EU Funds)
Spain	IVACE, European Union	Subsidies for the Implementation of Thermal Renewable Energy Installations in Different Sectors of the Economy
Spain	MITECO	Certificados de Ahorro Energético (CAE)
Italy	Agenzia delle Entrate	Bonus casa
Italy	Agenzia delle Entrate	Ecobonus
Italy	GSE	Conto Termico

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2. Innovative financing- and business models

This section elaborates on two innovative business- and financing models that have been applied in the past but cannot be considered as state of the art. Therefore, explanations about the general functionality, the pros and cons and the feedback from experts of the field of renewable and sustainable cooling are given.

2.1. ESCO (Energy Service Company)

The ESCO model in short: The ESCO (Energy Service Company) financing model enables energy efficiency projects without upfront costs. An ESCO analyses a client's energy usage, identifies savings opportunities, and agrees on a contract outlining planned measures and expected savings. The ESCO then finances and implements these projects. Once in place, the client saves energy and costs, paying the ESCO from the realized savings to cover investment and service costs.

This model allows clients to reduce energy expenses without initial investment, while the ESCO benefits from the savings.

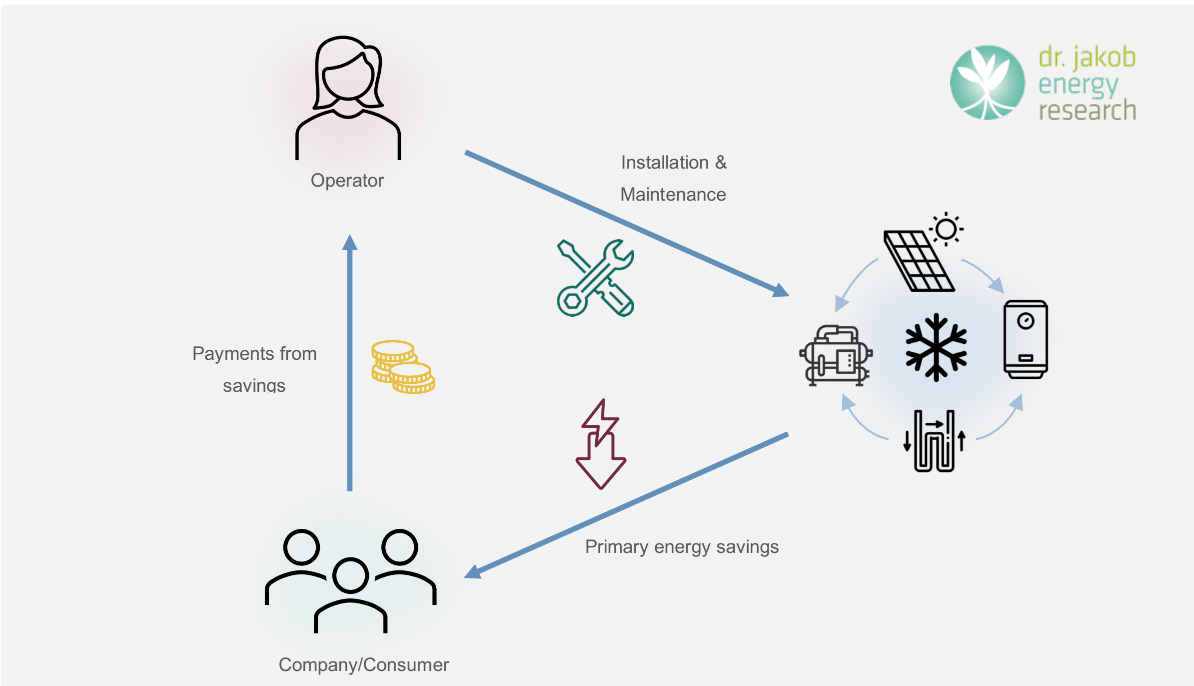

Figure 3: Energy Service Company model

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2.1.1. Expert meeting (Consortium)

The consortium meeting was used to receive feedback from the consortium's experts regarding the ESCO business model, used for cooling.

Table 3: ESCO – Expert feedback on model

Advantages	Disadvantages
Efficiency	Complicated contract
Easier life for consumers	Complex
Low costs for clients	Complexity procurement
Technicity	Definition of boundaries is complex
Investor incentivized	Finding an ESCO is difficult
Focus on efficiency	Good only for large project
Making investments easier	
Easier to combine techs	

The feedback of the experts shows, that there are possibilities to apply the ESCO model to cooling applications. However, it needs to evaluated in each specific case and depends on several boundary conditions like stakeholder goals or energy systems.

2.1.2. Calculation

The calculation of the ESCO model aims to show the outcome and amortisation for the ESCO company, as the company using the energy is not influenced directly, only after the defined timespan.

Operational costs need to be identified by

$$Operational\ costs = Maintenance\ costs + Energy\ costs$$

with

Operational costs, maintenance costs and energy costs in €/a

Cost savings can be estimated by dividing operational costs of renewable cooling from operational costs of conventional cooling.

$$Cost\ savings = OC_{conventional} - OC_{renewable}$$

with

Cost savings in €/a

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$OC_{conventional}$ = Annual operational costs for conventional cooling

$OC_{renewable}$ = Annual operational costs for renewable cooling

By the payback of the savings, depending on the contract, up to 100% of the cost savings through operational costs are passed by to the operator.

2.1.3. Stakeholder consideration

The following table shows the advantages and challenges of the model, regarding the different stakeholder groups.

Table 4: ESCO – Pros and Cons for Stakeholders

Consumer	Operator	Public administration
+ Full service for energy + Renovation of energy system + Owns installed technologies - No (or very small) ROI in first few years	+ Replacement of existing installations + Full service → Predictability + Takes risks	+ Push of renewable energy generation + Increased income for municipality by

2.2. Community Cooling Hubs

The Community Cooling Hubs model in short: Community Cooling Hubs, inspired by energy communities, provide efficient and sustainable cooling solutions for local areas. These hubs aggregate the cooling needs of a community, leveraging economies of scale to reduce costs and improve efficiency. Operational costs include maintenance of cooling equipment, energy expenses, and administrative costs, which are calculated as a rate based on maintenance and energy costs. Revenue is generated from the cooling demand, multiplied by the consumer price, and profit is determined by subtracting operational costs from sales. Investors receive returns based on their share of the annual profit minus their individual payments.

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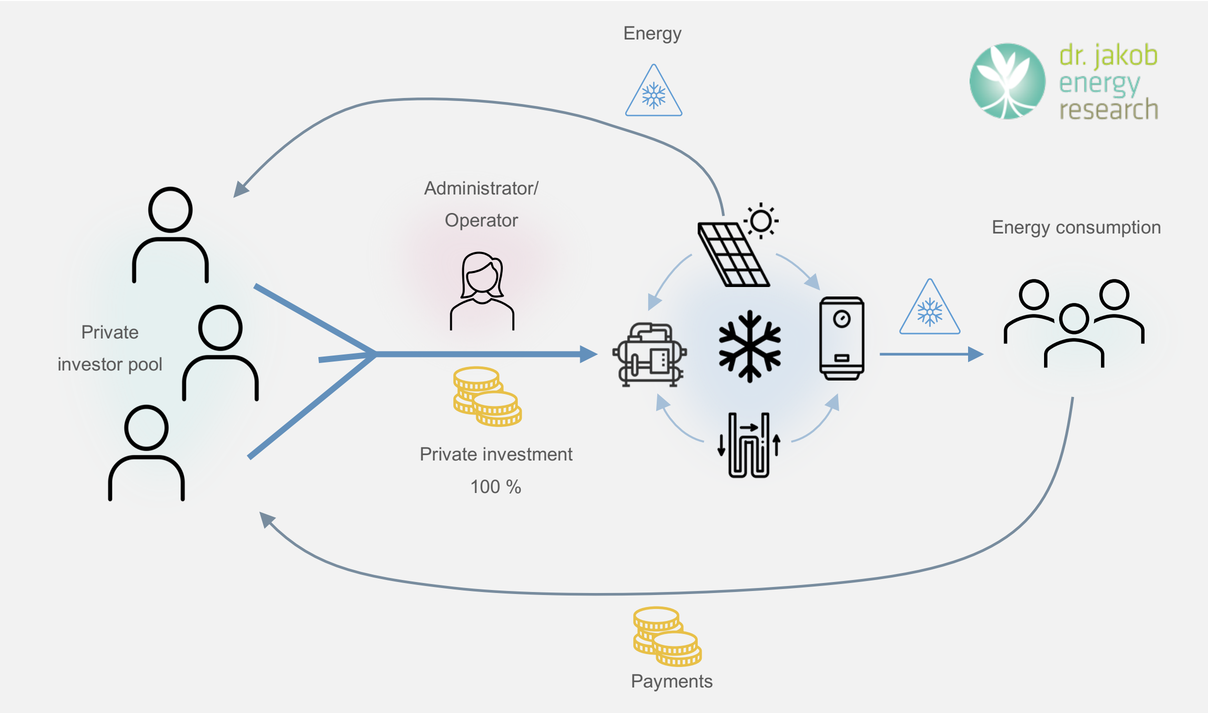

Figure 4: Community Cooling Hubs model

2.2.1. Expert meeting (Consortium)

The consortium meeting was used to receive feedback from the consortium's experts regarding the ESCO business model, used for cooling.

Table 5: C-C Hubs – Expert feedback on model

Advantages	Disadvantages
Democratic, including citizens	Not flexible
Empower energy poors	Complexity of decision
Social acceptance	Knowledge time needed
Knowhow for community	Additional cost
Contribute to HC planning	Lack of expertise
No technical knowledge needed	Governance
Awareness increase, Collective action	High initial costs
Direct involvement, Engagement of people	Early planning
Long-term clients engagement	Reduced climate impact
Shared responsibility	Risk: Lack of management

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The feedback from the experts shows, that there is interest in this model, especially by the argument of integrating citizens actively into the clean energy transition.

2.2.2. Calculation

Other than in the IAC and the ESCO model, the operational costs of this model do additionally contain administration costs.

Operational costs need to be identified by

$$Operational\ costs = Maintenance\ costs + Energy\ costs + Admin\ costs$$

with

Operational costs, maintenance costs, energy costs and admin costs in €/a

The private investors are selling the cold to customers for a defined price. This generates the profit per investor which can be calculated by

$$Profit_{Investor} = Energydemand * Energyprice * Investshare$$

with

$Profit_{Investor}$ = Profit per investor in €/a

Energydemand in €/a

Energyprice in €/kWh

Investshare = Share of invest per private investor in %

The amortisation can be calculated through comparing the investment with the profit, though this is depending on the annual change of energy demand, energy price, inflation and interest rate

2.2.3. Stakeholder consideration

The following table shows the advantages and challenges of the model, regarding the different stakeholder groups.

Table 6: C-C Hubs – Pros and Cons for Stakeholders

Private investors	Operator	Public administration
+ Opportunity for financial asset + Participation in CET	+ Very low risk + Different fields of expertise are needed	+ Push of renewable energy generation

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+ Owns facilities - Private investors have to deal with contracts		+ Externalities can be saved + Increased tax-income by higher citizens wealth

3. New innovative business model

In addition to the innovative models already presented in Section 2, this section introduces a new concept: the Initial-Aid Cashback model. Developed from scratch, this model offers citizens an additional avenue to participate in the CET.

3.1. Initial-Aid Cashback Model

The initial-aid cashback model in short: Customers provide an initial financial contribution to fund the cooling device. Subsequently, they benefit from discounted cooling services. This model is feasible due to the absence of bank interest, among other factors. This arrangement is also advantageous for the cooling service provider/operator, as there are vera minor risks

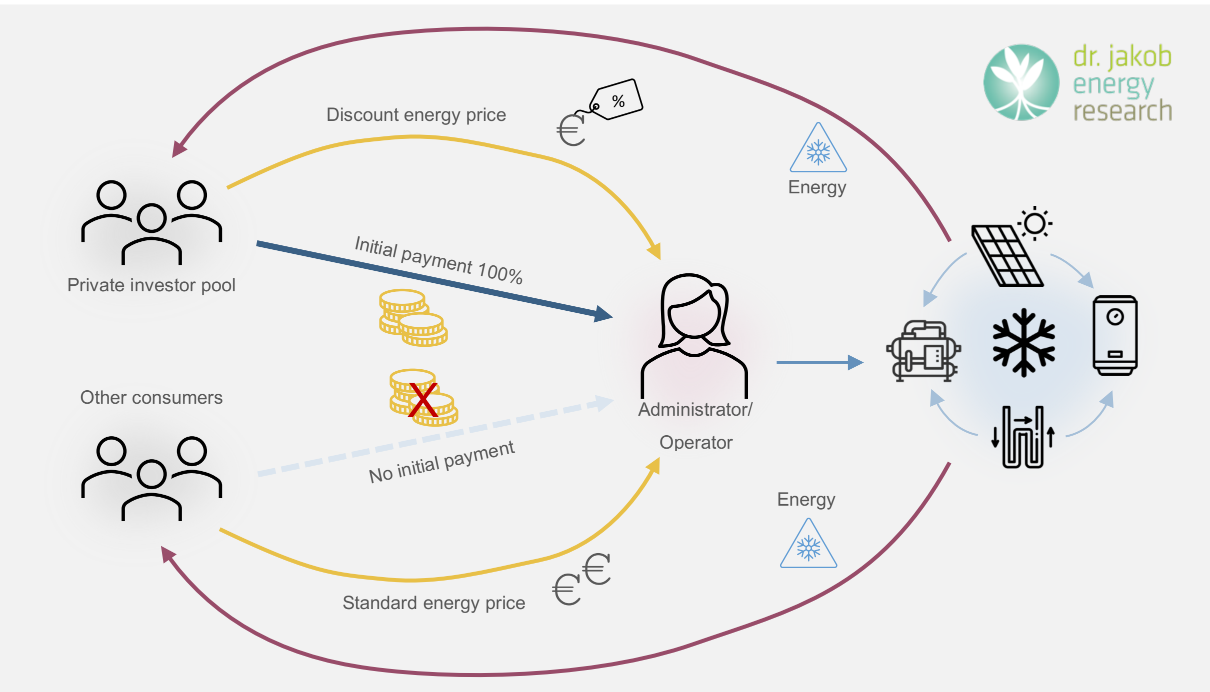

Figure 5: Initial-Aid Cashback model

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for them while offering cold, without the need for bank credit. Figure 5 shows the model and how the money and energy flows are considered to be.

3.1.1. Expert meeting (Consortium)

The consortium meeting was used to receive feedback from the consortiums experts regarding the new business model.

Table 7: IAC – Expert feedback on model

Advantages	Disadvantages
Possible opportunity for public dwellings	Minimum number of investors needed
Could help against energy poverty	Discount definition can be difficult
Good for private users	Where is efficiency
Investor incentivized	No help energy
Flexibility is given	Who will invest?
Easily expandable	**Only for energy-generation – what about efficiency?**
Good for diverse consumer	
Good for small consumer	Complicated contract
Housing associations	

3.1.2. Webinar results

At the webinar in December 2024, held by the Cooling Down consortium, the participants of the webinar were asked to give their valuation about the model.
The first question was: "What do you see as barriers to implementing the IAC model?"
Thereby the participants could insert user defined words. Only one word was given three times: trust. Other words were "agreement on discount, infrastructures, investment, legal conditions, long-term investment, low production, maintenance after install, ok, payback period, resources, return on investment, risk, too many participants invited".
The second question was targeting the applicability and practicability of the new model by asking "How do you rate the implementation of the new IAC model?", the results are shown in Figure 6 and 7. The question was divided in two subtasks, (I) "Feasibility of the new IAC model" and (II) "Future availability of the IAC model". Thereby the participants could rank their answer between 0 (unlikely) and 10 (very likely).

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Figure 6: Feasibility of the new IAC model (I)

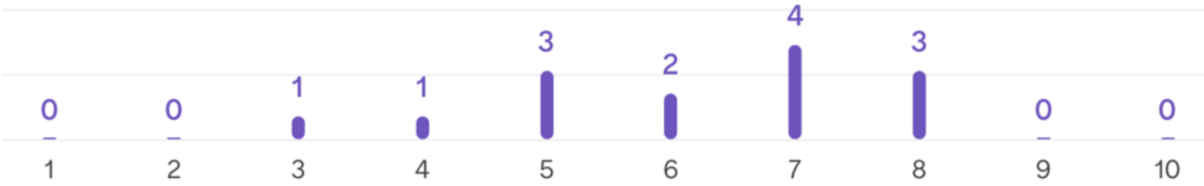

Figure 7: Future availability of the IAC model (II)

3.1.3. Cooling Down Day 2025 Feedback

Additionally, the Cooling Down Day 2025 final event in April 2025 in Brussels was used to collect further feedback and questions to be clarified. The responses are already summed up.

Table 8: Feedback and Subsumption from Cooling Down final event

Feedback
To be convincing, testing the new model will be required. Therefore, interested participants (Investors and operators) need to be found
The role of funding needs to be clarified and who will be funded – the operator or the investor?
The possibility using the model for district cooling and with 1 large consumer needs to be considered.
Does the model presume a certain governance model for the investors? One share one vote, one investor one vote, etc.?
How do you see potential follow-up, how the solutions will be picked up by parties involved (consumers, tech providers, financiers)?

This study shows that funding is an important tool to support the implementation of renewable cooling, no matter which business model is used. For the IAC model, fundings are given to the operator and owner of the cooling device and technology, who then needs to receive fewer initial payments from the private investors. It gives the opportunity to make the investment to be more attractive for private investors, while keeping the profit margin.

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The contract specifications depend on each single case and need to be adapted according to local requirements. For example, the rights of the investors can be defined accordingly.

3.1.4. Calculation

The Initial-Aid Cashback model can have positive effects for both the operator and the private investors. For the calculation the main factors are the

- investment costs,
- operational costs,
- number of private investors,
- number of consumers,
- annual energy demand and
- discount (%) for initial aid private investors.

Operational costs are calculated by

$$Operational\ costs = \ Maintenance\ costs + Energy\ costs$$

with

Operational costs, maintenance costs and energy costs in €/a

Sales of energy are calculated by

$$E_S = \ E_{Demand_{Investors}} * Price_{Discount} + E_{Demand_{Others}} * Price_{Standard}$$

with

E_S = Sales of energy in kWh/a

$E_{Demand_{Investors}}$ = Annual energy demand of investors in kWh/a

$E_{Demand_{Others}}$ = Annual energy demand of investors in kWh/a

$Price_{Discount}$ = Energy price for private investors, including discount in €/kWh

$Price_{Standard}$ = Energy price for consumers that not invested in €/kWh

Profit of operator per year can be calculated by

$$Profit\ of\ operator = \ Sales\ of\ energy - Operational\ costs$$

with

Profit of operator in €/a

Sales of energy in €/a

Operational costs in €/a

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Savings per private investor are resulting from calculating

$$Savings_{Investors} = E_{Demand_{Investors}} * (Price_{Standard} - Price_{Discount})$$

with

$Savings_{Investors}$ = Total annual monetary savings of investors in €/a

$E_{Demand_{Investors}}$ = Annual energy demand of investors in kWh/a

$Price_{Discount}$ = Energy price for private investors, including discount in €/kWh

$Price_{Standard}$ = Energy price for consumers that not invested in €/kWh

By the comparison of the total savings with the investment, the amortisation of the investment can be identified.

3.1.5. Stakeholder consideration

The following Table 9 shows the advantages and challenges of the model, regarding the different stakeholder groups.

Table 9: IAC – Pros and Cons for Stakeholders

Investing consumers	Operator	Public administration
+ Opportunity for financial asset + Discounted energy + Participation in CET - ROI can evtl. be higher with conventionals - Profitable only if enough investors take part	+ Very low risk + Owns facilities	+ Push of renewable energy generation + Increased tax-income by higher citizens wealth

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4. Evaluation and definition of financial KPI

For the evaluation of financing and business models the so-called **Bank KPI** (Bank Key Performance Indicator) have to be considered. Following several existing KPI are listed and compared to find the ones fitting the best for evaluating business models for cooling [26]. The following KPI listing is separated into 2 groups - soft KPI and hard KPI.

4.1. Qualitative KPIs

In this first part, the qualitative KPI are listed which means that the evaluation can hardly be made based on specific numbers but more considering knowledge about the market dynamics in terms of competitors, etc. Mainly they have to be rated within a range, for example between 0 and 1.

Competitiveness

Is it easy for competitor to gain market share? The competitiveness can be highly ranked if the business model delivers high market presence and unique selling points.

Efficiency

The efficiency shall be increased as much as possible to strengthen the business model. The efficiency can be measured by asking for the ratio between necessary functions and effort inputs. Therefor specific tasks can be outsourced to increase the efficiency of the business model itself.

Robustness

This indicator shows if the business model is robust against changes of the existing market forces and trading conditions. Questions to be answered are mainly targeting funding programs and if they have an impact on the business model if they are declined.

Income Component

The income component describes the income portion of a specific component which is part of an overall calculation. It indicates what part of the total income is accounted by specific factors, for example wages, interest or dividends. It can also represent the income share of a household member or group. The Income Component is used to analyse specific aspects of income [27].

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Sustainability

The economic sustainability is the most important kind at this place. The question has to be if the developed business model can exist theoretically forever in its current conditions. This shows that selling oil is not sustainable in an economic way, as it is fossil and one day the resources will be sold out.

Economic growth

Economic growth answers the question if the business model can be expanded in any way. This could be by upselling, the possibility of gaining new customers or the openness of for new target groups.

Exclusiveness

The evaluation of the business model regarding the exclusiveness of resources, contracts, patents, knowledge, etc. shows how successful the business can be in the future. If this KPI is highly rated, the business model can make the business increase a lot, as competitors are indirectly precluded from the market.

4.2. Quantitative KPIs

Hard KPIs are mostly prices and ratios that can be calculated as an amount of money that needs to be invested and is expected to be received.

Net Interest Margin

One of the most important KPIs for banks, net interest margin (NIM) reveals a bank's net profit on interest-earning assets, such as loans or investment securities. Since the interest earned on these assets serves as a primary source of revenue for a bank, this metric can indicate a bank's overall profitability.

Return on Assets

The return on assets (ROA) is a metric that indicates a company's profitability in relation to its total assets. So, the return of assets can be calculated by Net Income / Average Total Assets [28]. The ROA shows the efficiency of the company using their assets to generate income [29].

Return on Equity

The return on equity (ROE) shows parallels to the return on assets. The difference is the reference base, which is equity for the ROE instead of assets on the ROA. It also

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shows the companies efficiency by comparing the net income with all equity of the company [30].

Return of Invest

Return on Investment (ROI) is a financial metric that evaluates the profitability of an investment. It is calculated by dividing the net gain from the investment by the initial cost of the investment and expressing the result as a percentage. A higher ROI indicates a more favourable return relative to the initial investment, while a negative ROI implies a loss [31].

Direct price for user

By the direct pricing for the users the saleability can be shown, so the business model thereby receives a rating about the likelihood of profit.

Dept-to-asset ratio

This ratio shows the capital which has been given from outside in comparison to the assets of a company. It gives a clue, how well self-financing works in the company [32].

Risk-Adjusted Return on Capital

Risk-Adjusted Return on Capital (RAROC) is a financial ratio that measures the risk-adjusted return in relation to the capital employed. It considers the risk of an investment and compares the expected return with the cost of capital. RAROC enables companies to evaluate and compare the return on projects or investments, considering the associated risk. It is calculated as follows. The sum of revenue minus expenses and expected losses plus capital income, divided by the full capital [33].

Efficiency Ratio

A financial institution calculates its efficiency ratio by dividing its non-interest expenses by revenue. Combined with a few other metrics, such as expense ratio and revenues, the efficiency ratio can help institutions determine if branches are appropriately staffed. A lower efficiency ratio indicates that a company effectively controls its operating costs and retains a higher proportion of its revenues as profit.

Loans to Deposits Ratio

One of the main factors by assessing a company's funds is the liquidity of the company. The liquidity can be assessed by calculating the loans of deposits ratio (LDR). The LDR can be calculated dividing Total Loans by Total Deposits [34].

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Yield on Loans

The Yield on loans (YoI) refers to the return or yield a lender receives on a loan made. It is the percentage relationship between the interest payments received and the amount originally lent. The "yield on loans" considers interest, fees and any loan defaults [35].

Total Deposits

Cost of total deposits considers non-interest expenses and income, which can be related to products like free checking accounts. Banks can calculate cost of total deposits by subtracting interest expenses and non-interest expenses from non-interest income.

5. Development of Business model tool

For the evaluation and application of the developed and collected financing- and business models a business model tool was developed within the project. This Business model tool enables to compare the models regarding different stakeholder positions. The tool requires some detailed information about the considered energy system and boundary conditions. Thereby the tool was developed with the aim to support energy experts in their decision-making process for implementing renewable technologies, especially in the cooling sector.

5.1. Structure of Business model tool

The tool aims to compare the Initial-Aid cashback model (IAC), Energy service company (ESCO) and Community Cooling Hubs. Therefore, inputs from the user are needed, which enable calculations and to give output overviews. Additionally, a sensitivity analysis can be conducted automatically. The following sketch shows the process in a rough overview.

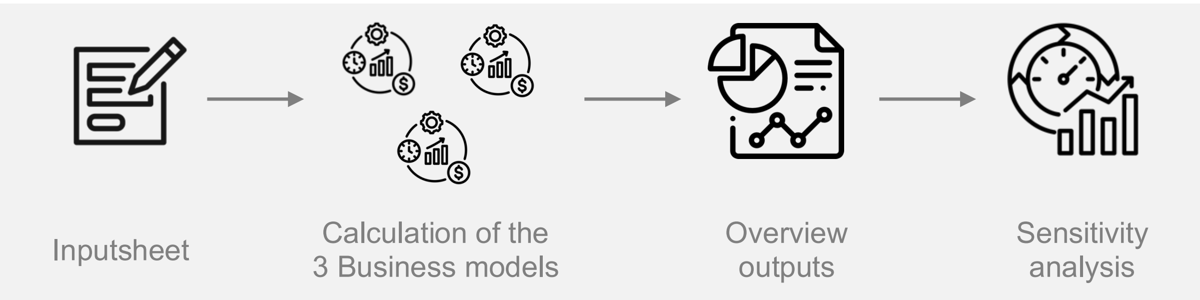

Figure 8: Calculation process of business models in Business model tool

Table 10 and 11 show the necessary inputs and specifications for the three business models.

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Table 10: General input parameters for the Business model tool

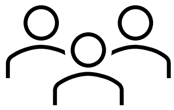
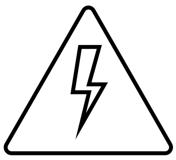
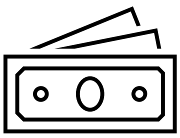
General information	
	Bank interest rate Inflation Timeframe Number of consumers Number of investors
Energy information	
	Annual cooling demand Annual increase of cooling demand EER
Financial information	
	Price of energy for consumer Conventional energy price Electric energy price Investment costs (Renewable + Conventional alternative) Maintenance costs Funding

Table 11: Specific input parameters for the Business model tool for the three models

Initial-Aid cashback model	
Price discount Discounted energy	The “price discount” defines how much discount the initial investors will receive. Additionally, the discounted energy is the amount of energy on which the initial investors will receive the discount. It is calculated as factor of the annual energy demand.
Energy service company	
Additional years of payback Residual value rate	The ESCO model means, that the operator receives the monetary savings, the consumer makes through energy savings. After the amortisation for the operator, receives the savings for some more time, to make the model more interesting.
Community cooling Hubs	
Administration costs	The rate of administration costs for running the energy systems regarding bureaucratic efforts, etc.

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5.2. Case study application on Business model tool

Within the Cooling Down project, several case studies were presented, showing sustainable cooling installations. On one of them, the business models were applied. Following the case study is presented in short and results of the calculation are given.

Multi-storey building in Romania:

The building is a three-story office structure with a total height of 10.5 meters, a usable area of 367.92 m², and a gross built area of 470.72 m². The interior volume is 1570.99 m³. It features excellent insulation, including 25 cm thick brick masonry walls with 200 mm mineral wool insulation and a ventilated façade. The windows are triple-glazed with a thermal transfer coefficient below 0.9 W/(m²·K), and the flat roof is made of reinforced concrete with 400 mm of thermal insulation.

Located in climatic zone I, the area has a temperate-continental climate with oceanic influences and an average annual temperature of 11.6°C. The building is situated in climatic zone II according to Romanian regulations. The average annual temperature in Oradea is 11.77°C, with heating degree days (HDD) at 3434 and cooling degree days (CDD) at 137.

The office building operates mainly during weekdays from 8:00 AM to 4:30 PM, featuring open-plan areas, individual offices, and meeting rooms for administrative tasks and collaborative workspaces. Energy-efficient systems minimize consumption outside peak hours.

Heating is provided by a central system with a geothermal source heat pump (GSHP) from Dimplex, while cooling uses a passive system that transfers ground temperature to a Thermally Activated Building Structure (TABS). The system includes five geothermal probes and maintains indoor temperatures efficiently.

The building employs a radiant TABS heating/cooling system managed by the heat pump controller. This system regulates indoor temperature and humidity, utilizing the ground's natural cooling capacity. The passive cooling system enhances energy efficiency by regenerating ground temperature seasonally, effectively creating an inter-seasonal energy storage system.

Further case studies have been considered but are not applicable for all three models, which is necessary for the comparison within this study.

The following table shows the inputs and assumptions considered for the calculation of the three business models adapted for the case study in Romania.

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Table 12: Inputs for the Business model tool

Parameter	Comment	Value	Unit
General information			
Annual cooling demand		17,530	kWh/a
Annual increase of cooling demand		2	%
Price of energy for consumer		0.22	€/kWh
Conventional energy price		0.09	€/kWh
Electric energy price		0.202	€/kWh
Bank interest rate		1.5	%
Inflation		2	%
Timeframe		10	years
Number of consumers		3	c
Number of investors		66	% (of consumers)
EER		4	
Renewable			
Purchase and Installation costs		19,886	€
Maintenance costs		199	€/a
Energy costs		885	€/a
Funding total		0	€
Conventional			
Purchase and Installation costs		4,000	€
Maintenance costs		300	€/a
Energy costs		1,578	€/a
ESCO			
Additional years of payback		2	
Residual value rate		15	%
Citizens cooperative specifications			
Administration costs	Rate on Maintenance + energy	35	%
Initial-Aid Cashback model specifications			
Price discount		90	%
Discounted energy (annual demand * x)		6	

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5.2.1. ESCO model

The results of the ESCO model show the following.

Figure 9: ESCO – Balance for operator in Euros by years

Depending on the energy demand, the amortisation rate changes significantly. However, it can be observed that in this case study, an ESCO would not be very effective.

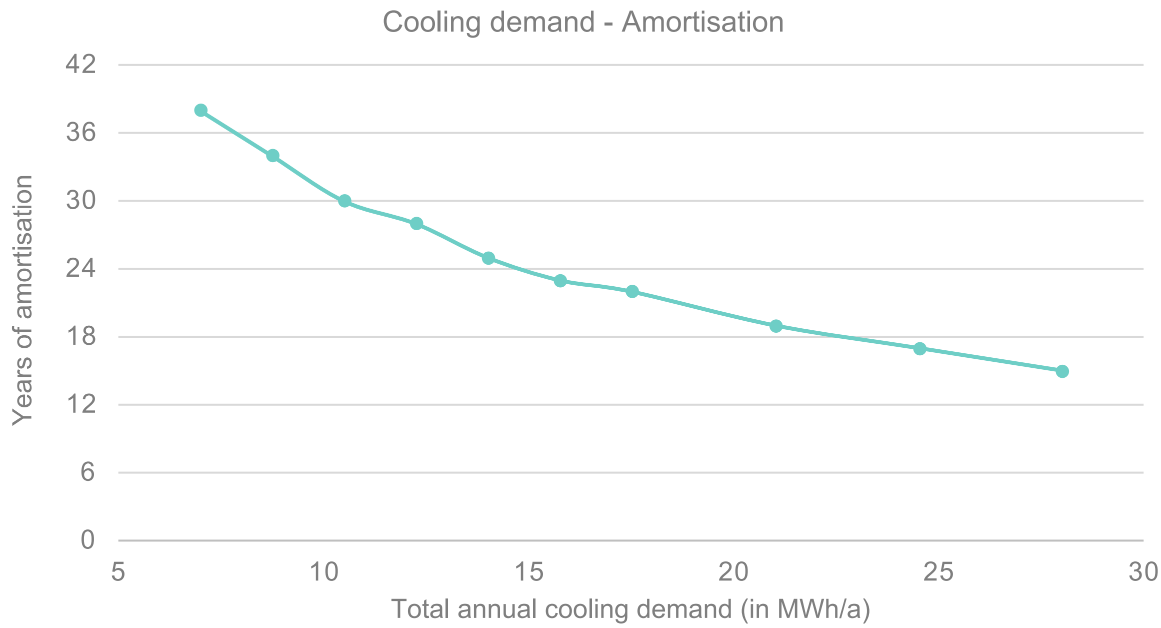

Figure 10: ESCO - Years of amortisation for operator related to cooling demand

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5.2.2. Community Cooling Hubs

For this case study, the following Figure shows the rentability of the community cooling hub model. The Figure shows the total profit after the specific time period, not the annual profit.

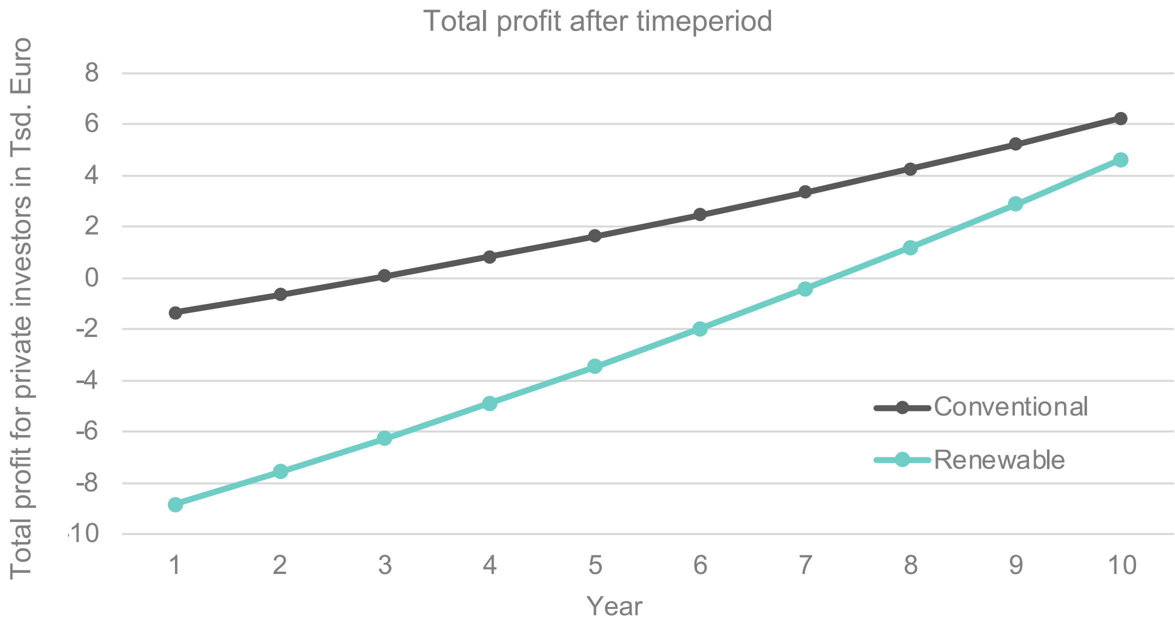

Figure 11: C-C hubs - Total profit for investors related to time period

In Figure 12 the cooling demand is put in relation with the profit after the defined time period.

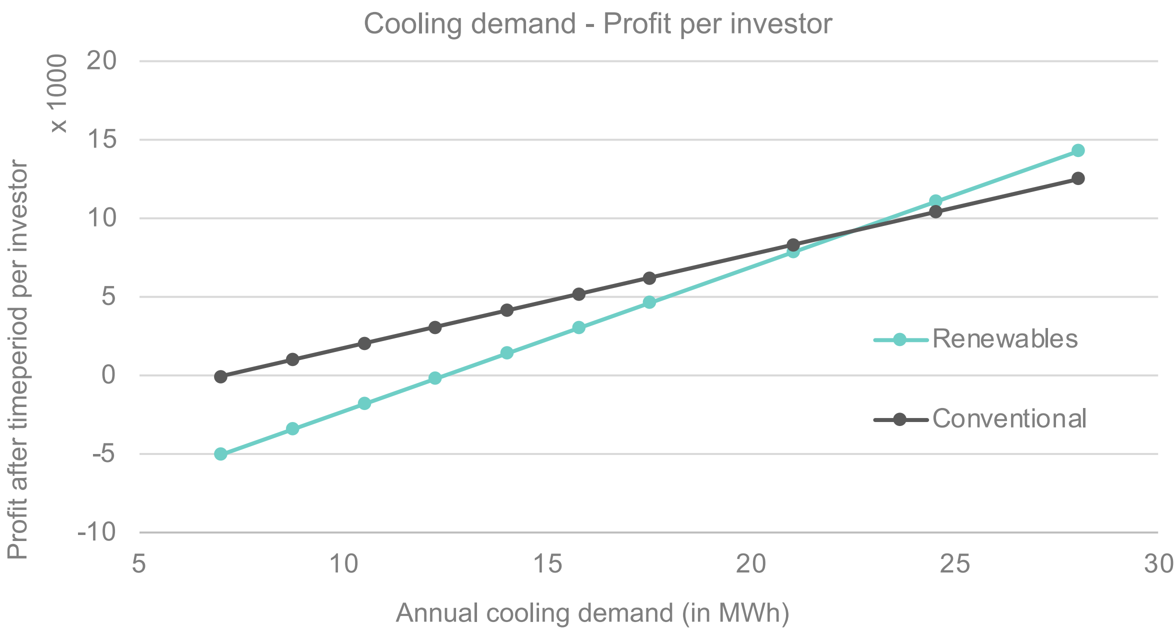

Figure 12: C-C hubs - Profit after time period per investor related to energy demand

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5.2.3. Initial-Aid Cashback model

The following sketch shows the profit of the operators per year, differentiated into renewable and conventional energies.

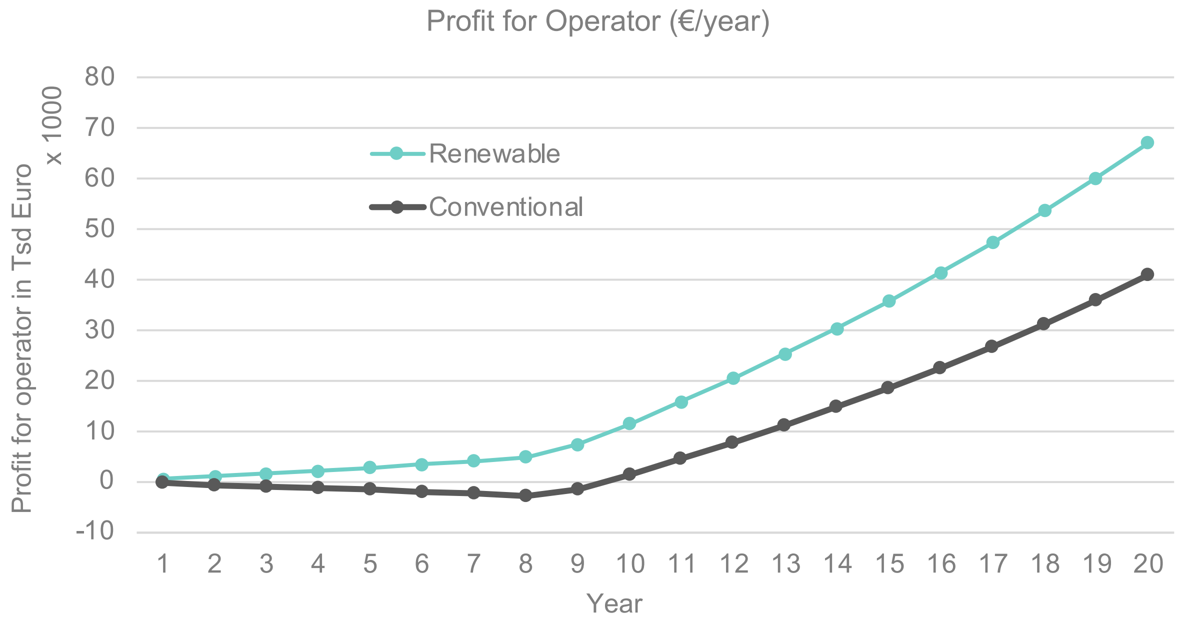

Figure 13: IAC - Profit for operator in Tsd. Euro per year

This needs to be compared with the amortisation of the private investors' investments.

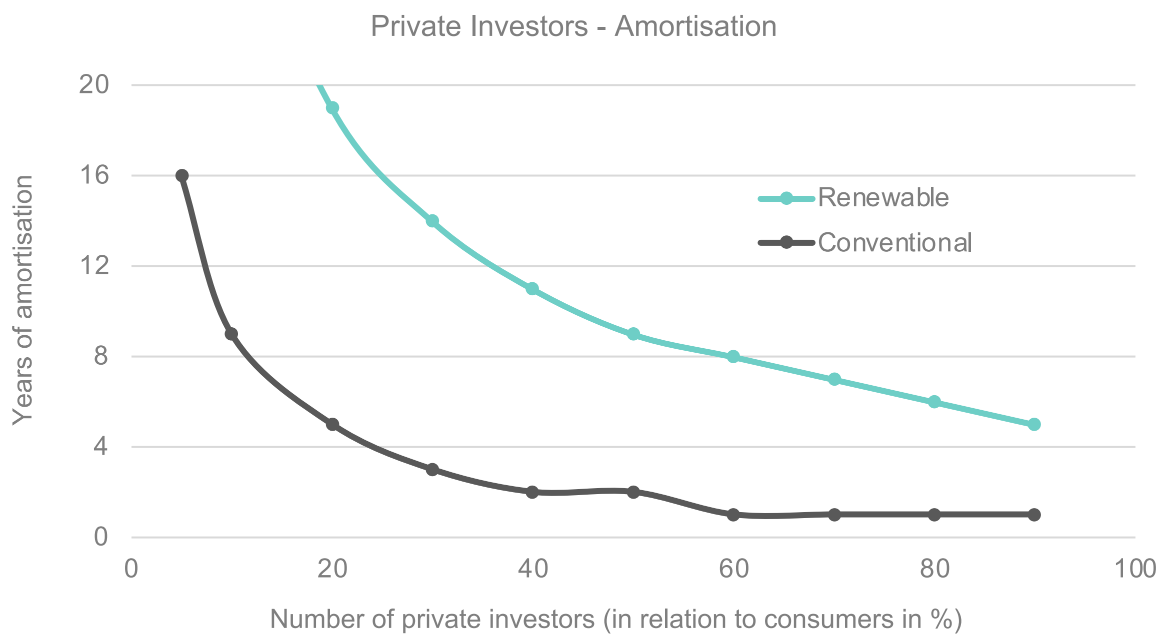

Figure 14: IAC - Years of amortisation for private investors

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6. Qualitative assessment

It can be stated, that the usability of the models depends on the aim of their usage. Generally, the following three findings mainly have been discovered.

- IAC: The model mostly is profitable for the operators at first, however for many cases it can be interesting for private investors (which are consumers) as well.
- ESCO: The ESCO model strongly depends on the energy demand as the profit for the operator relies on the energy supply.
- Community Cooling Hubs: The applicability depends on the profit from selling energy.

From the operator view, IAC often is most interesting, as investments are low risk. Community cooling hubs are better from consumer view, as private investors own the technology by that. By the results and previous observations, different target groups. Therefore, table 3 shows where the models can be applied in principle.

Table 13: Application of models for different stakeholders

	ESCO Model	C-C Hubs	IAC model
Private consumers	Applicable if they're owner of the facilities.	Not applicable.	Applicable, but advantage is only given if they're investors
Small private investors	Not applicable.	Very interesting as the investment can potentially generate a high ROI.	Applicable and interesting as alternative to stock or fund investments.
Large investors	Not applicable.	Not applicable.	Applicable but only if they are also consumers and other investors participate as well.
Energy System operators and energy providers	Applicable but only interesting for high energy demand companies.	Not applicable.	Very interesting, as they're owners of the technology and have very low risks.
Public authorities	Interesting for public buildings to increase energy efficiency easily.	Very interesting to foster participation of citizens on CET.	Interesting to foster this model, as small private investors can participate in CET.

Besides the different target groups, also different types of applications can be evaluated, regarding the applicability of the three considered business- and financing models. The decision for the different building- and use-types is based on Task 4.1 and its deliverable D4.1 of the Cooling Down project.

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Table 14: Application of models for different types of buildings

	ESCO Model	C-C Hubs	IAC model
Residential multi-family buildings	Applicable and interesting.	Applicable and very interesting. Justification, see IAC model.	Applicable and very interesting, as many parties have the chance to invest and to consume.
Residential single-family buildings	Applicable and interesting as the building owners do not need to have competences in CET. Some kinds of ESCOs for this type of building already exist [36].	Not applicable.	Not applicable.
Offices	Applicable and interesting as the building owners do not need to have competences in CET.	Applicable and interesting.	Applicable in buildings with several parties.
Health facilities	Applicable and interesting.	Applicable. Small, private investors can support and win from the energy supply of public institutions.	Not applicable, as mostly one party is investor and one party is energy consumer.
Shopping malls	Applicable and interesting.	Interesting, as small, private person investors can win from central shopping malls.	Applicable if owners of the stores are consumers or have energy contracts with the consumers.
Cooling grids	Application very difficult.	Applicable and interesting, as the grid doesn't have to be built by the municipality. The contracts are difficult to negotiate.	Interesting, especially for small grids.

The tables show, that the application of the models is not only a single case evaluation but can also be categorised in a broad way. In general, the IAC and the C-C Hub model are good to integrate many citizens and small, private investors in the CET – giving them the opportunity to gain money from the transition. The ESCO model is applicable many times and gives the opportunity to realise the CET without knowledge and bureaucratical efforts of the energy consumers.

7. Conclusion

For the **IAC (Initial-Aid Cashback)** model, several consumers and several investors which are also consumers are needed. The model gives the opportunity to the operators and energy suppliers to provide energy with very low risk, as they are owner of the technology but do not have to invest. At the same time, it provides the opportunity to small, private investors to participate on the CET and to gain money from that. The **C-C (Community Cooling)** Hubs model on the other side, is even more interesting for small, private investors, as they are owners of the technology and can participate on the CET even more. The calculations of the case study in Romania, the application of the business models and the sensitivity analysis

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have shown that in comparison the IAC model is more attractive for energy providers and operators than from the view of small, private investors, which are consumers. However, both parties gain a positive monetary balance of the contract. The **ESCO (Energy Service company)** model can be considered as interesting, but only with high energy demands, as the calculations of the case study have shown. However, after the payback period, the consumers have high winnings from the ESCO, as they are owners of the technology, just like applying C-C Hubs. A further advantage of the IAC and the ESCO model is, that – other than with C-C Hubs – the investors and consumers do not have to take efforts for the realisation, as they are not responsible for the operation of the systems.

Within the expert meetings, the new IAC model was evaluated by the experts as interesting for housing, especially for rentals. Thereby the houseowner could be operator and energy supplier, while the tenants could be investors to finance their own energy supply.

To accelerate the clean energy transition, it is crucial to reintegrate saved externalities into the process. This can be achieved through several policy recommendations. First, ensuring that contracts related to energy transitions are legally sound and can withstand challenges, known as IAC Anfechtbarkeit Verträge, provides stability for stakeholders. Second, implementing robust emission protection measures, or Emissionsschutz, safeguards environmental gains and promotes sustainable practices. Additionally, developing an easy-to-understand energy pricing system for carbon capture hubs (C-C hubs) facilitates private investment and ensures widespread access to clean energy solutions.

Promoting cooling systems as comprehensive solutions can further drive efficiency and sustainability. By leveraging synergies between cooling and heating systems, overall energy consumption can be optimized. This integrated approach should consider costs outlined in various project phases, such as D4.1, D2.1, and D2.2, to ensure feasibility and maximize impact.

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