



INVESTMENT OPPORTUNITIES REPORT:

REPORT ON INVESTMENT OPPORTUNITIES IN THE DHC SECTOR,
INCLUDING A LIST OF CRITERIA NECESSARY FOR EFFECTIVE
COMMERCIALIZATION BY TYPE OF INVESTOR



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I. Introduction

Deliverable Objectives

This report outlines a high-level framework for project developers to assess the financial feasibility of their projects and guidance on types and sources of investment potentially available. It aims to help developers take initial steps in identifying sources of financing best suited to their project.

Different types of projects tend to attract different types of investors depending on the characteristics of their business case. Amongst other factors, the level of risk and return, the size of the investment and the timing of payments and returns can influence which type of investors are most suitable to a particular project.

5G DHC projects generally share many similarities with conventional energy infrastructure: these are assets which require a large upfront investment, have a long asset life and deliver an essential service to customers, which make them potentially attractive to infrastructure investors. However other attributes of 5G DHC open the door to other groups of investors – in particular; relatively small total investment size, sustainability considerations, increased interdependency between local stakeholders, and use of innovative technologies can attract more specialised or non-conventional types of investors, such as crowd funding and green bonds.

This report provides an overview of the general classes of investors and how to assess projects to identify the most appropriate investors to target.

What is Risk and Return?

Generally, an investor's objective is to invest capital into project, and over a period of time receive back their investment, and a profit on top – known as the return. All investors will consider the risk of an investment (the possibility of not making a profit, or losing the investment altogether) as well as how much profit they stand to make.

Like all investments, district heating projects contain inherent risks for an investor. The project may suffer budget and timing overruns, it may fail to connect new customers, or it may be subject to rising levies or stifling regulations. Some risks are common across district heating investments such as increasing operating costs, while others are more project specific such as the loss of a critical large offtaker.

Investors are not necessarily averse to taking risks. Instead, investors will look to ensure that higher risk projects are also expected to yield higher returns, justifying the investment overall. Each investor will conduct its analysis (due diligence, financial modelling, market benchmarking) to understand the risk/return balance of the project and if they determine the return is commensurate to the risk – they are likely to invest.

Different types of investors seek a different risk/return profile and will look for different types of investment. A pension fund, with a focus of steadily growing its capital reserves will usually look for low risk/return investments where it can invest a significant amount, whereas a small venture capital fund is likely to look for higher risk/return opportunities and make a large number of smaller investments.

In this report, we will quantify returns through a 'rate of return' which is a percentage that can be compared to an interest rate in a standard bank account. If an investment is made at a 5% rate of return, the investors cash flow in and out would look much the same as investing in an interest-bearing account with an annual pay rate of 5%.

It is worth noting that not all investors are purely financially motivated, and some will look to fulfil sustainability or development goals. These are often publicly funded and can take larger risks for a relatively limited return that would otherwise not be acceptable to a purely financial investor. In doing so, they aim to catalyse early (high risk) development of new technologies to establish a business case that is investable for financial investors in the long term. These investors are typically under very high demand and vary widely across geographies, so projects must be able to demonstrate their value in achieving the non-financial benefits that the investor is targeting.

Example 1: Operational vs Construction Project

Consider two identical projects at different stages of development. Project A is about to begin construction, whilst Project B is fully operational and selling heat to customers.

Project A is clearly more risky, an investor would not see a return until the project is built, customers signed up and heat delivered and there are many things that could go wrong in that process. As a result, an investor is likely to demand a relatively high rate of return (typically >10%) to invest into the construction of that project.

Project B is lower risk, and the investor would start seeing a return shortly after they invest, with much better visibility on customers and no risk of budget or timing overruns on construction. An investor looking at this risk profile would be more likely to seek a lower return (possibly <10%).

II. Equity and Debt

There are two main ‘types’ of money that can be used to fund projects – *equity* and *debt*. Projects can be funded entirely by equity, or through a mix of equity and debt. Equity investors are also known as *shareholders*, whilst debt investors are known as *lenders*.

Equity investments change the ownership of the project company. The company issues *shares* which the investor then purchases from the company in exchange for a cash investment, becoming a shareholder. If any profits are earned by the company, the investor and all other existing shareholders receive a share of these, proportional to their relative shareholding. However, if no profit is made, or if the project fails and is forced to close, shareholders will lose their investment.

Debt investment does not change the ownership of a company. Instead, the company borrows money from an investor upfront and makes the promise to repay it, plus additional interest, over a given period. If the company fails to repay, the lender will usually have some form of ‘collateral’ – assets that they can seize and sell to recover their investment.

Debt investment is less risky than equity investment but offers no *upside*. This is because all debt repayments and interest must be paid before any shareholders receive the profits – i.e. debt has first ‘right’ to any cash flow coming out of the project (or, debt has *senior ranking*). Conversely, lenders do not benefit if a company is successful beyond expectation. Interest payments are usually fixed and as a result the returns made by lenders are also fixed.

The inclusion of debt into the funding structure of a project makes the project riskier for existing equity investors. If a project makes little profit after paying its lenders, the shareholders may not see a return until the debt is cleared, or worse, if the project cannot pay its lenders, shareholders may lose ownership of the project all together. However, shareholders will have to invest less into the project, magnifying the benefit from upside if a project is successful and generating large profits. A simplified example of this is shown below.

Example 2: Equity and Debt

A project is built for €100, and then rises in value to €110 (e.g. new customer contracts are signed). If the project was funded 100% with equity (€100), the increase in project value results in €10 or 10% profit to equity investor.

If the project was instead funded with 80% debt, and only 20% equity (€20), after the rise in value the project would have €80 of debt, leaving €30 of value to equity i.e. a €10 or 50% profit on the equity investment.

Conversely, if the value of the project *falls* by €10 (10% of the total project value), the equity investor would lose 50% of their investment. Both the risk and return increase with debt.

III. How to Assess Risk/Return

Developing infrastructure projects is difficult and a multitude of project risks need to be adequately managed to bring a project to life. The better these risks are managed, the more attractive the project will be to potential investors and the lower the cost of capital the project is likely to attract.

The table below aims to present a high-level summary of typical project risks encountered by district heating & cooling network developers, and how these can be best mitigated.

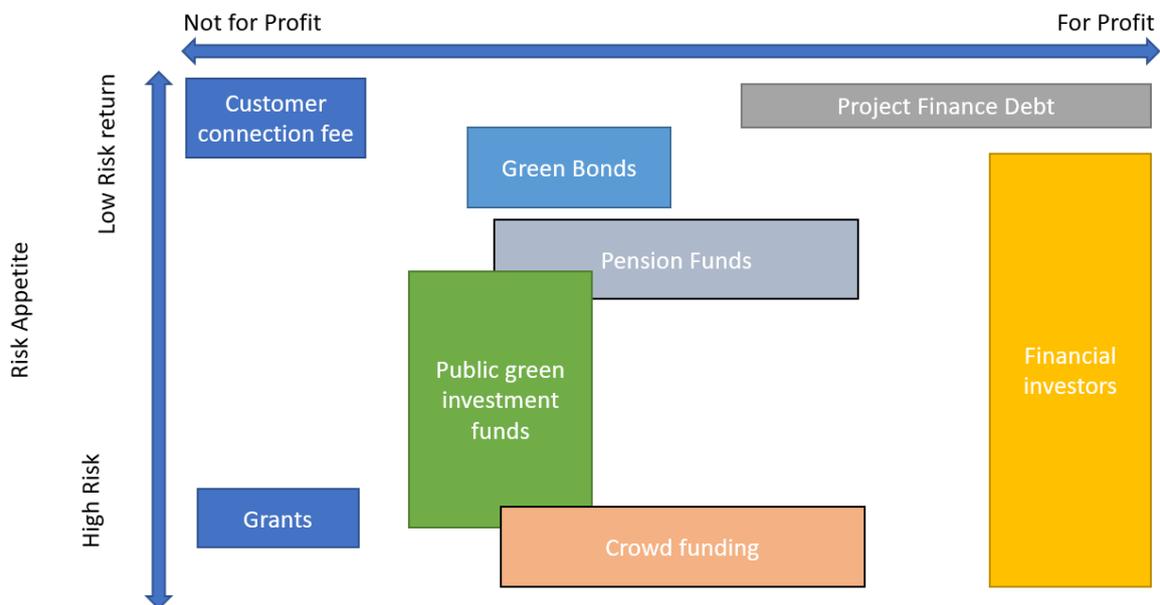
Risk category	Typical mitigants
Technology	<ul style="list-style-type: none"> • Proven technologies with long operational track record • Wide range of suppliers and robust supply chain • Not easily replaced by disruptive innovations • Widespread public support for technology at local and national levels
Development	<ul style="list-style-type: none"> • Permits/licenses granted • Key contracts negotiated and in agreed form/signed • Subsidies/incentives secured (if relevant) • Detailed engineering design and costing performed
Construction	<ul style="list-style-type: none"> • EPC contract with fixed timeframe and fixed price agreed, with credit backing from reputable supplier • Dedicated project team in place with clear roles and responsibilities' • Adequate maintenance schedule planned to justify asset life • Adequate contingencies • Adequate insurance policies in place
Revenues	<ul style="list-style-type: none"> • Long term (>10 years) contracts with credit-worthy offtakers → contracted cash flows can have a significant influence on the cost of capital a project may attract • Maximum number of signed contracts ahead of project's financial close • Clear pricing strategy with unequivocal indexation (ideally with pass-through of variable cost items) • Guaranteed volumes or exclusivity arrangements to limit variability of volumes • Inclusion of expected impact of climate change and energy efficiency measures on long-term heat/cooling volumes • Established sales strategy and advanced sales pipeline to support assumption of expected growth of network
Operating expenses	<ul style="list-style-type: none"> • Long term contracts on key operating expenses (O&M, fuel, electricity etc.) – including fixed pricing/clear indexation where possible • Defined operating strategy with clear roles/responsibilities with reputable suppliers and/or experienced staff
Regulation	<ul style="list-style-type: none"> • Clear regulatory framework with coherent policies and widespread public/political backing at local and national levels • Where relevant, fully funded and transparent subsidy support scheme in compliant with EU regulation

No risk can be fully mitigated, and all investors will be forced to take views on each investment made and assess the project's risk-return profile vs. their own appetite. In order to reach an investment decision, an investor will typically:

1. **Perform thorough due diligence** (often including technical, commercial, financial, tax and legal) to assess the risks encountered
2. **Put together a financial model** that will encompass all project assumptions, and run sensitivities to assess materiality of various risks
3. **Introduce contingencies** to the extent possible to cater for probable events and limit impact of materialising risks on project returns.

Investors with proven experience in a particular sector, and therefore a better understanding of project characteristics, are likely to be more efficient in their assessment than new entrants.

The illustration below shows the major types ordered by their appetite for high risk / high return projects and their level of financial motivations vs other factors (such as sustainability considerations)



IV. Details of Investors – External Long-Term Investors

The following section aims to identify and describe at a high level the main categories of investors that might be available for investments in 5G DHC projects. The descriptions are for illustration purposes only and based on the authors' general knowledge of these investors.

Project Finance Lenders

Investor Overview – Project Finance Lenders	
Type	Institutional Debt
Risk Appetite	Very Low
Investment size	€10m - €100m+ (multiple lenders possible)
Returns target	2-4%
Suitable For	Projects with long-term contracted cash flows (5-10y+)
Benefits	Low cost, long-term, minimal control over projects
Drawbacks	Significant due diligence and documentation, security over project equity
Typical providers	Barclays, RBS, Nord/LB, BNG, [French PF bank] Natixis

Key Features

- How it works:** Large initial drawdown of the loan to fund construction or release equity to shareholders, followed by long-term fixed repayments of principal and interest (similar to a mortgage).

Repayments to lenders take priority to shareholder returns and lenders will aim to have a high portion of repayments covered by contracted cash flow. High customer diversity, low technology risk and long-term, fixed-price contracts are attractive to Project Finance lenders.
- How much funding:** Debt investment can be very large and are typically calculated based on the forecast future cash flow of the projects. Lenders will assign a cover ratio to future cash flow depending on the level of risk they attribute to those cash flows. E.g. a lender may assess future cash flows is low risk – all allow a cover ratio of 1.2x meaning for every €1.2 of future cash flow, the project can borrow €1 up front.
- Process to raise funding:** Detailed due diligence undertaken on projects to ensure comfort that project can repay debt. Process typically takes 8 - 16 weeks but varies based on project complexity.
- Key Risks for Projects:** No control over operations or management of project as long as repayments are made, however, if missed (project defaulting on loan), lenders have security over all project cash flow, shares and contracts to ensure repayment

Institutional Investors (Pension funds, Insurance)

Investor Overview – Institutional Investors	
Type	Flexible
Risk Appetite	Low
Investment size	€50m - €500m
Returns target	4-8%
Suitable For	Operational projects generating stable, diversified cash flow over long periods of time
Benefits	Institutional investors are typically passive – limited oversight of project development and construction.
Drawbacks	Only available for very large transactions. May require working with a more actively involved investment manager to access these pools of capital
Typical providers	APG, BBC, FRR

Key Features

1. **How it works:** Limited understanding of energy sector so often require asset management services to be provided either by a 3rd party or the project developed. Not all pension funds make direct investments (into projects) but often work through a fund manager.

Objectives are typically to secure highly stable, inflation-linked revenues over long investment periods (20+ years) in order to meet long term pension or insurance liabilities.

2. **How much funding:** Institutional investors typically manage extremely large pools of capital of which a portion is allocated to infrastructure and energy investments. As a result, institutional investors looking at direct investment will often have large minimum investment volumes.

3. **Process to raise funding:** Given large ticket size, projects seeking long-term direct funding from institutional investors will usually be operational and generating substantial stable revenues. This path is therefore unlikely to be suitable to 5GDHC developers.

In order to gain exposure to higher risk development and construction investment (for small portions of their portfolio), institutional investors will often make investment through fund managers who will then reallocate that capital to invest in projects with potentially much smaller ticket sizes – see Specialised Infrastructure Funds

Green Bonds

Investor Overview – Green Bonds	
Type	High Yield Fixed Income
Risk Appetite	Moderate
Investment size	>€15m
Returns target	3m EURIBOR + (350-900 pbs)
Suitable For	Those looking to leverage operational projects to fund expansion, construction or acquisition of new projects
Benefits	Easier process and more forgivable covenants to PF. Can be used in conjunction with PF. Preferred option to lesser-known technologies.
Drawbacks	Expensive relative to PF. Admin intensive (quarterly reports to investors), requires secured cash flows from operational assets
Typical providers	DNB, NatWest, JPM, Etc..

Key Features

- How it works:** The project can issue bonds to investors which are in turn repaid by the cash generation from the operational projects. The bonds are repayable only after a certain period, usually between 3 - 5 years.

Projects are subject to certain criteria in how the business is managed and how further funding is raised, however this is less onerous than Project Finance debt.
- How much funding:** The sizing of the bond issuance is based on the projects ability to repay that debt through operational cash flow over the 3 to 5-year period.
- Process to raise funding:** Process typically managed by a financial advisor or investment bank, who will market the bond issuance to a broad list of investors. There is the additional step of qualifying as 'green' under the ICMA Green Bonds Principals, which then requires continued reporting over bond tenor to ensure invested proceeds meet green criteria.
- Key Risks for Projects:** This is an especially expensive form of debt for first time borrowers with limited relationships with financial advisors. Like Project Finance debt, bonds are secured by company shares and as a result non-repayment can result in loss of ownership.

V. Details of Investors – Energy Market Investors

Specialised Infrastructure Funds

Investor Overview – Infrastructure Funds	
Type	Flexible – usually including at least a portion of equity
Risk Appetite	Medium
Investment size	€5m - €200m
Returns target	8-15%
Suitable For	Projects/companies that have demonstrated feasibility, but need support and funding to grow
Benefits	Investors are able to take development and construction risk. Access to business and finance expertise and network of investor. Highly active management
Drawbacks	Investor takes equity ownership in the project
Typical providers	Infranode, Antin, Arjun, MEAG

Key Features

1. **How it works:** Investors understand sector well – able to understand the risks and more comfortable taking them. Infrastructure funds will usually look to own a portion (or all) of the project equity, and can provide funding as both equity and subordinated debt.

Investors will try to ‘add value’ to the projects and companies in which they invest. E.g. by assisting development teams in building their capabilities e.g. asset management, corporate structure, bank financing (see Project Finance Lenders). Often look to sell assets to a long-term buyer once they are operational, generating positive cash flows and largely de-risked (see Institutional Investors).

2. **How much funding:** Ticket sizes for Infrastructure funds can vary widely depending on the fund and are usually in the range of €5-200m. Some investors of this type are able to fund early-stage development and construction of projects, targeting higher returns commensurate to the level of development and construction risk they take. Other investors of this type may be focused on operational projects only and will typically have larger ticket sizes and lower return requirements.
3. **Process to raise funding:** Highly dependent on the strategy of any given fund. Some funds will target a full buy-out of the project and development team – they will own 100% of the development company and invest directly into that company to fund development or construction of underlying projects.

For operational projects, investors might instead target purchasing the ‘project company’ only, leaving the development and construction projects and teams under existing ownership.

4. **Key Risks for Projects:** These types of investors will usually look for oversight on the major business decisions of the company (e.g. new construction, raising financing, selling projects etc.) which removes control from the management and development team. This may be the preferred option if the

management teams would prefer to keep oversight for day-to-day decisions, but receive guidance on major business planning.

Utilities

Investor Overview – Utilities	
Type	Equity
Risk Appetite	Dependant on strategy
Investment size	€1m - €100m
Returns target	3-10%
Suitable For	A range of projects. Can be smaller development opportunities or very large acquisitions of operational projects
Benefits	Typically have access to large network of construction and operational teams, can help to bring small projects to large scale. Can continue to invest to provide follow-on funding
Drawbacks	Potential limitations in scope of investment – may be able to invest only in the network assets
Typical providers	Vattenfall, SSE, Enexis

Key Features

- How it works:** Utilities typically look to acquire equity in an existing project often with a view to provide ongoing investment to grow the company and additional projects. Depending on local regulations, utilities may only be able to acquire a portion of the total project (e.g. the network assets but not generation) which can lead to complex structure to split out the assets.
- How much funding:** Funding ranges widely for utilities, with initial investment volumes likely to be in the range of €5-20m but potentially significantly higher. One key benefit of utilities is that they may be able to provide continued investment (beyond the first) to grow the project and initiate additional projects or add-ons. This can be structured when first investments are made and can allow projects to not only raise immediate funding but secure a source of future investment.
- Process to raise funding:** Depending on local regulation and the nature of the utility, processes can vary. This can be more straightforward if utility investment is to acquire the whole project and invest directly. If a split of project assets is required to meet local regulations, this can be a more complex process.
- Key Risks for Projects:** Depending on the complexity of the investment. If assets splits and future investments make up a part of the initial deal, there may be a dependency on the utility to provide future investment to continue to grow projects. As a result these are typically agreed up front.

Energy Service Company (ESCO)

Investor Overview – ESCOs	
Type	Flexible
Risk Appetite	Variable – can be funded by consumers, financial investors or utilities
Investment size	€0 - €20m
Returns target	Varied 5-15%
Suitable For	More complex projects including wider energy services (development phase, insulation, city planning etc.) requiring consolidation
Benefits	“Full package” role taken in developing and evaluating the project, engineering and construction, financing and customer service. Take a portion of project risk – covering shortfall in returns if projects don't achieve plan
Drawbacks	Typically take a contractual share in the upside along with shareholders. Look for significant control of strategy and operation of the project
Typical providers	Either large utilities as previously shown, or project-specific organisations

Key Features

1. **How it works:** An ESCO provides energy and efficiency services to customers and can take a variety of different structures. Most typically, ESCOs are vertically integrated energy companies providing services including project design, evaluation, operation, customer service and financing.

An ESCO can be set up for a specific project, or a larger ESCO can invest directly into a new or existing project. ESCOs may be funded privately or through governmental organisations and are able to invest both equity and debt. ESCOs will typically look to share in project risk, seeking contractual exposure to upside / downside without necessarily taking a shareholding in the project.

2. **How much funding:** Similar to utilities, ESCOs are able to secure funding (potentially through third parties) across a wide range of investment volumes but typically for smaller investments than traditional utilities. This enables investment into smaller non-generation projects, such as retrofit insulation, to enable overall improvements in energy efficiency – the benefit of which is shared between the customer and the ESCO.
3. **Process to raise funding:** The responsibility for arranging the ultimate source of funding falls to the ESCO, so the challenge for project developers is in identifying and selecting the right ESCO. Typically, projects would run an RfP to several candidates who would provide proposals on project plans and pricing – and the owner can select the most appropriate solution for their project

Key Risks for Projects: ESCOs typically use performance-based contracts in which they receive a return only if the project meets certain success criteria. If the project has limited success, the ESCO will compensate a certain portion of the return to the shareholders. This provides a level of protection against suboptimal performance however if the project fails completely, the owner remains exposed to those losses. ESCOs typically look for strong governance rights over project operation and so may limit the developers flexibility to adapt the project.

VI. Details of Investors – End Users

Energy Cooperatives

Investor Overview – Energy Cooperatives	
Type	Equity
Risk Appetite	Variable
Investment size	€0 - €5m
Returns target	NA
Suitable For	Small projects within organised communities which can provide a material long-term saving for consumers
Benefits	Minimal control imposed by community shareholders over strategy and operations. Encourages local consumers to participate in network
Drawbacks	Portion of value captured directly by customers through reduced energy pricing. High resource demand in organising and structuring cooperatives
Typical providers	Energy4All, Enercoop, Greenpeace Energy

Key Features

1. **How it works:** Energy Cooperatives typically include members of the local community (who may or may not be consumers) which can collectively provide 5-100% of the funding required for a project.

The cooperative typically takes a shareholding in the project and receives a return either directly from their shareholding (company profits) or through a reduction in energy bills.

2. **How much funding:** The level of funding available is dependant on the number of local consumers that are expected to participate. Cooperatives in Germany, Belgium and the UK are particularly successful and have historically raised investment >€40m however smaller levels are more typical
3. **Process to raise funding:** Energy Cooperatives can either be formed through direct engagement with the local community or through facilitators which have experience in setting up these structures. Investment is made through a private community share offering when required and is typically used to provide construction funding. Cooperatives are less practical for early-stage development funding where there is less visibility on the final design of the project

Key Risks for Projects: Cooperatives allow for passive equity investment with limited governance or control rights however there can be significant complexity in the set-up process which can result in delays or funding shortfalls and access to additional investment if required is restricted.

Crowdfunding

Investor Overview – Crowdfunding	
Type	Flexible
Risk Appetite	Variable – funded by the general public
Investment size	€0 - €5m
Returns target	0%-30%
Suitable For	Well publicised projects looking to raise modest amounts of seed funding
Benefits	Limited to no control imposed by additional shareholders, in some circumstances no equity required
Drawbacks	Large administrative burden, limited capital, potential reputational damage (considered last-resort option)
Typical providers	One planet Crowd, Citizenenergy

Key Features

- How it works:** Typically, a project will crowd fund through an online platform that already has access to a large base of retail investors. There are specific platforms that specializes in crowdfunding in infrastructure (shown in table above).
- How much funding:** Funding can range from very small amounts to several million euros, and largely depends on the type of instrument being offered. The most popular for infrastructure related projects use a loan with interest rate of 1% - 4% per year.
- Process to raise funding:** Projects register to a platform and set a funding target as well as the type of instrument they intend to issue i.e. equity, debt, hybrid, donation, etc... The projects will then have a timeframe in which to meet their funding target and if reached the platform will facilitate transfer of funds.
- Key Risks for Projects:** In the event the target funding is not met any capital raised is returned to investors. Consideration should also be given to potential reputational damages to projects intending to raise future capital with institutional investors as crowdfunding can be perceived as a last resort option.

Customer Connections

Investor Overview – Customer Connections	
Type	Cost funding
Risk Appetite	NA
Investment size	€0 - €'00k per customer
Returns target	NA
Suitable For	Projects with customers required new energy supply (replacing legacy sources or new build)
Benefits	Upfront contribution from customers used to directly reduce construction and connection costs for the project. No long-term financial liabilities for the project.
Drawbacks	Connection charge typically considered by customer in combination with ongoing costs – higher upfront charge likely to require discount to energy prices
Typical providers	Connected customers

Key Features

1. **How it works:** customers considering a connection to a 5G DHC network are typically either new buildings or existing buildings replacing a legacy heat source and as such are facing an investment decision to install either new or replacement equipment. For example, a residential customer may consider a 5G DHC connection vs a new gas boiler.

Customers are therefore willing to contribute to the connection costs if the new solution represents good value for money. Contributions are typically made at the time of connection, meaning that the overall cost of each connection to the project developer is reduced – thereby reducing the overall level of investment required.

2. **How much funding:** A typical customer would contribute between 5-40% of the total connection cost. The main factor in determining the level of contribution is the upfront and ongoing cost of an alternative heat source vs that of 5G DHC.
3. **Process to raise funding:** Customer connection cost contributions are a typical component of pricing structures for conventional district heating networks. Agreements on levels of contributions are typically made during contract negotiation in tandem with ongoing pricing
4. **Key Risks for Projects:** High connection costs may make new connections prohibitively expensive for customers, resulting in fewer connections and limiting growth of the project. The correct balance between attracting customers, upfront contributions and ongoing pricing will depend on specific customers, geographies and projects.

VII. Conclusions

When seeking investment for projects, it is critical that developers take all necessary steps to fully understand the technical, financial and wider attributes of their projects. Using this information, developers are more likely to be successful in targeting the right types of investors who seek exposure to those attributes. Without a robust understanding of the project, it is challenging to find the right investors, and even more so to bring those investors to close.

5G DHC projects can have several attributes which are attractive to different types of investors. Projects may be:

- (a) Infrastructure in nature – they are capital intensive, have long asset lives and generate moderate but stable returns. These types of projects can attract long-term, low-cost capital such as project finance debt, green bonds and institutional equity. Smaller projects can attract specialised infrastructure funds as well as utilities
- (b) Technology driven – they are early adopters of new technology and leverage these to drive increased returns. This approach can be attractive to specialised infrastructure investors and crowdfunding which are at the higher end of the risk/reward scale.
Sustainable – they contribute positively to wider environmental and social issues. This is often a motivating factor behind public investment, but also drives investment through ESCOs, Cooperatives and specialist infrastructure funds.

Whilst all these attributes can be useful in raising investment for a project, they are rarely applicable in parallel. Large-scale infrastructure investors have limited appetite for technology risk but can be patient in receiving their return, whereas crowdfunding investors are more likely to seek higher profits in short periods of time. This reinforces the importance of understanding the characteristics of a project when seeking investment.

In addition to, and underpinning these attributes are the financial returns of the projects. There is a wide spectrum of financial motivation across different investors, with some being purely motivated by returns, and others prioritising social or environmental benefits. However, all will need to understand and accept the risk and return profile of the project before they make an investment. As such it is critical for projects to assess their financial feasibility throughout development and use tools such as financial models identify key metrics, challenges and financing options for their project.

As part of the Interreg D2Grids partnership, a template model for 5G DHC networks was developed and is publicly available with these materials.