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**CROWDFUNDING AS A NOVEL  
FINANCIAL TOOL FOR DISTRICT  
HEATING PROJECTS**



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## SUMMARY

The objective of this study is to provide a better understanding of the applicability of crowdfunding to the district heating sector in Europe. It is part of the work package “Replication – Business models (WP6)” of the TEMPO Temperature Optimisation for Low Temperature District Heating across Europe – project. TEMPO focuses on innovative technological solutions for district heating systems. The WP6 develops and optimises innovative business models for each solution package, in order to boost network competitiveness and attractiveness for stakeholder investment. In this context crowdfunding is studied as a potential viable option for district heating business model funding.

Crowdfunding is a form of alternative finance, which allows to fund a project or venture by raising small amounts of money from a large number of people, via web-based platforms. Initially started as a grassroots phenomenon during the financial crisis in the late 2000s, it has progressively become a valuable alternative source of funding for entrepreneurs and innovators. The European crowdfunding market volume has increased annually from 1.1 € billion in 2013 to 7.6 € billion in 2016. This study firstly reviews the energy crowdfunding sector presenting evidence on market developments and an overview of how crowdfunding models have been used to finance energy projects. Then it looks into how crowdfunding could be applied to the district heating sector, exploring which could be the benefits of using such innovative financing instrument in district heating investments.

Crowdfunding in the energy sector started around 2012 and it has been growing over time, reaching in 2017 over 300 € millions of funding volume. Crowdfunding in energy has begun as a fairly niche application to grassroots and community energy projects, allowing citizens to invest, become shareholders and benefit from the return on the investment. Most crowdfunding models (i.e. equity, lending, reward and donation) have been applied to the energy sector, but financial models are the most frequently used and accounting for over 90% of the active platforms in 2017. Among the financial models, lending has been prevailing over time as the preferred crowdfunding instrument: lending projects are higher in number and have raised the highest funding volume.

Key factors for the use of crowdfunding in energy are access to finance and public engagement. Crowdfunding is an additional source of funding to energy projects, providing potentially easier and faster access to capital than other institutional sources of finance. It has also a strong engagement, participation and communication function. Crowdfunding platforms are increasingly used by energy developers to engage citizens in their project investments in order to: have access to a wider audience of potential investors; increase visibility of the project; increase local acceptance and reduce nimbyism; increase local stakeholders’ awareness and reduce planning risks; redistribute revenues/royalties in the territories affected by the project.

The district heating sector has been evolving over time, along with the wider transition toward low carbon energy systems. The development of renewables has made district heating projects more modular and sustainable, leaving space for multiple potential architectures both from a technological and business model point of view. A variety of business models has been developing, including public-private partnership, full private and cooperative models. In this changing scenario the European district heating sector is facing

new market challenges. As all infrastructure projects financing can be challenging, especially in countries with weaker local governments and/or limited public spending. It requires the right investor, willing to accept long-term investment horizons. In addition, it is facing increasing competition from gas and energy efficiency measures, which reduce heat demand. On the other hand, the district heating sector is now more open to new opportunities of stakeholders' participation and cooperation. Cooperation and involvement of end-customers is increasingly relevant for district heating providers. Using customers as a community increases the chances of creating a sustainable business case for district heating development.

Crowdfunding can be one possible answer to the challenges as well as the opportunities that the district heating sector is facing. It could provide an additional source of finance, by allowing to raise capital from diffused investors, potentially more willing to accept lower or slower rate of returns on the investment in exchange of recognizable social and environmental benefits. In addition, the engagement, participation and communication function of crowdfunding can help in increasing public awareness on district heating networks' social and environmental benefits as well as in reducing potential negative perceptions among potential end customers.

All the available crowdfunding models (i.e. equity/community shares, lending, donation/reward) could be potentially applied in the district heating sector, but the financial ones are more likely to be used. Equity/community shares models could be used to facilitate access to equity capital for full private or public-private partnership initiatives or to support expansion of cooperatives. Lending crowdfunding campaigns instead could be potentially used under all possible district heating business models. In fact, debt can be raised through crowdfunding on the SPV developing the project whose ownership could be private, public or a combination of those. Non-financial models are much less used in energy crowdfunding. However, civic crowdfunding campaigns could potentially be an option in the district heating sector for projects developed and sponsored by the public sector.

This study has been conducted by Dr Chiara Candelise, a PhD qualified energy economist and policy specialist. She is researcher at Bocconi University (Italy) and Imperial College London (UK) as well as founder and CEO of Ecomill s.r.l., an Italian equity crowdfunding platform dedicated to the energy sector. Dr Candelise has sound economic background and professional experience in leading public and private institutions, including UK Government (Department for Environment Food & Rural Affairs), EU and UK Research Councils funded research and consultancy projects as well as collaboration and support to SMEs.

For the purpose of this study Dr Candelise tapped upon experience, skills and network developed both as researcher at Bocconi and Imperial College London universities, and as CEO of Ecomill and key player in the EU energy crowdfunding sector.

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## GLOSSARY / LIST OF ACRONYMS

ACRONYM	DEFINITION
<b>ICT</b>	Information and Communication Technologies
<b>CAPEX</b>	Capital Expenditure
<b>CE</b>	Community Energy
<b>DH</b>	District Heating
<b>RES</b>	Renewable Energy Sources
<b>SPV</b>	Special Purpose Vehicle

## 1 INTRODUCTION

This study is part of the work package dealing with “Replication – Business models” (WP6) of TEMPO - Temperature Optimisation for Low Temperature District Heating across Europe – project. The TEMPO project develops technical innovations that enable district heating networks to operate at lower temperatures. By decreasing the temperature in the systems, it reduces heat losses and allows a higher share of renewable and excess heat to be used as heat sources. Within TEMPO, the work package “Replication – Business models” (WP6) develops, demonstrates and optimises innovative business models for each solution package, in order to boost network competitiveness and attractiveness for stakeholder investment. The aim of including this study in the “Replication – Business models” work package is to determine to what extent crowdfunding can be used as a viable option for business model funding.

Crowdfunding is a form of alternative finance, which started in Europe and the USA around 2008 and has been gaining momentum since. The European crowdfunding market volume has increased annually from 1.1 € billion in 2013 to 7.6 € billion in 2016 (Ziegler, Shneur et al. 2018). Crowdfunding allows to fund a project or venture by raising small amounts of money from a large number of people, via web-based platforms. The use of crowdfunding in the energy sector has been relatively recent, mainly to support investments in renewable energy projects from a mix of technologies, including solar photovoltaic, wind, biomass and hydropower. Beside pooling capital to fund renewable energy projects, crowdfunding has been used to support community energy initiatives and to foster the involvement of local actors (citizens, small companies and local authorities) in the development and deployment of distributed generation projects. Private sector developers have also used it to increase project visibility and local acceptance of energy projects, overcoming nimbyism<sup>1</sup> by offering residents or communities the possibility to invest and to benefit from the returns of the energy projects.

The main objective of this study is to provide a better understanding of the potential applicability of this innovative financing tool to the district heating sector in Europe.

The study will firstly provide a review of the energy crowdfunding sector, evidence on market developments and an overview of how crowdfunding models have been used to finance energy projects. Then it looks into how crowdfunding could be applied to the district heating sector, exploring which could be the benefits of using such innovative financing instruments in district heating investments. The applicability of the different crowdfunding models and the implications in terms of citizens engagement are also evaluated.

The report is structured as follows: Section 2 provides an introduction to crowdfunding and its development worldwide; Section 3 presents and analyses evidence on crowdfunding in the energy sector; Section 4 addresses the potential applicability to the district heating sector and Section 5 provides some concluding remarks and recommendations.

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<sup>1</sup> Nimbyism (Not in my backyard) is used to describe opposition by local citizens to energy or in general infrastructure projects located in their neighbourhood or local area.

## 2 WHAT IS CROWDFUNDING

Crowdfunding has been rapidly emerging as alternative finance system for funding product developments, companies or social causes through open calls to the general public (the ‘crowd’) on online platforms. Initially started as a grassroots phenomenon during the financial crisis in the late 2000s, and partially as a response to reduced credit opportunities for citizens and firms (ESMA 2015, EU Commission 2015, UNEP 2015), it has progressively become a valuable alternative source of funding for entrepreneurs and innovators. The worldwide market has been increasing over time reaching a volume of over 250 € billion in 2016 (Figure 1). The largest market is currently in the Asia-Pacific region (largely driven by China, which accounts for 99.2% of the total Asia-Pacific alternative finance market and an estimated 85% of the total global market in 2016 (Garvey and Chen 2017)), despite the phenomenon initially started in Europe and the USA. Nonetheless European market has been growing over time, reaching 7.6 € billion in 2016, with the UK alone accounting for about 73% of the total European market (Ziegler, Shneor et al. 2018) (Figure 2).

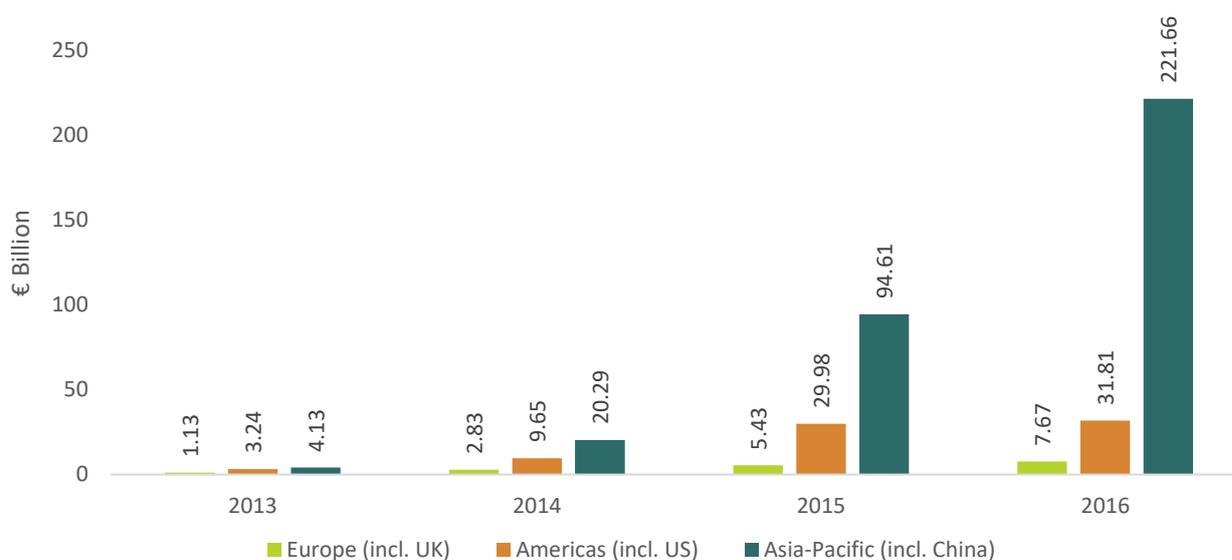


Figure 1. Alternative finance<sup>2</sup> market volumes worldwide, € billion (2013-2016). Source: (Ziegler, Shneor et al. 2018)

<sup>2</sup> Alternative finance is defined as crowdfunding and peer-to-peer lending.

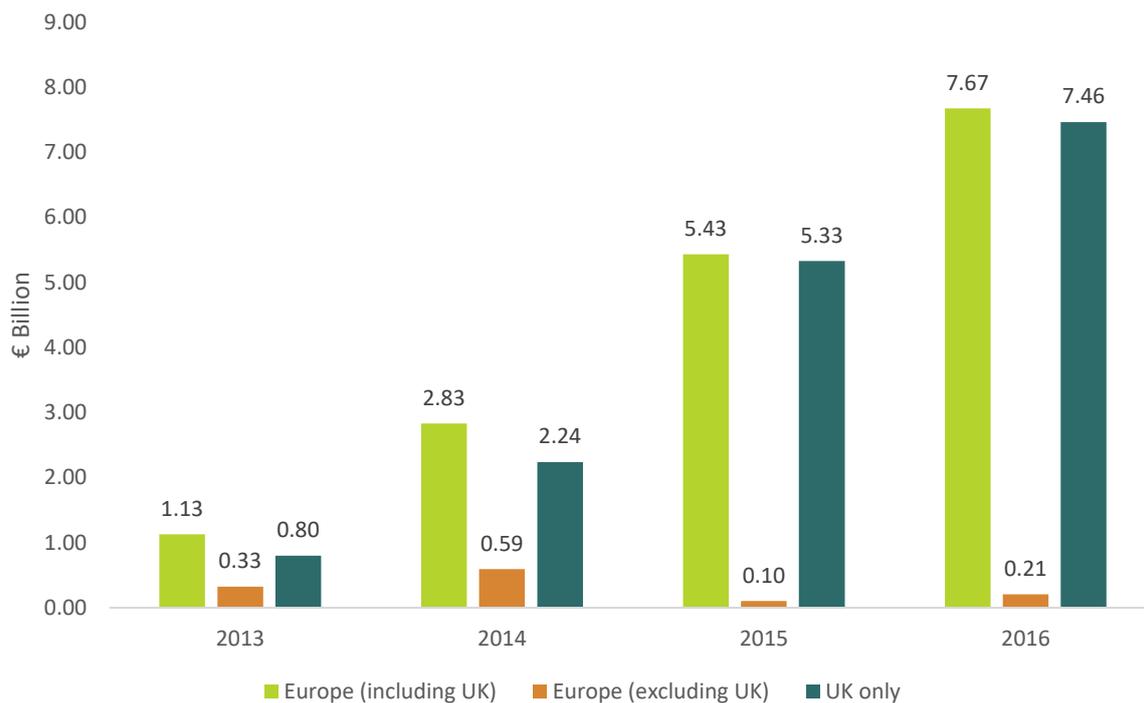


Figure 2. Alternative finance market volumes in Europe<sup>3</sup>, € billion (2013-2016). Source: (Ziegler, Shneor et al. 2018)

The concept of raising money through the general public is not new in socio-economic systems. What specifically characterises crowdfunding is the use of internet and dedicated web platforms where projects are presented to the public and through which people can donate or invest money. Indeed, it has been driven and made possible by the widespread adoption of information and communication technology (ICT) and the progressively increasing use of technology-enabled social networks to interact and connect online (Pew Research Center 2014).

Crowdfunding platforms are not only an alternative source of funding, but also communication and marketing tools, as they are strongly interconnected with social networks and use digital marketing to reach their audience of potential investors or donors. Moreover, publishing crowdfunding campaigns on online platforms allow full transparency and open communication on the projects to be funded and enable potential donors and investors to engage online with the project proponents, get involved and monitor progress over time. Donors and investors benefit from rewards or returns offered by project proponents in exchange for financial contributions, but can also actively participate to online communities, sharing information and providing suggestions (Ordanini, Miceli et al. 2011, Mollick 2014). For a crowdfunding campaign to be effective it is indeed necessary to engage people and catalyse them around a common need or feeling (Allegreni 2016).

The form of involvement and the benefits for the donor or investor accruing from the participation in crowdfunded projects can change considerably according to the type of

<sup>3</sup> Alternative finance is here defined as crowdfunding and peer-to-peer lending.

crowdfunding model chosen and the type of projects proposed (Belleflamme, Lambert et al. 2014). There exist several types of crowdfunding models, which are generally grouped in two overarching categories (Figure 3), differentiating themselves on the basis of the relationship between those who provide financial resources (the donors or investors) and those that receive the funds (the project proponents):

1. *Non-financial or donation crowdfunding*, where individuals' contributions are not associated with a financial return and;
2. *Financial or investing crowdfunding*, where financial instruments are sold in relation to companies assets and/or financial performance.

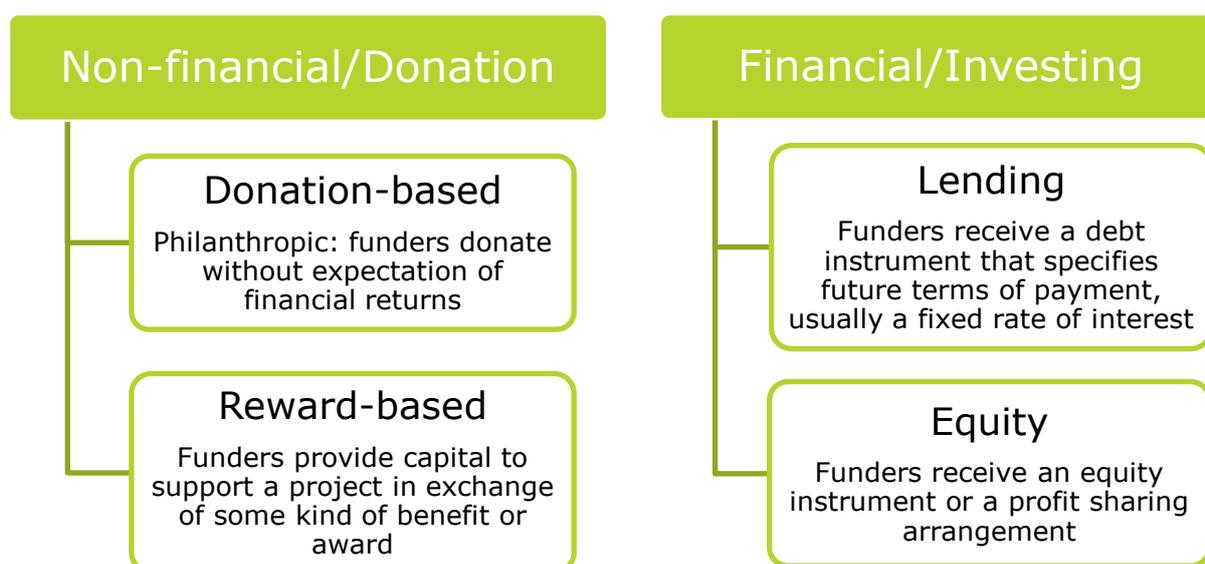


Figure 3. Crowdfunding models

Non-financial crowdfunding can be pure calls for *donations*, given without expectation of any financial returns or benefit, thus relying on altruistic motives. Typical donation campaigns are for charitable or public interest causes. Another form of non-financial crowdfunding is the *reward-based model*, where individuals provide capital to support a project in exchange for some kind of non-monetary benefit or reward. The reward could be immaterial (e.g. a mention in the movie that would be produced with the funding) or material in the sense that the donator receives a copy of the product that will be produced with the capital collected. Typical examples are musicians who raise funds to record an album in exchange for the copy of the album once released. Reward-based crowdfunding has also been used extensively by businesses or innovators, often as a tool to assess demand for a new potential product or service by raising on crowdfunding platforms capital for pilot design and production.

The main financial crowdfunding models are *lending* and *equity* based crowdfunding. With lending crowdfunding, funders receive a debt instrument that specifies future terms of

payment, usually a fixed rate of interest. Lending platforms can be *consumer lending* (i.e. lending among individuals) or *business lending* (i.e. lending to support a business activity). With equity crowdfunding, funders receive an equity instrument or a profit sharing arrangement. In this case the returns on the investment are dependent on the company’s performance, thus potentially higher than the case of lending, but also accompanied with a higher risk.

The crowdfunding sector has in practice evolved over time. The early years of crowdfunding have seen a prevalence of more socially oriented models, in particular consumer lending or non-financial donation/reward to support grassroots, innovation and social projects. In more recent years, financial models and crowdfunding campaigns on start-ups, SMEs, real estate or other businesses have progressively become more popular, raising more funds, and leading to a progressive differentiation of financial services provided and of crowdfunding models used (see Figure 4 presenting funding volumes in continental Europe across 2013-2016).

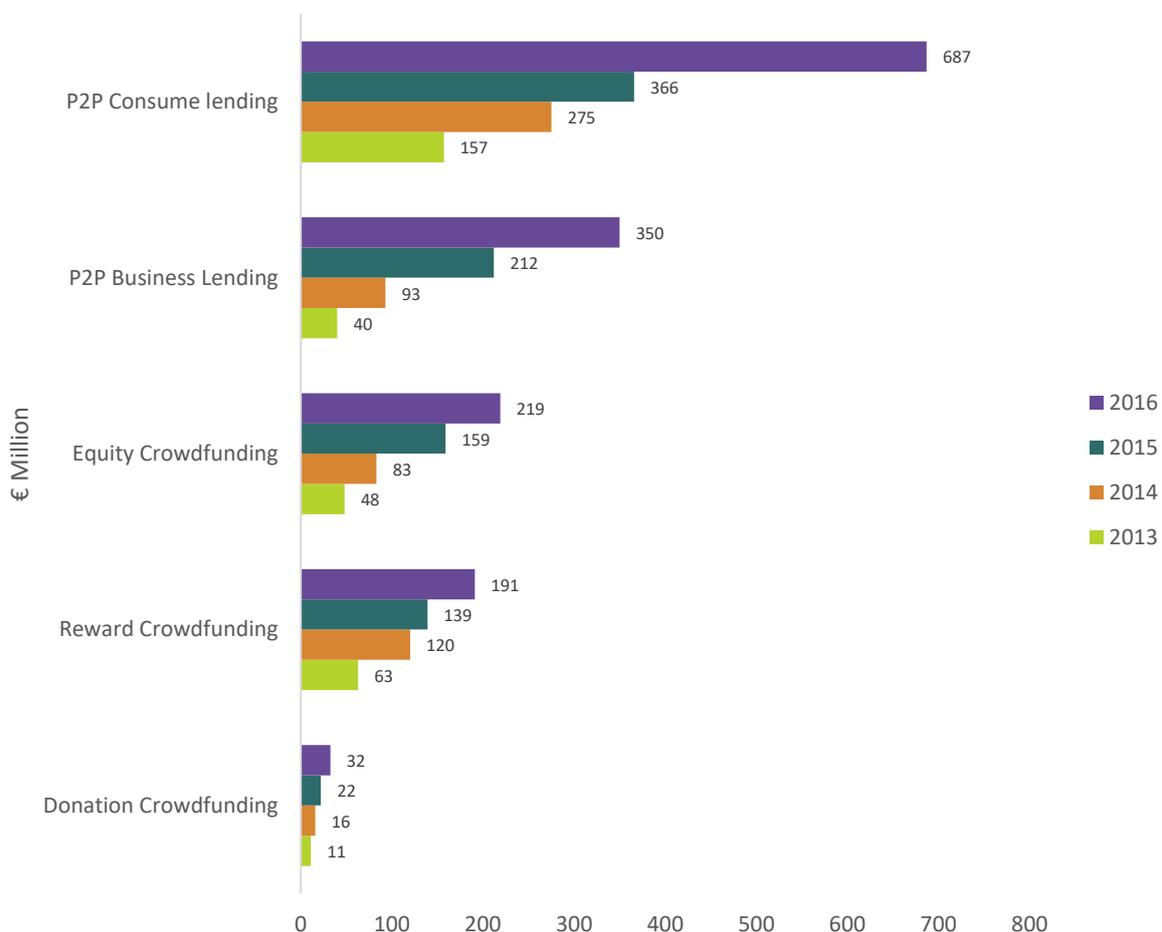


Figure 4. Funding volumes in continental Europe (excluding UK) across crowdfunding models (2013-2016) - € million. Source: (Ziegler, Shneur et al. 2018)

## 3 CROWDFUNDING IN THE ENERGY SECTOR

The next sections firstly look at the context in which the use of crowdfunding in the energy sector has evolved. Then they analyse evidence on energy crowdfunding platforms, how they have performed across countries, technologies and models. Finally, they assess what their use is and what added value exists for both project proponents and donors/investors.

The literature on the use of crowdfunding in the energy sector is quite limited. Two academic papers review best practices, mainly using case studies analysis (Lam and Law 2016, De Broeck 2018). Another study looks at the determinants of success of crowdfunding campaigns in the energy sector (Bonzanini, Giudici et al. 2016). A useful source is a recently ended European H2020 project, CrowdFundRES<sup>4</sup>, specifically focussing on crowdfunding practices in the renewable energy sector. CrowdFundRES reporting results include: surveys result on public perceptions, views of crowdfunding platforms and project developers; review of crowdfunding regulation and market developments for RES (Renewable Energy Sources) project financing; practical guidelines for potential investors as well as RES project developers.

Most of the data presented in this study are the results of a systematic review of the energy crowdfunding sector first run in November 2015 (Candelise 2016). Energy crowdfunding platforms have been identified through Boolean keyword searches, web browsing and analysis of grey literature<sup>5</sup>. Information on the platforms' characteristics and operation, project details and related documents have been collected and studied to build up a worldwide database of energy crowdfunding platforms and projects. The database includes data on energy crowdfunding platforms (including date of activity, funding volume, model adopted) and crowdfunded projects, including data on: type of project, financial instrument, target and amount raised, project technology, proponent, legal form, investment returns and terms. The systematic review only includes platforms 'vertically' focussing on the energy sector (i.e. publishing only energy related campaigns) or generalist ones, but with a relevant section dedicated to energy projects. It excludes single energy crowdfunding campaigns published on generalist platforms. The review has been updated in December 2017 to build up a database of over 40 energy crowdfunding platforms and a project samples of over 800 entries (Candelise, Grasso et al. 2017). This study presents for the first time the elaboration of the dataset as updated in 2017.

### 3.1 ENERGY TRANSITION AND GRASSROOTS MOVEMENTS

The use of crowdfunding in the energy sector is a relatively new phenomenon. It begins around 2012 in a context of reduced investments into the transition to decarbonised energy

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<sup>4</sup> <https://ec.europa.eu/inea/en/horizon-2020/projects/h2020-energy/energy-systems/crowdfundres>

<sup>5</sup> It is likely that the review does not cover the entire energy crowdfunding sector worldwide, in particular the Asia-Pacific region, despite being accurate for Europe.

systems (Geels 2013) and the need to improve access to capital to support the worldwide transition to a sustainable, low-carbon economy (UNEP 2015, Robins and McDaniel 2016).

It grows in the context of the energy sector transformation, which is ongoing since the late 90s. The liberalisation of the energy industry coupled with climate mitigation targets and the increasing proportion of renewable energy in the energy mix have set the basis for a shift in the energy system paradigm: from a centralized “top-down” system to decentralized generation, a “bottom-up” system. The modularity of renewable energy projects has allowed smaller size investments (than centralised generation plants) and the entrance in the energy market of new generators and investors, including citizens, local authorities and small firms (Kempener, Malhotra et al. 2015).

Indeed, while consumers’ participation to the energy transition is increasingly concerning policy-makers (IEA-RETD 2014, EU Commission 2015), community energy approaches and shared ownership approaches for investments in the energy sector have been developing worldwide (ILO 2013, REScoop 20-20-20 2015, van der Schoor and Scholtens 2015, Yildiz, Rommel et al. 2015, REN 21 2016). They are innovative business models enabling citizens to collectively develop and manage energy projects, presenting a different model of ownership than traditional business organisations (Seyfang, Park et al. 2013, Boon and Dieperink 2014, Yildiz, Rommel et al. 2015, Bauwens, Gotchev et al. 2016). Community energy (CE) initiatives can take several forms (ILO 2013, DECC 2014), but those mostly studied and relevant for this study are initiatives:

- which imply a form of citizens ownership or financing of an energy project;
- where citizens directly benefit from the outcomes of the initiative.

They are for the majority constituted in the form of energy cooperatives. The cooperative is the legal form generally deemed to provide the best institutional framework for locally owned and participatory approaches to renewable energy projects (ILO 2013, Yildiz, Rommel et al. 2015). Cooperatives generally encompass both the social and economic dimension in their scope and are characterised by a ‘one head one vote’ decision-making process, thus providing high levels of member co-determination (Viardot 2013, Huybrechts and Mertens de Wilmars 2014, Sagebiel, Müller et al. 2014). To give some examples, in Denmark, more than 1000 wind energy cooperatives have been founded since late 1990s and over 300 district heating cooperatives are currently operating (EBO Consulting 2018, Wierling, Schwanitz et al. 2018). Germany hosts more than 800 energy cooperatives (Yildiz, 2014).

Energy cooperatives are not a new phenomenon and have existed since the late 19<sup>th</sup>, early 20<sup>th</sup> century in several European countries (Spinnicci 2011, Yildiz, Rommel et al. 2015, REN 21 2016). Since then, the first energy cooperatives for renewable energy production are wind cooperatives developed in Denmark in the late 1970s and a wave of citizens’ initiatives after Chernobyl disaster in 1986 (in particular in Germany and Belgium). But, it is from the 2000s that they began emerging as new paradigms of people engagement in the energy transition, facilitated and driven by the last decade’s energy system liberalization and transition toward more decentralised energy systems (REN 21 2016).

Energy crowdfunding shares similar principles with the community energy sector. As for energy cooperatives, crowdfunding platforms involve citizens and other stakeholders in energy projects allowing them to invest, become shareholders and benefit from the return

on the investment itself (according to the type of crowdfunding model adopted - see Section 3.3 below). For this reason (and due to the limited amount of data, literature and analysis on crowdfunding in the energy sector), the literature dealing with energy communities is sometimes referenced within this study.

The use of crowdfunding in the energy sector has in fact begun as a fairly niche application to grass root and community energy projects, with the explicit aim of increasing participation of citizens in renewable energy investments. However, it must be stressed that energy crowdfunding is a different phenomenon from energy cooperatives. It is basically a new form of financial intermediation (or disintermediation) to raise funds and involve people in energy projects. The crowdfunding sector is strongly characterized by the use of online platforms, which are themselves a business activity, also regulated as such by the European and national regulators (in particular the financial models) (EU Commission 2014, Aschenbeck-Florange and Dlouhy 2016). Indeed, the platforms can be used by different types of energy projects proponents, not just cooperatives and including private sector actors. The next sections look at how the energy crowdfunding sector is structured and operates, as well as at how it has evolved over time since the initial crowdfunding campaigns.

## 3.2 OVERVIEW OF ENERGY CROWDFUNDING PLATFORMS

The first relevant crowdfunding platforms dedicated to energy appear in 2012. Since then the number of platforms and energy project campaigns have been increasing over time. In 2017, 49 energy crowdfunding platforms worldwide have been identified. Of those only 29 are currently operating (active, in Figure 5) (Candelise, Grasso et al. 2017). Since 2015 several platforms have instead stopped operating (closed, in Figure 5).

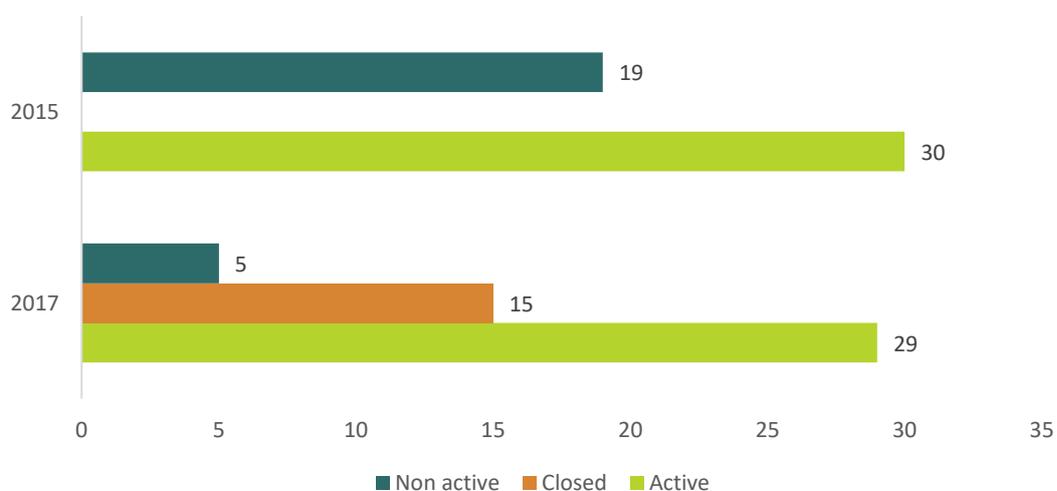


Figure 5. Number of platforms, 2015-2017. Source: (Candelise, Grasso et al. 2017)

Despite the number of active platforms has remained overall constant from 2015 to 2017, the number of energy projects published and the amount of capital raised has increased over time, reaching over 800 funded energy projects, for a total funding volume of over 300 € million in December 2017 (Candelise 2016, Candelise, Grasso et al. 2017) (Figure 6 and 7).

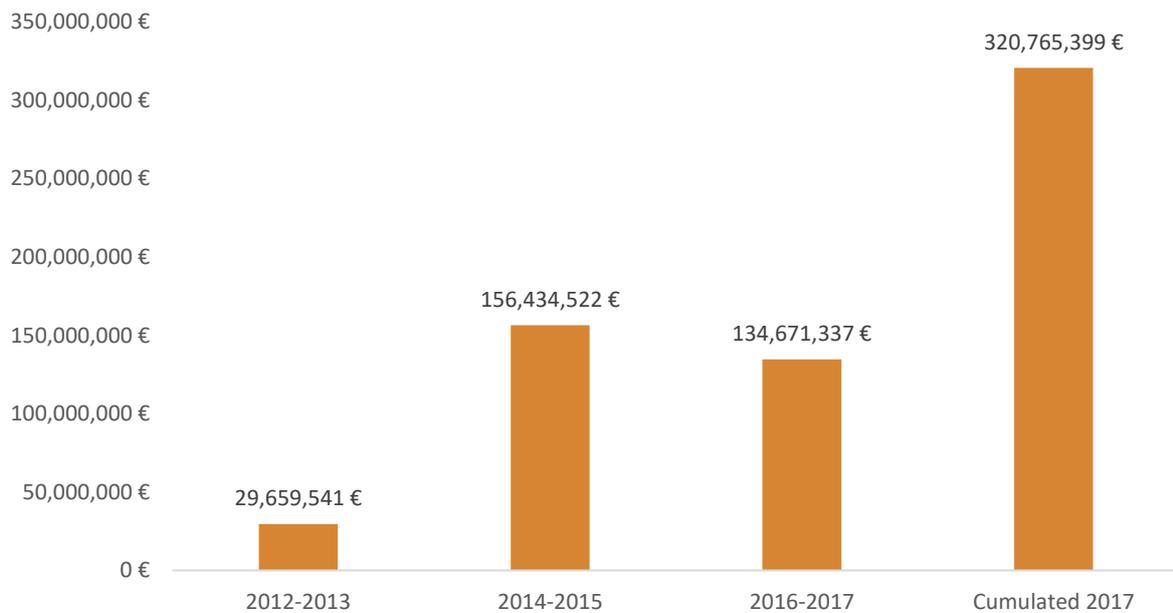


Figure 6. Total funding volume of energy crowdfunding, 2012-2017 (Candelise, Grasso et al. 2017)

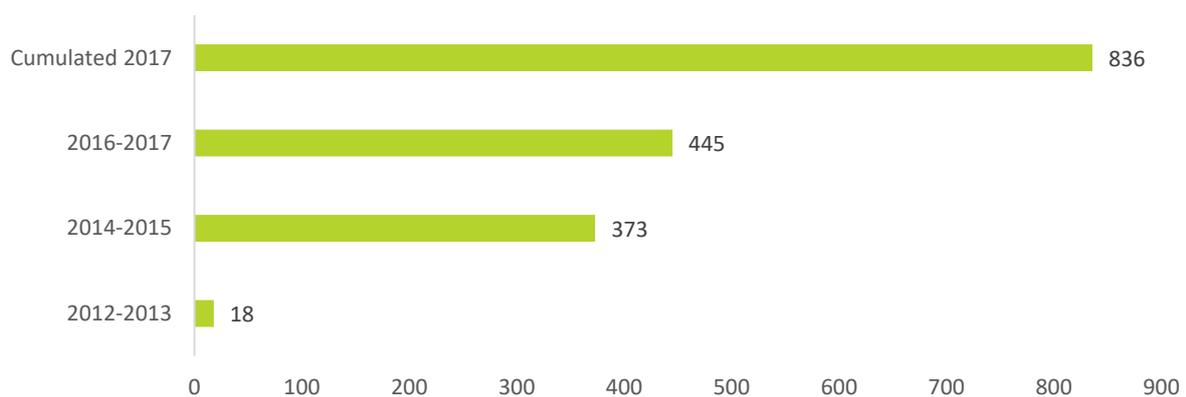


Figure 7. Number of energy crowdfunding projects, 2012-2017 (Candelise, Grasso et al. 2017)

United Kingdom, France, Netherlands and Germany are the best performing countries, both in terms of number of projects and funding volume. A closer look at the United Kingdom funding volume figures reveals that 2014-2015 data are strongly affected by the performance of one specific platform, Trillion Fund, which alone has raised about 100 € million, 50% of which only in funds. Trillion Fund and, in particular, the capital raised for investments in funds (despite focused on renewable energy) can be considered an outlier and less representative of the sector. Moreover, the platform is now closed (has not published projects since 2015). Therefore, the United Kingdom data are also presented in Figure 8 without Trillion Fund figures.

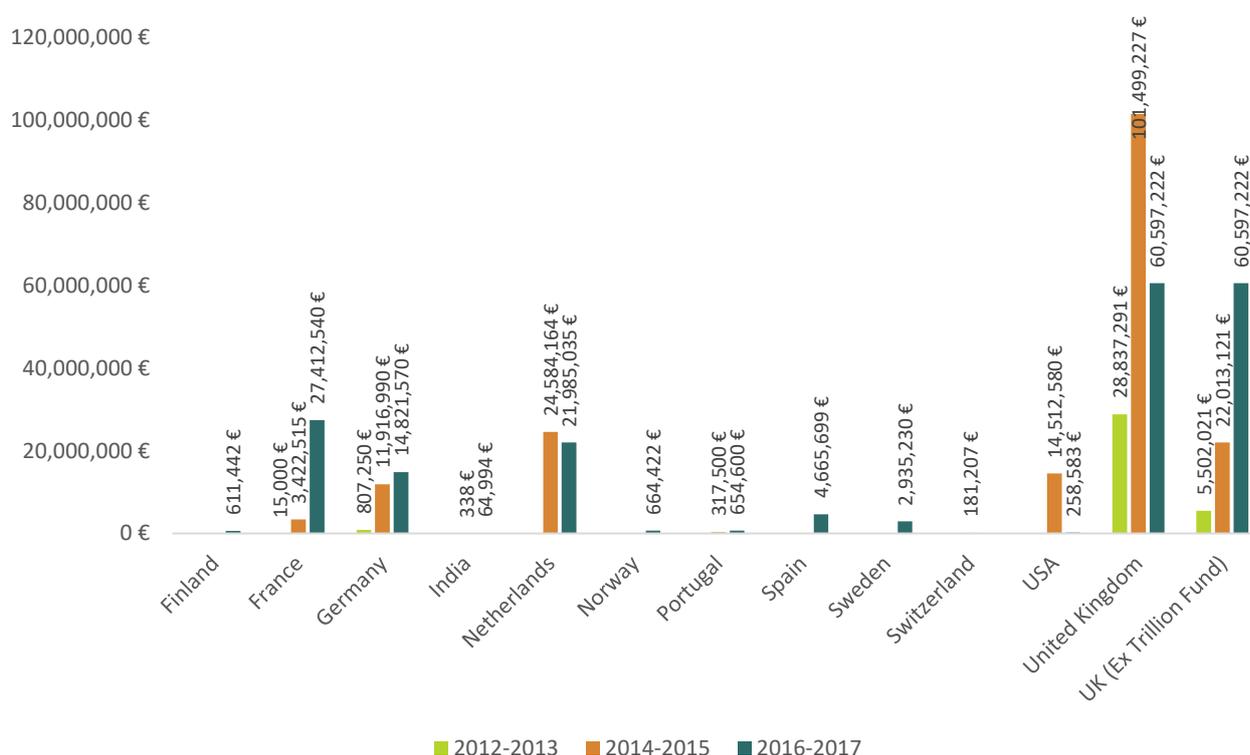


Figure 8. Funding volumes across countries. Source: (Candelise, Grasso et al. 2017)

Crowdfunding in the energy sector is associated with and serves only clean energy investments. Most of the platforms focus specifically on renewable energy and energy efficiency. Platforms generally offer to donate or invest directly to renewable energy projects from a mix of technologies (including solar photovoltaic, wind, biomass, hydropower), on companies or funds operating in the clean energy sector or, in some rare cases, in energy technologies start-ups or energy related technological research and development projects.

Among renewable energy technologies, wind and solar photovoltaic (PV) account for more than 70% of the total funding volume (Figure 9). Moreover, projects on solar photovoltaic have also been the most frequent (Figure 11), despite a lower average size in terms of budget of the project compared to projects on tidal or geothermal technologies (Figure 10).

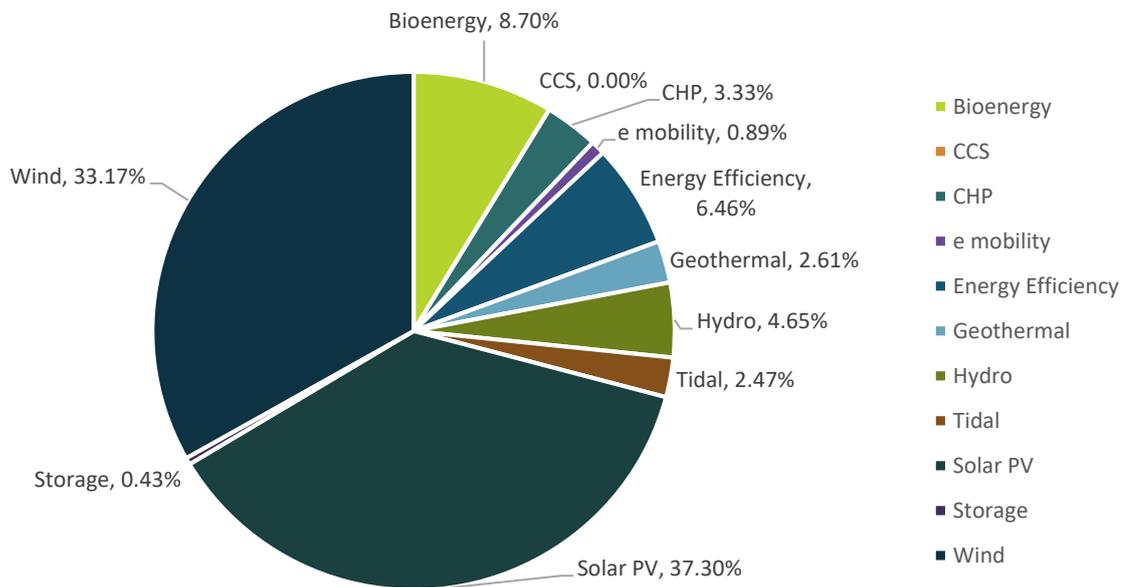


Figure 9. Percentage of total funding volume by technology, 2017

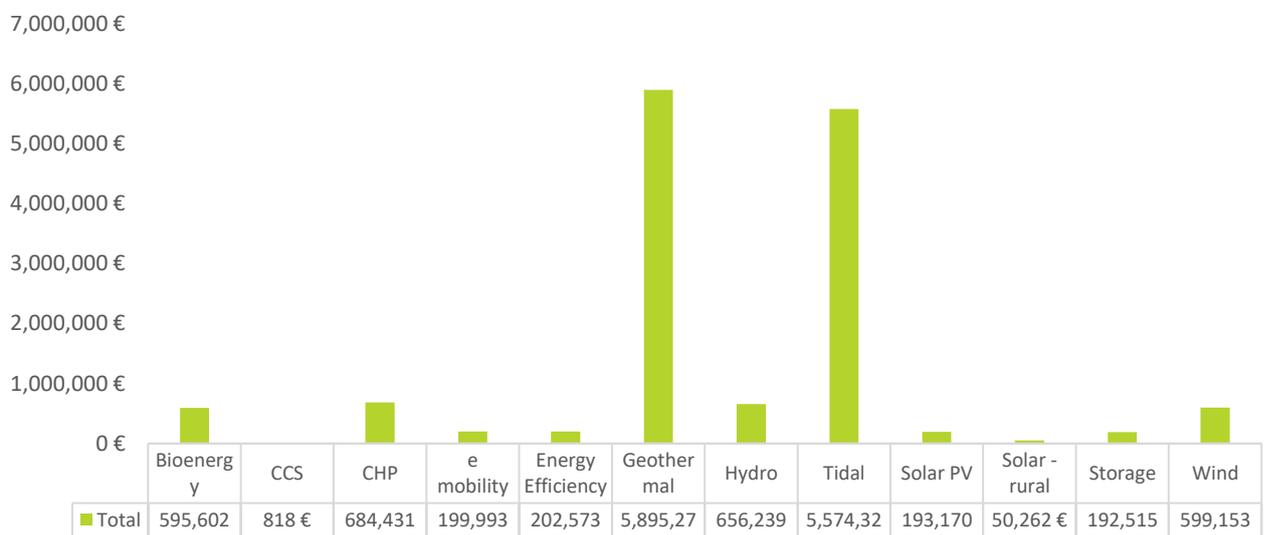


Figure 10. Average size of project by technology, 2017. Source: (Candelise, Grasso et al. 2017)

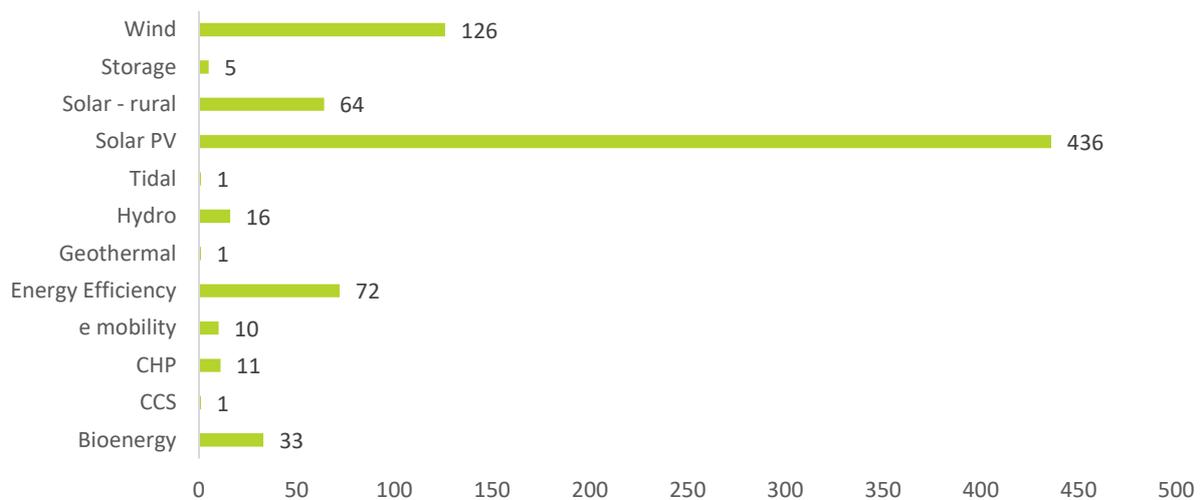


Figure 11. Number of projects by technology, 2017. Source: (Candelise, Grasso et al. 2017)

Nonetheless, the funding volume by technology for the leading European countries shows a progressive differentiation of energy technologies over time (Figure 12). In particular, in Germany, the Netherlands and the United Kingdom energy crowdfunding platforms have increasingly raised capital for investments in energy generation technologies other than wind and solar PV, such as tidal, geothermal, bioenergy as well as energy efficiency measures.

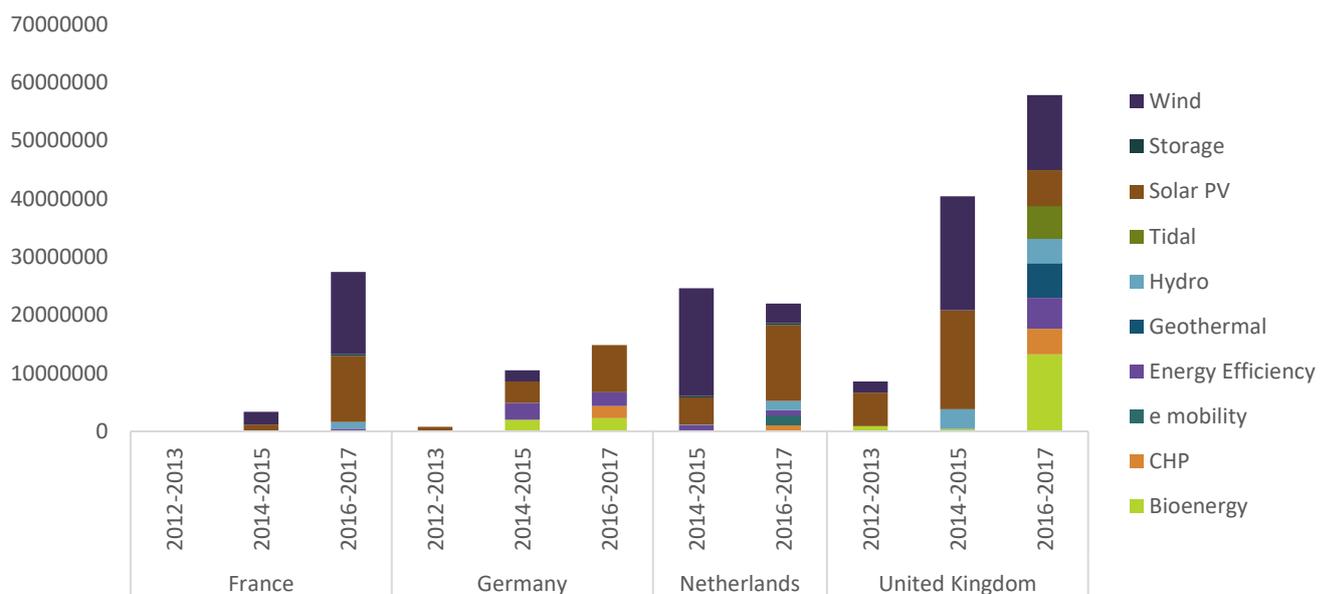


Figure 12. Funding volume by technology and country, 2012-2017. Source: (Candelise, Grasso et al. 2017)

### 3.3 CROWDFUNDING MODELS IN THE ENERGY SECTOR

Over 90% of the active platforms are financial/investing platforms. A good majority have adopted a type of the lending model. Some have adopted the equity/community share model and the remaining have adopted a hybrid model, which allows investors to choose among different types of investing options (debt instruments, bonds, company equity or shares in local cooperatives) (Figure 13).



Figure 13. Number of energy crowdfunding platforms per model, 2017. Source: (Candelise, Grasso et al. 2017)

*Lending* platforms in the energy sector all fall under *business lending*, meaning that the investor lends money through the platform to support investment in a specific energy project or to a company investing in renewable energy or energy efficiency. Platforms solicit online investments in clean energy providing the investor with a debt instrument. The investment is then repaid and remunerated over time, as a function of the revenues generated by the energy project or by the company's business activities. Debt instruments differ in terms of returns offered and maturity (in the database and Figure 14 and 15 all debt instruments with maturity lower than 10 years are short term debts). In some cases the remuneration is variable as a function of the revenues originating from the sale of the electricity generated by the renewable energy project, which vary due to both the fluctuations in the generation itself (e.g. solar, wind are intermittent and variable renewable power) and the variability of electricity selling price. In other cases the remuneration guaranteed is fixed. The dominant model used is the provision of debt to an

SPV (Special Purpose Vehicle)<sup>6</sup> which holds the generating asset (Harder and Maaren 2016).

*Equity crowdfunding* platforms active in the energy sector offer individuals the possibility to invest in exchange of shares of a company or cooperative operating in clean energy. In this way, the investor benefits from returns on investment through dividend payments and acquires rights to participate in legal entity activities. Most of these platforms have a focus on community energy projects, geographically characterized and with the explicit aim of increasing and improving the participation of local communities and citizens in the renewable energy investments accruing in their territories. The majority of the equity campaigns are in the form of *community shares* (withdrawable share capital, a form of share capital unique to cooperative and community benefit society legislation) which allow direct investment and participation in renewable energy projects (Figure 12). The returns to the investor depend on dividend payments as a function of the revenues of the energy project itself. *Pure equity* campaigns instead are offering shares of companies operating in the clean energy sector. Returns in this case would depend on the company performance.

*Hybrid platforms* allow investors to choose among different types of investing options: debt instruments, company equity or shares in local cooperatives. One of the hybrid platforms is for instance Trillion Fund (currently closed) where investors could browse among several types of investments. These include debt instruments such as bonds and funds (issued respectively by renewable energy company or investment funds) and direct loan to renewable energy projects; community shares (in co-operatives or firms serving a community purpose) or equity (shares to capitalize a renewable energy company).

*Donation* platforms are strongly socially oriented, providing renewable energy projects to communities and NGOs.

Not only have lending platforms are the most frequent crowdfunding model in the energy sector, but lending instruments have also been prevailing over time as they are mostly used (highest number of projects financed) and as they have the best performance (highest funding volume) (Figure 14 and 15). This is not surprising as renewables are predominantly debt financed, with often providing up to 100% of the project's CAPEX requirements (Harder and Maaren 2016).

Moreover, Figure 16 clearly shows a progressive reduction over time of community share projects and a significant increase of lending based offerings, including short and long term loans and funds. In other words, data shows a progressive move of the energy crowdfunding sector from niche, grassroots and community energy projects to offer a variety of investment options, involving a wide range of stakeholders, including the private sector.

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<sup>6</sup> The SPV is a company that develops the project and owns the cash flow originating from it.

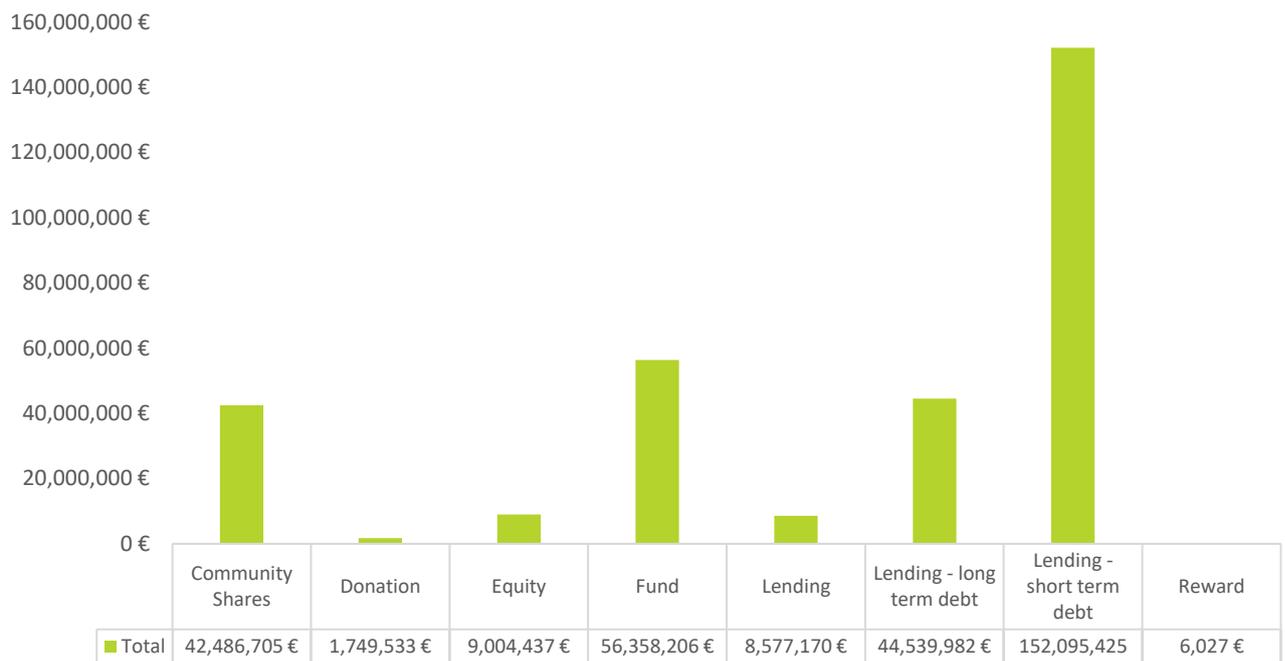


Figure 14. Funding volume per investment type, 2017. Source: (Candelise, Grasso et al. 2017) (Note: The "Lending" label includes all the projects for which it has not been possible to identify investment terms)

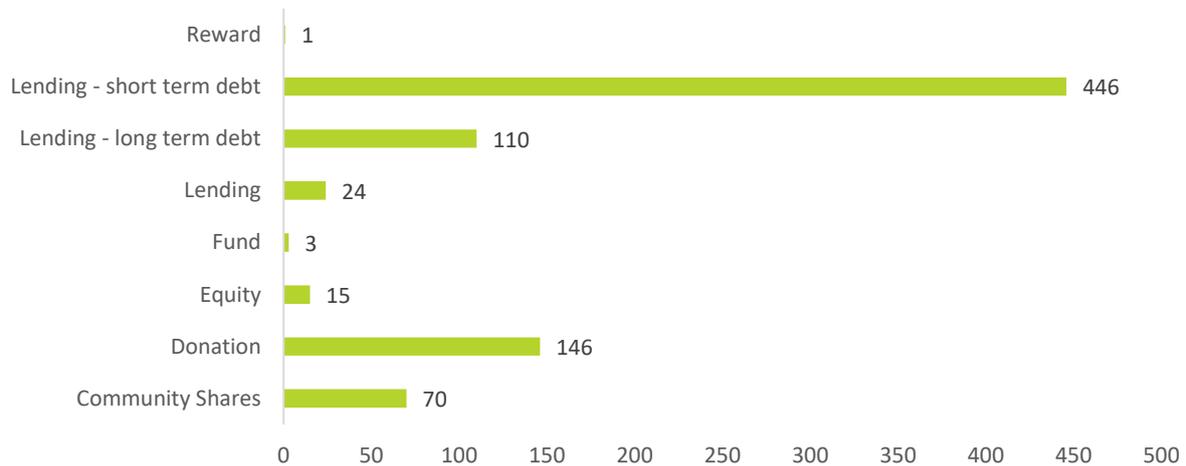


Figure 15. Number of projects per investment type, 2017. Source: (Candelise, Grasso et al. 2017) (Note: The "Lending" label includes all the projects for which it has not been possible to identify investment terms)

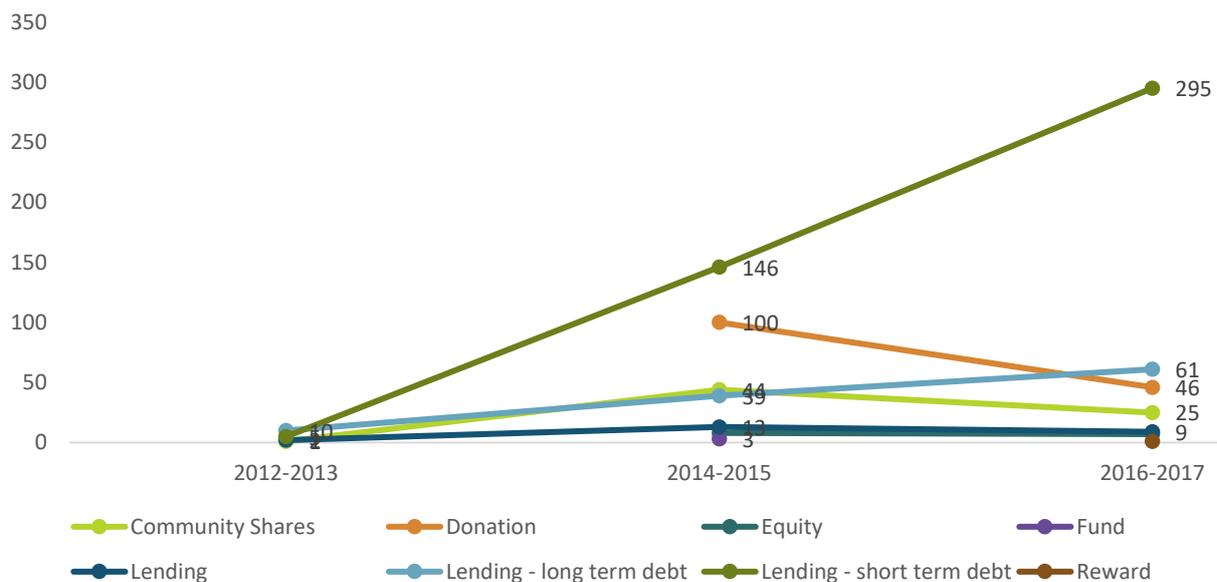


Figure 16. Evolution of number of projects per investment type, 2012-2017. Source: (Candelise, Grasso et al. 2017)

### 3.4 WHO USES ENERGY CROWDFUNDING AND WHY?

The progressive differentiation of the application of energy crowdfunding from grassroots community energy initiatives to more institutional projects and finance is also evident by looking at the data on project proponents (Figure 17) and company structure of the projects (Figure 18). Over 92% of the energy crowdfunding campaigns by December 2017 have been on projects initiated and developed by companies and only 5% by a community based initiative. Moreover, the majority of the crowdfunded projects in the database has been structured as limited companies (Ltd) (Candelise, Grasso et al. 2017). It must also be stressed that under the category 'public' of the database fall only initiatives explicitly and directly proposed by a public authority. This means that the category 'company' instead includes both private companies (e.g. ESCOs) and public companies (e.g. municipal utilities). Data presented in Figures 17 and 18 are not too distant from figures provided by a survey done by the CrowdfundRES project. Among 66 energy crowdfunding project proponents surveyed, about 59% are private companies (either limited companies or ESCOs), about 12% are cooperatives, 4% are public entity (e.g. municipality) and 20% are classified as 'others' (Bergmann, Betz et al. 2016). Nonetheless, future versions of the database here presented will better differentiate among different types of companies, as more evidence is needed on this topic in order to better analyse the role of public authorities as proponents of projects in energy crowdfunding (either directly or through controlled companies).

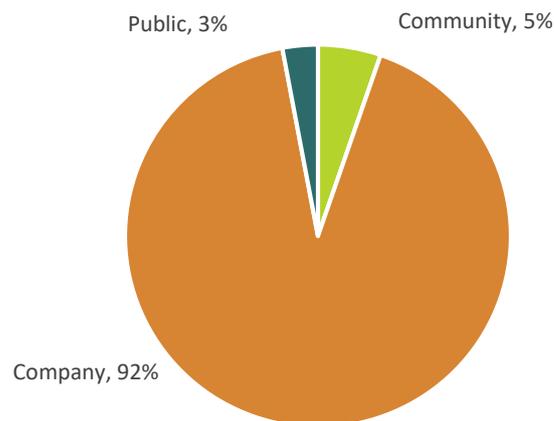


Figure 17. Proponents of energy crowdfunding campaigns, 2017. Source: (Candelise, Grasso et al. 2017)

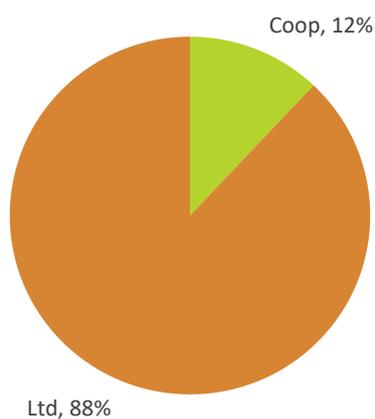


Figure 18. Company structure of energy crowdfunding projects, 2017. Source: (Candelise, Grasso et al. 2017)

Analysis and evidence on the motivations to use crowdfunding as an alternative finance method for renewable energy projects is relatively scarce and it can differ across project proponents. Nonetheless, it is possible to identify two main groups of motivations:

#### 1. Access to finance

Crowdfunding is an additional source of financing energy projects, alternative to traditional institutional finance. Access to capital can be a challenge, in particular for smaller renewable energy projects and for new small developers (such as community projects and citizens cooperatives). Smaller players often lack the balance sheet and the track record required by institutional finance. The financial crisis has made the situation worst, in particular for lending to small businesses (Harder and Maaren 2016). Difficulties accessing

sufficient finance and the nature and complexity of the planning process have in fact been inhibiting the growth of community-led schemes (Phimister and Roberts 2012) and the change in community energy policy support, in particular in European countries, has further left community energy projects under-resourced (Seyfang, Hielscher et al. 2014). More generally, the progressive reduction in Europe of direct RES policy support (such as Feed in Tariffs) has increased risk profile of investments in renewables and made access to finance more difficult (Yildiz 2014, De Broeck 2018).

Recent analyses and surveys among renewable energy project developers using energy crowdfunding highlight as main advantage of this financing tool the easiness and the timing to access finance (Friggens and Harder 2014, Bergmann, Betz et al. 2016). Crowdfunding is in some cases reported to make investments easier and faster. In other cases it is also reported to be cheaper, despite the fact that costs vary from case to case according to the size and type of the project, and the relative investment risk and expected returns (Bergmann, Betz et al. 2016).

## 2. Public engagement

As mentioned above, crowdfunding, beside its primary role (of financing energy projects), has a strong engagement, marketing and communication function. Crowdfunding platforms, using social networks and digital marketing, allow individuals to interact with project proponents as well as with each other. In the context of the energy sector, they can be enablers of the creation of online communities of individuals interested and affected by new energy projects (e.g. a local energy community) or even just pooled around a shared environmental or ethical vision. Indeed, all platforms mission and communication strategy emphasize the ethical and environmental dimension of their initiatives; a quick browsing of slogans on platforms' websites provides the best evidence for it:

- *"Investments that build a better world"*, Abundance Generation<sup>7</sup>
- *"Working together for a better future. Crowdfunding for energy efficiency and green technologies"*, Econeers<sup>8</sup>
- *"Enerfip, la plateforme de financement participatif pour la transition énergétique"*, Enerfip<sup>9</sup>

Thanks to their online and digital nature, energy crowdfunding platforms can widen the audience of potential investors beyond local communities, as such increase the potential of citizens' engagement in energy projects investments and more widely in the energy transition. Moreover, with the financial crowdfunding models individuals not only can engage and support an energy project or community, but can also invest and have a stake in them, even with small amount of capital. This means that through crowdfunding platforms people interested in investing in clean energy, but without suitable conditions (e.g. lack of sufficient capital or of a suitable area to develop the project), can get access to economic returns accruing from energy projects, while contributing to CO<sub>2</sub> emissions reduction. As community energy projects, crowdfunding platforms are a form of democratization in the energy sector, as they provide access to investment as well as

<sup>7</sup> <https://www.abundanceinvestment.com/>

<sup>8</sup> <https://www.econeers.de/>

<sup>9</sup> <https://enerfip.fr/>

redistribution of revenues of energy projects to a wider audience of individuals (than traditional finance). However, unlike community energy projects, crowdfunding platforms provide the opportunity to support, invest and benefit economically from the energy transition to anyone, not just to people located close to the energy projects or directly involved in them.

As discussed above, crowdfunding platforms are increasingly used by RES developers (including ESCOs and utilities) to engage and involve citizens in their energy operations and investments. The benefits of public engagement for energy project developers are various and can differ depending on who proposes the project, among those:

- access to a wider audience of potential investors, thus increasing the possibility of funding;
- increased visibility of the project, marketing and communication to final end users (this is in particular relevant for utilities, e.g. to reach electricity consumers and expand their core business of energy provision);
- engagement of citizens in investments in energy projects and infrastructures in order to increase local consent (particularly relevant for projects proposed by local public authorities) and reduce potential nimbyism (particularly relevant for private project developers interested in large projects with high perceived impact on the territory, e.g. large wind plant);
- redistribution of revenues/royalties in the territories affected by the projects (particularly of interest to local public authorities, interested in wider socio-economic benefits for their territories);
- reduction in planning risk, as a result of increased local involvement and support (mainly of interest of private developers, utilities).

For example, it is reported that developers working with the French crowdfunding platform Lumo<sup>10</sup> do not have trouble raising capital, but are increasingly facing local opposition to project development. Thus they use crowdfunding mainly to engage with the public, enable local investment and increase local support (Harder and Maaren 2016).

Policies in some European countries also provide incentives to developers to offer communities the chance to invest in energy projects. For example, France's Energy Transition for Green Growth Act provides higher electricity selling prices for RES plants which include crowdfunding among local citizens (Embassy of France 2016).

Table 1 presents data for some exemplary crowdfunded energy projects, extracted from the database (Candelise, Grasso et al. 2017). It shows that projects can differ quite substantially in terms of size of the investment, returns and terms of investment offered. This would most likely imply different project financing needs and arrangements and, as a consequence, different motivations for project proponents to use crowdfunding as a source of finance. Moreover, the size and the technology used in the projects can have different implications in terms of public perceptions. Larger projects and/or with strong impact on the territory (such as large wind plants or geothermal) are more likely to incur in nimbyism or local opposition, in particular when proposed by private companies or large utilities not directly connected with the local community. It would then be possible to assume that in such type of projects public engagement motivations would play a stronger role in directing

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<sup>10</sup> <https://www.lumo-france.com/>

project proponents' decision of using crowdfunding. However, none of the above has been proven with structured and empirically robust analysis of proponents motivations. Further work would be needed in the field.

<b>Platform</b>	Abundance Generation	Lumo	Abundance Generation	Lendosphere	LeihDeinerUmweltGeld	LeihDeinerUmweltGeld	Trillionfund
<b>Project Name</b>	United Downs Geothermal	EKWATEUR	Engynious Schools	Prêtez pour le projet éolien de Saint-Ellier-les-Bois et Ciral, en Normandie	Biomasse-HKW Papenburg	Windkraftanlage Glenough	Whalley Hydro
<b>Country</b>	United Kingdom	France	United Kingdom	France	Germany	Germany	United Kingdom
<b>Period (2 years)</b>	2016-2017	2016-2017	2014-2015	2016-2017	2014-2015	2014-2015	2014-2015
<b>Raised in euros</b>	5,895,270 €	242,975 €	882,142 €	105,000 €	150,000 €	1,000,000 €	824,425 €
<b>Investment term (years)</b>	2	3	19	2	4	7	3
<b>Return</b>	12%	7%	7%	5%	6%	4%	3%
<b>Minimum Investment</b>	5 €	25 €	5 €	50 €	100 €	100 €	250 €
<b>Technology</b>	Geothermal	Energy Efficiency	Solar	Wind	Bioenergy	Wind	Hydro
<b>Investment type</b>	Lending - short term debt	Lending - short term debt	Lending - long term debt	Lending - short term debt	Lending - short term debt	Lending - short term debt	Community Shares
<b>Proponent</b>	Public	Company	Company	Company	Company	Company	Company
<b>Legal form</b>	ltd	ltd	ltd	ltd	ltd	ltd	coop

Table 1. Some exemplary energy crowdfunding projects. Source: (Candelise, Grasso et al. 2017)

### 3.5 MOTIVATIONS TO INVEST

Energy crowdfunding focuses on clean and sustainable energy investments. It has flourished in a wider process of democratisation of the energy sector (Kunze and Becker, 2014, ILO, 2013). Thus the environmental, social/ethical and participatory characteristics of the investment are at least some of the drivers behind the decision to invest from the general public and the communities interested by the energy project (in particular in the case of community shares). However, these are definitely not the only ones. Most of the platforms are financial models, offering monetary returns on the investments, on average in the 4% to 9% range (apart from three outlier campaigns on funds published by Trillion Fund offering about 13% return) (Figure 19).

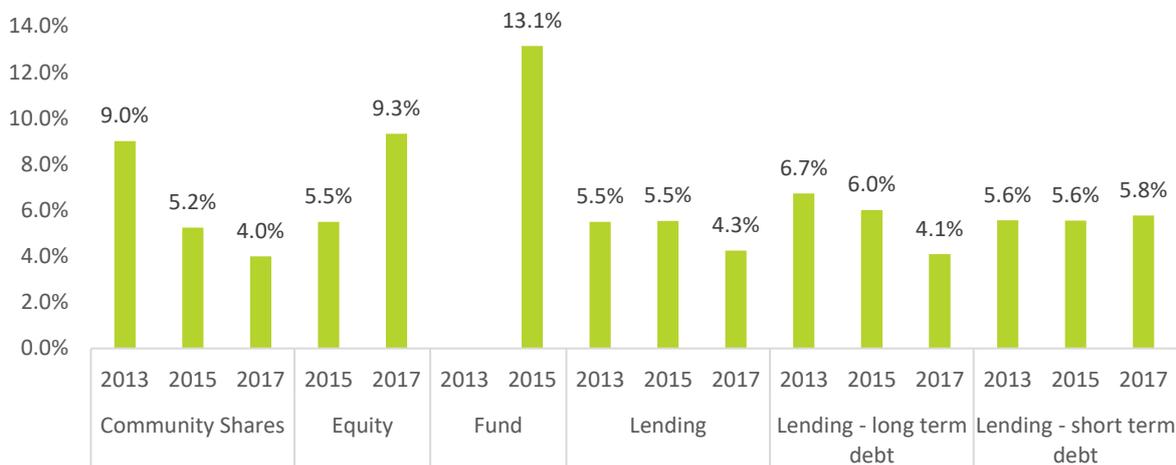


Figure 19. Average returns on investment offered per investment type, 2013-2017. Source: (Candelise, Grasso et al. 2017)

Literature looking at citizens’ willingness to invest in energy community initiatives highlights the importance of environmental and social motives behind investment decisions (Bomberg and McEwen 2012, Bauwens 2016, Holstenkamp and Kahla 2016, Kalkbrenner and Roosen 2016), while also stressing the relevance of combining them with financial attractiveness to galvanise citizen engagement (Reinsberger, Brudermann et al. 2015).

Initial evidence shows that it is indeed the combination of economic attractiveness and environmental and ethical concerns which triggers and motivates individuals’ investments in energy crowdfunding (Abundance Generation 2014, Bergmann, Betz et al. 2016). A recent survey exploring perceptions of EU citizens regarding the use of crowdfunding for renewables rank transparency, expected returns and sustainability impact as the most mentioned factors affecting the decision to invest (Bergmann, Betz et al. 2016). The same survey shows that “The moral and ethics of crowdfunding’s collaborative basis” (p.13) is

seen as the most relevant benefits of the use of crowdfunding for renewable energy projects by EU citizens (Figure 20).

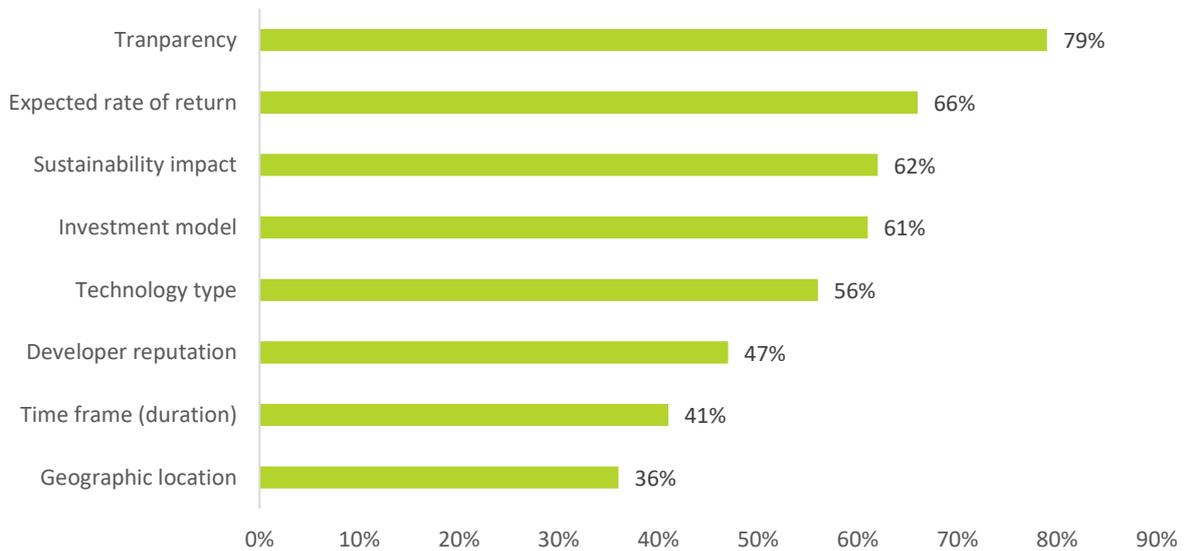


Figure 20. Ranking of factors taken into account in investment decisions (% occurrence over sample). Source: (Bergmann, Betz et al. 2016)

## 4 CROWDFUNDING IN THE DISTRICT HEATING SECTOR

This section of the report is dedicated to the analysis and of how crowdfunding could be applied to the district heating sector. The first section provides an overview of how the sector has been evolving since the 1970-80s and what this implies in terms of challenges as well as opportunities it is currently facing. Then the main business models used in district heating development are presented. The final section investigates how crowdfunding could be used to match the current challenges and opportunities of the district heating sector. It discusses how the different crowdfunding models could be applied and be of use to the different district heating business models and which are the implications in terms of citizen engagement.

### 4.1 EVOLUTION AND CHALLENGES FOR THE DISTRICT HEATING SECTOR

The European district heating sector has been evolving over time, along with the energy system transition as discussed in Section 3.1. District heating infrastructures built in the 1970-80's were large systems mainly relying on centralised, fossil fuel based energy supply (Galindo Fernandez, Roger-Lacan et al. 2016). They were traditionally implemented by the public sector, based on wholly public and centralised business models (IFC 2014, Galindo Fernandez, Roger-Lacan et al. 2016). Climate change mitigation policies and the entrance in the market of renewables has led to an evolution of sector. District heating systems now play a role in the European strategy of making heating and cooling in Europe more efficient and sustainable. They can be integrated with waste-to-energy and renewable energy sources to substitute fossil fuel generation. They can use resources that would be otherwise wasted, reducing CO2 emissions, and can now play a role in making local energy systems more efficient and sustainable.

The sector is currently characterised by scalable systems providing more flexible and collective infrastructures, which can be progressively developed and upgraded. There exists a wide variety of potential architectures both from a technological and from the business model point of view (Cornelis, Baastrup Holm et al. 2016). This implies different economics of the investment as well as different forms of stakeholder and customer engagement (Galindo Fernandez, Roger-Lacan et al. 2016).

In the context of this changing scenario, the European district heating sector is now facing market challenges on the one hand, but on the other hand it is also open to stakeholders and customer participation and cooperation (Cornelis, Baastrup Holm et al. 2016, Galindo Fernandez, Roger-Lacan et al. 2016).

### **4.1.1 MARKET CHALLENGES**

Financing district heating projects can be a challenge, as is the case for all infrastructure projects. It requires the right investor, willing to accept long-term investment horizons. They are long-term infrastructures typically offering stable, but long-term returns on the investments. In particular when combined with renewable generation, they have a high capital expenditure (CAPEX) and a relatively low operating expenditure (OPEX). This means that financial investors would need to be prepared to accept long periods of time before getting paid back their initial investment. Investors with a short-term vision of the business case would be less incentivised by district heating projects. This is why local authorities and national governments have been and still are important in the delivery of district energy (see also next Section 4.2). They can help in providing the business cases with more long-term vision, by e.g. enabling and easing access to low-cost finance (e.g. direct financing, setting up investment funds or through fiscal incentives) in order to stimulate private investment and industry activity. Nonetheless, in European countries where local authorities are less present and with reduced public investments, financing district heating and attracting private sector capital can be a challenge (Lygnerud 2015, UNEP 2015, Lygnerud 2018). This is particularly the case for district heating projects characterised by lower returns on the investments (see also Section 4.2).

District heating providers also face market competition for heat provision, from gas boilers in most European countries and from heat pumps in some countries, such as Sweden (Galindo Ferdandez, Roger-Lacan et al. 2016, Lygnerud 2018). The competition is particularly relevant in the domestic market segment. In addition, European climate mitigation policies are driving energy efficiency measures which reduces the energy demand for heating and, as a consequence, the district heating market (Lygnerud 2015). This is coupled with an increasing request for more transparent pricing models, favouring energy efficiency (Froning 2017), which reduces the possibility of charging customers for the fixed costs of the district system investment (Lygnerud 2018).

District heating providers are faced with the need of reinventing their relationship with customers. This is a challenge, but also an opportunity for the sector (see also next Section). Providers can adjust the value proposition they are offering (i.e. the bundle of products and services that they offer, and the relative tariffs) and improve their customer relationship in order to increase awareness of benefits of district heating as well as to meet customers' expectations (Cornelis, Bastrup Holm et al. 2016, Froning 2017, Trier, Paardekooper et al. 2017).

### **4.1.2 STAKEHOLDER PARTICIPATION AND COOPERATION**

More generally, the district heating sector is increasingly characterised by the potential and the need for cooperation and involvement of local stakeholders, including end-customers, surplus heat suppliers, regional authorities and urban planners, suppliers of district heating. The lack of understanding between the financial sector, political decision-makers

and promoters of district heating is an obstacle to new district heating expansions (Lygnerud 2015).

Cooperation with end-customers is of particular relevance in the context of this study. Customer relationship can be improved by highlighting the wide value proposition of district heating (Froning 2017, Trier, Paardekooper et al. 2017). The value proposition of district heating in fact does not just address heat supply, but can also include social benefits (e.g. in the form of tariff control), environmental objectives (e.g. local emissions) and community objectives (e.g. security of supply, local development, social & public benefits). Another avenue is increasing customers' participation options (Froning 2017). For example, involving citizens/end users in the development, ownership and/or governance of a district heating system provides opportunities for dialogue on the value proposition offered.

Community energy initiatives dedicated to district heating are one possible way to respond to such citizens engagement potential. They have fostered as grassroots initiatives in a fertile policy and civil environment in particular in some Northern European countries (REScoop 2012, Seyfang, Park et al. 2013, Huybrechts and Mertens de Wilmars 2014, Yildiz, Rommel et al. 2015, Bauwens, Gotchev et al. 2016). They generally are cooperatives which develop and manage district heating systems and are owned by their own customers. They encompass a high degree of members' co-determination and promote their members economic benefits guaranteeing an efficient heat supply at the lowest possible price for the end customer. Exemplary are the Danish district heating company members of the Danish District Heating Association (Dansk Fjernvarme)<sup>11</sup>. Out of the over 430 Danish district heating systems, 340 are operated as cooperatives, in addition to the municipally-owned ones (Jessen 2015, EBO Consulting 2018). In Germany 16% of the existing energy cooperatives (about 800) are dedicated to heating as business activity (REScoop 20-20-20 2015).

## 4.2 BUSINESS MODELS IN THE DISTRICT HEATING SECTOR

Business models for investment and implementation of district heating systems can vary considerably as they involve a variety of players, including project developers, municipalities, owners, investors, end users and citizens. Moreover, they are project specific and depend on techno-economic and financing site-specific circumstances.

Therefore, to design a business model for district heating implementation site-specific circumstances need to be considered. These include the economics of the investment (i.e. cost structure and revenue stream) and the available project finance. Profitability of district heating investment can vary widely depending techno-economic characteristics, financing conditions and cost of capital (which are affected by the timing of the project as well as by the credit worthiness and ability to access capital of the developer). The full value proposition of the project has also to be considered (thus including social and

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<sup>11</sup> <http://www.danskfjernvarme.dk/english/about-us>

environmental benefits and impacts) and the need of cooperation and involvement of all the stakeholders (Cornelis, Baastrup Holm et al. 2016, Trier, Paardekooper et al. 2017).

The DHC systems involve the public sector to some degree, at the least as facilitator, planner and policy maker, but also partially or totally as investor and owner of the project. Indeed, district heating projects have strong relevance and potential impact on territories and cities. They need to comply with planning and regulatory issues on one hand and to deliver a set of local objective and economic benefits wider than the pure economic return of the investment on the other hand. Local objectives and benefits might include: cheaper local energy for the customers or for particular categories of customers (e.g. fuel poor), local job creation, local redistribution of wealth, CO<sub>2</sub> emission and local air pollution reduction. Generally speaking, the role of public sector is relevant in district heating project development as:

- the public sector is able to leverage finance for project more easily and at a lower cost. As mentioned above, financing district heating infrastructures can be challenging, as the long term period of their returns on the investment does not always easily match private sector capital expectations.
- it could have an interest in developing and maintaining control over the project in order to meet wider social and environmental objectives;
- it could provide anchor loads in order to secure ex-ante sufficient heat demand and minimize energy demand risk (i.e. the risk of not having enough heat demand and relative revenues to sustain economic viability of the investment).

The combination of all the above factors with the site-specific conditions of district heating projects results in four main alternative business and ownership models: full public control (wholly public), full private control (private), mixed ownership and management (public-private partnership) and not-for profit (community owned cooperatives) (Lygnerud 2015, UNEP 2015, Cornelis, Baastrup Holm et al. 2016).

*Wholly public* business models are the most used common globally (also as they were the traditional models since the 1970-1980's). In this model the public has full ownership and management of the district heating plant and network. In current market conditions the main motivation behind the use of this business models is to guarantee the delivery of broader social and environmental objectives associated with the district heating project. This includes situations in which profitability of the investment would not be enough to attract private capital, despite the social and environmental value proposition of the project. Or otherwise cases in which the return on the investment and the profitability are kept explicitly lower because of public sector intervention in favour of social objectives such as cheaper energy delivery to final customer. Wholly public projects generally leverage public cash reserves and/or public grants (e.g. European funding) to finance the investment. This is often associated with public debt raised on the balance sheet of local authorities (Galindo Fernandez, Roger-Lacan et al. 2016).

*Public-private partnerships* are business models in which the public sector wants to maintain some control and carries some of the risk of the project, but the return on the investment is high enough to also attract private sector involvement. They are typically public-private joint ventures or concession contracts to the private sector (typically an ESCO). Financing in this model usually implies a contribution in equity by both public and private sector stakeholders. This equity is then used to leverage debt on the basis of the

future cash flow of the project. The presence of the public sector usually also allows to get easier access to other sources of finance such as public grants, local authority debt or local development bank loans.

The *full private* business model is appropriated in cases of highly profitable district heating projects in which the public sector has low propensity to risk and/or low interest in maintaining control. The public sector can still have a role in the project, for example by providing city assets such as land or anchor loads, but it is not involved in the ownership of the district heating system. Financing in these business models is provided by the private sector, usually through project financing composed by company equity and either inter-company debt or external commercial debt.

Table 2 below summaries the categorisation of district heating business models along the financial return dimension versus various degrees of public sector control, ownership and involvement in the project.

Financial Return on investment	Degree of control of public sector	Type of business model	Examples
Low	High	Wholly public	<ul style="list-style-type: none"> <li>District heating to meet social objectives related to housing or fuel poverty</li> </ul>
Medium/Low	High	Wholly public	<ul style="list-style-type: none"> <li>Public sector demonstrating the business case of district energy systems</li> <li>Public sector lowering the IRR by allowing cheaper energy tariffs than private sector would</li> </ul>
Medium/High	Medium	Public/private hybrid	<ul style="list-style-type: none"> <li>Public/private joint venture</li> <li>Community-owned not-for profit or cooperative</li> </ul>
High	Medium/Low	Private (with public facilitation)	<ul style="list-style-type: none"> <li>Privately owned project with some local authority support, through a strategic partnership or simply through local planning</li> </ul>

Table 2. Categorization of business models for district heating projects. Source:(UNEP 2015)

Finally, *community owned cooperatives*, as discussed in Section 4.1.2, are generally fully owned by their members, who have a high degree of control over the development and management of the project. They are non-profit cooperatives, mostly constituted with the goal of promoting members’ interests, in particular in terms of low cost heat supply.

Examples are the Danish district heating cooperatives or the cooperatives in South Tyrol (Italy). They are generally supported by the local municipalities in their feasibility study and planning stage. Financing arrangements vary across countries and contexts. In Denmark, for example, financing of the project development is usually covered 100% by bank loans, provided at a fixed low rate (currently of about 1.62%) thanks to a guarantee provided by the municipality (EBO Consulting 2018). In order to develop the plant at least 30% of the heat demand is guaranteed ex-ante by cooperative members, who commit to connect and repay the debt over the lifetime of the project. Members can terminate the membership paying a fee (EBO Consulting 2018). In South Tyrol, however, funding usually comes about 30% from local authorities, about 30% from members (in a form of equity/community shares) and the remaining from bank loans (SEV 2018). Nonetheless, a common factor characterising these business and financial models is the strong involvement and commitment of the members as both investors and end customers.

## 4.3 THE POTENTIAL ROLE OF CROWDFUNDING

The question here is to which extent, under which conditions and for which benefit crowdfunding could be used to finance district heating investments. The focus here is on energy crowdfunding platforms, strictly defined as a form of financial intermediation. They can be used by cooperatives as well as by other actors including local authorities and private developers. District heating cooperatives share very similar principles and characteristics with crowdfunding campaigns and sometimes they are referenced to as forms of crowdfunding in the literature. Nonetheless, energy crowdfunding is a different phenomenon from cooperatives, as also discussed in Section 3.

The potential role of energy crowdfunding platforms in funding and supporting district heating investments is analysed in relation to the two main groups of motivations of using this innovative financing tool (see Section 3.4): 1. access to finance and 2. public engagement.

### *1. Access to finance*

Generally speaking, financial crowdfunding models could provide an additional source of finance to district heating projects. In particular, this applies to the projects with a relatively low expected return on the investment, but otherwise relevant to meet wider social and environmental objectives. These types of projects are generally developed with a strong role of the public sector, thus either with a wholly public or public-private business models, or by cooperatives.

Crowdfunding campaigns could help in raising more capital from diffused investors, potentially more willing to accept lower or slower rate of returns on the investment in exchange of recognisable social and environmental benefits. In other words, crowd investors could be prepared to invest 'patient' capital (i.e. with no expectation of immediate/high returns) in district heating projects as they would also provide social and environmental benefits for their regions or for the end-users (e.g. explicitly promoting

economic benefits for members and/or fuel poverty alleviation). Indeed, evidence from the community energy sector and literature indicates how norm driven investments (i.e. dominated by social, ethical and environmental motives) are more likely to provide 'patient' capital with no expectations of immediate returns (Bomberg and McEwen 2012, Bauwens 2016).

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### *Case study: London - Bunhill Heat and Power, a wholly public business model*

*London's Inslington Borough, a local Council of the City of London, developed around 2013 a district heating network using a 1.9MW CHP plant with thermal storage and serving 850 apartments and two leisure centres. The Council considered connecting the network to an existing nearby heat network, but decided not to because the heat tariffs charged were too high. The Council had in fact as a major goal the affordability of warmth. The Council decided then to develop the project internally (to save money) and tendered the design, construction and operation to an external contractor.*

*In the first phase the project was fully funded by the Council cash, as debt financing would have had a negative impact on heat tariffs pushing them outside the affordable warmth objective. The second phase has also been funded by public money, i.e. Council cash and European project funding. Such financing arrangements were critical to make sure that the project would deliver low heat tariffs to the citizens/customers connected to the district network.*

*This is a typical district heating project where a crowdfunding campaign could be interesting and beneficial. Considering the strong and explicit social commitment of the project (i.e. affordable warmth) it would potentially be a project able to attract patient capital among interested citizens. This would definitely help the economics and financing of the business case and ease pressure on the Council's budget. Moreover, in the case the crowdfunding campaign would be structured and run on financial platforms, it would also be a way to redistribute revenues to citizens and end customers, thus providing additional economic benefits to the community affected by the investment.*

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## *2. Public engagement*

As discussed in Section 4.1, stakeholders' engagement and cooperation is increasingly relevant in the district heating sector. District heating providers have to improve their customer relationships, in particular in contexts of limited awareness of the social and environmental benefits of the projects as well as of potential negative perception of the cost of connection and heat provision. Recent work on public perceptions of district heating highlighted how using customers as a community increases the chances of creating a sustainable business case for district heating development. Increase in awareness and reduction in negative perceptions is deemed to be possible through: price and tariff regulation and control; providing participatory options; stressing and informing on the environmental and social benefits (Froning 2017).

As also discussed in Section 3.4, crowdfunding campaigns, besides raising capital, have a strong engagement, marketing and communication function. Crowdfunded district heating projects have to publish on the crowdfunding platform all the information about the project itself necessary to fully inform the citizens' investment decision. Moreover, platforms are connected to social networks which allow a wide communication and publicity of the project. Through crowdfunding platforms individuals and potential investors can connect and communicate with district heating developers and communities of interested stakeholders can be created around the project. These characteristic of crowdfunding can help in increasing public awareness on district heating networks' social and environmental benefits as well as in reducing potential negative perceptions among potential end customers.

Moreover, in defining business models and assembling finance for district heating projects it should be considered that:

- District heating projects might suffer of a considerable investment/revenue time lag, i.e. revenues are accruing after the project has been built.
- Projects can be subject to energy demand risk, i.e. lack of enough customers connected to the district heating network in order to guarantee profitability of the investment.

This means that in order to develop new district heating plants there need to be a minimum certainty on the future number of connections and relative heat demand. One solution to reduce time lag and energy demand risks is the identification of anchor loads that would ex-ante provide a minimum guarantee heat demand.

Crowdfunding campaigns, thanks to their public engagement potential, could also help in minimizing energy demand risk. At the very least, by increasing the visibility of the project, crowdfunding can increase public awareness and opportunities of marketing district heating services offered by the project developers. Through financial models crowdfunding can also empower and fully engage the final end-user/customer which, by financing (lending model) or even partially owning (equity model) the district heating project, would implicitly ex-ante provide guarantee of connection. Crowdfunding campaign could also be structured to combine the investment offer with a form of reward for potential final customer, for example a discount on energy tariffs, to further guarantee their network connection. Moreover, improved public engagement could help in achieving economies of scale: the higher the number of customers connected to the network, the higher the chance of an increased profitability of the investment. Experiences of district heating cooperatives mentioned in Section 4.2 (which require and achieve members' connection and commitment over a long time period) are a clear example of how participating citizens in the ownership of the project can help in easing energy demand risk and foster higher rates of network connection.

Distributed financing and/or ownership of infrastructures such as district heating is also a form of redistribution of revenues/royalties on the territories affected by the district network, which in turn further help in creating local consent. More generally public engagement can increase local support to the project, thus minimize potential nimbyism and planning risks.

Challenges	Could crowdfunding help?
<b>Access to finance</b>	
1. Access to finance, in particular for small to medium projects	1. Crowdfunding provides access to finance: <ul style="list-style-type: none"> <li>a) Equity model:                             <ul style="list-style-type: none"> <li>• allows to raise equity, possibly making easier access to bank loans</li> <li>• supports cooperative expansion</li> </ul> </li> <li>b) Lending model:                             <ul style="list-style-type: none"> <li>• Provides additional sources of debt</li> </ul> </li> </ul>
2. Projects with low/medium IRR: difficult to raise private capital, but wide social/environmental benefits and/or relevance for the territory	2. Crowd investors could be prepared to invest patient capital (no expectation of immediate/high returns), if combined with ethical/social/environmental/territorial benefits
<b>Public engagement</b>	
3. Lack of awareness and potential negative perceptions	3. Crowdfunding can increase local awareness and reduce negative perceptions by increasing the opportunities of communicating economic, social and environmental benefits of DH projects
4. Minimize impact of time lag and energy demand risk on profitability: need a minimum number of guaranteed customers connected to the DH network	4. Engagement of citizens through crowdfunding campaign during project development could help in guaranteeing a minimum number of connections
5. Economies of scale: increasing connections reduce the overall cost	5. Crowdfunding campaigns can help in increasing the public awareness, acceptance and customers connections
6. Reduce potential nimbyism (Not in my backyard syndrome)	6. Crowdfunding can reduce nimbyism by: <ul style="list-style-type: none"> <li>- allowing redistribution of economic returns in the territory and among citizens interested by the project</li> <li>- helping in creating a local community around the project</li> </ul>

7. Planning risk: relationships of private developers with local authorities and planners	7. Crowdfunding, besides raising capital, is a tool for local engagement
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Table 3. Summary of challenges encountered in developing and financing district heating projects and potential use of crowdfunding

## 4.4 THE APPLICATION OF DIFFERENT CROWDFUNDING MODELS

All the crowdfunding models (i.e. equity/community shares, lending, donation/reward) could potentially be used in the district heating sector. However, evidence presented on energy crowdfunding has shown how the financial models account for the majority of the market and it is most likely this would also be the case for district heating projects. Nonetheless, in what follow the applicability of each crowdfunding model is discussed, including considerations on the forms of public engagement implied by each model.

### 4.4.1 EQUITY AND COMMUNITY SHARES

District heating equity crowdfunding campaigns offer individuals the possibility to invest in exchange of shares of the company or the cooperative developing and operating the district heating plant. As such they could be used to facilitate access to equity capital which in turn could provide easier access to bank loans. This for example could apply to *public-private partnership* and *full private* business models where a successful equity crowdfunding campaign could provide an additional source of capital for the equity share of the project financing structure. In the form of community shares they can of course be used to support further expansion of *district heating cooperatives*. Thanks to the communication potential beyond the local dimension (as linked to ICT and social media) crowdfunding campaigns could facilitate the outreach of potential cooperative members among the citizens interested in participating to the venture, including those which are not necessarily located close to the district project itself.

Generally speaking equity crowdfunding campaigns on district heating could help in engaging citizens and stakeholders, with the consequent benefits in terms of awareness, reduction in nimbyism and wider local participation, as discussed in Section 4.3 above.

From the point of view of citizens/investors, equity/community shares models provide them with the possibility to invest and have a stake in the project. This implies that they will benefit of economic returns on the investment, as a function of the business profitability. As discussed above returns can vary according to the site-specific techno-economic characteristics and the business model chosen. However, the returns offered would be at

higher risk than in the case of lending models (see below), as they are not guaranteed but depend on dividend payments. The latter are in turn subject not just to the economic performance of the project, but also to the decisions at the governance level.

It must be stressed however that with equity/community shares crowdfunding models citizens/investors would have a certain degree of control over governance, operation and strategic decisions of the district heating project. This could include influence and control over decision on tariffs levels, financial management as well as on provision of wider social and environmental objectives, e.g. implementation of specific energy poverty alleviation strategies. Evidence on people perception of district heating has shown how offering customers the possibility of becoming co-owners is seen very positively and could compensate the perceived lack of choice customer have on heat provision cost (Froning 2017).

However, the level of control and co-determination would change depending on the legal structure adopted for the SPV or company owning the district heating project. Co-determination and control is higher in the case of cooperatives, as their governance is based on the 'one head one vote' principle.

#### **4.4.2 LENDING MODELS**

With regards to lending, crowdfunding platforms proponents and developers of district heating can raise debt from the general public. In practice they solicit online investment on the project providing the diffuse investors with a debt instrument. The investment is then repaid over time as a function of the revenues accruing from the district heating operation and business activity. Of course the debt instrument can be structured and offered with different levels of returns and maturity, as a function of the site-specific techno-economic and financing conditions.

Lending crowdfunding campaigns could be potentially used under all possible district heating business models. In fact, debt can be raised through crowdfunding on the SPV developing the project whose ownership could be private, public or a combination of those. It could also potentially be used by cooperative to partially fund the debt component of their financing structure. The main differences of using crowdfunding instead of other type of institutional loans are (see also Section 3.4):

- crowdfunding could potentially be easier and quicker access to debt funds (Friggens and Harder 2014, Bergmann, Betz et al. 2016).
- the public engagement potential, in terms of visibility of the project, general public awareness, potential reduction in nimbysm and wider local engagement as discussed in the previous Section 4.3.

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### *Case Study: Brescia, Italy - Existing high temperature district heating network (A2A Group)*

*As a pilot of TEMPO project A2A Group (the municipal utility of Brescia city, Italy) is developing a district heating network in a low density building area consisting mainly of terraced houses and some apartment blocks.*

*The existing network is heated by a waste-to-energy plant, residual heat from industry and CHP, and peak-load gas boilers. The A2A network in Brescia started operating in the '70s and currently operates at temperature levels of 120/60°C. The goal of the project is to lower the supply temperature in one branch of the existing network by mixing the supply with the return water from the same branch, using a shunt installation. The A2A's objective is to keep its networks competitive, achieving efficiency gains by reducing temperature levels in the network. This option is tested for the first time and includes the involvement of the end-consumers. Moreover, this demo site is representative of many networks throughout Europe, thus there is a large replication potential. Therefore customer engagement and stakeholders motivation are particularly important in this project.*

*A2A Group has a strong financial position and a business model which makes it able to attract customers and achieve enough income to cover the large initial investments. It is able to provide competitive heat prices to its customers (Galindo Fernandez, Roger-Lacan et al. 2016). Customer surveys are performed on a regular basis and show a good degree of satisfaction. However, there is still room for raising awareness about the value proposition of the DHC system. In particular awareness need to be increased about the non-economic benefits such as contribution to cleaner air and reduction in GHG emissions (Trier, Paardekooper et al. 2017).*

*Considering the financial stability of the A2A Group and the strong business model, a crowdfunding campaign on this new pilot project could mainly provide benefits in terms of public engagement and wider publicity of the demo site. A crowdfunding campaign could help in increasing awareness among local citizens and customers affected by the demo project. Moreover, it could be used to communicate and advertise more widely the innovative project with the view of increasing replication potential across Europe. This is a situation similar to project proposed by the utilities working with the French crowdfunding platform Lumo. They do not have problems in raising capital, thus they use crowdfunding campaign to increase local participation and minimise local opposition on their energy projects development (see Section 3.4). Either an equity or a lending crowdfunding campaign could be appropriated. Lending model could potentially be easier to implement as shareholding conditions and regulations of a big utility might complicate structuring of an equity campaign.*

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Lending crowdfunding provide the citizens/investor with a pre-defined and guaranteed return on the investment. As such it is a lower risk investment compared to equity crowdfunding campaigns. On the other hand, it allows lower levels of participation and engagement of citizens in the projects than equity/community shares model. In fact, it only allows them to invest and benefit from the return of the investment, thus does not provide an opportunity of co-ownership and relative potential of co-determination. Indeed, lending models do not provide to citizens/investors any form of active participation or control over the project governance nor over the service provision strategies and priorities.

Nonetheless, investment offers under lending crowdfunding models could be tailored to a certain extent to the project specific conditions and territory to allow different levels of engagement and potential benefits for citizens, such as:

- Platforms and project developers could offer higher returns to investors living in the area affected by the district heating network. This is for example a common practice of the French platform Lendosphere.
- Project developers could couple investment offers with some preferential treatment in terms of energy tariffs (a form of reward crowdfunding) for citizens/end consumers supporting the project.

#### **4.4.3 NON FINANCIAL MODELS**

Non-financial models are very rarely used in the energy sector. To date there exist only few experiences of donation platforms, which have been raising money for projects of rural electrification or for the non-profit sector. An example is the UK platform Solar Schools<sup>12</sup> which collected donations to install photovoltaic plants on school rooftops, leaving to the schools the property of the PV plant and the returns accruing from the investment. They managed to finance over 50 projects raising over 500,000£.

However, district heating projects are larger infrastructures than small, distributed PV plants, requiring higher amounts of investment, which evidence shows are more difficult to raise with donation and reward crowdfunding campaigns. Average project sizes of energy donation campaigns have been to date of about 12,000€ compared to about 600,000€ and 400,000€ of respectively equity/community shares and lending energy crowdfunding campaigns ((Candelise, Grasso et al. 2017) see also Figure 13). In addition, district heating projects intrinsically imply an economic relationship between the project developers and the citizens. The latter are, in fact, likely to be the final end users of the district heating service and, as such, they are due to pay the value of the heat provided. Therefore, their involvement as potential investors/donors in district heating investments seems to be more appropriate through financial crowdfunding platforms. Financial crowdfunding investments imply an economic transaction based on the returns of the investment. Therefore, they allow to provide a wide value proposition to final end-customers which would include not just heat supply, but also additional economic benefits as well as participation options and co-determination (in the equity form).

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<sup>12</sup> <https://1010uk.org/solar-schools/>

Nonetheless, it is important to mention a specific form of reward crowdfunding developing across Europe: civic crowdfunding. It is a form of donation/reward crowdfunding aimed at raising funds for the development of public projects strongly related to the local communities, in particular in urban environments. It is increasingly used as form of public engagement in local, public initiatives in order to incentivise active citizenship.

An often cited exemplary case is the Luchtsingel complex in Rotterdam (Netherlands), which includes a rooftop vegetable garden and a park connected to the city centre by a pedestrian bridge made of wood planks. In 2014, crowdfunders could fund the construction of the bridge donating for sections of the bridge or just for a wood plank in exchange for being able to customize it with their name or a message to the city (Figure 21).



Figure 21. Crowdfunded pedestrian bridge in Rotterdam

Another example is the restructuring of the Portico di San Luca (Italy), a 3.8km long roofed arcade, a landmark in the city of Bologna. The crowdfunders donated money to the campaign in exchange of little gadgets or free guided city tours. The Portico di San Luca campaign managed to raise about 300,000€ out of over 7,000 donations from local citizens.

Civic crowdfunding is also developing in the form of match-funding schemes: a form of co-financing of crowdfunded projects by institutions and local authorities. For example, in 2017 ANCI (the Italian Association of Mayors) launched a call which implied a match-funding of reward/donation crowdfunding campaigns dedicated to earthquake reconstruction projects which would have reached 50% of their crowdfunding target. The call managed to co-fund 18 reconstruction project which had raised 700,000€ on an Italian reward crowdfunding platform.

Civic crowdfunding campaigns could potentially be an option in the district heating sector for projects developed and sponsored by the public sector and the local authorities, i.e. the *wholly public* business models. The main goal of such campaigns would be the resulting increased citizen engagement and awareness. For example, a city committed to developing a new district heating system for demonstration purposes, and able to secure the necessary capital to finance the investment, could structure and launch a civic crowdfunding

campaign for the main purpose of increasing communication and information opportunities about the project itself, while engaging citizens in the development process. Rewards offered could be related to the district heating system itself, for example in the form of free connection or discounts on energy bill, or could be more creative types of reward (such as the example provided above).

## 5 CONCLUSIONS

Crowdfunding has rapidly emerged as an innovative finance tool across the world. It provides interesting opportunities both 1. as alternative source of finance (and additional to institutional channels) for new projects and business ventures; 2. to allow the general public easier, disintermediated access and participation to investments, from which they would most likely left apart. The application of crowdfunding to the energy sector and, within that, to district heating has been explored in detail by this study.

The following is a summary of some of the conclusions and messages emerging from the study:

- ❖ *Crowdfunding in energy is a novel and quickly evolving sector.* Despite being a relatively new phenomenon (starting in 2012), the energy crowdfunding sector has been quickly growing over time, reaching in 2017 over 300 € millions of funding volume. The best performing countries are United Kingdom, Germany, France and the Netherlands. The majority of the energy crowdfunding campaigns are dedicated to solar photovoltaic projects, followed by wind projects. This trend has been changing in the last couple of years, with an evident differentiation in terms of technologies in the most recent energy crowdfunding campaigns.
- ❖ *Lending models have been prevailing in the energy sector.* The use of crowdfunding in energy has begun as a fairly niche application to grassroots and community energy projects, allowing citizens to invest, become shareholders and benefit from the return on the investment. As such it shares similar principles with the community energy sector, mainly made of energy cooperatives aimed at enabling citizens to collectively develop and manage energy projects. Energy cooperatives have indeed been using crowdfunding platforms to raise capital mainly on in the form of community shares offers. However, evidence presented in this study shows a progressive reduction over time of community shares crowdfunding projects and a dramatic prevalence of the lending crowdfunding model. Lending projects are not just much higher in number, but they have raised the highest funding volume. Data also shows that 92% of the crowdfunding projects have been proposed by companies (against 5% of community led initiatives), 81% of which constituted as limited company and only 9% as cooperatives.

- ❖ *Access to finance and public engagement are key factors.* Analysis of the motivations for energy projects developers to use crowdfunding shows that: 1. crowdfunding is an additional source of funding, providing potentially easier and faster access to capital than other institutional sources of finance; 2. the strong engagement, participation and communication function of crowdfunding is very relevant for the energy sector. Crowdfunding platforms are increasingly used by energy developers to engage citizens in their project investments in order to: have access to a wider audience of potential investors; increase visibility of the project; increase local acceptance and reduce nimbyism; increase local stakeholders' awareness and reduce planning risks; redistribute revenues/royalties in the territories affected by the project.
  
- ❖ *The district heating sector is facing market challenges and increased opportunities for stakeholders' participation.* The district heating sector has been evolving over time. Traditionally district heating were developed and owned by the public sector, relying on centralized and fossil fuel base energy supply. With the development of renewable, district heating projects have become more modular and sustainable, leaving space for multiple potential architectures both from a technological and business model point of view. A variety of business models has been developing, including public-private partnership, full private and cooperative models. In this context the European district heating sector is facing new market challenges. In particular, financing can be challenging, especially in countries with weaker local governments and/or limited public spending. On the other hand, the district heating sector is now open to more opportunities of stakeholders' participation and cooperation. Cooperation and involvement of end-customers is increasingly relevant for district heating providers. Using customers as a community increases the chances of creating a sustainable business case for district heating development.
  
- ❖ *Crowdfunding could be successfully applied to district heating sector.* Crowdfunding can provide some answers to the challenges and opportunities that the district heating sector is facing. First, crowdfunding models could provide an additional source of finance to district heating projects. It allows to raise capital from diffused investors, potentially more willing to accept lower or slower rate of returns on the investment in exchange of recognizable social and environmental benefits. Crowd investors could be prepared to invest 'patient' capital (i.e. with no expectation of immediate/high returns) in district heating projects if they would also provide social and environmental benefits for their territories or for the end-users (e.g. explicitly promoting economic benefits for members and/or fuel poverty alleviation). Second, the strong engagement, participation and communication function of crowdfunding can help in increasing public awareness on district heating networks' social and environmental benefits as well as in reducing potential negative perceptions among potential end customers. In addition, crowdfunding campaigns, thanks to their public engagement potential, could also help in minimizing energy demand risk, thus improving the business case for district heating projects.

- ❖ *Different crowdfunding models can provide different funding and public engagement solutions.* All the available crowdfunding models (i.e. equity/community shares, lending, donation/reward) could potentially be applied in the district heating sector, but the financial ones are more likely to be used. *Equity/community shares* models could be used to facilitate access to equity capital for full private or public-private partnership initiatives (which in turn could provide easier access to bank loans) or to support expansion of cooperatives. They provide investors with the possibility to invest and have a stake in the project and benefit of economic returns depending on the business profitability and dividend payments. As such they are higher risk returns than those offered by the lending models. On the other hand, equity/community shares crowdfunding models allow citizens/investors to have a degree of co-determination and control over governance, operation and strategic decisions of the district heating project. This could include influence and control over decision on tariffs levels as well as on provision of wider social and environmental objectives. *Lending crowdfunding* campaigns instead could be potentially used under all possible district heating business models. In fact, debt can be raised through crowdfunding on the SPV developing the project whose ownership could be private, public or a combination of those. It could also potentially be used by cooperative to partially fund the debt component of their financing structure. Unlike equity models, lending crowdfunding provide the citizens/investor with a low risk and pre-defined return on the investment. On the other hand, they do not offer to citizens/investors any form of active participation or control over the project governance nor over the service provision strategies and priorities. Finally, non-financial models are much less used in energy crowdfunding. However, civic crowdfunding campaigns could potentially be an option in the district heating sector for projects developed and sponsored by the public sector, i.e. the *wholly public* business models. The main goal of such campaigns would be the resulting increased citizens' engagement and awareness rather raising capital.

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