THERMOS

Accelerating the development of low-carbon heating & cooling networks

Capacity Building and Train-the-trainer programme
Module 5: Heating and cooling market and finance

Module 5 of the THERMOS Capacity and Training Programme

The aim of this module is to provide an overview of the main characteristics of the heating and cooling market. This module is divided into five parts as follows:

5.1 Market actors at all governmental levels

5.2 Dominant market design and finance structure

5.3 Dominant market and traditional partnership models

5.4 Market and investment barriers and opportunities

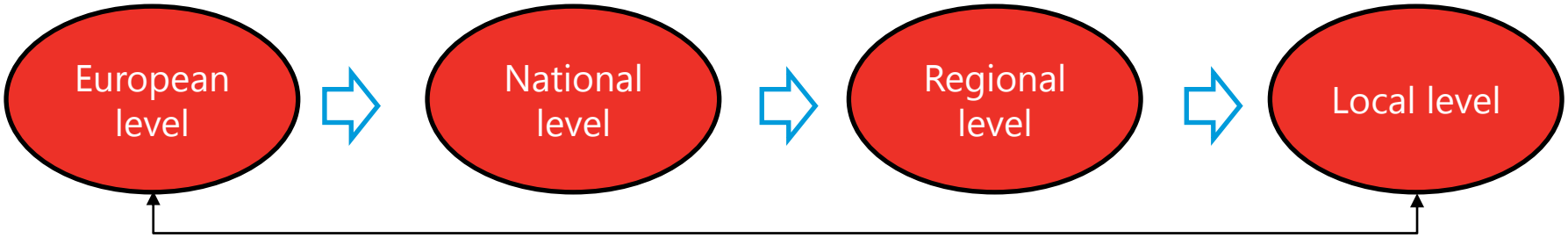
5.5 Innovative services and financing models

The development of district heating and cooling networks is strongly dependent on the actions of the market players at the distinct governmental levels. They should establish the adequate regulatory framework for DHC networks and pave the way for the market deployment.

The following governmental levels can be identified:

- **European level:** Mainly composed of the European Commission, which establishes the long-term roadmaps, objectives and the policy instruments to achieve them
- **National level:** National energy agencies or government departments that transpose the European regulations and set the energy policy of the country
- **Regional level:** Regional actors in charge of defining the specific applicable framework for a concrete area based on the national regulations
- **Local level:** Local authorities that promote the specific DHC projects at local level building on the framework set by the European, national and regional actors

For an effective deployment of the DHC market it is key that market actors on all governmental levels are aligned. To this respect, multi-level governance, which links up local, regional and national levels, is emerging as a possible solution to ensure that all interests are coordinated.



Multi-level governance

Multi-level governance is to be understood as a connection of decision-making processes by a variety of independent actors, often with different hierarchy levels and equipped with different competences.

Source:
https://cor.europa.eu/en/documentation/studies/Documents/Sustainable%20Energy%20Action%20Plans%20(SEAP).pdf

5.2 Dominant market design and finance structure

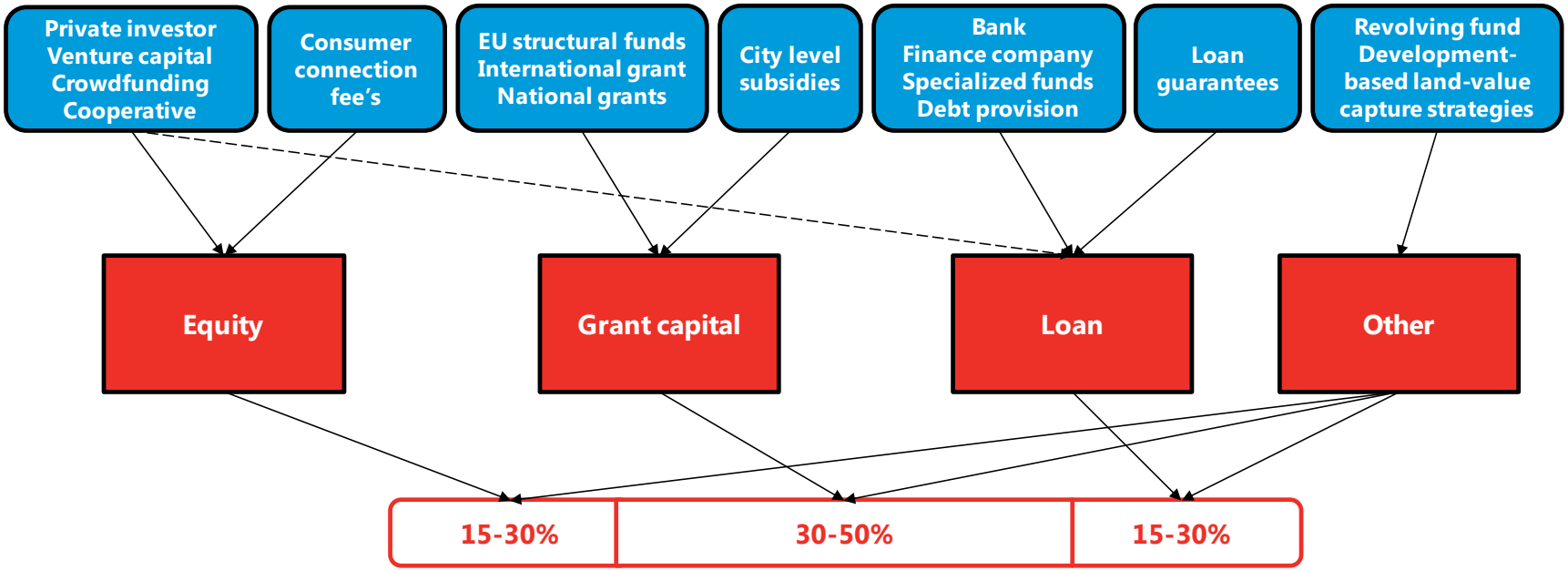
- The initial investment costs related to DHC projects are considerable. District heating networks should eventually pay for themselves, but it can take several years for the initial outlay of the design and construction to be recovered and for any profits to be generated

- This means that investors looking for long-term revenue streams are more suitable for district heating investments than investors seeking a quick return on their capital

Chapter 5.2 reviews the dominant market and the most traditional finance structure of district heating and cooling networks.

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf

The financial structure of DHC networks is commonly comprised of stockholders' investments, long-term loans, short-term loans (such as overdraft or bridging loan in case of approved investment subsidies), short-term liabilities (such as trade credit) and investment support grants:



Source:

http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf,
http://www.coolheating.eu/images/downloads/2_Per-Alex-Sorensen.pdf

The following slides describe the most relevant financing sources for district heating and cooling networks, as outlined in the H2020 Coolheating project:

- Equity
- Loan capital
- Grants
- Alternative sources of finance

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf,

5.2.1 Equity

Equity capital represents the personal investment of the owners in the project. It is also known as risk capital because investors assume the risk of losing their money if the business does not succeed. In contrast to the loan capital it does not have to be repaid with interest, but is instead reflected in the ownership structure of the planned project.

Equity capital can be provided internally by those developing the project (municipality/company/cooperative/individual) or can also come from external sources.

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf,

5.2.1 Equity

The most common sources of equity capital are:

- **Private equity** is the provision of equity capital by project initiators or financial investors over the medium or long term. The private equity can be provided by external investors in form of ownership or in the form of a loan

- **Venture capital** is usually provided by investors to start-up companies and small businesses that are believed to have long-term growth potential. Venture capital generally comes from well-off investors, investment banks and any other financial institutions that pool similar partnerships or investments

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf,

5.2.1 Equity

The most common sources of equity capital are:

- **Crowdfunding/ cooperative:** In DHC, cooperatives provide own funds for the investment structure. These funds can represent equity or, like venture capital funds, can also represent a loan given to the project operator and shall be returned by the DHC company, in which case these funds are translated into loan capital
- **Connection fees:** Usually minor sources of equity in the investment structure funds can also be provided by the connection fees. Return on investment is entirely dependent on the customer base of the network, so it is imperative that a scheme targets customers who can pay

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf,

5.2.2 Loan capital

Debt or loan capital differs from equity capital because subscribers to debt capital do not become part owners of the business, but are merely creditors, and the suppliers of debt capital usually receive a contractually fixed annual percentage return on their loan. This part of the investment funds must be repaid within a specified period with an established interest rate.

There are also certain loans that are a combination of debt financing and grants. A loan with subsidized interest rate is an example of this kind of hybrid financial mechanism. Loan capital may be obtained from a bank, finance company or other financial institution as long-term loans, or from specialized funds for projects utilizing RES.

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf,

5.2.2 Loan capital

The most common sources of loan capital are:

- **Debt provision and bond financing:** Cities can provide low-cost loans to projects by passing on their ability to raise low-cost recourse capital. Similarly, cities can issue general obligation bonds to provide debt to a project. Revenue bonds can also be issued to effectively provide this debt at a higher interest rate
- **Loan guarantees and underwriting:** Loan guarantees from cities allow access to low-interest debt for projects, which can greatly reduce the total project cost. Creditors may require some form of loan guarantee from municipalities, obliging the city to repay the loan if the project defaults

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf,

5.2.3 Grants

The majority of financing structures for DHC projects include funds from grants, either in the form of capital grants or in the form of subsidized interest rate loans. Grant funding of district energy systems tends to come from higher levels of government rather than the city or town itself.

Municipalities and local authorities can help individual projects gain funding from national or international grants or may also provide capital grants or annual payments to specific projects to enable their initial development or to help direct them to social or environmental objectives.

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf,

5.2.3 Grants

There are two main types of grants:

- **City-level subsidies:** Some cities exploring modern district energy systems have been advancing mechanisms – such as feed-in tariffs, net metering and heat incentives – that internalize the public benefits of these systems, in association with a public utility, although in general subsidies developed at a city level are less prominent
- **International or national funds or loans:** Significant international and national funds are being directed to DHC in cities, both for initial development and for rehabilitation. Cities can lobby for such funds to be made available to projects. Across Europe, EU Structural Funds play a key role in helping local and national governments modernize dilapidated district heating infrastructure

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf,

5.2.4 Alternative sources of finance

Other possible sources of finance consist of:

- **Revolving funds:** Some local governments are establishing investment funds or green funds to provide subsidies, grants and zero - or low - cost financing, particularly at early stages, for developments that are in the public interest. These endowments can stem from the sale of a city asset (such as city land, shares in a utility, etc.), a surcharge on utility energy bills or innovative sources such as avoided subsidy costs.
- **Development-based land-value capture strategies:** Rural land requisition allows for the development of new urban zones, increasing the value of the land. Future and continuing revenues from selling or leasing land in distinct zones, and capturing taxes from new landowners, provides the finance for infrastructure

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf,

5.3 Dominant market and traditional partnership models

- The selection of the ownership model can have a significant impact on the project realization and especially on the off-take motivation of the consumers.

- Initial public ownership has traditionally been the most common partnership model, but the proportion of private sector commitments is increasing in established systems. In addition, cooperative ownership models can be an interesting option in well-functioning and connected municipalities and communities.

This chapter reviews the dominant market and the major traditional and innovative partnership models in developing district heating and cooling networks.

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf, https://www.sciencedirect.com/science/article/pii/S036054421730614X

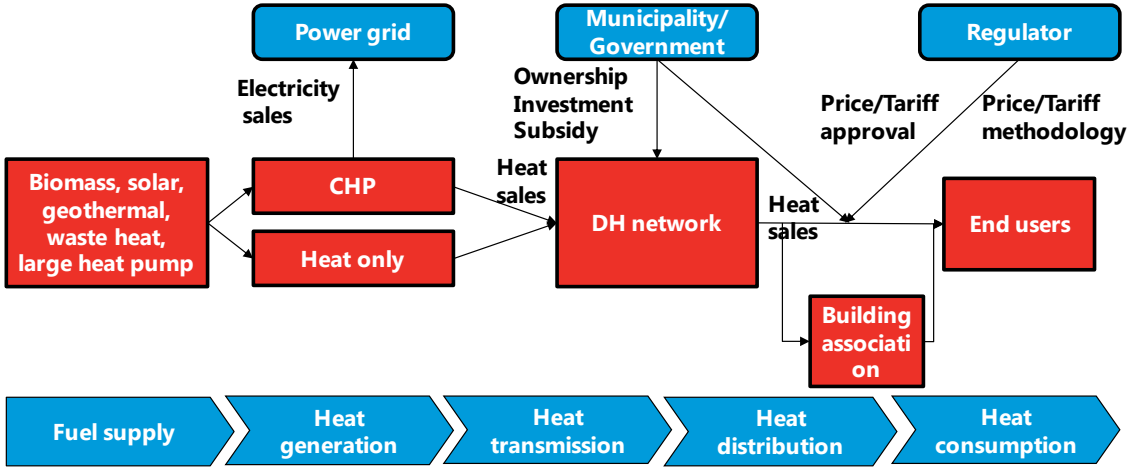
Specifically, chapter 5.3 will cover the following partnership models, as identified in the H2020 Coolheating project:

- Traditional public provision
- Management agreement
- Leasing agreement
- Concession agreement
- Privatization
- Heat Entrepreneurship
- ESCO

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf, https://www.sciencedirect.com/science/article/pii/S036054421730614X

5.3.1 Traditional public provision

The service is provided by the government or municipality or by a public authority or a publicly owned company. National frameworks define exact procedures and options for public provision of DHC.

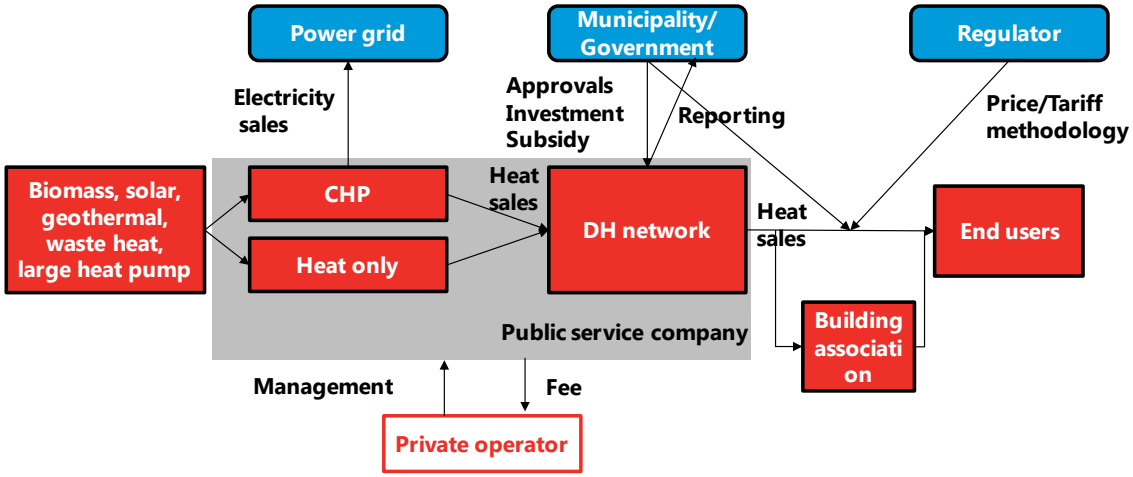


Under the traditional model, the government owns the heat generation plant and the DH network, regulates the sector, provides investment support and determines tariffs.

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf

5.3.2 Management agreement

A management agreement involves outsourcing the public service management, while the ownership and investment decisions are retained by the public sector. These agreements are usually short term (two to five years).

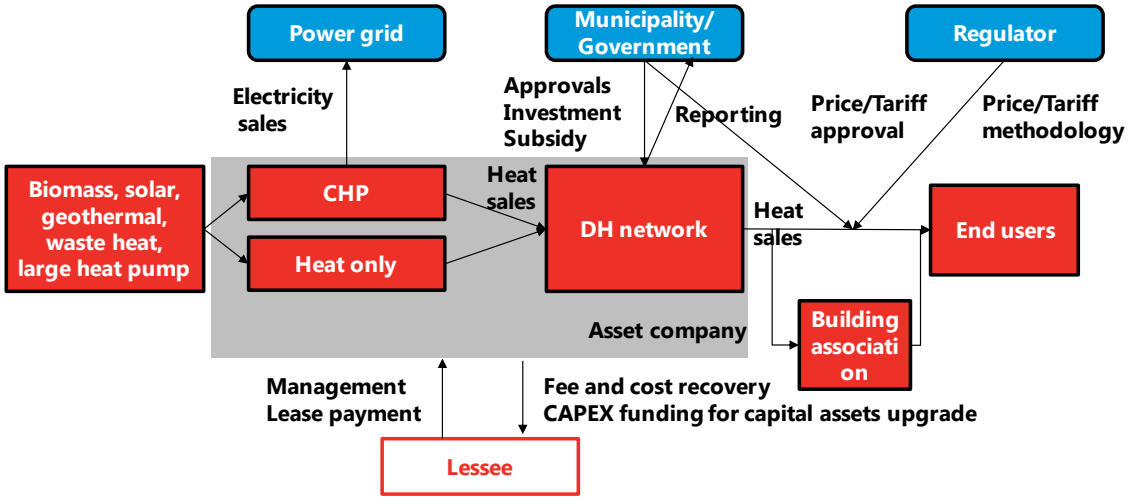


The (private) operator is paid a fixed fee to cover its staff and expenses, which can be complemented by a performance-based fee linked to the quality of the service provision, with liquidated damages for failure to achieve performance parameters

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf

5.3.3 Leasing agreement

In a lease model a private party (lessee) takes-on the operation and management of a DHC system, as well as the implementation of facility upgrades, under a contract with the public party (lessor).

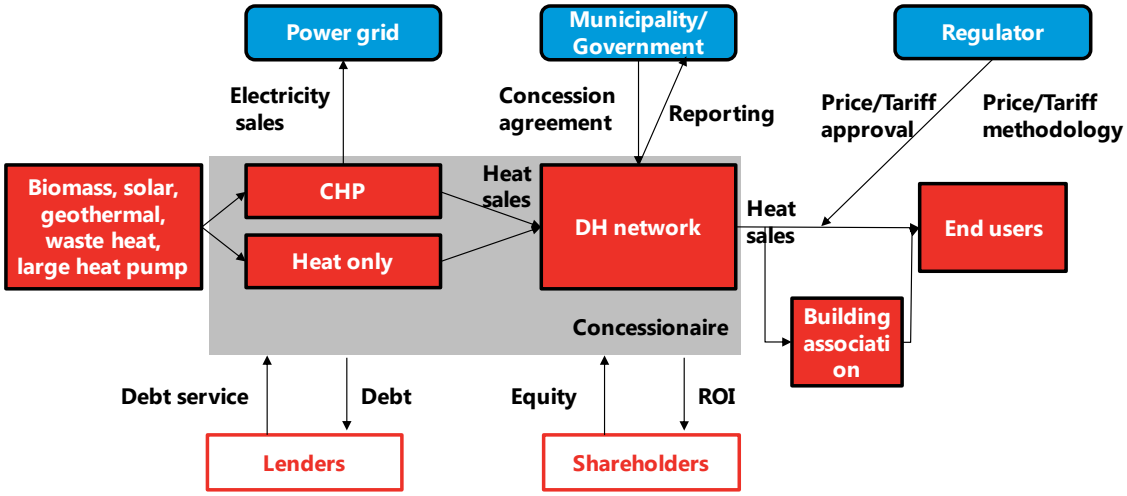


The public party (lessor) receives rent payments from the lessee, which are reinvested into operation upgrades (obligation by the lease contract). Lease agreements are of medium-length – usually 8 to 15 years and usually involve employees being seconded or transferred to the operator.

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf

5.3.4 Concession agreement

Under a concession agreement, the public authority grants the concessionaire (private party) the right to renovate, finance, and operate an existing infrastructure asset.

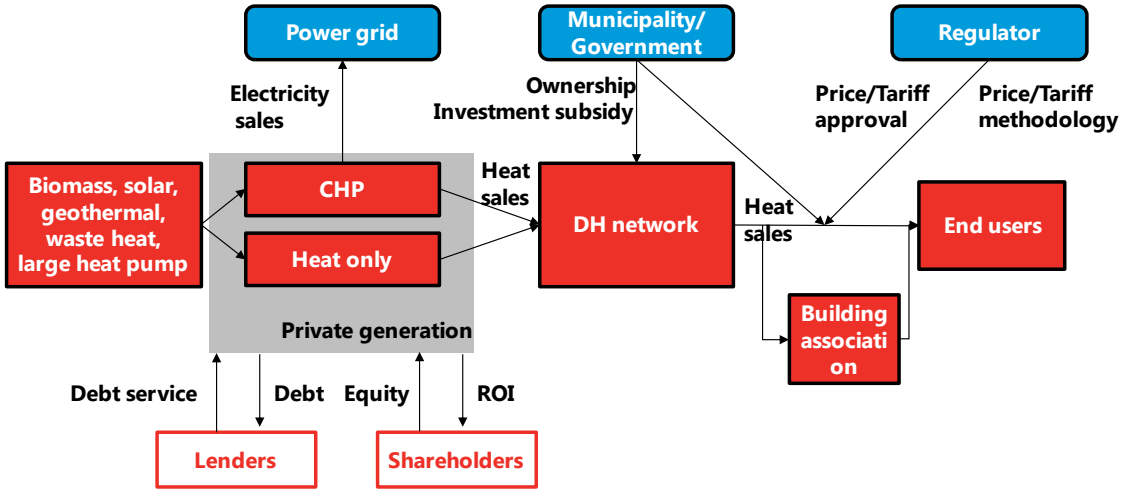


The assets very often remain owned by the public sector, but concession agreements are long-term in nature (typically 25–30 years or the life time of the facility) in order for the concessionaire to recover the investments, after which responsibility for the operation reverts to the public authority.

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf

5.3.5 Privatization

Privatization may involve full divestiture of an existing utility or private provision of new assets through Build-Operate-Transfer. Full divestiture will be usually accompanied by limitations on the private operator, which will be required to hold a license to provide the service, and such license is subject to termination.

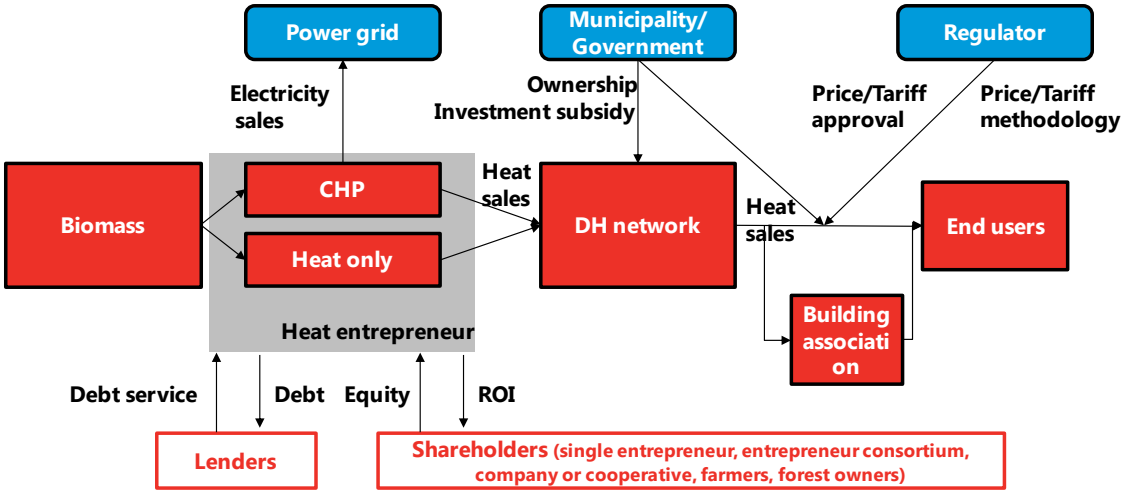


Another form of privatization is private provision of a new asset through a Build-OperateTransfer contract, typically used for entirely new or Greenfield operations.

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf

5.3.6 Heat Entrepreneurship

Heat entrepreneurship models differ from traditional energy models in that it is the customer who invests and, thus, the ownership relations are separate between the customer and the entrepreneur.

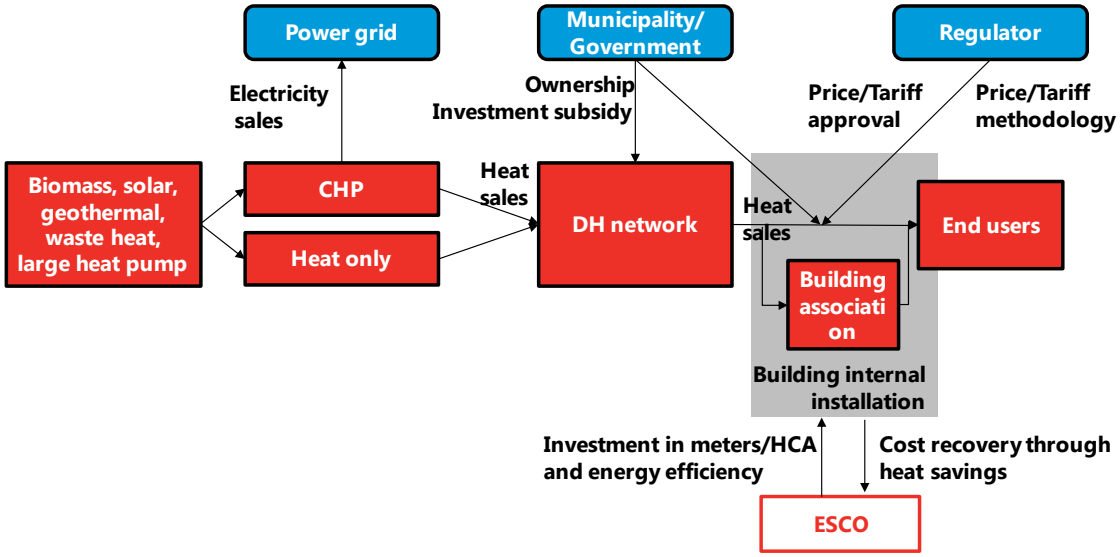


Heat entrepreneurship may be "investment by customer," where the entrepreneur oversees the practical operation and maintenance, while the municipality bears the investment risk. Alternatively, it may be "investment by entrepreneur," where the entrepreneur (or a third-party investor) bears the investment risk, and the involvement of the entrepreneur resembles a concession agreement.

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf

5.3.7 ESCO

The ESCO model can be used also in DHC business/ownership models. The key aspect in consumer willingness to connect to the DHC grid is the end cost for the consumer, for which consumer expects to be same or lower than their existing heating price and the costs of attachment to the DHC grid.



The connection cost to the district heating grid can be subsidized for the consumer in the ESCO principle. The consumer does not pay for the connection; instead the connection cost is covered by the energy price.

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf

The following table provides a final comparison of the main aspects of the partnership models revised:

	Operation and management	Payment for services	Investment	Ownership
Traditional public provision	Public	Public	Public	Public
Management agreements	Private	Public	Public	Public
Leasing	Private	Private	Public	Public
Concession agreement	Private	Private	Private	Public
Privatization	Private	Private	Private	Private
Heat entrepreneurship	Private	Public/Private	Public/Private	Public/Private
ESCO	Private	Private	Private	Public/Private

Source: http://www.coolheating.eu/images/downloads/CoolHeating_D5.1_Guideline.pdf

5.4 Market and investment barriers and opportunities

Although district heating and cooling networks have been in place in major European cities over the last few decades, there are a number of investment and market barriers that prevent the replication and further expansion of district heating systems across Europe.

However, there is also a wide range of opportunities that can help overcome the existing barriers, motivate an investment decision and incentivize the deployment of the district heating and cooling market.

Both market barriers and opportunities can be broken down into two levels:

- **Regional/local level**
- **European/national level**

Source: https://www.sciencedirect.com/science/article/pii/S036054421730614X

5.4.1 Market and investment barriers

At regional/local level, the most relevant barriers hindering market deployment are:

- Potential consumers' lack of awareness of the district heating and cooling benefits
- Consumers' reluctance to shift from a existing and known solution (e.g. decentralized systems) to a district heating system
- Lack of standardised tools that speed up the network planning process and reduce planning costs and DHC know-how
- A need for innovative financing sources and models that can help meet the high upfront investment can also be identified

5.4.1 Market and investment barriers (1/2)

At European/national level, relevant barriers include:

- Lack of precise and specific aggregated data (on demand, potential supply sources, infrastructure costs) that can help national regulators develop tailored policies on DHC
- Variation in reaching the fundamental idea of district heating and cooling across countries
- Misalignment between policies on DHC implemented at national and regional/ local level

Source: https://www.sciencedirect.com/science/article/pii/S036054421730614X

5.4.1 Market and investment barriers (2/2)

At European/national level, relevant barriers include:

- Technological barrier: need for improved solutions to make DHC suitable for new buildings and integrate RES sources in an efficient way
- Lack of national education and counselling programs concerning DH**C**

Source: https://www.sciencedirect.com/science/article/pii/S036054421730614X

5.4.2 Market and investment opportunities (1/2)

There are several opportunities that can motivate an investment decision at regional and local level:

- Improve energy efficiency of heat supply, air quality at local and regional level and reduce environmental impact
- Availability of European funds that could help mitigate the initial investment barrier. In addition, as described in chapter 5.5 of this module, some innovative financing schemes are being developed and could incentivize the market

5.4.2 Market and investment opportunities (2/2)

There are several opportunities that can motivate an investment decision at regional and local level:

- Opportunity to share expertise and replicate success factors for existing district heating networks
- The development of tools such as the THERMOS software will help reduce planning costs, avoid repeated analysis and will speed up the DHC network planning process

5.4.2 Market and investment opportunities (1/2)

At European and national level, the following opportunities can be identified:

- New EU policy on DHC: the Clean Energy Package for All Europeans sets ambitious EE and RES objectives for 2030 and specifically considers DHC networks
- The fourth generation of DH will help overcome the technological barrier and will make DHC suitable for low-demand buildings and RES integration

5.4.2 Market and investment opportunities (2/2)

At European and national level, the following opportunities can be identified:

- Abundant excess heat available and ready for exploitation: there is currently more heat being wasted in Europe than is required to heat all of the buildings. In addition, as identified in the HRE project, 46% of total EU27 excess heat volume is seized in 63 strategic heat synergy regions
- The work done in H2020 projects such as THERMOS will lead to improved data availability

5.5 Innovative services and financing models

District heating and cooling networks have been mainly funded through traditional financing models such as dedicated credit lines, subordinated loans or leasing. However, there are a number of innovative financing models that can help deploy the development of new district heating and cooling networks. Such financing models include:

- Property Assessed Clean Energy (PACE)
- Project Finance
- Forfaiting/Factoring
- PipeCo model

This chapter covers the main features of these innovative financing models and the possibilities for their adoption.

5.5.1 Property Assessed Clean Energy (PACE)

PACE is a financing mechanism that enables low-cost, long-term funding for energy efficiency, renewable energy and water conservation upgrades to buildings. PACE financing covers up to 100% of a project's costs and is repaid as a special assessment added to a property tax bill over a term of up to 20 years.

PACE was pioneered in 2007, in Berkeley, California and it quickly spread across the US and abroad, to Canada, Australia and more recently to South Africa. In the past four years, PACE has grown exponentially and reached over four billion US Dollars in funded projects, which resulted in more than 35,000 new local jobs and the creation of hundreds of new companies.

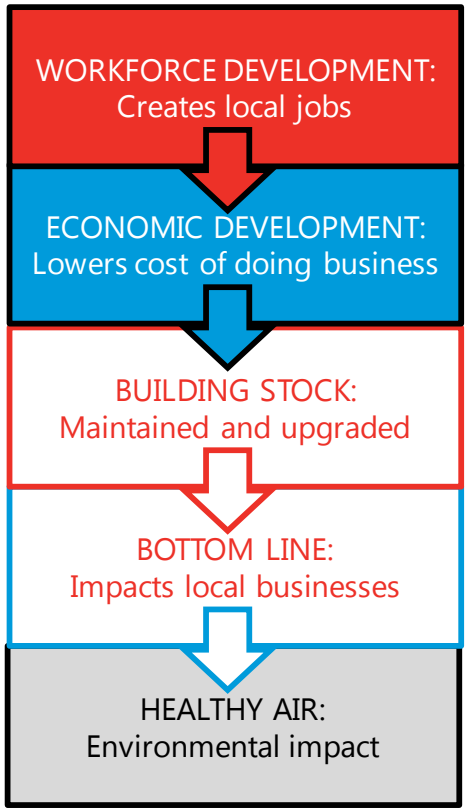
Source: http://pacenation.us/what-is-pace/, http://www.gnefinance.com/pace-for-cities

5.5.1 Property Assessed Clean Energy (PACE)

PACE's main features include:

- PACE is voluntary for all parties involved
- Funding for PACE financing is provided by institutional and private investors. PACE is a public-private partnership, where a local government allows the private sector to use its tax collection system to repay for the initial investments (on-tax financing mechanism)
- PACE programs do not generate debt or liabilities for the municipality, making of it a sustainable program from a financial standpoint too. In case of a home-owner default, the municipality issues a delinquent tax certificate (standard default procedure)

BENEFITS OF PACE

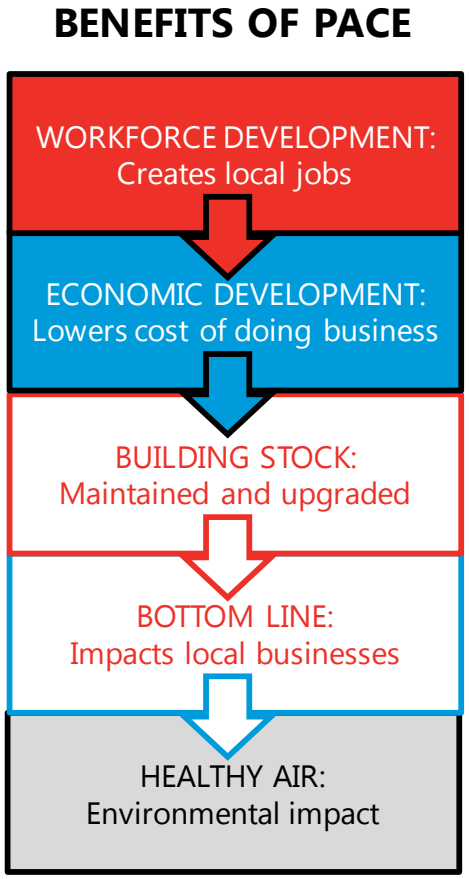


Source: http://pacenation.us/what-is-pace/, http://www.gnefinance.com/pace-for-cities

5.5.1 Property Assessed Clean Energy (PACE)

PACE's main features include:

- PACE financing overcomes major market barriers to investment in energy efficiency and renewable energy projects.
- PACE assessment is linked directly to the property, not the owner, so it is can be transferred to the next owner upon sale. On-tax financing is very attractive for investors because it offers a secure repayment stream and uses a familiar property tax structure.
- PACE programs have demonstrated the adoption of some of the most rigorous consumer protection standards to ensure that citizens take advantage of the full benefits of PACE financing while safeguarding them against potential wrong-doing in lending practice



Source: http://pacenation.us/what-is-pace/, http://www.gnefinance.com/pace-for-cities

5.5.1 Property Assessed Clean Energy (PACE)

However, although the PACE mechanism has been successfully replicated in several countries (e.g. Canada or Australia), PACE's wide adoption and implementation in Europe will require some regulatory revision and adaptations at national and local levels.

The Horizon 2020 EuroPACE project will adopt best practice from the US PACE market and further enhance its reach, scope, and overall impact to adapt it to Europe, seeking to boost energy generation and efficiency investments in the residential stock in Europe.

Source: http://www.gnefinance.com/pace-for-cities

5.5.2 Project Finance

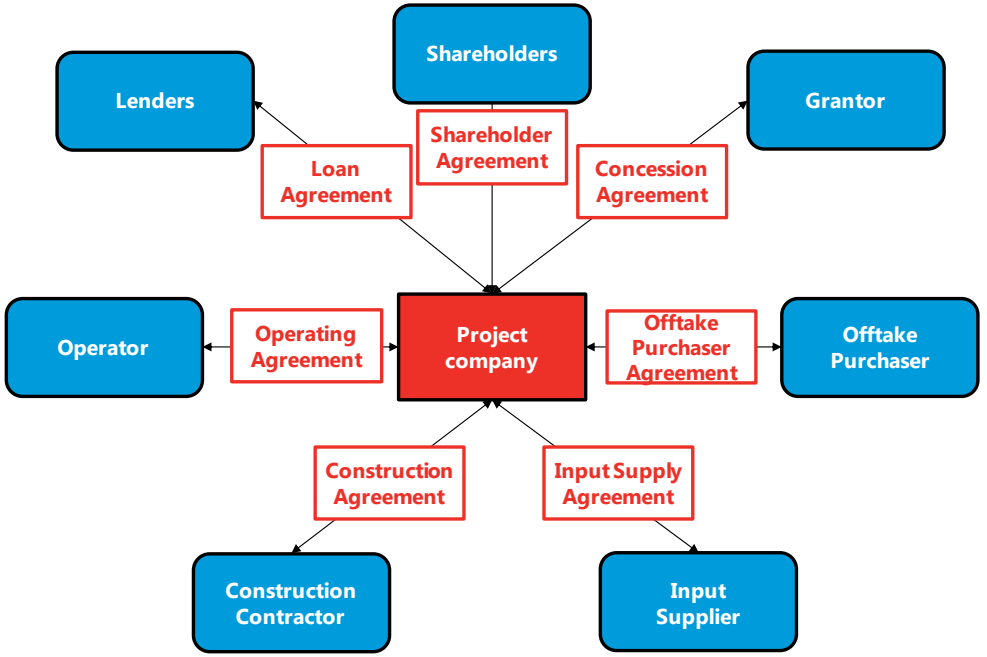
Project Finance is a financing scheme that relies only on the cash flows generated by the project to repay the loan, not on other assets the borrower may possess (i.e. the project by itself must be able to guarantee the repayment of debt even under negative scenarios). Thus, project's assets, rights and interests are held as secondary security or collateral. Financial institutions lend capital to a Special Purpose Vehicle (SPV).

Project finance is especially attractive to the private sector because companies can fund major projects off balance sheet. However, for this lack of recourse to the parent company, project financing is more expensive than corporate financing.

Source: http://ppp.worldbank.org/public-private-partnership/financing/project-finance-concepts

5.5.2 Project Finance

Project Finance has been widely used to fund renewable energy and energy efficiency projects across many European countries over the last few years and constitutes a valuable option for private companies seeking for financing mechanisms for the development of DH&C networks.



Source: http://ppp.worldbank.org/public-private-partnership/financing/project-finance-concepts

5.5.3 Forfaiting/Factoring

Forfaiting/factoring is a financial transaction in which an entity sells its accounts receivable (usually invoices) to a third party (called a factor) at a discount. Through forfaiting, funds would take over the credit of the clients.

Forfaiting has been mainly used for Energy Performance Contracts, where a factoring fund for Energy Performance Contracts purchases funded Energy Performance Contracts from their originators (usually ESCOs) at a discount, freeing up the balance sheet of the originators to originate more Energy Performance Contracts. As the risk of underperformance of an Energy Performance Contract is more likely to occur at the beginning of the contract, these "de-risked" contracts become a safer income stream which can be assigned (transferred) to a factoring fund.

Source: http://www.unepfi.org/fileadmin/documents/EnergyEfficiency-Buildings_Industry_SMEs.pdf

5.5.4 PipeCo model

A PipeCo model works on the basis of splitting the investment in a new district heating scheme into the expensive heat distribution network, which lasts for 50-60 years before refurbishment, from the energy generation plant and ancillaries, which have a lifecycle of 15-20 years before replacement.

The PipeCo model could work like this:

- Company "**A"** borrows money and builds a district heating scheme. After commissioning the scheme, the overall costs are known and the income from customers "**C"** has been secured. At this point, **A** sells the pipe network to Company "**B"**, the PipeCo. **B** is backed by institutional finance which is happy with a low-risk return over several decades

Source: https://www.carbontrust.com/news/2016/02/pipeco-alternate-approach-to-financing-heat-networks/

5.5.4 PipeCo model

- **"A"** continues to operate the system. From its energy center it supplies C over the PipeCo network, for which it pays a regular (but relatively small) use of system charge to B.

A has managed in the short term to offset its biggest cost (i.e. the pipe network) leaving it with the parts of the project with a higher IRR that can be financed for a shorter period at higher discount rates. A then starts looking for another project and the whole process starts again. A and B are in a symbiotic relationship but each have the funding structure suitable for their role in the project.

Source: https://www.carbontrust.com/news/2016/02/pipeco-alternate-approach-to-financing-heat-networks/

Conclusion

As analyzed throughout this module, the building process of a DHC network is usually complex, implies numerous stakeholders and can adopt several ownership and financial structures.

In this respect, the "Community Energy: Planning, Development & Delivery" defines the 10 stages that can be identified in this process:

1. Objectives setting
2. Data gathering
3. Project definition
4. Options appraisal
5. Feasibility study

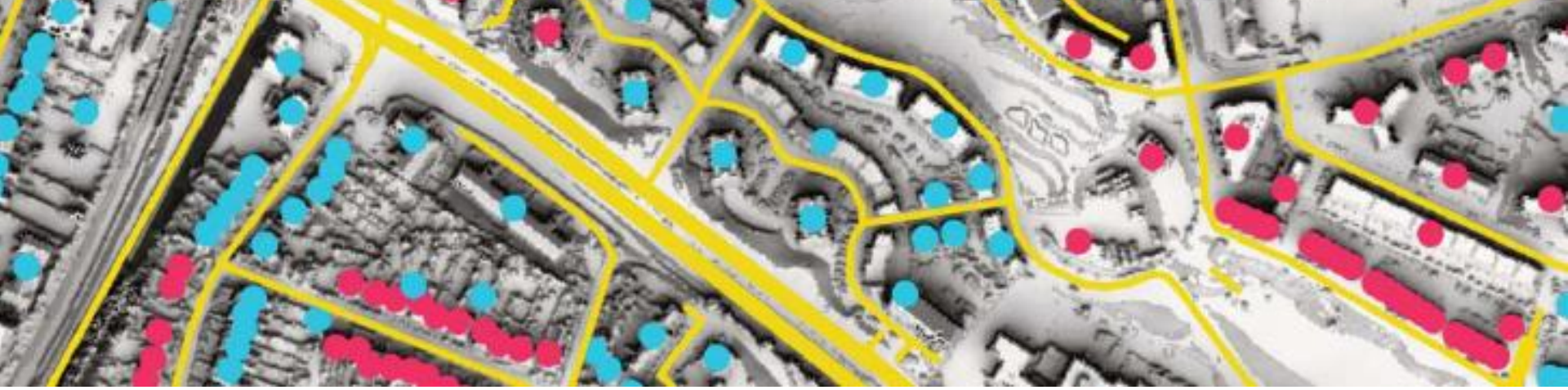
Source: https://www.districtenergy.org/resources/publications/community-energy-development-guide

6. Financial modelling
7. Business modelling
8. Market and business development
9. Project procurement
10. Delivery

The **THERMOS tools** can help energy planners in the first four stages of the "Community Energy: Planning, Development & Delivery" guide, allowing energy planners to set the objectives, define the project, realize a pre-feasibility study and identify the key information that needs to be gathered. In addition, it can help overcome the market barriers identified in chapter 5.4.

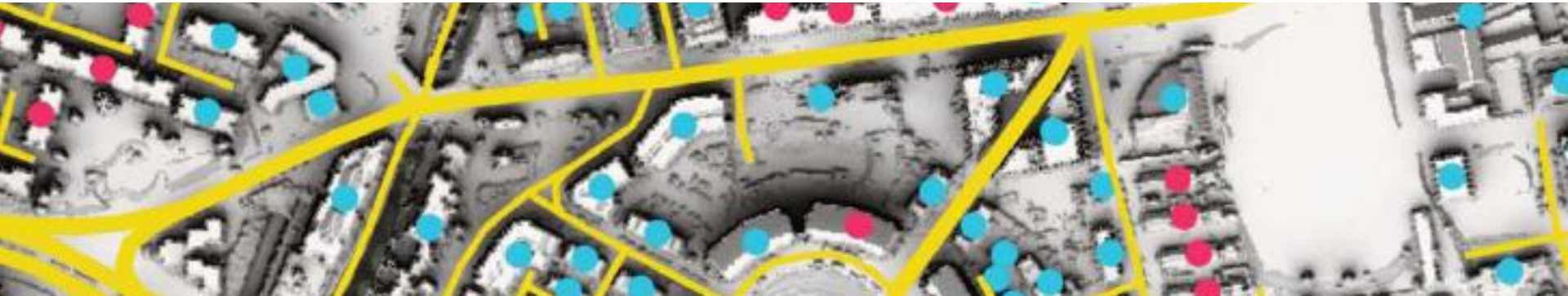
Once the project has been defined, the most suitable financial and ownership models from those analyzed throughout the module can be selected.

Source: https://www.districtenergy.org/resources/publications/community-energy-development-guide

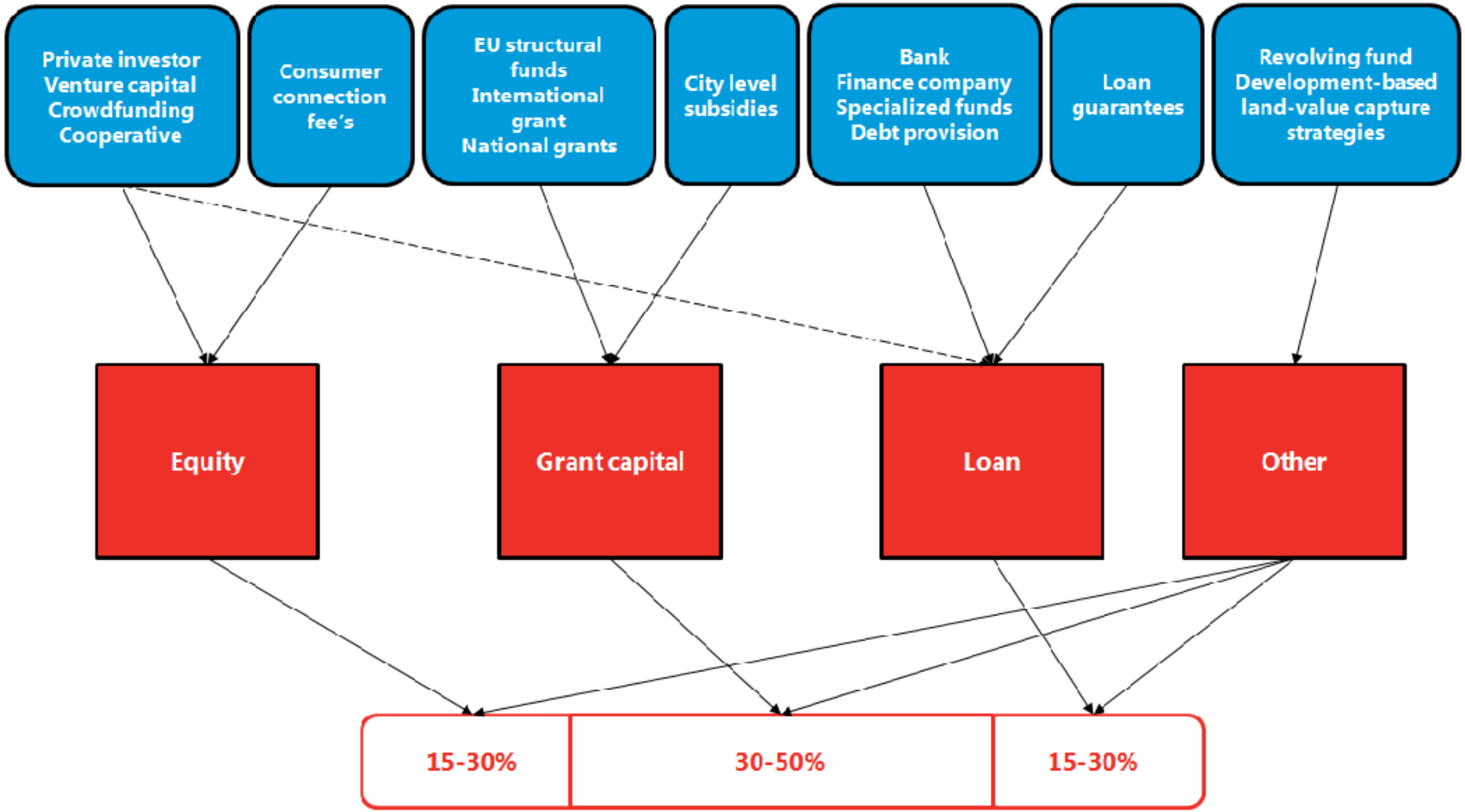


THERMOS

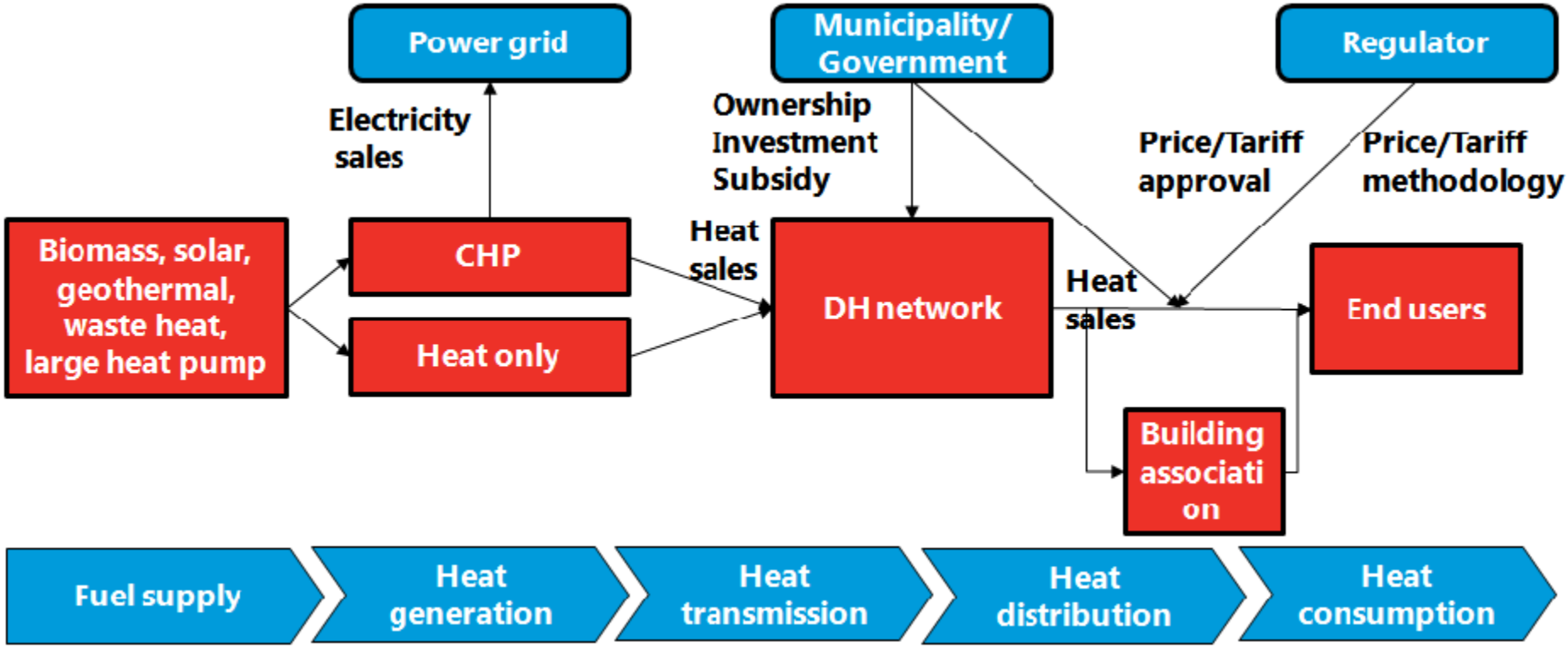
Annex



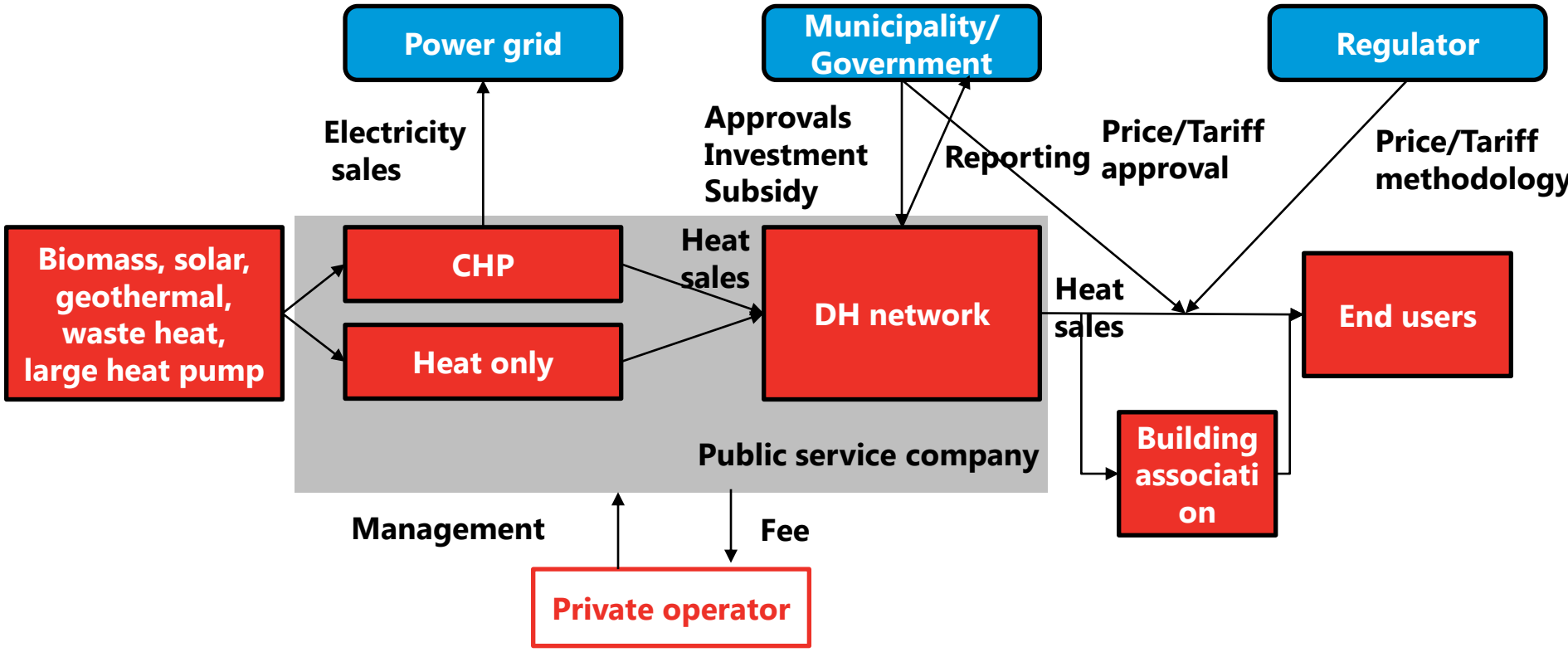
Finance structure



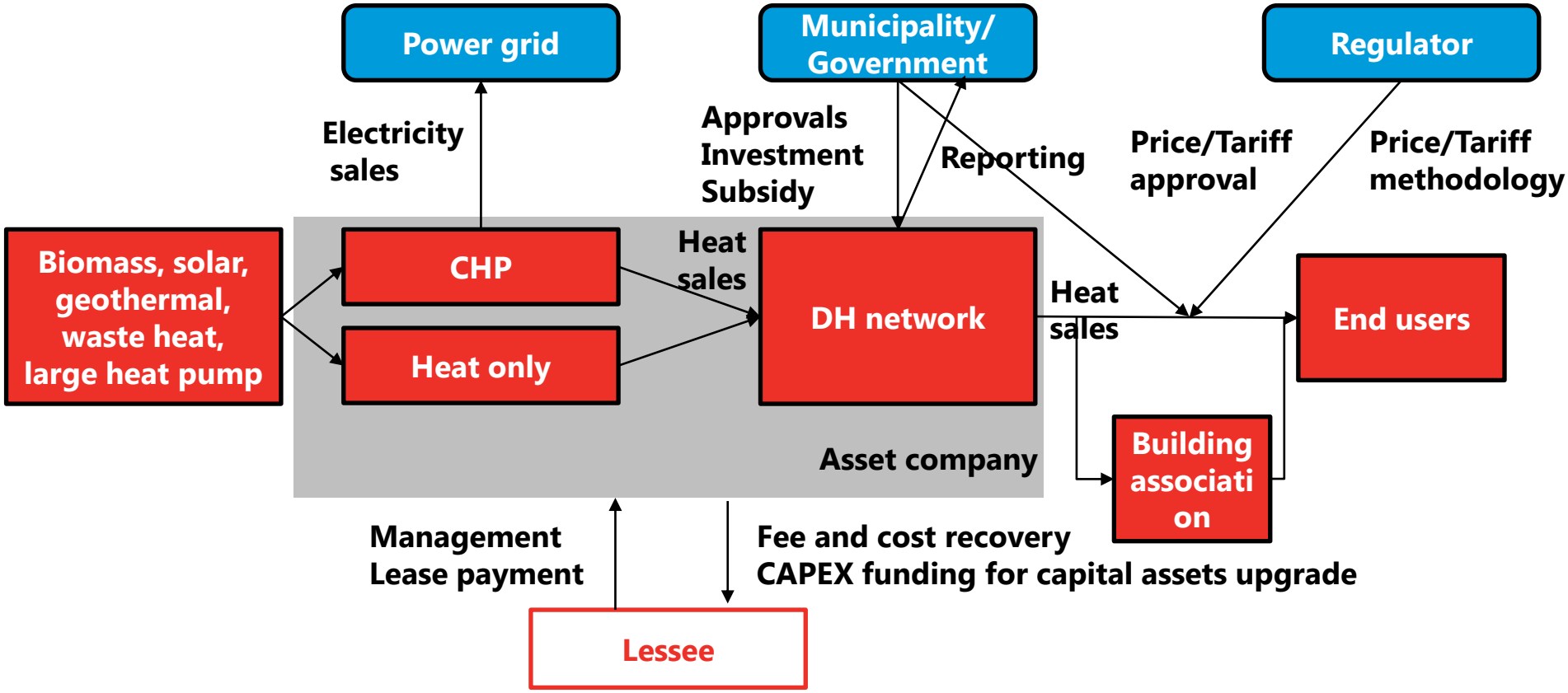
Traditional public provision



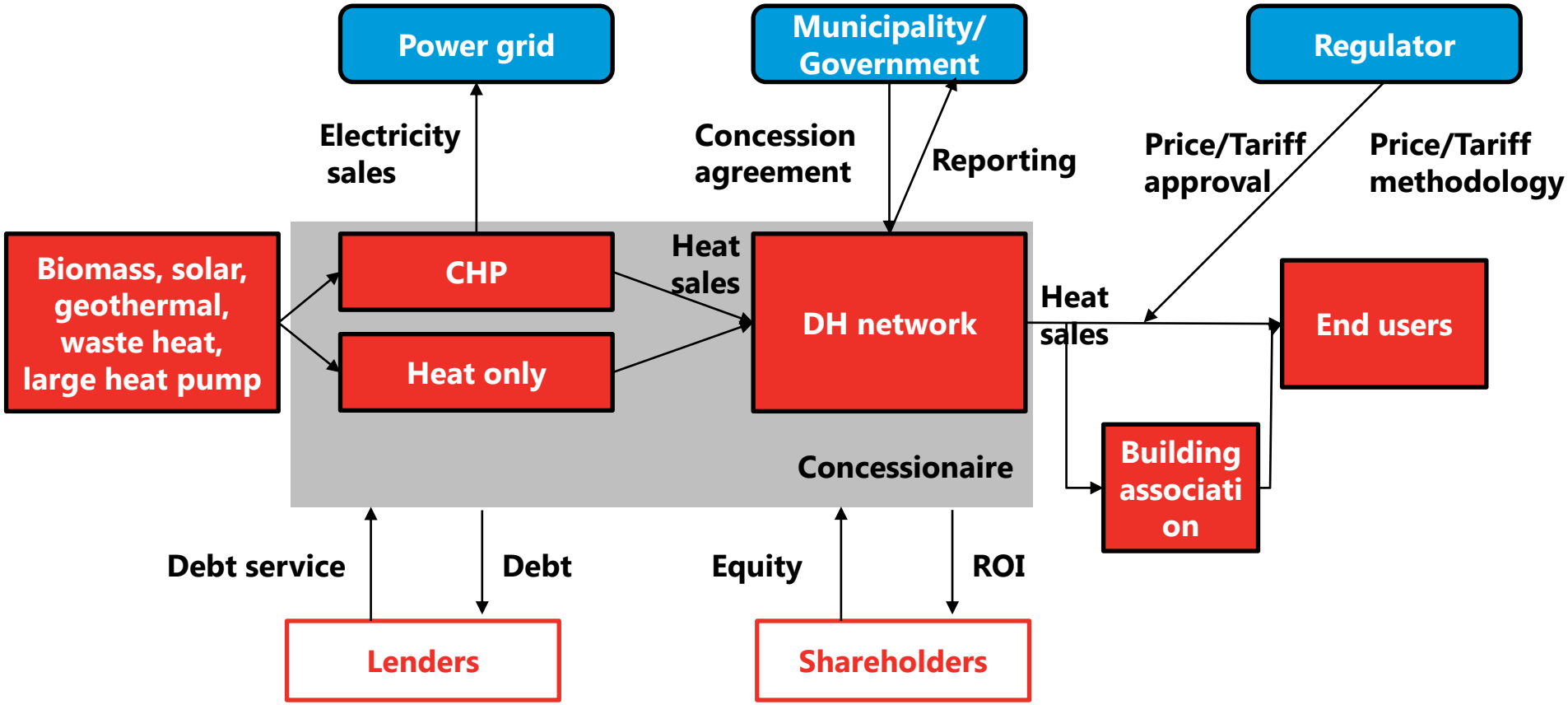
Management agreement



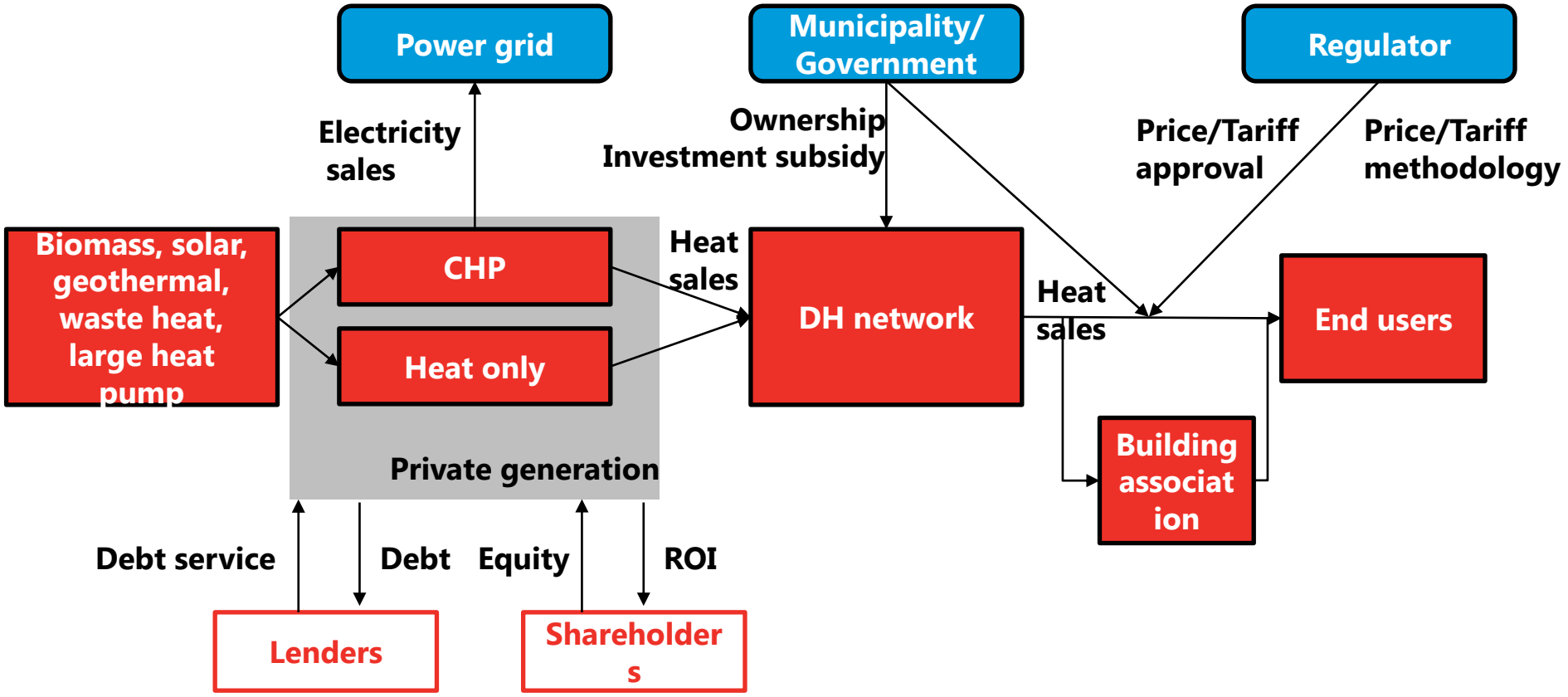
Leasing agreement



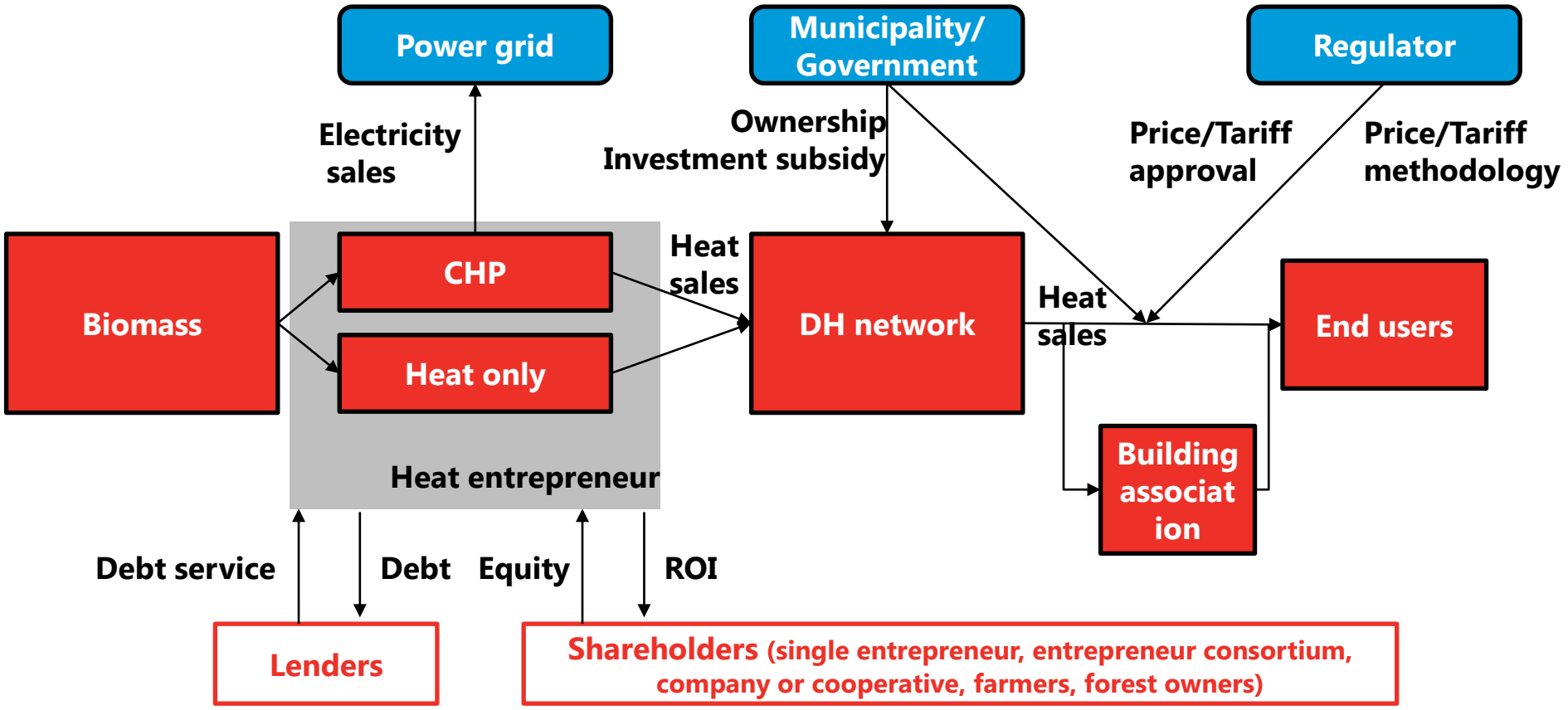
Concession agreement



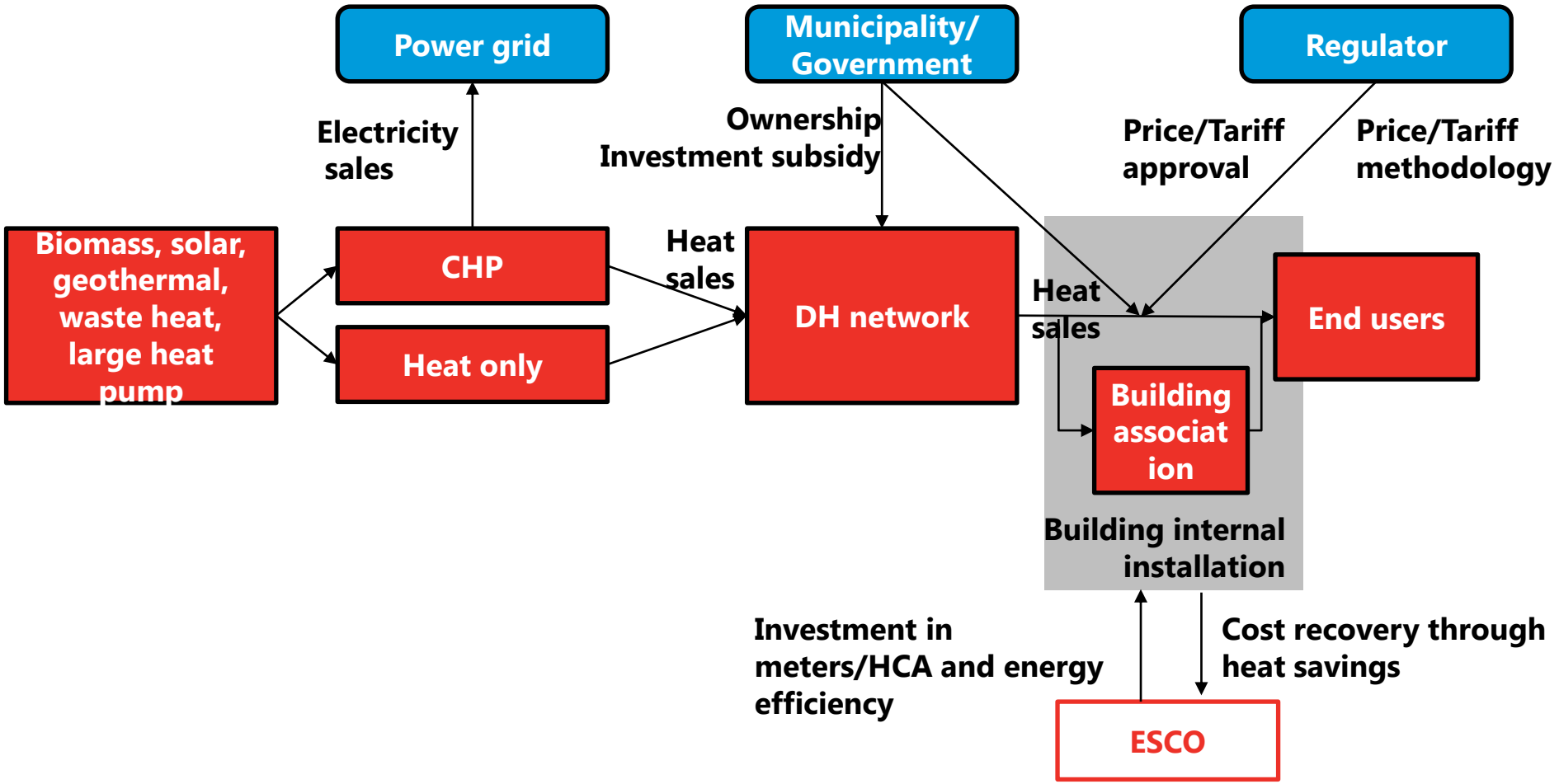
Privatization



Heat Entrepreneurship



ESCO


Power grid
Municipality/ Government
Regulator
Electricity sales
Ownership
Investment subsidy
Price/Tariff approval
Price/Tariff methodology
Biomass, solar, geothermal, waste heat, large heat pump
CHP
Heat only
Heat sales
DH network
Heat sales
End users
Building association
Building internal installation
Investment in meters/HCA and energy efficiency
Cost recovery through heat savings
ESCO

Summary table

	Operation and management	Payment for services	Investment	Ownership
Traditional public provision	Public	Public	Public	Public
Management agreements	Private	Public	Public	Public
Leasing	Private	Private	Public	Public
Concession agreement	Private	Private	Private	Public
Privatization	Private	Private	Private	Private
Heat entrepreneurship	Private	Public/Private	Public/Private	Public/Private
ESCO	Private	Private	Private	Public/Private

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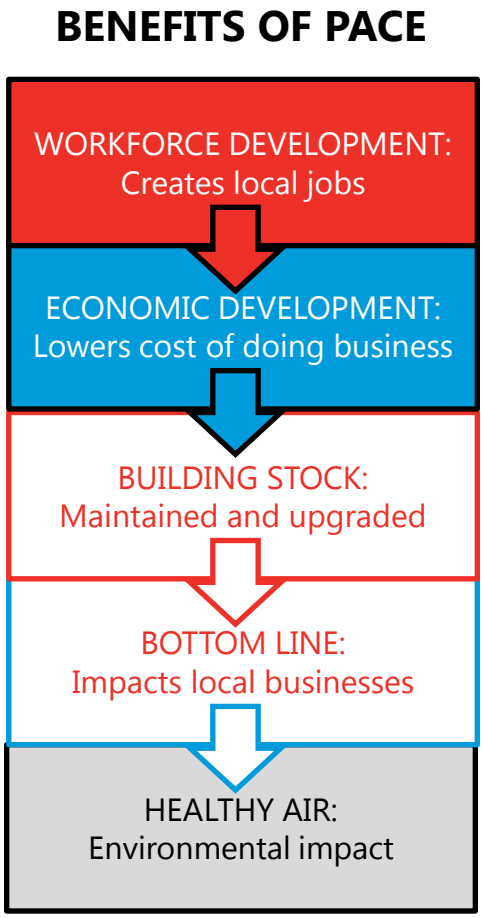
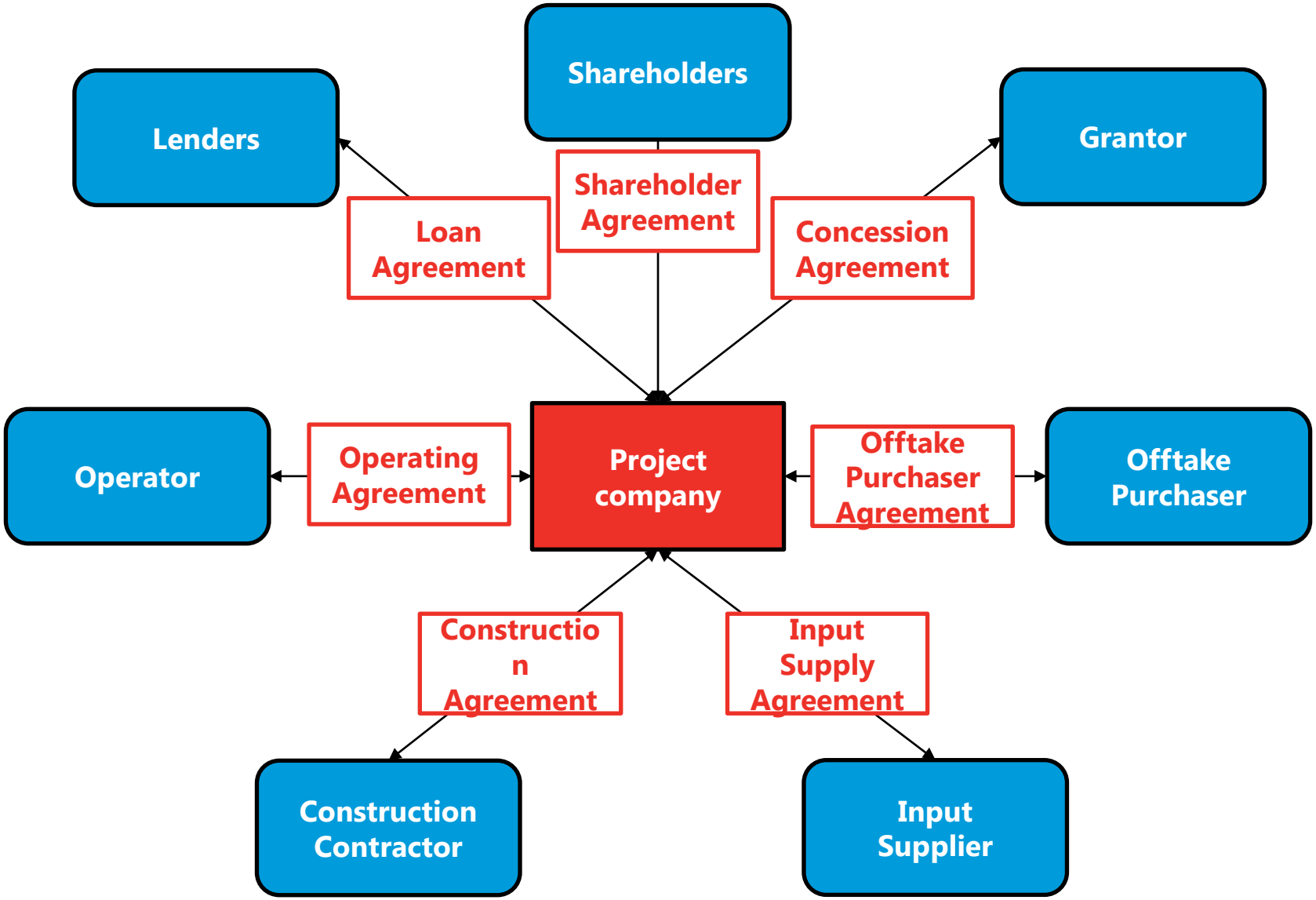


Project finance



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