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Exploration of efficiency regulation for Dutch district heating networks

Study for Authority for Consumers and Markets (ACM), The Hague

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1 Executive Summary

In 2025, the Dutch parliament passed the Collective Heating Act (in Dutch: *Wet collectieve warmte* - Wcw).[1] In terms of tariff regulation, the intention is to continue with the current "no more than otherwise" (in Dutch: *niet-meer-dan-anders*)" methodology in the initial phase (until around 2030). From approximately 2031 onwards, it is intended to introduce a cost-based tariff system applicable to larger district heating network companies (in Dutch *Grote Collectieve Warmtesystemen* - GCW)[2] and heat transport operators (HTO). The legislation requires a cost-based approach, which we understand will take the form of a cost-plus approach with accompanying efficiency measures in practice. ACM will be responsible for setting maximum tariffs, incorporating efficiency regulation to complement the cost-plus approach. Details are currently worked out in the consultation version of the Collective Heating Decree (in Dutch: *Besluit collectieve warmte* - Bcw). The ACM plans to utilise the findings of this exploratory study both for the feasibility and enforceability assessment of the Bcw, scheduled for finalization in 2027, and for the implementation of efficiency regulation in the context of the upcoming phase 2 (starting at around 2031) and the future phase 3 (starting date not defined yet) of the Wcw tariff regulation for GCW, whereas cost-based tariff regulation already starts in 2027 for HTO.

The proposed cost-plus system fits well into the current larger debate on regulation of network infrastructure in Europe (cf. Brunekreeft, 2023). Regulation of energy networks seems to experience a shift in focus away from efficiency-oriented regulation towards investment-oriented regulation. This is not attributable to any inadequacy of efficiency-oriented regulation as such; such regulation does indeed fulfil its intended purpose by establishing incentives for efficiency improvements. The shift reflects a change in overarching policy objectives; in particular, the energy transition has reoriented the focus towards the promotion of investment. To this end, efficiency-oriented regulation is not very well equipped, and the search now is for a more investment-oriented regulation. At the same time, efficiency remains a critical boundary condition. The search is for *efficient investment*.

This study aims to explore and assess efficiency safeguards that can complement the cost-plus approach envisaged for large district heating networks (GCW) and heat transport operators (HTO) in the Netherlands. The study is exploratory in nature and is intended to initiate and structure the discussion rather than to provide definitive recommendations or solutions. The analysis is entirely qualitative and does not include quantitative modelling, simulations, or empirical investigation. While the study draws on relevant literature and international experience, it does not seek to provide a comprehensive review of either. Finally, given its exploratory character, the regulatory options considered have not been developed in

[1] The authors gratefully acknowledge useful discussions with ACM and MinEZK both in The Hague, Polynomics AG in Switzerland and DUR in Denmark. All claims and arguments in the text are the sole responsibility of the authors. Furthermore, all translations of quotes and references are done by the authors, who bear sole responsibility for any mistakes therein.

[2] To be precise, the legal term in the Wcw is 'Collectieve warmtevoorzieningen', excluding the 'Kleine collectieve warmtesystemen (KCW)'. For readability this report uses the abbreviation GCW: all district heating systems excluding KCW.

full analytical or implementation detail. Where important questions remain unresolved, further research would be required.

In total, six options – 1. benchmarking, 2. light-handed control of publicly or consumer-owned utilities, 3. process review, 4. tendering, 5. sunshine regulation and 6. sharing factors – for efficiency regulation were outlined and assessed with a focus on practicability (i.e. feasible implementation with reasonable effort) and effectiveness (i.e. achievement of cost-efficiency). The assessment of the options was differentiated for the group of large district heating networks (GCW) on the one hand and – the currently only one – heat transport operator (HTO) on the other hand, and it differs, in some cases significantly, between these two groups.

Benchmarking fails due to heterogeneity and the structure of individual cases. For both GCW and HTO, benchmarking receives the lowest effectiveness rating. Even though it is one of the most methodologically established tools, benchmarking is structurally unsuitable in the context of district heating due to strong heterogeneity. However, “soft” benchmarking (i.e. “soft” application of benchmarking results) can be useful to support other options like the process review or sunshine regulation.

Public ownership alleviates the need for regulation to some extent, but does not replace it. Public ownership – and, to a greater extent, consumer ownership – reduces the need for strict regulation, as the focus is more on social benefits and less on profit – but it is not a substitute for efficiency regulation. One can draw an analogy with the electricity and gas networks in the Netherlands, which are regulated despite being fully state-owned. However, we need to differentiate. Whereas public-ownership will not be a justification for refraining from regulation for the publicly-owned large district-heating network companies, a stronger case to refrain from regulation can be made for consumer-owned utilities.

The regulation for electricity and gas networks in the Netherlands implements a process review to complement the cost-plus regulation. This process review, which is currently in development, contains three elements: 1. monitoring of cost and performance, 2. process-audit and 3. “investigation & intervention”, which is ex-post disallowance of cost as a measure of last resort. Overall, if well-designed, a process review can be effective as an efficiency safeguard, but possibly at the expense of high regulatory effort to get reliable data and at the risk of micro-management. It seems important to use the synergies with the electricity and gas regulation.

Due to design restrictions leading to beauty contests and incumbent lock-in at contract renewal, effectiveness of tendering has limits and we cannot expect tendering to be an effective standing-alone efficiency safeguard. However, it supports other instruments. At the same time, tendering processes already exist and are common practice. Where tendering processes already exist, they will create pressure on cost-efficiency and should be used as efficiency safeguards. Possibly, tendering procedures can be improved within the regulation.

Sunshine regulation means the collection and publication of key performance and cost parameters. Sunshine regulation is relatively easy to implement and can provide incentives for efficiency – particularly in co-operative, consumer-ownerhsip or local authority structures with strong local ties and public ownership. However, sunshine regulation cannot be expected to

be sufficiently effective for efficiency regulation standing-alone, but it can usefully support other instruments.

The use of sharing factors is the most significant difference between GCW and HTO: for HTO, sharing factors are feasible and potentially effective, as an investment plan and a validation process are in place. For GCW, an approach with sharing factors can be ruled out for the time being due to a lack of data. Things may change in the future, as reliable data becomes available and networks start to mature. An important caveat of this option are strategic incentives, which must be actively addressed if considered for application to HTO.

Overall, we conclude:

- Due to strong heterogeneity, full-cost benchmarking is not a feasible option for the regulation of the district heating networks in the Netherlands at this moment.
- Public ownership, tendering and sunshine regulation are promising in their own right, but are not sufficiently effective to be efficiency regulation standing-alone. They can and will be useful to support other instruments though; public ownership, tendering and sunshine regulation (transparency) exist as it is and may as well be used and further developed.
- In principle, sharing factors can set strong economic efficiency incentives; however, data availability and reliability are crucial. Using sharing factors for GCW is not feasible in the short run, because data availability and reliability are currently poor. For HTO, data availability and reliability are better and applying sharing factors seems promising. We note that strategic incentives need to be addressed.
- The process review seems effective and feasible for both GCW and HTO. Surely, effectiveness will have limits, but support of other instruments mentioned above may give a strong overall package. As the process review is currently developed for the regulation of electricity and gas networks in the Netherlands, application to district heating networks exploits synergy effects.

2 Background of the study

2.1 Legal background for district heating in the Netherlands

The Netherlands has identified collective heat networks — systems that deliver heat to multiple homes and buildings through shared infrastructure — as a key tool for reducing carbon emissions from the built environment. Under the 2019 Climate Agreement, the government set a target of connecting 500,000 additional homes and buildings to such networks by 2030. Looking further ahead, the ambition is to reach around 2.6 million heat connections by 2050.

To support this development, the Dutch parliament passed the Collective Heating Act (*Wet collectieve warmte* - Wcw) in 2025. A central element of this law concerns how heat tariffs — the prices consumers pay for their heat — are regulated. Until recently, tariffs were governed by the so-called "no more than otherwise" principle (in Dutch: *niet-meer-dan-anders*, NMDA). This meant that the price of heat supplied through a network could not exceed what a consumer would have paid for the equivalent amount of natural gas. The approach offered a straightforward consumer protection benchmark. However, it came under increasing pressure

as gas prices moved out of step with the actual costs of producing and delivering heat through networks, making the gas price an unreliable reference point.

The Wcw organises the Dutch district heating sector into three distinct categories, each subject to a different regulatory regime. The key dividing line is the size of the system, measured by the number of connected consumers, with a threshold set at 1,500 connected persons.

Large collective heat systems (in Dutch: *Grote Collectieve Warmtesystemen*; GCW[3]) — those serving 1,500 or more connected customers — are operated by designated heat companies and are subject to the most comprehensive regulatory framework. Under the new framework, the Authority for Consumers and Markets (ACM) will set maximum heat tariffs in the first phase (from 2027 to 2030) using a methodology broadly comparable to the current NMDA approach — still referencing gas costs as a benchmark. From 2031 onwards, the plan is to move to a fundamentally different system.

From the start of the second phase, from around 2031, a cost-based tariff system will replace the gas-reference approach for these larger heat networks. Under this system, maximum tariffs set by ACM will reflect the actual costs of running a heat network, rather than being pegged to gas prices (Wcw Article 7.5, in conjunction with Bcw Articles 7.12–7.19). The cost-plus approach will be complemented with efficiency regulation, called efficiency safeguards. The overarching objective of additional efficiency regulation to support the cost-plus approach is to enhance the affordability of heating networks, thereby accelerating the transition to sustainable heat supply. The cost-based approach will continue in a third phase with a final tariff structure.

In terms of ownership and governance, the Wcw establishes a public-majority or heat-community model as the structural default for new designations for large district heating companies. Existing private operators may continue to operate under transitional arrangements, but these are generally time-limited to a maximum of thirty years.

The efficiency regulation, complementing the cost-plus approach, which is the focus of this study, applies primarily to this category of large district heating companies (GCW).

Small collective heat systems (in Dutch: *Kleine Collectieve Warmtesystemen*; KCW) — those serving fewer than 1,500 connected customers — fall into a lighter regulatory category. In practice, small systems are typically operated by homeowners' associations, local community initiatives, or modestly sized private or public operators.

From 2031 onwards, small systems will not be subject to the same individualised cost-based tariff regulation as large systems. Instead, they will be regulated by means of a cost-based reference tariff — a standardised benchmark that provides consumer protection without requiring the full regulatory apparatus applied to larger operators. The precise details of this lighter regime are expected to be set out in the forthcoming updated version of the Collective Heating Decree (in Dutch: *Besluit Collectieve Warmtesystemen*, Bcw).

A separate and distinct category under the Wcw covers heat transport operators (HTO) — entities that do not supply heat directly to end users, but instead transport heat through pipeline

[3] To be precise, the legal term in the Wcw is 'Collectieve warmtevoorzieningen', excluding the 'Kleine collectieve warmtesystemen (KCW)'. For readability this report uses the abbreviation GCW: all district heating systems excluding KCW.

infrastructure on behalf of heat companies. Heat companies purchase heat (either from an external source or their own production), pay the transport operator a fee for moving it through the network, and then sell it on to their customers. Because heat companies operate under a cost-based tariff regime, transport fees are effectively passed through to end consumers.

At present, only one heat transport operator (HTO) is envisaged in the Netherlands: *WarmteTransportSysteem* (WTS), a subsidiary of the publicly owned Gasunie. WTS operates the WarmtelinQ pipeline system, which connects industrial heat sources in the Port of Rotterdam with the cities of The Hague and Leiden.

WTS receives substantial subsidies from central and local government to keep transport costs — and therefore consumer prices — affordable. Its two contracted customers are Eneco (serving The Hague) and Vattenfall (serving Leiden), who together account for 46% of WarmtelinQ‘s potential capacity.

Unlike the tariff regulation for heat companies, which is still being developed for the upcoming phase 2 and future phase 3, the regulatory framework for heat transport operators is already set out in more detail in the Wcw and Bcw (Wcw Article 7.37 and Bcw Article 7.17). This regulation is designed to take effect from 2027, aligned with the expected start of WarmtelinQ operations.[4]

The proposed cost-based approach for large district heating companies and heat transport operators fits into a wider debate currently taking place across Europe about how to regulate network infrastructure (cf. Brunekreeft, 2023). Traditionally, regulation of networks — such as electricity grids — has focused heavily on efficiency: pushing operators to cut costs and pass savings on to consumers. This type of regulation works well for its intended purpose. However, the policy landscape is shifting. The energy transition has created an urgent need for large-scale investment in new and upgraded infrastructure. Efficiency-focused regulation, while valuable, is not well-suited to driving this kind of investment. As a result, regulators and policymakers across Europe are increasingly looking for approaches that promote investment while still keeping efficiency as an important boundary condition. This emerging thinking may be described as regulation oriented towards efficient investment - a framework that seeks to balance both goals.

Cost-plus regulation may work well to facilitate and promote investment, but suffers from poor efficiency incentives. Therefore, the cost-plus approach will be complemented with additional efficiency safeguards to strengthen cost-efficiency incentives. Such efficiency safeguards are to be developed.

A similar approach is currently developed and implemented in the Netherlands for the regulation of electricity and gas networks: a cost-plus approach complemented with efficiency regulation. This development can provide inspiration for the regulation of district heating network companies. At the same time, heat networks have specific technological characteristics that set them apart from electricity and gas grids. This means that a careful, tailored examination of available regulatory instruments — and their effects on both investment

[4] In the remainder of this study, we will use the more general term Heat Transport Operator (HTO), unless the text explicitly addresses WTS as the sole HTO.

decisions and day-to-day operational behaviour — is necessary before drawing direct parallels.

2.2 Aim of the study

The main aim of this study is an exploration and evaluation of efficiency safeguards to complement the cost-plus approach for district heating network companies in the Netherlands. The evaluation of various options for efficiency regulation focusses on practicability and effectiveness. The ACM plans to utilise the findings of the exploratory study both for the feasibility and enforceability assessment of the Bcw, scheduled for finalization in 2027, and for the implementation of efficiency regulation in the context of the upcoming phase 2 and the future phase 3 of the Wcw tariff regulation.

2.3 Method

The study applies a qualitative Multi-Criteria Analysis (MCA). In the given case, this approach structures the evaluation of different regulatory options against two criteria:

- Practicability — Can the regulatory approach be implemented in a feasible and robust manner with reasonable effort within the institutional context of the Dutch heating sector? In this case, practicability includes, among other aspects:
  - the availability, quality, and reliability of the necessary data;
  - the possibility of defining reliable cost, output, or performance measures;
  - the administrative and regulatory burden associated with implementation;
  - the required analytical tools, expertise, and monitoring capacity;
  - compatibility with the legal framework, existing regulatory framework and market structure of Dutch heating networks.
- Effectiveness — Is the regulatory approach likely to achieve its intended objective of improving cost-efficiency of district heating networks regulated by a cost-plus approach? Further criteria follow logically from the criterion effectiveness and are thus included implicitly. In particular:
  - promoting cost efficiency and productive efficiency at the network level;
  - strengthening incentives for efficient investment, operation, and maintenance;
  - safeguarding affordability for end users;
  - avoiding distortions that could undermine long-term network development;
  - and supporting, or at least not hindering, the transition towards a sustainable and reliable heat supply system in the Netherlands.

The focus of the study and thus the focus of the evaluation is on the application for large district heating network companies (GCW) and heat transport operators (HTO); these cases are similar, but different nonetheless. Small district heating companies are not within the scope of this study and will be discussed only briefly.

2.4 Disclaimers and limits of the study

This study is explorative in nature. Its purpose is to open up and structure a discussion — not to deliver final answers. We note the following scope conditions in this study:

The analysis is entirely qualitative. The study does not include quantitative modelling, simulations, or empirical analysis to substantiate individual claims. Where evidence is cited, it is illustrative rather than exhaustive.

The study does not provide a full literature review, nor does it provide a systematic survey of international regulatory practice. References to academic literature and examples from other countries are deliberately selective, chosen to illustrate specific points rather than to map the field completely.

It is worth noting that efficiency incentives within cost-based regulatory frameworks — the central subject of this study — represent a relatively new area of regulatory thinking, particularly as applied to heat networks. Practical experience is still accumulating, and no established standard approach yet exists.

Because this is an exploratory study, the various regulatory options discussed have not been worked out in full analytical or implementation detail. That level of specification lies beyond the scope of what this study sets out to achieve. Accordingly, the study deliberately refrains from drawing final conclusions or making concrete recommendations. Its primary aim is to identify and frame the relevant options, outline the key trade-offs, and provide a structured basis for further discussion among ACM and relevant stakeholders.

3 Cost-plus approach with efficiency regulation for district heating networks in the Netherlands

The new regulation of district heating networks in the Netherlands is introduced by the Collective Heating Act (*Wet Collectieve Warmte*, Wcw). The Wcw was passed in 2025 and enters into force in 2027. The Wcw replaces the Heat Act (*Warmtewet*) of 2014, which set the maximum heat tariff using a gas-reference approach known as the “no more than otherwise” (*niet meer dan anders*, NMDA) principle. It capped the heat tariff at the equivalent cost of heating with natural gas - without reference to the actual costs of heat generation and distribution.

The implementation of the new regulatory framework in the district heating sector is planned to take place in three phases, with relatively minor adjustments to the current system in the initial phases (see chapter 2). From the start of the second phase (from around 2031) and to be continued in the third phase, a cost-based tariff system is to be introduced for larger networks (GCW) with approximately 1,500 connections or more, whilst a reference tariff rate is to continue to apply to smaller systems (KCW). For heat transport operators (HTO), statutory tariff regulation will come into force as early as 2027.

The Wcw is supplemented by the Collective Heating Decree (*Besluit Collectieve Warmte*, Bcw), which sets out the details of the regulation. The decree is currently in draft form and is not to be regarded as a finalised regulation.

This study focuses on the regulation for large networks (GCW) and heat transport operators (HTO). The following section therefore outlines in some more detail the defined and proposed regulatory frameworks for these two groups.

Regulatory framework for large district heating network companies (GCW)

For large heat networks, the Wcw stipulates in Article 7.3(3) that the method for determining permissible costs must, in principle, be cost-based and should include a reasonable rate of return for the designated heating company, to be set by the ACM. Furthermore, the method must include efficiency safeguards that encourages the company to bear only costs that are customary in commercial practice. In addition, an incentive is provided to minimise heat losses as far as is reasonably possible. Finally, the method must ensure a reliable, affordable and sustainable heat supply and promote the development of district heating.

In its current version, the Bcw draft (Art. 7.16) provides for the ACM to develop a tariff formula comprising standardised costs and actual costs, with the ACM determining the weighting of both components in such a way as to create a sufficient incentive for efficiency. For certain cost categories — in particular energy and heat procurement, as well as intra-group supplies — different rules are envisaged, designed to ensure that only prices based on market- or production-costs may be applied (Art. 7.17).

Regulatory framework for heat transport operators (HTO)

For heat transport operators, the Wcw similarly requires a cost-based method including a reasonable rate of return to be set by the ACM, as well as efficiency safeguards to encourage the heat transport operator to bear only costs customary in commercial practice, and an incentive to minimise heat losses as far as reasonably possible (Art. 7.37(3)). Compared to GCW, however, the scope is narrower: the method is focused solely on the economics of transport, and there is no explicit requirement to ensure affordability or to promote the development of collective heat more broadly.

The draft Bcw distinguishes between two types of efficiency safeguards for heat transport operators. For capital costs, the projected construction and development costs should be validated by an independent external research firm prior to investment, and actual costs that deviate by more than 15% from the validated projections must be reported and justified by the operator to ACM (Art. 7.15). For operational costs, the options are still open (Art. 7.16); a system with sharing factors is explicitly mentioned in the draft version of the Bcw. However, it is not settled as yet, how the reference value for OPEX for a system with sharing factors should be determined. Unlike the hybrid standardised/actual cost model envisaged for GCW, the approach relies more directly on project-specific cost validation and ex-post reconciliation. In addition to an efficiency incentive, it is stated that the ACM could introduce a heat loss incentive and/or a full-capacity utilisation incentive for heat transport operators.

Equalization Fund

In Article 7.17 the Wcw establishes an Equalization Fund (*Vereveningsfonds*) to balance financial disparities between designated district heating companies. The idea is that regionally high costs leading to regionally unreasonably high charges will be socialised nationally sharing the burden nationally. The mechanism redistributes financial burdens across the sector so that

companies in high-cost areas are compensated while consumer prices remain capped. Companies whose cost-based tariffs exceed the price caps may apply for an equalisation contribution from the fund. A separate financial attractiveness contribution — funded by government — compensates companies where caps were deliberately set below cost-reflective levels to keep heat affordable. The fund is financed through equalisation surcharges paid annually by heating companies (set by the ACM) and potential government contributions. Companies may pass surcharge costs on to consumers, but only up to the regulated price cap.

Concurrent changes to the regulation of electricity and gas networks

Alongside the changes to the regulation of district heating, the regulation of the electricity and gas networks is also currently undergoing changes. The methodology decisions (in Dutch: *methodenbesluiten*) for the new regulatory period commencing in 2027 will implement cost-plus regulation, thereby replacing the previous revenue cap approach. In future, the ACM will determine the permitted revenue based on the actual, efficient costs of the respective network operator. To mitigate the traditional drawback of cost-plus regulation, efficiency safeguards are added; we will discuss these below in chapters 4.3 and 4.5.

4 Options for efficiency regulation to complement the cost-plus approach

According to the Wcw, the cost-plus regulation of larger district heating companies (GCW) should be complemented by efficiency-enhancing measures. While substantial experience exists with efficiency measures in network industries more generally, the combination of efficiency measures with cost-plus regulation - and particularly their application to district heating - represents a comparatively novel regulatory approach. As a result, practical regulatory experience with such mechanisms is limited.

Against this background, the present analysis examines existing efficiency measures, their application in comparable regulatory contexts, and the extent to which they may be adapted to the specific circumstances of heating networks. As outlined in chapter 2.3, the analysis concentrates primarily on larger district heating companies (GCW) and assesses both the expected effectiveness of each measure and the effort required for its implementation. Section 4.8 will zoom in on HTO. Section 4.9.3 will briefly touch upon smaller district heating companies (KCW), which are often consumer-owned. Below, we present and discuss six options for efficiency regulation to complement a cost-plus approach.

4.1 Option 1: Benchmarking

Full-cost benchmarking is a powerful tool, often used for efficiency-oriented regulation, such as price-caps, revenue-caps and yardsticks. Also, the previous regulatory approach in the Netherlands for electricity and gas networks relied quite heavily on full-cost benchmarking. The key notion of benchmarking is to compare cost-efficiency of different firms in a sector and use this information to set requirements to improve efficiency for individual firms. Usually, these requirements are translated into the individual X-factors for firms; the X-factor reflects

individual inefficiency (relative to the best in the field) and prescribes an ex-ante reduction of the revenue cap as an incentives to improve efficiency.

By definition, full-cost benchmarking requires that the firms in the benchmarking are good comparators. If they are not, we cannot reliably use the benchmarking results. In more technical terms, heterogeneity among firms in the sector should be reasonably low. In the current context of district heating networks in the Netherlands, we have reasons to believe that heterogeneity is too large such that we cannot usefully apply benchmarking. We note that the literature currently further develops benchmarking models to deal with strong heterogeneity, but such developments are in preliminary stages and have limitations (cf. e.g. Polynomics & EERA, 2025).

As of 2024, the Dutch district heating sector comprises 527 networks operated by 30 licensed suppliers, serving 556,740 regulated connections (households and small commercial consumers) and an estimated 700,000+ households in total when accounting for block connections (ACM, 2024, p. 10). Total heat delivery amounts to approximately 21.2 PJ per year (RVO, 2025, Table 1). Furthermore, there are additional 150 projects in development, intended to serve additional 560,000 planned connection, i.e. potentially almost doubling the current capacities. However, 37% of pipeline projects face delays or cancellations as of early 2026 (Berenschot, 2026, p. 6–7). The three largest suppliers — Eneco, Ennatuurlijk, and Vattenfall — account for approximately 75% of all licensed connections (ACM, 2024, p. 10). There are 33 heat networks (operated by nine suppliers) that serve more than 1,500 connections (ACM, 2024, p. 11) and hence classify as large heat networks (GCW).

The ACM explicitly describes the heat market as very heterogeneous and documents a spread in supplier returns on regulated activities (ROIC) of −56% to +15% in 2024 (ACM, 2024, p. 12). The ACM further notes that it cannot establish a clear relationship between these returns and network age, network size, supplier size, or primary heat source (ACM, 2024, p. 14). The following dimensions illustrate this heterogeneity.

Network and company size

Dutch district heating networks vary strongly in their size with respect to both number of connections and delivered heat. Even within the category of large heat networks (more than 1,500 connections), significant differences can be found. For example, Rotterdam (Eneco) delivered with 2.6 PJ the most heat in 2024. This is more than the 15 smallest networks from this category together (based on RVO, 2025, Table 1). Similar applies also to the number of connections. The largest district heating network (Utrecht-Nieuwegein, Eneco) in this category counts almost 59,000 connections. Next to the large heat networks, there are 43 mid-sized networks serving between 500 and 1,500 connections and a long tail of 451 small networks serving less than 500 connections. Nevertheless, even in these groups, heterogeneity is high. B-driehoek (Eneco), serving only 71 connections, delivered over 600 TJ in 2024. By heat delivery alone, this exceeds most networks in the large-scale category (RVO, 2025, Table 1). Cost structures — overhead allocation, procurement scale, access to capital — are expected to differ substantially across this range.

Heat source and input cost structure

The primary heat source determines a network's cost structure and is largely fixed by the physical infrastructure in place. Across the 22 largest networks (those that delivered more than 150 TJ heat in 2024) from the large-scale category, the renewable energy share ranges from 0% to 89% and the CO_2 intensity from 5.4 to 94.8 kg/GJth (RVO, 2025, Table 1). While these networks are dominated by residual/waste heat (77%) and biomass (15%); medium networks (with less than 150 TJ in 2024 but more than 500 connections; 11 with more than 1,500 connections) show a considerably more diverse heat source mix, where next to residual/waste heat (33%) and biomass (10%) also aquathermal (33%) and natural gas (17%) have a significant share (Berenschot, 2026, Figure 10). The ACM identifies the type of heat source as one of the primary drivers of cost variation (ACM, 2024, p. 14).

Temperature technology

District heating networks can be differentiated along four temperature categories: very low temperature (10–30°C), low temperature (30–55°C), medium temperature (55–75°C), and high temperature (>75°C). Based on a sample covering ca. 64% of large and ca. 48% of medium networks (Berenschot, 2026, Figure 10), high- (36%) and medium-temperature (64%) systems dominate among networks that delivered more than 150 TJ in 2024. Medium-sized networks with lower delivery levels but more than 500 connections are also primarily characterized by medium-temperature systems (61%), but show a more even spread across the other three remaining categories. Furthermore, the diversity of the district heating networks is likely to increase as the planned projects come online (see Berenschot, 2026, Figure 21). Temperature level is a key driver of infrastructure specifications, heat loss, and compatibility with available heat sources. All categories coexist in the Dutch market.

Phase in the life cycle

Network age is explicitly identified by the ACM as a potential explanatory variable for return variation (ACM, 2024, p. 14). The ACM further notes that a high ROIC can reflect a low book value of assets in older networks, rather than excessive pricing (ACM, 2024, p. 13). This illustrates that the financial profile of a mature, largely depreciated network is structurally different from one in early-stage development. With 33 established large-scale networks and at least an additional 22 large-scale projects currently in development (Berenschot, 2026, Figure 21), the sector will consist of networks at fundamentally different capital recovery stages. Systematic data on age distribution across large-scale or other sized district heating networks are not publicly available.

Scope of the value chain

Dutch heat suppliers operate across different segments of the value chain. The RVO sustainability reporting framework explicitly accounts for situations where multiple suppliers deliver heat via a shared transport network, each filing separate reports (Harmelink, 2023, p. 9). This reflects that network ownership and heat supply are not always integrated within a single entity. The ACM's regulatory accounting rules separately track costs for production/procurement, transport/distribution, and retail supply — and note that a significant share of costs is allocated to regulated vs. unregulated customer groups via distribution keys

(ACM, 2024, p. 13–14). The scope of activities subject to regulation therefore differs across operators.

Business Environment

The business environment of district heating operators varies along two dimensions. First, the customer structure differs across networks: regulated customers (households, small commercial consumers, housing associations) require dense street-level distribution infrastructure and are subject to the ACM maximum tariff, while unregulated large consumers connect only to the main transport network, pay lower energy tax on gas, and hold stronger negotiating leverage — resulting in structurally lower revenues per GJ for suppliers serving them (ACM, 2024, p. 13). The regulated/unregulated customer mix therefore directly shapes both cost structure and revenue profile. Second, the local energy network context— the availability of gas infrastructure and electricity grid capacity — determines the feasibility of competing technologies such as individual heat pumps and influences whether district heating is the preferred or constrained solution in a given area (Berenschot, 2026, p. 16-18). Networks therefore develop differently depending on local conditions, even under the same regulatory framework.

Overall, we conclude that due to strong heterogeneity among large district heating network companies in the Netherlands, comprehensive full-cost benchmarking cannot usefully be applied to cap revenues of these companies. We note that this may change in the future, when more refined methods have been developed to deal with heterogeneity or if heterogeneity decreases, especially when the sector matures. Perhaps benchmarking is more feasible for parts of the value chain, such that it can be applied at least partially. Moreover, full-cost comprehensive benchmarking can still play role. It can be done in principle, but given heterogeneity, the results are not sufficiently reliable for strong application, such as revenue regulation. In contrast, “soft” benchmarking may very well be possible: the result of the benchmarking may be used for “soft” applications, to support options such as the process review (section 4.3) and sunshine regulation (section 4.5).

4.2 Option 2: Light-handed-control of publicly- or consumer-owned utilities

The Wcw mandates that large district heating systems must be predominantly in public ownership within 30 years of the Wcw’s implementation. For existing heating companies, a transition period of at least 14 and a maximum of 30 years applies before they need to transfer a majority of their shares into public ownership. Additionally or alternatively, district heating systems may be owned by consumers. For this purpose the Wcw implemented in Art. 2.3 specific rules and regulations for heat communities (*warmtegemeenschap)*, which are legal entities or partnerships that operate as heat suppliers for the benefit of their members, partners, or shareholders. The heat communities’ primary purpose is not profit-making, but the provision of environmental, economic, or social benefits to these groups or to the local areas in which it operates. In addition, it primarily relies on sustainable heat sources.

The question then is whether public and/or consumer ownership reduces the need for efficiency regulation. We differentiate the analysis between municipal ownership versus

consumer-owned utilities. In the literature, both types of public ownership and their influence on the need for efficiency regulation are discussed. For public ownership several empirical studies investigate the effect of privatisation on efficiency (cf. e.g. the review by Megginson & Netter, 2001). Concerning state-ownership (including municipal), the literature suggests that ownership has a significant effect in competitive markets; private ownership allows competitive and efficiency pressure and thereby eliminates the need for regulation. The situation differs in the case of natural monopolies. In such settings, ownership structure appears to have a comparatively limited impact, and the distinction between public and private ownership is less consequential than in competitive markets. Two countervailing effects can nevertheless be identified. On the one hand, public ownership tends to weaken profit orientation, thereby reducing the need for regulatory mechanisms aimed at constraining excessive profits. On the other hand, public ownership may also weaken incentives for cost-efficiency, which in turn strengthens the case for regulatory measures designed to promote efficiency. Profit-orientation implies being cost-efficient and reverse: if the focus on profit is less, the incentives for cost-efficiency will be less accordingly.

This might be different for local consumer-owned companies, specifically heat communities, which for example constitute a significant share of the heat market in Denmark, where 83% of all district heating companies are consumer-owned. Evidence from several countries suggests that consumer-owned companies can effectively protect customers against the market power of natural monopolies while operating cost-efficiently. In New Zealand, for example, 12 out of 18 consumer-owned electricity distribution utilities are sufficiently controlled by their customers to be exempt from price regulation (Meade and Söderberg, 2020). In the United States, local energy cooperatives are exempt from efficiency regulation in 36 states (Deller et al., 2009). A study on electricity distribution companies in Sweden reaches similar conclusions (Biggar et al., 2024). Therefore, the need for regulation of (small) consumer-owned utilities may be small indeed. This protection is based on the assumption that customers feel effectively represented in the governance of the utility and that the costs of collective decision-making are not prohibitively high.

Overall, we conclude that public ownership of large district heating companies (GCWs) and the heat transport operator (HTO) in the Netherlands does not provide sufficient grounds to refrain from profit regulation (here cost-plus), nor efficiency regulation.[5] Monopoly elements are persistent and public ownership does not set strong incentives for cost-efficiency. At the same time, public ownership may reduce profit orientation, thereby lessening the need for especially stringent regulatory oversight, monitoring, and control, as publicly owned firms are likely to operate somewhat more closely in line with broader societal objectives.

For consumer-ownership, the assessment is slightly different. As mentioned above, if consumers have sufficient control over the utility, the need for regulation is reduced. We expect, however, that this control reduces with the size of the utility. In the Netherlands, some

[5] This is particularly true since the Wcw specififes in Article 2.6 a temporary transition mechanism for up to 10 years after the Wcw enters into force. During that period, a municipality may allow another heat company, meaning a company that is not a publicly majority-owned heat company and not a heat community (*warmtegemeenschap*), to apply for designation for a district heating network, if no publicly majority-owned heat company or heat community expressed an intention to apply.

large district heating companies (GCWs) are actually consumer-owned utilities and several heat communities are in development, and we should consider exemptions from the regulation in these cases, or at least reduced regulatory control. However, we expect to find consumer-owned utilities mostly in the group of small district heating companies (KCWs), which would similarly require reduced regulatory control. We will address the regulation for KCW briefly in section 4.9.3.

4.3 Option 3: Process review

Within the framework of a cost-plus system, a "process review" towards efficiency incentives refers to a regulatory model in which the regulatory authority does not simply accept the costs reported by the companies and the resulting tariffs at face value. Rather, the authority engages in a continuous and detailed review of those costs, while retaining the discretion to disallow specific cost items where appropriate.

Reflecting this process review, ACM shifted the regulation of electricity and gas for the regulatory period 2027-2031 to a cost-plus regulation complemented by efficiency safeguards.[6] These rules are specified in more detail in the four Methodology Decisions (in Dutch: *Methodebesluiten*) for the electricity and gas TSOs and DSOs (see e.g. ACM, 2026a)[7]. ACM intends to monitor the developments in efficiency and performance of the electricity and gas network companies on a continuous base, rather than limiting such oversight to predetermined regulatory review moments.

To monitor efficiency and performance, ACM applies two measures:[8]

- Monitoring of cost and performance
- Process-audit

Based on the findings within these measures ACM plans to implement "investigation & intervention" measures for regulating electricity and gas networks, which effectively will give ACM the option to disallow costs associated with these inefficiencies, if the network operator fails to address identified inefficiencies.

As these measures will be used for the regulation of electricity and gas in the Netherlands, they can be important sources of inspiration for the efficiency regulation of district heating networks in the Netherlands as well. Using the same principles for the regulation of district heating will allow learning- and synergy-effects. We will describe these in more detail below.

Monitoring of costs and performance

ACM (2026a, pp. 45-46) outlines a monitoring approach in which the assessment of operational processes is complemented by the structural monitoring of system operators' costs

[6] The reader may be referred to ACM's website: https://www.acm.nl/nl/publicaties/overzichtspagina-publicaties-methodebesluiten-reg2027.

[7] In the text, we mostly refer to the methodology decision for electricity DSOs (ACM, 2026a), but the methodology decisions for the other groups are actually very similar (see to compare ACM, 2026b).

[8] In fact, ACM also lists transparency as an efficiency safeguard, but for this report, we address this under sunshine regulation in chapter 4.5.

and cost developments in order to track efficiency. The purpose of this monitoring is to identify unexpected, unexplained, or unusual costs or cost trends, as these may signal either opportunities for efficiency improvement or the presence of clearly inefficient expenditures. In this respect, ACM adopts both a monitoring and a benchmark perspective: It monitors the development of costs and efficiency within each individual network operator over time, while also comparing costs and efficiency across different network operators. For the analysis of cost developments, ACM refers to a three-year trend period as the basis for comparison.

More specifically, ACM indicates that it will monitor at least three categories of indicators. First, it will assess costs and investment expenditure. Second, it will examine the relationship between these costs and investment expenditures and relevant technical or structural indicators, such as network size, number of connections, and volume of energy transported. Third, it will include a set of non-monetary indicators.

We note, however, the risk of a slippery slope. Comparing selected partial KPIs between different firms effectively amounts to a form of partial benchmarking and almost inevitably gives rise to questions concerning the validity and comparability of such assessments. Once structural and exogenous differences between comparators are taken into account, the exercise might ultimately lead back to a comprehensive benchmark approach, and the challenges associated with benchmarking under large heterogeneity as discussed in section 4.1; however, as noted there, “soft” benchmarking (i.e. softer application of benchmarking results), such as to support the process review as explained here, may well be feasible. These are points to be carefully considered after implementation.

Process-audit

ACM (2026a, p. 44) defines an operational process as “a structured series of activities aimed at achieving the system operator's goals.” The idea of the instrument process-controlling is to critically examine this chain of activities, whether effective and efficient operational processes contribute to the overall efficiency of the system operator. Given that it would be impracticable to assess all processes across the entire company, ACM will set priorities and, at a minimum, examine risk management, procurement and tendering processes, and planning and control. ACM will publish the results and discuss these with the company. This can lead to the step of investigation & intervention, which may result in an improvement plan with the potential for the eventual disallowance of costs.

In Germany, the regulator BNetzA intends to implement a cost-plus approach for the electricity TSOs. Similar to the approach adopted in the Netherlands, the BNetzA intends to install efficiency safeguards, including process-controlling. The BNetzA (2025, p. 10) describes the intended process-controlling as follows (the original term in German is *Prozesskostenrechnung* (PKR), which can be translated with process-based cost accounting): “Process-based cost accounting (PKR) represents a specialized form of cost accounting that allocates costs to individual business processes. It enables a detailed analysis and assessment of costs associated with operational processes. The implementation of PKR pursues several objectives - such as detailed transparency regarding the cost structure of operational processes, the identification of cost drivers and potential efficiency gains, the comparability of costs across

different processes, and the establishment of a basis for the targeted optimization of process costs - and is inherently forward-looking." The details are currently under discussion and are not yet fully developed.

Generally, process-audit is well-known and well-established in the fields of management and business administration and this experience will be very helpful in the context of regulation.

Investigation & intervention (used-and-useful rule)

In the preceding section, we discussed ACM's intention to implement "investigation & intervention" measures for regulating electricity and gas networks. Should ACM identify systematic inefficiencies, the network operator will be granted the opportunity to enhance efficiency and/or performance. However, if the network operator fails to implement the improvement plan effectively, ACM reserves the authority to disallow the associated costs. This measure serves as a last resort. More generally, this constitutes an application of the so-called used-and-useful rule, a concept well established in the United States. To prevent the automatic pass-through of unnecessary costs, U.S. regulators apply this rule to assess whether specific cost items are genuinely used and useful in the provision of the regulated service. Where this criterion is not met, the relevant costs may be excluded from the regulatory cost base and must therefore be borne by shareholders rather than passed on to consumers.[9]

State and federal regulators in the U.S. apply the used-and-useful standard alongside the prudence review. In the 1980s, substantial nuclear assets were subject to the use-and-useful rule (Lyon & Mayo, 2000). Together, these mechanisms determine what costs a utility may pass on to ratepayers (Malko & Baldwin, 2011). Prudence review evaluates whether a utility's investment or expenditure decision was reasonable at the time it was made, based on the information available then - explicitly not judged with hindsight. The assessment relies on a five-criteria framework:

1. Compliance with applicable regulatory statutes, rules, and standards
2. Evaluation based on foresight, not hindsight
3. Application of a reasonable business standard (not a hypothetical ideal)
4. Awareness of and response to changing business risks
5. Awareness of relevant practices at other utilities

The five criteria are applied to construction and operational costs for each utility. If costs are found imprudent, they are excluded from the approved revenue requirement, with the result that the utility, rather than ratepayers, must bear those costs.

Whilst this rule helps to discipline firms and prevent them from excessive capital expenditure, its overly broad or frequent application by the regulator will increase regulatory uncertainty.

In general, the instrument investigation & intervention can be a strong threat. ACM (2026a, p. 48 ff.) suggests a two-tier approach:

- An ex-ante tier, in which ACM, upon investigation of the plans, suggests improvement of efficiency and performance. In that moment, the expenses have not yet been made. Firms have time to propose an improved plan. ACM (2026a, p. 49) will apply the instruments

[9] More generally, most regulatory systems have some kind of cost reviews, in which possibly, expenses which have already been made, are disapproved ex-post. It would be the exact same principle.

monitoring of costs and performance and process-controlling; moreover, ACM intends to use the investment plans for efficiency investigation.

- An ex-post tier. If the company does not propose an improved plan, or fails to implement the improved plan, ACM can decide to disallow “evidently inefficient” expenses which have been made. These will subsequently have to be borne by the shareholders, as a windfall loss.

Importantly, the scope to apply ex-post cost disallowance is narrow. ACM indicates that recovery will be denied only for costs that can be qualified as evidently inefficient. This will, at a minimum, be the case where a system operator does not carry out an identified efficiency improvement. Beyond that, ACM also retains the authority to classify certain expenditures as inefficient in their own right, for instance where they result from managerial choices made in the presence of a clearly available, more efficient alternative that would still have allowed the operator to fulfil its statutory obligations adequately ACM (2026a, p. 48).

A process review may prove effective in principle. In the limiting case of an ideal regulatory environment - one in which the regulator possesses complete and symmetric information and unlimited resources to collect, assess, and process that information - such an approach would be capable of delivering highly efficient outcomes. However, regulators neither have perfect information, nor unlimited resources. The effectiveness of a process review is therefore necessarily bounded by the extent of these limitations. Yet, if the regulator is able to collect sufficient and reliable information and maintains effective communication and cooperation with regulated companies, administrative oversight could create pressure to increase efficiency. Presumably, the credibility of enforcement mechanisms is likely to be key to incentivize the companies to cooperate. It may help if publicly-owned companies are less profit-oriented.

The process review can be effective, but it is not without problems. In particular, efficiency checks such as process-audit create a risk of regulatory micro-management, whereby the regulator may start to take the role of corporate management. Moreover, the associated monitoring, reporting, and review processes can be time- and resource-consuming for the regulator *and* companies. In particular, the collection, processing, and exchange of relevant data can be expected to pose a substantial operational challenge for firms. With the efficiency check “investigation & intervention”, the ACM has reserved the right to apply an ex-post used- and useful rule: in last resort the ACM can disapprove of certain cost items, which would then not be recoverable through regulated remuneration. While this mechanism appears intuitively justified and may well be necessary, it also entails the risk of increasing regulatory uncertainty. However, the explicit constraint to evidently inefficient costs limits effectiveness, but also the regulatory uncertainty. Lastly, legal disputes and judicial challenges are likely, if the ACM and the regulated company cannot agree. Recent experience with legal disputes concerning ACM’s efficiency measures suggests that the identification and implementation of ex-post budget cuts on the basis of detected inefficiencies have not been upheld by the courts.[10]

An important advantage to use efficiency safeguards of a process review also for the district heating networks in the Netherlands are synergy effects: As mentioned, similar efficiency

[10] Examples include ECLI:NL:CBB:2023:319, College van Beroep voor het bedrijfsleven, 21/1178 en 21/1179 and ECLI:NL:CBB:2023:318, College van Beroep voor het bedrijfsleven, 21/1180.

measures are being introduced for electricity and gas networks. It seems promising to use this expertise and experience for the regulation of district heating networks.

Overall, if well-designed, in principle a process review can be quite effective as an efficiency safeguard, but possibly at the expense of high regulatory effort to get reliable data and at the risk of micro-management.

4.4 Option 4: Tendering

A well-established market instrument is competitive tendering. Tendering either constitutes genuine market competition or serves as a structural approximation thereof. Competitive markets are widely regarded in regulatory economics as the most effective mechanism for achieving productive and allocative efficiency. The Methodology Decisions for electricity and gas regulation in the Netherlands mention tendering at different occasions. We note that the Monopolkommission (2025, p. 92), which is an advisory board for the German government, also examines the option of tendering the way-of-right licence for a heat area, and refers to Demsetz (1968), who coined this “competition for the field”.

Implementation of tendering into the regulatory framework for heat networks in the Netherlands seems fairly straightforward. In many cases, some form of tendering is already part of the existing processes. We distinguish three complementary applications for tendering in the given context:

- The communalities can tender off the licence for heat network/supply in a predefined heat area. This is competition-for-the-field precisely as intended by Demsetz (1968), which is powerful within limits, yet difficult to implement effectively.
- The licence holder will tender off construction works of the network. This may also concern maintenance.
- Procurement of inputs by means of tenders, in the given context, especially heat.

These considerations imply that effectiveness may be different for new versus incumbent networks, as the first two applications primarily apply to new networks. In a general business environment, the latter two approaches are established practice. For the purpose here, these can be made more explicit and strengthened via regulation if so desired. As mentioned further above, for the efficiency safeguards for electricity and gas, the ACM (2026a, p. 45) intends to examine tender-processes in the instrument process-audit.

The academic literature and practical experience on tendering, and more generally, auction design are extensive; a detailed review falls outside the scope of this study. Yet, we note the following questions, which seem particularly relevant in the present context:

- Does the tendering of the right-of-way licence for a heat area conform to the notion of public ownership? Possibly, adjusted legal entities will be required to facilitate this.
- Given the specific technological requirements of district heating networks and dependency on at least one larger heat source, will there be sufficient competition for a tendering process? Put differently, is it possible to prevent local authorities from becoming dependent on a single company that drafts its own tender documents?
- Can tendering be applied in case of expansion of district heating networks or does this approach result in a vendor-lock-in?

In sum, the presence of competitive tendering across various stages in the development of district heating, including network development, is a useful tool for efficiency pressure on regulated entities to some extent. The ACM may examine where the tender processes can be improved. At the same time, it would be unreasonable to expect tendering to function as the sole instrument for efficiency regulation. Rather, tendering should be understood as a complementary tool that supports other instruments and reduces some of the pressure placed on these other regulatory instruments.

For effectiveness, the assessment is mixed. Tendering seems very powerful, but will have limits. Demsetz (1968) made a strong argument for tendering public utilities. Indeed, the background argument was to refrain from regulation if a tender can create sufficient "competition for the field". Somewhat later, Williamson (1976) convincingly set the limits of the approach. Usually the tendered contracts "for the field" run about 10 to 20 years, after which contract renewal is again tendered. Here is where the effectiveness of tendering reaches its limits. Firstly, critical for the success of tendering is the availability of sufficient bidders. For the contract renewal, the incumbent party will be at an advantage compared to outside companies. Secondly, at contract renewal, sunk assets may distort bidding and it may be difficult to negotiate a fair hand-over of sunk assets.

A theoretical challenge for efficient tendering is the so-called beauty-contest problem[11]. When concessions are awarded not solely on the basis of price, but on a combination of (qualitative) criteria — such as investment commitments, service quality standards, or technical capabilities — the auction process necessarily involves a degree of subjective and ambiguous evaluation. This results in high effort for the regulator to identify and address strategic behaviour on the part of bidders. Moreover, strategic bidding may lead to overly optimistic bids, which may result in post-award renegotiation: once the concession is awarded and irreversible investments are sunk, the winning bidder may seek to revise contractual terms, knowing that the regulator's outside option — re-tendering or in-house provision — is costly.

We note an interaction with sunshine regulation (section 4.5). In the early stages, the firms may become the 'outsourcing' companies running construction, maintenance, repair or other operational functions for municipalities and other public shareholders. If transparency measures show that these networks generally perform better on KPIs, this may have an impact on municipalities willingness to award new contracts to them; in other words, tendering would create a reputational incentive.

Overall, where tendering processes already exist, they will create pressure on cost-efficiency and should be used as efficiency safeguards. Possibly, tendering procedures can be improved within the regulation. At the same time, effectiveness has limits and we cannot expect tendering to be an effective standing-alone efficiency safeguard. It supports other instruments.

4.5 Option 5: Sunshine regulation

As mentioned above in section 4.3, as part of the process review for efficiency safeguards for electricity and gas networks, ACM aims to enhance efficiency incentives by employing

[11] see also dena et al. (2025) for the specific challenges arising for tendering of heat networks

transparency through the publication of various Key Performance Indicators (KPIs) (see e.g. ACM, 2026a, ch. 8, p. 57-59). We consider transparency to be part of the more general instrument of sunshine regulation.

For the regulation of electricity and gas networks, ACM (2026a, ch. 8) intends to implement a two-tier approach:

- The firms are required to publish a performance report, containing a prescribed minimal set of KPIs, and,
- The firms are required to organize stakeholder workshops, with at least consumer associations and ACM, to discuss the tariff proposal. We note that underlying the tariff proposal are the cost-projections.

Similarly, for electricity regulation, Switzerland just implemented an explicit form of sunshine regulation (ElCom, 2026). The Swiss regulator ElCom (2026, p. 6) defines sunshine regulation as: "Sunshine regulation refers to forms of regulation that define indicators for a specific industry or group of companies and publish the extent to which these targets are met; typically, the metrics involved cover not only financial aspects - such as costs, profits, or tariffs - but also quality and other characteristics relevant to the sector in question. Publishing these results sheds light ("sunshine") on the regulated area."

Sunshine regulation contains two key aspects:

- Comparison of selected KPIs among different firms, or against some reference value, or in time.
- Publication of these comparisons.

We note the interaction with benchmarking, as discussed in section 4.1. If comparison starts to become comprehensive, it starts to become a type of benchmarking. Where KPIs are employed for inter-firm comparisons, the problem of heterogeneity persists, since firms in the given context cannot easily be compared. However, as discussed in section 4.1, the critical point is not so much the benchmarking itself, but rather the application of the results. Sunshine regulation aims to increase transparency and then relies on the pressure of the stakeholders; the benchmarking results are less critical. Thus, in contrast to “tough” benchmarking for the revenue cap in profit regulation, “soft” benchmarking seems a feasible and useful instrument to facilitate and support sunshine regulation.

The key notion is that public pressure constrains behaviour of the company to at least some extent. Sometimes this is also called “public shaming”, “shame and blame”, or more positively “naming and faming”. Sunshine regulation may have an effect through the following channels:

- Reputational pressure
    - Nobody wants to appear at the bottom of a ranking.
    - Managers, politicians, and organizations care about public image.
- Political accountability
    - Legislators, regulators, municipalities, and ministries can ask questions.
    - Poor performers become visible.
- Stakeholder pressure
    - Customers, citizens, journalists, and advocacy groups can react.
- Peer competition

- Organizations compare themselves against visible peers.

Switzerland never switched to efficiency-based revenue- or price-caps for electricity and gas networks, but retained cost-plus regulation; consequently, the regulator implemented additional efficiency regulation like sunshine regulation. Data collection for the sunshine regulation for electricity networks has been taking place in Switzerland for 10 years now, but because there was no legal basis for it, the results were never public and only shared with each individual utility. This has changed recently and in January 2026, the results of comparison of various network operators were published for the first time. ElCom (2026, p. 9) works with indicators as specified in Table 1.

Table 1: Sunshine regulation in Switzerland

Quality	Grid Costs	Grid and Energy Charges	Performance Indicators
Supply quality – duration of outages (total and unplanned)	Grid costs in CHF per line kilometer for grid levels 5 and 7	Tariffs for grid usage for households and businesses	"Franc rule": compliance with the directive on maximum amounts for administration and sales incl. profit in the energy business
Supply quality – frequency of outages (total and unplanned)	Grid costs in CHF per capacity unit for transformation at grid level 6	Tariffs for energy supply for households and businesses, i.e., for the consumption categories C2, C3, C4, C6, H1, H4, and H7	Compliance: meeting submission deadlines Service quality: Is information about power outages provided, and what is the lead time in days?

Source: own illustration based on ElCom (2026, p. 9) © EERA consulting GmbH

The Swiss electricity-price-comparison website displays the tariffs and key performance indicators of individual network operators, alongside a visual comparison showing where each operator stands relative to the sector median. The median is calculated as a population-weighted average: rather than treating all network operators equally, each operator's value is weighted by the number of inhabitants in its coverage area. This ensures that larger networks — which serve more consumers — carry proportionally greater weight in the overall median. Operators are compared visually on a map of Switzerland, with each operator's coverage area colour-coded according to how its tariff or indicator compares to the overall median.

In Germany, the Monopolkommission, which is an advisory board for the German government, also mentioned sunshine regulation - implemented via a price transparency platform - as an option for district heating in Germany (Monopolkommission, 2025, pp. 96-100). Their main argument is that the mere publication of prices and the resulting improved comparability of prices can have a disciplining effect, particularly on expensive providers.

The international experience with this instrument is interesting, but modest. In Switzerland, while the database for sunshine regulation was prepared in the past 10 years, the results were

only published at the beginning of this year. So far, there has been hardly any public reaction to this, despite the wide variation in network charges and energy tariffs. It remains to be seen how and when the results will be acted upon.

In Denmark, all district heating companies are required by law to report their prices to the authority DUR twice a year. The DUR publishes these price statistics on its website every six months, enabling consumers to compare providers directly. In addition, the Danish District Heating Association (Dansk Fjernvarme) regularly publishes data and key figures of the district heating sector in Denmark, and the Danish Energy Agency also publishes information and analyses on the heating sector. The multitude of different information sources, including private ones, could limit the effectiveness of the instrument. Based on the Danish experience, consumer-owned utilities (cooperatives) appear to be considerably more responsive to the publication of regulatory disclosures, whereas privately owned companies demonstrate comparatively lower sensitivity to sunshine regulation as an incentive mechanism. Because public and/or consumer ownership is foreseen for large district heating companies in the Netherlands, sunshine regulation may be comparatively more effective than with private companies only. Drawing on the Danish experience, where consumer-owned and publicly accountable operators have shown greater sensitivity to regulatory disclosures than their privately-owned counterparts, local public authorities in the Netherlands are likely subject to a similar form of local accountability — making price publications and key data more likely to function as an effective disciplining mechanism. Sweden introduced transparency obligations through the District Heating Act in 2008, requiring all Swedish district heating activities to annually publish balance sheets and profit and loss statements at the Swedish Energy Markets Inspectorate's website. To complement this, a voluntary price dialogue process was established as a Swedish model for regulating district heating prices, combining local dialogues with a central review of price changes. Additionally, a consortium of consumer groups annually publishes the 'Nils Holgersson report', which provides facts on price levels and price differences in district heating across various municipalities.

Overall, we conclude that effectiveness will be modest. The empirical literature consistently shows that, whilst the ‘light-handed’ model does increase transparency and works in municipally dominated markets, it has structural weaknesses when it comes to disciplining private district heating providers, who charge significantly higher prices than municipally owned firms (e.g. Lundin, 2025; Hellström, 2021; Åberg et al. 2016). Price variation between networks has remained significant despite more than 15 years of transparency regulation. This suggests that information transparency without enforcement mechanisms has limited effectiveness, particularly when it comes to private companies. One reason for this may be that municipally owned companies are more politically oriented, whereas private companies are more financially orientated (Hellström, 2021). Municipal operators are subject to a form of political accountability — elected officials and local communities can exert pressure through democratic channels, making price comparisons such as the Nils Holgersson report a more effective disciplining mechanism. Private companies, lacking this accountability structure, face fewer reputational or political consequences for deviating from peer prices. Interpreted with due caution, Gerrish’s (2016) meta-analysis of 49 studies on performance management across various public-sector settings suggests that the effect is, at most, moderate. This finding should

not, however, be overstated. The meta-analysis focuses primarily on performance management systems intended for internal managerial purposes, whereas sunshine regulation entails the external public disclosure of performance information. The potential additional effect arising from public scrutiny and external pressure is not explicitly captured in Gerrish (2016). Even so, the analysis suggests that one should not expect sunshine regulation to produce large effects. In fact, effects may go the other way. Ranking can create negative social norms: when heating companies see others being inefficient, they feel less pressure to behave efficiently themselves. Crucial here is how rankings are presented and communicated to the public.

The design of sunshine regulation and the assessment of its effectiveness should be approached in a more differentiated manner. More specifically, targeted sunshine regulation - based on selected KPIs and directed at particular stakeholder groups - may have some potential for effectiveness. In this regard, the following dimensions seem particularly important to distinguish:

- Local versus national scope
- Public versus private ownership
- Selection of KPIs; depending on context and stakeholders
- Choice of targeted stakeholders
- Form of publication of results.

A key advantage of sunshine regulation is the relatively low effort required for its introduction. However, if degree of differentiation increases, implementation may progressively become more challenging and require more effort in data collection and processing.

Overall, we assess that sunshine regulation (“transparency”) will be easy to implement but will have limited effectiveness in general. However, differentiated sunshine regulation designed for targeted stakeholders can be more effective, especially for publicly-owned companies and heat communities. Sunshine regulation can unlikely be a standing-alone efficiency safeguard, but can usefully support other instruments.

4.6 Option 6: Sharing factors

The draft Bcw article 7.16, paragraph 3 (GCW) suggests the use of yardstick weighting on operating costs. Elaboration in complementing documents confirms that this suggests the use of sharing factors (also known as sliding scales). Similarly, as will be discussed in more detail in section 4.8, a mechanism with sharing factors can be implemented for HTO as well. This opens up a wide field of using efficiency *incentives*.

A powerful tool for efficiency safeguards is the targeted use of sharing factors, that is, deviations between actual costs and a reference value are shared between the company and its customers according to a predefined sharing factor. In principle, this can apply to anything (e.g. output-oriented incentives often rely on this), but as this study is on efficiency regulation, we concentrate on cost-efficiency.

An application of sharing factors for cost-efficiency could be based on the following logic: Actual expenses of a regulated district heating company may be compared to planned or

budgeted expenses. Planned costs are agreed with the regulator in advance. For ex-post cost overruns or underruns (actual costs) sharing factors can be used. A low-powered sharing factor implies that a substantial proportion of the difference between planned and actual costs is passed through by the firm to the end-users. When actual costs exceed planned costs, such a low-powered sharing factor results in consumers bearing most of the difference through heating tariffs. Conversely, with a high-powered sharing factor, the firm absorbs a larger proportion of the deviation between planned and actual costs, while consumers bear only a limited share. Hence, the sharing factor affects efficiency incentives and risk for the firm. Both, the efficiency incentive and the risk for the firm, are high with a high-powered sharing factor. The downside of a high-powered sharing-factor is that incentives may overshoot and may impede investments. Vice versa, efficiency incentives and the risk for the firm are low with a low-powered sharing factor (high cost-pass-through), while retaining investment incentives.

Typically, a system with sharing factors is structured as described in the following equation (cf. EERA, 2025), which specifies the allowed revenue (REV). Here, we differentiate for CAPEX and OPEX:

$$REV = \Big((1-\delta)CAPEX_{ref} + \delta \cdot CAPEX_{real}\Big) + \Big((1-\alpha)OPEX_{ref} + \alpha \cdot OPEX_{real}\Big)$$

Where the subscript “ref” denotes “reference”. As a matter of definition, note that a low sharing factor, δ close to 0, means that the firm takes a large portion of the CAPEX-over- and -underruns, meaning a high-powered incentive, and vice versa, for a high sharing factor, δ is close to 1. A CAPEX-sharing-factor of δ equal to 1 resembles a full CAPEX-pass-through, meaning a low-powered incentive. And similar for α for OPEX. The level of the sharing factors is determined by the regulator. The level of sharing factor is far from obvious; there is no theoretical guide and it seems that practical reflections on balancing risk versus incentives drive the decision.

The system typically shares the difference between actual expenses or costs and planned expenses or costs. The latter is called the reference value. The specification of the reference value is important and subject to many debates if such a system is to be implemented. In the context here, two options to define the reference value are discussed.

Norm costs

Conceptually, the firm is a large collection of different components and processes. The costs for these components and processes can be estimated exogenously. Definition and demarcation of components and processes is open to debate. The estimated costs are the norm costs. These norm costs can be used as the reference value.

The norm-cost approach, which is currently widely debated for regulation of network industries in other countries as well, is powerful, but also faces significant challenges:

- Defining components and/or processes is difficult and may give rise to persistent debate.
- The norm costs are hard to determine unambiguously. The broader the definition and application of components and/or processes, the greater the ambiguity of the estimates is likely to be. More importantly, the resulting estimates are likely to vary across firms; if there is one industry-wide norm, firms may have under- or over-coverage of real costs.

- To the extent that estimates of the norm costs are biased for different components and/or processes - with some estimates exceeding actual costs and others falling below them - incentives will be distorted, thereby creating systematic biases in favour of or against some components and processes.
- The borderlines between components and processes may themselves cause strategic incentives, particularly by facilitating strategic cross-subsidisation to segments that remain subject to cost-plus regulation.

Denmark took a step in this direction by employing the technology catalogue (*Teknologikatalog*), a corpus of standardised, publicly accessible reference documents compiled by the Danish Energy Agency (DEA), providing techno-economic data across a range of energy technologies encompassing electricity generation, district heating, renewable energy, and energy storage. In the present context, the thematically most pertinent volumes of the catalogue are those addressing technology data for the generation of electricity and district heating, and technology data for heat transport infrastructure. The catalogue carries regulatory weight under the Heat Supply Act (*Varmeforsyningsloven*), which mandates its use as the authoritative database for socioeconomic project assessments submitted to municipal authorities in connection with the approval of new or modified heat supply projects. In this respect, the Danish approach constitutes one concrete institutional realisation of the norm-cost principle — albeit one confined in its application to the project planning phase rather than to ongoing tariff or cost regulation.

Of particular relevance is the institutional maturity underlying the Danish technology catalogue: its current iteration (version 18 from April 2026) has been published by the DEA since 2016, while analogous catalogues in the regulatory domain date back to the 1980s. This extended developmental trajectory implies a substantial accumulation of institutional knowledge on the part of the regulator, as well as considerable practical familiarity with the catalogue's application on the part of industry actors. Should comparable initiatives be pursued in other jurisdictions - such as the Netherlands, where the establishment of a standardised cost reference framework for investment planning in heat networks has been discussed - it is reasonable to anticipate that multiple iterative revision cycles would be necessary before both the regulator and regulated entities attain sufficient confidence in the reliability and representativeness of the published cost estimates.

Crucially, however, even the mature Danish framework does not extend the application of catalogue-based cost data beyond the project planning phase. In Denmark, the technology catalogue serves exclusively as the evidentiary basis for socioeconomic cost-benefit assessments of heat network projects and has not been operationalised as an instrument of ongoing economic regulation - such as benchmarking, tariff-setting, or incentive regulation. This institutional boundary is analytically significant: it suggests that even under favourable conditions - long regulatory experience, established industry practice, and broad institutional acceptance - the translation of standardised norm-cost data into a fully-fledged regulatory instrument remains an unresolved challenge. The Danish case may therefore serve less as a replicable template than as an indicative approximation of the complexity inherent in establishing a credible and operationally robust norm-cost basis for the regulation of heat networks.

Budgets

As an alternative to a norm-cost approach, budgets (in € per year) can serve as a reference value. However, since budgets can be applied for different purposes, the specific requirements need to be taken into account when designing a budget approach. Usually, the firm develops and requests a budget to execute a predetermined (investment) plan. The requested budget will be validated by the regulator and after several rounds of negotiation and adjustment will be approved as the working budget. The budgetary framework may span a multi-year period of up to five or eight years, with the provision for annual specification within that interval; intertemporal flexibility through the carry-over of unused budget allocations across regulatory periods should be permitted. Once validated, such budgets can serve as the reference value against which sharing mechanisms are applied. Where actual expenditure falls below the approved budget, the regulated firm retains a defined proportion of the resulting cost savings; conversely, where expenditure exceeds the budget, the firm bears a corresponding share of the overrun. This symmetric incentive structure constitutes the core efficiency signal of the budget-based approach. Additional caps and floors can limit the risk for the company if deviations get very large.

As with any regulatory instrument, however, the budget approach entails advantages and limitations that warrant careful consideration.

- Depending on the level of incentive parameters, the budget approach can set powerful incentives. While this might be the goal from a regulatory perspective, a strong incentive directly translates into higher risk for the regulated company. The trade-off needs to be balanced.
- As compared to the norm-cost approach, the demarcation problem is less severe in the budget approach if the budgets are specified to cover a wide scope.
- A primary limitation of the budget-based approach concerns data availability. Establishing accurate forward-looking budget estimates over extended regulatory periods is inherently problematic under conditions of uncertainty: planned quantities, input prices, and project specifications are subject to revision, rendering ex-ante budget projections susceptible to material inaccuracies over time. Accordingly, regulatory provisions must be incorporated to account for exogenous uncertainty and to accommodate budget deviations that fall outside the reasonable control of the regulated firm - as illustrated by recent legal disputes in which ex-post budget cuts imposed by the ACM on the basis of detected inefficiencies were not upheld by the courts.
- A budget approach suffers from strategic incentives. The firms will tend to inflate the requested budget and then underspend once the budget has been approved. Inflated budgets lead to high prices, and underspending may lead to output underperformance. Such strategic incentives need to be addressed.

The key idea of this option using sharing factors is to exploit the information in business plans / investment plans / heat-area plans / network development plans to define a good reference value to apply a sharing factor. We explicitly use this rather awkward formulation: these are not merely different names, but rather different variations containing different depth of information. We distinguish three types of information that can be contained in these plans:

- Information for network development itself. This is by and large technical information about topology, capacities, timing and technology of developing the network. Presumably, this conforms to the heat-area-plan (*Kavelplan*) in the Wcw and Bcw in the Netherlands.
- Information on cost of network development. Relying on the information in the network development plan as such, adding the costs, provides an estimated budget. Presumably, this is best captured by an investment- or business-plan. Clearly, incumbent firms do not need to develop the network (because it is in steady state) and thus, a network development plan would be superfluous; yet, a business plan (stating maintenance, replacement and general OPEX) might be required nonetheless. In contrast, firms which need to develop a new network will need an extensive investment plan.
- Information on the benefits of the network development. This would lead to an implicit or explicit social cost benefit analysis. This is not foreseen in the Netherlands, but it is already applied in Denmark. Under Danish heat planning act (§ 4), the construction of a new heat network — or any material modification to an existing one — is contingent upon the prior completion of a socioeconomic cost-benefit analysis.[12] This ex-ante assessment serves as the primary regulatory gatekeeping instrument, requiring the project proponent to demonstrate that the proposed heat supply solution is socioeconomically superior to available alternatives (especially decentralized heat pumps). The analysis evaluates costs and benefits from a broad societal perspective, encompassing capital expenditure, operational costs, fuel costs, and externalities such as CO2 emissions, using the standardised assumptions and cost data prescribed by the DEA in the before mentioned technology catalogue. The outcome determines whether municipal authorities grant project approval.

The plans need to be differentiated between new and incumbent firms. Heat companies are in different stages of the life cycle; some firms are new, others are incumbents. Some are in the phase to build-up and roll-out the network (expansion investment), some are long established and operate an old network (replacement investment and maintenance). Their investment- or business plans will look completely different, which would have effect on the use of sharing factors.

In the context of this study for efficiency regulation for district heat networks in the Netherlands, we observe that - at least for GCW - data availability is a key problem. Timing of the investment plans for GCW is uncertain, but probably, the first plans will not be available till 2028/29 and we should expect that the first round(s) of investment plans will be in a learning-phase and will likely not be very reliable. The scale of such uncertainty is well illustrated by a recent study in which five consultancy agents were independently asked to estimate costs for district heating in a Dutch neighbourhood — their results varied between 150 and 250 % (Witkamp, 2024). Getting accurate budgets will be a major obstacle. A norm-cost approach will be equally difficult, because neither a useful demarcation of components or processes, nor the associated norm-costs are available; it will take a long time to set up a reliable system. As we will discuss in section 4.8, prospects may look somewhat more promising for HTO.

[12] The procedural and methodological requirements governing these assessments are further elaborated in the Project Order (Projektbekendtgørelsen, BEK nr. 697 af 6. juni 2023).

Overall, we conclude for GCW that the use of sharing factors is economically powerful in principle, but suffers from the lack of data to set accurate and reliable reference values. Presumably, the use of sharing factors may be a better option in a later regulatory period, after sufficient experience with investment plans has been made.

4.7 Assessment of the efficiency regulation options for GCW: Overview

The following section assesses the options outlined above for introducing efficiency regulation in addition to a cost-plus approach in the specific context of large district heating companies (GCW) in the Netherlands. As explained in chapter 2.3, the evaluation is based on the two criteria of practicability and effectiveness, which are considered separately.

The key results and main arguments are summarized in table 2.

Table 2: Overview of the assessment for GCW

Option	Practicability	Effectiveness	Main arguments (focus GCW – large district heating companies in NL)
1. Benchmarking	0	- -	• Practicability: data available, established method, but not applied to heating sector yet • Effectiveness: basically good, but problematic under high heterogeneity
2A. Light-handed control of publicly owned utilities	+	-	• Practicability: local public ownership foreseen, but still needs to be implemented for each network • Effectiveness: public ownership still requires efficiency regulation.
2B. Light-handed control of consumer-owned utilities	+	(+)	• Practicability: consumer ownership legally implemented but not much experience yet • Effectiveness: potentially more effective for (smaller) consumer-owned utilities and cooperatives than for publicly owned
3. Process review	+/0	+/0	• Practicability: synergy effects with efficiency regulation electricity/gas in NL, but risk of micromanagement • Effectiveness: potentially effective, but limited; so far no experience with electricity and gas in NL (still in development)
4. Tendering	0	+/-	• Practicability: tendering is already part of existing practice, but might result in high effort for beauty contest • Effectiveness: tendering for-the-field potentially effective (not for incumbents), but competition possibly limited and potential lock-in
5. Sunshine regulation	+	+/0	• Practicability: relatively easy and synergy effects with efficiency regulation electricity/gas in NL (transparency) • Effectiveness: differentiated targeted approach potentially effective, but generally limited
6. Sharing factors	-	+/0	• Practicability: challenge of finding adequate reference value; heat area plans for GCW not yet available • Effectiveness: potentially effective but strongly depending on reliability of data

Source: own illustration

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The assessment will be expressed on a qualitative scale ranging from– – (very negative) to 0 (neutral) to ++ (very positive).

Benchmarking (Option 1) scores neutrally on practicability, as the underlying methodology is established as such, yet has not been applied to the heating sector. So, while ACM and other regulators have significant experience with this efficiency measure, there exists no explicit experience with its application to the specific context of district heating companies. Its

effectiveness is rated poorly (- -), primarily because the approach becomes problematic under conditions of high heterogeneity among district heating systems. The limited comparability especially in the development phase of these networks as well as between established and new networks will limit the effectiveness to a large extent.

Light-handed control is considered in two variants. Option 2A, applicable to publicly-owned utilities, scores positively on practicability given that public ownership is already anticipated for larger district heating companies within the Wcw, though implementation must still occur on a network-by-network basis. Nevertheless, public ownership of energy networks is an established practice in the Netherlands, hence, the administrative and legal processes should be established as well. Its effectiveness is limited (-), as public ownership alone does not substitute for formal efficiency regulation. Similarly, other publicly-owned energy infrastructures (electricity and gas) in the Netherlands, though 100% state-owned, are subject to efficiency regulation as well. Option 2B, targeting consumer-owned utilities and cooperatives, shares the same practicability assessment (+) but is considered potentially more effective ((+)), particularly since experience from Denmark for local cooperatives point at the potential for smaller cooperative structures where ownership incentives may better align with efficiency goals.

The process review (Option 3) receives a mixed rating on both dimensions (+/0). A clear advantage of this approach is that synergy effects with existing electricity and gas regulation in the Netherlands enhance its practicability. ACM is currently implementing similar measures for electricity and gas networks and can apply this knowledge to district heating as well. However, since this approach is based on detailed oversight of processes and investments, it requires high effort and bears the risk of micromanagement, overall limiting practicability. Effectiveness is similarly constrained, as no comparable experience with this instrument exists in the Dutch electricity and gas sectors, and the approach is in development and effectiveness is to be awaited.

Tendering (Option 4) is rated neutral on practicability (0), given that tendering procedures are already embedded in existing practice. However, administrative effort will be high, if tenders are organized as so-called beauty contests, which increases complexity and effort to implement and execute tenders significantly. Its effectiveness is ambiguous (+/-) as well: On the one hand, tendering for-the-field holds potential to increase efficiency to a large extent, particularly for new district heating networks. On the other hand, competition may be structurally limited due to the local market structure, existing heat sources, etc. Importantly, for network expansion or reinforcements the risk of incumbent lock-in undermines its long-term regulatory value – once a district heating company is active in one specific area, real competition will be low, resulting in a strong negotiation position for the incumbent with potentially very limiting effects on efficiency.

Sunshine regulation (Option 5) is assessed as relatively practicable (+), owing to the straightforward nature of its implementation and the synergy effects it shares with efficiency regulation in the electricity and gas domains. Its effectiveness, however, remains generally limited and difficult to evaluate. Evidence from Denmark suggests that local cooperatives and publicly-owned municipal district heating companies tend to be more receptive to public responses to published key performance indicators, attributable to the strong local ties these

organisations maintain with their communities. Consequently, depending on design, implementation and the specific circumstances and the degree of local stakeholder involvement in the district heating company, this approach may generate efficiency incentive (0/+) to some extent.

Sharing factors (Option 6) score negatively on practicability (-), primarily due to the difficulty of identifying adequate reference values (norm costs or budgets) and the current unavailability of heat area plans for the larger district heating companies. Despite this implementation challenge, the option is considered potentially effective (+/0), contingent on the reliability of the underlying data.

Overall, the assessment in Table 2 gives the following impression for the efficiency regulation for GCW. Efficiency regulation with a process review may suffice to a large extent. It seems manageable, if challenging.

The main problem for the efficiency regulation with sharing factors for GCW is that the investment plans are not available as yet; and even if they become available, we have to expect that the accuracy will be low at first. For this reason, it is not feasible as yet to use incentive mechanisms with sharing factors. There is no good data to set reliable reference values. This drawback holds for budgets and norm costs.

Moreover, there are reasons why in the given context regulation does not have to be very strict. The district heating companies will be publicly owned, which may shift the focus of the companies from a profit-orientation towards the benefits of society to some extent. This will be particularly relevant for (small) consumer-owned cooperatives. There will remain to be outside options (e.g. individual heat pumps); therefore, the companies will face some competition, which relaxes the need for strict regulation. Also, in the value chain, various possibilities for tendering increase pressure of cost-efficiency. Possibly, the regulator can tighten the rules for tendering to exploit this potential. Lastly, targeted sunshine regulation, if well designed will provide further pressure on firms' efficiency and performance, again relaxing the need for strict efficiency regulation. Public-ownership, tendering and sunshine regulation are not sufficiently effective to be efficiency regulation standing-alone. They can and will be useful to support other instruments though; public ownership, tendering and sunshine regulation (transparency) exist as it is and may as well be used and further developed.

4.8 Zooming in on heat transport operators (HTO)

The discussion above explored different options for efficiency regulation in addition to a cost-plus approach on a general level, with a focus on the larger group of GCW, for whom regulation will start 2031 and for whom the regulatory system is still to be designed. Things are different for heat transport operators (HTO), for which the regulatory system starts in 2027 and at the time of writing the regulatory system is already far more detailed. This section addressed specific questions concerning HTO.

So far, WTS is the only HTO in the Netherlands. WTS is a subsidiary of the publicly-owned Gasunie. It operates a heat transport pipeline system, WarmtelinQ, connecting the Port of Rotterdam with The Hague and Leiden. The section to The Hague is expected to commence

operations in March 2027, whereas the extension to Leiden is still under development. Regulation starts soon and larger parts of the investments have already been done; further major investments are expansions which will soon follow. The company has, at present, two contracted customers - Eneco for The Hague and Vattenfall for Leiden - which together represent 46% of the system's potential capacity.

The assessment of the options for the efficiency regulation for HTO is somewhat different from the assessment for the group of GCW. For most options, the difference only slightly affects the evaluation; for option 6 – sharing factors – however, the difference is significant. Because of this significantly different evaluation, HTO has a separate subsection with a separate MCA. Why the difference?

- In contrast to GCW, where the first investment plans will probably not be available till 2028/29, for WTS (being the first and so far only HTO), the business plan has already been made. Data from the business plan is readily available.
- The Bcw foresees an explicit validation process by an external independent consultant for the business plan for HTO. The decree seems to aim at CAPEX, but supposedly, the investment plan and thus validation may and could include controllable OPEX as well. Hence, available data may be quite accurate.
- For the HTO-case, technology and value chain are easier for regulatory purposes. HTO is only the network, whereas GCW also includes heat procurement and distribution.
- Since so far WTS is the only HTO, there are no comparators. Benchmarking is not at all feasible, but also comparison in sunshine regulation would not be possible. Hence, only the assessment of development of costs in time seems to be a possible approach for efficiency regulation.
- In the current situation, WTS has only few large commercial customers, who are district heating firms in their own right. In contrast, GCW generally have a customer base consisting of a large group of small customers. These large commercial customers of WTS will likely exert pressure on WTS to keep tariffs low and will thus exert pressure on cost-efficiency. This may change in time and the same argument may not hold for HTO more generally.

Regarding the regulation of HTO, the Bcw (art. 7.15 - 7.17) foresees two key elements.

(1) CAPEX and non-controllable OPEX

For CAPEX and non-controllable OPEX, the system appears settled. The Bcw requires an explicit validation of the business case by an external independent consultant. The validation of the investment plan concerns both initial roll-out and large expansions. This is in fact an important difference with the GCW, where the validation process is not foreseen.

Deviations of planned and actual CAPEX up to 15% above planned CAPEX will be passed-through. CAPEX-overruns of more than 15% must be announced to ACM and be justified to be efficient costs. If ACM concludes that the CAPEX-overrun is efficient, the costs will be passed-through; if ACM concludes that the overrun is not efficient, the overrun will not be passed through and ACM will use the validated planned CAPEX to determine allowed revenues.

The scheme for CAPEX can be interpreted as a budget approach with a non-linear sharing factor. The budget is the validated business case. The sharing factor is a full cost-pass-through up to a CAPEX-overrun of 15% and beyond 15% either a full cost-pass-through or no cost-pass-through. The threat that sometimes CAPEX-overruns may be disapproved will certainly set an incentive for the firm to be careful with CAPEX-overruns, but the system works only with the extremes. Alternatively, it might be an option to use a continuous, possibly non-linear sharing factor ranging between the two extremes.

(2) Controllable OPEX

For controllable OPEX, the system is still open to discussion. The Bcw suggests an OPEX-revenue-cap, for which ACM estimates OPEX at the beginning of the regulatory period. One important question is how ACM will make the estimate of OPEX for the next regulatory period. One option is to use historic data; this is a problem, because this data does not yet exist. The alternative would be to use planned data from the business case. A second and related question is whether efficient OPEX should be incentivized. This alternative relates to the use of business plans as discussed in section 4.6. The use of a strict revenue cap is in fact a budget approach with a high-powered sharing factor of no cost-pass-through.

To balance between efficiency incentives and risk, we suggest to use available data to implement the OPEX-revenue-cap as a budget approach with a sharing factor for OPEX-budget-deviations. The scheme might use the year-on-year estimated cost-base; the regulated firms typically make ex-ante estimate of next year's cost-base which is the base for calculating next year's network tariffs. Strict cost-plus regulation would make a full ex-post correction for over- under underruns of actual costs as compared to estimated costs. But to set some efficiency incentives, the ex-ante estimate of next year's cost-base may be used to set sharing factors as compared to actual costs.[13]

The obvious problem is that once the estimated budget is used for a sharing budget, strategic incentives will emerge; in particular, the firm will have strategic incentives to inflate the cost-data in the business case and then, after the budget is approved, strategically underspend at the expense of performance. We suggest to examine the following options to address these strategic incentives:

- First, as time proceeds, historic data of actual costs will become available, and thus the ACM will get a better grip on efficient OPEX.
- Second, the budget-deviations between planned and actual OPEX may be used as a 3-year-moving-average to correct next year's budget. Systematic underspending, which is the same as a systematically inflated budget, will then lead to a corrected budget next year. Reverse for budget overruns. This reduces strategic incentives. In time, the budget

[13] In fact, ACM actually uses a similar approach in the regulation of electricity and drinking water utilities in the Caribbean Netherlands (cf. ACM, 2025). Actual audited total costs (capital and operational) from the previous year, adjusted by ACM for inflation, investment and major occurrences, are the basis. After the end of a year, actual costs are compared to these ex-ante estimated costs. The difference is shared between the company and the end-users with a sharing factor of 50 %. As a preliminary assessment, this system may work well for small system in a relative steady-state, which key parameters are relatively stable.

deviations would decrease. We note that at this stage in this explorative study, this is merely a preliminary idea and requires further research.

- Third, additional output-oriented incentives can counteract strategic incentives to underspend and underperform (cf. Brunekreeft et al., 2020). The regulation in the UK calls such incentives output-delivery-incentives (ODIs). Many examples of ODIs are available. Importantly, a detailed analysis should first indicate where underperformance of which outputs is especially critical and requires targeted correction.

Avoiding a CAPEX-bias

We could roughly summarize the regulatory approach for HTO as suggested in the Bcw as a cost-pass-through for CAPEX and a revenue cap for (controllable) OPEX.[14] This approach is asymmetric: treatment of CAPEX and OPEX are different. As is well-known from other experience and as can be seen analytically, the asymmetry creates an OPEX-CAPEX-incentive-bias, short, CAPEX-bias (aka as the Averch-Johnson-effect (1962)). If CAPEX is a cost-pass-through, and OPEX has no cost-pass-through (or put differently, CAPEX has low-powered and OPEX has high-powered incentives), the firm has a strategic incentive to substitute OPEX for CAPEX, resulting in inefficiently high CAPEX and inefficiently low OPEX. This is called the CAPEX-bias. In the system as suggested by the Bcw, incentives for a CAPEX-bias exist as well.

There are ways to address the CAPEX-bias. One option would be to use what is called a FOCS-system (cf. Bebenburg et al., 2023); FOCS stands for fixed-OPEX-CAPEX-share and is known in the UK as TOTEX-approach. FOCS is a regulatory mechanism designed to eliminate the CAPEX-bias by treating all expenditures — regardless of whether they are CAPEX or OPEX — identically as TOTEX (total expenditure). The mechanism works as follows:

- All costs (CAPEX + OPEX) are pooled into TOTEX
- A fixed capitalisation rate (set by the regulator) determines what share of TOTEX is treated as quasi-CAPEX — entered into the regulatory asset base (RAB), depreciated over time, and earning a regulated return
- The remaining share is treated as quasi-OPEX — expensed directly within the accounting year ("pay-as-you-go")

Because the original CAPEX or OPEX does not affect regulatory treatment as CAPEX or OPEX, the firm is indifferent between CAPEX- and OPEX-solutions, and will choose the cost-efficient option. The distortion disappears.

FOCS is a variant of TOTEX regulation, pioneered in the UK by Ofgem (energy networks) and Ofwat (water networks). Ofwat found that TOTEX regulation contributed to technology-neutral incentives: the OPEX share of total spending increased from 40–43% to 52% over one regulatory period, indicating a measurable reduction in CAPEX-bias (Ofwat 2021). Ofgem

[14] We note that this conforms by and large to the current regulatory system practiced in Germany, which, however, is currently in a reform process.

similarly confirmed that the TOTEX approach encourages companies to choose the overall cost-effective solution rather than defaulting to capital investment (Ofgem 2017).

Additionally, ARERA (Italy's Regulatory Authority for Energy, Networks and Environment) applies the FOCS-approach for electricity distribution networks as well. The allowed revenue is determined based on total expenditures (TOTEX), adjusting for efficiency targets, and then splitting TOTEX into "slow money" (remunerated through the regulatory asset base, i.e. quasi-CAPEX) and "fast money" (expensed directly, i.e. quasi-OPEX) (Bovera et al. 2024).

Incentivizing capacity utilization and volume increase

The Bcw suggests an incentive to utilize more capacity because the revenue cap for controllable OPEX is adjusted retrospectively via recalculation based on the realized volumes. This is a topic with many dimensions, which deserve more discussion than can be offered within the scope of this explorative study. We do make the following notes though.

Firstly, the topic relates to a difference between a price cap and a revenue cap. Under a revenue cap, the revenues are predetermined during the regulatory period, irrespective of volume. In contrast, under a price cap, the price is predetermined, whereas volume is a flexible. As a result, under a price cap, revenue automatically adjusts with volume, whereas under a revenue cap, it does not. Consequently, the incentives to increase volume are stronger under a price cap, than under a revenue cap. We note that the revenue-cap approach can be adjusted with additional elements to account for volume changes, shifting it gradually to a price cap.

An important question is how this relates to underlying costs. If the volume is a cost-driver, an increase in revenues is justified. But if the costs are constant in the short term, then an increase in revenues is not cost-based.

Secondly, a cost-reflective price cap, which accounts for volume increases, will facilitate but not explicitly incentivize the firm to increase volume through capacity utilization. A cost-reflective price cap merely allows higher revenues proportionate to the higher OPEX (and thus corrects the disincentive of the revenue cap), but does not set an additional incentive to accelerate capacity utilization. To the extent that better capacity utilization should be incentivized, different options can be thought of:

- An explicit capacity utilization incentive could be implemented. Usually, a capacity utilization incentive is a bonus/malus system around a target value, which can also be a growth target.
- A straightforward approach would be that the price cap is somewhat higher than the underlying unit-costs. Such a mark-up on the marginal controllable OPEX can set an additional incentive to incur OPEX if this increases volume.
- A more academic approach is the so-called Vogelsang-Finsinger-mechanism (1979). As a forerunner of the RPI-X price-cap approach, this incentive mechanism sets year-on-year incentives to increase volume, as long as this decreases unit-costs, by exploiting scale effects.

Thirdly, this topic touches on the rather special issue of the ramp-up phase. Large infrastructure projects relying on forward-looking anticipatory investment decisions tend to have a ramp-up phase of several years in which demand is not yet sufficient to recover full costs; demand growth in later years will compensate early losses. Faced with large fixed investment costs, this is not inefficient investment. If early users are charged average costs, the charges are unreasonably high in the early years. This is an intertemporal distribution effect, because early users finance a large part of the infrastructure. Moreover, users may wait for charges to go down, before they connect; this will slow down the connection up-take and capacity utilization. The problem of the ramp-up phase is an issue in its own right, but goes beyond the scope of this study to be addressed in full depth. We note, however, that different options to deal with the ramp-up phase are currently debated (cf. EU-Commission, 2025).

Table 3: Overview of the assessment for HTO (specifically WTS)

Option	Practicability	Effectiveness	Main arguments (focus on HTO (specifically WTS) – heat transport operator in NL)
1. Benchmarking	0	- -	• Practicability: data available, established method, but not applied to heating sector yet • Effectiveness: benchmarking for one company not possible
2. Light-handed control of publicly owned utilities	+	-	• Practicability: public ownership established • Effectiveness: public ownership still requires efficiency regulation, no direct local pressure
3. Process review	+/0	+/0	• Practicability: synergy effects with efficiency regulation electricity/gas in NL, but risk of micromanagement • Effectiveness: potentially effective, but limited; so far no experience with electricity and gas in NL (still in development)
4. Tendering	0	-	• Practicability: tendering is already part of existing practice, but might result in high effort for beauty contest • Effectiveness: lock-in (investment already done)
5. Sunshine regulation	+	0	• Practicability: relatively easy and synergy effects with efficiency regulation electricity/gas in NL • Effectiveness: B2B-relation can result in efficiency pressure, but limited, due to missing benchmark
6. Sharing factors	+	+(+)	• Practicability: investment plan for WTS is available, explicit validation process foreseen and network only • Effectiveness: potentially effective and data quality supported by validation process but could create strategic incentives

Source: own illustration

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For benchmarking (Option 1), the practicability score – as is the case for large district heating companies – is neutral (0), because the data and methodology remain available in principle. Effectiveness is, however, rated critically (--) as in the previous case but for different reasons: Benchmarking is fundamentally not applicable to a single company. Without comparable entities against which performance can be measured, the instrument loses its analytical foundation, rendering it ineffective in this context regardless of its broader methodological merits.

Regarding light-handed control of publicly owned utilities (Option 2A), practicability is assessed positively (+), as public ownership is already established for WTS; presumably, possible additional HTO will also be largely public. Nevertheless, a limited effectiveness (-) rating is

maintained. As we have noted above in chapter 4.2 public ownership does not in itself generate sufficient efficiency pressure. Notably, the absence of direct local stakeholder pressure — which in cooperative structures can serve as an informal disciplining mechanism — further weakens the effectiveness of this option in the present context.

For the process review (Option 3), the assessment is consistent with the prior evaluation for large district heating companies. Synergy effects with electricity and gas regulation in the Netherlands support practicability, while the risk of micromanagement and the lack of domestic implementation experience constrain both dimensions to a mixed rating (+/0).

With respect to tendering (Option 4), the effectiveness rating has been revised downward to a negative (-) compared to large district heating companies. The central reason is that investment in the relevant infrastructure has already been made, creating a structural lock-in that eliminates the competitive dynamic upon which tendering's effectiveness depends. In this context, the instrument cannot fulfil its intended function and is therefore considered inappropriate as a primary regulatory tool for WTS; this may differ for later HTO.

For sunshine regulation (Option 5), the positive practicability rating (+) is maintained, as implementation remains straightforward and synergy effects with existing regulation persist. Effectiveness is, however, moderated to 0 compared to large district heating companies. In this context, the relevant pressure mechanism is not public accountability to local communities, but rather business-to-business dynamics. In the specific case of WTS (being the one HTO so far), this B2B pressure is concentrated among a small number of large consumers — currently two, accounting for 46% of total capacity. This concentration introduces a degree of countervailing power.

Finally, the evaluation of the use of sharing factors (Option 6) for HTO represent the most significant revision relative to the prior assessment for large district heating companies, with both dimensions upgraded. On practicability, the availability of an investment plan for the HTO (here specifically WTS) and the explicit foresight of a validation process resolve the data availability concerns that previously warranted a negative score, resulting in a positive rating (+). On effectiveness, this option is considered to hold genuine promise (+(+)), as the validation process directly supports data quality. One important caveat is nonetheless noted: the process could inadvertently create strategic incentives, which need to be addressed.

The overall evaluation for HTO differs somewhat from the assessment for GCW; however, it is not a radical change, but rather a shift of focus.

Overall, for the reasons mentioned above, for HTO, we see more potential to use sharing factors relying on budgets. For CAPEX for new investments, it may be an option to smooth the sharing factor, instead of having the somewhat extreme approach with the 15%-rule as suggested in the Bcw. For controllable-OPEX, it seems possible to implement sharing factors, but it would be necessary to examine more deeply how to address strategic incentives following from the sharing factors.

The use of sharing factors requires careful attention by the regulator. The sharing factors will set strategic incentives, e.g. to inflate the budget. Both the budgets and the actual costs need to be controlled carefully. Thus, the instruments in the process review (including the validation

process) will also be important for the regulation of HTO, but here not as the central instrument, but rather to support the use of sharing factors.

The other options support the main instrument. Since WTS is also in public ownership, we would expect that the need for strict regulation is somewhat relaxed. There will also be elements of tendering in the HTO value chain, which further create some pressure on efficiency. However, as the system and the firm are already operational, the basic tender "competition for the field" can no longer apply. Sunshine regulation also supports the main approach; we expect especially pressure from the large commercial users, for instance in transparency workshops as foreseen for the regulation of electricity and gas networks and should also be a part of the HTO regulation.

4.9 Further topics

The Bcw suggests many topics, which are directly or indirectly related to regulation of the district heating companies. At the moment of writing, the Bcw is still in consultation phase and many topics are still debated. This section briefly discusses a selection of further topics, which are beyond the scope of this study, but are related to the key questions of this study nonetheless. As the topics are beyond the scope of the study, we can merely touch upon the topics and not go into detail.

4.9.1 Cross-area-equalization

The Wcw equalization mechanism may socialise part of the tariff impact of heat supply areas whose calculated tariff exceeds the applicable statutory cap (Wcw Article 7.6), funded through a cross-area equalization fund (in Dutch: *Vereveningsfonds*; Wcw Articles 7.17 to 7.20).

The cost structure of district heating networks varies considerably across concession areas (*kavels*). Certain networks entail significantly higher operational costs — attributable, inter alia, to the nature of the heat source, the length of the distribution infrastructure, or the density of the built environment. In the absence of a compensatory mechanism, consumers located in high-cost concession areas would face substantially higher tariffs relative to those in more low-cost areas. The *Vereveningsfonds* (equalization fund) is designed to mitigate these structural disparities in the cost base across concession areas, thereby ensuring equitable tariff conditions for all district heating consumers.

Variant designs include sector-wide insurance, a state-funded backstop, an efficiency-tested treatment that distinguishes preventable from unavoidable causes, or the maintenance of the equalization mechanism as the sole instrument. Currently, Article 7.17 till 7.20 Wcw sets the rules for the fund as follows:

- The Ministry of Economic Affairs sets a maximum tariff on an annual basis.
- The tariff of the individual company is determined by the ACM.
- If the individual tariff exceeds the tariff cap, the difference is reimbursed by the fund.
- The fund receives its resources from all district heating companies, which pass on the costs to their customers.

This is primarily a political problem of a fair distribution of income: The costs are socialized. For the context of this study, it is important to note that an ill-designed mechanism for cross-area-equalization can potentially destroy efficiency incentives, especially for high-cost firms. If these firms can simply pass through (inefficiently) high costs and get these refunded through the fund, they will not have any incentive to be cost-efficient.

The cross-area-equalization reminds of a similar approach in Germany to redistribute the network cost of integration of renewable energies onto the electricity networks, implemented in 2024. It is a very similar problem. Renewable energies are geographically unevenly distributed across the country (especially wind in the North) and by mechanism, the network costs of renewable-energies connection are charged regionally. Thus, network users in areas with a lot of renewable energies pay disproportionally high network charges. It was politically desired to redistribute the cost across the country.

The problem pointed out above, that an ill-designed fund can potentially destroy incentives for cost-efficiency was recognized. To address this issue, the mechanism in Germany applies an exogenous factor for a cost-pass-through of “excess costs”; the RES-factor. A network operator is eligible for compensation only if it is affected by the integration of renewable energies "to a particularly significant degree". This condition is assessed by means of the Renewable Energy Index (*Erneuerbare-Energien-Kennzahl* EKZ), which is calculated separately for each grid and transformer level. In effect, only estimated excess costs, irrespective of the real excess costs, can be passed-through to the fund. Similar to the general principle of a budget approach, the firm will now have an incentive to keep real cost low.

4.9.2 Reasonable rate of return

A somewhat special topic concerns the WACC. The 'buffering hypothesis' put forth by Peltzman (1976) explains the effect of market risk on the regulated firm. The crucial factor is how much of the shocks can be passed through to customers. Profit-maximising prices of a firm with market power pass through only some of the demand and cost shocks, absorbing the remainder; consequently, profits vary with demand and cost shocks. Under an extreme notion of rate-of-return regulation, the firm passes through all of the shocks in order to stick to the allowed rate of return. The investment in the rate-of-return-regulated firm gives moderate, but safe returns. Therefore, rate-of-return regulation is low risk.

Price- and revenue caps shift risk from the consumer to the firm. Under price-cap regulation the cost of capital is higher than for an unregulated firm if there is cost uncertainty. This is intuitive because, if costs change while prices stay the same, the variability in profits will be strong.

Thus, price-based regulation increases risk of cost or demand uncertainty more for the regulated firm than for firms subject to cost-based regulation. The consequence of this is that different types of regulation should apply a different risk-adjusted rate of return on capital to reflect the appropriate cost of capital of the investment (Grout & Zalewska, 2003). The options for efficiency regulation as discussed in this study work out differently on the balance of risk allocation and will thus affect the WACC. The ACM should consider this effect on the WACC in the design of efficiency regulation.

4.9.3 Treatment of small systems

Small collective heat systems (KCW) are defined as having less than 1,500 connections. Small systems (KCW) face a distinct regulatory challenge: heterogeneity and number make a GCW-style system-by-system cost assessment administratively infeasible. As described in the Bcw direction of travel is a cost-based reference tariff in which efficiency discipline rests primarily on competition for the market - through project-developer tendering in new-build and provider diversity (heat companies alongside heat communities) in existing-build - rather than on regulator-led cost assessment.

As KCW is not the focus of this study and as details of the cost-based reference tariff are unknown as yet, we can only touch upon the issue without going into detail. Indeed, the small-scale and large number of KCW makes system-by-system detailed cost-assessment by the regulator infeasible; regulatory costs would be unreasonably high. Moreover, the argument put forth by Biggar et al. (2024) (compare section 4.2) that small consumer-owned utilities seem to have sufficient incentives to charge cost-based tariffs and to be cost-efficient without regulation may apply to the cooperatives in KCW to a large extent. Hence, the regulation may be relatively relaxed.

A reference price is a price cap, which reflects the outside option, thereby it mimics (intermodal) competition. This is called yardstick competition (Shleifer, 1985). A recent example of a related regulatory instrument is the Danish Heat Supply Act reform of 2025 (§ 20a), which introduced price caps on heating tariffs (DEA, 2026) — though these fall short of strict price caps: If the utilities average heat price exceeds the cap over a period of three years, consumers must be awarded the right to disconnect from the heating network (i.e. the right to switch) and the companies must make a plan to reduce the costs. 2026 is the first year in which a price cap will be published.

Provided there is a good outside option, which can be broadly applied, this approach will lower regulatory costs. Implementation is straightforward. However, finding a reference price, and especially a cost-based reference price may be challenging. We see the following challenges and open issues in particular.

Firstly, if it is one and the same reference price for companies, the heterogeneity problem is not addressed adequately. If the reference price differs to account for heterogeneity, regulatory costs will increase. Secondly, if the reference price indeed conforms to yardstick competition, this is a strong form of efficiency regulation, and not a relaxed form of regulation as was intended. Thirdly, it needs to be decided how often and when the reference price(s) should be adjusted. What happens if the costs of the companies increase, but the reference price does not? Fourthly, preliminary experience in Denmark suggests that the level of the reference price itself can be affected by market parties (i.e. the reference cost of an individual heat pump increased significantly in the past years).

Overall, as a preliminary assessment, the approach with a cost-based reference price for KCW may work well and seems to be feasible, but, depending on the details, the approach is not without problems of its own.

5 Conclusions

This study aims at an exploration and evaluation of efficiency safeguards to complement the cost-plus approach for district heating network companies in the Netherlands, which is foreseen for large district heating networks (GCW) and heat transport operators (HTO). In total, six options – benchmarking, light-handed control of publicly or consumer-owned utilities, process review, tendering, sunshine regulation and sharing factors – for efficiency regulation were outlined and assessed with a focus on practicability (i.e. feasible implementation with reasonable effort) and effectiveness (i.e. achievement of cost-efficiency). The assessment of the options was differentiated for the group of large district heating networks (GCW) on the one hand and the heat transport operators (HTO) on the other hand, and it differs, in some cases significantly, between these two groups.

Benchmarking fails due to heterogeneity and the structure of individual cases. For both GCW and HTO, benchmarking receives the lowest effectiveness rating. Even though it is one of the most methodologically established tools, benchmarking is structurally unsuitable in the context of district heating due to strong heterogeneity. However, “soft” benchmarking (i.e. “soft” application of benchmarking results) can be useful to support options like the process review or sunshine regulation.

Public ownership reduces the need for regulation to some extent, but does not replace it. Public ownership – and, to a greater extent, consumer ownership – reduces the need for strict regulation, as the focus is more on social benefits and less on profit – but it is not a substitute for efficiency-regulation. One can draw an analogy with the electricity and gas networks in the Netherlands, which are regulated despite being fully state-owned. However, we need to differentiate. Whereas public-ownership will not be a justification for refraining from regulation for the publicly-owned large district-heating network companies, a stronger case to refrain from regulation can be made for consumer-owned utilities.

The regulation for electricity and gas networks in the Netherlands implements a process review to complement the cost-plus regulation. This process review, which is currently in development, contains three elements: 1. monitoring of cost and performance, 2. process-audit and 3. “investigation & intervention”, which is ex-post disallowance of cost as a measure of last resort. Overall, if well-designed, a process review can be quite effective as an efficiency safeguard, but possibly at the expense of high regulatory effort to get reliable data and at the risk of micro-management. It seems important to use the synergies with electricity and gas regulation.

Due to design restrictions leading to beauty contests and incumbent lock-in at contract renewal, effectiveness of tendering has limits and we cannot expect tendering to be an effective standing-alone efficiency safeguard. It supports other instruments. At the same time, tendering processes already exist and are common practice. Where tendering processes already exist, they will create pressure on cost-efficiency and should be used as efficiency safeguards. Possibly, tendering procedures can be improved within the regulation.

Sunshine regulation means the collection and publication of key performance and cost parameters. Sunshine regulation is relatively easy to implement and can provide incentives for efficiency – particularly in co-operative or local authority structures with strong local ties and

public ownership. However, sunshine regulation cannot be expected to be an effective efficiency regulation standing-alone, but it can usefully support other instruments.

The use of sharing factors is the most significant difference between GCW and HTO: For HTO, sharing factors are feasible and potentially effective, as an investment plan and a validation process are in place. For GCW the use of sharing factors can be ruled out for the time being due to a lack of data. Things may change in the future, as reliable data becomes available and networks start to mature. An important caveat of this option are strategic incentives, which must be actively addressed if considered for application to HTO.

Overall, we conclude:

- Due to strong heterogeneity, full-cost benchmarking is not a feasible option for the regulation of the district heating networks in the Netherlands at this moment.
- Public ownership, tendering and sunshine regulation are promising in their own right, but are not sufficiently effective to be efficiency regulation standing-alone. They can and will be useful to support other instruments though; public ownership, tendering and sunshine regulation (transparency) exist as it is and may as well be used and further developed.
- In principle, sharing factors can set strong economic efficiency incentives; however, data availability and reliability are crucial. Using sharing factors for GCW is not feasible in the short run, because data availability and reliability are currently poor. For HTO, data availability and reliability are better and applying sharing factors seems promising. We note that strategic incentives need to be addressed.
- The process review seems effective and feasible for both GCW and HTO. Surely, effectiveness will have limits, but support of other instruments mentioned above may give a strong overall package. As the process review is currently developed for the regulation of electricity and gas networks in the Netherlands, application to district heating networks exploits synergy effects.

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7 List of abbreviations

ACM – Autoriteit Consument & Markt

B2B – Business to business

Bcw - Besluit collectieve warmte

BNetzA – Bundesnetzagentur (German regulatory agency)

CAPEX – capital expenditure

DEA – Danish Energy Agency

DSO – Distribution system operator

FOCS – fixed OPEX CAPEX share

GCW - Grote Collectieve Warmtesystemen (large collective heatsystems; > in principle 1,500 connections)

HTO – Heat Transport Operator

KCW - Kleine Collectieve Warmtesystemen (small collective heatsystems; < 1,500 connections)

KPI – Key performance indicator

MCA – Multi criteria analysis

NMDA – niet meer dan anders (no more than otherwise)

OPEX – operating expenditure

PKR – Prozesskostenrechnung (process-cost cost accounting)

ROIC – Return on invested capital

TOTEX – total expenditure

TSO – Transmission system operator

WACC – weighted average cost of capital

Wcw - Wet collectieve warmte

WTS - WarmtelinQ Transport Services