

# APPENDIX A - TOWARDS A COMPREHENSIVE POLICY FRAMEWORK

DATA HEAT: Sector Coupling Data Centers and District Energy

February 2026



# 1 INTRODUCTION

Heating remains one of the slower sectors to decarbonize. Waste heat represents a potentially large but relatively untapped resource for decarbonizing heat at scale, especially low-temperature heat sources for use in buildings, greenhouses and aquaculture. Waste heat recovery can reduce or completely displace the primary energy (electricity, green gases and other primary energy sources) that would otherwise be required to produce low-carbon heat. It can also help alleviate growing pressure on electric grid capacity from the combined effects of economic growth, increased electrification, and rapid growth of data processing and storage.

With increasing digitalization and the introduction of AI, data centers represent a large and growing source of waste heat. They also consume a large and growing amount of electricity. Coupling the data, power, and heating sectors is a useful strategy for supporting digitalization, electrification, and decarbonization, while also managing pressures on electric grids and water supplies. But this coupling can have other benefits. For example, stakeholders interviewed for this project suggested that data center heat recovery can enhance the perceived benefits and local acceptance of data centers, possibly more than additional tax revenues or other sustainability initiatives by data centers such as investments in (often remote) green power projects. Opportunities for waste heat recovery can also be a tool for attracting data centers as part of local, state or national industrial development and data sovereignty policies.

Data center owners and operators increasingly face pressure from institutional investors, tenants, and corporate customers who have their own ESG commitments and sustainability reporting obligations. For hyperscale operators serving major tech companies, the ability to demonstrate tangible local benefits like heat recovery can be important for maintaining preferred supplier status with clients who must report Scope 3 emissions and demonstrate sustainable supply chain practices. Heat recovery offers a unique, quantifiable community benefit that resonates well in ESG disclosures, unlike renewable energy purchases that may occur far from the facility.

There are many examples globally of on-site or adjacent waste heat recovery, including within data centers. There are fewer examples of waste heat recovery at scale, particularly in North America. This is due to a variety of factors, including a lack of awareness, inadequate industry expertise and capacity, a lack of basic infrastructure (e.g., thermal energy networks<sup>1</sup>), a lack of established business models and contracting frameworks, policy misalignments, and poor market conditions (which may be due in part to policy misalignments). One critical policy misalignment is a lack of policies requiring both new and existing buildings to decarbonize, and where such policies exist a failure to recognize off-site waste heat recovery as a valid compliance mechanism. There are also tax and regulatory barriers to waste heat recovery in some jurisdictions.

A balanced and coordinated policy framework is essential to enable and promote waste heat recovery from data centers, and indeed all sources of waste heat. Achieving large-scale heat recovery will

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<sup>1</sup> Policies reviewed for this project use a variety of terms of shared thermal energy systems including thermal energy networks (TENS), district energy systems, and district heating or cooling networks. For this report (other than quotations from specific policies) we adopt the umbrella term of thermal energy networks (TENS) to refer to any system that interconnects shared thermal energy sources (including waste heat sources) with multiple end users. There are a variety of ways to design these systems (operating temperatures, distribution media, etc.). The detailed design should be driven by the local conditions and objectives, and the detailed design of individual systems is not particularly relevant for the general policies discussed here.

require a mix of direct and indirect policies. Broad policies may support all forms of waste heat recovery. More targeted policies focus on heat recovery from specific sources such as data centers (Figure 1). Indirect support can come from policies that stimulate investments in the basic infrastructure required for large-scale heat recovery such as thermal energy networks and intra-seasonal thermal energy storage. A balance of push and pull policies is often required. Policies that promote or require the provision of waste heat by producers are ineffective unless coupled with policies to stimulate the demand for waste heat by consumers (e.g., low-carbon building standards). Policies may include a mix of carrots (e.g., financial incentives) and sticks (e.g., regulations). Other enabling measures are critical such as information and awareness programs, reporting requirements, and new planning tools. No single policy instrument can deliver the transformation alone. A coherent and evolving policy mix is needed to align market signals, investment conditions, and institutional capacity over time, across sectors and among different levels of government.

All levels of government have a role to play in a coherent policy framework. National governments can play an important role in building awareness and establishing umbrella visions and guiding principles for both the heating sector and data centers. National governments can support early pilots of plans, policies and projects, and also help build industry capacity through workforce development and technical/commercial guidelines. They also have a role in providing capital, financial incentives or tax credits to support investments in thermal energy networks, intra-seasonal thermal storage, and heat recovery projects.

States or provinces can develop similar or complementary strategies and policies for their own jurisdictions. They also have a direct role in regional energy and infrastructure planning, which should consider data centers and waste heat recovery. And they play a direct role in the ownership or regulation of electric utilities, which must eventually align interconnection policies and rates with overarching heating or data center policies.

Local governments have an important role to play in local planning, zoning and permitting processes to support sustainable development of data centers, thermal energy networks, and waste heat recovery projects. They may also play a direct role in developing thermal energy networks or heat recovery projects.

States or provinces must ensure local governments have the necessary powers and tools to develop and implement plans or investments, along with the capacity and resources to use them. This could even include mandating their use (e.g., preparation of local heating and cooling plans). States or provinces must also ensure local data, objectives and plans are integrated into regional energy and infrastructure plans.

Higher levels of governments can support direct investments by local governments in thermal energy networks or waste heat recovery projects through grants or financing support. All levels of government have a role to play in aligning building codes, policies and practices with waste heat recovery policies. They can also align their procurement policies and processes to support waste heat recovery (e.g., in procurement of energy or digital services for public buildings and government operations).

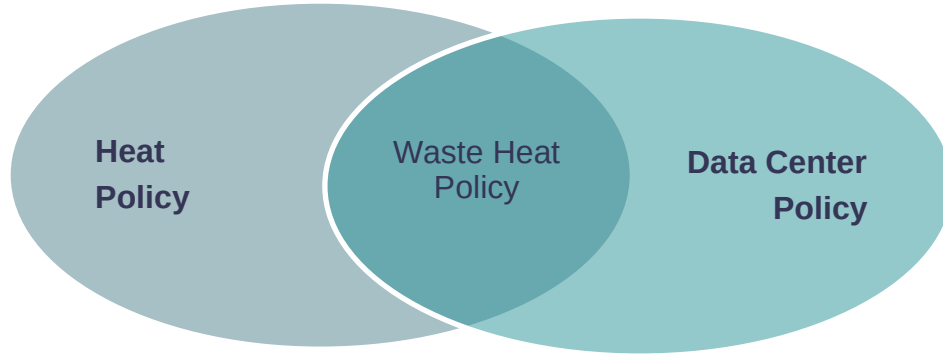
A balanced and coordinated policy framework for waste heat recovery should be evolutionary and adaptive. Early efforts must often focus on increasing awareness, removing administrative and technical barriers, increasing policy alignment, and “future-proofing” communities and data centers (or other large sources of waste heat) through siting and permitting (design) requirements to preserve promising opportunities for future heat recovery.

Early efforts should also include plans and policies that support investments in basic infrastructure such as thermal energy networks and intra-seasonable thermal storage. As markets, infrastructure, and institutional capacity mature, policy can transition toward more active stimulation of projects through incentives and regulations to promote or require heat recovery. A staged approach (often overlapping) recognizes that the ecosystem for waste heat recovery—spanning technology, business models, infrastructure, and governance—must evolve together, supported by a coherent and coordinated policy framework (Figure 2).

Many of these themes were flagged in interviews conducted as part of this project, including:

- The need for policies to ensure demand for waste heat (e.g., building policies) and more basic infrastructure to support heat recovery (i.e., thermal energy networks and seasonal thermal storage).
- The need for flexible and collaborative approaches to regulation, reflecting jurisdiction- and site-specific circumstances and stakeholder.
- The importance of energy planning and information for energy planning to support heat recovery.
- The value of public reporting requirements for data centers to support planning and create additional pressures on data centers.
- The need to influence upfront siting decisions for data centers to maximize future opportunities for heat recovery.
- The need for better metrics to incent heat recovery (e.g., replace, modify or supplement the Power Usage Effectiveness (PUE) metric commonly used by the data center industry and sometimes by governments in efficiency standards for data centers, which does not capture the benefits of heat recovery and in some cases can create disincentives for heat recovery).
- The value of future proofing data centers and communities for future heat recovery.

Figure 1: General vs Sectoral Policies affecting Heat Recovery from Data Centers



General Heat Policies	Data Centre Policies
<ul style="list-style-type: none"> <li>• Heat transition vision &amp; strategy (including definition/role of waste heat)</li> <li>• Low-carbon or electrification policies for new and existing buildings</li> <li>• Thermal energy network and heat recovery pilots</li> <li>• Technical &amp; commercial guidelines for heating infrastructure and resources</li> <li>• Regional energy plans</li> <li>• Local heating &amp; cooling plans</li> <li>• Neighbourhood transition strategies</li> <li>• Planning / development of thermal energy networks &amp; thermal storage</li> <li>• Regulation of waste heat (all sources)</li> <li>• Alignment of regulation and tax regime with heat transition</li> <li>• Tax credits, financial incentives, financing for heat transition strategies</li> </ul>	<ul style="list-style-type: none"> <li>• Sector vision &amp; strategy</li> <li>• Heat recovery pilots</li> <li>• Technical &amp; commercial guidelines</li> <li>• Public reporting requirements (electricity use, heat re-use, sustainability metrics)</li> <li>• Siting and permitting requirements (including design criteria)</li> <li>• Grid interconnection policies and procedures</li> <li>• Electricity rates</li> <li>• Regulation of waste heat</li> <li>• Tax credits, financial incentives, financing</li> </ul>

Figure 2: Evolutionary Approach to Heat Re-use Policies

	Immature Markets	Developing Markets	Mature Markets
Conditions	<ul style="list-style-type: none"> <li>Limited awareness</li> <li>Limited infrastructure and industry capacity</li> <li>Limited data or planning frameworks</li> <li>Poor policy alignment</li> <li>Poor market conditions</li> </ul>	<ul style="list-style-type: none"> <li>Good awareness among policy makers and industry</li> <li>Emerging infrastructure and industry capacity</li> <li>Improving data and planning processes</li> <li>Better policy alignment</li> <li>Better market conditions</li> </ul>	<ul style="list-style-type: none"> <li>Broad awareness</li> <li>Extensive infrastructure and industry capacity</li> <li>Good data and planning processes</li> <li>Established regional and local energy plans</li> <li>Good policy alignment</li> <li>Good market conditions</li> </ul>
Policy Focus	<ul style="list-style-type: none"> <li>Developing preliminary visions and policy frameworks (general and sectoral)</li> <li>Removing existing barriers to heat recovery</li> <li>Piloting plans, policies and projects in targeted locations</li> <li>Mapping heat demands and resources</li> <li>Establishing reporting requirements</li> <li>Building sector capacity</li> <li>Stimulating demand for waste heat</li> <li>Future proofing large heat sources (strategic siting and design decisions)</li> </ul>	<ul style="list-style-type: none"> <li>Refining visions and policy frameworks</li> <li>Preparing regional and local energy plans</li> <li>Developing basic infrastructure (thermal energy networks and storage)</li> <li>Deepening demand for waste heat</li> <li>Introducing limited regulations and financial incentives for waste heat producers</li> </ul>	<ul style="list-style-type: none"> <li>Updating visions and policy frameworks</li> <li>Updating regional and local energy plans</li> <li>Expanding basic infrastructure and industry capacity</li> <li>Strengthening sector integrations</li> <li>Expanding regulations and financial incentives for waste heat producers</li> </ul>

## 2 UMBRELLA STRATEGIES & POLICY FRAMEWORKS

Umbrella strategies and policy frameworks provide the foundation for a coherent mix of policies and programs to support large-scale waste heat recovery, including heat recovery from data centers. These can be developed by multiple levels of government. They can focus on the overall heat transition, or they can be targeted more directly at data centers. Below we provide examples of both.

### 2.1 EU Strategy on Heating & Cooling

Although heating and cooling are critical for achieving policy goals for net zero, affordability and energy security, important heating and cooling solutions such as thermal energy networks and waste heat recovery typically fall between the cracks in current energy policy and planning silos. As a result, decarbonization of electricity generation has proceeded far faster than the electrification or decarbonization of heating. Geopolitical concerns (energy security) have provided some support for new solutions to heating and cooling, but growing affordability concerns coupled with the increasing demands for electricity from data centers (which is exposing current infrastructure constraints and also putting some upward pressure on electricity rates) have created some further headwinds for the heating and cooling transition.

The 2016 EU Heating & Cooling Strategy remains one of the few examples of governments attempting to develop a more proactive and integrated transition strategy specific to heating and cooling.<sup>2</sup> This Strategy recommended actions to decarbonize heating and cooling across both buildings and industry, including maximizing reuse of waste heat and cold, as well as encouraging greater development of thermal energy networks, which are an important foundation for increased waste heat recovery at scale.<sup>3</sup> The Strategy also encouraged Member States to adopt integrated energy planning that specifically considers heating and cooling requirements and infrastructures, and also called for better data, mapping, and planning tools, such as heat atlases and energy system modelling that includes heat.

Although 2016 EU Heating & Cooling Strategy is a non-binding, transnational policy framework, the ideas were subsequently embedded into binding EU laws, especially in subsequent revisions to the EU's *Energy Efficiency Directive (EED)* and *Renewable Energy Directive (RED)*. For example, waste heat has been given significant attention in the European Union's latest Renewable Energy Directive 2023/2413 (RED III).<sup>4</sup> RED III defines waste heat as heat that is an unavoidable and unused byproduct in three specific sectors: industrial plants, electricity generation, and the tertiary (commercial) sector. This last sector encompasses includes data centers.

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<sup>2</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1575551754568&uri=CELEX:52016DC0051>

<sup>3</sup> The Strategy was supported by multiple regional studies and heat transition roadmaps prepared by Heat Roadmap Europe, which demonstrated the important roles of efficiency, thermal energy networks, and waste heat in the transition. See: <https://heatroadmap.eu>

<sup>4</sup> [https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive\\_en](https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive_en)

Article 25.6 of the revised EU Energy Efficiency Directive adopted in July 2023 requires member states to pass legislation that directs all municipalities with populations over 45,000 to prepare local heating and cooling plans.<sup>5</sup> Under the Directive, member states must also provide resources and support capacity for cities to fulfill this obligation. These plans aim to identify, prioritize and utilize local clean and renewable heating and cooling sources by area of the city, including waste heat. Based on this requirement and following the lead of several German states with existing mandates for heat planning, Germany established a nationwide heat planning obligation for all cities since January 2024. Cities with a population of more than 100,000 must draft heat plans by 2026. Smaller cities with more than 10,000 inhabitants must draft plans by 2028. Planning is supported by a national Municipal Heat Transition Competence Centre (KWW) and similar agencies set up by some individual states.<sup>6</sup> Seven other Member States have now transposed article 25.6 into national law or have the appropriate legal frameworks (France, the Netherlands, Denmark, Croatia, Hungary, Estonia, and Finland).<sup>7</sup>

The EU recently launched a call for evidence and public consultation to inform an updated Heating and Cooling Strategy (closing end of November 2025).<sup>8</sup> Planned for publication in the first quarter of 2026, an updated EU Heating and Cooling Strategy is expected to support the implementation of current legislation to accelerate decarbonization of the sector and also improve efficiency and system integration through more integrated planning of energy infrastructure, TENS development, and waste heat recovery. Among proposed strategies, the EU is proposing strategies to ensure better system integration including improvements to local heating & cooling plans, better integration of heat planning with electricity system planning (e.g., better coordination of investments in thermal energy networks and electric grids; more interaction between thermal energy networks and electric grids through demand flexibility and thermal storage). With respect to waste heat, the EU is also exploring how to remove remaining regulatory barriers, strengthen the business case for waste heat recovery and better map waste heat recovery potential.

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<sup>5</sup> <https://data.consilium.europa.eu/doc/document/PE-15-2023-INIT/en/pdf>

<sup>6</sup> <https://energy-cities.eu/countries/germany>

<sup>7</sup> <https://energy-cities.eu/energy-cities-calls-out-missed-opportunities-by-member-states-to-support-local-heating-and-cooling-planning/>

<sup>8</sup> [https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14818-Energy-Heating-and-Cooling-Strategy\\_en](https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14818-Energy-Heating-and-Cooling-Strategy_en)

**Textbox 1: Definitions & Accounting Issues for Waste Heat**

Clear definitions and accounting policies for waste heat are important for developing coherent policies and programs. Ambiguities or inconsistencies in definitions or accounting policies can create policy misalignments, and in turn uncertainty for project developers. Waste heat is commonly defined as an **unintended, unavoidable and unused byproduct** of some other (primary) process or activity. But there are many possible interpretations of these criteria. In the case of data centers, there is a debate about the extent to which some types of data processing (e.g., crypto mining) are publicly desirable or truly unavoidable. Several jurisdictions have put caps on or suspended connections of crypto miners (including British Columbia and Quebec) or removed or tightened the tax advantages provided to other types of data centers (e.g., Sweden and Norway). Another question is whether the waste heat from data centers should be evaluated against some minimum efficiency criterion for data processing and cooling systems to ensure they are not producing more waste heat than necessary. Another question arises whether on-site heat recovery should be treated as an efficiency measure and given preferential treatment to off-site heat recovery. Ideally, policies would support the approach that both maximizes waste heat recovery and allocates it to the highest and best uses.

There is sometimes a debate about whether waste heat policies should also distinguish between waste heat derived from activities or processes that use fossil fuels (including data centers powered by gas-fired generation) and waste heat derived from activities or processes powered entirely or mostly from renewable or low-carbon energy sources. RED III does not consider the primary energy source within the definition of waste heat. The assumption is that if waste heat is unavoidable, recovery has benefits regardless of the primary energy source. Further, precluding heat recovery is unlikely to change the use of fossil fuels in the primary activity, particularly if these are permitted in policy or law. More direct regulation or economic penalties for the use of fossil fuels in those processes is likely required. In the meantime, heat recovery can still reduce overall emissions and will continue to have benefits if and when fossil fuel use is reduced or eliminated in the primary process.

For the reasons noted above, waste heat is generally considered zero-emission heat, regardless of the source of energy for the primary process or activity. This is because recovery does not produce any new emissions. An exception is where a heat pump is required to raise the temperature of waste heat. The emission factor for electricity used in the heat pump would normally be included in the GHG signature of the recovered heat. There could also be a small amount of GHG emissions associated with the distribution of waste heat (e.g., electric water pumps). These emissions are often far less than gas-fired heat, and often lower than using electricity to produce heat from ambient sources of energy at a lower efficiency (e.g., air source heat pumps).

**Textbox 1 continued**

Although waste heat recovery may not create any new emissions, contracts for waste heat may allocate some of the GHG benefits to the producers of the waste heat. In the absence of other regulations or incentives, some sharing of GHG benefits may be required to incent the producer to make its waste heat available. However, the extent of these contractual reallocations may also be constrained by the regulatory requirements on consumers of waste heat. For example, a building that has a zero-emission mandate cannot purchase heat with a positive GHG emission factor. However, buildings that have less stringent requirements may be able to share GHG reductions with the providers of waste heat. The goal of these reallocations is to create a win-win situation for the producer and consumer of the waste heat in order to increase project viability. Most GHG accounting protocols and regulations would preclude double counting of emission reductions. However, there may be (temporary) exceptions for double counting to help stimulate waste heat recovery.

### Textbox 2: ESG Commitments as Drivers for Data Center Heat Recovery

ESG (Environmental, Social, and Governance) commitments are becoming increasingly material for data center owners and operators. Major institutional investors, including pension funds and sovereign wealth funds that finance data center infrastructure, now routinely screen investments against ESG criteria. Real estate investment trusts (REITs) specializing in data centers face growing pressure to demonstrate sustainability performance.

Heat recovery addresses multiple ESG dimensions simultaneously:

- **Environmental:** Reduces overall energy system emissions and improves resource efficiency beyond what renewable energy procurement alone can achieve.
- **Social:** Provides tangible community benefits, improving local acceptance and the “social license to operate.”
- **Governance:** Demonstrates proactive engagement with emerging regulations and stakeholder expectations.

ESG reporting frameworks relevant to data centers include CDP (formerly Carbon Disclosure Project), GRI Standards, SASB (now part of ISSB), and the emerging CSRD requirements in the EU. The EU’s reporting requirements for data centers (discussed elsewhere in this report) are increasingly being used by investors to compare ESG performance across operators. Operators with strong heat recovery metrics may benefit from lower cost of capital, improved tenant relationships, and reduced regulatory risk.

The interaction between policy frameworks and ESG commitments merits ongoing attention. Well-designed policies can provide standardized metrics, clear expectations, and regulatory certainty that support robust ESG reporting by data center operators. This in turn enables market-based incentives through investor pressure, tenant requirements, and green financing (e.g., sustainability-linked bonds). The most effective policy frameworks may be those that create transparency and establish minimum standards while leaving room for operators to exceed requirements in pursuit of competitive ESG positioning. As ESG reporting frameworks mature and investor scrutiny intensifies, the reputational and financial value of demonstrable heat recovery may increasingly complement, or even exceed, the direct economic value of heat sales.

## 2.2 National Data Center Strategies

National data center strategies offer a complementary but sector-specific vision and umbrella policy framework to promote digitalization, infrastructure development, and data sovereignty, while also ensuring sustainability and community benefits, including heat recovery from data centers. There are limited but useful examples of such strategies.

Norway has been actively courting data centers since the mid-2010s, highlighting its cheap and flexible hydropower, cool climate and secure infrastructure. Early national guidance framed data centers primarily as an economic opportunity.<sup>9</sup> In 2018, Norway launched one of the world's first national data center strategies (*Norwegian data centers – sustainable, digital powerhouses*). The first iteration of this strategy aimed to position Norway as an attractive jurisdiction for data center developers to boost jobs and support the digital economy. In 2021, the Norwegian government updated its data center strategy to address emerging challenges and ensure sustainable development of the sector.<sup>10</sup> The updated strategy sought to balance rapid growth of hyperscalers and AI workloads with other national goals, including security and sustainability. The updated strategy included commitments to:

- Strengthen marketing of Norway as a data center location.
- Increase competitiveness through:
  - Stable framework conditions for data center development,
  - Streamlined transmission network development,
  - Increased workforce skills and capacity in Norway, and
  - Partnership agreements with educational institutions in Norway.
- Facilitate sustainable development through:
  - A national heat map to support better utilization of waste heat,
  - Requirements for utilization of waste heat, and
  - Regulations to ensure digital security, combat crime and protect national security interests.
- Reinforce the digital foundation including:
  - Risk and vulnerability analyses for core infrastructure,
  - Commercial expansion of networks connecting Norway to other countries,
  - State grants for rural broadband expansion, and
  - Continued long-term state investment in fiber infrastructure.

In 2024, the Norwegian government published a national digital strategy (*The Digital Norway of the Future*).<sup>11</sup> The strategy seeks to make Norway the most digitalized nation by 2030 through expanded digital infrastructure, improved data, better trust and security measures, new business innovation, digital transformation of public services, and increased sustainability. In October 2025, Norway released the latest update to its national data center strategy (*The data center industry - a sustainable*

<sup>9</sup> [https://www.oecd.org/content/dam/oecd/en/publications/reports/2024/06/shaping-norway-s-digital-future\\_d6492358/d3af799c-en.pdf](https://www.oecd.org/content/dam/oecd/en/publications/reports/2024/06/shaping-norway-s-digital-future_d6492358/d3af799c-en.pdf)

<sup>10</sup> <https://www.regjeringen.no/contentassets/0eabdbcbfb2540699466a4a1a801d737/en-gb/pdfs/h-2510-e-datasenterstrategi.pdf>

<sup>11</sup> [https://www.regjeringen.no/contentassets/c499c3b6c93740bd989c43d886f65924/en-gb/pdfs/digitaliseringsstrategi\\_eng.pdf](https://www.regjeringen.no/contentassets/c499c3b6c93740bd989c43d886f65924/en-gb/pdfs/digitaliseringsstrategi_eng.pdf)

*industry of the future for the digital Norway*).<sup>12</sup> The latest strategy recognizes the data center industry as a key enabler of a digitalized Norway. Among other things, the updated strategy reframes data centers from being primarily an economic benefit to being critical infrastructure that must deliver societal value (support digitalization, jobs, security, sustainability) and fit with national energy and resilience needs. The updated strategy introduces even stronger government control and transparency. For the first time the government sets enforceable requirements (registering centres, security obligations) and signals legal changes to give authorities tools to manage grid access in exceptional circumstances. The strategy also introduces a temporary ban on new high-energy proof-of-work crypto-mining activities within data centers and moves to use planning law and reporting obligations to restrict such activity. The new or strengthened emphasis on (1) security & preparedness, (2) value creation for local communities, (3) low climate/environmental footprint, and (4) transparency for planning & grid management is reflected in more concrete actions than in earlier iterations of the strategy:

- New registration requirements for data centers >500 kW to increase transparency for local planning, security and grid management.<sup>13</sup>
- Clearer security and preparedness requirements for centers now regarded as critical infrastructure.
- Better utilization of excess heat from data centers, including explicit demands that new data centers consider supplying heat for TENs or other local uses where feasible.
- Requirements for data centers to demonstrate value creation for local communities, including heat reuse.
- Proposed amendments to the Energy Act (sent to hearing in June 2025) that would give stronger legal basis for prioritising electricity supply in exceptional situations and managing grid capacity (e.g., allowing authorities to prioritise socially critical uses of electricity over certain data center loads when necessary).

It is difficult to isolate the effects of Norway’s data center strategy on the industry, but some recent statistics suggest rapid growth since 2018. In 2019, Norway had the second lowest qualified supply among all the Nordics.<sup>14</sup> Between 2019 and 2024, Norway’s cumulative annual growth rate for qualified supply was 43%, exceeding all other Nordic countries. As of 2024, Norway had the highest qualified supply among all the Nordics. Norway now has the third highest qualified supply of European countries outside the traditional data center hubs of Frankfurt, London, Amsterdam, Paris, and Dublin.

Norway’s progressively stronger requirements for transparency, local value creation, and heat recovery align with broader ESG trends in the data center sector. The 2025 strategy’s registration requirements and emphasis on demonstrable community benefits respond to both regulatory and

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<sup>12</sup> [https://www.regjeringen.no/contentassets/dff2f4dc656043be9ad5837ebbca6fae/en-gb/pdfs/datasenteraeringa-strategi-eng.pdf?utm\\_source=chatgpt.com](https://www.regjeringen.no/contentassets/dff2f4dc656043be9ad5837ebbca6fae/en-gb/pdfs/datasenteraeringa-strategi-eng.pdf?utm_source=chatgpt.com)

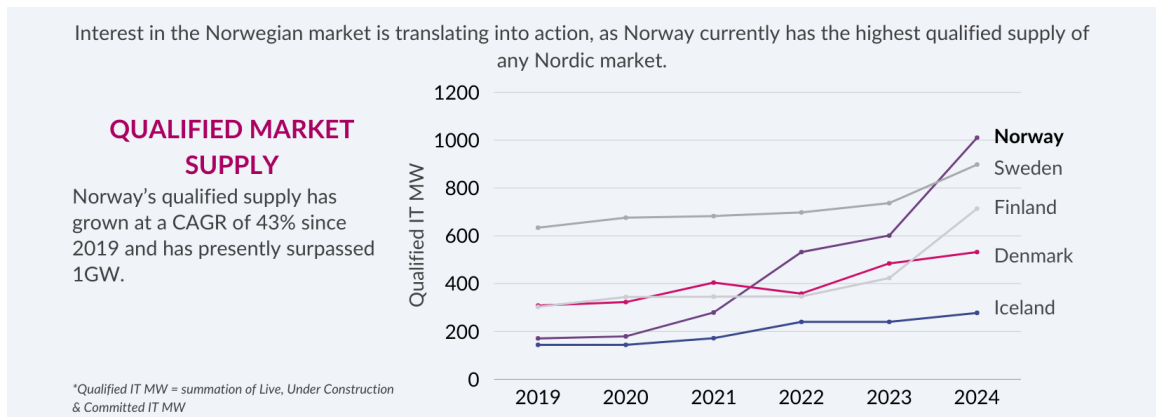
<sup>13</sup> The strategy notes that Norway is seeing very large capacity requests (GW scale) with hundreds of requested MWs in queue. Grid capacity, interconnection queueing, and regional impacts are seen as increasingly important issues. The strategy seeks to link new registration/transparency to better grid planning.

<sup>14</sup> Qualified supply refers to the sum of live, under construction and committed IT capacity in MW.

investor expectations. Data center operators can leverage compliance with Norwegian requirements as evidence of strong ESG governance for international investors and corporate tenants.

Despite the focus on heat recovery and local benefits in Norway’s data center strategy, Norway has far less extensive TENs compared to other Nordic countries. Most existing or planned connections of data centers to TENs are currently located in greater Oslo. Norway also has examples waste heat from more remote data centers being used for wood drying and aquaculture. According to the 2023/24 annual report of the Norwegian Datacenter Industry (Norsk Datasenterindustrien), 9 out of the 18 largest data centers in Norway had some form of heat recovery, with more in planning.<sup>15</sup>

Figure 3: Data Centers in Norway<sup>16</sup>



<sup>15</sup><https://static1.squarespace.com/static/6129463e215bea534c574c7f/t/65af9080f355fa3c6d5fbd3c/1706004611208/The+Norwegian+Datacenter+Industry+2023-2024.pdf>

<sup>16</sup> <https://www.dcbYTE.com/market-infographics/data-centres-in-norway/>

**Textbox 3: An Overview of Danish Policy**

Denmark does not have a national data center strategy like Norway, although several stakeholders interviewed for this project expressed interest in developing such a strategy for Denmark. However, Denmark has a long tradition of policies targeted specifically at the heating sector. Denmark was also a pioneer of local heat planning. One outcome of these early policies and plans is extensive TENS infrastructure, which provides an important foundation for large-scale waste heat recovery. Indeed, many of these systems are already recovering waste heat from electricity generation.

In recent years, national/local heat policies and plans have shifted towards reducing GHG emissions. Denmark’s current climate action strategy includes expanding TENS, phasing out fossil fuels for heating, and supporting heat pumps.<sup>17</sup> Low-carbon waste heat is expected to play a much larger role in TEN supply in coming years, particularly with the reduced reliance on thermal power plants and concerns about the sustainability of heavy reliance on imported wood waste.<sup>18</sup> Danish policy and municipal heat planning both encourage the capture and integration of waste heat, and Denmark has multiple operational waste heat projects, including heat recovery from data centers. That said, waste heat from data centers must still compete with other sources of low-carbon heat, including other waste heat sources.

Despite extensive TEN infrastructure (a significant advantage relative to other jurisdictions without such extensive networks), there have still been some challenges for integrating low-grade waste heat in Denmark, which the government and industry have been working to address. For example, network operators have been working to lower operating temperatures to facilitate efficient waste heat recovery. This requires changes to both networks and connected buildings. Until recently there were also financial and regulatory barriers for waste heat recovery in Denmark. Until 2021, Denmark applied an “excess-heat tax” which made selling or re-using process heat uneconomic or administratively complex for many waste heat suppliers. There was also uncertainty whether electricity-based processes (e.g. data centers) triggered energy taxes when their heat was reused or sold, discouraging electrified sources of surplus heat. As part of climate/energy policy changes at the end of 2021, Denmark reworked the excess-heat taxation regime (law nr. 2606 of 28 Dec 2021). Beginning January 2022, the excess-heat tax rates were reduced, and a certification regime was introduced so that certified suppliers (especially suppliers of heat from electrically driven processes that meet certain criteria) could be exempt or face much lower charges. These reforms also cut back heavy reporting requirements and simplified administrative procedures around utilizing excess heat.

<sup>17</sup> [https://www.europarl.europa.eu/RegData/etudes/BRIE/2024/767173/EPRS\\_BRI\(2024\)767173\\_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2024/767173/EPRS_BRI(2024)767173_EN.pdf)

<sup>18</sup> <https://vbn.aau.dk/en/projects/varmeplan-danmark-2021-en-klimaneutral-varmeforsyning>

An additional barrier to waste heat recovery was regulations governing what costs district heating companies (TEN owners) could incur and recover in rates for waste heat recovery. The initial ceiling methodology introduced by the regulator, Forsyningstilsynet, was criticized as a barrier to economic waste heat recovery. In early 2025 the government and industry stakeholders agreed to remove the surplus-heat price cap to allow market negotiation and improve incentives to capture and value surplus heat.

One stakeholder interviewed for this project noted that Denmark (along with Sweden and Italy) has implemented a single point of contact for large projects to navigate government support and approvals among all departments and all levels of government. This was noted as a useful tool for data center development, reducing bureaucratic hurdles and accelerating project timelines. This single point of contact could also provide guidance or support for heat recovery.

### 3 INDIRECT POLICY SUPPORT & ALIGNMENT

There are indirect supports and policies that are often preconditions for advancing heat recovery at scale through more targeted policies. Although many data centers seem willing to offer their waste heat at no or low cost, even without being compelled to do so, they often lack adequate consumers and supply infrastructure (thermal energy networks) to justify the effort. Indirect policies are required to stimulate demand for waste heat and increase availability of thermal energy networks to support waste heat recovery. More integrated and local energy planning is important to guide these policies and investments.

#### 3.1 Building policies, standards, codes and incentives

A market for waste heat requires a value proposition for off takers. While waste heat may be competitive with heat derived from fossil fuels in some locations and applications, there is more often a capital and/or operating premium for low-carbon heat sources such as waste heat. While some companies and businesses may be willing to pay a voluntary premium, there is often insufficient voluntary demand for significant projects, particularly if new infrastructure such as thermal networks is also required.

Policy makers can stimulate demand for waste heat through a variety of measures including restrictions on fossil fuel use for heating, taxes on fossil fuels for heating, or building policies requiring electrification or lower carbon emissions (which can be achieved through electrification or other means).<sup>19</sup> While electrification or low-carbon heat requirements are becoming more common for new buildings, similar policies are also required for existing buildings in order to meet future net zero goals and stimulate adequate demand for large waste heat recovery projects (outside large master planned communities or other special situations).<sup>20</sup> There are still few examples of direct electrification or low-carbon heating requirements for existing buildings, particularly in North America. New York City's Local Law 97 is the highest-profile example of regulations to reduce GHG emissions for existing buildings.<sup>21</sup> Other examples include Boston's Building Emissions Reduction and Disclosure Ordinance

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<sup>19</sup> Similar policies may also be required for industrial and commercial loads (e.g., to encourage waste heat demand in aquaculture, greenhouses or lower temperature industrial processes such as drying wood).

<sup>20</sup> Large institutions are possible early off-takers for waste heat since many large institutions have existing thermal energy networks (although heat recovery may initially be constrained by technology or operating temperatures of in these systems) and voluntary net zero commitments.

<sup>21</sup> <https://www.nyc.gov/site/buildings/codes/l197-greenhouse-gas-emissions-reductions.page>

(BERDO) 2.0,<sup>22</sup> Washington D.C.'s Building Energy Performance Standard (BEPS),<sup>23</sup> and Seattle's Building Emissions Performance Standard (BEPS).<sup>24</sup>

Even where jurisdictions have electrification or low-carbon heating requirements for buildings, the design of many building policies, standards, codes and incentives may be biased against off-site heat recovery or not even recognize off-site heat recovery as a compliance option. For example, on-site heat recovery from sewage leaving a building often receives greater recognition in building policies and incentives than purchased heat from a much larger, more efficient and more consistent off-site sewer heat recovery project, or other forms of waste heat recovery. Building policies and incentives based on primary energy use or carbon savings could level the playing field between off-site heat recovery and on-site efficiency strategies. Stronger and more aligned building policies are required to increase demand or reduce demand risk for waste heat recovery projects.

Some jurisdictions have also created renewable energy targets or carbon limits for thermal energy networks.<sup>25</sup> These can help stimulate demand for waste heat, but they cannot entirely replace the requirement for policies targeted directly at buildings. In the absence of building policies, some consumers could simply leave thermal energy networks to install cheaper fossil-fuel based solutions on site. Further, performance requirements for thermal energy networks must consider the regulatory requirements for different types of buildings. For example, setting minimum standards based on new building requirements may create barriers to connecting existing buildings with lower standards. The different requirements for new and existing buildings could be managed through green heat rates that allocate different mixes of heat sources to consumers based on their individual regulated requirements or voluntary commitments.

### 3.2 Thermal energy networks

A lack of existing TENS can be a major impediment to large-scale waste heat recovery in the near term. This can also create the classic chicken and egg problem where the viability of heat recovery is limited by a lack of thermal energy networks (and off takers for low-carbon heat) while the lack of existing waste heat recovery could be an impediment to the development of those thermal energy networks (and off takers). General support for thermal energy networks (policy, regulation and funding) is an important but indirect enabling strategy for waste heat recovery. Thermal energy

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<sup>22</sup> <https://www.boston.gov/departments/environment/berdo>

<sup>23</sup> <https://dc.beam-portal.org/helpdesk/kb/BEPS/>

<sup>24</sup> <https://www.seattle.gov/environment/climate-change/buildings-and-energy/building-emissions-performance-standard>

<sup>25</sup> The EU's revised Energy Efficiency Directive (EU) 2023/1791 establishes a progressive definition of "efficient district heating and cooling" with escalating thresholds toward full decarbonization by 2050. Member states can demonstrate compliance using either of two pathways: proportions of renewable energy, waste heat, and cogenerated heat, or alternatively through grams of CO<sub>2</sub>/kWh emissions intensity. However, many member countries have yet to translate these requirements into national law. Direct regulation of TENS can also be unnecessary or in conflict with direct regulation of emissions from buildings. Emission requirements for TENS and for buildings should be considered in parallel to minimize redundancies and conflicts.

networks contribute to a more flexible, resilient and low-carbon energy system, regardless of the exact mix of energy sources. Recognition of the broader benefits of TENs can reduce the economic barriers to individual heat recovery projects. As illustrated in other jurisdictions with more extensive thermal energy networks, waste heat recovery can scale rapidly when this basic infrastructure is already available (e.g., Denmark, Sweden, Finland and Iceland as examples).

The full scope of policies and programs to support thermal energy networks is beyond the scope of this project. However, there are some important interactions between policies for thermal energy networks and strategies for waste heat recovery. Many jurisdictions have implemented or are considering the introduction of regulation of thermal energy networks. This can benefit not only consumers (transparency, price protections, security of supply, etc.) but also investors (regulation may enhance voluntary connections or be a precondition for implementing strong connection policies to reduce demand risks for new systems). The design of regulations for thermal energy networks can affect the viability of waste heat projects. As noted previously in the case of Denmark, cost of service regulation and price caps may inadvertently constrain the development of beneficial heat recovery projects. Regulation may also support heat recovery through performance standards for thermal energy networks (ideally aligned with policies for connected buildings) as well as open access policies for thermal energy networks. Open access policies are requirements for thermal network operators to consider or allow the injection of waste heat. This is often only possible in large, interconnected heat networks with many customers. There may also be constraints on the price waste heat providers receive. This may mirror requirements on waste heat producers to make their waste heat, when requested. While not a blanket, binding mandate, EU's revised EED, Article 24 ("Efficiency in Heating and Cooling") strengthens obligations on Member States to promote the use of waste heat and cold and to ensure that TENs systems progressively open access to third parties where it is technically and economically feasible.

### 3.3 Energy Planning Frameworks

Regional and local energy plans (e.g., local heating & cooling plans or local area energy plans) are crucial to support the development of thermal energy networks and large heat recovery projects. These plans provide insights on existing heat demands and energy infrastructure (including electric grid capacity and constraints). They can also indicate areas of high growth in heating demand. They can be used to identify the least cost pathways to heat decarbonization in specific zones, including the most promising areas for developing thermal energy networks. Benefits of local planning can be enhanced through collaboration with electric and gas grids. Local energy plans can help to reduce or avoid electric grid upgrades and upward pressure on electric rates (through thermal networks, waste heat, energy storage, targeted efficiency and DSM activities, and coordinated heating system transitions). They also be used to prioritize grid upgrades, and to target retrofit or conversions strategies to maximize the utilization of those upgrades. They can also be used to coordinate decarbonization and electrification (including indirect electrification through thermal energy networks) with the pruning of gas grids. Finally, regional and local area energy plans are essential for future proofing communities for waste heat recovery if used to guide siting (and design) decisions for large waste heat sources based on anticipated development and optimal decarbonization pathways for individual neighbourhoods or zones.

## 4 TARGETED HEAT RECOVERY POLICIES

In addition to the supporting policies highlighted in Section 3, new targeted policies, regulations and programs are also required to enable or promote waste heat recovery, including waste heat recovery from data centers. These measures can be broadly grouped into the following categories: 1) information, awareness & capacity building; 2) local zoning & approvals; 3) regulation; and 4) financial measures (including penalties, incentives and other financial support). While these measures can apply to a variety of waste heat sources, we focus here mostly on examples targeted at data centers, where available.

The measures discussed below are not mutually exclusive. As noted in Section 1, a balanced and coordinated package of measures is required to realize the full potential of waste heat recovery. The design and mix of these measures should change over time as the sector matures. Regulations or incentives to require or encourage data centers to provide waste heat may be premature or ineffective if there is inadequate demand or infrastructure to support heat recovery.

One stakeholder interviewed for this project noted that policies should recognize that heat recovery is not always economically viable everywhere (e.g., locations without TENs or other potential off-takers), so requirements should be flexible and allow for alternative investments where heat reuse is not practical. This stakeholder emphasized that regulatory frameworks should apply common sense, be as simple as possible, and tailor requirements to varying local conditions and stakeholder needs. Close collaboration with industry associations (e.g., European/National Data Center Associations) is key for effective advocacy and policy input.

The measures reviewed in this section are informed by literature, interviews with industry stakeholders, and our own direct experience with projects and policies. Most implementation examples are from Europe. Policies in North America are less developed, due in part to the less favorable market conditions, lower penetration of supporting infrastructure, and lack of formal planning processes to support heat recovery.

### 4.1 Information, Awareness and Capacity Building

Information, awareness and capacity are a critical foundation and important early intervention to enable and promote large-scale waste heat recovery, including from data centers. Awareness of the potential for and benefits of waste heat recovery is essential to secure buy in from policy makers and other stakeholders for further efforts to remove barriers and develop more proactive visions and policies for the sector. Information gaps often hinder planning and investment. Capacity is required to seize available opportunities and develop new ones. This includes skills and resources for planning and project development. Established planning, technical and commercial frameworks for heat recovery are required to accelerate and scale heat recovery. Standardized business models and contractual frameworks, tailored to individual jurisdictions, are particularly rare still.

Some key measures to build awareness, information and capacity include the following:

### 1) Pilots

Given a lack widespread infrastructure or well-developed markets, the near-term potential for heat recovery projects may be limited. Well-designed pilots are still possible and often crucial to showcase the technical and economic viability of heat recovery. Pilots can serve as real-world examples, building confidence and momentum among policy makers, investors and other stakeholders for additional policies and investments. Pilots are also important to demonstrate viability within a specific jurisdiction, and to help tailor planning, technical, and commercial frameworks to that jurisdiction. Pilots should focus on the most promising opportunities, ideally in locations with existing leadership and infrastructure. In very immature markets, pilots of thermal energy networks or local heating & cooling planning may need to be initiated in advance of heat recovery pilots. Alternatively, pilots of heat recovery may be bundled with pilots of basic infrastructure and planning frameworks. Pilots of neighbourhood-scale decarbonization are particularly useful for illustrating planning, thermal energy networks and waste heat recovery strategies as a single package.

### 2) Mapping and Reporting Mechanisms

Adequate data is often a barrier to planning for heat recovery. Mapping existing and anticipated heat demands and heat sources is often the first step to more proactive heating & cooling plans that consider optimal pathways, policies and investments for decarbonizing heating and cooling, including waste heat recovery. However, stakeholders noted there are often data gaps in initial mapping exercises (e.g., existing utility infrastructure), particularly in mapping exercises led by local governments. Many initial mapping exercises are also static. Maps must eventually be fully digitized and linked to real-time data on development, community plans, and existing infrastructure to allow data sharing (e.g., between local governments and utilities) as well as more regular and coordinated updates to plans and policies for decarbonizing heating and cooling.

In addition to mapping, some jurisdictions have established mandatory reporting requirements on energy use and available waste heat for large waste heat producers such as data centers. Such information is essential for identifying heat recovery opportunities and informing ongoing policy decisions. For example, the EU's revised Energy Efficiency Directive (EU Directive 2023/1791) and the associated Commission Delegated Regulation (2024/1364) requires data centers with an installed IT power greater than 500kW to provide an annual report that includes:

- Name of data centre, owner/operator, date started, and municipality or location;
- Floor-area and installed IT power demand (in kW);
- Type of data centre (enterprise / colocation / co-hosting; and
- Data on Key Performance Indicators (KPIs) for data processing, energy use, water use, waste heat production and use, and overall sustainability, including PUE (Power Usage Effectiveness), WUE (Water Usage Effectiveness), Energy Reuse Factor (ERF) or

equivalent (waste heat reuse), and Renewable Energy Factor (REF) or similar indicator for renewables energy shares.<sup>26</sup>

This information must be submitted in digital form to the relevant national energy authority and some of these data must also be made public on the data center’s website. The EU also publishes these data in aggregated form. Several stakeholders interviewed for this project suggested that these new reporting requirements have stimulated increased awareness and scrutiny of data center operations, and this scrutiny has also increased the interest of data centers in improving these KPIs, including heat recovery, as a means of building or maintaining public support and confidence in the industry. Many stakeholders noted public relations is currently a key motivator for heat recovery from data centers.

The EU’s mandatory reporting requirements also have implications for ESG reporting. Many data centers are now incorporating the mandated KPIs (PUE, WUE, ERF, REF) into their broader sustainability disclosures and ESG reports. The Energy Reuse Factor (ERF) provides a standardized metric that investors and tenants can use to compare heat recovery performance across facilities and operators. This creates a feedback loop where public disclosure drives competitive pressure for improved performance. Some industry observers suggest that voluntary ESG commitments by data centers, reinforced by investor and tenant pressure, may prove as effective as regulations in driving heat recovery adoption—particularly in jurisdictions without strong regulatory frameworks.

### 3) Planning, Technical and Commercial Guidelines

Governments can support new technologies and approaches by creating and disseminating frameworks and best practice guides to support planning, technical design and commercial arrangements. These may be targeted at municipalities (e.g., heat planning guidelines and case studies), waste heat producers (e.g., data centers) and/or possible users of waste heat (e.g., TENS and other potential users such as agricultural users). Guidelines can help standardize technical and commercial approaches to waste heat recovery, reduce development costs, and support widespread adoption of best practices. Many such guidelines have already been developed but these must often be further tailored to specific jurisdictions and sometimes sectors. Technical guidelines tailored to local conditions and applications can be of value, but many people interviewed for this project also noted a need for more commercial guidance to support implementation of heat recovery projects.

The EU has funded numerous case studies and handbooks to support waste heat recovery from a variety of sources.<sup>27</sup> There are a variety of technical guidelines available for heat recovery from data centers, but stakeholders interviewed for this project highlighted a need for more commercial guidance

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<sup>26</sup> Some stakeholders interviewed for this project noted possible conflicts among some KPIs for data centers which may not be conducive to heat recovery. For example, heat recovery improves performance on ERF but can have a negative impact on PUE. The industry and regulators need to consider what is a more important criterion for evaluating overall sustainability of data centers.

<sup>27</sup> For example:

[https://api.euroheat.org/uploads/Re\\_Use\\_Heat\\_Handbook\\_For\\_Increased\\_Recovery\\_of\\_Urban\\_Excess\\_Heat\\_c050f4a3fe.pdf](https://api.euroheat.org/uploads/Re_Use_Heat_Handbook_For_Increased_Recovery_of_Urban_Excess_Heat_c050f4a3fe.pdf); [https://heatleap-project.eu/wp-content/uploads/2023/06/HEATLEAP\\_Policy\\_Paper\\_7-June-2023.pdf](https://heatleap-project.eu/wp-content/uploads/2023/06/HEATLEAP_Policy_Paper_7-June-2023.pdf)

including some standardization of business models and commercial contracts, tailored to individual jurisdictions. However, there is a challenge creating best practices or templates for commercial arrangements where the full contracts for many existing arrangements are confidential. However, the Danish Data Center Association is working on developing standard, "copy-paste" contract models to simplify and speed up the process of setting up heat recovery agreements between data centers and TENS.

#### 4) Training

Training programs for data center operators, local authorities, and energy utilities are vital to build the necessary skills for implementing waste heat recovery. Engaging stakeholders through workshops and collaborative platforms can foster partnerships and facilitate knowledge exchange. This should include learning from local pilot projects and knowledge transfer from more jurisdictions with more advanced jurisdictions.

## 4.2 Local Zoning & Permitting

As noted in Section 3, local (and regional) energy planning is an important tool for local governments to promote and facilitate waste heat recovery. These plans can inform local zoning and permitting processes and conditions for data centers (or other large waste heat sources) in order to influence siting and design decisions to maximize and preserve opportunities for heat recovery. For example, zoning and permitting processes can encourage or require co-location of data centres in areas with adequate grid capacity, high projected heat demands, and existing or planned thermal energy networks. Permits can also influence the design and location of cooling systems to future-proof data centers for heat recovery. This is particularly important where there is inadequate thermal energy demands or infrastructure for heat recovery, but demand and infrastructure is anticipated in the future. Faster or streamlined permitting processes can also be an incentive for heat recovery projects.

Zoning and permitting can be important tools for future proofing communities and data centers for heat recovery. Local zoning and permitting policies can also interact with or be reinforced by policies of utilities or higher levels of government. For example, zoning and permitting processes may be connected to electric grid interconnection policies and rates. They may also be strengthened by regulated requirements for heat recovery from senior governments.

A few examples of the existing or potential use of zoning and permitting processes to increase waste heat recovery:

- Establishing approved zones for data center development which consider heat recovery opportunities (such as current or future thermal energy networks) along with other siting considerations.
- Requiring data centers to study heat recovery opportunities as part of development approval processes.
- Requiring data centers to be designed to be easily connected to thermal energy networks.
- Requiring data centers to make heat available free of charge if or when thermal energy networks or other potential users are available.

Some local governments have already defined and regulated data centers as a distinct use in zoning and permitting (e.g., Loudoun County, Virginia).<sup>28</sup> This strategy was originally developed as a tool to attract data centers (economic development) while managing community impacts. Heat recovery opportunities could be an additional consideration in identifying future zones. Local governments could also designate specific zones or neighbourhoods for a targeted and integrated energy and net zero transitions plans, which may consider waste heat recovery as a strategy. For example, Dublin City has identified strategic Decarbonizing Zones in which a range of climate mitigation measures can co-exist to address local low carbon energy, greenhouse gas emissions and climate needs.<sup>29</sup>

Several U.S. states have begun piloting neighborhood-scale decarbonization projects that require gas and electric utilities to work together and with local communities to transition buildings within a specific neighborhood to zero emission alternatives, including direct electrification and thermal energy networks with low-carbon energy sources such as waste heat. These initiatives typically follow one of two approaches: targeted electrification (transitioning entire neighborhoods from gas to electric service) or thermal energy networks (TENS), which use shared underground pipe infrastructure to distribute heating and cooling from sources such as geothermal boreholes, waste heat from data centers, or heat exchange between buildings.<sup>30</sup> For example, the recently enacted California Senate Bill 1221 enables pilot programs for the creation of up to 30 neighborhood decarbonization zones to help communities transition away from gas usage.<sup>31</sup> Examples of other states with neighbourhood-scale decarbonization pilots underway or in planning include Massachusetts, New York, Colorado, Maryland, Washington State, and Illinois. These state programs share several common features: they typically require utility commission approval; mandate or prioritize service to disadvantaged or low-income communities; address the legal "obligation to serve" that would otherwise require utilities to maintain gas service; and often leverage existing gas utility infrastructure expertise and pipe replacement budgets to fund the transition.

Ontario Bill 5, officially titled the *Protect Ontario by Unleashing our Economy Act, 2025*, received Royal Assent on June 5, 2025.<sup>32</sup> This omnibus legislation introduces significant changes to Ontario's regulatory landscape, aiming to expedite infrastructure and resource development projects. One key change is the enactment of the *Special Economic Zones Act, 2025* (SEZA). While Bill 5 does not specifically address data centers, its provisions could influence their development indirectly. The SEZA grants the government authority to designate areas as SEZs, potentially allowing data center projects to bypass certain provincial regulations and municipal bylaws if they meet prescribed criteria. This could streamline the approval process for data center developers. Bill 5 also introduces a "registration first" approach under the Species Conservation Act (SCA), replacing the Endangered Species Act. This shift may reduce the regulatory hurdles related to environmental assessments, potentially expediting the development of data centers in areas with sensitive ecosystems. While Bill 5 does not explicitly mandate or encourage heat recovery from data centers, the establishment of SEZs and the relaxation of certain environmental regulations could create an environment where innovative

<sup>28</sup> <https://www.planning.org/planning/2021/summer/data-centers-evolved-a-primer-for-planners/>

<sup>29</sup> <https://www.dublincity.ie/sites/default/files/2022-12/Final%201-03%20%20Climate%20Action.pdf>

<sup>30</sup> <https://buildingdecarb.org/resource-library/neighborhoodscale>

<sup>31</sup> [https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill\\_id=202320240SB1221](https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202320240SB1221)

<sup>32</sup> <https://www.ola.org/en/legislative-business/bills/parliament-44/session-1/bill-5/status>

energy solutions, such as heat recovery systems, are more feasible. Local governments within SEZs may have the flexibility to implement policies that promote or require heat recovery from data centers, depending on regional priorities and infrastructure capabilities.

Area-based decarbonization plans and programs (where decarbonization is planned and coordinated among multiple buildings and infrastructure systems across a targeted area) are more conducive to securing investments in large-scale heat recovery projects. These area-based approaches may also be necessary to secure incentives from electric or gas utilities for so-called non-wire and non-pipe alternatives to capital expenditures to maintain, upgrade or expand grids.

**Textbox 4: Coordinating Local Heat Planning with Grid Infrastructure**

Local heat planning is most logically led by municipal and regional governments, which possess the land-use authority, zoning/permitting powers, and local knowledge necessary to identify heat supply zones and match heat sources (including data centers) with demand. This is the predominant model in jurisdictions with mandatory heat planning: Germany's *Wärmeplanungsgesetz* (Heat Planning Act) requires municipalities to designate heat supply areas by 2026–2028; the EU Energy Efficiency Directive (recast) mandates local heating and cooling plans for municipalities above 45,000 inhabitants; and Denmark's Heat Supply Act has required municipal heat planning since 1979, with city councils responsible for zoning different forms of collective heating in cooperation with utility companies.

Given that local governments control land use and permitting while utilities manage energy infrastructure, effective coordination is essential. However, coordination need not depend on formal mandates from higher levels of government, although mandates or policy from higher levels of government can support (or hinder) coordination. The mechanisms available range from informal information-sharing to structured joint planning processes.

Informal coordination can rely on publicly available data that utilities publish voluntarily or under regulatory requirements unrelated to heat planning. In several jurisdictions, electric utilities are now required to publish hosting capacity maps showing available grid capacity for new connections. As of mid-2024, 58 utilities across 26 US states had published such maps, with California and New York having the most advanced mandatory requirements.<sup>33</sup> The EU's revised Electricity Market Regulation (Articles 50 and 57), published in June 2024, now requires both transmission and distribution system operators to publish capacity information with high spatial granularity (monthly for TSOs and quarterly for DSOs).<sup>34</sup> Ontario's Energy Board is implementing a similar requirement with Phase 1 completed in early 2025.<sup>35</sup> Local governments can consult these maps when developing heat plans and siting policies, even without direct engagement with utilities, although this approach provides only partial visibility into future network development and may not capture thermal infrastructure at all.

Semi-formal coordination involves utilities proactively publishing data specifically intended to support local energy and heat planning. The most comprehensive example is UK Power Networks, an electricity distribution system operator covering London, the South East, and East of England. Through its "Your Local Net Zero Hub" and associated open data portal, UK Power Networks provides over 170 datasets explicitly curated for Local Area Energy Planning (LAEP), including network capacity and available headroom data, technology catalogues, load forecasts under different scenarios, and third-party datasets on land use, socio-economics, and building stock.<sup>36</sup> The DSO also offers a free geospatial planning tool (LAEP+) for local authorities in its service area.<sup>37</sup> This model allows local governments to undertake sophisticated heat planning without requiring bilateral negotiations, while giving the utility influence over how its network constraints are understood.

By contrast, major German DSOs have taken a more transactional approach. While Germany's Energy Efficiency Act requires large energy consumers (including data centers) to report waste heat availability to a national "Heat Recovery Exchange" (*Wärmekataster*) accessible to municipalities,<sup>38</sup> the major distribution network operators themselves do not offer comprehensive open data platforms comparable to UK Power Networks. Instead, DSOs such as EWE, Netze BW, and Westnetz position heat planning support as a consulting service or partnership offering, requiring municipalities to engage directly.<sup>39</sup>

Formal joint planning represents the most integrated approach. In Denmark, where district heating serves roughly two-thirds of households, municipalities conduct heat planning in close cooperation with utility companies, with the national Danish Energy Agency setting general conditions and supervising outcomes. All municipal utilities are currently developing implementation plans specifying when district heating connections will be available in each area. This institutionalized collaboration reflects Denmark's 45-year history of mandatory municipal heat planning and its cooperative or municipal ownership structure for most district heating companies, a governance model that naturally aligns utility and local government interests.

For jurisdictions seeking to promote data center heat recovery without higher-level mandates for utility-local government collaboration, several pathways exist. At minimum, local governments can leverage existing hosting capacity data (where available) to identify grid-constrained areas where data centers may seek locations and assess whether heat demand exists nearby. More proactive local governments can approach distribution utilities directly to request data sharing or joint planning exercises, drawing on the UK Power Networks model as a template for what comprehensive LAEP support can include. Zoning and permitting powers remain firmly within local control: municipalities can condition data center approvals on heat recovery feasibility assessments, require developers to demonstrate engagement with district heating operators, or designate heat priority zones where large heat-generating facilities must connect to thermal networks when technically and economically viable, all without requiring utility participation in formal planning processes. However, the most effective outcomes typically emerge when local governments, utilities, and potential heat users collaborate on integrated plans that align electrical infrastructure, thermal networks, and land-use decisions from the outset.

<sup>33</sup> <https://www.energy.gov/cmei/us-atlas-electric-distribution-system-hosting-capacity-maps>

<sup>34</sup> <https://eur-lex.europa.eu/eli/reg/2024/1747/oj/eng>

<sup>35</sup> <https://oeb.planview.ca/Ontario-capacity-map/>

<sup>36</sup> <https://dso.ukpowernetworks.co.uk/dso-data>. See also:

<https://ukpowernetworks.opendatasoft.com/pages/laep/>

<sup>37</sup> <https://www.yourlocalnetzerohub.co.uk/plan/laepplus-planning-tool>

<sup>38</sup> <https://www.bfee->

[online.de/BfEE/DE/Effizienzpolitik/Plattform\\_fuer\\_Abwaerme/plattform\\_fuer\\_abwaerme\\_node.html](online.de/BfEE/DE/Effizienzpolitik/Plattform_fuer_Abwaerme/plattform_fuer_abwaerme_node.html)

<sup>39</sup> See for example: <https://www.ewe.com/de/zukunft-gestalten/energiedienstleistungen/dienstleistungen-fuer-kommunen>

### 4.3 Regulations

Some jurisdictions are exploring or have introduced regulations to encourage or require waste heat recovery from data centers. For example, under the EU's revised Energy Efficiency Directive (EU Directive 2023/1791), data centers with a total rated energy input exceeding 1 MW are mandated to utilize their waste heat or other waste heat recovery applications, unless it is technically or economically unfeasible. This requirement aims to promote energy efficiency and reduce carbon emissions across the EU. But the requirement is not really a binding obligation since data centers can avoid it by demonstrating it is not technically or economically feasible. Under the regulation, data centers would appear to have no real requirement to choose locations that would be more favorable for heat recovery. Norway has adopted a similar approach as the EU. Norway's Data Center Strategy strongly encourages heat recovery but policy currently only requires them to carry out a cost-benefit analysis of heat utilization options. In the Netherlands, heat recovery from data centers is not mandated but there are in some cases requirements that new data centers be designed to be able to connect to TENS and may have obligations to supply waste heat free of charge when requested.<sup>40</sup>

Unlike the EU or Norway, Germany has established mandatory targets for heat recovery from new data centers. In 2023 Germany passed a new Energy Efficiency Act (Energieeffizienzgesetz or EnEFG). While the Act contains non-specific requirements for most sectors (the details will be determined in future regulations), there are explicit requirements for energy efficiency and reuse in data centers. Germany is the third largest market for data centers in the world. The law requires heat recovery in all data centers that enter service after 2026. The amount of waste heat that must be recovered increases over time depending on when the data center is brought into service:<sup>41</sup>

- In service after 01.07.2026: 10%
- In service after 01.07.2027: 15%
- In service after 01.07.2028: 20%

These requirements are more likely to affect the actual location decisions of new data centers. However, some stakeholders interviewed for this project suggested there may be some pressure to remove these requirements, particularly given the extent and location of existing TENS in Germany (which is more extensive than North America but not as extensive as Denmark, Sweden, or Finland). Indeed, it appears the targets may have already been watered down from early proposals, likely in recognition of less extensive heat recovery opportunities.

One possible solution to the uneven quality and locations of heat recovery opportunities would be to establish a trading scheme for compliance. Under a trading scheme individual data centers could choose locations that maximize economic heat recovery and sell excess heat recovery credits to data centers with fewer opportunities. A trading scheme would ensure the largest and most cost-effective heat recover opportunities are developed first, while ensuring the entire industry contributes to these opportunities. The requirements could then be expanded over time with expanded TENS and better siting decisions for new data centers. We have not seen any jurisdiction consider such an option yet.

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<sup>40</sup> Some local authorities include requirements for cost benefit analyses of heat recovery opportunities or for designs that facilitate future heat recovery as part of the local permits required to site, construct and operate data centers in their jurisdiction.

<sup>41</sup> Section 11, Paragraph 2 of the ENEFG, available here: [https://www.gesetze-im-internet.de/enefg/\\_11.html](https://www.gesetze-im-internet.de/enefg/_11.html)

The heat recovery requirements and trading system could also be extended to other large waste heat sources. This would ensure heat recovery investments are targeting the most cost-effective opportunities across all sectors first.

France recently passed its own law (effective April 30, 2025) to transpose the revised EU EED directive (2023) into French law. In addition to enforcing the EU reporting requirements for data centers, Article L236-2 of the French Energy Code now requires that data centers with a power rating of more than 1 MW must set up systems to recover the waste heat they generate. Data centers considered “vital” or that are related to defense may be exempted from these requirements. France is proposing to introduce a system of penalties for operators that do not comply, combining fines and “name and shame.”<sup>42</sup>

Policy makers should consider how regulations interact with voluntary ESG commitments by data center operators. Well-designed policies can reinforce and accelerate voluntary action by providing standardized metrics, clear expectations, and a level playing field. Conversely, overly prescriptive regulations may crowd out innovation or create compliance burdens that distract from more effective voluntary initiatives, at least in the near term. The EU’s approach—combining mandatory reporting with flexible heat recovery requirements—may offer a model that leverages both regulatory and market-based ESG pressures. Reporting requirements are particularly synergistic with ESG since they generate data that flows directly into investor disclosures and sustainability reports.

There is also a risk that regulations in one jurisdiction could create ESG reporting complications for multinational operators. Harmonization of metrics and definitions—or at least clear mapping between different regulatory frameworks—would help operators demonstrate consistent ESG performance across their portfolios. Inconsistent definitions of “waste heat recovery” or incompatible efficiency metrics could complicate ESG reporting and reduce comparability for investors.

#### 4.4 Financial Mechanisms

There are a variety of potential financial mechanisms (carrots) to encourage heat recovery, including grants, tax credits, and low-cost financing. These can be designed to support any and all economic forms of waste heat recovery, or they can be targeted more directly at heat recovery from data centers. In less mature markets, financial mechanisms to support the development of basic infrastructure (e.g., thermal energy networks) may be required first, or these may need to be combined with financial mechanisms to support heat recovery projects. Either way financial mechanisms focused solely on heat recovery may be pointless if there is inadequate infrastructure or additional mechanisms to support the development of this infrastructure as part of heat recovery projects.

Even before implementing new financial mechanisms, many jurisdictions have run into financial barriers to heat recovery that must often be addressed before considering additional support measures, if these are still considered necessary. As noted previously, until recently taxes on waste heat in Denmark were a major impediment to heat recovery, even where data centers are willing to offer the heat for free (excluding the costs of upgrading and distributing the heat). Despite progress in Denmark, in 2024 the Court of Justice of the EU recently ruled that under Article 16(1) of the VAT Directive (Council Directive 2006/112/EC), surplus heat provided free of charge may be taxable if the

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<sup>42</sup> [https://www.morganlewis.com/pubs/2025/05/france-attracts-major-data-center-investment-a-legal-framework-overview?utm\\_source=chatgpt.com](https://www.morganlewis.com/pubs/2025/05/france-attracts-major-data-center-investment-a-legal-framework-overview?utm_source=chatgpt.com)

generating facility (or its components) is eligible for input tax deductions and the heat is supplied for economic activities.<sup>43</sup> As a result, data center operators remain liable for VAT, even when providing the heat for free. In the absence of a price for heat, the VAT could be calculated on the cost of heat, but there is some uncertainty over how this would be determined in the case of unavoidable waste heat.<sup>44</sup> This represents a potential ongoing barrier or drag for heat recovery projects in the EU.

After financial barriers to heat recovery are eliminated, there are a variety of proactive financial mechanisms that could be used to promote greater heat recovery:

### 1) Taxes on waste heat

In theory governments could levy taxes on waste heat rejected to the environment to create more incentive for beneficial recovery. This is analogous to fees and levies on other types of discharges (e.g., liquid and solid wastes). However, to our knowledge there are no active examples of such levies on waste heat discharges.

### 2) Tax credits for waste heat recovery

An alternative to taxes on waste heat are tax credits for waste heat recovery. There are many precedents of tax credits for beneficial technologies and projects. For example, there is a long history of federal or state tax credits to promote solar, wind and even CHP projects. There are even some recent examples of tax credits for waste heat recovery. For example, the Consolidated Appropriations Act passed by the US Congress in 2021 includes a 26% investment tax credit (ITC) for “Waste Energy Recovery Property.” However, this credit is only available for installing waste heat to power (WHP) technologies.<sup>45</sup> Nonetheless, it provides a template for tax credits for other forms of waste heat recovery.

### 3) Property taxes

In addition to zoning and permitting requirements to increase heat recovery, municipalities could also use property taxation to encourage heat recovery. This could include property tax breaks for waste heat producers that implement heat recovery, inclusion of waste heat recovery projects in Property Assessed Clean Energy (PACE) schemes, and area-based levies (improvement taxes) to fund thermal networks or heat recovery projects that benefit multiple properties. These mechanisms can also reduce project risks and financing costs (e.g., by tying cost recovery to properties rather than the specific owners of those properties which may change). While there has been discussion of these kinds of measures and there are examples of their use in other projects and contexts, we are not aware of any existing examples targeted specifically at waste heat recovery.

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<sup>43</sup> See <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A62023CJ0207>

<sup>44</sup> <https://www.scitepress.org/Papers/2025/134331/134331.pdf>

<sup>45</sup> <https://kpmg.com/kpmg-us/content/dam/kpmg/pdf/2022/amcs-waste-energy-recovery.pdf>

#### 4) ESG-linked financing

ESG-linked financing presents another avenue for incentivizing heat recovery. Green bonds and sustainability-linked loans increasingly fund data center construction and expansion. Loan covenants and bond frameworks could include heat recovery commitments or targets, with margin adjustments tied to achievement of ERF or similar metrics. This market-based approach aligns the financial interests of operators with heat recovery outcomes without requiring direct government subsidies. Some lenders are already incorporating data center sustainability metrics into credit assessments, creating indirect financial incentives for heat recovery. While ESG-linked financing is not directly in the control of policy makers, they may influence ESG-linked financing through industry reporting requirements and regulations.

#### 5) Capital grants and incentives

Some jurisdictions have developed support schemes specific to waste heat. In the EU, large emitters have to pay for their greenhouse gas emissions via the EU Emissions Trading System. The money raised by this system is reinvested into the EU's Innovation Fund, one of the world's largest funding programs for innovative low-carbon technologies, including heat recovery projects.<sup>46</sup>

Quebec has developed one of the few significant subsidy programs in North America aimed specifically at waste heat recovery, including data centers.<sup>47</sup> The program specifically targets off-site heat recovery with thermal distribution infrastructure. The main objectives of the program are to:

- Encourage projects that capture and reuse thermal waste from industrial, municipal or large institutional sources; and
- Reduce energy consumption and greenhouse-gas emissions by redirecting waste heat to productive uses such as TENS, greenhouse/agricultural use, industrial parks, etc.

There are two program streams. The first supports technoeconomic feasibility studies (including resource assessments, modelling, regulatory and contracting studies, and business cases. Under this program stream, the province will fund up to 75% of eligible study costs to a maximum of \$150,000 per project. In addition, the total public funding from all levels of government (federal, provincial and municipal) must not exceed 75% of eligible costs. A second program stream supports capital and other implementation costs for “bankable” heat recovery projects. These can include the costs to capture, interconnect and exchange waste heat.<sup>48</sup> However, projects must show quantifiable GHG savings. The level of subsidy for each project is capped at the lesser of:

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<sup>46</sup> [https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund/innovation-fund-projects\\_en](https://climate.ec.europa.eu/eu-action/eu-funding-climate-action/innovation-fund/innovation-fund-projects_en)

<sup>47</sup> *Programme Valorisation des Rejets Thermiques* for which a detailed program guide for participants is available here: <https://cdn-contenu.quebec.ca/cdn-contenu/environnement/rejets-thermiques/guide-participant-valorisation-rejets-thermiques.pdf>

<sup>48</sup> While the funds could cover the interconnection costs of waste heat sources to thermal networks, the cost of downstream thermal networks are not currently eligible costs in this program and Quebec

- \$75% of eligible project costs;
- the value of avoided emissions and energy which is calculated as CDN\$ 125/tonne of CO<sub>2</sub>e avoided over the first 20 years and CDN\$ 8/GJ of renewable energy reduced for the first 20 years (e.g., reduced biomass, biogas or renewable electricity consumption); or
- CDN\$ 40 million.

These calculations must be based on a credible scenario of what would have supplied the thermal load in the absence of the project (e.g., e.g., electric resistance heaters, electric boilers, gas boilers, heat pumps, fuel oil, etc.), consistent with ISO 14064-2. Displaced electricity must reflect the efficiency of the displaced heating system (e.g., resistance heaters or heat pumps) vs. efficiency of the heat recovery and upgrading equipment. Where the project increases electricity consumption (e.g., by switching from gas heating to heat pumps driven by waste heat) the reduction in renewable energy is set to zero. Standardized emission factors for different fuels must be used. The program requires submission of all documentation, data and calculations of expected emission reductions and ISO 14064-3 level validation/verification of the emissions reductions at specified intervals (1 year and 5 years after project completion).

Capital grants are intended to bridge gaps between private costs and societal benefits for energy efficiency or decarbonization projects, including heat recovery. Capital grants can also mitigate project risks and advance learning or capacity. The problem is that available capital funding is often limited, and some of the financial gaps it is intended to address may eventually be addressed by future changes in policy (e.g., taxes or restrictions on fossil fuel use or carbon taxes). In addition, some project risks may never actually materialize (e.g., technology failure). As a result, capital grants could in some cases provide an unintended future windfall for investors or consumers.

Contingent/recoverable grant mechanisms are one strategy to maximize the benefits from limited public sector funds while reducing the chances of windfalls for investors or consumers. One example of this approach to grants is a profit-linked repayment scheme in Canada's Clean Fuels Fund.<sup>49</sup> The Clean Fuels Fund, administered by Natural Resources Canada (NRCan), is intended to derisk the capital investment required to build new or expand existing clean fuel production capacity in Canada. The Fund provides up to 30% of the capital cost of eligible projects (50% for Indigenous-led projects) to a maximum of \$CDN 50 million. These are conditionally repayable contributions with a unique profit-linked structure. Repayment is required for up to 10 years after commissioning when the project generates profit (up to the original contribution amount). The annual repayment is calculated as annual profit times the contribution by NRCan a percentage of total capital costs. The value of credits generated through offsets and carbon regulations is considered in project profits. For example, if carbon credit values increase, this flows through to profit calculations and increases repayment to NRCan. In the case of heat recovery projects, the excess profit could be calculated with reference to

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does not have any other subsidy program specifically targeted at thermal energy networks. The stakeholders interviewed for this project noted that the lack of explicit policies and programs to develop thermal networks may be an impediment realizing the full benefits of subsidies for heat recovery. They also noted stronger building policies may be required to incent the use of waste heat.

<sup>49</sup> <https://natural-resources.canada.ca/energy-sources/clean-fuels/building-new-domestic-production-capacity-general-stream-applicant-guide>

the costs and value of waste heat, which may vary with fuel prices, regulations regarding heating systems, or the market value of carbon emissions or emission reductions.

## 6) Operating grants

An alternative to capital grants is operating grants. Operating grants can reduce some of the risk of windfalls associated with conventional capital grants as the level of subsidy is tied to actual production, operating costs and market revenues. One emerging example of this is Carbon Contracts for Difference (CCfDs), which provide upfront or ongoing support based on the gap between project costs and revenues from carbon markets.

For example, Germany's CCfD program, launched in March 2024, uses a true two-way payment system designed to minimize the risk of excessive public subsidies.<sup>50</sup> Under the mechanism, if the actual market price for emission allowances is lower than the actual carbon avoidance costs, the state pays the difference to the company. If the market price is higher, the company must pay the difference back to the state. Once clean production becomes cheaper than conventional methods, companies begin repaying financial surpluses to the state budget. Companies have the option to terminate the contract within three years once repayment obligations begin.

Another example is the Stimulation of Sustainable Energy Production and Climate Transition (SDE++) scheme in the Netherlands which provides operating subsidies to a range of approved projects that reduce CO<sub>2</sub> emissions based on a specified value of CO<sub>2</sub> reductions. Subject to some base amount, the maximum available CO<sub>2</sub> subsidy can vary by technology or application. The actual subsidy will also vary with changes in energy prices or other conditions affecting the profitability of projects. Individual projects compete for the available pool of subsidies, which may be provided for terms of 12 or 15 years. There are also carve-outs in the budget for specific domains to ensure adequate support for technologies that are less cost-effective in the short term (thereby requiring higher CO<sub>2</sub> subsidies than the base amount) but are necessary to achieve the energy transition in the longer term. Current domains include low-temperature heat, high-temperature heat and low-carbon molecules. The SDE++ subsidy for waste heat is an incentive to decouple waste heat from a heat source, including the facilities needed to deliver the waste heat to the customer (business or TEN). Only off-site heat recovery is eligible for the subsidy. The distribution network itself is not covered by the subsidy. Rather the subsidy is for heat recovery equipment and any heat pumps required to raise the temperatures of waste heat.<sup>51</sup>

## 7) Electricity grid connection policies, DSM programs, rate designs, and taxes

There are opportunities to promote greater heat recovery through electricity grid connection policies, DSM programs, rate designs and taxes. There are already many examples of such programs to

<sup>50</sup> <https://www.klimaschutzvertraege.info/en/home>

<sup>51</sup> <https://english.rvo.nl/sites/default/files/2023-08/English%20brochure%20SDE%2B%2B%202022%20-%20juli%202022.pdf>

promote efficiency and beneficial electrification. These could be adapted to beneficial heat recovery from electricity-intensive processes.

While not entirely a financial mechanism, grid interconnection policies and costs could influence the location and heat recovery decisions of large waste heat producers. Opportunities for and commitments to heat recovery could be considered in prioritizing applicants within connection queues, within the criteria for approving interconnections, and within the calculation of interconnection costs.

Under the new Bill 69, which came into effect in June 2025, Hydro-Québec must obtain the Minister's authorization to distribute electricity to any new or existing customer requesting 5 MW or more of additional electricity supply (unless a financial commitment agreement was made before December 2, 2022). The Minister's approval is based on an assessment of:

- Economic benefits: Including job creation and regional development.
- Social impacts: Such as community engagement and public health considerations.
- Environmental considerations: Including sustainability and compliance with environmental standards.

The criteria aim to ensure that energy projects align with Québec's broader policy goals and contribute positively to the province's development. Stakeholders interviewed for this project noted that while heat recovery is not specifically mentioned, this could be considered as an economic, social or environmental benefit when approving new interconnections.

Utilities have long provided DSM incentives for on-site heat recovery projects through commercial and industrial efficiency programs. Some electric utilities have also offered incentives for off-site heat recovery projects (e.g., BC Hydro). This may require expanding the system boundaries for calculating electric system benefits to include off-site impacts. Off-site waste heat recovery could also be part of so-called non-wire or non-pipe solutions for reducing or eliminating capital requirements to maintain, upgrade or expand grids. This may open other possibilities for utility contributions to heat recovery projects and thermal energy networks.

There are already many examples of tariff designs to encourage beneficial electrification. These include tariff designs to encourage electrification of heating and promote electric vehicles while also minimizing impacts on electric grids (e.g., time of use prices to shift the timing of EV charging or incent thermal energy storage). It would not be a stretch to develop tariffs or supplements that reward heat recovery from electricity-intensive processes such as data centers through a lower electricity tariff. This could be justified as indirect electrification of heating and a way to save electricity at a systems level.

There are already examples of tariffs targeted specifically at data centers. For example, the Public Utilities Commission of Ohio recently approved the 2024 Data Center Tariff (DCT) by American Electric Power (AEP).<sup>52</sup> This tariff requires data centers to pay 85% of their projected electricity usage upfront. The aim of this tariff is to finance necessary grid upgrades without shifting the financial burden onto residential consumers. Although major tech firms with data centers in Ohio opposed the rate, consumer advocates and state regulators argued they must contribute their fair share to infrastructure costs to prevent increases in household utility bills. While the tariff is designed to minimize the financial burdens of data centers on other ratepayers, these tariffs also offer opportunities to reward

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<sup>52</sup> <https://www.powermag.com/regulator-approves-aep-ohios-landmark-data-center-tariff/>

heat recovery from data centers (e.g., through rate reductions or credits for data centers with heat recovery).

Some jurisdictions offer reductions in taxes on electricity bills to attract data centers (e.g., Tennessee, South Carolina, Texas, and Kansas to name a few). Reduced taxes on electricity bills could be contingent on heat recovery. Alternatively, greater reductions could be provided for projects with heat recovery.

## **8) Insurance schemes**

A major barrier to waste heat recovery projects is supply risks. Some waste heat sources are more predictable and reliable than others (e.g., sewer heat). However, waste heat from industrial or commercial activities could be affected by future changes in technology, activity levels, and product mix, as well as outright closures or relocations. Many data centers currently have a 10-year planning horizon and often are not willing to enter into contracts for longer than 10 years or to guarantee waste heat availability within the initial contract terms.

Off-takers may not want to invest in heat recovery infrastructure or forgo investments in other heat sources if the quantity, quality or duration of available waste heat is uncertain. Financing may also be harder to obtain for waste heat projects with supply risks. These risks could also reduce the price off-takers may be willing to pay for waste heat or the infrastructure to capture and use waste heat.

Capital or operating grants may offset some of the supply risks associated with waste heat projects. But these schemes could also provide potential windfalls for project developers (or off-takers depending on the design of contracts) if such risks never materialize. Public guarantees could also help with financing, but public guarantees would only transfer and not necessarily offset or diversify supply risks.

Supply risks for waste heat could also be mitigated through diversification (i.e., aggregation of multiple waste heat projects). However, diversification may not be possible where local waste heat sources, infrastructure, or heat demands prevent the integration of multiple waste heat resources within a single network or utility. In the case of data centers the available waste heat may far exceed current or future demands, but off-takers may be unwilling to rely on a single heat source with supply risks.

Another way to support projects and diversify risks would be through an insurance scheme for waste heat projects. An insurance scheme could pool and diversify supply risks across multiple projects, waste heat sources, users and geographies. This solution is analogous to crop insurance where the risks faced by individual farmers can be pooled and diversified across a larger range of crops, geographic areas and forms of risk. A scheme to backstop failed waste heat projects may prove less costly and more effective or palatable for advancing waste heat recovery projects than large capital grants to individual waste heat projects.

We are not yet aware of any examples of such insurance schemes, although stakeholders consider this an interesting mechanism to support heat recovery projects.

## 5 CONCLUSION

Waste heat recovery from data centers represents a significant but underutilized opportunity to advance decarbonization, improve energy system efficiency, and deliver tangible local benefits. Demonstrating local benefits is becoming important as local opposition to data center siting is increasing. As digitalization accelerates, data centers consume an ever-larger share of electricity, coupling the data, power, and heating sectors offers a pathway to manage grid pressures while turning an environmental liability into a community asset. This research has examined policy frameworks across multiple jurisdictions and engaged with industry stakeholders to identify what works, what is missing, and where future efforts should focus.

### 5.1 Key Takeaways

A coherent and coordinated policy framework is essential to realize the potential for waste heat recovery at scale. No single policy instrument can deliver the transformation alone. Rather, a balanced mix of direct and indirect policies - spanning umbrella strategies, building requirements, infrastructure investments, planning frameworks, and targeted regulations and incentives - must evolve together as markets and institutional capacity mature.

Indirect policies are often preconditions for success. Policies to stimulate demand for low-carbon heat, particularly building codes and performance standards requiring decarbonization of both new and existing buildings, are essential to create viable markets for waste heat. Without strong demand-side policies, even willing waste heat suppliers will struggle to find economically viable off-takers. Similarly, investments in thermal energy networks provide the critical infrastructure needed to connect distributed heat sources with distributed heat demands at scale.

Regional and local energy planning is crucial. Heat planning at the local level, ideally coordinated with electric and gas utilities, enables communities to identify optimal decarbonization pathways, prioritize zones for thermal energy network development, and guide siting decisions for data centers and other large heat sources. Jurisdictions with mandatory local heat planning requirements, such as Germany and Denmark, are better positioned to capture waste heat recovery opportunities.

Information, awareness, and capacity building are foundational. Reporting requirements such as those established by the EU's revised Energy Efficiency Directive have proven effective in increasing scrutiny of data center operations and motivating operators to improve performance metrics including heat recovery. Public relations and ESG pressures are currently among the strongest motivators for data center heat recovery, and mandatory reporting reinforces these market-based incentives.

ESG commitments are emerging as powerful complements to regulation. Data center owners and operators face growing pressure from institutional investors, tenants, and corporate customers with sustainability reporting obligations. Heat recovery addresses environmental, social, and governance dimensions simultaneously, offering quantifiable community benefits that enhance the social license to operate. Well-designed policies that create transparency and establish minimum standards while leaving room for operators to exceed requirements may prove most effective in leveraging both regulatory and market-based pressures.

Policy frameworks should be evolutionary and adaptive. In immature markets, early efforts should focus on removing barriers, piloting plans and projects, building awareness, and future-proofing

communities and data centers through siting and design requirements that preserve opportunities for heat recovery. As markets mature, policy can transition toward more active stimulation through incentives and regulations. A staged approach recognizes that the ecosystem for waste heat recovery - spanning technology, business models, infrastructure, and governance - must evolve together.

Flexibility is essential. Stakeholders consistently emphasized that heat recovery is not economically viable everywhere, and requirements should allow for alternative investments where heat reuse is not practical. Regulatory frameworks should apply common sense, remain as simple as possible, and be tailored to varying local conditions and stakeholder needs.

## 5.2 Knowledge Gaps

This research has identified several significant knowledge gaps that merit further investigation.

Commercial frameworks and business models remain underdeveloped. While technical guidance for heat recovery is widely available, stakeholders consistently highlighted the need for more commercial guidance, including standardized business models and contract templates tailored to specific jurisdictions. The confidentiality of existing commercial arrangements limits the development and dissemination of best practices.

The interaction between metrics such as Power Usage Effectiveness (PUE) and heat recovery performance requires further examination. PUE does not capture the benefits of heat recovery and can create disincentives in some cases. The industry and regulators need to develop and adopt metrics that better reflect the overall sustainability of data center operations, including the Energy Reuse Factor (ERF) and related indicators.

Definitions and accounting policies for waste heat vary across jurisdictions, creating potential policy misalignments and uncertainty for project developers. Further harmonization of definitions - particularly regarding the treatment of waste heat from fossil fuel-powered processes, minimum efficiency criteria, and the allocation of GHG benefits between producers and consumers - would support more coherent policy development.

The effectiveness of different financial mechanisms for waste heat recovery has not been rigorously evaluated. Questions remain about the relative merits of capital grants versus operating subsidies, the design of contingent or recoverable grants, and the potential for innovative mechanisms such as carbon contracts for difference or insurance schemes to address specific barriers.

The role of electricity grid interconnection policies in promoting or hindering heat recovery is underexplored. There is limited experience with using grid connection queues, approval criteria, or interconnection costs as tools to influence heat recovery decisions by data centers and other large electricity consumers.

North American policy experience remains limited. Most implementation examples and lessons learned come from Europe, where more favorable market conditions, extensive thermal energy network infrastructure, and established planning frameworks have supported greater progress. The transferability of European approaches to North American contexts requires further investigation.

### 5.3 Future Policy Research and Pilots

Based on this research, several priorities emerge for future policy research and pilot projects.

**Pilot integrated neighbourhood-scale decarbonization projects** that bundle heat planning, thermal energy network development, and waste heat recovery into coordinated demonstrations. These pilots should target locations with existing data centers or planned developments, adequate heat demand density, and willing utility and municipal partners. Pilots should document commercial arrangements, regulatory challenges, and lessons learned to inform replication.

**Develop standardized commercial frameworks** including template contracts, risk allocation guidance, and pricing methodologies tailored to specific jurisdictions. This work should engage data center operators, thermal energy network developers, and legal experts to create practical tools that reduce transaction costs and accelerate project development. The efforts underway by the Danish Data Center Association offer a model that could be adapted elsewhere.

**Research the design of tradeable heat recovery obligations** that would allow data centers with strong heat recovery opportunities to sell compliance credits to those with fewer opportunities. Such a system could ensure the largest and most cost-effective opportunities are developed first while maintaining industry-wide accountability. Research should examine precedents from renewable energy certificate markets and other tradeable obligation systems.

**Explore the feasibility of insurance or guarantee mechanisms** to address supply risks associated with waste heat projects. Research should examine how risks could be pooled and diversified across multiple projects, waste heat sources, and geographies, drawing on analogies from agricultural crop insurance and other risk-sharing mechanisms. Pilot programs could test different models in partnership with insurers and development finance institutions.

**Pilot local heat planning requirements** in North American jurisdictions to test approaches for identifying heat recovery opportunities, coordinating with utilities, and integrating heat planning into zoning and permitting processes. These pilots should assess the resources and capacity support needed to enable effective local planning and identify approaches suitable for different governance contexts.

**Evaluate grid interconnection policies** as tools for promoting heat recovery. Research should examine how opportunities for and commitments to heat recovery could be incorporated into connection queue prioritization, approval criteria, and cost allocation methodologies. Pilots with willing utilities could test specific approaches and measure their effectiveness.

**Assess the role of ESG reporting frameworks** in driving heat recovery adoption and identify opportunities to strengthen alignment between regulatory requirements and investor expectations. Research should examine how mandatory reporting requirements interact with voluntary ESG commitments and green financing mechanisms, and whether harmonization of metrics across jurisdictions would support more consistent and comparable disclosure.

**Develop guidance for building policy alignment** to ensure that building codes, performance standards, and incentive programs recognize off-site waste heat recovery as a valid compliance pathway on par with on-site efficiency measures. Research should identify specific barriers in existing building policies and develop model provisions that could be adopted across jurisdictions.

The window of opportunity for waste heat recovery from data centers is significant but not unlimited. Decisions being made today about data center siting, design, and interconnection will shape heat recovery possibilities for decades. Similarly, investments in thermal energy networks and building decarbonization create path dependencies that can either enable or foreclose future heat recovery. A proactive, coordinated approach to policy development, informed by continued research and learning from pilots, will be essential to realize the full potential of this underutilized resource.

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