Developing an Electricity Storage Policy Framework for Ireland

IrDEA Consultation Response | 27 January 2023

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About IrDEA

The Irish District Energy Association (IrDEA) was founded in 2017 to promote the development of low-carbon District Energy in Ireland. IrDEA currently represents over 25 members from a variety of sectors across consultancy and technology providers, the public sector, and academia. It is the only association in Ireland dedicated to supporting the District Energy industry.

Countries across Europe with similar climates, populations, and energy systems to Ireland have proven that district energy can deliver sustainable and cost-effective heating to urban areas serving millions of people. There is, however, currently a shortage of knowledge, policy support, capacity, and standards and regulations to facilitate the implementation of large-scale district energy networks in Ireland.

IrDEA's objective is to overcome these barriers by informing key stakeholders in Ireland about all aspects of district energy.

About District Energy

Benefits of district heating[1]

District energy is a proven low-carbon solution for the heating sector, it has existed for over 100 years, and is facilitating the highest shares of renewable heat in Europe.
Dubbed 'central heating for towns and cities', district energy is a network of insulated pipes that delivers heat from a central energy source to provide space heating or cooling and hot water to buildings. It has the flexibility to combine multiple locally available, renewable heat sources and it can also recycle surplus

[1] (HeatNet North-West Europe 2021)

heat from applications such as electricity generation, industrial processes, data centres, and breweries. District heating has many economic, environmental, and social benefits, such as lower carbon emissions, reduced maintenance costs, increased comfort, and less fuel poverty.

District energy enables higher shares of renewable heat and a lower carbon emissions
The countries with the highest shares of renewable heat in Europe – i.e. Sweden, Finland, Latvia, Estonia, Lithuania and Denmark – are also the top six countries in Europe in terms of district heating. Each of these countries has a renewable heat share above 40%, whereas Ireland has the worst renewable heat share in Europe at 6.3%.

Evidence shows 54% of the buildings in Ireland could benefit from district heating
SEAI's National Heat Study provides a comprehensive assessment of the options available to decarbonise Ireland's energy used for heating and cooling homes, businesses and industry. Published in February 2022, the study indicates that district heating can meet up to 54% of building heat demand with measures to close the viability gap (SEAI). This is in line with similar findings from the Irish Heat Atlas[2] developed by Flensburg University on behalf of the Irish District Energy Association. According to this work, one-third of the heat used for buildings in cities, towns, and villages in Ireland is suitable for district heating technology that is widely deployed across Europe today, with a further 21% of the heat demand capable of being satisfied through more advanced 4th Generation District Heating, bringing the total predicted potential to 57%.

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The district heating industry is ready to deliver district heating in 10% of buildings by 2030.
Delivering 10% district heating by 2030 will mean the connection of approximately 200,000 homes and 2500 public/commercial buildings with low-cost, low-carbon heat. The total investment required has been estimated at €1.2 billion (€650 million in public piping and €600 million in homes) for the deployment of the heat networks and associated heat production plants (mostly surplus heat recovery systems). This investment, together with the operation, maintenance and heat supply to the DH networks will lead to the creation of over 2,000 full-time jobs over the next decade.

This target can be met primarily due to the well-established district heating industry in Europe which can be leveraged for the rapid roll out of district heating in Ireland. For example, there are already over 30 million homes with district heating in Europe, so connecting 200,000 in Ireland by the end of the decade will require less than 1% of what the industry has already delivered in Europe.

There are members of the Irish District Heating Association willing to invest hundreds of millions of euro in district heating in Ireland if there is a clear long-term commitment for the sector. Our members will invest in local people, facilities, and infrastructure to ensure that Ireland can reduce its carbon emissions in the heat sector, which historically has been extremely slow to decarbonise.

Introduction

At approx. 60 TWh per annum, heat makes up 42% of final energy demand in a typical year for Ireland (SEAI 2019). Decarbonisation in the sector has, however, lagged behind electricity, with total fossil fuel based CO_2 emissions from building and industrial process heating remaining around 14.1 $MtCO_2$. This equates to approx. 38% of total energy-related CO_2 and 24% of total national greenhouse gas emissions – natural gas (39%), oil (36%), and coal and peat (25%) (SEAI 2019). Significant action must be taken to address this if Ireland's net zero emissions ambitions are to be realised.

The Irish District Energy Association (IrDEA) aims to help address this problem by driving the development of the Irish district energy sector. Though relatively new and underdeveloped in Ireland, district heating is well-established as means of providing sustainable heating solutions to industrial, commercial and residential energy consumers. With between 54% (SEAI) and 58% (Europa-Universitat Flensburg 2019) of Irish building identified as being suitable for district energy, this form of heating is primed to lead the decarbonisation of the sector. Energy storage, particularly largescale thermal energy storage systems (TES), is an integral part of this.

IrDEA offers the following comments in response to the call for submissions on developing an Electricity Storage Policy Framework for Ireland. We have focused specifically on energy storage as it relates district energy sector, in particular thermal energy storage systems (TES). As a general comment, however, we would strongly encourage the expansion of the policy framework beyond electricity storage to facilitate a whole system approach with respect to energy storage.

We are grateful for the chance to input into this consultation and would be most happy to provide follow-up information or clarification if needed.

Overview of the Role of Electricity Storage in the Energy System including its Potential Benefits and Challenges

1. In broad terms, what future role do you see for electricity storage in the energy sector?

   Electricity storage is the key to unlocking Ireland's renewable energy potential. As we transition to a greater saturation of intermittent renewable generation, storage is a vital part of balancing demand and variable generation capacity. This is not just limited to electricity storage, but other mediums such as largescale thermal energy storage (TES), which are integral to a whole system approach to energy storage, load balancing, sustaining energy security, and achieving decarbonisation.

   When considering the potential impact of thermal energy storage alone, it becomes apparent how vital energy storage in a broader sense is to bringing about the efficiency and flexibility needed to facilitate the transition to a greater saturation of intermittent renewable electricity on the energy system. Its importance in this regard cannot be underestimated, and appropriate forms of energy storage must, therefore, be investigated for use and deployed across the system to greatest effect.

2. What barriers exist that might prevent electricity storage from fulfilling this role or roles?

   Incentive Structures

   From a district energy perspective, it will be necessary to include thermal storage as part of any future government-backed incentive schemes promoting investment in decarbonised energy in general and storage. Reducing costs, risk, and uncertainty is a key means of incentivising and facilitating the level of private sector infrastructural investment that will be needed to deliver on Ireland's decarbonisation ambitions. Though thermal storage is less expensive than many other forms of storage, to retain market competitiveness and encourage its development at the scale and with the durations needed to achieve optimal storage outcomes, it will be necessary to provide financial incentives and supports for developers.

In particular, the efficiencies and cost savings offered by largescale thermal energy storage systems are many times greater than those provided by smaller scale forms such as small tanks intended to provide storage for only a matter of hours (Romanchenko et al. 2018; Hennessy et al. 2019; Yang et al. 2021). From an energy system perspective, it is more advantageous to incentivise the deployment of largescale and, indeed, long-duration (seasonal) thermal storage. Yet, one of the key barriers to doing this is the lack of nuance in the current crop of incentive structures. For example, the capacity market treats all storage capacity of 6 hours or more the same way. This means there is no direct incentive to invest in storage of over 6 hours as the capacity market return is equal to that of smaller installations that involve significantly lower levels of capital expenditure. Similarly, as it stands there is a specific DS3 tariff for system services that could be provided by longer-duration storage, however that is currently not provided for.

Any incentive structure introduced must reflect the profile of system benefit offered by different forms, scales, and durations of storage solutions. One size will not fit all, and, absent a nuanced system-benefit-led approach, lower capacity options could come to dominate the storage market as developers respond to market signals set by government. This could result in an overall opportunity loss for the system, which would undermine the ability of the storage sector to meet its potential.

Grid Constraints

Grid connections for electrical heat production units are vital in maximising the use of TES for greatest energy and cost efficiency. As with other forms of system development, constraints and delays in grid connections poses a considerable risk for district energy networks served by TES systems owing to their reliance on electrical heat production (heat pumps, electrode boilers, etc.). This risk must be managed to ensure district energy systems, and their accompanying thermal energy storage systems, can be deployed in line with demand to meet the government's ambitious targets to deliver 0.8 TWh of district heating installed capacity by 2025, and up to 2.5 TWh by 2030 (DECC 2022).

In addition, also to grid connections themselves, greater clarity and standardised guidance is needed with respect to the IT systems and controls for electrical heating production units needed to provide grid services (balancing, ramping, frequency response, removing grid congestion, etc.). This is particularly important to new entrants into the market and those who have had limited interaction with grid services, e.g., current actors in the heat sector who may be less familiar with the standard requirements of the systems needed to engage in the electricity market.

3. What regulatory and policy measures are needed now to ensure that electricity storage does fulfil its optimum role in the energy system?

In a broad sense, the planning and regulatory systems must be evolved to support innovative approaches to thermal storage capacity development. It is vital to ensure that thermal storage technologies are included in incentive schemes being developed and evolved to promote the shift to low and no carbon energy solutions. In particular, thermal storage must be acknowledged and its use incentivised given its flexibility, rapid deployment potential, and low cost relative to other forms of energy storage.

Planning regulation and policy is one route to achieving this. Where district energy proposals are, for example, being evaluated by planning authorities, a presumption in favour of incorporating elements such as thermal storage should be incorporated into planning regulations. This would help to streamline the planning process for district energy network developers and ensure that the incorporation of thermal storage does not present the prospect of delaying or obstructing the planning consent process. This is vital to de-risking projects and facilitating a rapid ramp up of district energy delivery in line with Climate Action Plan targets for 2025 and 2030.

Definition of Electricity Storage and Current Technology

4. Do you believe there is a saturation point for battery storage, whereby adding further battery capacity provides limited benefit to the system? If so, how would you define that saturation point? Please provide evidence to support your argument.

There is a natural saturation point for any form of storage. It is, therefore, vital to promote the adoption of a variety of storage options to ensure the most appropriate use of each option across the system. This is particularly the case when it comes to ambitions to move the electricity system to 80% RES-E, as the efficiency profile of storage solutions changes as the RES-E saturation increases. Per Figure 2 below, the greater the saturation of intermittent renewables within the system the greater the need for long-duration storage options.

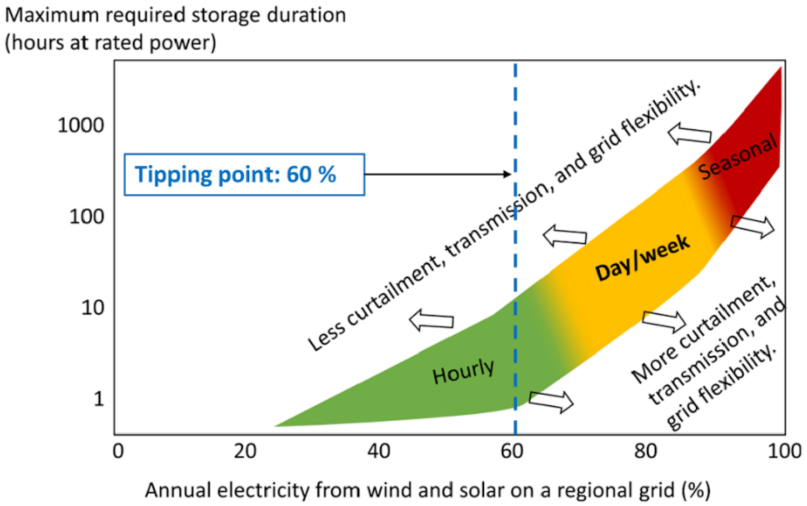

Figure 4: Y-axis shows maximum duration of electricity storage needed to ensure demand is met at all times (logarithmic scale) versus fraction of annual energy from variable renewable generators (wind and solar) on a regional/local level. The arrows indicate either more restrictive (to the left) or aggressive (to the right) assumptions for curtailment, transmission and grid flexibility. For example in a system where curtailment is minimised (arrow to the left), storage duration required is longer than in the case where more curtailment is allowed (arrow to right). Adapted from ref [7].

Figure 1. Storage durations for intermittent renewables led electricity generation systems.

As it currently stands, most battery storage today is limited to durations of 2 to 4 hours as durations beyond this have proven expensive to deliver. While this works for an energy mix of under 40% RES-E, once we move beyond that point longer duration storage is needed to support the system, which demands storage durations of multiple hours to days. While battery technology is evolving and advancing at pace with new batteries beginning to offer longer durations than the more established 2-4 hour range, this technology is neither freely available nor well established. This presents a short to medium term problem for the energy system as the Irish energy system gradually ramps upward towards an 80% RES-E saturation goal by 2030.

Alternative forms of long-duration storage are, therefore, needed to meet the storage needs of a system with an increasingly renewables-led energy mix. Thermal storage is ideally placed to address this gap as larger scale, longer-duration TES systems prove to be more cost effective than shorter term and smaller scale alternatives, it is an established and tested technology, and it is primed and ready for deployment across the system.

5. What technologies for electricity storage are currently in use internationally? What are their main characteristics and which ones should be considered for use in Ireland?

Though thermal storage can be classified and grouped various ways, comes in a range of forms, has the capacity for durations from seconds to seasons, and can involve a spectrum of vectors, thermal TES used within the context of district energy systems tends most commonly to come in the form of pit, aquifer, and tank.

Pit Storage

Pit storage involves a large reservoir being created, reinforced with a waterproof lining, filled with water, covered with a further waterproof and insulated lining, and used as a vector to store and release heat (or coolant) into the district energy system. Reservoirs of the scale involved provide significant capacity to capture excess solar and wind energy (for example) during times of high generation, thereby reducing curtailment and boosting efficiency in renewables generation.

Typically, this is used as a form of seasonal storage where excess solar energy is captured during summer for deployment through district heating systems during winter. Similarly, the converse can be the case, with cooling systems being charged during winter for deployment during warmer summer months.

As with many forms of storage, economies of scale have been found to apply with pit storage, with larger volumes are used to reduce overall costs per m^3.

> *Denmark´s first big (10,000 m³) pit storage demonstration system, built in Marstal, came to 67 EUR/m³. This made it nearly three times as expensive as today's biggest seasonal storage, which was put up in 2015 in Vojens and cost only 24 EUR/m³. Nielsen suggests using a benchmark of around 30 EUR/m³ when calculating the cost of pit heat storage with a capacity of 100,000 m³ or more.* (Epp 2019)

In other words, if we assume 58 kWh/m3, €67/m3 would be €1.15/kWh or €1150/MWh and €24/m3 would be €0.4/kWh or €400/MWh. Alternatively, Figure 1 above provides an up-to-date cost comparison for thermal storage versus others. This is an extremely cost-effective form of storage at 0.065% of the cost of battery storage. However, it is not suited to all contexts owing to the significant land area and favourable ground conditions required for its development.

Figure 2. Solar heating plant and pit storage in Vojens, Denmark (Ramboll Sverige 2015)

Figure 3. Seasonal thermal energy storage pit at Dronninglund Fjernvarme, Denmark (Epp 2019)

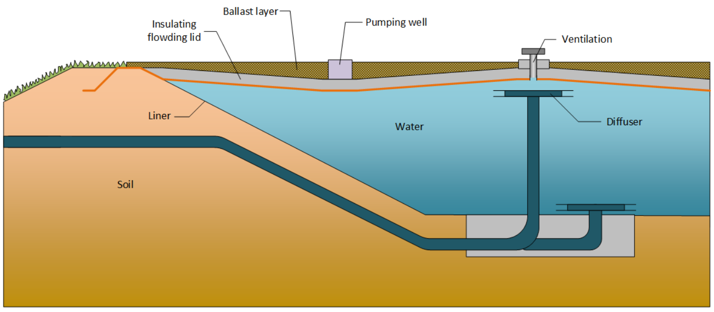

Figure 4. Diagram of pit storage system (Zourellis 2022)

Aquifer

Aquifer thermal energy storage does not require large areas of land but does require specific sub-surface conditions i.e. an aquifer covered with a clay layer for the aquifer to be used in this way. As with most forms of thermal storage (with the exception of molten salt storage) this is a one-way storage system where the electricity is converted to heat for use as heat at a later time rather than for generating electricity. Nevertheless, where the conditions are right, availing of existing aquifers in this way can be a sustainable and effective use of resources to create a storage solution with natural capacity for long-duration heat retention.

Tank Storage

Tank storage can range dramatically in scale from domestic water tanks of 100 to 200 litres to largescale industrial tanks such as the 56million litre tank being developed by Vattenfall for a Berlin district heating system (Jekat 2022). Domestic tanks and system buffer tanks tend only to have the capacity to retain heat for a matter of hours or days depending on the quality and extent of insulation being used to limit heat loss. Whereas the largest and most highly insulated can provide for multiples of that.

Sensible thermal storage tanks of this sort are 50 to 100 times cheaper than electrical storage (see Figure 2). Moreover, as installing this form of storage onto a district heating network requires little additional infrastructural investment, they are a cost effective means of introducing much needed flexibility onto a district heating system. This form of storage is used across a great many district energy systems, making it an important form of thermal storage for district energy (Hennessy et al. 2019).

6. What emerging technologies for electricity storage should be considered for future use in Ireland?
7. What are the main characteristics of these emerging technologies?
8. In terms of creating a balanced portfolio of technologies, how do you see the relationship between storage and demand-side response, alongside other flexibility measures, developing if Ireland is to meet its decarbonisation objectives?

   To maintain security of supply as we move to a higher infiltration of renewable generation as part of Ireland's decarbonisation ambitions, it will be necessary to address the load imbalance that comes with using intermittent generation technologies. This must be done through demand-response strategies and the introduction of greater storage capacity onto the network.

   Much potential exists for demand-response solutions to limit demand on the electricity system, however there is an upper limit on the extent to which this approach can help manage the issue of load imbalance inherent in an intermittent renewables-led system. Demand can be reduced but it is improbable that it will be brought to zero. Equally, demand-response strategies aim to bring about a cultural of such a degree that the profile of demand is markedly altered. Such changes take time, and by providing a buffer for both the time-lag involved and the extent to which demand can be curbed, energy storage has an important role to play addressing load imbalance.

Thermal Storage

9. What role do you see for thermal storage in terms of its ability to support the decarbonisation of the electricity/industry sector? What advantages/disadvantages does it pose vis-à-vis other storage technologies? What changes, regulatory or other, would be required?

   Thermal energy storage (TES) is shown to reduce heat load variation in district heating systems by flattening demand peaks. This can, in turn, lessen capital expenditure as the level of generation required to satisfy peak demand is lower than in the absence of a stored energy reservoir. TES also facilitates system flexibility that allows for cost savings through smart energy use, typically achieved by capturing energy when demand and costs are low and deploying when demand and costs are high (SEAI).

   By helping to flatten demand curves, particularly when applied at a larger scale (Romanchenko et al. 2018), TES reduces the amount of generation capacity needed to meet demand on district energy systems, which positively impacts consumer energy costs and wider system demand. Incentivising and facilitating thermal storage as part of district energy systems will be crucial to delivering 0.8 TWh of district heating installed capacity by 2025, and up to 2.5 TWh by 2030 set out in the Climate Action Plan 2023.

   Cost Effective Storage

   Largescale TES systems typically cost a fraction of best-case large-scale battery storage, this is in the order of 0.65% - 4.4% or 50 to 100 times less (Lund et al. 2016a; Hennessy et al. 2019). Broadly speaking, these systems add significant value to the energy system. For example, using largescale installations in Irish district energy networks, as commonly seen in countries like Denmark (Ramboll Sverige 2015; Zourellis 2022) would cost approx. 0.065% when compared with equivalent battery storage. Further savings can then follow from, for example, making use of lower night-time electricity rates to generate heat for storage. In this case, the capital cost of the storage would only relate to the cost of the controls required to link its operation to signals from the electricity grid operator or market with the necessary response times. Large-scale TES also benefits from reduced levels of degradation through the charge and discharge cycles over its lifespan when compared with battery storage.

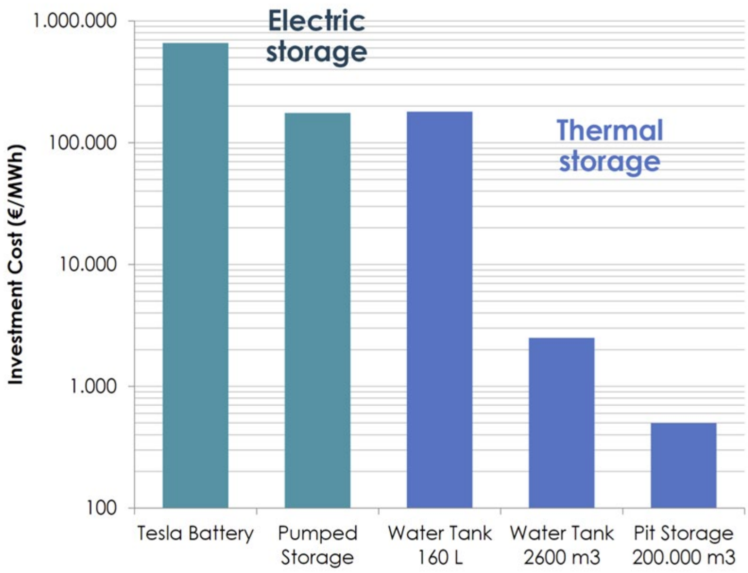

Figure 5. Energy Storage Technology Cost Comparison (replicated with the permission of Codema) (Lund et al. 2016b)

Largescale thermal energy storage systems can help to reduce curtailment of renewable electricity generators by acting dispatchable demand during low demand periods. They can also provide frequency response to keep the grid stable as the proportion of renewable generation increases and help to reduce congestion on the network by introducing flexibility to meet demand (particularly in peak winter when peak heat and electricity demand coincide). This further reduces electricity network constraints by delivering more efficient heat production and by-passing large sections of the lower voltage electricity grid when compared with other forms of electricity integrated heating such as individual building heat pumps. Codema has estimated a 71% reduction in low and medium voltage grid reinforcement costs when utilising DHC networks compared with individual building heating solutions based on the Dublin Region Energy Masterplan (O'Shea 2021).

Flexible Duration / Long Duration Storage

The need for storage across various durations (up to 8 hours) is estimated at 2,475MW or 10.8GWh for a 'Central' scenario (Eirgrid 2022). If the Climate Action Plan 2023 targets for District Heating & Cooling are achieved, it could provide 1300MW or 9.1GWh of low-cost large-scale thermal storage to support the electricity grid (between 53% and 84% of the storage capacity required based on the MW and GWh estimates from Eirgrid respectively) by 2030 (Codema 2023). This is a particularly important function considering the duration limitations on battery storage solutions, which tend to decrease in cost-effectiveness as storage duration is increased. Conversely, TES systems become more cost effective the larger their scale and the longer their duration.

Reduced Curtailment in Renewable Generation

The intermittent nature of renewable electricity generation means the energy system oscillates between an overabundance of generation capacity and too little to satisfy demand. This results in curtailed renewable generation at times of low demand or high output, while times of low output and high demand force a shift back to reliance on thermal generation. District energy systems with incorporated TES have the potential to act as offtakers for renewable energy generation at times of high output or low demand, thereby reducing curtailment. They can also reduce demand on the grid at times of peak demand by releasing stored energy to flatten peaks, this will provide significant value to the wider energy system from a system security and affordability perspective as it will reduce reliance on flexible thermal generation to provide load balancing.

Evidence from other jurisdictions shows the efficacy of using sector coupling to reduce curtailment in renewable energy generation (IRENA 2020). Significant gains of this sort have been demonstrated at scale in energy systems with high concentrations of district energy systems. For example, with approx. 50 GWh of thermal storage as compared with less than 2 GWh in Ireland, Denmark is well placed to harness a greater proportion of its significant renewable generation potential. When there is excess wind power in Denmark, large-scale electric boilers and heat pumps are activated to produce heat on district heating systems. If there is no demand for the heat at that specific time, it is stored as thermal energy until a heat demand occurs. Wind power that would otherwise be curtailed is instead used to generate heat before it is needed.

The proportion of energy that can be saved in this way is variable contingent on a range of factors. However, there is research to indicate a substantial benefit can be derived from this form of sector coupling. For example, a collaborative demonstrator project led by the Birmingham Centre for Energy Storage, funded by the UK Engineering and Physical Sciences Research Council and the Natural Science Foundation of China, was able to pull 80% of its electricity demand, over 5 000 MWh per year, from wind energy sources that would otherwise have been curtailed.

From an Irish perspective, Renewable Energy Ireland (2021) estimates that by 2030 the annual electricity surplus will be approx. 2.8 TWh due to dispatch-down of intermittent renewable generation. Indeed, enough renewable electricity was lost in the first six months of 2020 to power Galway for a year (Wind Energy Ireland 2020). Yet, if harnessed by large scale heat pumps, with a current efficiency of 300%, 8.5 TWh of renewable heat could be produced cost-effectively as part of a demand-response strategy. Capturing this heat through thermal storage would allow for it to be used within district energy networks, thereby contributing to the decarbonisation of the heat network while simultaneously using a greater level of the potential generation capacity of the renewables feet.

Supporting Flexible Power Plant Generation

The 80 RES-E by 2030 target requires ongoing reliance on flexible thermal generation. By capturing waste heat, thermal storage offers a unique opportunity for thermal generation operators to improve the efficiency of their power outputs by making use of heat that would otherwise evaporate. By offering a potential additional revenue stream, this could help to offset some of the considerable operational and capital expenditure costs associated with thermal facilities, thereby adding security to the electricity system and curbing wholesale energy price rises.

As most thermal generation plants currently release heat equivalent to approx. 40% of their fuel input, it is estimated that waste heat could be equivalent to 8.7 TWh per year by 2030. If captured and stored for use within district energy systems, this waste heat could be used to boost the energy output of these plants. This will be vital from a viability and affordability standpoint when it comes to flexible thermal generation as the proportion of intermittent renewable generation in the energy mix increases.

Energy Price Stability

Though the share of the energy mix has been increasingly moving toward renewables, most of Ireland's energy needs are still provided for through fossil imports. The Russian war in Ukraine and the resulting gas and oil shortages have shown the difficulty this can present both for security of supply and affordability. The greater the amount of local renewable heat and electricity in the energy system, the greater the level of local control and insultation from price and supply volatility.

Thermal energy storage as part of a district energy system allows for greater use of sustainable and renewable energy sources, which can help to reduce pressure on the grid and lessen demand for fossil generated energy. TES has the potential to reduce energy costs by flattening peak demand, which can reduce capital costs as it reduces the headline generation capacity needed to satisfy peak demands. It also allows for capitalisation on cheaper rates of energy production as energy can be used to create heat while prices are low and released into the network when demand and costs are higher.

To incentivise investment and ensure energy is affordable for consumers, a balance must be struck between placing sufficient storage on the system and keeping capital costs to a minimum. As one of the most cost-effective storage forms currently available, TES has the potential to help achieve this; for example, when incorporated into a district heating system, TES is approximately 100 times cheaper than electricity grid storage (Lund et al. 2016a).

Changes Required – Regulatory or Otherwise

As set out in other areas of this response, promoting the development of TES linked to district energy networks, it will be necessary to address the key barriers to the development of both. This must include measures such as a further revision of the Part L building regulations to ensure that the sustainability impact of these systems is correctly accounted for. Equally, barriers within the planning system must be addressed to ensure that infrastructural development can be de-risked and delivered in a more streamlined way.

Financial incentives, including the greater inclusion of district energy and thermal storage in government incentive schemes for sustainable energy would also help to offset the cost of investment. It is also necessary to introduce nuance into the financial incentives that currently exist for energy storage to incentivise investment in larger scale and longer-duration solutions capable of satisfying the needs of the renewables led generation system we are creating.

What role do you see for thermal storage as a long-term (e.g., seasonal) energy storage in Ireland?

Largescale TES systems are naturally suited to long-duration storage, which will be increasingly vital to sustaining the renewables-led electricity system being developed in Ireland. Thermal storage is a cost effective means of introducing long-duration storage onto the energy system. In Denmark, the experience of developing and operating seasonal TES systems has been a positive one, and there is much to be learned from the pioneering work done in this market.

Seasonal thermal energy storage such as the pit thermal Energy Storage (PTES) installations in Vojens and Aalborg in Denmark or Aquifer Thermal Energy Storage (ATES) such as that located in the De Bruggen and the University of Utrecht in the Netherlands can provide long-duration energy storage. This form of storage may be adapted to the Irish setting, which would be a worthwhile endeavour given its cost effectiveness (0.065% of the cost of battery storage) and technological readiness. Though it does require significant land area and favourable ground conditions for its development, this could be a means of introducing a much-needed form of flexible long-duration onto the Irish system. Similarly, aquifer thermal energy storage does not require large areas of land but does need specific sub-surface conditions to be viable i.e. an aquifer covered with a clay layer.

Future Role of Electricity Storage

20. What electricity storage technologies exist that can provide Long Duration Storage to balance supply and demand in an electricity system that relies heavily on renewable power?

Thermal energy storage is a prime candidate for this form of energy storage, as discussed elsewhere in this submission.

21. Do any emerging technologies have the potential to provide Long Duration Storage in the future?

Thermal energy storage is a prime candidate for this form of energy storage, as discussed elsewhere in this submission.

22. What policy and market arrangements, if any, are needed to facilitate investment in Long Duration Storage?

It is important to introduce financial incentives and market signals to help de-risk and promote private investment in this form of storage. Whether through a renewable energy support scheme or other such mechanism, it is necessary to indicate market stability and future viability to encourage the significant capital expenditure needed to bring long duration storage solutions such as TES systems onto the system.

It is also vital that a nuanced approach to incentivised investment in energy storage is taken to ensure that long-duration storage is positively acknowledged in any market arrangements. As it currently stands, all storage of 6 hours or more in duration is treated equally, which fails to take account of the often considerable difference in capital expenditure necessary to develop longer duration storage.

The comments made elsewhere in this submission on policy and regulatory changes also apply to this section.

23. Are there other ways in which Government can support the acceleration of long duration storage in terms of promoting research and development?

Collecting subsurface data to highlight areas which could be suitable for Aquifer Thermal Energy Storage. Such data may also be useful for further government objectives such as further the development of geothermal energy to provide renewable heating and greater security of supply when compared with imported fossil fuels (Codema 2023).

Conclusion

Energy storage has an integral role to play in helping to decarbonise not just electricity use in Ireland, but energy overall. As a well-established, safe, and highly cost-effective storage solution, particularly in relation to Ireland's growing long-duration storage needs, thermal energy storage is set to play an important role in Ireland's energy future. IrDEA would, therefore, strongly encourage either the broadening of the policy framework to which this consultation relates or addressing the energy storage needs of the system through a complementary policy framework. This is important to ensuring that blind spots are not created and opportunities missed to create a well-integrated, sustainable, storage system capable of supporting the renewables-led energy system being developed in Ireland.

We welcome the opportunity to contribute to this consultation, and would be happy to provide further information and feedback on our comments here.

For further information or queries, contact:

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