Taina Wilhelms

5.12.2025

Finnish Energy on the Review of the EU Taxonomy Climate Delegated Act

Finnish Energy supports the Commission's aim to improve the usability and clarity of the EU Taxonomy. It's essential that the revision doesn't jeopardize the taxonomy alignment of existing plants and new investments but rather improves the usability of the taxonomy by simplifying and clarifying the current criteria where this is needed. All changes should support the competitiveness and simplification agenda of the Commission.

Finnish Energy on the GHG emission thresholds

We do not support tightening the GHG thresholds; rather, we believe that at this stage, the focus should be on ensuring that the existing criteria are properly understood and correctly applied by different stakeholders (interpretation challenges are significant) so that the taxonomy can be implemented effectively and fulfill its intended purpose. We understand that the Commission aims to specifically improve the usability and clarity of the taxonomy to advance its practical implementation, and we do not see how tightening the thresholds would support this goal.

Thus, the ongoing review should focus on an impact assessment of current thresholds and Technical Screening Criteria before any tightening of targets is considered. A life cycle assessment needs to prove the feasibility of a lower emission threshold in the current technological environment.

Companies already reporting in line with taxonomy have just established practices and adapted their reporting to meet the current criteria. Therefore, it would be desirable to avoid immediately imposing additional administrative burden on companies. This would also contradict the Commission's objectives to enhance the EU's economic competitiveness.

The constant revision of standards creates legal and investment uncertainty, which is likely to delay the investment decisions needed to bridge the funding gap for sustainable activities. In other words, tightening the thresholds could lead to investments not being realized, which would in turn slow the transition towards climate neutrality and make it unnecessarily expensive. This, too, is inconsistent with the Commission's competitiveness objectives.

Most energy investments have long lifecycles, during which there is a need to refinance or restructure existing loans. Revising the EU Taxonomy GHG thresholds in the middle of such long-term projects could create significant practical and economic challenges. For instance, older solar panel technologies generate higher emissions than modern ones, and it would be neither practical nor economically sensible to decommission them before the end of their operational life. Similarly, hydropower plants can operate for a century, and their lifecycle emissions, including those incurred during construction, cannot be retroactively mitigated.

Thus, investment decisions that were made under current technical screening criteria and thresholds need to benefit from grandfathering in case thresholds change in the future. This is indispensable to maintain trust and investor confidence in the EU Taxonomy.

Bioenergy criteria including the GHG emission savings threshold should refer to RED. Referring to the Renewable Energy Directive has also been recognised as an appropriate procedure in case law, in accordance with the decision of the Court of Justice of the European Union in 2025. As a result, the Commission should further strengthen the use of existing legislation and rely on the current version of the RED. The Commission's work programme for 2026 sets out evaluation of the functioning of the RED III criteria, and it would be prudent not to update the Taxonomy criteria before this assessment has been carried out. It is also known that Member States still have shortcomings in the implementation of RED III criteria, the effects of which the Commission will be assessing next year.

We do not support tightening the GHG emission savings threshold for bioenergy until there is accurate modeling of how it would affect the use of different fractions in different installations. It could in worst case narrow down the use of low-value biomass fractions for energy, even though their use should be increased according to the cascade hierarchy. This could also result in less flexible operation of CHP plants in areas where the demand for useful heat varies more (reduce interest in CHP production compared to condensing power). Furthermore, the demand for 80 % GHG savings and 100% biomass (wording in climate DA "exclusively from biomass") is already tighter than in RED.

Finnish Energy's proposals for simplifying the existing Taxonomy Climate Criteria

4.8., 4.20., 4.24. Bioenergy / The description of the activity:

The description of bioenergy activities (4.8., 4.20., 4.24.) should be revised to more clearly reflect the purpose of the Taxonomy.

The term "exclusively" used in the descriptions causes interpretative challenges among operators and does not take into account multi-fuel boilers, co-incineration plants, or, if interpreted strictly, even start-up and support fuels. The term "exclusively" also fails to consider temporary needs to replace biofuel with other fuels. The description should be changed to indicate that the taxonomy accepts energy production with bioenergy regardless of any other fuels that may also be used.

We propose to delete the wording "exclusively" from the description of the activity (4.8.) as follows: Construction and operation of electricity generation installations that produce electricity ~~exclusively~~ from biomass, biogas or bioliquids, excluding electricity generation from blending of renewable fuels with biogas or bioliquids (see Section 4.7 of this Annex).

We propose to delete the wording "exclusively" from the description of the activity (4.20.) as follows: Construction and operation of installations used for cogeneration of heat/cool and power ~~exclusively~~ from biomass, biogas or bioliquids, and excluding cogeneration from blending of renewable fuels with biogas or bioliquids (see Section 4.19 of this Annex).

We propose to delete the wording "exclusively" from the description of the activity (4.24.) as follows: Construction and operation of facilities that produce heat/cool ~~exclusively~~ from biomass, biogas or bioliquids, and excluding production of heat/cool from blending of renewable fuels with biogas or bioliquids (see Section 4.23 of this Annex).

4.8., 4.20., 4.24. Bioenergy / DNSH5 -criteria (Pollution prevention and control):

In the DNSH5 criteria (Pollution prevention and control) for bioenergy activities (4.8., 4.20., 4.24.), the reference should be made only to the MCP Directive (instead of its Annex II, Part 2).

In the DNSH5 criteria (Pollution prevention and control) for bioenergy activities (4.8., 4.20., 4.24.), reference is made to the emission limit values for new installations set out in Part 2 of Annex II of the MCP Directive. The current wording does not take into account existing installations (Part 1 of Annex II) or the exemptions or transitional periods provided for in Article 6 of the Directive.

We propose to delete wording "Annex II, part 2, to" from the paragraph as follows:
For combustion plants with thermal input greater than 1 MW but below the thresholds for the BAT conclusions for large combustion plants to apply, emissions are below the emission limit values set out in ~~Annex II, part 2, to~~ Directive (EU) 2015/2193.

GENERIC CRITERIA FOR DNSH TO PROTECTION AND RESTORATION OF BIODIVERSITY AND ECOSYSTEMS (Appendix D), Appendix D is used e.g. in the 4.8., 4.20., 4.24. Bioenergy / DNSH6 - criteria (Protection and restoration of biodiversity and ecosystems:

GENERIC CRITERIA FOR DNSH TO PROTECTION AND RESTORATION OF BIODIVERSITY AND ECOSYSTEMS (Appendix D) should be clarified.

The criteria seem to require the completed procedure of an Environmental Impact Assessment (EIA) or screening in accordance with Directive 2011/92/EU.

The EIA Directive is intended for the assessment of projects that likely have significant environmental effects. Likewise, the screening process - that is, the assessment of the need for an EIA - is not appropriate for projects whose effects will in no case exceed the threshold of significance.

We propose to add following sentence "considering activities that have been commissioned after the entry into force of the EIA Directive and that are likely to have significant effects on the environment" to the paragraph as follows:
An Environmental Impact Assessment (EIA) or screening has been completed in accordance with Directive 2011/92/EU considering activities that have been commissioned after the entry into force of the EIA Directive and that are likely to have significant effects on the environment.

4.5. Hydropower / DNSH3-criteria (Sustainable use and protection of water and marine resources):

The DNSH criteria for hydropower should be based on adherence to principles and requirements of the Water Framework Directive (WFD) as implemented in member states.

The DNSH3 criteria for Sustainable use and protection of water and marine resources under the hydropower section (4.5.) in both Annexes (mitigation/adaptation) should refer only to existing EU legislation, especially the Water Framework Directive, to ensure coherent implementation of the criteria and to avoid unnecessary administrative burden.

The current Do No Significant Harm ('DNSH') criteria for "Sustainable use and protection of water and marine resources" for hydropower should be changed. The DNSH criteria should refer to compliance with EU legislation, especially the Water Framework Directive as implemented in member states. This is already the case in other sections of the Annexes, such as the wind power offshore requirements, and in the Taxonomy Appendix B. The DNSH criteria for hydro power also differ from other water-related activities that rely on WFD implementation and have no additional specific Do No Significant Harm criteria in the taxonomy. The same assessment principles must apply to all technologies, whereas criteria should be set in accordance with existing EU law.

Water Framework Directive has been in place for over 20 years. The regulation and especially its environmental objectives already cover hydropower operations. Also, the cumulative impact assessment in the Annex I/II of the taxonomy regulation for construction of new hydropower plants are fully covered by the reporting requirements in WFD.

Additional and overly specific criteria at EU level will contradict current EU policy goals, such as simplifying regulations and reducing administrative burdens, and it will impede a coherent implementation of the Taxonomy regime across the EU. It may even lead to a loss of flexible renewable electricity needed to keep the level of security of supply high and to ensure a safe energy transition.

The Commission has indicated incorporating some of the FAQ answers into the hydropower criteria. We do not support this, as it would only create ambiguity and inconsistency in interpretation, potentially leading to unequal application of the criteria across member states. Moreover, the FAQ answers have not undergone any impact assessments, and therefore their inclusion would lack a proper evidence-based justification.

4.10. Pumped hydropower storage / DNSH3-criteria (Sustainable use and protection of water and marine resources):

Pumped hydropower storage (4.10.) DNSH criteria should refer only to existing EU legislation, such as the Water Framework Directive (WFD).

The current DNSH3 criteria (Sustainable use and protection of water and marine resources) for pumped hydro is different depending on whether it is connected to a river body or not. There is no justification to use overly specific DNSH3 for hydropower (4.5) in pumped hydropower storage connected to a river body. When the head of pumped hydropower storage is very high, usually over 100 metres, and the upper basin is totally artificial, the ideas to have downstream or upstream fish migration, ecological flows etc. are not relevant.

Pumped hydropower storage (4.10.) DNSH criteria should thus refer only to existing EU legislation, such as the Water Framework Directive. Compliance with the WFD should be sufficient for DNSH alignment under Taxonomy also for pumped-hydropower storage connected to a river body.

4.9. Electricity transmission and distribution / Substantial Contribution -criteria:

The Substantial Contribution criteria for electricity transmission and distribution (4.9.) should be simplified to avoid unnecessary justification and verification burdens.

The paragraph "*Infrastructure dedicated to creating a direct connection or expanding an existing direct connection between a substation or network and a power production plant that is more greenhouse gas intensive than 100 g CO_2e/kWh measured on a life cycle basis is not compliant*" in Section 1 of the

Substantial Contribution criteria should be deleted. This provision is not relevant for DSOs or TSOs, as they are legally obliged to connect and transmit electricity to all customers. As such, the criteria impose unnecessary justification and verification burdens and should therefore be deleted.

If the 100 g CO_2e/kWh threshold in the Taxonomy was lowered, as suggested by the Sustainable Finance Platform, even connecting solar power could negatively impact DSOs' and TSOs' Taxonomy alignment. Such a scenario would clash with the fundamental role of electricity networks in facilitating the EU's transition to carbon neutrality.

Electricity System Operators (DSOs and TSOs) have an obligation to connect to their grids all customers (consumption and production) that fulfil the technical requirements (e.g. European Network Codes). Electricity Market Directive (2019/944) requires that in any event, the system operators shall not discriminate between system users. As required by the Directive, each electricity system operator acts as a neutral market facilitator, fulfilling the needs of the customers connecting to the grid and transmitting in the grid in a non-discriminatory way. This means that the System Operators have no possibility to choose or affect what types of electricity production units are connected or will be connected into their grids. The eligibility of a transmission or distribution system shall not be dependent on actions the system operators cannot affect. Electricity transmission and distribution networks have a crucial role in achieving the EU climate and energy objectives and in enabling a cost-efficient transition towards a fully decarbonised economy.

Similar criteria, though formulated somewhat differently, also appear under Substantial Contribution criteria 2(a). The inclusion of the criteria in that context appears justified, as the criteria seem to relate to the customer's direct connection.

4.27: Construction and safe operation of new nuclear power plants, for the generation of electricity or heat, including for hydrogen production, using best-available technologies.
4.28: Electricity generation from nuclear energy in existing installations.

In the coming years, Finland and Europe will have to tackle several critical challenges – combat climate change and the loss of nature, while at the same time improving competitiveness and energy security. Nuclear energy is a key part of the solution. Nuclear energy has one of the lowest life cycle emissions of energy production. Also, the land use of nuclear energy is highly efficient in relation to the energy produced, which also serves biodiversity protection targets.

Companies in Finland are able to function within the existing Taxonomy framework and use the current sustainability criteria of nuclear energy and be defined as sustainable. However, in case the sustainability criteria of nuclear energy investments are updated, nuclear energy should be treated equally with renewables, as a permanent net zero energy solution. Nuclear energy should not be considered as a transitional activity and the sunset clauses should be removed. In case the criteria are updated, also the requirement for ATF should be removed, since it is unclear and not connected to environmental sustainability.

Finnish Energy’s proposal for a new activity in the Taxonomy Climate Delegated Act

Electric boilers reduce emissions in district heating and industrial steam production, particularly by supporting energy system flexibility and using renewable electricity.

Electric boilers are currently not included in the EU Sustainable Finance Taxonomy and we recommend that this technology be included under the climate change mitigation criteria for the following reasons:

Flexible heat production: Electric boilers can be used when electricity is abundant and prices are low, such as during surplus wind or solar power situations. In these instances, electric boilers can produce heat without using fossil fuels, thereby reducing carbon dioxide emissions. This also helps increase the share of renewable energy and reduces the need for curtailment.
Balancing the energy system: Electric boilers can balance the electricity system by utilizing surplus electricity in district heating production. This helps reduce emissions from electricity generation because electricity can be directed to district heating production rather than being generated by burning fossil fuels.
Enabling heat storage production: Electric boilers can be combined with heat storage, allowing heat production during times when electricity is emission-free or cheaper. This way, heat can be produced and stored for future use, reducing the need for fossil fuels during peak demand periods.
Supporting heat pumps: Electric heatboilers can be used to increase the temperature after a heat pump utilising excess heat from datacentres or other industrial processes. Utilising excess heat is highly energy efficient and reduces carbon dioxide emissions by replacing use of fossil fuels in boilers.

The suggested technical screening criteria for substantial contribution:

- If the emission intensity of electricity in the price area has been verified to be below the threshold of 18 gCO2eq/MJ (= 65 gCO2eq/kWh, similarly to hydrogen criteria), electric boilers' production would be considered to contribute significantly to climate change mitigation.

- If the electricity price area does not meet the emission intensity threshold, the producer must demonstrate low-carbon production through alternative means.

Practical examples:

Helen:
Helen’s heating production has diversified further with the commissioning of new electric boilers at Salmisaari in spring 2025. Construction is also underway on a large electric boiler facility in Hanasaari, where Europe’s largest electric boiler plant is scheduled for completion during the 2026–2027 heating season. In addition, a new heat pump and electric boiler facility in Eiranranta is nearing completion and is expected to enter operation by the end of 2025. Further investments, including a plant in Patola, will increase Helen’s total electric boiler capacity to approximately 570 megawatts by 2027, providing significant new flexibility between the electricity and district heating networks. These investments mark Helen’s first heating season entirely without coal already in 2025–2026.

Patola
- Total capacity of electric boilers: 100 MW
- Annual production: ~300 GWh
- Annual CO_2 reduction: 30,000 tons
- Production start: Heating season 2026–2027

Hanasaari

- Construction began in September 2025
- The plant, consisting of four electric boiler units, will be the largest in Europe with a total capacity of 200 MW.
- Heat storage capacity: 1,000 megawatt-hours.
- Expected completion: Heating season 2026–2027.

Salmisaari

- Capacity: 2 x 50 MW.
- New electric boilers will reduce Helen's CO_2 emissions by over 240 kilotons during their first five years of operation.
- In operation since spring 2025.

Eiranranta

- In addition to heat pumps, an electric boiler will be built to support the wastewater processing and district heating systems.
- The electric boiler will enable wastewater heating during periods when its temperature is too low for heat pump production.
- Capacity: 30 MW.
- Eiranranta heat pump plant and electric boiler will be taken into commercial use during winter 2025.

Turku Energia

Turku Energia is increasing its carbon-neutral district heating production by investing in an electric boiler. This investment supports Turku Energia's goals of transitioning away from fossil fuels towards renewable energy production. The estimated completion date for the electric boiler is autumn 2026, with the building permit application process now underway.

Once operational, the electric boiler will replace combustion-based district heating production and fossil fuels, reduce the share of imported fuels, and take advantage of low-cost electricity periods for district heating production. The building permit is being applied for the boiler's construction near the Pääskyvuori substation.

The planned electric boiler will have a heat output of 60 megawatts. Annually, it will replace heat production using oil, pellets, and other fuels during low-cost electricity periods, equivalent to the heating needs of approximately 5,000 detached houses.

Nevel

Nevel is investing in two 10 MW electric boilers and a 100 MWh thermal storage unit at Atria's Nurmo production facility. This solution enhances flexibility and optimization in energy production while reducing CO_2 emissions by up to 5,800 tons annually. The new systems will be operational at the Nurmo plant by the end of 2025, enabling more environmentally friendly heat production. Atria and Nevel are expanding their collaboration to support the goal of a carbon-neutral food chain.

Nevel will supply Fazer's confectionery factory in Lappeenranta with a new 10 MW electric steam boiler and a 2 MW heat pump system to recover heat from the factory's processes. This investment will improve the environmental sustainability, energy efficiency, and reliability of energy production. The factory's CO_2 emissions will be reduced by 4,000 tons annually. The new systems are scheduled to be operational in summer 2026.

Additionally, a 14 MW electric boiler has been installed in Forssa, reducing combustion-based heat production and lowering emissions by approximately 2,000 tons annually. The electric boiler has been in operation since spring 2025.

Fortum

Fortum’s Espoo Clean Heat project is transforming the district heating in the second largest city in Finland, Espoo, to carbon neutral. The use of coal was discontinued in 2024 and fossil fuels are being replaced with smart and flexible solutions that are largely based on renewable electricity: waste heat utilisation, heat pumps, heat accumulators and electric boilers. Over the recent years, several investments have been made in order to discontinue the use coal and transform heating towards electricity-based heat production. At the moment, the plant consists of four CHP units, as well as a heat pump plant that re-uses heat from treated wastewater. The 60 MW heat pump plant includes three heat pumps that provide up to 25% of all the heat consumed in the district heating network area.

The Suomenoja site also hosts a 20,000 m3 heat accumulator that can store about 800 MWh of heat energy in water. In addition, a 100 MW electric boiler plant was commissioned on the site in 2023. Together, they can increase flexibility in production: the electric boilers can heat the district heating water during periods of cheaper power prices, and furthermore, this energy can be stored in the accumulator and released to the network when heat demand peaks.

Additionally, Fortum is building a new zero-emission, electricity-based district heating production facility in the Nuijala area of Espoo. The facility will feature a 50 MW electric boiler and an 800 MWh thermal storage unit. This boiler-storage combination enhances flexibility in heat production and balances electricity demand by utilizing fluctuations in electricity prices. Construction began in the spring 2024, with production scheduled to start during the 2025–26 heating season.

The Nuijala facility's location is ideal for both the district heating network and electricity supply. The plant will optimize the entire district heating network, as heat can be directly transferred to the network from the electric boiler. The thermal storage unit can also be charged with CO_2-free heat produced elsewhere in the network. The facility reduces the need for existing fossil fuel-based peak capacity, and heat storage minimizes the need for investments in new peak capacity.

Water heated by the electric boiler can also be directed straight to the thermal storage unit. The boiler can increase the water temperature to levels suitable for the district heating network during times when electricity is inexpensive and widely available. Heat from the storage unit can then be discharged as needed to meet peak district heating demand. The stored thermal energy is equivalent to the daily heating needs of approximately 13,000 detached houses.

The electric boiler’s capacity will be brought online in phases due to initial electricity transmission constraints. Once fully operational, the Nuijala facility will account for around 10% of total electricity-based district heating capacity. The facility’s launch will contribute to replacing the use of fossil and bio-based fuels.

Scientific literature on electric boilers

1. **Economic Dispatch of Combined Heat and Power Energy Systems Using Electric Boiler to Accommodate Wind Power**

Liu, B., Li, J., Zhang, S., Gao, M., Ma, H., Li, G., & Gu, C. (2020). Economic dispatch of combined heat and power energy systems using electric boiler to accommodate wind power. *Ieee Access*, *8*, 41288-41297.

ABSTRACT: It is of significant economic value to use an electric boiler to coordinate the heating network and power grid to reduce wind curtailment during heating supply seasons in the north area. This paper presents an optimal economic dispatching model of combined heat and power energy systems to minimize the total operation cost and wind curtailment by using electric boilers. The proposed model comprehensively considers the thermal characteristics of buildings and the constraints of electric and thermal power balancing, combined heat and power (CHP) units, heat storage tanks, electric boiler power, and wind power. To address this model, a linearization optimization model is built, where different dispatch strategies under CHP only, CHP + HST (heat storage tanks), and CHP + HST + EB (electric boiler) different conditions are conducted. Thereafter, the relationship between indoor temperature and thermal power is analyzed with consideration of the temperature time-delay effect and the heat loss on heating balance. A 6-node combined heat and power energy system is used to validate the effectiveness of the proposed model and solution method. Furthermore, the case studies illustrate the impact of heat storage tanks and the electric boiler on wind power curtailment and coal consumption.

2. **Electrification of boilers in US manufacturing**

Zuberi, J., Hasanbeigi, A., & Morrow, W. R. (2021). Electrification of boilers in US manufacturing.

Osa executive summary: Boiler electrification is projected to result in over 195 MtCO2 per year reduction in CO2 emissions in 2050, as shown in Figure ES.1. This significant decrease in CO2 emissions in the future is projected as the consequence of the higher adoption of renewable electricity or grid decarbonization between 2018 and 2050.

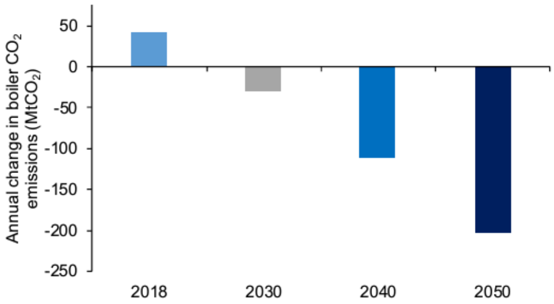

Figure ES - 1. Potential change in boilers' annual CO_2 emissions after electrification in U.S. manufacturing in 2018-2050 (This is the technical potential assuming 100% adoption rate).

3. **Heat and power load dispatching considering energy storage of district heating system and electric boilers**

Huang, X., Xu, Z., Sun, Y., Xue, Y., Wang, Z., Liu, Z., ... & Ni, W. (2018). Heat and power load dispatching considering energy storage of district heating system and electric boilers. *Journal of Modern Power Systems and Clean Energy*, *6*(5), 992-1003.

Abstract: As one of promising clean and low-emission energy, wind power is being rapidly developed in China. However, it faces serious problem of wind curtailment, particularly in northeast China, where combined heat and power (CHP) units cover a large proportion of the district heat supply. Due to the inherent strong coupling between the power and the heat load, the operational flexibility of CHP units is severely restricted in winter to meet the heat supply demand, which imparts considerable

stress on the wind power connection to the grid. To promote the integration of wind power and enhance the flexibility of CHP units, this paper presented a method of heat and power load dispatching by exploring the energy storage ability of electric heating boilers and district heating systems. The optimization results indicate that the proposed method can integrate additional wind power into the grid and reduce the coal consumption of CHP units over the optimized period. Furthermore, the thermal inertia of a district heating system is found to contribute more to the reduction of coal consumption, whereas the electric heating boilers contribute to lower wind curtailment.

4. Control power provision with power-to-heat plants in systems with high shares of renewable energy sources – An illustrative analysis for Germany based on the use of electric boilers in district heating grids

Böttger, D., Götz, M., Theofilidi, M., & Bruckner, T. (2015). Control power provision with power-to-heat plants in systems with high shares of renewable energy sources–An illustrative analysis for Germany based on the use of electric boilers in district heating grids. *Energy*, *82*, 157-167.

Highlights

- A power market model for spot and control power markets is proposed.
- Model is applied to electric boilers in district heating grids for control power.
- Electric boilers are able to support integration of renewable energy sources.
- Electric boilers can reduce overall CO_2-emissions of the power sector.

5. Electrification of industrial boilers in the USA: potentials, challenges, and policy implications

Zuberi, M. J. S., Hasanbeigi, A., & Morrow, W. (2022). Electrification of industrial boilers in the USA: potentials, challenges, and policy implications. *Energy Efficiency*, *15*(8), 70.

Highlights:

1. Bottom-up approach to study the sector- and state-level potentials of electric boilers.
2. The potential energy savings by electrifying ind. boilers are 595 PJ p.a. in 2050.
3. The potential CO2 savings by electrifying ind. boilers are 200 Mt p.a. in 2050.
4. Ind. boiler elec. can initially increase the CO2 emissions by 43 Mt p.a. in 2018.

6. Reducing curtailment of wind electricity in China by employing electric boilers for heat and pumped hydro for energy storage

Zhang, N., Lu, X., McElroy, M. B., Nielsen, C. P., Chen, X., Deng, Y., & Kang, C. (2016). Reducing curtailment of wind electricity in China by employing electric boilers for heat and pumped hydro for energy storage. *Applied energy*, *184*, 987-994.

Highlights

- Quantitative evaluation of benefits of PHS and EBs for reducing wind curtailment in China
- Deployment optimization of wind power, PHS and EBs for a CHP-dominated, high-wind power system.
- Simulation of both the power and heating systems by an improved hourly chronological approach.
- Identification of EBs a cost-effective means to reduce wind curtailment in a CHP-dominated system.

7. RENEWABLE POWER-TO-HEAT INNOVATION LANDSCAPE BRIEF

IRENA (2019), Innovation landscape brief: Renewable power-to-heat, International Renewable Energy Agency, Abu Dhabi.

Page 9: Electrification of heating can help decarbonise the sector when the extra load is supplied with renewable electricity and smartly managed. Power-to-heat systems can help integrate greater shares of VRE (variable renewable energy)(by using heat pumps and electric boilers as a source of demand-side flexibility in power systems. These electric loads can be used to reduce curtailment of surplus renewable generation, to load shift to coincide with renewable energy generation, and to provide grid services (see Figure 2).

Page 10: To avoid curtailment, the Chinese National Energy Administration is installing electric boilers with a capacity of 50 megawatts (MW) that can be used to generate heat using excess renewable energy for the district heating system, which has conventionally depended on inefficient coal boilers. The project is targeted for completion in 2020 and aims to generate about 2.8% of yearly district heat generation (IRENA, 2017).

Page 17: Table 2 describes select projects and case studies in which power-to-heat technology has been adopted for different purposes.

- **picture attached**

Table 2 Power-to-heat system projects and case studies

Project/case study	Location	Description	Impact
Vattenfall	Germany	Vattenfall, a Swedish utility company, operates an electric boiler in Hamburg using excess wind generation, avoiding thus wind power curtailment. Also, Vattenfall will be investing in power-to-heat boilers to generate district heat in Berlin. The units will use electricity from renewable energy sources to heat water, which will transmit heat to residences and commercial buildings (Vattenfall, 2017).	In Berlin, the electric boilers replaced one unit in a coal-fired plant and provided a total capacity of 330 MWh, reducing the use of fossil fuels in heating applications.
Heat Smart Orkney	Orkney Islands, Scotland	As a part of the Heat Smart Orkney project funded by the Scottish government, a wind power-to-heat scheme is being implemented. Households will be provided with energy-efficient heating devices that will draw excess power generated from the community-owned wind turbine, which would have otherwise been curtailed. The household heating devices will be connected to the internet and will get switched on when the wind turbine receives a curtailment signal (Colthorpe, 2018).	Excess power from wind energy is converted to heat
Power-to-heat expansion in Denmark	Aarhus, Denmark	The city of Aarhus in Denmark expanded the capacity of an existing combined heat and power plant by adding an 80 MW electric boiler and a 2 MW electric heat pump in 2015 to provide district heating to the neighbourhood. The heat pump's capacity is planned to be expanded up to 14 MW after assessing the performance of the existing heat pump (IRENA, 2017).	The electric boiler and heat pump are designed to use excess wind generation in western Denmark, which is typically greatest in winter months, coincident with increased demand for heat.
District heating network	Qingdao, China	The city of Qingdao is investing USD 3.5 billion to build a district heating network. The district heating systems will use heat pumps that transfer heat from the air, the ground and the waste heat from industries to buildings in the city. Qingdao District Heating & Power Co. is also investing in upgrading the buildings to be compatible with the district heating network.	The city aims to use clean energy sources for all its heating needs, which would reduce coal consumption by over 3 million tonnes annually (C40 Cities, 2017).
Smart Energy Islands	Isles of Scilly, United Kingdom	This project is led by Hitachi Europe, in partnership with Moixa and PassivSystems. About GBP 10.7 million (USD 13.2 million*) has been invested to double the islands' renewable energy capacity and implement smart energy systems to balance supply and demand. As part of the project, smart energy technologies such as air source heat pumps and smart batteries will be installed and connected to smart home energy management solutions (Moixa, 2017).	Given their remote location, the islands have to import fossil fuels through underwater pipes for their energy usage. The project will double the islands' renewable energy usage to 448 kW. The smart energy systems will provide flexibility to the network by contributing to the grid, according to its supply and demand requirements.
GM Smart Energy trial	Manchester, United Kingdom	Greater Manchester Combined Authority is working with Japan's New Energy and Industrial Technology Development Organization to demonstrate the ability of heat pumps to provide flexibility to the grid. This pilot project connected 500 heat pumps via an aggregator to provide ancillary services to the grid (Delta Energy & Environment, 2018).	Heat pumps as flexibility provider for the grid.

*Converted at the exchange rate GBP 1 = USD 1.23

Case examples from Finland

District heating

	Location	Capacity, MW	More information
Lappeenrannan Energia Oy	Lappeenranta, Mertaniemi	40	https://www.epressi.com/tiedotteet/energia/kesakauden-kaukolampo-syntyy-puhtaasti-sahkolla-korjattu.html
Vaasa Sähkö Oy	Vaasa, Vaskiluoto	160	https://www.epv.fi/2021/12/08/uusi-sahkokattila-otettiin-kayttoon-vaskiluodossa-vaasassa/
EPV Energia	Seinäjoki	40	https://www.energiauutiset.fi/kategoriat/markkinat/kaukolampoakku-ja-sahkokattila-seinajoelle.html
Tampereen Energia Oy	Tampere, Lielahti	45	https://yle.fi/uutiset/3-12440181?text=Tampereen%2520S%25C3%25A4hk%25C3%25B6laitos%2520rakentaa%2520Lielahteen%2520j%25C3%25A4ttim%25C3%25A4isen%2520%2522vedenkeittimen%2522%2520tasaamaan%2520kaukol%25C3%25A4mp%25C3%25B6%25C3%25A4%2520ja%2520tuulienergian%2520vaihtelua%2520&utm_medium=social&utm_source=twitter-share
Fortum	Espoo, Suomenoja	100	https://caruna.fi/ajankohtaista/fortum-toteuttaa-carunan-kanssa-taysin-uuden-laisen-sahko-kat-ti-la-kon-septin
Turun Seudun Energiantuotanto Oy	Turku, Naantali	45	
Oulun Energia Oy	Oulu, Laanila	40	https://yle.fi/a/74-20020175
Tornion Voima (EPV)	Tornio, Röyttä	40	https://www.tovo.fi/tornion-voiman-sahkokattila-valmistui/
Savon Voima	Joensuu	20	mm. yhtiön vuosikertomuksessa vuodelta 2023
Etelä-Savon Energia	Mikkeli, Pursiala	30	https://ese.fi/fi-fi/article/uutiset/uusi-sahkokattila-pursialan-voimalaitos/1662/
Hyvinkään Lämpövoima	Hyvinkää, Sahamäki	20	https://hlv.fi/ajankohtaista/hyvinkaan-lampovoima-rakentaa-sahkokattilan-sahanmakeen/
Vaasan Sähkö	Vaasa, Vaskiluoto	60	https://www.vaasansahko.fi/tiedotteet/vaskiluodon-lampovaraston-kapasiteetti-kasvaa/
Helen Oy	Helsinki, Salmisaari	100	https://www.helen.fi/uutiset/2023/pelletti-korvaa-kivihiilen-kayttoa-salmisaaressa

Helen Oy	Helsinki, Hanasaari	140	https://www.helen.fi/uutiset/2023/hanasaaren-voimalaitosalue-muuttuu-voimakkaasti
Lahti Energia	Lahti, Kymijärvi	60	https://www.lahtienergia.fi/lahti-energia/energiantuotanto/
Helen Oy	Helsinki, Eiranranta	30	https://www.helen.fi/uutiset/2022/tyo-ja-elinkeinoministerio-on-myontanyt-investointitukea-helenin-uudelle-eiranrannan-lampopumppulaitokselle
Porvoon Energia	Porvoo	20	https://pbe.fi/fi/tiedotteet/porvoon-energia-monipuolistaa-lammontuotantonsa/
Kokkolan Energia	Kokkola	20	https://www.kokkolanenergia.fi/fi/yritys/ajankohtaista/rakennamme-suuren-lampoakun-ja-sahkokattilan-kosilaan/
Turku Energia	Turku, Pääskyvuori	50	https://www.turkuenergia.fi/uutiset-ja-artikkelit/70071402
Tampereen Energia	Tampere, Lielahti	100	https://www.tampereenenergia.fi/tampereen-energia/energia/energiantuotanto-tampereella/sahkokattila/
Vantaan Energia	Vantaa, Martinlaakso	60	
Vantaan Energia	Vantaa, Varanto	120	https://www.vantaanenergia.fi/vantaan-energia-aloittaa-maailman-suurimman-lammon-kausivaraston-varannon-rakentamistyot-vantaalla/
Herrfors	Ylivieska	5	https://www.herrfors.fi/fi/ajankohtaista/herrfors-investoi-saehkoevarastoon-ja-saehkoekattilaan
Oulun Seudun Sähkö	Liminka	2	https://indd.adobe.com/view/4c70ddca-1c03-4593-b1f8-16c21de56f6a
Fortum	Espoo, Hepokorpi	100	https://www.fortum.fi/media/2024/03/fortumin-seuraavan-lampopumppulaitoksen-rakentaminen-alkanut-espoon-datakeskusalueella
Fortum	Espoo, Nuijala	50	https://www.fortum.fi/media/2024/03/fortum-rakentaa-lisaa-joustavaa-sahkopohjaista-kaukolammontuotantoa-espoossa
Fortum	Kirkkonummi, Kolabacken	100	https://www.fortum.fi/media/2023/09/fortumin-lampopumppulaitoksen-rakennustyot-kaynnistyneet-microsoftin-kirkkonummen-datakeskusalueella
Neve	Rovaniemi	60	https://neve.fi/ajankohtaista/neven-kaukolammon-tulevaisuusskenaario-paivitettiin-paastolaskuriin-investointi-sahkokattilaan-lisaa-uusiutuvan-energian-maaraa-lahivuosina/
Alva	Jyväskylä	120	https://www.alva.fi/blog/2024/04/11/sahkokattiloilla-puhtaampaa-lampoa-ja-hintavakautta-alvan-lammontuotantopaletti-monipuolistuu/
Loiste Lämpö	Kajaani		https://www.sttinfo.fi/tiedote/69997955/loiste-lampo-oy-uuden-tuotantoportfolion-investoinnit-etenevat?publisherId=69819775

Keravan Energia	Kerava, Yli-Kerava	30	https://www.keravanenergia.fi/blog/artikkeli/sahkokattila-lisaa-kaukolammon-tuotantokapasiteettia-ja-valinnanvaraa/
Raaseporin Energia	Tammisaari	20	https://re.fi/fi/nextgeneration-lampo-2030/
Helen	Helsinki, Patola	100	https://www.helen.fi/uutiset/2024/helen-investoi-kohti-kaukolammon-hiilineutraalisuutta-patolaan-uuteen-teknologiaan-pohjautuva-lampopumppulaitos-ja-kaksi-sahkokattilaa
Kotkan Energia Oy	Kotka, Hovinsaari	30	https://www.kotkanenergia.fi/ajankohtaista/kotkan-energia-kurottaa-kohti-hiilineutraalia-tulevaisuutta-miljoonainvestoinnit-ja-sahkokattilan-asennus-edessa/
Loimua	Hämeenlinna	30	https://loimua.fi/ajassa-ja-blogi/loimua-investoi-sahkokattilaan-hameenlinnan-kaukolampoa-tuotetaan-yha-enemman-polttamatta/
Helen	Helsinki, Hanasaari	200	https://www.helen.fi/uutiset/2024/helen-rakentaa-hanasaareen-euroopan-suurimman-sahkokattilalaitoksen
Oulun Energia	Oulu, Toppila	60	https://www.oulunenergia.fi/uutiset/08--2024/sahkolla-tuotetun-kaukolammon-osuus-tuplaantuu-toppilan-voimalaitoksen-uuden-sahkokattilan-myota/

Industry

Owner	Location	Capacity, MW	Links
Stora Enso	Kouvola, Anjalankoski	60	https://yle.fi/a/74-20037679
UPM	Valkeakoski, Tervasaari	50	
UPM	Valkeakoski, Tervasaari	60	https://puunvuoro.fi/ajankohtaista/upm-kiihdyttaa-fossiilisista-polttoaineista-luopumista/
UPM	Lappeenranta, Kaukas		https://energiatehokkuussopimukset2017-2025.fi/upm-kaukaan-sellutehdas-vahemman-paastoja-ja-lisaa-uusiutuvaa-sahkoa/
UPM	Rauma		
Mirka	Uusikaarlepyy, Jepua	10	https://www.pietarsaarensanomat.fi/artikkeli/mirkan-jepuan-tehtaalle-sahkokattila-ja-aurinkovoimala-tuotannon-paastot-alenevat-kolmanneksella
Suominen	Nakkila	12	https://adven.com/fi/uutiset/adven-sahkoistaa-suomisen-kuitukangastehtaan-energiantuotantoa-nakkilassa/
Adven	Turku	12	https://www.ts.fi/uutiset/6417102
Valio	Haapavesi	12	https://www.epressi.com/tiedotteet/energia/advenin-sahkokattilatoteutus-siirtaa-valion-haapaveden-tehtaan-sahkolla-tuotettuun-lampoon.html

For additional information, please contact:

Taina Wilhelms
Senior Advisor, Energy production
Finnish Energy
taina.wilhelms@energia.fi
+358 40 548 7145