

DOCUMENT DE TRAVAIL N°38

Heat Pumps in Luxembourg: Overcoming an Unfavorable Context to Accelerate Deployment



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Executive Summary

In Luxembourg, heat pumps are financially attractive in the long run with current subsidies and significantly reduce CO₂ emissions, yet deployment remains slow.

The building sector accounts for around **20% of national energy-related GHG emissions**, with residential space heating alone accounting for around **13% in 2024**. There is therefore significant potential to decarbonize the sector through heat pumps, particularly as Luxembourg's housing stock remains strongly dependent on gas and heating oil.

Yet deployment remains limited. At the end of 2024, Luxembourg had an estimated **20,000 heat pumps**, equivalent to fewer than **80 installations per 1,000 households**. STATEC nevertheless envisages more than **150,000 heat pumps by 2050**, implying a considerable acceleration from today's market.

In Luxembourg, air-to-water heat pumps are the dominant heat-pump technology and the focus of this study. **Geothermal heat pumps** also receive support but are less suitable for many households because of their higher cost and more demanding installation requirements. **Air-to-air heat pumps receive no public support and generally do not provide domestic hot water.**

Key Findings:

The study compares air-to-water heat pumps with gas and oil boilers across three household scenarios over a **20-year period**. The model assumes annual useful heat demand of **15,000 kWh**, a heat-pump SCOP of 3.0, annual energy-price increases of **2% for electricity and 3% for gas and heating oil**, and a **5% discount rate**. The figures below represent **discounted 20-year costs**.

- **Scenario 1 - New construction:** around **€38,500** for a heat pump, compared with **€45,900** for gas; break-even after about **7 years**.
- **Scenario 2 - Standard renovation:** around **€37,500**, compared with **€45,900** for gas and **€54,300** for oil; break-even with gas after about **6 years**.
- **Scenario 3 - Complex renovation:** around **€42,500**, compared with **€45,900** for gas; break-even only after around **14 years**.
- The heat pump's long-term advantage is driven by **current subsidies, relatively favorable electricity prices and its much higher energy efficiency**: with a SCOP of 3.0, it delivers around three units of useful heat per unit of electricity consumed.
- **Oil heating is clearly the least attractive option** in the renovation scenarios, combining the highest lifetime costs with the highest emissions.
- The result remains broadly robust even if electricity and gas prices both rise by **2% annually**, although the advantage becomes small in complex renovations and break-even is delayed.
- Considering the lack of data and the variability in costs from one renovation project to another, it is worth noting that the **maximum heat pump installation cost at which a heat pump remains less expensive than a gas boiler over a 15-year period is €39,585** (discounted cost, €50,928 undiscounted cost).

Luxembourg Compared with Selected European Markets

- **Luxembourg's representative gross air-to-water installation cost of around €35,000** is among the highest in the comparison, at the same level as in Germany but higher than in France around **€15,000**, **€12,000 in the Netherlands** and **€10,000 in Belgium**. However, Luxembourg benefits from **comparatively favorable electricity prices**.
- Higher Luxembourg incomes do not fully compensate for the high gross installation costs: after adjusting incomes for purchasing power, the installation-cost burden is around **29% lower in**



France, 40% lower in Belgium and 42% lower in the Netherlands than in Luxembourg, while Germany's burden is around 70% higher.

Climate Impact and Cost-Effectiveness

- Replacing a gas boiler with a heat pump reduces operational heating emissions by around **68%**, while replacing an oil boiler reduces them by around **76%**.
- Public support is much more cost-effective in some situations than others: the subsidy cost is around **€87 per ton of CO₂ avoided in new construction, €325/tCO₂ in a standard gas-boiler replacement, and €434/tCO₂ in a complex renovation**. In new construction, the heat pump even has a **negative social abatement cost**, meaning that it reduces emissions while also lowering total lifetime costs before subsidies.

Challenges - Broader Cluster of Mutually Reinforcing Factors:

- **High installation costs:** Gross installation costs remain particularly high compared with neighboring countries and comparable European markets.
- **Limited perceived need for renovation:** A significant share of Luxembourg households does not consider renovation necessary, reducing the willingness to undertake major heating-system upgrades.
- **Cheap natural gas:** Relatively inexpensive gas continues to weaken the financial incentive to move away from fossil heating.
- **Uncertain future electricity prices:** Uncertainty over long-term electricity costs complicates the household investment decision, particularly for a technology with a high upfront cost.
- **Limited market transparency:** Scarce information on installation prices, system performance and the existing heat-pump stock makes it harder for both households and policymakers to assess the market with confidence.
- **Rental and multi-owner housing barriers:** In rental housing, the landlord often bears the investment cost while the tenant benefits from lower energy bills. In multi-owner buildings, individual owners may also have limited control over building-level renovation decisions.

Policy Priorities to Accelerate Heat-Pump Deployment

- **Improve market data, collection and monitoring.** Luxembourg still lacks a reliable and regularly updated picture of its heat-pump stock, installation costs and real-world performance. Better data would help households and policymakers make more informed decisions, while identifying where heat pumps work best, where costs remain excessive and where public support is most effective.
- **Preserve a favorable electricity-to-gas price ratio.** Heat pumps are particularly attractive when electricity remains inexpensive relative to gas. Luxembourg's comparatively cheap natural gas weakens the incentive to electrify heating.
- **Ban fossil heating in new construction.** Where heat pumps are already financially competitive even before subsidies, Luxembourg could set a clear future date after which new fossil-fuel boilers are prohibited in new residential buildings, following an appropriate transition period and allowing only justified technical exceptions.
- **Address rental and multi-owner housing explicitly.** A purely voluntary approach is unlikely to be sufficient where landlords, tenants and co-owners face different incentives. Fiscal advantages, pre-financing and future minimum-performance requirements could be combined, while providing additional support for lower-income households.



Résumé exécutif

Au Luxembourg, les pompes à chaleur sont financièrement attractives à long terme grâce aux aides actuelles et permettent de réduire significativement les émissions de CO₂, mais leur déploiement demeure lent.

Le secteur du bâtiment représente environ **20 % des émissions nationales de gaz à effet de serre (GES) liées à l'énergie**, tandis que le chauffage des logements à lui seul en représente environ **13 % en 2024**. Il existe donc un potentiel important de décarbonation du secteur grâce aux pompes à chaleur, d'autant plus que le parc résidentiel luxembourgeois reste fortement dépendant du gaz naturel et du fioul.

Malgré cela, le déploiement des pompes à chaleur reste limité. Fin 2024, le Luxembourg comptait environ **20 000 pompes à chaleur**, soit moins de **80 installations pour 1 000 ménages**. Le STATEC envisage néanmoins un parc de **plus de 150 000 pompes à chaleur d'ici 2050**, ce qui implique une accélération considérable du marché par rapport à son niveau actuel.

Au Luxembourg, les **pompes à chaleur air-eau** constituent la technologie la plus répandue et sont au cœur de la présente étude. Les **pompes à chaleur géothermiques** bénéficient également d'un soutien public, mais elles sont moins adaptées à de nombreux ménages en raison de leur coût plus élevé et de contraintes d'installation plus importantes. Les **pompes à chaleur air-air** ne bénéficient pas d'aides publiques et ne produisent généralement pas d'eau chaude sanitaire.

Principaux résultats

L'étude compare les **pompes à chaleur air-eau** aux **chaudières au gaz et au fioul** dans trois scénarios résidentiels sur une période de **20 ans**. Le modèle repose sur une demande annuelle de chaleur utile de **15 000 kWh**, un **SCOP de 3,0** pour la pompe à chaleur, une hausse annuelle des prix de l'énergie de **2 % pour l'électricité** et de **3 % pour le gaz et le fioul**, ainsi qu'un **taux d'actualisation de 5 %**. Les montants présentés ci-dessous correspondent à des **coûts actualisés sur 20 ans**.

- **Scénario 1 - Nouvelle construction** : environ **38 500 €** pour une pompe à chaleur, contre **45 900 €** pour le gaz ; seuil de rentabilité atteint après environ **7 ans**.
- **Scénario 2 - Rénovation standard** : environ **37 500 €**, contre **45 900 €** pour le gaz et **54 300 €** pour le fioul ; seuil de rentabilité par rapport au gaz atteint après environ **6 ans**.
- **Scénario 3 - Rénovation complexe** : environ **42 500 €**, contre **45 900 €** pour le gaz ; seuil de rentabilité atteint seulement après environ **14 ans**.
- L'avantage économique à long terme de la pompe à chaleur repose sur les aides actuellement disponibles, des prix de l'électricité relativement favorables et une efficacité énergétique nettement supérieure : avec un **SCOP de 3,0**, elle fournit environ **trois unités de chaleur utile pour une unité d'électricité consommée**.
- Dans les scénarios de rénovation, le **chauffage au fioul** apparaît clairement comme l'option la moins attractive, combinant les coûts sur la durée de vie les plus élevés et les émissions les plus importantes.
- Les résultats demeurent globalement robustes même dans un scénario où les prix de l'électricité et du gaz augmentent tous deux de **2 % par an**, bien que l'avantage économique devienne limité dans le cas des rénovations complexes et que le seuil de rentabilité soit repoussé.



- Vu le manque de données et les questions de périmètre de coût à prendre en compte, dans le modèle utilisé, le montant maximum du coût d'installation d'une pompe à chaleur pour rester rentable après 15 ans par rapport à une chaudière au gaz est **d'environ 40 000 €** (avec actualisation des coûts, 51 000 € sans actualisation).

Le Luxembourg comparé à certains marchés européens

- Avec un coût brut représentatif d'installation d'une **pompe à chaleur air-eau d'environ 35 000 €**, contre environ **15 000 € en France, 12 000 € aux Pays-Bas** et **10 000 € en Belgique**, le Luxembourg figure parmi les pays les plus chers de l'échantillon étudié. En revanche, le Luxembourg bénéficie de **prix de l'électricité relativement avantageux**.
- Toutefois, les revenus plus élevés au Luxembourg ne compensent pas entièrement ces coûts. Après ajustement des revenus en fonction du pouvoir d'achat, le poids du coût d'installation est environ **29 % plus faible en France, 40 % plus faible en Belgique** et **42 % plus faible aux Pays-Bas** qu'au Luxembourg, tandis qu'il est environ **70 % plus élevé en Allemagne**.

Impact climatique et efficacité économique

- Le remplacement d'une chaudière au gaz par une pompe à chaleur permet de réduire les émissions liées au chauffage d'environ **68 %**, tandis que le remplacement d'une chaudière au fioul permet une réduction d'environ **76 %**.
- L'efficacité des aides publiques varie fortement selon les situations. Le coût de la subvention est estimé à environ :
 - **87 €/tCO₂ évitée** dans le cas d'une nouvelle construction ;
 - **325 €/tCO₂ évitée** dans le cas du remplacement standard d'une chaudière au gaz ;
 - **434 €/tCO₂ évitée** dans le cas d'une rénovation complexe.

Dans le scénario de nouvelle construction, la pompe à chaleur présente même un **coût marginal d'abattement social négatif**, ce qui signifie qu'elle permet de réduire les émissions tout en diminuant les coûts totaux sur la durée de vie, même avant prise en compte des subventions.

Défis : un ensemble de facteurs qui se renforcent mutuellement

- **Coûts d'installation élevés** : les coûts bruts d'installation restent particulièrement élevés par rapport aux pays voisins et à d'autres marchés européens comparables.
- **Perception limitée du besoin de rénovation** : une part importante des ménages luxembourgeois ne considère pas la rénovation comme nécessaire, ce qui réduit la propension à engager des investissements importants dans les systèmes de chauffage.
- **Gaz naturel bon marché** : le coût relativement faible du gaz continue de réduire l'incitation financière à abandonner les systèmes de chauffage fossiles.
- **Incertitude quant aux prix futurs de l'électricité** : l'incertitude entourant l'évolution à long terme des prix de l'électricité complique les décisions d'investissement des ménages, en particulier pour une technologie caractérisée par un coût initial élevé.
- **Manque de transparence du marché** : les informations limitées sur les coûts d'installation, les performances réelles des systèmes et le parc existant de pompes à chaleur rendent plus difficile une évaluation fiable du marché, tant pour les ménages que pour les décideurs publics.





- **Obstacles liés au logement locatif et à la copropriété** : dans le parc locatif, le propriétaire supporte souvent le coût de l'investissement tandis que le locataire bénéficie de la baisse des factures énergétiques. Dans les immeubles en copropriété, les propriétaires individuels disposent également d'une marge de manœuvre limitée pour décider de rénovations à l'échelle du bâtiment.

Priorités d'action pour accélérer le déploiement des pompes à chaleur

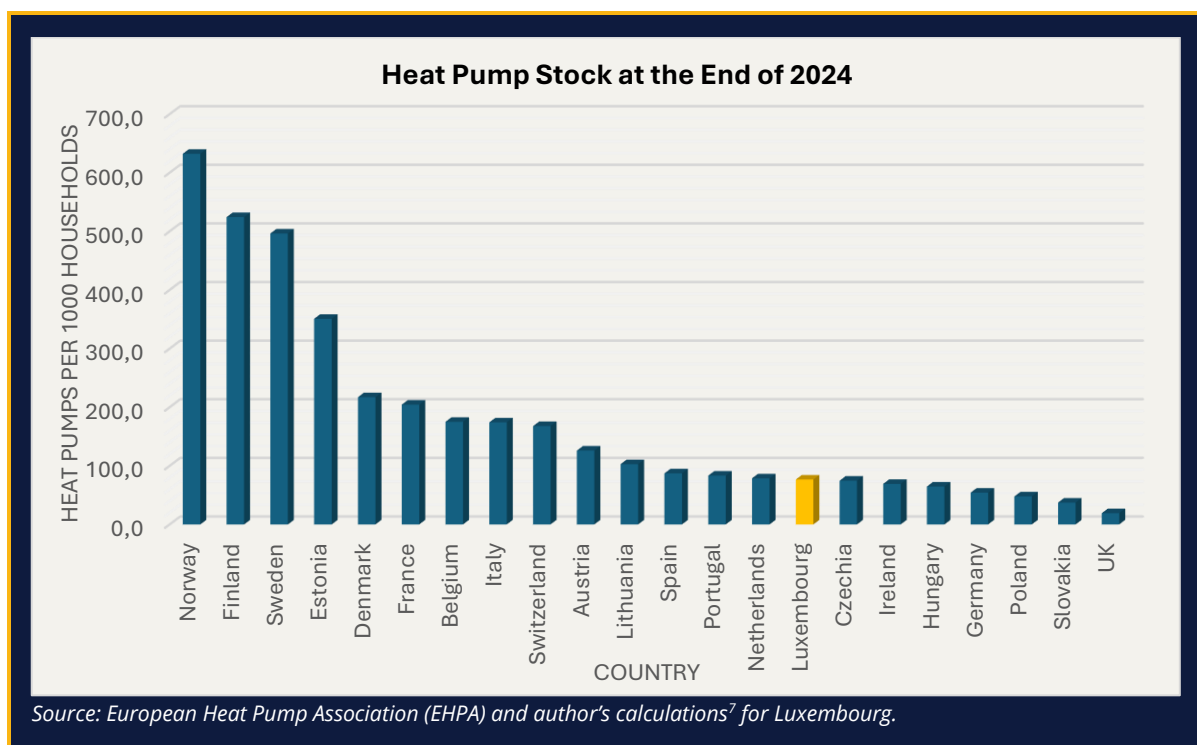
- **Améliorer la collecte, le suivi et la qualité des données de marché.** Le Luxembourg ne dispose toujours pas d'une vision fiable et régulièrement actualisée du parc de pompes à chaleur, des coûts d'installation et des performances observées en conditions réelles. De meilleures données permettraient aux ménages et aux responsables publics de prendre des décisions plus éclairées, tout en aidant à identifier les situations où les pompes à chaleur sont les plus performantes, où les coûts restent excessifs et où le soutien public est le plus efficace.
- **Préserver un rapport de prix favorable entre l'électricité et le gaz.** Les pompes à chaleur sont particulièrement attractives lorsque l'électricité reste relativement peu coûteuse par rapport au gaz. Le prix relativement faible du gaz naturel au Luxembourg réduit aujourd'hui l'incitation à électrifier le chauffage.
- **Interdire le chauffage fossile dans les nouvelles constructions.** Lorsque les pompes à chaleur sont déjà compétitives sur le plan économique, même sans subventions, le Luxembourg pourrait fixer une date claire à partir de laquelle l'installation de nouvelles chaudières fossiles serait interdite dans les bâtiments résidentiels neufs, après une période de transition adaptée et avec des exceptions limitées aux cas techniquement justifiés.
- **Traiter explicitement les enjeux du logement locatif et de la copropriété.** Une approche purement volontaire a peu de chances d'être suffisante lorsque propriétaires, locataires et copropriétaires font face à des incitations divergentes. Des avantages fiscaux, des mécanismes de préfinancement et de futures exigences minimales de performance pourraient être combinés, tout en prévoyant un soutien renforcé en faveur des ménages à faibles revenus.



Introduction

Following the Paris Agreement¹, Luxembourg has set an ambitious climate objective through its updated National Energy and Climate Plan (NECP)², which aims to reduce non-ETS greenhouse-gas emissions³ by 55% by 2030 compared with 2005. Reaching it will require deep changes across the economy, particularly in the buildings sector, which accounted for over 20% of national energy-related GHG emissions in 2024, with 13% stemming from residential space heating alone⁴. As the sector remains heavily dependent on fossil fuels such as natural gas and heating oil, the NECP sets a courageous reduction path for residential and tertiary buildings, with annual emissions allocations falling from 1.497 MtCO₂e in 2021 to 0.590 MtCO₂e⁵ in 2030. To reach this goal, the plan foresees a stronger role for renewable heat, expecting it to reach 40% of final heat-sector consumption by 2030.

In this context, heat pumps stand out as one of the most promising technologies for decarbonizing residential heating. They are more efficient than traditional boilers because they transfer existing heat from the air, ground or water, producing over three units of heat per unit of electricity consumed, while boilers generate heat directly and lose part of that energy in the process. In Luxembourg, air-to-water heat pumps dominate the market, as many homes already rely on water-based central-heating systems such as radiators or under-floor heating. However, other types also exist, including air-to-air, ground-source and water-source heat pumps, which differ in cost, efficiency, installation requirements and suitability for different buildings⁶.



¹ United Nations Framework Convention on Climate Change (UNFCCC), [The Paris Agreement](#), 12 December 2015.

² European Commission, [Luxembourg - Final Updated National Energy and Climate Plan \(NECP\) 2021-2030](#), 24 July 2024.

³ emissions not covered by the EU Emissions Trading System, mainly buildings, transport, agriculture, etc.

⁴ International Energy Agency (IEA), [Luxembourg 2026: Energy Policy Review](#), 8 June 2026.

⁵ Million tons of carbon equivalent

⁶ Comparative table with characteristics of the various existing heat pump technologies can be found in the annex.

⁷ For Luxembourg, the value was calculated by dividing the estimated stock of 20,000 heat pumps in 2024 (reported by Statec) by approximately 261,000 households (reported by Statec) and multiplying by 1,000: $(20,000 / 261,000) \times 1,000 \approx 76.6$ heat pumps per 1,000 households.



Despite their potential, heat-pump deployment in Luxembourg remains limited compared with most other European countries. At the end of 2024, according to our estimation⁸, Luxembourg still recorded fewer than 80 heat pumps per 1,000 households, remaining well below the Nordic countries where heat pumps have become the dominant residential heating technology. While climatic conditions, building characteristics and financial incentives differ across countries, deployment numbers still highlight the upward potential for further development in Luxembourg. Part of Luxembourg's comparatively low heat-pump stock can be explained by its historical reliance on gas and oil heating⁹, unlike several Nordic countries, where low-cost and readily available electricity has traditionally played a much larger and earlier role in residential heating¹⁰. Political choices, including limited communication on the greater efficiency of heat pumps compared with fossil-fuel heating systems, can also partly explain the low number of heat pump installations. A similar legacy of fossil heating also explains Germany's relatively low deployment.

Statec's 2024 modelling of residential heating scenarios emphasizes their strategic importance in reducing emissions and notes that the number of heat pumps would need to rise from an estimated number of 20,000 in 2024 to more than 150,000 by 2050 in order to represent 80% of residential heating systems¹¹, with one central installation assumed to serve an average of eight dwellings in apartment buildings. Although the government has introduced sizable financial incentives and laid out broader climate-policy measures, adoption remains a challenge, reflected by economic and institutional barriers, from high installation costs and building suitability to slow renovations, split incentives, energy-price uncertainty and installer capacity. Nonetheless, accelerating heat-pump deployment remains essential to Luxembourg's climate strategy, as they reduce building-sector emissions, improve energy efficiency, lower dependence on fossil heating, and help households reduce their heating bills.

⁸ See "1.3 The national data gap on heat pumps" for more details on data about installed heat pumps in Luxembourg.

⁹ STATEC, Housing in 2021: Change within Continuity, 2024.

¹⁰ International Energy Agency (IEA) and Nordic Energy Research, Nordic Energy Technology Perspectives: Pathways to a Carbon Neutral Energy Future, 2013.

¹¹ STATEC, Pompes à chaleur dans le secteur résidentiel, 12 July 2024.



Luxembourg's Heat Pump Policy Retrospective: Support, Barriers and Market Conditions



Part 1: Luxembourg's Heat Pump Policy

Retrospective: Support, Barriers and Market Conditions

1.1 Over Two Decades of Support for Renewable Heating

Luxembourg's support for renewable heating dates to the turn of the millennium. Already in 2001, a Grand-Ducal Regulation¹² introduced a financial aid regime for investments promoting rational energy use and renewable energy sources, including heat pumps. Over time, this support regime was continuously revised, extended and reorganized, moving from relatively limited investment assistance to a comprehensive policy framework combining subsidies, technical standards, fossil-heating replacement incentives and, more recently, measures intended to address households' financing constraints¹³. A major institutional step was taken through the 'Law of 23 December 2016', which embedded renewable heating support within a broader aid regime for sustainability, rational energy use and renewable energies in housing¹⁴. Under PRIME House¹⁵, and later Klimabonus Wunnen¹⁶, financial support increasingly targeted energy renovation, renewable heating systems and the replacement of fossil-fuel boilers. Recent measures, including the 2026 Klimabonus regime¹⁷ and the temporary Resilienzpak¹⁸, further reflect the government's increased support for heat pumps: Klimabonus offers up to €10,000 for replacing fossil heating with an air-to-water heat pump, while the Resilienzpak adds a temporary €2,000 bonus from January 1, 2026 until June 30, 2027. Temporary increases in support like the Resilienzpak have also been used in the past. Following the 2022 tripartite negotiations, the Solidaritéitspak 2.0¹⁹ also temporarily increased the replacement bonus for switching from fossil heating to renewable systems, including heat pumps, from 30% to 50%.

This national commitment also aligns with the broader EU policy direction. The revised Renewable Energy Directive (RED III, 2023)²⁰ strengthens the role of renewable heating and cooling, while the revised Energy Efficiency Directive²¹ requires annual public-sector energy savings and a 3% renovation rate for public buildings. The revised Energy Performance of Buildings Directive²² complements this by requiring national renovation trajectories to improve building performance and move towards a zero-emission building stock by

¹² Grand Duchy of Luxembourg, Règlement grand-ducal du 17 juillet 2001 instituant un régime d'aides pour la promotion de l'utilisation rationnelle de l'énergie et la mise en valeur des sources d'énergie renouvelables, 17 July 2001.

¹³ Luxembourg Government, "Klimabonus Wunnen" 2026-2030: un soutien renforcé à la transition énergétique et plus de sécurité de planification, 16 July 2026.

¹⁴ Grand Duchy of Luxembourg, Loi du 23 décembre 2016 instituant un régime d'aides pour la promotion de la durabilité, de l'utilisation rationnelle de l'énergie et des énergies renouvelables dans le domaine du logement, 23 December 2016.

¹⁵ Guichet.lu, Applying for Financial Aid for Energy Efficiency Renovation of a Residential Building (PRIME House 2017), 12 February 2025.

¹⁶ Guichet.lu, Aide financière pour la rénovation énergétique d'un logement (Klimabonus 2026), 10 August 2026.

¹⁷ Guichet.lu, Financial Aid for Renewable Energy-Based Technical Installations (Klimabonus 2026 Scheme), 6 January 2026.

¹⁸ Luxembourg Government, Resilienzpak 2026, 8 June 2026.

¹⁹ Luxembourg Government, Adoption par le Conseil de gouvernement d'un paquet de mesures accélérant la transition énergétique des ménages, 14 November 2022.

²⁰ European Parliament and Council of the European Union, Directive (EU) 2023/2413 on the Promotion of Energy from Renewable Sources (RED III), 18 October 2023.

²¹ European Parliament and Council of the European Union, Directive (EU) 2023/1791 on Energy Efficiency (EED), 13 September 2023.

²² European Parliament and Council of the European Union, Directive (EU) 2024/1275 on the Energy Performance of Buildings (Recast), 24 April 2024.



2050. Together, these directives place heat pumps at the center of Europe's building decarbonization strategy, as one of the key technologies for replacing fossil-fuel heating.

1.2 Strong Support Meets Technical Challenges

Heat-pump performance depends fundamentally on installation quality. Unlike a conventional boiler, a heat pump's successful installation requires careful consideration of the building's heating demand, distribution system and technical characteristics. Its performance depends on correct sizing, hydraulic design, system settings and commissioning. A field study by ADEME, the French government agency for ecological transition²³, covering 100 heat pumps in individual houses found stark differences in the performance of air-to-water systems, with measured coefficients of performance²⁴ ranging from below 1.8 to above 4. These differences were linked particularly to installation quality, sizing and system settings. ADEME also found that around one-third of the heat pumps studied could have performed better through improved installation or adjustment, emphasizing the economic importance of ensuring high-quality installations.

The importance of correct sizing also makes subsidy design particularly relevant. While Luxembourg has stepped up its climate support measures, generous nominal subsidies for heat pumps do not automatically translate into aspired adoption. Under the former subsidy regime, the amount of aid granted to a household depended more directly on the installed capacity and cost of the heat pump. The ministerial response to parliamentary question no. 3991²⁵ shows that under that subsidy regime, air-to-water heat pumps with a capacity between 10 and 14 kW received an average subsidy of €10,000 for an average investment cost of €32,300²⁶, while installations above 14 kW received an average subsidy of €13,600 for an average investment cost of €34,300. Thereby, a relatively limited increase in investment costs of around €2,000 could lead to the acquisition of an increase in public aid of around €3,500. This mechanism could therefore have created an incentive for the oversizing of heat pump systems, encouraging households and installers to choose units with a higher capacity than required. Thus, the previous regime led to inefficient use of public funds, while reducing the heat pumps' operating efficiency and incurring higher operating costs.

To address the previously flawed regime, a flat-rate subsidy scheme²⁷ was put forward for the period 2026-2030 by replacing capacity-based support with fixed subsidy amounts. The amount of Klimabonus support is now determined according to three main criteria:

- the type of heat pump installed (air-water or geothermal);
- the type of building (single family residence or multi-unit building);
- and the nature of the project (new construction or existing residence).

Thereby, the current system removes the direct financial incentive to install a more powerful heat pump simply to receive a larger subsidy.

²³ ADEME, Mesure des performances de 100 PAC air/eau et eau/eau installées en maisons individuelles, 7 October 2025.

²⁴ The coefficient of performance (COP) is the ratio of heat delivered to electricity consumed. A COP of 3 means three units of heat are produced per unit of electricity used.

²⁵ Chambre des Députés, Question parlementaire n°3991 - Méthode de calcul pompe à chaleur, 9 June 2026.

²⁶ Heat pump installation projects may sometimes involve additional costs, some more necessary than others, such as adapting the premises, or costs arising from certain comfort preferences (for instance aesthetic considerations requiring the heat pump to be placed in a specific location, and therefore longer connections). Some concrete examples are given in Annex 2.

²⁷ Chambre des Députés, Projet de loi n°8585 instituant un régime d'aides pour la promotion de la durabilité, de l'utilisation rationnelle de l'énergie et des énergies renouvelables dans le domaine du logement, 18 July 2025.





Box n°1: Is the Luxembourg heat pump market vulnerable to subsidy pass-through?

Better installation-level data could also help determine whether public subsidies are fully passed through to households. In markets with limited price transparency or competition, part of the additional support may instead be reflected in higher gross installation prices, reducing the benefit ultimately received by households. Research on residential solar PV in California shows that subsidy pass-through can depend strongly on market structure and installer pricing behavior²⁸. Without a comprehensive database combining subsidy amounts, technical characteristics and invoiced installation prices, it is difficult to determine whether subsidies are being captured by installers or heat pump manufacturers.

1.3 The National Data Gap on Heat Pumps

The recently implemented subsidy reform corrects the clearest weakness of the previous regime. However, assessing whether the new system leads to better-sized installations, improved performance and faster deployment requires reliable information on the heat pumps being installed. Without such information, it is difficult to measure deployment accurately, determine whether past policy weaknesses have been addressed and evaluate whether generous public support is achieving its intended results.

Despite the central role assigned to heat pumps in the National Energy and Climate Plan (PNEC)²⁹, no official institution appears to publish a comprehensive and regularly updated statistic on the size and characteristics of the national heat-pump stock. Existing estimates differ substantially depending on the methodology used and the latest estimate of around 20,000 heat pumps, cited in STATEC's 2024 note "Pompes à chaleur dans le secteur résidentiel"³⁰ and subsequently repeated in other policy documents, is not based on a direct count of installed heat pumps. According to STATEC, it originates from the 2021 Population Census³¹, which identified dwellings heated with electricity. A simplifying assumption was then made that all electrically heated dwellings were equipped with heat pumps, even though STATEC acknowledges that some are likely heated by direct electric systems. As a result, the estimate should be interpreted as a modelling approximation rather than an observed measure of the installed stock. For subsequent years, the evolution of the heat-pump stock is based on scenario assumptions regarding the share of new buildings equipped with heat pumps and the replacement rate of fossil boilers, rather than on observed installations.

In contrast, EurObserv'ER estimates a stock of only around 5,200 heat pumps in 2023³², based on estimated annual market sales and cumulative installations, but without disclosing the Luxembourg-specific methodology or underlying data source.

Given the importance of heat pumps for achieving Luxembourg's climate objectives and the generous level of public support provided for them, improving data collection and making it publicly accessible, should become a policy priority. Following the example of the Netherlands, which publishes detailed data on heat-pump sales, capacity, type and subsidy uptake³³, Luxembourg could establish a regularly updated national register to provide policymakers with a reliable basis for monitoring deployment, evaluating support

²⁸ American Economic Association (AEA), *Pass-Through as a Test for Market Power: An Application to Solar Subsidies*, October 2019.

²⁹ Government of the Grand Duchy of Luxembourg, *Updated Integrated National Energy and Climate Plan for Luxembourg 2021-2030*, 17 July 2024.

³⁰ STATEC, *Pompes à chaleur dans le secteur résidentiel*, 12 July 2024.

³¹ STATEC, *Population Census 2021 - Territorial Distribution of the Population: A New Approach to Luxembourg by 1 km² Grid*, 30 March 2023.

³² EurObserv'ER, *Heat Pumps Barometer 2024*, 31 October 2024.

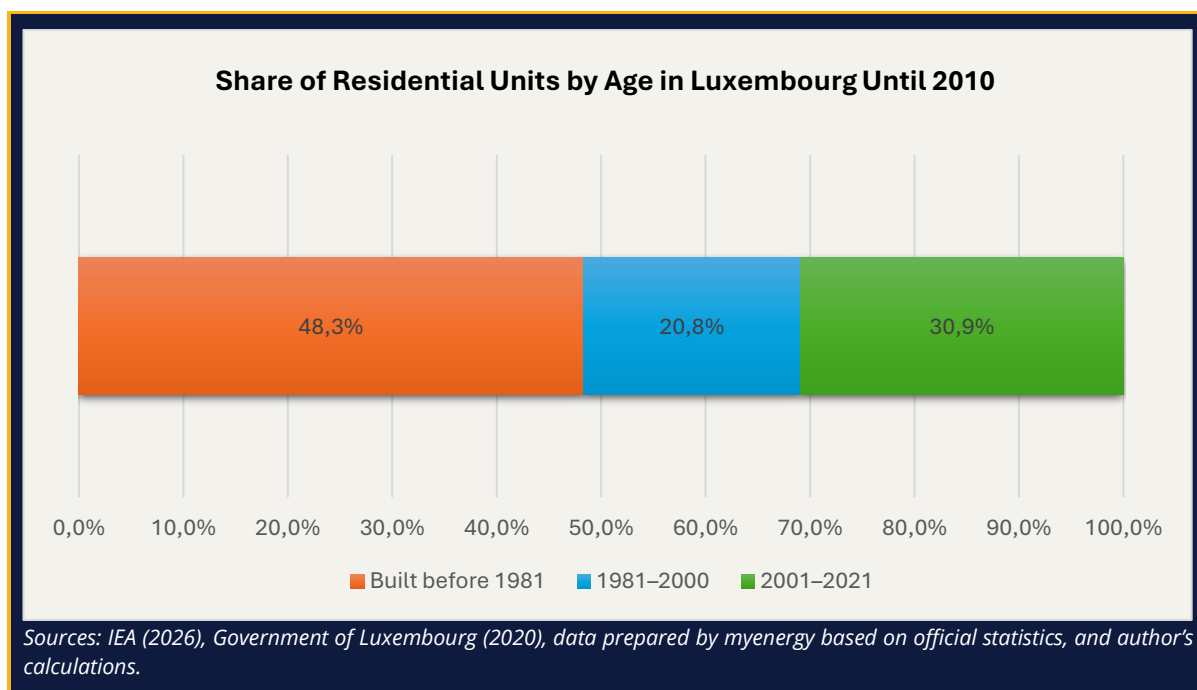
³³ Statistics Netherlands (CBS), *Verkoopcijfers warmtepompen, 2024-2025*, 30 April 2026.



measures and identifying where additional policy intervention is needed. The recently adopted Law no. 8595³⁴, approved by the Chamber of Deputies on 15 July 2026, provides a useful foundation by introducing requirements relating to documented heat-load calculations, commissioning and periodic inspections. Useful statistics can already be derived from commissioning data, as commissioning has been mandatory since September 2025. Information generated through these procedures, combined with data from subsidy applications, could support such a register and help determine whether installation quality has improved and whether oversizing remains a problem.

1.4 The Old Nature of Luxembourg's Housing Stock... Does it Make Heat Pumps Less Compatible?

Heat pumps work best in well-insulated homes with low-temperature heating systems, while older buildings require radiator upgrades, hydraulic balancing, electrical adaptations or broader renovation before heat pumps can perform efficiently. In Luxembourg, less than 10% have an Energy Performance Certificate (EPC) rating of A or B³⁵. This is mainly due to the old nature of Luxembourg's housing stock:



Furthermore, in their 2026 Energy Policy Review, the IEA reports that among households living in homes built between 1960 and 1990, 60% do not see a need for renovation and even among households living in homes built before 1960, 42% do not see a need for renovation³⁶. Consequently, heat-pump deployment in Luxembourg is constrained by two mutually reinforcing barriers: a limited perceived need for renovation and the additional cost of adapting older buildings for efficient heat-pump operation.

By contrast, heat-pump deployment has progressed faster in countries where homes were already commonly heated by electric radiators, particularly in Nordic and Baltic markets. These households could often add relatively inexpensive air-to-air heat pumps without replacing a fossil-fuel boiler or modifying a water-based heating network, enabling a faster and less costly transition. Luxembourg starts with delay and still relies on fossil-fuel boilers connected to radiators and hydraulic systems. A considerable share of Luxembourg's housing stock is located in denser urban areas, where attached or closely spaced homes may offer

³⁴ Chambre des Députés, [Projet de loi n°8595 concernant l'exploitation des pompes à chaleur](#), 30 July 2025.

³⁵ [International Energy Agency \(IEA\), Luxembourg 2026: Energy Policy Review, 8 June 2026.](#)

³⁶ [International Energy Agency \(IEA\), Luxembourg 2026: Energy Policy Review, 8 June 2026.](#)



limited space for an outdoor unit, often restricting its placement to the front or rear of the property³⁷. Outdoor-unit placement is sometimes also constrained by municipal planning and building regulations³⁸, which may differ across municipalities and create additional uncertainty for households. Depending on the municipality and the characteristics of the building, an installation may require a formal building permit or compliance with specific siting and noise requirements. This adds administrative delays and, in some cases, additional costs where acoustic protection, alternative positioning or more complex installation solutions are required. As a result, constraints can therefore partly work against national policy objectives, as the State financially supports heat-pump deployment while local planning rules may make individual installations more difficult or costly.

The need for greater harmonization has already been recognized at national level. In 2023, the government issued model provisions intended to harmonize municipal rules for heat pumps and other renewable-energy installations³⁹. More recently, in July 2026, the government approved a draft national building regulation⁴⁰ intended to replace the separate municipal building regulations with a single framework applying across all 100 municipalities. Such harmonization is essential to simplify installation procedures, reduce uncertainty for households and installers, and limit the additional costs created by differing municipal requirements.

1.5 €10,000-€50,000 per Installation: High Costs, Limited Transparency

The lack of reliable information does not concern only the number of heat pumps installed. Considerable uncertainty also surrounds the price of installing an air-to-water heat pump in Luxembourg. The amounts communicated on installer websites, cited in government documents or used in information provided by Klima-Agence differ substantially and listed prices range from 10,000 Euros to 50,000 Euros for air-to-water heat pumps. The differences partly reflect the highly variable nature of heat-pump renovations, as costs depend on factors such as the building's size and layout, existing heating system and required electrical or hydraulic adaptations. Unlike photovoltaic panels or electric-vehicle charging points, for which installation costs are generally easier to estimate in advance, heat-pump projects are much more building-specific. Nevertheless, numerous other European countries provide households with more accessible cost ranges, comparison tools and standardized simulations than are currently available in Luxembourg.

The European heat-pump market is far from homogeneous. Depending on the country, households face installation costs that differ by a factor of two or more for comparable systems⁴¹. Although cost data for Luxembourg remains scarce, several characteristics of the national market suggest that many of the factors contributing to Germany's comparatively high installation costs are also present in Luxembourg:

- **High labor costs:** Luxembourg has the highest average labor costs in the European Union⁴².
- **A small and relatively immature market:** Limited demand reduces economies of scale, competition, installer specialization and the standardization of installation procedures, while increasing the risk of market concentration among a small number of suppliers and installers.

³⁷ The practical feasibility of outdoor-unit placement depends on planning rules, property boundaries, access, noise exposure and proximity to neighboring dwellings. The importance of this constraint varies substantially by municipality and building type.

³⁸ Ville de Luxembourg, *Séance du conseil communal du 5 décembre 2022*, 5 December 2022.

³⁹ [Ministry of Home Affairs, Transition énergétique: simplifier les procédures pour les citoyens, 15 September 2023.](#)

⁴⁰ [Government of the Grand Duchy of Luxembourg, Présentation du règlement national des bâtisses et de la simplification des procédures PAP/PAG, 10 July 2026.](#)

⁴¹ For example, VAT is not the same in every country : it amounts to 3% in Luxembourg but 21% in the Netherlands.

⁴² Eurostat, [EU hourly labour costs ranged from €12 to €57 in 2025](#), 31 March 2026.





- **Building-specific adaptation work:** Relatively old building stock in Luxembourg requires more extensive electrical upgrades, changes to radiators or pipework, and modifications to the hydraulic system which in turn increase installation time and associated labor costs.
- **Technical and administrative requirements:** Subsidized installations must meet requirements such as hydraulic balancing and the installation of electricity and heat meters, increasing equipment, labor, documentation and installation time.

A comparative analysis⁴³ of prices in the United Kingdom and Germany shows that the difference stems primarily from VAT (0% in the United Kingdom versus 19% in Germany), but also from the equipment used (the German market is largely dominated by European manufacturers, unlike other European markets where Chinese products are more common) and from technical requirements (in particular the obligation to install the outdoor unit on a concrete slab).

However, these findings cannot automatically be assumed to apply fully to Luxembourg. In Luxembourg, the VAT rate on heat pumps is only 3%. While installation costs for heat pumps are currently high, these could decline as the market expands. Greater heat pump demand may attract additional domestic and foreign installers, increase price competition between manufacturers and enable firms to adopt more standardized, repeatable and faster installation processes. Regulations should support this development by establishing clear and proportionate quality standards without creating unnecessary barriers to entry. The reception, inspection and qualification requirements introduced under Law nr. 8595⁴⁴ may prevent poor-quality installations and increase consumer confidence, but their administrative burden and cost should be monitored. If certification procedures for installers are unnecessarily complex or limit the number of professionals able to operate legally in the market, they could constrain competition and offset the price reductions expected from a larger, more competitive and more mature heat-pump sector.

1.6 No More Waiting for Reimbursement? Reducing the Pre-Financing Burden

Regardless of the precise national average, the available estimates agree that installing an air-to-water heat pump in an existing house requires a substantial upfront investment. The average renovation scenario used in the subsequent microeconomic analysis assumes an installation cost of €35,000. Compared with an estimated replacement cost of €16,000 for a gas boiler, this represents an additional gross investment of €19,000 before subsidies.

Until 15 July 2026, this cost difference was reinforced by the requirement for households to prefinance the entire heat-pump installation themselves, as applications for public support could only be submitted once the works had been completed⁴⁵. Prefinancing an average €35,000 installation created a significant financing constraint for most households.

The new Klimabonus Wunnen scheme, which entered into force retroactively from 1 January 2026, partly responds to this problem. From 1 January 2027, a new pre-financing option will allow the expected subsidy to be deducted directly from the installer's invoice, so households only have to pay the remaining installation cost, while the installer subsequently claims reimbursement from the State.

The mechanism is optional and will coexist with the standard Klimabonus application procedure. However, companies wishing to offer pre-financing must first register in a dedicated register, so the practical impact will depend on whether enough installers participate.

⁴³ Jan Rosenow, «[Why are German heat pumps so much more expensive?](#)», 9 August 2026.

⁴⁴ Chambre des Députés, [Projet de loi n°8595 concernant l'exploitation des pompes à chaleur](#), 30 July 2025.

⁴⁵ Guichet.lu, [Financial aid for renewable energy-based technical installations \(Klimabonus 2026 scheme\)](#), 6 January 2026.

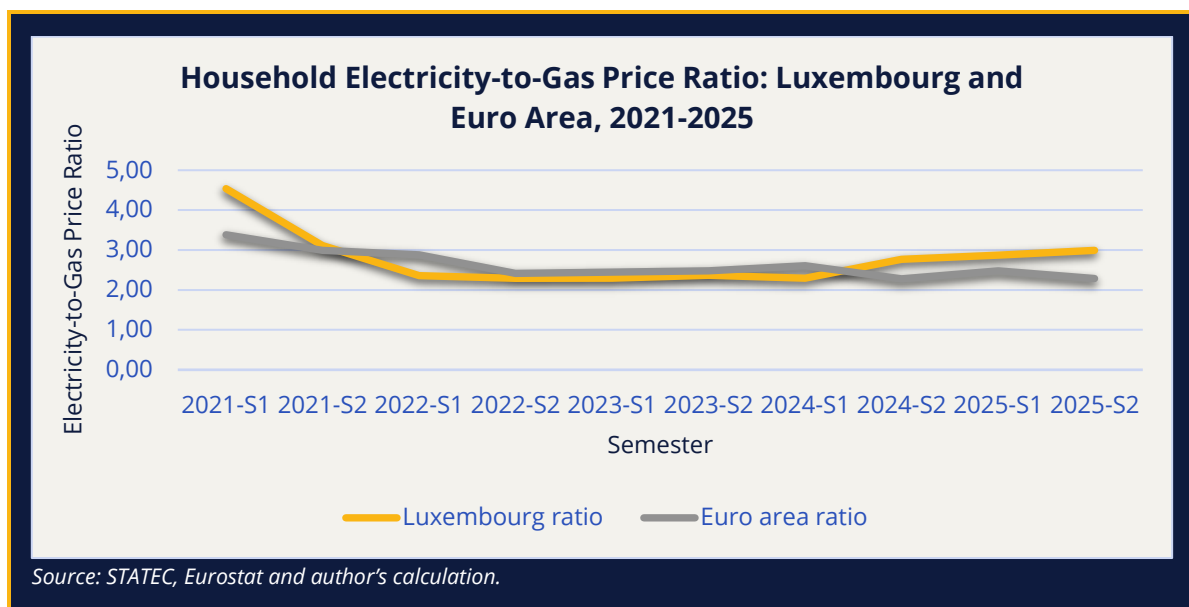




1.7 The Importance of Preserving a Favorable Electricity-to-Gas Price Ratio

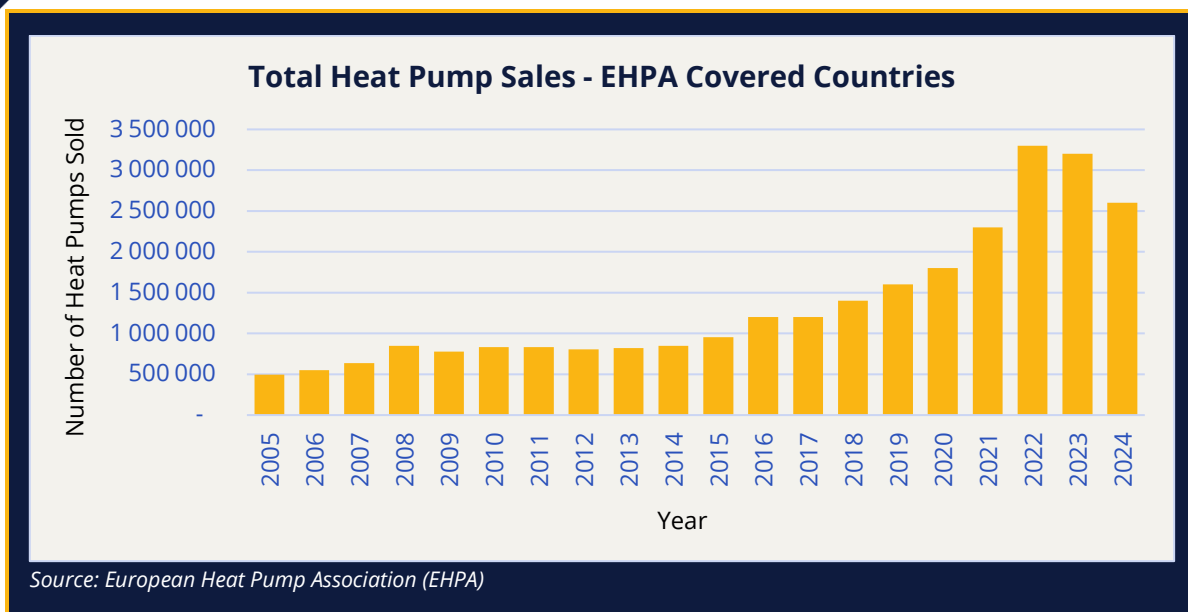
Despite fiscal support through subsidies and the lifting of pre-financing, households must still assess whether the installation costs of a heat pump can be offset by lower energy bills over time. Heat pumps generally benefit from a strong operating-cost advantage because their seasonal coefficient of performance (SCOP)⁴⁶ typically ranges between 3 and 3.5. They can therefore deliver approximately three to three-and-a-half units of useful heat for every unit of electricity consumed. By comparison, a gas boiler converts around 90%⁴⁷ of the energy contained in gas into useful heat. Consequently, the financial attractiveness of a heat pump depends strongly on the relationship between electricity and gas prices, commonly expressed through the electricity-to-gas price ratio.

Developments at the European level demonstrate the importance of this relationship. Heat-pump sales increased sharply following Russia's invasion of Ukraine in 2022, when rising fossil-fuel prices made electricity-based heating comparatively more attractive. However, the comparison shown in Figure below highlights a particular feature of the Luxembourg market. Household electricity prices are not unusually high and remain below the European average. Instead, it is Luxembourg's comparatively low gas price that stands out. This keeps the operation of a gas boiler relatively inexpensive and weakens the potential annual savings associated with switching to a heat pump.



⁴⁶ SCOP (Seasonal Coefficient of Performance) measures the average amount of useful heat delivered per unit of electricity consumed over a heating season.

⁴⁷ The 90% expresses the boiler's efficiency as a percentage: it means that 90% of the energy contained in the gas is converted into useful heat, equivalent to an efficiency factor of 0.9.



Government intervention also influences this relationship. Luxembourg has repeatedly supported household electricity prices through price ceilings, network-cost assistance and other temporary measures. The planned support for electricity-network costs in 2026⁴⁸ and the stronger assistance provided to electricity than to heating oil under the Resilienzpak indicate a policy direction aimed at keeping electricity affordable as heating and transport become increasingly electrified. Nevertheless, continued support for gas prices can work in the opposite direction by preserving the short-term attractiveness of fossil heating.

The electricity-to-gas price ratio therefore provides an important link between the macroeconomic and policy conditions discussed in this section and the individual household investment decision. The following micro-economic analysis examines whether the operating-cost savings generated by a heat pump are sufficient to compensate for its higher installation cost over a 20-year period.

⁴⁸ Ministry of the Economy, [State aid to reduce electricity bills](#), 3 August 2026.



Micro-Cost Analysis: Are Heat Pumps Financially Attractive for Households?



Part 2: Micro-Cost Analysis: Are Heat Pumps Financially Attractive for Households?

2.1 Three Household Cases: Consumption, Costs and Technical Assumptions

The following microeconomic analysis examines the costs faced by a household choosing between an air-to-water heat pump and two types of conventional fossil-fuel heating systems: gas boiler and oil boiler. Its purpose is to provide a transparent and reproducible cost comparison over the heating systems' lifetimes based on clearly defined assumptions. The model's inputs can be adjusted to reflect different buildings, energy prices, subsidy entitlements or levels of technical performance.

The model considers three household situations. The first represents a new single-family house in which a heating system is installed for the first time. The second considers a standard renovation in which an existing heating system is replaced without major adaptation work. The third represents a complex renovation requiring additional technical adaptations. Energy demand and operating assumptions remain identical across the three scenarios, while installation costs and subsidy amounts vary.

Each dwelling is assumed to require 15,000 kWh of useful heat⁴⁹ per year, covering both space heating and domestic hot water. This level of heating demand reflects a moderately insulated single-family house of 120 to 150 m². Such a dwelling size is broadly representative of Luxembourg's housing stock, where more than half of all homes have a surface area exceeding 120 m²⁵⁰. Eurostat data indicates that Luxembourg has the largest average dwelling size in Europe for two-adult households⁵¹.

Key factors in the comparison are the type of energy used by each heating system and their energy efficiency. The efficiency of heat pumps is influenced by the temperature of the heat circuit (better if the temperature is low), insulation of the building and the distribution system (floor heating has a better efficiency than wall radiators). Although electricity is more expensive per kilowatt-hour, a heat pump requires less purchased energy because it uses electricity much more efficiently. With a SCOP of 3.0, an air-to-water heat pump converts one unit of electricity into three units of useful heat, whereas a gas boiler with an efficiency of 90% converts one unit of gas into 0.9 units of useful heat. As a result, the heat pump remains cheaper to operate as long as electricity costs less than approximately 3.3 times the price of gas.

An air-to-water heat pump with a seasonal coefficient of performance (SCOP)⁵² of 3.0 requires 5,000 kWh of electricity per year to provide 15,000 kWh of useful heat. A gas boiler with a seasonal efficiency⁵³ of 90% requires around 16,667 kWh of gas, while an oil boiler operating at an efficiency of 88% consumes approximately 1,647 liters of heating oil. These figures are calculated by dividing the dwelling's annual useful-heat demand by the seasonal efficiency of each system and therefore represent the amount of energy that the household must purchase to obtain the same level of heating and domestic hot water.

⁴⁹ Useful heat demand refers to the heat delivered to the dwelling for space heating and domestic hot water. It differs from purchased energy because each heating system converts electricity, gas or oil into useful heat at a different efficiency. The analysis assumes an annual useful heat demand of 15,000 kWh, corresponding approximately to a well-insulated single-family dwelling of around 150 m² with a specific heat demand of about 100 kWh/m²/year (around energy class C, under Luxembourg's building energy performance framework). This assumption is consistent with examples used for Luxembourg residential buildings and lies within the range commonly observed for existing single-family homes.

⁵⁰ STATEC, [Housing Conditions in Luxembourg: Results of the 2021 Population Census](#), 2024.

⁵¹ Eurostat, [Average Size of Dwelling by Household Type and Degree of Urbanisation \(ilc_hcmh02\)](#), 2026.

⁵² SCOP (Seasonal Coefficient of Performance) measures the average amount of useful heat delivered per unit of electricity consumed over a heating season.

⁵³ Seasonal efficiency measures the proportion of the fuel's energy that is converted into useful heat over a heating season.



The energy prices used in the model are €0.20 per kWh for electricity⁵⁴, €0.10 per kWh for natural gas⁵⁵ and €1.189 per liter for heating oil⁵⁶. The electricity and gas values are based on average final household prices published by STATEC, including taxes and network charges, while the heating-oil value is drawn from Luxembourg's regulated petroleum-product price data. Final energy prices have fluctuated substantially since the energy crisis in 2022, often in response to temporary taxes, subsidies, price caps, network-cost support and other government interventions. Instead of relying on the latest semester observation, the model therefore uses rounded values based on recent price developments as more representative starting points for a 20-year analysis.

This is particularly relevant for electricity. Household electricity prices were around 30% higher in 2025, at €0.259 per kWh, partly reflecting the partial withdrawal of government support introduced during the energy crisis. A new network-tariff structure also entered into force in January 2025, although its impact varied according to households' peaks in simultaneous electricity use⁵⁷. Electricity prices subsequently fell to around €0.198 per kWh in Q1 2026 as the State began covering a substantial share of network costs and financing the renewable-energy compensation mechanism directly from the public budget, with these measures scheduled to remain in place for at least three years⁵⁸. Since the observed electricity price remains strongly influenced by temporary occurrences, the model retains a rounded baseline of €0.20 per kWh. Under these starting assumptions, annual energy expenditure amounts to approximately €1,000 for the heat pump, €1,667 for the gas boiler and €1,958 for the oil boiler.

To represent a plausible long-term development of energy prices, the model assumes that electricity prices will increase by 2% per year, while gas and heating-oil prices will rise by 3% annually⁵⁹. Historical data provides some context for these assumptions. Based on Eurostat household price data, between 2008 and 2025 electricity prices in the euro area increased at a compound annual rate⁶⁰ of approximately 3.5%⁶¹, while gas prices increased by around 4.0% per year⁶². A similar pattern can be observed in Luxembourg: over the same period, household electricity prices increased at an average annual rate of approximately 3.4%, while natural-gas prices increased by around 3.6% per year. However, including the first-half 2026 electricity price which fell sharply to €0.198 per kWh, lowers the average annual growth rate from about 3.4% to 1.6%. This illustrates how strongly the calculated long-term growth rate can be affected by short-term price fluctuations. On this basis, Luxembourg electricity prices have increased at roughly half the annual rate of gas prices since 2008.

⁵⁴ STATEC (LUSTAT), [Composition of electricity price by client type](#), 29 July 2026.

⁵⁵ STATEC (LUSTAT), [Composition of natural gas price by client type](#), 29 July 2026.

⁵⁶ STATEC (LUSTAT), [Prix maxima du gasoil chauffage](#), 24 April 2026.

⁵⁷ Klima-Agence, [Electricity 2025: Prices and Tips for Reducing Your Costs](#), 2025.

⁵⁸ Ministry of the Economy, [State Aid to Reduce Electricity Bills](#), 3 August 2026.

⁵⁹ The European Commission has published projections of future energy prices in the EU. These projections are used, among other inputs, for the development of National Energy and Climate Plans (NECPs). While the energy component of gas prices is expected to decline, increases in network charges and carbon pricing are projected to more than offset this reduction. Consequently, end-user gas prices are expected to nearly double by 2045. Source: European Commission, "Recommended parameters for reporting on GHG projections in 2025".

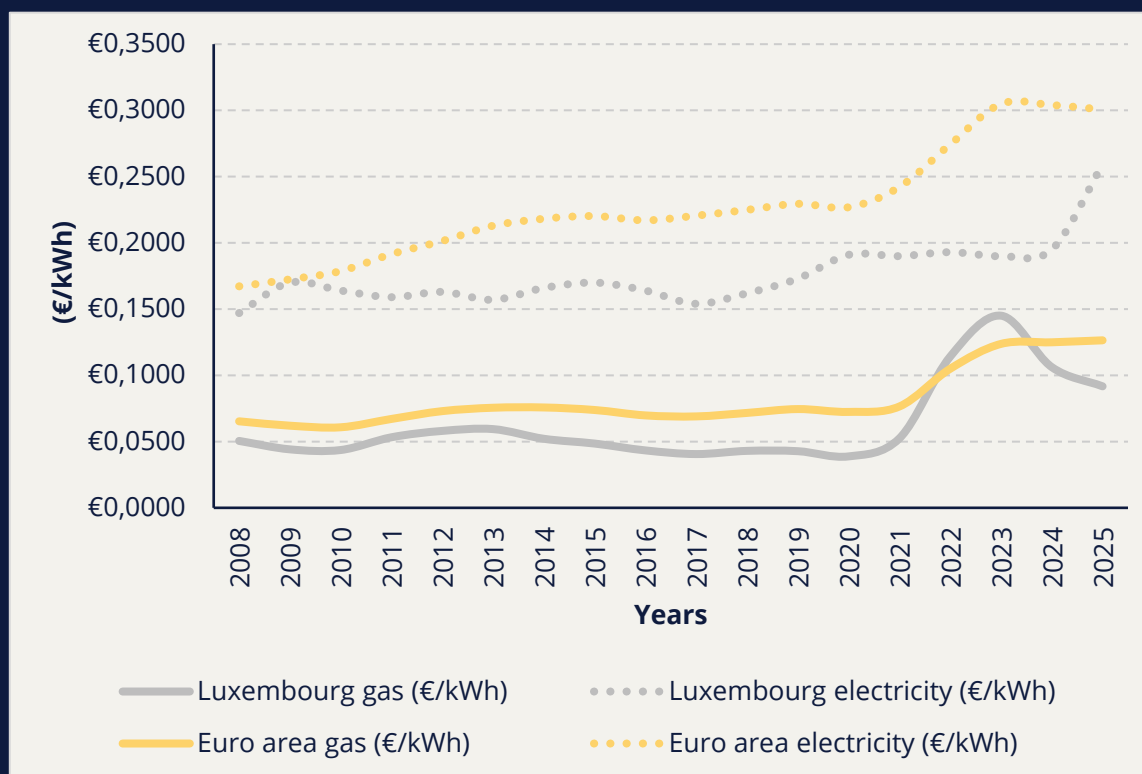
⁶⁰ Compound annual growth rate (CAGR) measures the average annual rate at which a value would have grown if it had increased at a constant rate over the period considered.

⁶¹ Eurostat, [Electricity Prices for Household Consumers - Bi-Annual Data \(from 2007 Onwards\) \(nrg_pc_204\)](#), 2026.

⁶² Eurostat, [Gas Prices for Household Consumers - Bi-Annual Data \(from 2007 Onwards\) \(nrg_pc_202\)](#), 2026.



Household Gas and Electricity Prices for Household Consumers



Source: Luxembourg annual figures come from STATEC, Euro area annual figures come from Eurostat.

This period (2008-2025) includes the exceptional energy-price shock of the early 2020s and should therefore not be interpreted as indicative of future price growth. There are several reasons for assuming a more favorable future long-term development for electricity prices than for fossil fuels: The progressive decarbonization of the electricity system, increasing renewable generation and climate policies should gradually phase out fossil fuels, while carbon pricing is expected to make fossil heating increasingly expensive. Furthermore, the EU's REPowerEU strategy⁶³ supports faster renewable deployment and electrification, while ETS2⁶⁴ will extend carbon pricing to fuels used in buildings starting from 2028.

However, electricity prices may not necessarily increase slowly. Electrification of heating and transport, rapidly growing electricity demand from data centers and AI, new industrial loads such as semiconductor production, and the need for substantial grid investment could all create upward pressure on electricity-system costs⁶⁵. Future fossil-fuel prices are equally uncertain. Geopolitical developments can rapidly disrupt supply and substantially alter gas and oil prices, as illustrated by the European energy crisis following Russia's invasion of Ukraine⁶⁶ and more recent shocks linked to conflicts in the middle east⁶⁷. Conversely, expanding U.S. oil and gas production and record LNG exports⁶⁸ could increase global supply and place downward pressure on European gas prices. Demand for fossil energies may also decrease as electrification progresses, particularly in major markets such as Europe and China. In China, rapid electric-vehicle deployment has already

⁶³ European Commission, [REPowerEU Plan](#), 18 May 2022.

⁶⁴ European Commission, [ETS2: Buildings, Road Transport and Additional Sectors](#), 23 July 2026.

⁶⁵ International Energy Agency (IEA), [Electricity 2026 - Grids](#), 6 February 2026.

⁶⁶ International Energy Agency (IEA), [Russia's War on Ukraine](#), 2024.

⁶⁷ International Energy Agency (IEA), [The Middle East and Global Energy Markets](#), 2026.

⁶⁸ U.S. Energy Information Administration (EIA), [Today in Energy](#), 2026.



contributed to a slowdown in oil-demand while in Europe⁶⁹, the increasing use of heat pumps and electric vehicles is expected to follow that trend⁷⁰. Fossil-fuel prices are therefore subject to globally opposing pressures from supply, demand, climate policy and geopolitical developments, making their long-term evolution uncertain.

On the other hand, households and companies relying on the gas distribution network could face higher costs in the future as the number of users declines, increasing the risk of the network becoming a stranded asset and forcing a shrinking customer base to bear the fixed infrastructure costs.

The assumed annual growth rates of 2% for electricity and 3% for gas and oil should therefore be interpreted as a transparent baseline scenario rather than a forecast⁷¹, as actual prices may develop above or below these paths. A sensitivity analysis consequently tests an alternative trajectory with identical price paths of 2% for both electricity and gas annually to assess whether the heat pump remains financially attractive.

Under the assumed annual price increases of 2% for electricity and 3% for gas, the electricity price rises from €0.20 to €0.297 per kWh over 20 years, while the gas price increases from €0.10 to approximately €0.181 per kWh. The electricity-to-gas price ratio consequently falls from 2.0 at the beginning of the analysis to approximately 1.64 after 20 years, strengthening the heat pump's operating-cost advantage over time.

The model applies annual maintenance cost assumptions of €200 for the heat pump, €200 for the gas boiler and €250 for the oil boiler. Published annual maintenance costs vary across installer websites and should therefore be treated as indicative rather than fixed tariffs. The higher allowance for oil boilers reflects their higher maintenance and servicing costs, particularly the more frequent cleaning requirements associated with oil-fired heating systems compared with other heating technologies⁷². Major repairs and full system replacement are excluded because of their unpredictability.

The installation-cost assumptions for the different heating technologies and scenarios are based primarily on indicative average prices communicated by Klima-Agence and, given the limited, highly variable and sometimes difficult-to-compare data available, are cross-checked against official government data on subsidized air-to-water heat-pump projects. In the new construction case, the model assumes a gross heat-pump installation cost of €25,000. This rises to €35,000 in the standard-renovation case and €45,000 in the complex-renovation case, where more extensive electrical, hydraulic or heat-distribution adaptations may be required. The corresponding installation costs of €16,000 for a gas boiler and €19,000 for an oil boiler are based on the indicative average prices provided by Klima-Agence.

The analysis presents both undiscounted and discounted costs. Undiscounted totals correspond to the nominal sum of the initial investment and all operating expenditure incurred over the period. Discounted totals apply a 5% discount rate to future expenditure, recognizing that costs incurred in the future are worth less in present-value terms than costs paid today. This distinction is particularly relevant for heat pumps, whose higher initial investment is gradually offset by lower annual operating costs and the resulting future savings.

It should also be noted that heat pumps generally have a longer operational life - around 20 years on average, compared with roughly 15 years for gas and oil boilers⁷³ - which can provide an additional long-term financial advantage by delaying replacement costs. However, actual lifespans vary considerably depending on equipment quality, installation and maintenance, making this difference difficult to monetize reliably. High-quality modern fossil-fuel boiler installations can nevertheless be expected to approach a 20-year lifespan, meaning

⁶⁹ International Energy Agency (IEA), *Oil 2025 - Executive Summary*, 17 June 2025.

⁷⁰ International Energy Agency (IEA), *Delivering on the EU's Electrification Ambitions*, 19 June 2026.

⁷¹ Based on data published by the European Commission regarding global market price trends and the anticipated increase in carbon taxation, gas prices are expected to increase by an average of 3.3% annually through 2045.

⁷² Klima-Agence, *Règlement et inspection du chauffage*, 2026.

⁷³ This difference is generally attributed to the absence of combustion and lower thermal stress on components.



that the common 20-year assumption remains realistic for comparison purposes. The model therefore assumes a 20-year operational life across all heating technologies for comparability, although accounting for shorter fossil-boiler lifespans could further strengthen the long-term cost advantage of heat pumps.

Subsidy component	New construction (Scenario 1)	Standard renovation with fossil-fuel boiler replacement (Scenario 2)	Complex renovation with fossil-fuel boiler replacement (Scenario 3)
Gross installation cost	€25,000	€35,000	€45,000
National Klimabonus	€3,000	€10,000	€10,000
Resilienzpak bonus	Not applicable (€0)	€2,000	€2,000
Adaptation bonus	Not applicable (€0)	Not included (€0)	€2,000
Municipal support	€0 - €1,500 (amount retained = €1,000)	€0 - €6,000 (amount retained = €2,000)	€0 - €7,000 (amount retained = €4,000)
Energy-provider support	Not applicable (€0)	€750 - €2,500 (amount retained = €1,000)	€750 - €2,500 (amount retained = €2,000)
Social top-up	Not applicable (€0)	Up to €12,000 (amount retained = €0)	Up to €14,000 (amount retained = €0)
Modelled total subsidy	€4,000	€12,750 - €20,500 (amount retained = €15,000)	€14,750 - €23,500 (amount retained = €20,000)
Net upfront cost	€21,000	€20,000	€25,000

Sources: Klima-Agence subsidy simulator, Luxembourg Government (Klimabonus) and author's calculations.

These three situations represent the main differences in subsidy support. The microeconomic analysis retains three scenarios: 'new construction', 'standard renovation with fossil-fuel boiler replacement', and 'complex renovation with fossil-fuel boiler replacement'. In the model, it is worth noting that the more generous subsidies for switching heating systems make installing a heat pump as a replacement cheaper than in the case of a new build. However, as mentioned above, switching from a fossil-fuel boiler to a heat pump may also involve certain additional costs (whether necessary or optional).

Eligibility for the Social Topup Klimabonus depends on household composition and average net household income⁷⁴, with the following maximum income thresholds:

- Single person: €45,100.92
- Household without dependent children: €67,651.39
- Household with 1 dependent child: €85,687.95
- Household with 2 dependent children: €103,734.03

⁷⁴ Ministry of Housing and Spatial Planning, [Prime d'amélioration pour assainissement énergétique \(Topup Klimabonus\)](#), 16 February 2026.



- Household with 3 dependent children: €121,770.60
- Each additional dependent child: +€13,532.18 to the applicable threshold.

For eligible households, the Social Topup ranges between 10% and 100% of the Klimabonus received under each scenario, with the support rate increasing as household income decreases. At the maximum rate, the top-up can therefore equal the full amount of the original Klimabonus and effectively double the support received. This represents a substantial level of additional support and can significantly reduce a household's remaining upfront investment.

Because Social Topup, municipal and energy-provider support varies considerably, several simulations were carried out using the Klima-Agence subsidy simulator. The resulting amounts were averaged and adjusted as far as possible, taking into account that a simple unweighted average would give equal importance to all municipalities even though some differ substantially in population size, housing structure and heat-pump installation potential. Some municipalities, for example, have a much larger share of single-family homes, while others are dominated by multi-story or collective housing, which affects both the feasibility and relevance of heat-pump installations. Similar uncertainty applies to electricity suppliers, which offer different subsidy levels, while market-share data are limited. These considerations were used to define the subsidy assumptions retained in the model, while households can use the simulator to obtain an estimate tailored to their own situation.

In the absence of comprehensive data on municipal support, electricity suppliers' market shares, household profiles determining eligibility for the Social Topup, and the possible extension of the Resilienzpak bonus, it was necessary to make a judgement regarding the subsidy amounts retained in the different modelled cases. A relatively cautious approach was therefore adopted. In particular, the Social Topup was excluded because both eligibility and the amount granted vary substantially with household income and composition, and only households below the applicable income thresholds qualify. Conservative assumptions were also retained for municipal support, in order to avoid producing results that would be artificially favourable to the economic attractiveness of installing a heat pump.

Lastly, the assumptions simplify the diversity of real household situations. The total cost of an installation over its operational life will vary according to the size and insulation of the dwelling, required flow temperature, installation quality, household heating behavior, individual subsidy entitlement, maintenance requirements, future energy prices and the heating system's operational life.

2.2 €37,451 over 20 Years: The Cost of a Heat Pump in a Standard Renovation

The results show that the air-to-water heat pump is the least costly heating option over the 20-year analysis in all three scenarios, although in the complex renovation scenario this advantage only emerges at a relatively late break-even point. The heat pump's financial advantage is primarily driven by lower annual operating costs, which progressively offset its higher installation costs. Subsidies are crucial in reducing the initial cost disadvantage and bringing forward the break-even point⁷⁵.

The analysis initially considers both gas and oil boilers as fossil-fuel alternatives. However, the oil boiler is excluded from the new construction scenario given its much higher operating costs, shorter expected operational life and continued reliance on heating oil, particularly carbon-intensive fossil fuel. The oil-boiler results are still presented for the replacement scenarios, but they show that oil heating is at a clear market disadvantage compared with a heat pump or a gas boiler in terms of long-term costs and environmental performance. The new construction comparison therefore focuses on the more competitive choice between a heat

⁷⁵ The break-even year is the first year in which the cumulative cost of the heat pump falls below that of the alternative system.

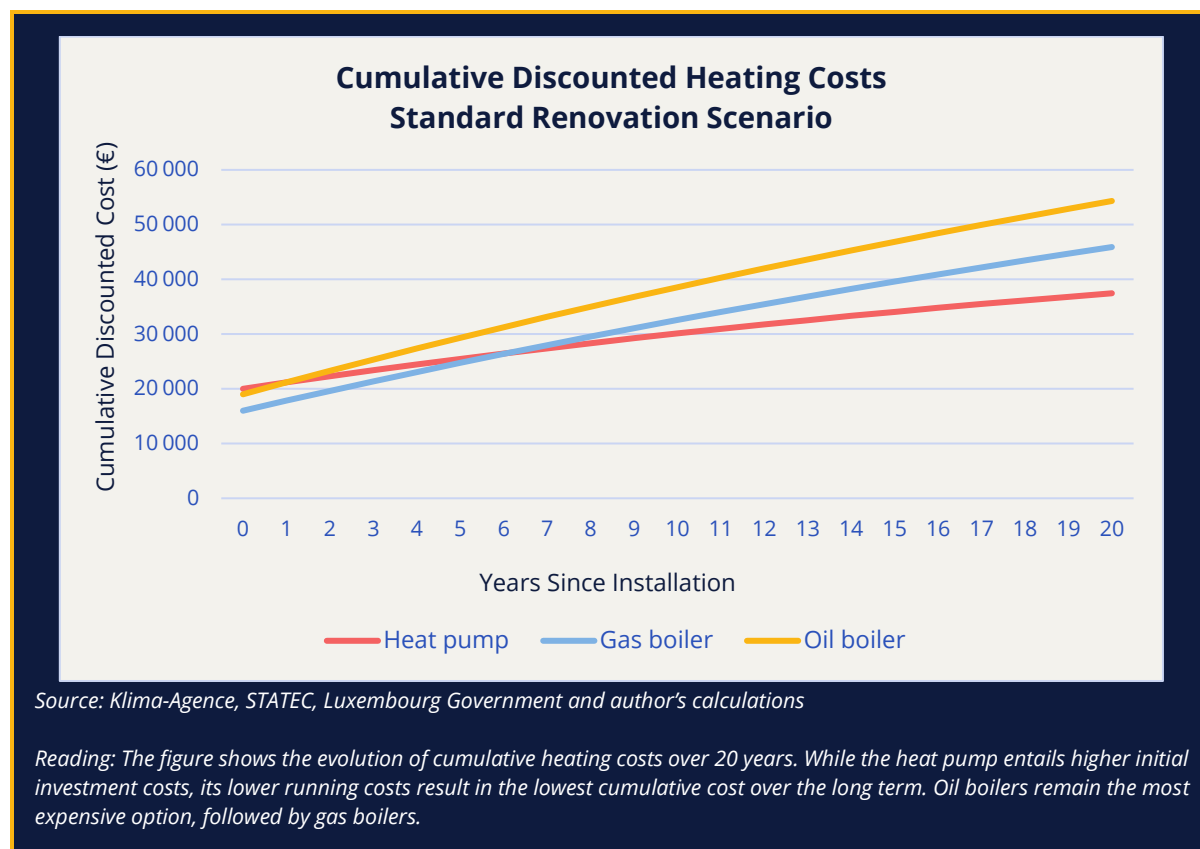




pump and a gas boiler. The 20-year cost estimates presented below incorporate annual energy-price increases of 2% for electricity and 3% for gas and heating oil. Considering the lack of data and the variability in costs from one renovation project to another, it is worth noting that the maximum heat pump installation cost at which a heat pump remains less expensive than a gas boiler over a 15-year period is €39,585 (discounted cost, €50,928 undiscounted cost).

Scenario	Heating system	Net upfront cost (after subsidies)	Undiscounted 20-year cost	Discounted 20-year cost
New construction	Heat pump	€21,000	€49,783	€38,451
	Gas boiler	€16,000	€66,127	€45,899
Standard renovation	Heat pump	€20,000	€48,783	€37,451
	Gas boiler	€16,000	€66,127	€45,899
	Oil boiler	€19,000	€78,195	€54,315
Complex renovation	Heat pump	€25,000	€53,783	€42,451
	Gas boiler	€16,000	€66,127	€45,899
	Oil boiler	€19,000	€78,195	€54,315

Source: Klima-Agence, STATEC, Luxembourg Government and author's calculations.





2.2.1 New construction

In the new construction scenario, the heat pump has a net upfront cost of €21,000 after subsidies, compared with €16,000 for the gas boiler. The household therefore initially pays €5,000 more for the heat pump.

This difference is progressively offset by lower annual operating expenditure. Under the baseline assumptions of a 2% annual increase in electricity prices and a 3% annual increase in gas prices, the heat pump becomes less expensive on a cumulative basis after approximately seven years.

After 20 years, the undiscounted total cost amounts to approximately €49,800 for the heat pump and €66,100 for the gas boiler. When future expenditure is discounted at 5%, the corresponding totals are approximately €38,500 for the heat pump and €45,900 for the gas boiler, leaving the heat pump with a present-value advantage of roughly €7,400.

2.2.2 Standard renovation

In the standard-renovation scenario, the assumed €15,000 subsidy reduces the heat pump's gross installation cost from €35,000 to €20,000. As such, the heat pump remains €4,000 more expensive upfront than a gas boiler and €1,000 more expensive than an oil boiler.

The break-even point occurs after approximately six years compared with gas. Compared with oil, the heat pump reaches cumulative cost parity already after approximately one year because the initial cost difference is small and the annual operating-cost advantage is considerably larger.

Under the baseline assumptions of a 2% annual increase in electricity prices and a 3% annual increase in gas and heating-oil prices, the undiscounted 20-year cost of the heat pump amounts to approximately €48,800, compared with €66,100 for the gas boiler and €78,200 for the oil boiler. On a discounted basis, the corresponding 20-year costs amount to approximately €37,500 for the heat pump, €45,900 for gas and €54,300 for oil.

2.2.3 Complex renovation

In the complex-renovation scenario, the heat pump has a gross installation cost of €45,000 and receives €20,000 in subsidies, resulting in a net upfront household cost of €25,000. This is €5,000 higher than in the standard-renovation scenario and €9,000 above the upfront cost of a gas boiler.

Because the annual operating-cost assumptions remain unchanged, the higher upfront cost is the main factor distinguishing this scenario. Under the baseline assumptions of a 2% annual increase in electricity prices and a 3% annual increase in gas and heating-oil prices, the heat pump reaches cumulative cost parity with gas only after approximately 14 years.

After 20 years, the undiscounted total cost of the heat pump amounts to approximately €53,800, compared with €66,100 for the gas boiler and €78,200 for the oil boiler. On a discounted basis, the corresponding costs amount to approximately €42,500, €45,900 and €54,300, respectively.

2.3 Energy-Price Sensitivity on the Heat Pump's Profitability

Across all three scenarios, the results suggest that the combined subsidy package leaves the heat pump less expensive than the gas boiler on a discounted basis over 20 years, assuming annual price increases of 2% for electricity and 3% for gas. In the standard-renovation scenario, the heat pump reaches break-even with the gas boiler after approximately six years, while in the complex-renovation scenario the higher upfront cost pushes the break-even point to approximately fourteen years. The higher subsidy assumed in the complex-





renovation case partly compensates for eligible adaptation work rather than rewarding greater installed heating capacity, thereby limiting the additional net investment required from the household compared with a standard renovation. This removes the oversizing incentive associated with the previous subsidy regime⁷⁶.

The assumed price paths should nevertheless be interpreted as scenarios rather than precise forecasts, since future household energy prices will depend on a range of uncertain factors. If both electricity and gas prices were instead both assumed to increase by 2% annually, the heat pump would remain the least costly option in all three discounted household cases, although its financial advantage would be significantly reduced:

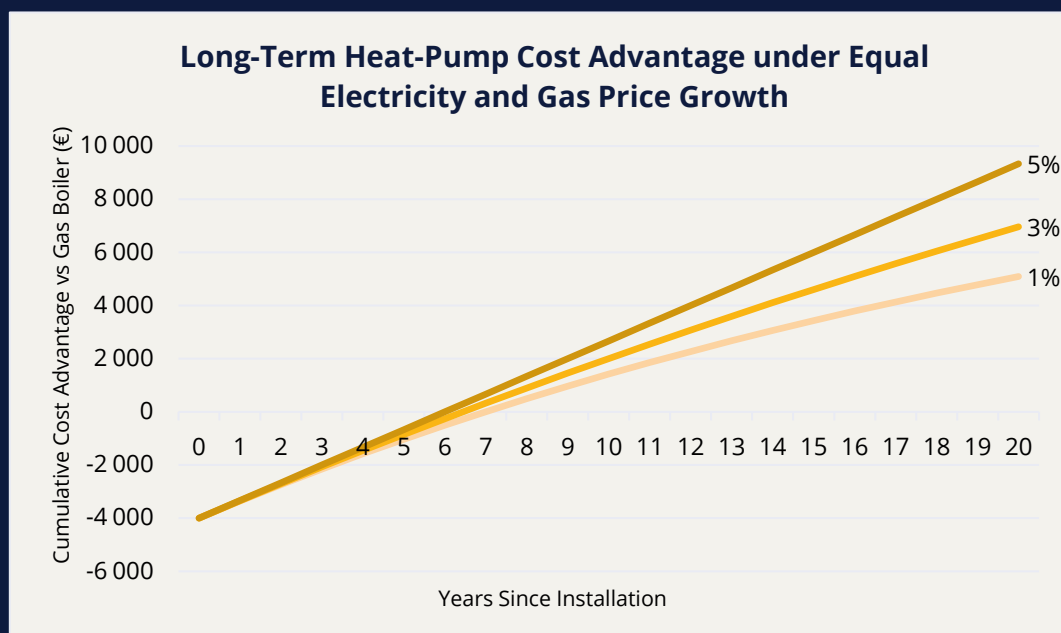
Scenario	New construction	Standard renovation	Complex renovation
Heat pump - 2% electricity growth	€38,451	€37,451	€42,451
Gas boiler - 3% gas growth	€45,899	€45,899	€45,899
Heat-pump advantage - baseline	€7,448	€8,448	€3,448
Gas boiler - 2% gas growth	€43,424	€43,424	€43,424
Heat-pump advantage - sensitivity	€4,973	€5,973	€973
Change in heat-pump advantage	-€2,475	-€2,475	-€2,475

Source: author's calculations based on the assumptions presented above.

In this case, the discounted break-even timing would remain broadly similar in the new-construction and standard-renovation scenarios, at approximately eight and six years respectively, while the complex-renovation break-even point would be pushed back from approximately fourteen to seventeen years.

The long-term advantage of a heat pump can also increase even when the electricity and gas prices grow at the same rate. In this case, their price ratio remains unchanged, but higher energy prices increase the absolute value of the heat pump's operating-cost savings because of its lower energy consumption. The following figure illustrates this effect under different common energy-price growth assumptions.

⁷⁶ Chambre des Députés du Luxembourg, Question parlementaire n° 3991, June 2026



Source: author's calculations

Reading: The figure illustrates how the heat pump's cumulative cost advantage develops when electricity and gas prices are assumed to increase at the same annual rate (1%, 3% and 5%). Even with constant energy prices, lower annual operating costs allow the heat pump to progressively recover its higher initial investment cost. When both electricity and gas prices rise at the same rate, their price ratio remains unchanged, but the absolute operating-cost savings generated by the heat pump increase over time. Higher common energy-price growth therefore strengthens its long-term cost advantage.

The sensitivity analysis confirms the importance of the electricity-to-gas price ratio. At the baseline prices used in the model - €0.20 per kWh for electricity and €0.10 per kWh for gas - the ratio is 2.0, which is well below the approximate operating-cost threshold of 3.3 implied by a heat-pump SCOP of 3.0 and a gas-boiler efficiency of 90%. As such, annual energy expenditure amounts to around €1,000 for the heat pump, compared with approximately €1,667 for the gas boiler, giving the heat pump a substantial operating-cost advantage.

In 2025, however, higher household electricity prices in Luxembourg pushed the ratio to around 2.8, considerably narrowing this advantage. Had this development continued or worsened and the ratio risen above approximately 3.3, the gas boiler would have become less expensive to operate. Maintaining an electricity-to-gas price ratio comfortably below 3 is therefore crucial, as it allows the heat pump's lower running costs to offset its higher upfront investment and strengthens its overall financial attractiveness.

Box n°2 : Combining Heat Pumps with Solar PV: Opportunities and Limitations

Returning to the cost of electricity, an additional consideration not included in the model is the possibility of combining a heat pump with photovoltaic panels and, potentially, battery storage. The potential lies in further reducing the effective operating cost of the heat pump by replacing part of the electricity





purchased from the grid with self-generated electricity⁷⁷. Such combined installations are actively supported by Luxembourg's energy-policy framework, including through Klimabonus support for photovoltaic installations and battery storage⁷⁸.

Storage can further increase self-consumption by shifting part of the available energy to periods when it is needed, for example through a battery or the storage of heat in a hot-water tank. However, this potential is constrained by a known seasonal mismatch: heat-pump electricity demand is highest during the colder winter months, precisely when photovoltaic production is lowest. Batteries can shift electricity over the course of a day but cannot fully compensate for this seasonal difference. As heat pumps and electric vehicles become more widespread, they will add substantial new electricity demand to local distribution networks, especially during winter periods when heating needs are highest. This can increase simultaneous peak loads and place greater pressure on local transformers and distribution cables. Creos therefore identifies the electrification of heating and transport as important drivers of future grid reinforcement needs, with winter peak demand becoming a key challenge for network planning⁷⁹.

2.4 Replacing Gas with a Heat Pump: Around 68% Lower CO₂ emissions

Besides their potential to reduce household energy bills, the other objective for installing a heat pump - and one that is central to the government's efforts to accelerate the transition away from fossil heating and meet Luxembourg's climate targets - is the substantial reduction in CO₂ emissions it can deliver. For the same dwelling requiring 15,000 kWh of useful heat annually, a gas boiler with a seasonal efficiency of 90% consumes approximately 16,700 kWh of natural gas. Using an average energy content of around 10.55 kWh per m³, this corresponds to roughly 1,580 m³ of gas and approximately 3.3 tons of direct CO₂ emissions per year. An oil boiler with an efficiency of 88% requires around 1,650 litres of heating oil, producing approximately 4.4 tons of CO₂ annually.

A heat pump with the SCOP of 3.0 used throughout the cost analysis consumes approximately 5,000 kWh of electricity to provide the same amount of useful heat. Its operational emissions depend on the carbon intensity of the electricity consumed. For households supplying most of their electricity through rooftop solar panels, emission stay minimal, while grid-powered systems reflect the carbon intensity of the electricity supplied by Luxembourg and its international suppliers. The country's high dependence on electricity imports thus makes the choice of emission factors particularly important. Klima Agence reports that in 2025, domestic generation covered only around 21% of Luxembourg's electricity consumption, of which 18.3 percentage points came from renewable sources and 2.4 from non-renewable sources⁸⁰. Of the remaining 79% supplied through imports, mainly from Germany⁸¹, as well as France and Belgium, the precise renewable and non-renewable shares are difficult to determine because electricity is continuously exchanged across the interconnected European grid.

A further layer of complexity is that Luxembourg's national import shares do not directly reflect household-level electricity consumption. The public electricity network serving residential consumers is primarily interconnected with Germany, whereas electricity imported from France mainly supplies the separate Sotel industrial network in southern Luxembourg⁸². Belgium's electricity contribution into Luxembourg's interconnected system serves more as system balancing and security of supply. As such, aggregate national import

⁷⁷ [Klima-Agence, Why Produce Photovoltaic Electricity or Consume It Yourself?, 2026.](#)

⁷⁸ [Guichet.lu, Financial Aid for Renewable Energy-Based Technical Installations \(Klimabonus 2026 Scheme\), 2026.](#)

⁷⁹ [Creos Luxembourg, Network Development Plan for the Electricity Distribution Grid 2025-2035, 2026.](#)

⁸⁰ Klima-Agence and Ministry of the Economy, [Energieaueur: Key Energy Figures for Luxembourg](#), 26 August 2026.

⁸¹ Institut Luxembourgeois de Régulation (ILR), [Réseau luxembourgeois et interconnexions](#), 2026.

⁸² Institut Luxembourgeois de Régulation (ILR), [Structure réseaux](#), 2026.





shares cannot be translated directly into the electricity mix consumed by an individual household, while simply applying Luxembourg's own largely renewable domestic generation mix to the total electricity consumption would likewise provide a misleading picture.

Electricity Maps⁸³ uses IPCC-based emission factors and a peer-reviewed flow-tracing methodology that accounts for cross-border electricity exchanges, making its consumption-based carbon-intensity estimate particularly suitable for Luxembourg, where a substantial share of electricity is imported. It reports an average consumption-based carbon intensity of approximately 211 g CO_2 per kWh for Luxembourg in 2025⁸⁴. Applying this value, annual heat-pump emissions amount to approximately 1.1 ton of CO_2 . Replacing a gas boiler with a heat pump would therefore reduce direct operational emissions by approximately 2.2 tons of CO_2 per year, equivalent to a reduction of around 68%. Replacing an oil boiler would avoid roughly 3.3 tons annually, corresponding to a reduction of about 76%.

These household-level savings are meaningful in relation to the NECP objective, which foresees annual emissions from residential and tertiary buildings falling from 1,497,000 tCO_2e in 2021 to 590,000 tCO_2e in 2030, a reduction of around 910,000 tCO_2e . Replacing fossil-fuel boilers with heat pumps could therefore contribute materially to achieving this target, with each replacement avoiding around 2.2 tCO_2e per year for gas and 3.3 tCO_2e for oil.

These reductions are likely to increase as the electricity system becomes progressively less carbon intensive. In order to translate household-level savings into a national emissions estimate would require more precise information on the number, type and capacity of future heat-pump installations, the share of central systems serving multiple dwellings, the characteristics of the buildings concerned and their actual heating demand.

An important methodological distinction also arises between how much emissions are materially diminished as estimated above and the way emissions are accounted for under Luxembourg's NECP. The NECP relies on the territorial greenhouse-gas inventory⁸⁵ used under the UNFCCC and EU climate-accounting framework, which records emissions where fossil fuels are actually combusted⁸⁶. Thus, if natural gas is burned in a Luxembourgish household, regardless of where it is imported from, those emissions are counted in Luxembourg's inventory. By contrast, imported electricity does not add to Luxembourg's territorial emissions, because the emissions from generating that electricity are recorded in the country where the electricity and its underlying emissions, were produced. As such, a household switching from a gas boiler to a heat pump consequently reduces Luxembourg's reported territorial emissions by more than the true reduction in global emissions when most of the electricity used by the heat pump is imported. The consumption-based estimate used above, which still attributes approximately 1.1 tons of CO_2 per year to the heat pump using Electricity Maps' carbon intensity, therefore provides a more complete indication of the emissions associated with its operation, while the reduction recorded in Luxembourg's territorial inventory may be larger due to the difference in accounting emissions.

⁸³ Electricity Maps, [Electricity Maps Emission Factors Methodology](#), 19 March 2024.

⁸⁴ Electricity Maps, [Interactive Map](#), 2026.

⁸⁵ Eurostat, [Emissions of Greenhouse Gases and Air Pollutants](#), 2026.

⁸⁶ Eurostat, [CO₂ Emissions from EU Territorial Energy Use: -2.8%](#), 9 June 2023.



Heat-Pump Costs Across Countries: Where Does Luxembourg Stand?



Part 3: Heat-Pump Costs Across Countries: Where Does Luxembourg Stand?

By 2024, data from the European Heat Pump Association suggested that heat-pump deployment had progressed more rapidly in countries such as France and Belgium than in Luxembourg⁸⁷. The Netherlands has also begun to accelerate deployment, while at the same time developing very detailed market data⁸⁸ and dedicating greater policy attention to affordability and uptake. Germany, by contrast, appears to face challenges more similar to those observed in Luxembourg when installations are compared on a per-capita basis. Part of these differences reflects the strong role of air-to-air heat pumps in several countries, whereas this technology remains less common in Luxembourg and is not supported under the national subsidy scheme. However, technology choice alone does not explain the observed gap, as installation costs, subsidy design, electricity prices, building characteristics other market conditions also play an important role.

The following cross-country comparison therefore examines the cost of installing and operating an equivalent heat pump over 20 years in Luxembourg, France, Germany, Belgium and the Netherlands. Its purpose is to assess how differences in installation prices, subsidies, electricity costs and maintenance affect household affordability and may help explain variations in deployment.

3.1 Heat-Pump Installation Costs: Luxembourg Ranks Among the Highest

The gross installation-cost assumptions retained in the model amount to €35,000 in Luxembourg, €15,000 in France, €35,000 in Germany, €10,000 in Belgium and €12,000 in the Netherlands. These values are based primarily on evidence published by national or regional public authorities as well as commercial quotations.

The French cost assumption stems from an extensive field study by ADEME⁸⁹, the French Agency for Ecological Transition, which reports an average acquisition and installation cost of €15,287 for an air-to-water heat pump. Other estimates for renovation projects of that size also report installation costs within the same range. The model therefore uses an installation cost of €15,000. By contrast, the €35,000 assumption for Germany reflects the substantially higher costs identified in official German assessments. A 2026 study published by the Federal Environment Agency⁹⁰ estimates that installing an air-source heat pump as part of a partial renovation of a single-family house generally costs more than €30,000 and may exceed the maximum expenditure eligible for federal support. A separate cross-country analysis⁹¹ similarly identifies Germany as one of Europe's most expensive heat-pump markets. The model therefore retains €35,000 as a representative central estimate for a comparable renovation project.

For Belgium, the comparison uses Flanders as the reference region, since support schemes and market conditions differ between Flanders, Wallonia and Brussels. The Flemish government's cost model⁹² assumes an investment of approximately €10,000, including installation but excluding VAT⁹³, for an air-to-water heat pump. Official Flemish guidance also provides a broader indicative equipment-cost range of €8,000 to €14,000, although that range excludes VAT and installation. The €10,000 model value is therefore retained for Flanders but should not be interpreted as a Belgian national average. For the Netherlands, the €12,000

⁸⁷ European Heat Pump Association (EHPA), [Heat Pump Market Intelligence - Interactive Platform](#), 2026.

⁸⁸ Statistics Netherlands (CBS), [Verkoopcijfers warmtepompen, 2024-2025](#), 30 April 2026.

⁸⁹ ADEME, [Mesure des performances de 100 PAC air/eau et eau/eau installées en maisons individuelles](#), 7 October 2025.

⁹⁰ Umweltbundesamt (UBA), [Sozio-ökonomische Folgenabschätzung zum Projektionsbericht 2025](#), February 2026.

⁹¹ Heat Pumps Watch, [Heat Pump Installation Costs: Germany vs. Europe](#), 10 February 2026.

⁹² Flemish Government, [Koelen met een warmtepomp](#), 2026.

⁹³ VAT depends on the age of the dwelling: 6 % for dwellings more than 10 years old that are used as owner's main residence, otherwise the standard of 21% applies.





assumption is based on observed administrative data published by Statistics Netherlands⁹⁴. Using anonymized invoices submitted through the national ISDE subsidy scheme, CBS estimates that heat pumps in the 11-20 kW capacity category cost approximately €12,600 on average in 2024, including equipment, accessories and installation. The model rounds this value to €12,000.

The precise scope of an installation differs across sources, and prices can therefore still vary considerably around these estimated national averages depending on the equipment included and the extent of the required adaptation work. The factors that drive these differences - and help explain the particularly high costs observed in Luxembourg and Germany- are examined later in this section.

3.2 How do Countries Structure Their Heat-Pump Support Schemes?

The model uses support assumptions of €15,000 for Luxembourg, €6,000 for France, €11,000 for Germany, €1,500 for Belgium and €2,825 for the Netherlands. The structure and eligibility rules of the support mechanisms differ considerably between countries.

For Luxembourg, the €15,000 subsidy assumption is retained from the preceding microeconomic analysis, where it represents the average combined support obtained from the Klima-Agence subsidy simulations.

France uses a more explicitly income-related system. Under MaPrimeRénov'⁹⁵ in 2026, an air-to-water heat pump receives €5,000 for very low-income households, €4,000 for low-income households and €3,000 for intermediate-income households, while higher-income households are not eligible for this single-measure grant. Since this support can be combined with CEE assistance⁹⁶, whose amount varies by household, supplier and project, the model retains a rounded combined subsidy of €6,000.

In Germany, the KfW heating-support scheme⁹⁷ provides a basic grant of 30% of eligible expenditure, capped at €28,000 for the first dwelling, with additional income and climate-speed bonuses available. The model retains €11,000, which broadly corresponds to a 40% support rate applied to the eligible-cost ceiling, while households qualifying for further bonuses may receive substantially more.

For Belgium, the model refers to Flanders, where Mijn VerbouwPremie⁹⁸ provides €1,500 for an air-to-water heat pump for applications submitted from 1 March 2026. Higher support of €4,500 or €6,000 remains available to eligible lower-income households, so the Flemish amount should not be interpreted as a uniform Belgian subsidy.

In the Netherlands, support is linked directly to the approved heat-pump model and its thermal capacity. Each eligible product appears on an official RVO list with a specific subsidy amount⁹⁹. For air-to-water systems, the calculation starts from €1,250 and adds €225 for each additional kilowatt above the first; some highly efficient units may receive a further label bonus. An eligible 8 kW air-to-water heat pump receives €2,825, which is the assumption used in the model.

The VAT rate applied may also be regarded as a form of support. While the installation of a heat pump is subject to a reduced VAT rate of 3% in Luxembourg, the corresponding rates are 5.5% in France, 6% in Belgium (for dwellings more than 10 years old), 19% in Germany, and 21% in the Netherlands.

⁹⁴ Statistics Netherlands (CBS), [Prijsonwikkeling van warmtepompen](#), 2023-2024, 12 September 2025.

⁹⁵ Service Public, [MaPrimeRénov' \(MPR\)](#), 19 June 2026.

⁹⁶ Service Public, [Certificats d'économie d'énergie \(CEE\)](#), 26 June 2026.

⁹⁷ KfW, [Anpassungen in den KfW-Produkten der Bundesförderung für effiziente Gebäude - Start Umstellungsphase](#), 8 July 2026.

⁹⁸ Flemish Government, [Mijn VerbouwPremie voor warmtepomp](#), 2026.

⁹⁹ Netherlands Enterprise Agency (RVO), [ISDE: Meldcodelijst Warmtepompen](#), 9 July 2026.



The five countries thus use different combinations of fixed grants, income-based support, percentage subsidies and technology-specific incentives. The modelled values therefore represent comparable household cases as identical policy entitlements are impossible to extract.

3.3 Electricity-Price Assumptions Across Countries

Household electricity prices include all taxes, levies and network charges and mainly reflect values derived from Eurostat's household consumption band¹⁰⁰ of 5,000 to 14,999 kWh per year¹⁰¹. As in Part 2, the most recent semester is not automatically used. Instead, the model applies rounded electricity-price assumptions based on recent price developments, since household prices have fluctuated substantially since the energy crisis, often in response to temporary taxes, subsidies, price caps and other national interventions. These rounded values are considered more representative of the model's 20-year horizon than any single semester observation. The model therefore uses €0.20/kWh for Luxembourg, €0.25/kWh for France, €0.35/kWh for Germany and Belgium, and €0.24/kWh for the Netherlands.

Unlike the analysis in Part 2, this cross-country model does not apply an annual increase in electricity prices because future developments will depend heavily on country-specific price developments. Applying one common growth rate to national forecasts would introduce additional uncertainty. However, a 5% discount rate is applied to express future expenditure in present-value terms.

Model input	Luxembourg	France	Germany	Belgium	Netherlands
Useful heat demand	15,000 kWh				
Heat-pump SCOP	3.0				
Annual electricity use	5,000 kWh				
Electricity price, all taxes included	€0.20/kWh	€0.25/kWh	€0.35/kWh	€0.35/kWh	€0.24/kWh
Gross installation cost	€35,000	€15,000	€35,000	€10,000	€12,000
Representative subsidy assumption	€15,000	€6,000	€11,000	€1,500	€2,825
Net installation cost	€20,000	€9,000	€24,000	€8,500	€9,175
Annual maintenance	€200	€150	€200	€150	€150
Analysis period	20 years				
Discount rate	5%				

Source: Eurostat, Klima-Agence, Luxembourg Government, French Ministry for Ecological Transition, ANAH (France), KfW (Germany), Heat Pumps Watch, Flemish Government, CBS (Netherlands), RVO (Netherlands), EHPA, and author's assumptions and calculations.

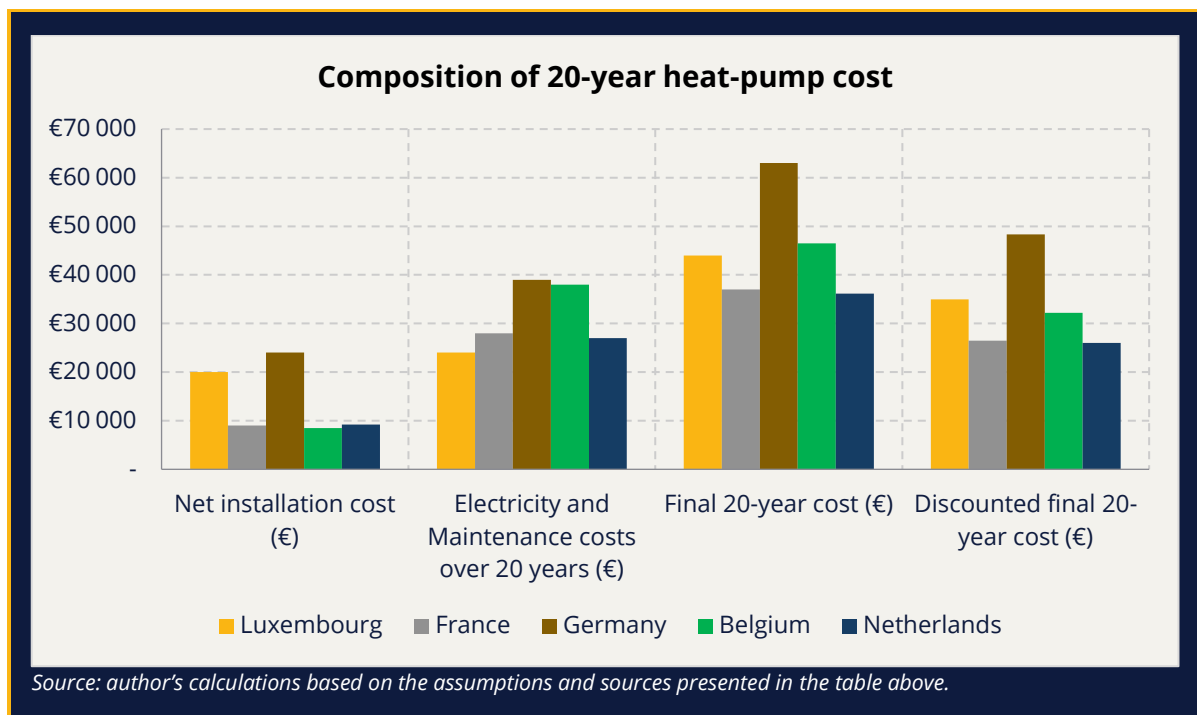
¹⁰⁰ This band is used because the modelled heat pump consumes approximately 5,000 kWh annually before other household electricity use is included. Actual households may fall into a different Eurostat band depending on their total electricity consumption.

¹⁰¹ Eurostat, [Electricity Prices for Household Consumers - Bi-Annual Data \(from 2007 Onwards\) \(nrg_pc_204\)](#), 2026.



3.4 Strong Subsidies and Favorable Electricity Prices Partly Offset Luxembourg's High Installation Costs

The results show substantial differences in the estimated costs of owning and operating an equivalent air-to-water heat pump over 20 years. After subsidies and discounting future electricity and maintenance expenditure at 5%, the total present-value cost ranges from approximately €26,000 in the Netherlands and €26,400 in France to €48,300 in Germany. Flanders reaches approximately €32,200, while Luxembourg records an estimated total cost of around €35,000.



France and the Netherlands achieve the lowest discounted costs in the comparison, with nearly identical totals. Their relatively low installation prices substantially reduce the initial financial burden and compensate for electricity prices that are somewhat higher than in Luxembourg.

Germany's relatively generous subsidy reduces the initial household investment, but the net installation cost still amounts to €24,000. Combined with high electricity prices, this makes Germany the most expensive country in the comparison. Flanders presents a different situation: its subsidy is comparatively limited and electricity is expensive, but its low assumed installation cost keeps the discounted total below that observed in Luxembourg and Germany. This is because the upfront cost advantage is immediate, while the higher operating costs are spread over 20 years and carry less weight after discounting.

Although Luxembourg benefits from both the lowest electricity-price assumption and the highest subsidy support, it still records the second-highest discounted total cost. Its total remains around €8,500 higher than in France and approximately €9,000 higher than in the Netherlands. This result is explained by the very high gross installation price. Even after the assumed €15,000 subsidy, a Luxembourg household faces an initial net investment of €20,000, more than twice the corresponding amount in France, Flanders or the Netherlands.

3.5 Interpreting Luxembourg's Position

The cross-country results point to Luxembourg's high installation price as the main explanation for its relatively weak position. The €35,000 gross installation cost used in the model is itself a relatively cautious as-



sumption, as Klima-Agence estimates suggest that the average cost of a heat-pump installation in a renovation project may be slightly higher. Even at €35,000, Luxembourg's assumed cost is more than twice the French value, three-and-a-half times the Flemish value and almost three times the Dutch value. It is therefore important to understand the factors contributing to these high prices.

As discussed above, several factors are likely to contribute to Luxembourg's high installation costs:

- higher equipment prices and the dominance of premium manufacturers;
- more elaborate foundations and outdoor-unit installation;
- costly electrical connections and grid-integration requirements;
- long installation times and higher labor costs;
- greater planning, documentation and administrative work;
- capacity constraints and limited competition;
- older buildings and the need for larger or more complex systems;
- a fragmented market with less standardized installation processes.

One interconnected factor with considerable potential to drive up installation prices in Luxembourg is the age of the building stock, as older buildings often require more extensive planning, documentation and administrative work, thereby increasing the use of already costly labor.

3.6 High Incomes Do Not Fully Compensate for Luxembourg's High Installation Costs

The preceding comparison shows that Luxembourg's high installation price remains an important barrier even after substantial subsidy support. However, nominal costs alone do not provide a complete picture of affordability, since household incomes differ considerably across countries. This final comparison therefore helps show what proportion of their disposable income households in disparate countries would need to mobilize to finance an identical heat pump installation.





Variable	Luxembourg	France	Germany	Belgium	Netherlands
Median equivalized disposable income, 2024, euros¹⁰²	€50,046	€26,459	€28,891	€31,299	€34,466
Median equivalized disposable income, 2024, PPS¹⁰³	37,673 PPS	23,792 PPS	26,594 PPS	26,860 PPS	29,714 PPS
Country-specific installation cost (after subsidies)	€20,000	€9,000	€24,000	€8,500	€9,175
Adjusted installation cost as % of income	40.0%	34.0%	83.1%	27.2%	26.6%
Adjusted Installation cost as % of income, PPS-adjusted	53.1%	37.8%	90.2%	31.6%	30.9%
Relative PPS-adjusted installation-cost burden vs Luxembourg	-	-28.8%	+69.9%	-40.5%	41.8%

Source: INSEE, based on Eurostat statistics; model inputs and sources presented in previous table; and author's calculations.

This comparison shows how differences in both installation costs and household incomes affect the relative affordability of heat pumps across countries. Once the representative country-specific costs after subsidies are considered, the net installation cost represents 40.0% of median income in Luxembourg, but only 34.0% in France, 27.2% in Belgium and 26.6% in the Netherlands. Germany records the highest burden at 83.1%, reflecting the combination of a high net installation cost and a substantially lower median income than Luxembourg. Luxembourg's higher household incomes partly compensate for its high installation prices, but not sufficiently to produce the lowest relative burden. Households in France, Belgium and the Netherlands face lower net costs in relation to their incomes because their installation prices are substantially lower.

The closest measure of comparable affordability emerges when incomes are expressed in PPS, as this adjusts for differences in general price levels across countries. Including it, further reduces Luxembourg's apparent income advantage, reflecting its higher cost of living and therefore the smaller relative purchasing power advantage implied by its higher nominal income. Relative to Luxembourg, the PPS-adjusted installation-cost burden is approximately 29% lower in France, 40% lower in Belgium and 42% lower in the Netherlands, while it is around 70% higher in Germany.

Overall, the cross-country comparison suggests that Luxembourg's main disadvantage relative to countries with faster heat-pump deployment is its high installation cost. Electricity prices are comparatively favorable and help offset part of the high installation costs over the system's lifetime, while the assumed subsidy support is the highest among the countries examined. Reducing the underlying installation cost may be difficult because renovation projects in Luxembourg often require expensive labor, extensive adaptation work and building-specific solutions that limit the potential for cheaper, standardized installation processes.

The analysis applies identical assumptions for heat-pump efficiency and operational life across all countries and may therefore not capture the full benefits of Luxembourg's stricter technical standards and installation

¹⁰² INSEE, [Niveau de vie médian dans l'Union européenne - en euros](#), 21 July 2026.

¹⁰³ INSEE, [Niveau de vie médian dans l'Union européenne - en standard de pouvoir d'achat](#), 21 July 2026.



requirements. Better sizing, planning and commissioning potentially improves the heat pump's performance and reduces operating expenditure, thereby reducing part of the cost difference over the heat pump's life. Nevertheless, given the scale of Luxembourg's upfront installation-cost disadvantage, its effective 20-year cost is still likely to remain higher than in France, Belgium and the Netherlands.



**Abatement-Cost Analysis: Are
subsidies Cost-Effective from a
Climate-Policy Perspective?**



Part 4 Abatement-Cost Analysis: Are subsidies Cost-Effective from a Climate-Policy Perspective?

4.1 Abatement-Cost Methodology

The microeconomic analysis in Part 2 shows that subsidies can make heat pumps financially attractive for households, but it does not assess whether this public support achieves decarbonization objectives in a cost-effective manner. To examine this, an abatement-cost analysis is carried out, following the approach applied in another IDEA publication¹⁰⁴. Abatement costs express the economic cost associated with avoiding one ton of CO_2 and therefore provide a common indicator for assessing the cost-effectiveness of climate measures.

$$\text{Abatement cost} = \frac{\text{Discounted cost of heat pump} - \text{Discounted cost of alternative}}{\text{CO}_2 \text{ emissions of alternative} - \text{CO}_2 \text{ emissions of heat pump}}$$

As such, the calculation divides the additional cost or saving associated with the heat pump by the tons of CO_2 avoided relative to the alternative heating system. The numerator is then adapted depending on the perspective considered:

- *Private abatement cost*: asks whether reducing emissions costs the household money. It compares the difference between the heat pump's and the alternative heating system's total discounted lifetime costs after subsidies divided by the CO_2 reductions. A negative value means that the household both reduces emissions and saves money.
- *Public subsidy cost*: asks how much public support is paid per ton of CO_2 avoided, by dividing the subsidy by cumulative emissions reductions.
- *Social abatement cost*: measures the difference in total discounted lifetime costs before subsidies, divided by the CO_2 reductions. It therefore shows the underlying economic cost per ton of CO_2 avoided, independent of how that cost is shared between households and the State.

The analysis retains the main assumptions of the household model in Part 2 for all heating technologies: annual useful heat demand of 15,000 kWh, a heat-pump SCOP of 3.0, gas-boiler efficiency of 90%, oil-boiler efficiency of 88%, a 20-year operating period and a 5% discount rate. Electricity prices are assumed to increase by 2% annually, while gas and oil prices increase by 3%.

The emissions assumptions are the same as those used in Part 2.4. The gas boiler emits approximately 3.3 tCO_2 per year, the oil boiler around 4.4 tCO_2 , and the heat pump around 1.1 tCO_2 . Electricity emissions are calculated using Electricity Maps' carbon intensity of approximately 211g CO_2/kWh for Luxembourg¹⁰⁵. Over the 20-year period, this corresponds to approximately 46.1 tCO_2 avoided relative to gas and 66.1 tCO_2 avoided relative to oil. As in Part 2.4, these figures cover emissions from operating the heating systems and do not include embodied emissions from manufacturing and installation. As the electricity-related emissions are calculated on a consumption basis and partly originate from imported electricity, part of the emissions accounted for falls outside the territorial emissions perimeter of Luxembourg's NECP.

¹⁰⁴ IDEA, Document de travail n°34 : Objectifs et efficacité des incitations environnementales : le cas du marché de l'électromobilité au Luxembourg, Frédéric Meys 2025

¹⁰⁵ Electricity Maps, Luxembourg - Yearly Electricity Data, 2026.



4.2 Around €325 per Ton of CO_2 Avoided in the Standard Renovation Case

Scenario	Comparison	CO_2 avoided over 20 years	Private abatement cost	Public subsidy cost	Social abatement cost
New construction	HP vs gas	46.1 t	-€161/t CO_2	€87/t CO_2	-€75/t CO_2
New construction	HP vs oil	66.1 t	-€240/t CO_2	€61/t CO_2	-€180/t CO_2
Standard renovation	HP vs gas	46.1 t	-€183/t CO_2	€325/t CO_2	€142/t CO_2
Standard renovation	HP vs oil	66.1 t	-€255/t CO_2	€227/t CO_2	-€28/t CO_2
Complex renovation	HP vs gas	46.1 t	-€75/t CO_2	€434/t CO_2	€359/t CO_2
Complex renovation	HP vs oil	66.1 t	-€180/t CO_2	€303/t CO_2	€123/t CO_2

Source: model inputs and sources presented in Part 2, Electricity Maps, and author's calculations.

The amount of CO_2 avoided is identical across the three installation scenarios for a given heating-system comparison, because the model assumes the same annual heat demand, system efficiencies, energy use and emission factors in each case. Only installation costs and subsidy levels differ.

The negative private abatement costs in each scenario show that, with the current subsidies included, households reduce both their lifetime heating expenditure and their emissions in every modelled scenario.

Public expenditure ranges from around €61 to €434 per ton of CO_2 avoided, depending strongly on the installation situation and the heating system replaced. Support is most cost-effective in new construction, where the required subsidy is comparatively small, and when replacing oil heating, because the larger emissions reduction spreads the subsidy across more avoided tons of CO_2 .

The social cost results provide an additional perspective. In new construction, the heat pump already produces a negative resource abatement cost of around -€75/t CO_2 , meaning that its discounted lifetime cost is lower than that of gas even before the subsidy is deducted. In other words, the emissions reduction is achieved alongside an overall economic saving rather than at an additional social cost to society. A standard renovation replacing an oil boiler also produces a negative social cost of approximately -€28/t CO_2 . By contrast, the social abatement cost rises to approximately €359/t CO_2 when gas is replaced in the complex-renovation scenario and €123/t CO_2 when oil is replaced. This increase is driven by the higher gross installation cost in complex renovations, which raises the underlying economic cost while delivering the same emissions reduction. Complex renovations therefore represent the least economically favorable case from a resource-cost perspective.

Public subsidy cost is probably the most directly relevant indicator from a climate-policy perspective, as it shows how many euros of public support are spent for each ton of CO_2 avoided. In the standard renovation case, where a gas boiler is replaced by a heat pump, the current subsidy corresponds to around €325/t CO_2 avoided. This places the cost towards the higher end compared with carbon values used in European investment appraisal. For example, the European Investment Bank applies a shadow carbon value of €250/t CO_2 by 2030¹⁰⁶, representing the monetary value assigned to the climate benefit of avoiding an additional ton of emissions when assessing investments. A public subsidy cost of €325/t CO_2 would exceed this benchmark.

¹⁰⁶ European Investment Bank (EIB), *EIB Group Climate Bank Roadmap 2021-2025*, 14 December 2020.



However, the comparison remains indicative, since the EIB value is a general appraisal benchmark, whereas the subsidy cost calculated here also reflects Luxembourg-specific conditions, including comparatively high installation and labor costs.

Another useful point of comparison is the EU Emissions Trading System (EU ETS)¹⁰⁷. Allowances under the existing ETS1 traded at an average of around €76/ tCO_2 between March and August 2026. However, this price is not a directly comparable benchmark for residential heating, since buildings are not covered by ETS1. Emissions from fuel combustion in buildings will instead be covered by the separate ETS2¹⁰⁸, which is expected to be fully operational in 2028 and will apply to fuel suppliers who will likely pass at least a part of that carbon cost onto consumers through higher gas or oil-heating prices. Since no observed ETS2 allowance price is yet available, the present analysis instead uses a shadow carbon value as an appropriate benchmark for assessing the climate-policy cost-effectiveness of the investment, as it assigns a value to avoided emissions consistent with long-term climate objectives.

To put these results into perspective, in the “Document de travail n°34¹⁰⁹”, IDEA estimates total social abatement costs to be between €393-€923 per ton of CO_2 avoided for Luxembourg’s electric-vehicle subsidies, which lies substantially above the range found for heat pumps in this analysis. Heat-pump support therefore appears to achieve emissions reductions at a considerably lower cost per ton, although the comparison remains indicative because the technologies and modelling assumptions differ.

To illustrate the potential scale of Luxembourg’s emissions savings, STATEC projects that the number of heat pumps should reach around 150,000 by 2050¹¹⁰. Based on STATEC’s 2021 Population Census, natural gas accounted for 59.5% of dwellings’ main heating fuels, while heating oil accounted for 27.8%¹¹¹. This implies that the fossil-heating systems potentially replaced by heat pumps can be approximated as roughly two-thirds gas and one-third oil. Applying the emissions reductions estimated in this analysis of around 46.1 tCO_2 per gas boiler replacement and 66.1 tCO_2 per oil boiler replacement over 20 years, we would obtain a central estimate of around 7.9 million tons of CO_2 avoided over 20 years. When allowing the replacement mix to vary by 20% towards either gas or oil gives an indicative range of approximately 7.8-8.0 $MtCO_2$, equivalent to around 0.39-0.40 $MtCO_2$ per year once all 150,000 installations are operating. However, these figures remain illustrative, as the future mix of heating systems replaced, household heat demand, heat-pump performance and electricity’s carbon intensity may differ from the assumptions used here.

¹⁰⁷ [European Commission, Auctioning of Allowances - EU Emissions Trading System \(EU ETS\), 3 September 2026.](#)

¹⁰⁸ [European Commission, ETS2: Buildings, Road Transport and Additional Sectors, 2 September 2026.](#)

¹⁰⁹ IDEA, [Document de travail n°34 : Objectifs et efficacité des incitations environnementales : le cas du marché de l’électricité au Luxembourg](#), Frédéric Meys 2025

¹¹⁰ STATEC, [Pompes à chaleur dans le secteur résidentiel](#), 12 July 2024.

¹¹¹ STATEC, [Housing in Luxembourg: Results of the 2021 Population Census](#), 2024.





Making Heat-Pump Policy Work: Gaps and Recommendations



Part 5 Making Heat-Pump Policy Work: Gaps and Recommendations

5.1 Moving from Estimates to Useful Evidence

A priority in accelerating heat pump deployment in Luxembourg should be to improve the availability, quality and updating of the underlying data. As discussed earlier, available figures rely on estimates which differ considerably across sources, while detailed information on installation costs, technologies, building characteristics and actual operating performance remains scarce. This makes it difficult not only to assess the current state of the market and determine whether subsidies are appropriately calibrated or installations deliver the expected economic and environmental benefits, but also limits the information available to current installers, potential installers, prospective buyers and the wider public when evaluating heat-pump options and market conditions.

Part of this gap may soon be addressed. Klima-Agence is currently commissioning a more detailed study of the Luxembourg heat-pump market, which will also include comparisons with other EU markets, with results expected around November 2026. Since September 2025, all newly installed water-based heat pumps in Luxembourg must be registered through a mandatory acceptance procedure, which includes the submission of technical information and a compliance inspection of the installation. This will help build a more accurate picture of newly installed heat pumps in Luxembourg. However, it will not address the existing data gap resulting from shortcomings in the collection and publication of data on the current heat pump stock. The example of the Netherlands, as well as that of most other European countries, demonstrates that highly granular data can be collected and made available. Such information is crucial for guiding public spending decisions and for monitoring the country's climate and energy transition objectives.

In the future, that study could be complemented by more systematic monitoring of installed systems. An ADEME-style study¹¹² based on a sufficiently large sample of Luxembourg installations could examine seasonal performance, electricity consumption, installation costs, building characteristics, required adaptation works and user experience over several years. Better data would not only improve the monitoring of Luxembourg's heat-pump market but also provide a stronger basis for determining which technologies, building types and installation situations genuinely require public support.

5.2 Adding Push to Pull: Strengthening Heat-Pump Incentives

At present, Luxembourg's heat-pump policy relies mainly on "pull" measures such as generous subsidies and favorable electricity prices, drawing households to adopt heat pumps. While these incentives are important, they are unlikely to be sufficient on their own to deliver the required pace of decarbonization. Reaching climate targets will also require "push" measures that progressively make fossil heating less attractive, even if this entails some short-term costs. In fact, delaying the transition and avoiding those short-term costs is unequivocally going to impose higher economic costs on households and society in the long run¹¹³.

Better heat pump statistics should help determine where public support remains genuinely necessary, particularly in new construction. The abatement-cost analysis shows that, under the assumptions used in this study, the heat pump already has a negative social abatement cost compared with gas under the assumed energy-price developments, meaning that it both reduces emissions and lowers total discounted lifetime

¹¹² ADEME, *Mesure des performances de 100 PAC air/eau et eau/eau installées en maisons individuelles*, 7 October 2025.

¹¹³ For example, allowing the continued installation of gas boilers may expose households to higher long-term costs. As fewer households remain connected to the gas grid, network maintenance and operating costs will be shared among a shrinking number of consumers, potentially resulting in higher tariffs for those who continue to rely on gas.



costs even before subsidies are taken into account. Yet Luxembourg continues to subsidize heat pumps in new constructions while not prohibiting the installation of new fossil-fuel heating systems.

While the NECP identifies heat pumps as the reference technology for new construction¹¹⁴, and the Grand-Ducal Regulation on the energy performance of buildings¹¹⁵ requires all new buildings to meet strict energy-efficiency standards, it has not introduced an explicit prohibition on installing new gas or oil boilers in residential buildings. In principle, a fossil heating system may therefore still be installed where the building satisfies the required overall energy performance through insulation, renewable-energy production or other measures. According to experts from Klima-Agence, it appears that, in practice, new single-family homes are unlikely to install fossil fuel boilers. However, for residential buildings, this still seems to be possible. According to STATEC's modelling, 50% of fossil boilers reaching the end of their lifetime are assumed to be replaced by renewable heating systems by 2030, of which 95% are expected to be heat pumps and 5% wood-based heating systems¹¹⁶.

Meanwhile, several European countries have gone one step further by regulating both building performance and heating technology. In Norway, fossil heating systems have been prohibited in new buildings and major renovations since 2016, while the use of mineral oil for heating residential, public and commercial buildings has been banned since 2020¹¹⁷. In Switzerland, certain Cantons, such as Geneva require new heating installations or replacements in both new and existing buildings to use renewable energy, with fossil boilers being allowed only in exceptional circumstances¹¹⁸. Denmark prohibits the installation of oil-fired boilers in new buildings and combines this restriction with stringent building-energy standards, high taxation on oil and natural gas, and extensive district-heating coverage¹¹⁹. The Netherlands has adopted an infrastructure-based approach. Since 2018, newly built houses and buildings have generally no longer been permitted to connect to the natural-gas grid under the amended Dutch Gas Act. Although the measure was initially introduced as part of the strategy to phase out production from the Groningen gas field, it has also accelerated the transition towards low-carbon heating technologies by making gas-free construction the default choice.¹²⁰ Likewise, Luxembourg could consider gradually phasing out fossil-fuel boilers in new residential construction, with a ban introduced after an appropriate transition period and subject to justified technical exceptions. Such a measure is politically sensitive: in Germany, the 2023 amendment to the Buildings Energy Act (GEG, commonly referred to as the "Heating Law"), which required every newly installed heating system to run on at least 65% renewable energy, sparked strong controversy and became a major electoral issue, before being repealed by the new coalition in July 2026¹²¹. It is nevertheless justified by the need to contain gas network costs: each new connection extends the lifetime of an infrastructure whose largely fixed costs will have to be borne by a shrinking customer base, driving up bills for the remaining users. Regulation in new construction would provide one form of "push" away from fossil heating. A second, and likely more influential to push households towards adopting heat-pumps involves strengthening the incentive through a more favorable electricity-to-gas price ratio. As shown in Part 2, the financial attractiveness of a heat pump depends strongly on the relationship between electricity and gas prices.

¹¹⁴ Government of the Grand Duchy of Luxembourg, [Plan national intégré en matière d'énergie et de climat du Luxembourg pour la période 2021-2030 - Mise à jour](#), July 2024.

¹¹⁵ Grand Duchy of Luxembourg, [Règlement grand-ducal du 9 juin 2021 concernant la performance énergétique des bâtiments](#), 9 June 2021.

¹¹⁶ [European Commission, Luxembourg - Final Updated National Energy and Climate Plan \(NECP\) 2021-2030, 24 July 2024](#).

¹¹⁷ Norwegian Ministry of Climate and Environment, [Norway's Eighth National Communication](#), 12 April 2023.

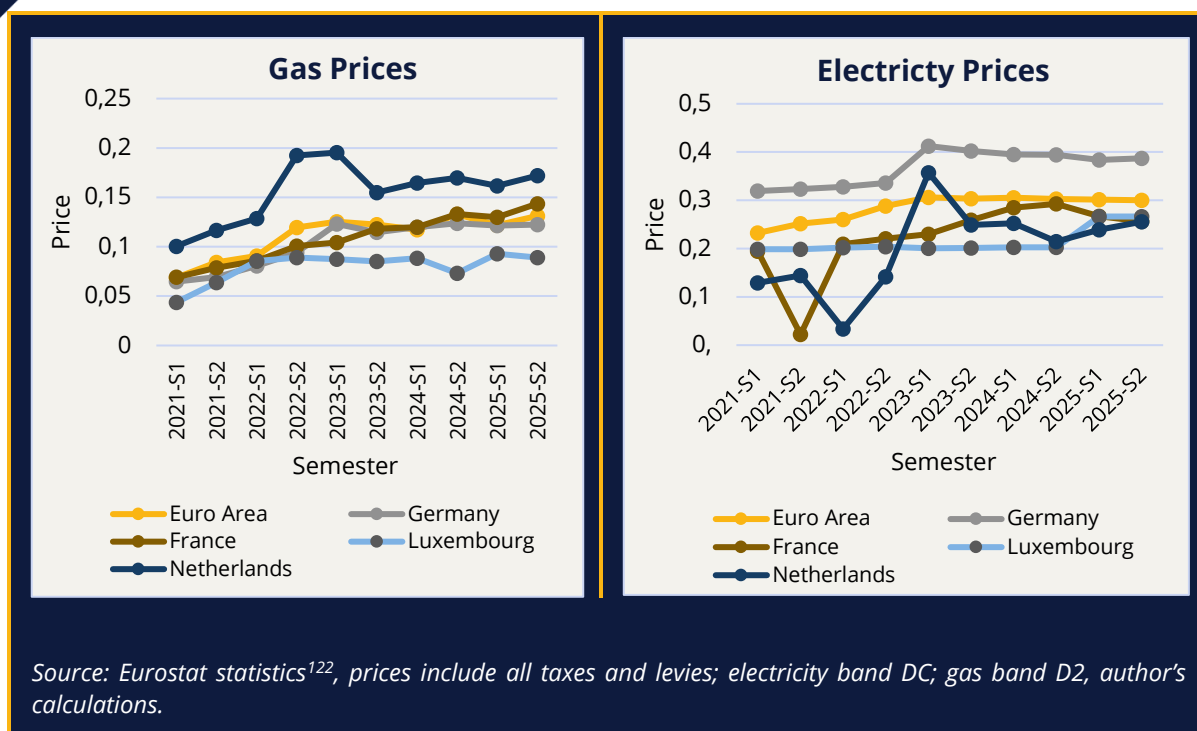
¹¹⁸ State of Geneva, [Installer ou remplacer un chauffage](#), 21 November 2025.

¹¹⁹ Danish Energy Agency, [Biomass Analysis](#), 18 May 2020.

¹²⁰ Ministry of Economic Affairs and Climate Policy (Netherlands), [Preventive Action Plan 2023 - The Netherlands](#), 29 February 2024.

¹²¹ [Bundesgesetzblatt](#) (BGBl. I, n° 226/2026 du 28 juillet 2026





Eurostat data lists Luxembourg among the countries where household gas is particularly inexpensive relative to household purchasing power, ranking second lowest in the EU in the second half of 2025¹²³. The IEA notes that progressively rising CO₂ taxation on natural gas and oil improves the business case for electrification and that this effect may currently be underestimated by households. Yet Luxembourg's comparatively low household gas prices keep gas boilers attractive while weakening households' incentive to transition to heat pumps.

Similar approaches have already been adopted in other European countries. Germany introduced a progressively rising CO₂ price on heating oil and natural gas¹²⁴, with regular announcements in advance to provide households and businesses with greater planning certainty, while the Netherlands has deliberately shifted energy taxation by reducing taxes on electricity and increasing them on natural gas to make sustainable energy use more attractive. Likewise, Luxembourg could establish a clear and gradual trajectory under which fossil heating becomes progressively less financially attractive. A predictable, gradually rising carbon price on natural gas, transparently announced in advance by the government, could influence household decisions even before the increases take effect by signaling that fossil heating will become progressively more expensive. This would push households towards heat pumps when planning future renovations, while also improving the electricity-to-gas price ratio over time.

Using the Part 2 household model in which annual gas consumption is around 16,700 kWh, the following table shows how even small gas-price increases can accumulate into substantial costs over time.

Additional gas price	After 1 year	After 5 years	After 10 years	After 20 years
+€0.01/kWh	€167	€833	€1,667	€3,333
+€0.02/kWh	€333	€1,667	€3,333	€6,667

Source: author's calculations based on the household-model assumptions presented in Part 2.

¹²² Eurostat, *Electricity Prices for Household Consumers - Bi-Annual Data (from 2007 Onwards)* (nrg_pc_204), 2026.

¹²³ Eurostat, *EU Household Gas Prices Up in the Second Half of 2025*, 5 May 2026.

¹²⁴ German Federal Government, *What the Government Is Doing for the Climate*, 2020.



The heat pump's electricity costs would remain unaffected by the gas price increase¹²⁵, thereby increasing its annual operating-cost advantage and bringing forward the break-even point.

However, an increase in the price of fossil heating should not be introduced without addressing its distributional effects. Households with lower incomes would be particularly vulnerable to higher heating costs while having fewer financial opportunities to respond. A suggestion could present better income-targeted support, including higher social top-up bonuses for lower-income households undertaking a heat-pump installation or necessary renovation works¹²⁶. The IEA already recommends differentiating replacement incentives by income and developing additional mechanisms to reduce upfront barriers for lower-income households.

The resulting policy mix would therefore combine the already existing pull incentives with push measures to entice households considering a heat pump. Such an approach would reduce the need to rely indefinitely on increasingly generous subsidies while creating clearer long-term incentives for households to electrify their heating.

5.3 Landlord-Tenant Split Incentive

A further barrier, which has so far received relatively limited policy attention because of its complexity and sensitivity, concerns landlord-tenant households and affects roughly one third of Luxembourg's population¹²⁷. In rental housing, the landlord usually bears the cost of an energy efficiency renovation, such as a heat pump installation, while the tenant often benefits most directly from lower energy bills. This 'split incentive' is widely recognized as a significant cause of underinvestment in energy efficiency in rented and multi-owner buildings. Currently, Luxembourg relies on a voluntary approach to residential energy renovation based on information, advice, awareness-raising and financial support, including Klimabonus Wunnen, Klima-Agence guidance, planned pre-financing mechanisms and future one-stop-shop renovation services¹²⁸. Given Luxembourg's slow renovation rate and widespread perception among homeowners that renovation is unnecessary, financial support alone may not be sufficient to encourage landlords to undertake the upgrade needed for efficient heat-pump deployment. IEA nevertheless recommends considering minimum energy-performance requirements when homes are renovated, sold or rented, as well as requirements applying when fossil heating systems are replaced.

France on the other hand provides a strict regulatory example, but also illustrates the risks associated with linking rental eligibility directly to energy-performance thresholds: Since January 2025, accommodations with an energy-performance rating of G can no longer be newly rented or have their leases renewed; the restriction will extend to F-rated accommodations in 2028 and E-rated accommodations in 2034¹²⁹. While this creates a direct obligation for landlords to improve the worst-performing accommodations, its application in already tight rental markets can risk exacerbating housing shortages by encouraging some owners to withdraw properties rather than undertake the required renovations. In Île-de-France, around 745,000 private rental dwellings could eventually be affected in the absence of effective renovation, with Paris particularly exposed¹³⁰. If applied to Luxembourg, such a policy could create similar challenges in an already constrained housing market.

Germany addresses the landlord-tenant split incentive through a combination of public support, regulated rent increases and carbon-cost allocation. Landlords can receive subsidies and preferential loans for heating replacement and energy renovation. Where renovation costs are partly passed on through higher rent, any

¹²⁵ The calculation holds electricity prices constant and assumes that the gas-price increase has no broader effect on electricity prices.

¹²⁶ International Energy Agency (IEA), *Luxembourg 2026: Energy Policy Review*, 8 June 2026.

¹²⁷ Eurostat, *Distribution of Population by Tenure Status, Type of Household and Income Group (ilc_lvho02)*, 2026.

¹²⁸ International Energy Agency (IEA), *Luxembourg 2026: Energy Policy Review*, 8 June 2026.

¹²⁹ Service Public, *Diagnostic immobilier : diagnostic de performance énergétique (DPE)*, 1 January 2026.

¹³⁰ INSEE, *Sans travaux de rénovation énergétique, près d'un logement francilien sur deux bientôt interdit à la location*, 13 October 2022.





public subsidy received is deducted first, so that only the landlord's remaining out-of-pocket investment can be reflected in the rent. Followingly, when a heating system is replaced in line with the Building Energy Act¹³¹, the resulting rent increase is capped at €0.50 per square meter per month. In parallel, the CO₂ Cost Allocation Act divides carbon costs between landlords and tenants according to the building's emissions: the less efficient the building, the larger the share borne by the landlord. While this approach seeks to preserve an incentive for owners to renovate while protecting tenants from excessive rent increases, the complexity and practical implementation of the rules have also attracted criticism from both landlord and tenant representatives¹³².

For Luxembourg, an intermediate approach between the current voluntary model and the French model of restricting rental eligibility could focus on strengthening landlords' financial incentives to renovate. Instead of immediately preventing poorly performing dwellings from being rented, fiscal incentives could progressively make energy-efficient rental housing more attractive to landlords than inefficient housing. Luxembourg has already moved into this direction by using accelerated tax depreciation to encourage sustainable energy renovation in rental housing: from 2026, the applicable rate was increased from 6% to 10% for qualifying renovation expenditure¹³³. More generally, owners of rental properties can also reduce their taxable rental income through the tax treatment of renovation investments. Investment expenditure that improves a rental property is not normally deducted in full in the year in which it is incurred but can be deducted progressively through depreciation. This reduces the effective after-tax cost of the investment and can therefore make investments such as heating-system upgrades more attractive to landlords. While this provision does not necessarily cover the heat pump installation itself, the same fiscal approach could be extended or strengthened to make heat-pump investment in rental properties more attractive. The incentive could be enhanced further, for example by increasing tax advantages for owners undertaking substantial energy renovations, while progressively reducing or withdrawing selected fiscal benefits for the worst-performing rental properties where no renovation action is undertaken. It could also be combined with the planned public pre-financing mechanism, allowing the State to finance part or all eligible renovation costs upfront and recover the contribution gradually through rental income. A more comprehensive minimum-performance requirement could then be considered only after a sufficiently long transition period and once financing mechanisms and renovation capacity are firmly established. This would give property owners sufficient time and financial capacity to carry out the necessary investments while limiting the risk that dwellings are withdrawn from the rental market.

Particular attention would be required for apartments in multi-unit buildings. In Luxembourg, the energy-performance certificate is generally established at building level and therefore reflects characteristics of the building as a whole, including the envelope and shared technical installations. Individual apartment owners may consequently have limited control over some of the factors affecting the building's energy rating, particularly where improvements require collective action by the co-ownership¹³⁴. A landlord could therefore face a poor energy rating even after renovating the elements of the dwelling under their direct control if further improvements depend on decisions by the co-ownership. Any fiscal advantage or future minimum standard linked to rental eligibility or energy performance would therefore need exemptions or alternative compliance routes where the relevant improvements require collective approval or otherwise lie outside the individual landlord's control. Eligibility could, for example, also be demonstrated through verified qualifying renovation measures undertaken within the dwelling, so as not to disadvantage owners whose building-level energy rating depends partly on factors beyond their direct control.

It is worth noting that Luxembourg has already begun examining this issue. Through Measure No. 13, the Ministry of the Environment, Climate and Biodiversity (MECB), the Ministry of the Economy (MECO) and Klima-

¹³¹ Federal Ministry for Housing, Urban Development and Building (BMWSB), Gebäudeenergiegesetz, 2026.

¹³² German Bundestag, *Aufteilung der CO₂-Kosten im Wohnungsmarkt bleibt strittig*, 27 September 2022.

¹³³ *Administration des contributions directes (ACD), Newsletter du 4 mars 2026, 4 March 2026.*

¹³⁴ Guichet.lu, *Requesting an Energy Performance Certificate (Energiepass) for a Residential Building*, 3 May 2022.



Agence, together with the Institut für Energie- und Umweltforschung (ifeu), are analyzing the specific challenges of energy renovation in rented housing and consulting stakeholders on possible policy measures. The approaches outlined above should therefore be viewed as possible contributions to this ongoing policy discussion rather than as a single prescriptive solution. Nevertheless, stronger action will likely be needed in rental and multi-owner housing if renovation and heat-pump deployment are to accelerate. A purely voluntary approach is unlikely to be sufficient, particularly as long as gas remains comparatively inexpensive and both landlords and individual apartment owners may face weak incentives or limited control over building-level renovation decisions. At the same time, stronger requirements should be accompanied by better-targeted support for households and owners with limited financial capacity, so that the transition does not disproportionately burden those least able to finance renovation.

Box n°3: Insulation, Heat Pumps... Where Should We Set the Level of Ambition?

The transition towards a decarbonized economy raises the question of how quickly and how far requirements should go. Policies that are not strong enough may lead to higher costs in the future, while those that are too demanding, even if more environmentally ambitious, may also discourage action altogether. The objective lies in finding an equilibrium wherein setting realistically achievable climate objectives and guaranteeing broad uptake lie in balance.

From a perspective of order, aimed at minimizing greenhouse-gas emissions, it is generally more effective to insulate older buildings before considering the replacement of fossil-fuel heating with a heat pump. ADEME has shown in a study that poor sequencing of renovation works - for example, installing a heat pump before carrying out insulation works - can result in an oversized heating system once the building's heat demand is reduced¹³⁵. This can lead to unnecessarily high initial capacity, increase cycling and potentially shorter equipment life, particularly if the life system is not properly readjusted after renovation. An oversized system therefore reduces the overall cost-effectiveness of the investment.

Should policy therefore prioritize a rapid phase-out of fossil fuels, or favor a slower but more structured renovation pathway? One possible transitional response could lie in air-to-air heat pumps, which are often easier to install but generally do not achieve the same performance as air-to-water heat pumps, let alone geothermal systems. Like reversible air-to-water systems, air-to-air heat pumps can provide both heating and cooling, with the additional advantage of delivering cooling directly through the indoor air and therefore responding rapidly during periods of high temperatures. If successfully integrated into a broader policy strategy, their deployment could help increase public acceptance of heat-pump technologies, improve household comfort during increasingly frequent periods of extreme heat, accelerate CO₂ reductions and contribute to a more structured decarbonization pathway for the building sector.

The drawback is that this can increase electricity consumption and therefore offer a less favorable environmental outcome than other solutions. Moreover, without a clear replacement strategy, promoting air-conditioning systems could allow fossil-fuel boilers to remain in place as part of a "hybrid" heating system. The production of domestic hot water is not possible with air-to-air heat pumps and therefore requires additional technical installations. In addition, thermal comfort is generally considered to be lower than with conventional heating systems.

Nevertheless, given the still relatively low penetration of heat pumps in Luxembourg, this remains a strategic option worth considering.

¹³⁵ ADEME, *Rénovation performante par étapes*, 2021.



Conclusion: An Efficient Alternative Requiring More Than Subsidies

The analysis undertaken in this document suggests that heat pumps can present both an economically attractive and environmentally effective heating option in Luxembourgish households. Under the assumptions retained in the household model, the air-to-water heat pump records the lowest lifetime cost in each of the three scenarios, including the less favorable energy-price trajectory in which both electricity and gas prices increase by 2% annually. Under the baseline assumptions and depending on the type of installation, the heat pump's 20-year discounted cost is around 8% to 18% lower than that of a gas boiler and, in the renovation cases, around 22% to 31% lower than that of an oil boiler. At the same time, replacing a gas boiler with a heat pump reduces a household's operational heating emissions by approximately two thirds, while replacing an oil boiler reduces them by approximately three quarters.

This result contrasts, however, with the relatively slow deployment observed in Luxembourg. The estimated heat-pump stock still represented fewer than 80 installations per 1,000 households at the end of 2024, while STATEC's long-term scenario foresees the number of heat pumps increasing from around 20,000 to more than 150,000 by 2050. The gap between the technology's modelled economic attractiveness and its observed uptake suggests that Luxembourg's challenge does not simply stem from insufficient subsidies as considerable financial support is already available.

The evidence instead points to a broader cluster of mutually reinforcing challenges. Gross installation costs remain particularly high compared with neighboring countries and comparable European markets, while Luxembourg's residents continue to show a relatively limited perceived need for renovation. In addition, relatively inexpensive natural gas continues to weaken the incentive to move away from fossil heating, and uncertainty surrounding future electricity prices complicates the long-term investment decision. As a starting point for both households and policymakers, limited information on installation prices, system performance and the existing heat-pump stock further reduces market transparency and can weaken confidence in undertaking such a significant investment. In rental housing, the landlord-tenant split incentive creates an additional barrier in an already strained housing market. These barriers reinforce one another and help explain why attractive lifetime economics do not necessarily translate directly into household investment decisions.

Several recent developments nevertheless suggest that Luxembourg's heat-pump policy is evolving in a more favorable direction. The redesigned subsidy regime removes the previous incentive to oversize heat-pump systems. The planned pre-financing mechanism will lower the amount households need to directly finance a heat pump installation while measures under *Projet de loi n°8595* are being taken to help improve heat pump performance, strengthen consumer confidence and support their successful long-term deployment. Split-incentive issues are already being examined by the Ministry of the Environment, Climate and Biodiversity, Klima-Agence and other stakeholders, while further national studies on heat pumps are also underway.

The next stage of heat-pump policy could therefore focus more on providing clearer long-term incentives for households. European heat-pump sales rose sharply during the energy crisis following Russia's invasion of Ukraine, highlighting how strongly relative energy prices can influence uptake. In Luxembourg, reducing the electricity-to-gas price ratio over time could strengthen this signal, preferably through a gradual increase in comparatively cheap gas costs rather than renewed volatility in electricity prices. Combined with targeted protection for vulnerable households, this could reinforce existing support without relying on ever-higher subsidies.

Improved data will be essential for determining whether this is happening. Future analysis could combine invoices, subsidy amounts, building characteristics, required adaptation works and measured seasonal performance to provide a precise picture of where heat pumps perform well, where installations remain excessively costly, where other measures should be considered and where public support has the greatest effect on uptake. Such evidence could also help assess whether subsidies are fully passed through to households and whether deployment differs systematically between building types or geographical areas. The data and registration reforms currently being introduced should make such an assessment feasible and would allow



the assumptions used in this document to be tested against observed outcomes. A closer examination of the costs actually borne by consumers could help address the issues identified in Luxembourg, including installation prices that are higher than in other European countries.

The transition will not occur quickly and will likely be driven by global trends. However, if Luxembourg is to remain on track with the climate objectives set nationally and globally, the pace of change will have to accelerate to create the informational, regulatory and market conditions under which the financial and environmental advantages of heat pumps are sufficiently clear for households to act upon them.



Annexes

1. Main Characteristics of Heat-Pump Technologies

Heat pump type	Heat source	Typical seasonal efficiency (SCOP)	Life Expectancy	Best suited for	Main advantages	Main limitations
Air-to-water	Outdoor air	3.0-4.0	~ 15 years	New and existing buildings with water-based heating systems	Relatively straightforward installation; compatible with radiators or under-floor heating; can provide space heating and domestic hot water	Performance falls as outdoor temperature decreases and/or required flow temperature rises; outdoor-unit noise and siting must be considered
Air-to-air	Outdoor air	2.5-5.0	~ 20 years	Zone heating and cooling, smaller or low-load dwellings, buildings without a hydronic distribution system, or complementary retrofit	Lowest upfront cost; simple installation; directly heats and cools indoor air; rapid cooling response	Conventional systems do not provide domestic hot water; several indoor units may be required for whole-house coverage; may remain complementary to another heating system
Ground-source (ground-to-water)	Ground via horizontal collectors or vertical boreholes	3.6-5.4	20-25 years	New or existing buildings where a ground collector or borehole is technically feasible	High and relatively stable seasonal efficiency; less affected by outdoor-air temperature	High upfront cost; groundworks or drilling required; feasibility depends on site, geology and permitting
Water-source (water-to-water)	Groundwater, Surface water, sea water, or sewage water	4.0-5.0+	20-25 years	Sites with suitable and sufficiently accessible groundwater and the necessary authorizations	Very high and stable seasonal performance because source temperatures fluctuate relatively little	High upfront cost; highly site-specific; requires wells and sufficient water flow and quality; hydrogeological assessment and permits required

Source: Heat Pumps Watch, International Energy Agency (IEA), U.S. Department of Energy (DOE), and author's synthesis.

2. Real-World Examples of Heat Pump Investments

As part of the research conducted for this paper, several concrete examples of households replacing a fossil-fuel boiler with a heat pump were shared with us. While these individual cases cannot be generalised, they illustrate the complexity and cost that can be associated with certain heating system transitions.

The first case concerned a house built in the 1960s that was previously heated with natural gas. The replacement was relatively straightforward and broadly consistent with the investment costs assumed in our study, amounting to approximately €32,000 for a 10 kW heat pump.

The second case involved a house of around 300 m², significantly larger than the average Luxembourg dwelling. The project consisted of replacing an oil-fired boiler with a 14 kW heat pump. The property also has several specific heating features, including a solar water heater and a wood-burning stove that can contribute to domestic hot water production. The final price reflects also the integration costs to a more complex system. Because the heat pump had to be installed some distance from the house, additional piping infrastructure was required at a cost of approximately €12,000 to €15,000. The heat pump itself cost around €50,000



and consumes between 10,000 and 12,000 kWh of electricity per year, replacing the consumption of approximately 2,000 to 3,000 litres of heating oil. Based on the assumptions used in our model, this investment is not economically profitable, although it allows the property to comply with the highest contemporary energy standards. It is interesting to note that the installation costs represent 20 % of total cost.

The third case concerns a rented single-family house in Luxembourg with a floor area of approximately 200 m². For this project, an indoor heat pump system was selected because no technically feasible outdoor installation was possible. Even before the heat pump could be installed, adaptation works in the technical room were required at a cost of around €20,000. The quoted cost for the heat pump installation amounted to €62,000 for a system with a capacity of 12 kW. Once again, under the assumptions of our model, this investment does not appear to be economically profitable.



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