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The effect of GSHP installation on real estate value in Norway and Europe

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Abstract

Installation of energy efficiency measures in buildings does not only affect energy bills but also has the potential to increase real estate values. Positive effects on real estate value by investing in a ground source heat pump (GSHP) have been observed in several countries, but there has been a lack of such data from Norway. This paper summarizes findings from studies on the increased real estate value of GSHP installations and other energy efficiency measures in European countries. Additionally, results from Norway are covered and discussed. Overall, the paper aims to present the current European valorisation of GSHPs. It is found that Sweden, France and Italy have the highest increases in real estate value from investing in a GSHP and Germany, Belgium and Spain show the highest returns of investment upon sale of a residence with energy efficiency measures in general, whereas Norway is lagging behind with only 4-8% increase. The paper also shows that systematic errors are likely to affect the result for expected increase in real estate value, and measures are proposed in order to avoid this error when estimating the real estate value after a GSHP installation in different locations.

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1. Introduction

Energy efficiency measures in buildings represent a dual investment: they reduce operating costs while potentially increasing property values. Ground source heat pumps (GSHPs) are an energy efficiency measure that can be applied both for heating and cooling of buildings at relatively low cost all year round due to their excellent performance in contact with the ground at stable temperatures. However, their market share is relatively low in most European countries, partly due to their high investment costs. The increase in real estate value due to investments in GSHPs is well documented in studies for Sweden [1] and Finland [2]. There are also data published for France [3] and Poland [4], yet without the detailed study openly available. For other European countries the value is more uncertain, however, there are several countries where data are available on increased real estate value due to investment in heat pumps [5, 6] or other energy efficiency measures [7]. Most of this information is in local languages and no good overview of the real estate value of GSHP installation exists. This fragmentation makes it challenging to assess the broader European perspective on increased real estate value through GSHP installation.

Many of the available studies focus on energy efficiency measures more broadly rather than GSHPs specifically. These studies typically use energy labels as a metric for quantifying energy performance improvements and their impact on property values. For buildings, the energy label is set from the primary energy demand of the building/residence per square metre. Primary energy refers to energy that is delivered from external sources/bought, unlike internal production of solar power or surrounding heat utilized in a heat pump. Energy labelling is mandatory in EU countries and in Norway, and the countries have agreed to reduce

GHG emissions by 55% by 2030, have only zero emission buildings by 2050 and only build zero emission buildings from 2030 [8]. Given that buildings emit 34% of the European emissions from energy usage [9] and are mostly heated by natural gas in Europe [10], improving building energy efficiency is crucial for meeting these climate targets.

Installing a GSHP would substantially reduce the climate impact of buildings, but the installation cost is higher than for traditional heating systems [2]. Due to the high investment cost, GSHPs are in Norway typically only found to be economically viable when the heating demand of a building exceeds around 20 - 30 MWh/year [11,12], limiting their use mainly to larger and more expensive buildings [2]. However, if GSHP installations significantly increase property values, making property buyers and owners aware of this potential benefit could improve the investment case and broaden the market for GSHP installations. Despite this importance, data on increased real estate value due to GSHP installation remains very limited, particularly for Norway.

This work addresses this knowledge gap by presenting 1) an overview of the expected real estate value increase for GSHPs in different European countries based on available sources and 2) the first systematic analysis of the corresponding increase in real estate value for Norway based on actual sales data from 2008 to 2025. These findings can inform investment decisions and policy measures aimed at accelerating GSHP adoption.

2. Method

2.1 Norway

To determine the difference in property value for buildings with and without GSHP installation, the database of finn.no real estate sales between 2008 and 2025 was analysed. This is Norway's largest database for property sales, containing a total of 976.000 sales within this period. Note that the data set made available for this study contained very limited data on prices for 2024-2025 and for earlier than 2015.

The analysis method consisted of a three-step method. First, all sales where the property description included the Norwegian word commonly used for GSHP, "bergvarme" (Norwegian for "ground heat"), were identified. This resulted in a total of 3.538 identified sales. Next, a set of reference sales of properties without GSHP installations were identified for each of these 3.538 sales. These reference sales were defined as all property sales that a) were within a specific radius X of the property of interest b) the property description did not include the Norwegian word commonly used for GSHP, c) had residence area within ±50% of the property of interest, and d) had been sold within a specific date range of the property of interest. Finally, the average difference in property was calculated based on average price per square metre.

There are several possible sources for errors that need to be considered when analysing the results. The main error sources are:

- The choice of area metric when determining the price per square meter. Using the internal useable area, the effect of a large garden or terrace is neglected. Dividing by the owned ground, the number of floors is neglected, and apartments may have no private ground. Here, it was chosen to use the internal useable area as this is the metric used in official statistics.
- There are many real estate factors that this study did not account for, including for example number of bedrooms, build year, refurbishment needs, views, garden facilities etc.

The following sources of error were mitigated:

- Some areas have higher prices due to popularity, and the difference between the capitol centre and rural districts is large. Therefore, each building with GSHP installation was only compared to reference buildings within a relatively small radius X. In order to determine the radius *X* to be used in the search for reference properties in the main investigation, a pre-investigation was made to determine a range to be used for this radius in the main investigation.
- Only larger/costlier buildings can afford a GSHP installation, and comparing to buildings of all sizes would thus not be a relevant comparison. Therefore, only buildings with an area within ±50% were considered.

It must also be noted that even if buildings without GSHP in Norway usually have direct electric heating as their main heating source, there is no per-building data available on how other heat sources are applied. This aspect could therefore not be included as part of the study.

2.2 Other European countries

As GSHPs are not common in all European countries, the overview of GSHP installations from Sanner et al. [13] was used to select countries from whence information was sought. Countries listed in Figure 10 in [13] were targeted, and a literature review along with web searches in English and local languages were performed

to collect information on increased property values due to GSHP installations. Due to limited published data on GSHP installations, the search was extended to the impact on the real estate value due to heat pumps and energy labelling. Countries for which a result was found were included. It should be noted that the level of methodological detail available varies considerably across sources, with some providing only summary results.

For Denmark, the increase in sales prices were given as absolute values of Danish Kroner (DKK) rather than as percentage increases as in the other results. The increase was about 50 000 DKK per increase in energy label level, with an investment in GSHP typically leading to an improvement in the energy label by 2-3 levels. To convert these absolute values of increased real estate value to relative values as for the others, the absolute values for increase were compared to typical housing prices in Denmark. 3-6 million DKK were considered as the most typical residence price (0.5-20 million DKK was the price range found by searching for Danish residences, but 3-6 million DKK is considered most typical) [15]. 2-3 levels up in energy label divided by 3 and 6 million DKK gave the range for the main result in Figure 5, and using 2-10 million DKK as sales prices gave the uncertain ranges.

3. Results

3.1 Norway pre-investigation

To determine the appropriate search radius *X* for identifying reference properties, a systematic analysis was conducted on the full dataset comparing results for radii from 50 to 750 m for two different time windows: properties sold within ± 150 days and within ± 50 days, respectively. As shown in Figure 1, the measured average price difference between properties with GSHP installations and their respective reference properties varied substantially with the chosen radius. For the ±150 days time window, the price difference increased from around zero at 50m radius to 1.5% at 150m, 3.5% at 300m, and plateaued around 5% for radii beyond 500m. A similar pattern was observed for the ±50 days time window.

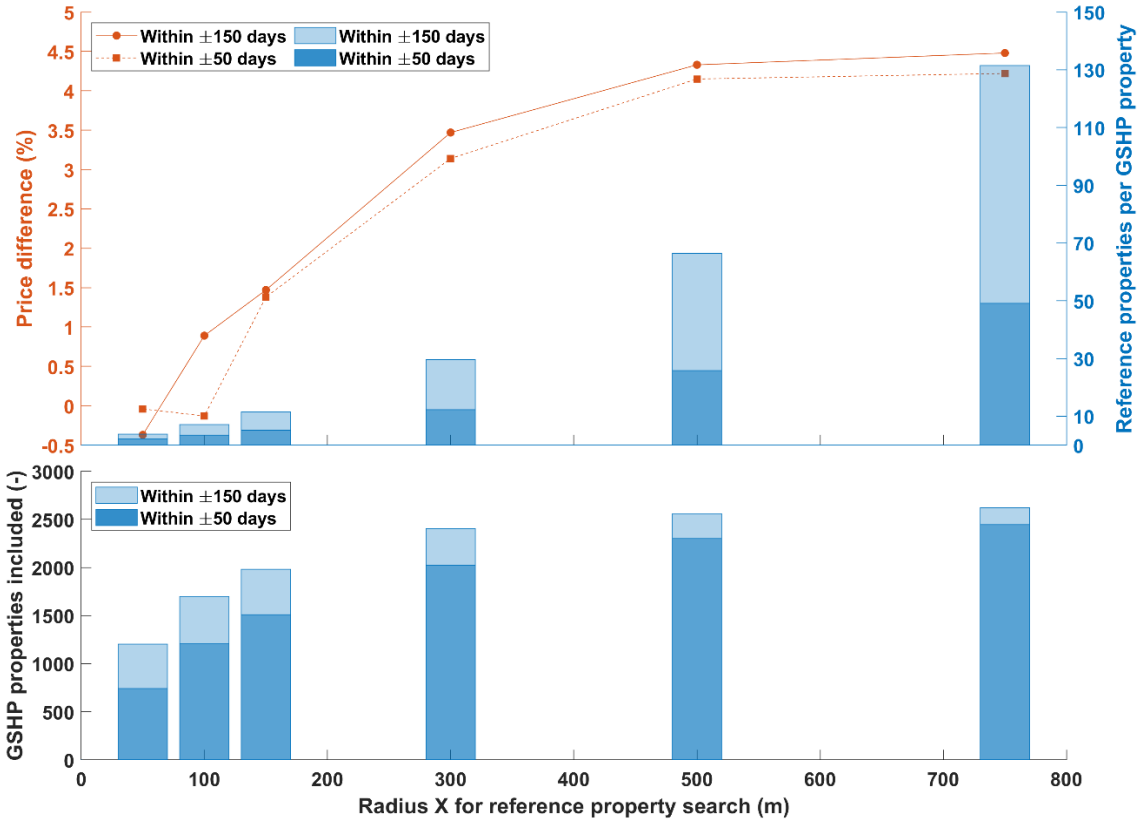

Figure 1: Determination of search radius X for reference property search. Upper panel: Average price difference for properties with GSHP versus their reference properties as a function of search radius X, shown for two temporal windows (±150 days and ±50 days). Lines show price difference (left y-axis); stacked bars show average number of reference properties per GSHP property (right y-axis). Lower panel: Total number of GSHP properties included in analysis for each radius and temporal window.

This relationship between radius and measured price difference reflects two competing effects. At very small radii (50-100m), the average number of reference properties per GSHP property is below 10 (Figure 1, bars, upper panel). In addition substantially fewer GSHP properties could be included in the analysis due to cases where no reference properties where identified (Figure 1, lower panel). This increases statistical uncertainty in the results. At larger radii (>300m), substantially more reference properties are found per comparison. However, the continuous increase in price difference with radius suggests that larger comparison areas increasingly capture systematic differences in neighborhood characteristics rather than isolating the GSHP contribution. Properties with GSHP installations tend to be located in areas with higher overall property values, and larger radii progressively include this neighborhood overall property value in the measured effect.

Based on these findings, X∈ [150, 300] meters was selected for the main investigation. This range balances statistical reliability while maintaining relatively localized comparison to minimize confounding from neighborhood-level price variations.

3.2 Norway main investigation

Based on the results from sensitivity analysis on reference building search radius in the pre-investigation, the main investigations where made with a reference building search radius of 300 m. For this search radius, the average increase in actual sales prices for the whole data set was 3.2% for sales within ±50 days. However, the standard deviation was high, mainly due to the limited number of properties with GSHP installations for sale in Norway. The yearly averages, numbers of datapoints per year and estimated standard deviation are shown in Table *1*, and all ratios of prices of residences with GSHP compared to those without are plotted together with the yearly averages in Figure 2. The figure reveals a potential increase from negligible impact to approximately 5% increase in value for properties with a GSHP installation, but the relatively high uncertainties must be noted when interpreting the results. No increase in real estate value is seen before 2019 and the last year with sufficient datapoints to give reliable data is 2023, for which the number had increased to 7.6. It should be noted that the number of datapoints reported in Table 1 is not the same as the total number of residences with GSHP sold each year, as buildings with GSHP without reported sales prices or without comparable reference residences within the specified radius are not included in this analysis.

Table 1: Yearly results for increase in real estate value for residences with GSHP compared to those of same type and size within 300 m sold within 50 days of the residence, including estimated standard deviation (std) in the results and number of data points behind the results.

Year	Increase	Std	Number of data points
2011	-6.2 %	7.1 %	6
2012	-0.1 %	17.5 %	14
2013	1.2 %	11.9 %	14
2014	5.1 %	18.5 %	54
2015	-1.2 %	16.6 %	77
2016	1.3 %	16.8 %	132
2017	-1.7 %	17.5 %	274
2018	0.6 %	17.5 %	363
2019	5.4 %	27.7 %	164
2020	3.9 %	25.8 %	206
2021	6.3 %	27.9 %	189
2022	5.4 %	30.5 %	224
2023	7.6 %	26.8 %	257
2024	3.9 %	30.4 %	42
2025	19.6 %	20.7 %	4

Figure 2: Ratio of sales prices for residences with GSHP in Norway compared to the average price within 300 m and 50 days in time of the same type and plus/minus 50% of the size: Upper: all data; Lower: enlarged main results.

In Figure 3, the sensitivity of the price increase with respect to the time window (±50 days, ±91 days, and ±150 days) and search radius (±150 m, ±225 m, and ±300 m) for reference properties is shown. The same trend can be observed for all six considered cases in the year-by-year data. After 2019 the increase is consistently around 4-5%.

The parameter combination with the lowest uncertainty in the years with at least 100 data points (2016-2023) is found for a search radius of 150 m and a time window of ±150 days. Figure 4 shows the 75% confidence interval for the price increase for this case. Here, the confidence interval includes 0% (no price increase) from 2012 to 2015 and from 2018 to 2019, but excludes 0% after 2019 when a price increase of approximately 4.6% ±2 percentage points is observed. High uncertainty can be observed for the years before 2016 and after 2023.

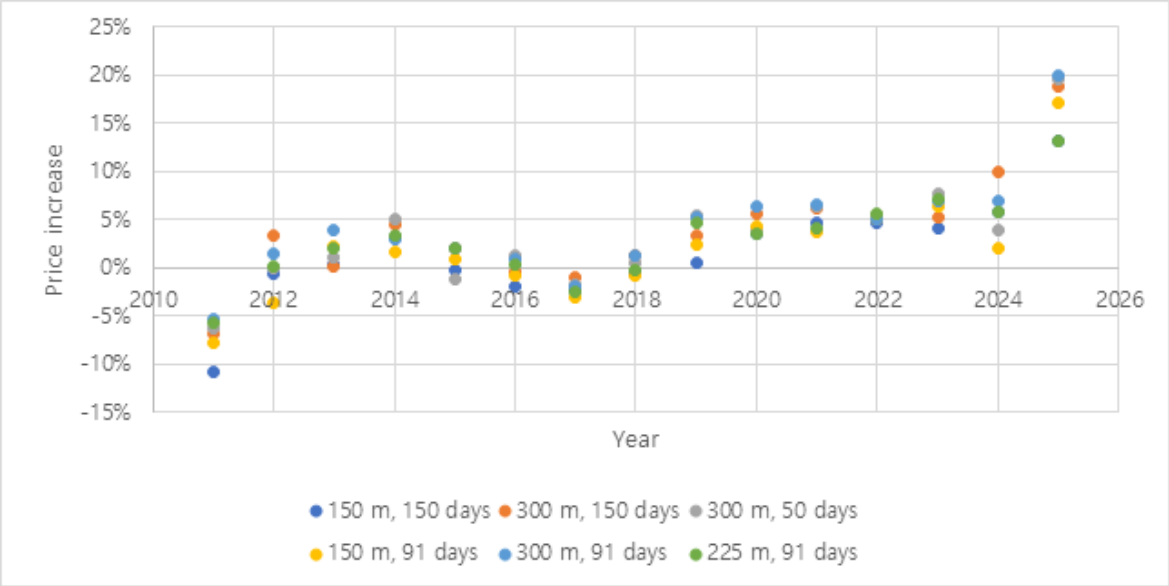

Figure 3: Average increase in real estate value for buildings with GSHPs per year for different ranges of comparison: geographic radiuses and time spans for comparison are given in the legends.

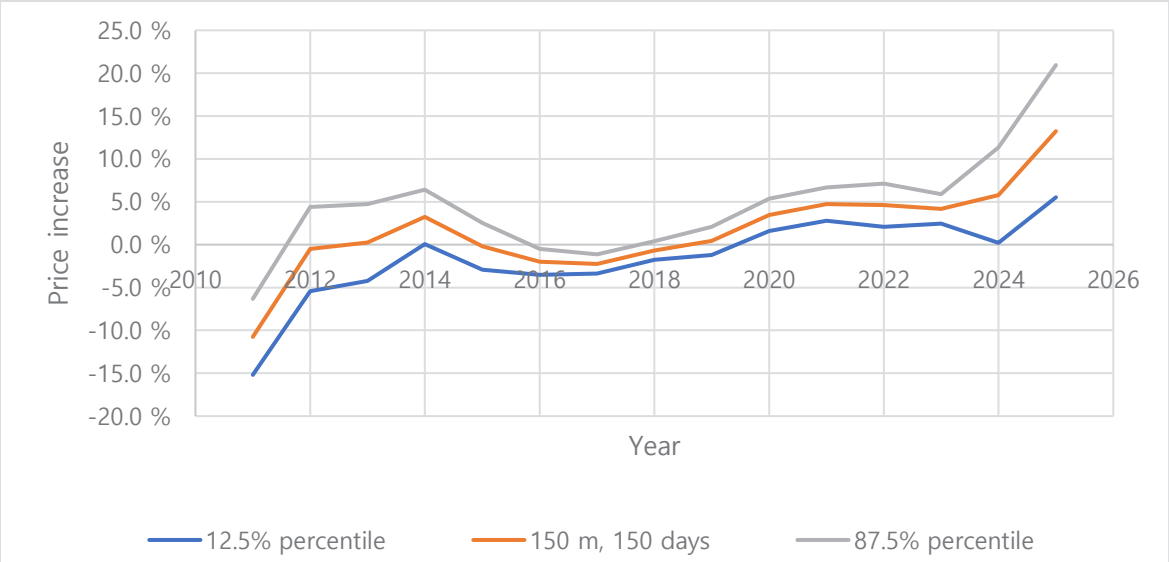

Figure 4: Increase in real estate value and 75% confidence interval limits when comparing prices to buildings within 150 m sold within 150 days of the reference residence. This is the case with the lowest uncertainty in 2016-2023.

3.2 Europe

The increase in real estate value for energy efficiency measures or GSHP or other heat pumps in several European countries from web searches are presented in Figure 5. The average price of buildings with GSHP was typically 5-10% higher than for buildings without GSHP.

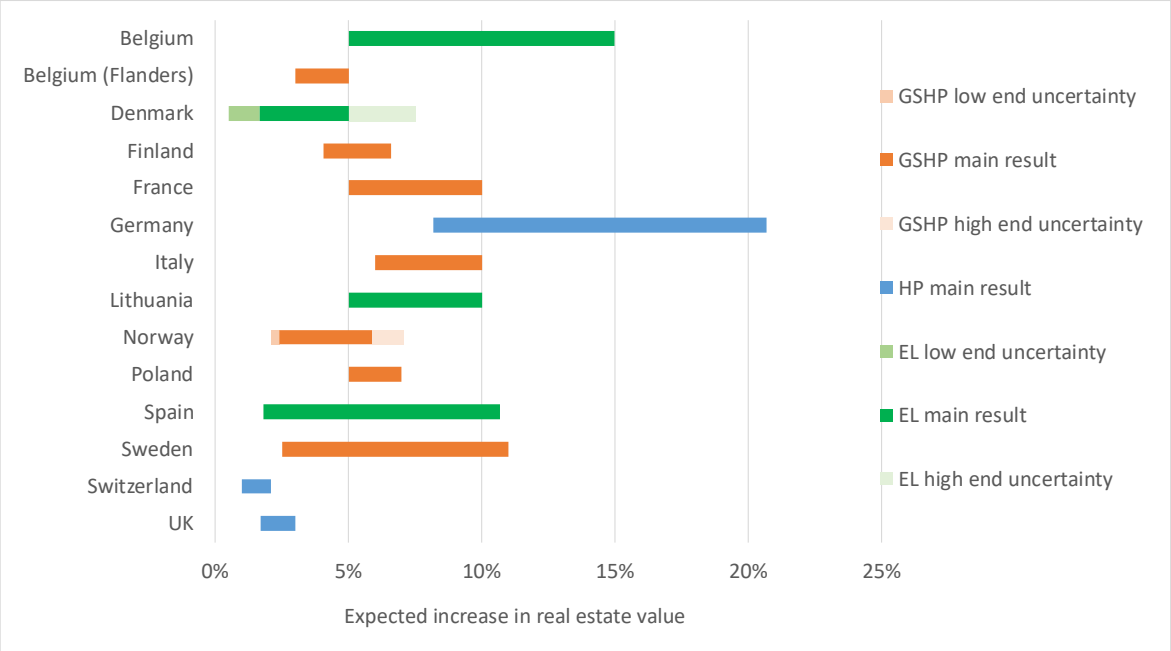

Figure 5: Increase in real estate value for residences in European countries for green investments in GSHP (orange); heat pump (red) or energy efficiency measures in general: The lighter colour indicate uncertain ranges. The sources for each country are: Belgium: [20]; Belgium (Flanders region): [14]; Denmark: [15]; Finland: [2]; France: [3]; Germany: [16] and detailed table in [17]; Italy: [18]; Lithuania: [19]; Poland: [4]; Spain: [21] [22]; Sweden: [1]; Switzerland: [5] and UK: [6]. Source quality and methodological detail vary across countries

For Italy, the range is even higher than shown in Figure 5 in the urban areas [18], but no number for this case was given and is thus not shown in the result graph. For Germany, the lower end of the range (8.2%) is the comparison to gas heating while the upper end of the range is the comparison to oil heating [16, 17]. The source also discusses the impact of location and housing type on the price increase, with increases being higher in smaller cities and for apartments [17]. For Belgium, a heat pump, but not specifically a GSHP, is said to recoup at least 35% to 50% of the market value upon selling the residence [23].

4. Discussion

There is limited research on the topic of increased real estate value due to investments in GSHP in Europe, and this type of data was only found for six countries. Detailed studies are only available for two countries, Finland and Sweden. Understanding the impact of GSHPs on property values is of importance because, while GSHPs can provide coupled heating and cooling with high efficiency all year (seasonal performance factors typically exceeding 4), they are hindered from reaching high market shares by their high installation costs. Documenting the increased real estate value could help reduce the investment barrier by demonstrating the full economic value of GSHP installations beyond energy savings alone.

For all countries where an investigation of the impact on real estate value exists, an increase is found. However, results in most countries are not specific to GSHPs, and for most cases there is very limited documentation available on the underlying methodology and on how they have been determined. Generally, though, a 5-10% increase in real estate value is typical across the reported data. For Norway, a price increase of around 4 to 8% was found after 2018, but with high uncertainty as there are several other factors impacting the prices and as there are few residences with GSHP installations, both of which increase the uncertainty of the data. A trend towards higher values with time may be present, as no clear increase is found before 2020 and 3.9% or higher is found after 2018. The last year with enough data points was 2023, giving a 7.6% increase in real estate value in Norway.

The countries with the highest reported increase for improved energy label or general heat pump are Germany, Spain, and Belgium. For GSHP-specific impacts, Sweden shows the highest increase, followed by Italy and France. The Swedish values are also expected to increase with time [24] and as the presented results are from 2021, they might be higher now than reported here. The relatively low values for UK and Switzerland are expected as these sources are for general heat pumps, and air-to-air heat pumps are cheaper than GSHPs.

The impact is also reported to be higher in urban areas [1, 2, 18] than in rural ones, though for Norway the number of installations is too low to conclude whether this trend also applies. The reasons for the relatively low number of installations in Norway compared to Sweden and Finland with similar geology, climate, and population, are believed to include scarce funding for GSHP installation, high salaries, cheap electricity and competition from air-to-air heat pumps.

A key methodological finding is that the comparison area should be limited to 300 m radius when analysing GSHP impact on Norwegian property values. Future studies could attempt to further reduce uncertainty by controlling for property characteristics beyond location, building type, and size, as demonstrated in the Finnish study[2].

5. Conclusion

The real estate value has been found to increase by about 5-10% across different European countries when investing in a GSHP or in energy efficiency measures. The largest increases in real estate value from GSHPs have been found for Sweden, France and Italy, whereas for general energy efficiency measures, the largest price increases are reported for Germany, Belgium and Spain . Norway lags behind with around 4 to 8% price increase for properties with GSHP installations the last years, with no clear impact before 2020. A weak increasing trend may be present. Further work could reduce the uncertainty by controlling for more factors than in this work. A finding is that the surrounding area for comparison should not exceed 300 m.

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