Nordic Energy Research

Energy Savings from Ecodesign and Energy Labelling in the Nordics

Contents

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https://pub.norden.org/nordicenergyresearch2024-03/

FOREWORD

The Nordic countries share a vision of becoming the most sustainable and integrated region in the world. Achieving this vision relies on energy efficiency, technological advancements, and behavioral change.

Efficient energy use is a key factor in the success of the Nordic countries' energy systems, which have significantly reduced greenhouse gas emissions. Nordic collaboration on energy will continue to prioritise energy efficiency. By leveraging advanced technology and promoting behavioral changes, energy consumption across households, businesses, and various sectors will be minimised, further supporting sustainable practices.

Nordic cooperation on energy is strengthened by joint efforts on EU/EEA regulations for ecodesign and energy labeling. It's vital to ensure Nordic conditions, especially for key products like heat pumps, are considered in EU regulations due to the region's unique climate and industries.

EU regulations are estimated to have reduced primary energy use by around 10%, delivering significant climate and environmental benefits. The total electricity savings are nearly equivalent to the EU’s entire hydro or wind energy production. However, these studies lack a breakdown of savings at the member state level, making it challenging for individual countries to conduct cost-benefit analyses of their national implementation of EU policies or to consider additional national energy-efficiency measures.

To address this gap, Nordic Energy Research and Nordsyn (a working group under the Nordic Council of Ministers) commissioned this report, providing updated estimates of energy savings from ecodesign and energy labeling in the Nordic countries.

The results of a survey are offering valuable insights into the sources used for room heating and cooling, as well as the methods employed for water heating.

Enjoy your reading.

Klaus Skytte CEO
Nordic Energy Research

1. SUMMARY

In this project, the Nordcrawl tool was updated to calculate the latest savings from ecodesign and energy labelling policies in the Nordic countries, providing a current 'snapshot' calculation. Two calculation methods were used, and both were implemented on the online platform Nordcrawl, where assumptions and input data can be changed to produce alternative calculations.

In the top-down method, the estimated EU savings from the 2023 Ecodesign Impact Accounting (EIA) report were scaled down for the Nordic countries using updated, product-specific scales. In the bottom-up method, savings were calculated using the latest sales data, including from the new, rescaled energy labels introduced in 2021.

The study shows continued large savings from ecodesign and energy labelling in the Nordic countries. The updated top-down calculations estimate yearly primary energy savings in 2030 (with final energy savings in parentheses) of approximately the following:

Denmark: 27.52 TWh/year (16.34)

Sweden: 51.01 TWh/year (25.85)

Norway: 35.50 TWh/year (17.42)

Finland: 41.58 TWh/year (24.07)

Iceland: 1.93 TWh/year (0.97)

2. INTRODUCTION

Ecodesign and energy-labelling requirements for energy-related products are crucial components of the EU's energy and resource-efficiency policies. Studies have demonstrated that these policies deliver significant energy savings, with the Ecodesign Impact Accounting (EIA)[1] reports estimating 10% energy savings across the EU in 2020 compared to a business-as-usual (BAU) scenario and savings of 18% in 2030. However, these EU-level studies do not provide a breakdown of the savings at the member state level, which makes it difficult for countries to conduct cost-benefit analyses of their national implementation of the EU policies or to consider complementary national energy-efficiency measures.

This project, initiated by Nordsyn and funded by the Nordic Council of Ministers, aims to enhance the Nordcrawl tool to provide updated estimates of the energy savings from ecodesign and energy labelling in the Nordic countries. Nordsyn collaborates with the agencies responsible for policy and market surveillance related to ecodesign and energy labelling in the Nordic region. Kasper Mogensen, a consultant at Big2Great ApS, conducted the project.

One new aspect of this project, inspired by the ElmodelBolig survey, was conducting a survey to obtain better data. Nordstat administered the survey in Finland and Norway, and it had 1,025 participants in representative groups. The survey, originally in English, was translated into the local languages and included questions on background information, heating, water heating, and ventilation. The results were weighted to ensure representativeness.

The key updates in this version include the use of the latest 2023 EIA data; conversion to the new, rescaled energy labels; improved downscaling factors; and updated assumptions and results based on the most recent available data, including insights from the survey. The online tool makes it easy to modify the input data and assumptions, enabling future updates as better information becomes available.

This report outlines the updated methods used in the top-down and bottom-up models and provides a current snapshot of the results for each of the five Nordic countries.

1. European Commission, Directorate-General for Energy, *Ecodesign Impact Accounting. Overview Report 2023 – Overview and status report*, Publications Office of the European Union, 2024, (p12)

3. METHODS

3.1 Method: Scaling of ecodesign savings from EU level to the Nordic countries

The method for calculating the ecodesign savings for each country by scaling down EU savings is quite simple. As shown in the equation below, country savings are calculated by multiplying the EU savings with a country- and product group-specific downscaling factor. All relevant scales, references, and specific assumptions appear in the notes on the scale-down module at Nordcrawl.org.

$$Country\ savings = EU\ savings * downscaling\ factor$$

3.1.1 Top-down: Choosing between scaling factors

When choosing a feasible scaling factor, the question to answer is the following: **How much of the total EU savings does this country account for?** In the following, I explain the factors that must be considered to answer this question.

First, we must examine the generic/basic equation for a scaling factor – the energy share – assuming that the savings are proportional to the energy consumption:

$$Scaling\ factor = \frac{Country\ consumption}{EU\ consumption}$$

where the consumption[2] is calculated by:

$$Consumption = standard\ consumption\ per\ appliance\ in\ stock * stock * usage$$

This equation shows that the three factors to consider are the stock, usage, and consumption per appliance in the stock. In many cases, at least one of these factors is the same for the EU as for the specific country, and in that case, it should not be considered because it does not add additional information to the scaling.

The stock of products compared to EU/market penetration

The first question concerns a specific country's share of the EU stock. For example, if a country accounts for 5% of the EU stock, and the usage of the product is the same in all countries, then the scaling factor should be 5% (0.05).

2. It should be noted that the "consumption per appliances in stock" may not be the same for the EU stock as in the specific country. If the stock of appliances in a country is newer or more expensive it might use less energy than The EU average and vice versa.

In many cases, we do not know the actual stock. Still, the stock and usage can be substituted with another factor, such as 'number of houses' (like all houses have one unit of this product) or economic factors such as 'GDP', 'energy consumption', or 'electricity consumption'. For those cases, a scaling factor is chosen based on a substitute factor. For instance, transformers are correlated with electricity consumption.

Usage

If a product's usage differs from the EU average, this should be reflected in the scaling factor. For example, the usage of heating products is higher in the Nordic countries than the EU average. This can be corrected by using heating degree days[3] in the scaling factor.

Consumption per appliance in stock

The real question here is whether the appliances in one country are more efficient than the EU average and, if so, whether their greater efficiency is a result of EU policy or other factors. The 'consumption per appliance in stock' should only be considered when setting the scaling factor when other factors are known to cause the additional efficiency.

3.1.2 Data

EU savings

Data for the ecodesign savings comes from the 2023 EIA annual report, which VHK prepared for the European Commission. The report describes how the impact accounting is calculated as follows:

The projections in EIA are taken from the impact assessment reports, integrated with data from preparatory- and review-studies where necessary. These projections are the result of various years of study and have been discussed with stakeholders (see input-data verification above). They consider e.g. the historical and ongoing trends, the expectations from manufacturers, boundary conditions from EU policy, climate change effects, changes in EU population and households, trends in new-building and renovation, changes in user-demand (more comfort, larger displays and fridges, more light sources, rebound effects), and expected energy efficiency developments. Where the projection in the underlying studies does not cover the entire accounting period up to 2050, EIA extrapolates the existing trends without assuming any new measures, i.e. it is not in the scope of EIA to develop new policies. Projections use two scenarios:

- *A 'business-as-usual' (BAU) scenario, which represents what was perceived to be the baseline without measures at the time of the (first) decision making, and*
- *An ECO scenario that is derived from the policy scenario in the studies which comes closest to the most recent measures taken, adapted to the final published regulation where necessary and possible.*

3. Heating degree days (HDD) are a measure of how cold the temperature was on a given day or during a period of days.

- *The differences in outcomes between the two scenarios are presented in EIA as 'savings' due to the policy measures. EIA takes into account product interactions, e.g. between ventilation units and space heating, the comments from the European Court of Auditors [12], and corrects for double counting in a transparent manner [13]. The EIA methodology is explained in detail in chapter 2 of the Status report.*[4]

Scaling factor input

Input for the scaling factor highly depends on the data sources available for a specific country. The most common data sources are the following:

- Eurostat
- Odyssee-Mure database
- National statistics
- National report (such as a report on data centres in Norway)
- Stock calculated in the bottom-up model
- Stock from the EIA report

4. European Commission, Directorate-General for Energy, *Ecodesign Impact Accounting Overview Report 2023 – Overview and status report*, Publications Office of the European Union, 2024, (p. 11)

Table 1: Sources

Source	Explanation
Eurostat	Eurostat is the statistical office of the European Union. It provides data on population, energy, and electricity.
Odyssee-Mure database	The Odyssee database concerns energy-efficiency indicators and energy consumption by end-use and underlying drivers in industry, transport, and buildings. The database provides consumption data for industry, residential, and service sectors.
National statistics	National statistical offices. They provide national data that are not included in Eurostat or Odyssee. An example is Statistics Iceland,[5] which provides data on Iceland's industry consumption on, for example, aluminium smelters.
National reports	National reports provide specific input for the consumption of a particular product group in one country. An example is the Norwegian report[6] on data centres.
Stock calculated in the bottom-up model	Stock calculation from the NordCrawl bottom-up model, which is described later in this report. One example is the stock of dishwashers in Finland.
Stock from the EIA report	In the EIA report, the total EU stock is calculated. The stock is used, for example, for the scale for dishwashers in Finland.
Survey	Survey of households conducted for this study.

Preferably, the data for the scaling should be from between 2010 and 2020.

5. https://statice.is/
6. Energibruk fra datasentre i Norge – NVE 2019 - Energiavdelingen - Jarand Hole og Hallgeir Horne http://publikasjoner.nve.no/faktaark/2019/faktaark2019_13.pdf

3.1.3 Survey

To improve the accuracy of the downscaling factors used in the top-down model, a survey inspired by the Danish ElmodelBolig survey was conducted in households in Finland and Norway. This survey aimed to gather more representative data on heating, water heating, and ventilation systems in these countries. Denmark was not included because data from previous surveys already existed; Iceland was too small to include, and Sweden had another approach and data sources.

Nordstat administered the survey, targeting a representative sample of 1025 respondents in each country. The questionnaire, originally in English, was translated into the local languages to ensure better understanding and response quality. The survey covered background information and specific questions related to heating, water heating, and ventilation systems in households.

The results were weighted to ensure that they accurately represented the population in each country. The data collected from this survey provided valuable insights into the primary heating sources, water-heating methods, and the use of heat pumps for cooling during summer. This information was then used to refine the downscaling factors in the top-down model, leading to more precise estimations of energy savings from ecodesign and energy-labelling policies in the Nordic countries.

The table below presents a comparison of the survey results for Finland and Norway, data from Denmark from the Danish ElmodelBolig Survey, and data for Iceland obtained from other sources.

Table 2: Primary heating source in Nordic countries (excluding Sweden)

	FI	NO	DK[7]	IS[8]
District heating	47%	9%	49%	90%
Heat pump (air-air)	7%	26%	6%	
Heat pump (air-water)	4%	3%	4%	
Heat pump (exhaust air)	1%	1%	0%	
Heat pump (liquid-water/geothermal/bergvarm)	8%	2%	2%	
Central heating with boiler/furnace – oil	4%	1%	2%	
Central heating with boiler/furnace – wood pellets	1%	0%	2%	
Central heating with boiler/furnace – firewood /briquettes/straw	2%	0%	2%	
Central heating with boiler/furnace – gas	0%	0%	12%	
Central heating with boiler/furnace – electricity	2%	1%	0%	
Traditional electric radiators	12%	21%	6%	10%
Electric heater with fan	0%	3%	2%	
Wood stove(s)	2%	17%	13%	
Open fireplace	5%	1%	1%	
Electric floor heating	3%	10%	11%	
Oil radiators (electric radiator with oil)	1%	2%	1%	
Solar thermal collector (produces heat, not solar cells/PV)		0%	1%	
Do not know	4%	3%		

7. ElmodelBolig DK 2022, Elmodelbolig.dk
8. Sveinbjorn Bjornsson, Geothermal Development and Research in Iceland (Ed. Helga Bardadottir. Reykjavik: Gudjon O, 2006)

Table 3: Primary water heating

	FI	NO	DK[9]	IS[10]
District heating	46%	9%	59%	90%
Heat pump – hot water	7%	7%		
Central heating with boiler/furnace – oil	5%	2%	2%	
Central heating with boiler/furnace – wood pellets	1%	0%	2%	
Central heating with boiler/furnace – firewood/briquettes/straw	2%	0%	2%	
Central heating with boiler/furnace – gas	0%	1%	12%	
Electric water heater	28%	70%	10%	10%
Solar thermal collector	0%	0%	2%	
Do not know	11%	11%		

3.1.4 Energy types

The model considers the following 'types' of energy:

- **Primary energy**
  Primary energy is determined as follows: '
  *only electricity' * primary energy factor for electricity + 'only fuel'.*
  The primary energy factor for electricity was 2.5 and was adjusted to 2.1 in 2018 through the Energy Efficiency Directive (2018/2002). The primary energy factor can be changed for each country in the system.

- **Only electricity**
  The savings in electricity.

- **Only fuel**
  Savings in fuels such as oil, gas, and wood.
- **Final energy**
  The total savings in the final energy is 'only electricity' + 'only fuel'.

In some cases, it might be necessary to exclude 'only electricity' or 'only fuel' if there are no savings in the energy type in the country. For example, if the water is always heated by electricity and never by fuel, then 'only fuel' should be excluded.

9. ElmodelBolig DK 2022, Elmodelbolig.dk
10. Assumed based on: Sveinbjorn Bjornsson, Geothermal Development and Research in Iceland (Ed. Helga Bardadottir. Reykjavik: Gudjon O, 2006)

3.2 Bottom-up method

The bottom-up models require sales data and the distribution of sales across energy classes. The model was used for product groups for which these data were available: refrigerator, refrigerator/freezer, freezer (chest), freezer (upright), washing machine, dishwasher, and tumble dryer.

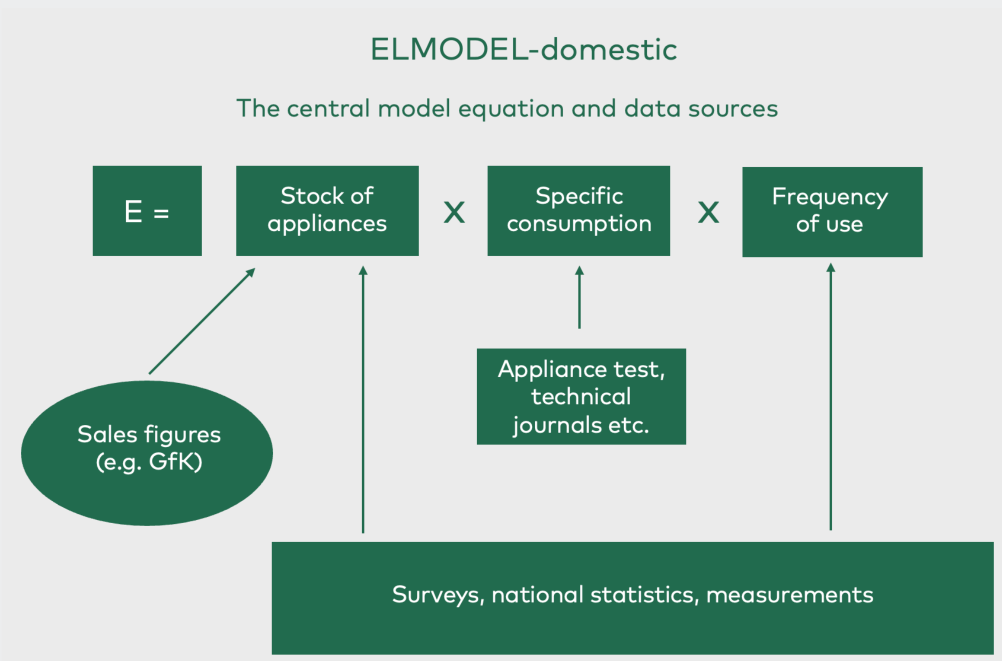
3.2.1 Background

The bottom-up method is based on an Excel bottom-up model developed for Sweden and Denmark. The new model was developed as an online tool on the NordCrawl platform and is based on the old model's method, which was updated to accommodate all Nordic countries and new requirements, such as rescaling energy labels (in March 2021).

The bottom-up tool's methodological basis is the Danish bottom-up stock model ELMODEL – domestic (Fjordbak Larsen et al. 2003).

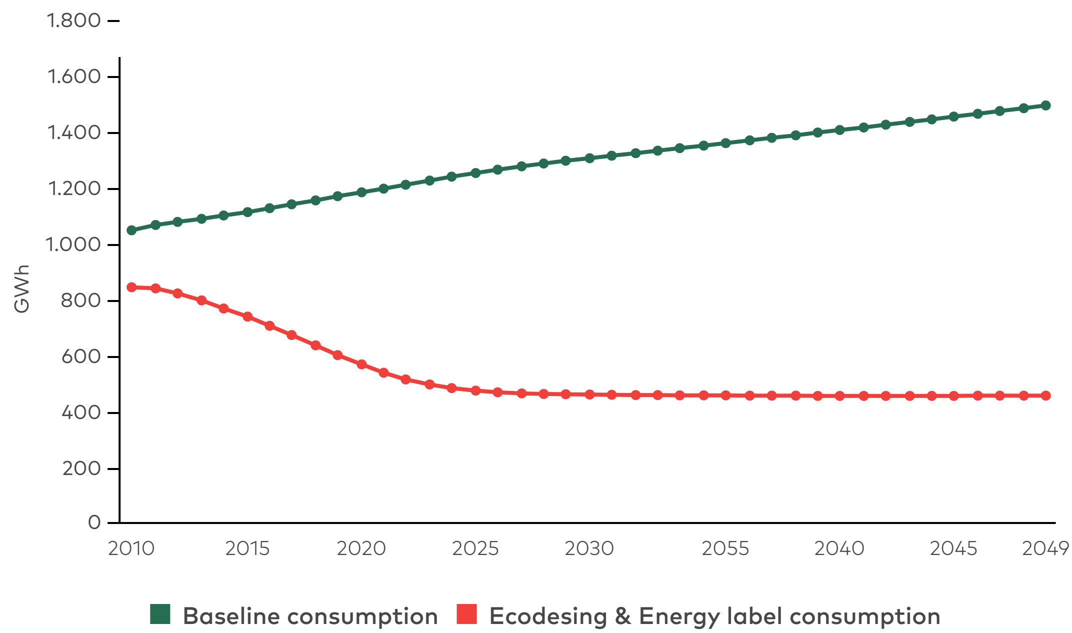
The tool's basic equation is as follows:

Figure 1: ElmodelBolig – domestic equation



The energy savings of the ecodesign and energy-labelling regulations were estimated by comparing the energy use of a product group in a baseline scenario (without regulations, or BAU) with the energy use of the product group in a policy scenario (with the effect of the regulations).

Figure 2: Example of baseline and scenario consumption



3.2.2 The two scenarios

Table 4: Characteristics of the two scenarios

	Baseline scenario	Policy scenario
Policy (MEPS + energy label)	NO	YES
Sales number (total number sold per year)	Same as sale until 2021; from 2022, 2021 + natural development	Same as baseline scenario
Energy class sales distribution (before 2022)	Same as first year + natural development; annually, 2% of the sale in each class is moved up one class	Sales distribution
Energy class sales distribution (after 2022)	Same as before 2022	Sales distribution 2022 + energy label effect + ecodesign cut-off
Rescaled label (2022)	NO	YES (dishwasher, washing machine, refrigeration)

Ideally, the estimations would be based on data for the stock of appliances in the households by energy class, as shown in Figure 3. Detailed data of this kind are not collected in any Nordic country for any product groups. Attempts have been made to use surveys to collect this type of data in Denmark[11] and Norway, but respondents have been unsure about the energy class to which their products belong. Instead, the model uses sales data by energy class and simulates the stock using a normal-distribution assumption for the lifetime of the appliances. Multiple years of sales will then make up the total stock.

The next step in the model is to calculate a projection of the sales and the stock. For the baseline scenario, this is done as a simple forecast of the total sales (e.g., linear trend) and an assumed natural development in the sales distribution on energy classes.

With these inputs, the stock per energy class in a given year can be calculated as the sum of all sales until then that survived according to the lifespan distribution; see Figure 3. The figure illustrates how the lower energy classes are phased out, while the higher energy classes comprise larger shares of the stock.

A policy scenario parallel to the baseline scenario is used to estimate the effects of ecodesign (minimum energy performance standards [MEPS]), limiting the sales to the allowed energy-efficiency classes according to the legislation stages that successively come into effect. If a particular energy class is banned through an ecodesign MEPS criteria, the sales are simulated at the next energy class level. This is illustrated in Figure 3, where sales of banned energy classes are assumed to be zero in the years after the ecodesign requirements enter into force, which, in this example, occurs in two stages in 2022 and 2025.

The estimated savings caused by the ecodesign requirements (MEPS) are the difference between the baseline scenario curve and the policy scenario curve. Note that the natural development of the sales distribution remains active in the ecodesign scenario, preventing the ecodesign scheme from accounting fully for the efficiency improvements in sales.

The tool also provides a means to estimate the effects of energy labelling. This process is similar to natural development simulation, that is, setting an assumed annual change in percent towards more sales in higher energy classes. This shift in sales is illustrated in Figure 3. The energy labelling affects the sales in all energy classes every year. The effects of labelling are calculated in parallel to the ecodesign effects, ensuring that any effect in sales that MEPS already simulates are not accounted for when simulating the effects of labelling. This also ensures that no measures are double counted.

11. ElmodelBolig

Table 5: Example of banned energy class

** Class "F" banned*

Class	2022	2023	2024	2025	2026	2027
G	0	0	0	0	0	0
F	44,370	43,917	43,469	0*	0	0
E	65,929	66,153	66,365	109,592	109,343	109,088
D	65,929	66,588	67,245	67,900	68,552	69,201
C	2,684	3,988	5,292	6,597	7,901	9,205
B	0	54	134	240	371	526
A	0	0	1	4	9	16

As mentioned above, the savings from the ecodesign and energy-labelling regulations are estimated as the difference between the base-case scenario and the policy scenarios for ecodesign and energy labelling.

3.2.3. Assumptions

Table 6: Table with assumptions (washing machine example)

Changeable assumption	Example	Explanation
Start year data	1995	First year in the data series
Starting year for baseline projections	1996	The first year where the baseline is projected; in most cases, the year after the times series starts
Starting year for projections	2023	The first year of projections in the policy scenario. The starting years can be changed to focus on the policy effects for a shorter period
End year for projections	2050	The last year in the projection and thus the last year in the analysis
End year for sale	2022/2050	The last year of sales of this product group. 2021 was chosen for cases in which a new time series for the new label will replace the old label
End year for baseline sale	2050	The last year of sale for the baseline
Baseline development (% p.a.)	2% p.a.	The natural development of the baseline; this assumes that energy efficiency will improve naturally without policies
Lifetime	12 years	The lifespan of a product
EEI ref consumption	380.7 kWh/year	The Energy Efficiency Index reference consumption calculated the equation in the regulation using assumed size(s)
EEI ref size	7 kg	The Energy Efficiency Index reference size(s) used for the consumption calculation

The modelling is based on several other assumptions, including the following:

- A normally distributed lifetime of products typically has mean value between 8–16 years for white goods.
- The energy consumption per year reference was calculated using an assumed average size (or sizes) and the equations for the annual consumption per unit from the regulations. Some cases, such as that of refrigerators, have many options for different compartment types, etc. In those cases, we simplified the product to the most common types where data are available.
- Each energy class can be characterised by a mean annual energy consumption value. For example, on the old label for washing machines, class A++ has an EEI between 46 and 52, and the mean is EEI 49.
- The baseline is defined by a natural development in the market, which is 2% per year of the sales in the specific energy class are assumed to move one energy-efficient class up. This number can be adjusted because the market's development can differ for different types of products.
- Non-compliant sales, (below MEPS) move the sale to the nearest available energy class.
- The effect of labelling is simulated by shifting X% of the sale in each energy class to the next most efficient labelling class every year, where X is assumed to be high (~25%) for the first several years after the requirements come into force, after which it is lower (~5%). This assumption is based on knowledge from the introduction of energy labelling for white goods in the late 90s.

All assumptions can be modified for each simulated product group.

3.2.4 Data

The following data sources were used for the modelling:

- Sales data from APPLiA Danmark and Sweden (the Association for Suppliers of Electrical Domestic Appliances); the association collects sales figures for white goods from its members
- Elektronikkbransjen Norge, the Consumer Electronics Trade Foundation; members are suppliers, dealer chains, independent dealers, and workshops
- National energy statistics
- ElmodelBolig, a bi-annual Danish survey of about 2,000 households performed by Energistyrelsen
- Other product-specific reports, such as JRC for data centres; see footnotes
- NordCrawl

3.2.5 Data-sharing and sales-scaling

The sales data used to estimate the savings from ecodesign and the energy labelling of white goods are from APPLiA in Demark and Sweden (for only select years); this group collects sales data for white goods from their members. Likewise, Elektronikkbransjen in Norway collects sales data (the number of products and energy classes) from their members. It has been assumed that the Nordic consumers have approximately the same energy-efficiency preferences when buying white goods, which means that we can use the sales distribution of energy classes from Denmark, Norway, or Sweden in Iceland and Finland. The country that is the best match can be determined by examining factors such as housing type distribution and the economy. An argument for this assumption is the fact that online shops such as Elgiganten (known as Elkjøp Norway, Gigantti Finland) have similar websites and selections. The sales figures (the number of models sold per year) were scaled to adjust to different household stock. Sales data from Norway and Sweden cover fewer years than data from Denmark, so Danish sales data were used to extend those time series.

Table 7: Sales data-sharing and data-scaling

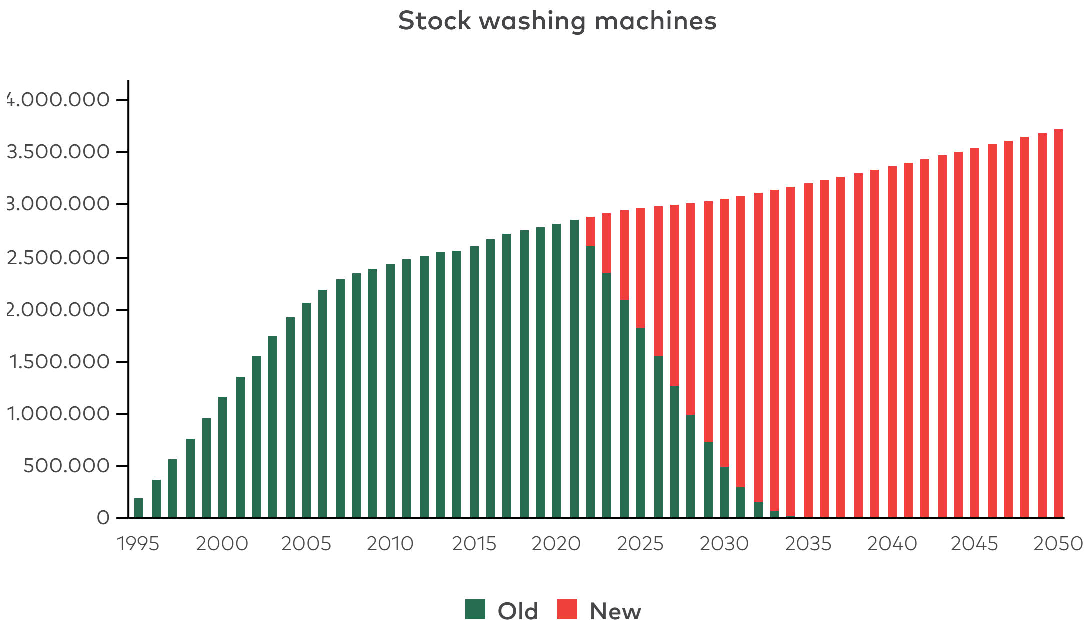
Country	Data source	Scaling factor (for the annual sale in units of appliances)
Denmark	1995–2022: APPLiA DK	–
Sweden	1995–2016: APPLiA DK, 2017–2022: APPLiA SE + 2022 DK dist	SE sales/DK sales (per product group)
Norway	1995–2005: APPLiA DK, 2006–2022: Elektronikkbransjen Norge	NO sales/DK sales (per product group)
Finland	1995–2022: APPLiA DK	FI households/DK households
Iceland	1995–2022: APPLiA DK	IS households/DK households

Rescaled energy labels

During the last project, the energy labels for the appliances in this project were rescaled. The rescaling came into force on 1 March 2021. Therefore, no sales data for the new, rescaled energy class distributions were available at that time, and we thus had to create a conversion from the old energy label to the new. For this project, sales data for the new energy label are available, so we did not have to convert them.

At the same time, new, more stringent MEPS were introduced. To handle the new MEPS and the new label with the new thresholds for the energy-labelling classes, we decided to treat appliances with a new label as a new product, replacing the models with the old label. When calculating the savings, we added the savings from the old label to the savings from the new one. Over time, appliances with the old label will be replaced with appliances with the new label in the stock. The figure below shows how appliances with the new label replace those with the old label over time.

Figure 4: Example of how the stock changes from the old to the new energy label



3.2.6 Uncertainty

The bottom-up modelling is data demanding, and the quality of the results naturally depends on the quality of the input data; especially detailed sales data can improve the quality. Since these data can be difficult to obtain, assumptions must be introduced to establish sales data at the needed granularity, which adds to the uncertainty.

The long-term projections of the model are also uncertain, since many of the assumptions made to establish the bottom-up basis are not valid over a long period. The model should only be used for projections of five to 15 years, which is equal to one generation of most white goods. Otherwise, the model should be developed further to incorporate top-down elements to guide some assumed developments (or statistics). An example of long-term uncertainty in a bottom-up model is that it is difficult to predict when a new technology is introduced for an appliance (often called technology leaps; e.g., the use of heap pumps in tumble dryers). Another example is consumer preference changes. In some Nordic countries, we observed a change from chest freezers to upright freezers. If the model is used to project too far into the future, such changes will not be adequately reflected.

In summary, the model can estimate the composition of the stock in any given year in terms of energy parameters using data for how the actual annual sales are distributed over energy classes. This enables us to calculate the total energy consumption for a baseline situation, as well as the energy consumption for policy scenarios. The difference between the baseline scenario and the policy scenario constitutes the savings at the national level that is attributable to the policies.

3.2.7 Quality assurance of assumptions

The following quality controls were performed to ensure the robustness of the assumptions.

Product penetration

We analysed the product penetration, which is the quantity of a product in a household (stock/households). Surveys in Denmark and Norway clarify the approximate expected penetration, and by comparing the calculated with the expected penetration, we can evaluate the assumptions. For example, the general penetration of a refrigerator is around one refrigerator per household. If the calculated penetration is 0.5 refrigerators per household, there could be a problem with the scaling of sales data (in most cases, the Danish APPLiA data) or the assumed lifetime.

Comparison between countries

We compared the assumptions and results between Nordic countries. Some variations are expected due to different lifestyles, such as the popularity of dryers or housing types; many apartments have fewer washing machines and have shared washing machines, typically in the basement. However, the central assumption is that the results should be comparable, and we should be able to explain the variations logically.

3.3 Combining scale-down and bottom-up results

For product groups where bottom-up results are available, they are preferable to those from the scale-down method, as the bottom-up approach provides more accurate estimates. In these cases, rather than applying a scale-down factor to the EU savings, we directly replaced the EU savings with the country-specific savings calculated using the bottom-up method. This effectively meant using a scale-down factor of 100% for these product groups.

In Sweden, some savings for heating products were also calculated separately, and the results were added in the same way as for the bottom-up results. This further enhances the accuracy of the savings estimates for these specific product groups in Sweden.

This approach allowed us to combine the two methods into one comprehensive result, ensuring that we used the most accurate data available for each product group. By prioritising the bottom-up results where possible, incorporating separately calculated savings for certain product groups in Sweden, and relying on the scale-down method for product groups without detailed data, we generated a more precise overall estimate of the energy savings from ecodesign and energy-labelling policies in the Nordic countries.

4. RESULTS

The results are presented for each country. First, the scale-down result with an explanation of the scaling factors appears. Subsequently, the bottom-up results are presented, and the results of the bottom-up and the scale-down models are then compared for each country. Finally, all results are summarised.

5. DENMARK

Table 8: Danish results CO2

	2020		2030	
	Electricity	**Fuel**	**Electricity**	**Fuel**
Total savings TWh/year	6.59	2.72	10.17	6.19
Ton CO2eq (2022 average emissions) (219K T/TWh)	1,443,210		2,227,230	
Kg CO2eq per person (2021 population)	247		381	

5.1 Denmark: Scale-down results

Scaling factors

Below is a list of available scales. Not all scales are used, but they can be used to indicate the country population, GDP size, etc. The description column explains the data in the scale, the source, and the year. The scale represents the country's percentage of the total EU consumption.

Table 9: Danish scaling factors

Name	Description	Scale	Times used
Population	Population, 2021	1.31 %	0
GDP	GDP, 2022; Current prices, million euro	2.39 %	0
Electricity	Final energy consumption by product Eurostat [ten00123] 2022, Electrical energy; TOE	1.29 %	1
Energy	Gross inland consumption 2016, All products; TOE	1.06 %	0
Population	Population, 2021	1.31 %	0
GDP	GDP, 2022; Current prices, million euro	2.39 %	0
Houses	Stock of dwellings (permanently occupied), EUROSTAT; 2020	1.50 %	0
Residential	Final consumption of residential with climatic corrections; 2016; Odyssee; Mtoe	1.76 %	0
Space heating	Final consumption of residential for space heating with climatic corrections; Odyssee 2015; Mtoe	2.11 %	0
Car consumption	Car consumption 2021; Odyssee; TOE	1.55 %	1
Industry	Final energy consumption in industry by type of fuel (elec) [ten00129]; ESTAT 2021	0.97 %	4
Service	Electricity consumption of services; Odyssee 2020; Mtoe	1.72 %	4
Residential electricity	Final energy consumption in households by type of fuel (elec) [ten00125]; ESTAT 2021	1.46 %	0
Circulators	DK stock *HDD / EU avg	1.61 %	1
Residential appliances electricity	Electricity consumption for dwellings for electrical appliances and lighting; Odyssee 2020	1.99 %	5
None	None	100.00 %	2
Data centers	JRC (COWI)	2.29 %	1
Residential & Service	Average residential electricity and Service	1.32 %	0
Residential appliances & Service	Average residential appliances electricity and Service	1.85 %	6
Dedicated Water Heater	DK stock / EU stock	0.22 %	1
Central Heating water	DK stock / EU stock	3.40 %	1
Central space heating	DK stock * HDD * area /EU stock	0.80 %	1
Local space heaters	DK stock * HDD * area /EU stock	0.64 %	1

Solid fuel boilers	DK stock * HDD * area / EU stock	1.65 %	1
Air to Air HP	DK stock * HDD * area / EU stock	1.23 %	1
Ventilation residential	DK stock / EU stock	3.40 %	1
Placeholder	Placeholder for bottom-up	0.00 %	0
Bottom-up	100% for bottom-up	100.00 %	4

Top-down results

The scale-down results are in TWh/year. Most products only have electricity savings, but several heating-related products have both electricity and fuel savings. Savings for tyres are only calculated for fuel and not for electric vehicles.[12]

Table 10: Danish top-down results

	2020			2030			Scale	
Group	**Elect-ricity**	**Fuel**	**Final energy**	**Elec-tricity**	**Fuel**	**Final energy**	**Scale factor**	**Scale name**
Dedicated water heater	0.01	0.01	0.02	0.03	0.02	0.05	0.22%	Dedicated Water Heater
Central heating combi, water heating	0.00	0.51	0.51	-0.07	1.33	1.26	3.40%	Central Heating water
Central heating boiler, space heating	0.04	1.08	1.12	-0.02	2.13	2.11	0.80%	Central space heating
Solid fuel boilers	0.00	0.07	0.07	0.00	0.18	0.18	1.65%	Solid fuel boilers
Central air cooling	0.05	0.00	0.05	0.21	0.00	0.21	1.72%	Service
Central air heating	0.03	0.10	0.13	0.10	0.28	0.38	1.72%	Service
Local heaters	0.04	0.02	0.06	0.08	0.12	0.20	0.64%	Local space heaters
Room air conditioner (of which cooling)								None
Room air conditioner (of which heating)	0.14	0.00	0.14	0.16	0.00	0.16	1.23%	Air to Air HP
Circulator pumps <2.5 kW	0.21	0.00	0.21	0.23	0.00	0.23	1.61%	Circulators

12. The Impact Accounting report only calculate savings for fuel.

Ventilation units (res. and nonres.)	0.17	0.44	0.61	0.58	1.19	1.77	3.40%	Ventilation residential
Light sources	1.50	0.00	1.50	1.78	0.00	1.78	1.86%	Residential appliances & Service
Electronic displays	0.37	0.00	0.37	0.95	0.02	0.97	1.86%	Residential appliances & Service
Set top boxes	0.10	0.00	0.10	0.08	0.00	0.08	1.99%	Residential appliances electricity
Video	0.08	0.00	0.08	0.08	0.00	0.08	1.99%	Residential appliances electricity
Enterprise servers and data storage	0.05	0.00	0.05	0.07	0.00	0.07	2.29%	Data centers
Personal computers	0.00	0.00	0.00	0.00	0.00	0.00	1.86%	Residential appliances & Service
Imaging equipment	0.13	0.00	0.13	0.13	0.00	0.13	1.86%	Residential appliances & Service
SB (networked) stand-By (rest)	0.35	0.00	0.35	0.30	0.00	0.30	1.86%	Residential appliances & Service
External power supplies	0.09	0.00	0.09	0.10	0.00	0.10	1.86%	Residential appliances & Service
UPS total								None
Household refrigeration	1.16	0.00	1.16	1.37	0.00	1.37	100.00%	Bottom-up
Commercial refrigeration	0.00	0.00	0.00	0.28	0.00	0.28	1.72%	Service
Professional refrigeration products	0.05	0.00	0.05	0.17	0.00	0.17	1.72%	Service
Cooking appliances	0.08	0.00	0.08	0.22	0.02	0.24	1.99%	Residential appliances electricity
Household coffee-makers	0.04	0.00	0.04	0.04	0.00	0.04	1.99%	Residential appliances electricity
Household washing machines	0.33	0.00	0.33	0.51	0.00	0.51	100.00%	Bottom-up

Household dishwashers	0.34	0.00	0.34	0.59	0.00	0.59	100.00%	Bottom-up
Household laundry dryers	0.48	0.00	0.48	0.76	0.00	0.76	100,00%	Bottom-up
Vacuum cleaners	0.24	0.00	0.24	0.30	0.00	0.30	1.99%	Residential appliances electricity
Industrial fans >125W	0.14	0.00	0.14	0.30	0.00	0.30	0.97%	Industry
Electric motors LV 0.12-1000 kW	0.27	0.00	0.27	0.57	0.00	0.57	0.97%	Industry
Water pumps	0.03	0.00	0.03	0.04	0.00	0.04	0.97%	Industry
Standard air compressors	0.00	0.00	0.00	0.01	0.00	0.01	0.97%	Industry
TRAFO utility transformers	0.07	0.00	0.07	0.22	0.00	0.22	1.29%	Electricity
Tyres, total Cl+C2+C3	0.00	0.49	0.49	0.00	0.90	0.90	1.55%	Car consumption

5.2 Denmark: Bottom-up results

Below are the bottom-up results for 2030. The table also shows the main assumptions for sizes in litres, kilograms, place settings, and lifetime in years. All results are for households (not commercial or service sectors).

Table 11: Danish bottom-up results

	Size	Lifetime[13]	Baseline GWh/year	Scenario GWh/year	Savings GWh/year
Refrigerator	230 l	14	309.2	136.6	172.6
Refrigerator/ freezer	260/90 l	15	1,357	554.1	802.9
Freezer (chest)	230 l	18	126.2	43.7	82.5
Freezer (upright)	200 l	16	503.3	191.9	311.4
Washing machine	7 kg	9	757.6	243.8	513.8
Dishwasher	12 ps	10	1,082.8	495.8	587
Dryer	7 kg	13	1,167.8	405.8	762

13. Lifetime is the number of years a product is used. It's not necessarily the same as technical life (until the product dies)

6. SWEDEN

Table 12: Swedish results CO2

	2020		2030	
	Electricity	**Fuel**	**Electricity**	**Fuel**
Total savings TWh/year	14.25	1.55	22.87	2.99
Ton CO2eq (2022 average emissions; 28K T/TWh)	399,000		640,360	
Kg CO2eq per person (2021 population)	38		61	

6.1 Sweden: Scale-down results

Scaling factors

Below is a list of available scales. Not all scales are used but can be used to indicate the country population/GDP size etc. The description column explains the data in the scale, source, and year. The scale represents the country's percentage of the total EU consumption.

Table 13: Swedish scaling factors

Name	Description	Scale	Times used
None	None	100,00 %	0
Electricity	Final energy consumption by product Eurostat [ten00123] 2022, Electrical energy; TOE	5.12 %	1
Population	Population, 2021	2.34 %	0
GDP	GDP, 2022; Current prices, million euro	3.54 %	0
Houses	Stock of dwellings (permanently occupied), EUROSTAT; 2020	2.54 %	0
Car consumption	Car consumption 2021; toe	2.65 %	1
Industry	Final energy consumption in industry by type of fuel (elec) [ten00129]; ESTAT 2021	5.05 %	0
Service	Electricity consumption of services; Odyssee 2020; Mtoe	5.17 %	9
Residential electricity	Final energy consumption in households by type of fuel (elec) [ten00125]; ESTAT 2021	6.24 %	0
Circulators	SE stock * HDD / EU stock	5.10 %	1
Residential appliances electricity	Electricity consumption for dwellings for electrical appliances and lighting; Odyssee 2021	4.15 %	4
Water heaters	Energy in sweden, 3.4 elvärme in småhus 25% of total / EU consumption BAU scanario	2.97 %	0
Solid fuel boilers	Energy in numbers in sweden, 3.4, småhus, Fuel share 0.6 (Expert assumption); Eco scenario 2020, reduced 30% (NEW)	2.40 %	0
Central Air Heating	3.6*0.5; Eco scenario 2020 only Electricity (new)	3.83 %	1
Central Air Cooling	Energy in numbers in sweden, 3.3, lokaler, Cooling share of driftsel 0.1 (Expert assumption); Eco sceario 2020 (new)	1.99 %	0
Solid fuel boilers	Energy in numbers in sweden, 3.4, småhus, Multi, loc Fuel share 0.6 but reduced 30% (Expert assumption); BAU 2020 (NEW)	2.41 %	0
Local Heaters weighted	Energy in numbers in sweden, 3.4, småhus 20, Fuel share 0.4,(Expert assumption); BAU scenario 2020 (new)	1.78 %	0

Air-Air HP heat	Energy in numbers in sweden, 3.4, småhus, Air-air HP share of elvärme 0.15 (heat 0.9 of that) (Expert assumption); Eco scenario 2020	8.26 %	0
Air-Air HP cooling	Energy in numbers in sweden, 3.4, småhus, Air-air HP share of elvärme 0.15, cooling (0.1 of that) (Expert assumption); Eco scenario 2020	1.91 %	1
Residential+service	Residential + service sector merged	4.00 %	0
Washing machine	Washing machine bottom up / EU	1.89 %	0
Dishwasher stock	Dishwasher stock SE/EU *365 cycles/280	3.65 %	0
Dryers stock	Stock 2020 SE /EU	3.90 %	0
Central Heating - Water	Energy in Sweden 2019 – 10% of El in Houses, Multi, Locals – BAU 2020.	52.50 %	0
Central Heating - Heating	Energy in Sweden 2019 – 35% of El in Houses, Multi, Locals – BAU 2020. Scale x5 since Savings EU 2030 are understimated by factor 5	30.37 %	0
Servers & Data storage	JRC – Swedish Energy Agency (2023)	6.25 %	1
Motors & more	70% av El i industry Energiläget 20 vs EU BAU20 (new)	4.46 %	4
Bottom up		4.46 %	11

Top-down results

The scale-down results are in TWh/year. Most products only have electricity savings, but some heating-related products have both electricity and fuel savings. Savings for tyres are only calculated for fuel and not for electric vehicles.[14]

14. The Impact Accounting report only calculate savings for fuel.

Table 14: Swedish top-down results

	2020			2030			Scale	
Group	**Elec-tricity**	**Fuel**	**Final energy**	**Elec-tricity**	**Fuel**	**Final energy**	**Scale factor**	**Scale name**
Dedicated water heater	0.18	0.00	0.18	0.38	0.00	0.38	100.00%	Bottom up
Central heating combi, water heating	0.14	0.00	0.14	0.42	0.00	0.42	100.00%	Bottom up
Central heating boiler, space heating	0.03	0.01	0.04	0.12	0.02	0.14	100.00%	Bottom up
Solid fuel boilers	0.00	0.12	0.12	0.00	0.44	0.44	100.00%	Bottom up
Central air cooling	0.00	0.00	0.00	0.00	0.00	0.00	100.00%	Bottom up
Central air heating	0.08	0.23	0.31	0.23	0.00	0.23	3.83%	Central Air Heating
Local heaters	0.05	0.00	0.05	0.14	0.00	0.14	100.00%	Bottom up
Room air conditioner (of which cooling)	0.13	0.00	0.13	0.11	0.00	0.11	1.91%	Air-Air HP cooling
Room air conditioner (of which heating)	0.15	0.00	0.15	0.12	0.00	0.12	100.00%	Bottom up
Circulator pumps <2.5 kW	0.66	0.00	0.66	0.71	0.00	0.71	5.10%	Circulators
Ventilation units (res. and nonres.)	0.13	0.34	0.47	0.44	0.91	1.35	2.60%	Residential
Light sources	3.36	0.00	3.36	3.98	0.00	3.98	4.15%	Residential appliances electricity
Electronic displays	0.83	0.00	0.83	2.12	0.04	2.16	4.15%	Residential appliances electricity
Set top boxes	0.26	0.00	0.26	0.21	0.00	0.21	5.17%	Service
Video	0.21	0.00	0.21	0.21	0.00	0.21	5.17%	Service
Enterprise servers and data storage	0.12	0.00	0.12	0.19	0.00	0.19	6.25%	Servers & Data storage
Personal computers	0.00	0.00	0.00	0.00	0.00	0.00	5.17%	Service
Imaging equipment	0.36	0.00	0.36	0.36	0.00	0.36	5.17%	Service
SB (networked) stand-by (rest)	0.98	0.00	0.98	0.83	0.00	0.83	5.17%	Service

External power supplies	0.26	0.00	0.26	0.28	0.00	0.28	5.17%	Service
UPS total	0.00	0.00	0.00	0.00	0.00	0.00	5.17%	Service
Household refrigeration	1.62	0.00	1.62	2.26	0.00	2.26	100.00%	Bottom up
Commercial refrigeration	0.00	0.00	0.00	0.83	0.00	0.83	5.17%	Service
Professional refrigeration products	0.16	0.00	0.16	0.52	0.00	0.52	5.17%	Service
Cooking appliances	0.17	0.00	0.17	0.46	0.04	0.50	4.15%	Residential appliances electricity
Household coffee-makers	0.08	0.00	0.08	0.08	0.00	0.08	4.15%	Residential appliances electricity
Household washing machines	0.46	0.00	0.46	0.87	0.00	0.87	100.00%	Bottom up
Household dishwashers	0.60	0.00	0.60	0.94	0.00	0.94	100.00%	Bottom up
Household laundry dryers	0.60	0.00	0.60	0.59	0.00	0.59	100.00%	Bottom up
Vacuum cleaners	0.31	0.00	0.31	0.39	0.00	0.39	2.60%	Residential
Industrial fans >125W	0.63	0.00	0.63	1.38	0.00	1.38	4.46%	Motors & more
Electric motors LV 0.12–1000 kW	1.25	0.00	1.25	2.63	0.00	2.63	4.46%	Motors & more
Water pumps	0.15	0.00	0.15	0.17	0.00	0.17	4.46%	Motors & more
Standard air compressors	0.00	0.00	0.00	0.04	0.00	0.04	4.46%	Motors & more
TRAFO utility transformers	0.29	0.00	0.29	0.86	0.00	0.86	5.12%	Electricity
Tyres, total Cl+C2+C3	0.00	0.85	0.85	0.00	1.54	1.54	2.65%	Car consumption

6.2 Sweden: Bottom-up results

Below are the bottom-up results for 2030. The table also shows the main assumption for sizes in litres, kilograms, place settings, and lifetime in years. All results are for households (not commercial or service).

Table 15: Swedish bottom-up results

	Size	Lifetime	Baseline GWh/year	Scenario GWh/year	Saving GWh/year
Refrigerator	345	12	575.5	229	346.5
Refrigerator/ freezer	240/90	12	1,713.9	601.9	1,112
Freezer (chest)	260	15	188.9	71.5	117.4
Freezer (upright)	260	12	1,005.9	325.1	680.8
Washing machine	7	12	1,308.1	442.1	866
Dishwasher	12	9	1,747.2	805	942.2
Dryer	6	10	895.1	303.9	591.2

7. NORWAY

Table 16: Norwegian results CO2

	2020		2030	
	Electricity	**Fuel**	**Electricity**	**Fuel**
Total savings TWh/year	10.09	0.43	16.42	0.97
Ton CO2eq (2022 average emissions; 15K T/TWh)	151,350		246,300	
Kg CO2eq per person (2021 population)	28		45	

7.1 Norway: Scale-down results

Scaling factors

Below is a list of available scales. Not all scales are used but can be used to indicate the country population/GDP size etc. The description column explains the data in the scale, the source, and the year. The scale represents the country's percentage of the total EU consumption.

Table 17: Norwegian scaling factors

Name	Description	Scale	Times used
Electricity	Final energy consumption by product Eurostat [ten00123] 2022, Electrical energy; TOE	4.82%	4
Population	Population, 2021	1.21%	0
GDP	GDP, 2022; Current prices, million euro	3.55%	2
Houses	Stock of dwellings (permanently occupied), EUROSTAT; 2020	1.29%	0
Car consumption	Car consumption 2021; TOE	1.21%	1
Industry	Final energy consumption in industry by type of fuel (elec) [ten00129]; ESTAT 2021	5.37%	1
Service	Electricity consumption of services; Odyssee 2020; Mtoe	1.72%	0
Circulators	Country proportion of EU stock (guesses) X degree days above EU avg 2021	2.16%	1
Space heating	Final consumption of residential for space heating; Odyssee 2015; Mtoe; NVE 2018	1.63%	0
Residential electricity	Final energy consumption in households by type of fuel (elec) [ten00125]; ESTAT 2021	5.39%	0
Residential appliances electricity	Electricity consumption for dwellings for electrical appliances and lighting; Odyssee 2021; NVE 2018	2.12%	10
Air-to-Air-Heatpump	Electric consumption of Air-Air HP in Norway 2018; NVE calculation divided by Ecodesign scenario 2018, TWh/ year	17,.79%	0
Data centers	JRC, NVE, 2020	1.67%	1
Dedicated water heaters	This survey stock /EU stock	1.57%	1
Dishwashers	Household Dishwashers 2020 Stock Norway calc / Report (new)	2.40%	0
Washing Machines	Household Washing Machines 2020 stock calc /EU stock (new)	1.34%	0
Household Refrigerators & Freezers	Household Refrigerators & Freezers Stock 2020 / EU Stock (new)	1.88%	0
Household Laundry Driers	Household Laundry Driers stock 2020 /EU stock (new)	2.28%	0
Central water	Survey stock / EU stock	0.36%	1
Central space heating	Survey stock * HDD * area / EU	0.59%	1
Room ac heating	Survey stock * HDD * area / EU	10.50%	1
Ventilation residential	Survey stock / EU stock	3.87%	2
Bottom up	Bottom up	100%	4

Top-down results

The scale-down results are in TWh/year. Most products only have electricity savings, but several heating-related products have both electricity and fuel savings. Savings for tyres are only calculated for fuel and not for electric vehicles.[15]

Table 18: Norwegian top-down results

	2020			2030			Scale	
Group	**Elec-tricity**	**Fuel**	**Final energy**	**Elec-tricity**	**Fuel**	**Final energy**	**Scale factor**	**Scale name**
Dedicated Water Heater	0.09	0	0.09	0.22	0	0.22	1.57%	Dedicated water heaters
Central Heating combi, water heating	0	0	0	-0.01	0	-0.01	0.36%	Central water
Central Heating boiler, space heating	0.03	0	0.03	-0.01	0	-0.01	0.59%	Central space heating
Solid Fuel Boilers	0	0	0	0	0	0	0.00%	
Central Air Cooling	0	0	0	0	0	0	0.00%	
Central Air Heating	0.08	0	0.08	0.23	0	0.23	3.87%	Ventilation residential
Local Heaters	0.1	0.04	0.14	0.18	0.25	0.43	1.41%	Residential
Room Air Conditioner (of which cooling)	0	0	0	0	0	0	0.00%	
Room Air Conditioner (of which heating)	1.15	0	1.15	1.36	0	1.36	10.50%	Room ac heating
Circulator pumps <2.5 kW	0.28	0	0.28	0.3	0	0.3	2.16%	Circulators
Ventilation Units (res & nonres)	0.19	0	0.19	0.66	0	0.66	3.87%	Ventilation residential
Light Sources	1.72	0	1.72	2.03	0	2.03	2.12%	Residential appliances electricity
Electronic Displays	0.42	0	0.42	1.08	0.02	1.1	2.12%	Residential appliances electricity
Set Top Boxes	0.07	0	0.07	0.06	0	0.06	1.41%	Residential

15. The Impact Accounting report only calculate savings for fuel.

VIDEO	0.08	0	0.08	0.09	0	0.09	2.12%	Residential appliances electricity
Enterprise Servers and Data Storage	0.03	0	0.03	0.05	0	0.05	1.67%	Data centers
Personal Computers	0	0	0	0	0	0	2.12%	Residential appliances electricity
Imaging equipment	0.15	0	0.15	0.15	0	0.15	2.12%	Residential appliances electricity
SB (networked) Stand-By (rest)	0.4	0	0.4	0.34	0	0.34	2.12%	Residential appliances electricity
External Power Supplies	0.11	0	0.11	0.11	0	0.11	2.12%	Residential appliances electricity
UPS Total	0	0	0	0	0	0	0.00%	
Household Refrigeration	1.15	0	1.15	1.18	0	1.18	100.00%	Bottom up
Commercial Refrigeration	0	0	0	0.57	0	0.57	3.55%	GDP
Professional refrigeration products	0.11	0	0.11	0.36	0	0.36	3.55%	GDP
Cooking Appliances	0.08	0	0.08	0.23	0	0.23	2.12%	Residential appliances electricity
Household Coffee Makers	0.04	0	0.04	0.04	0	0.04	2.12%	Residential appliances electricity
Household Washing Machine	0.3	0	0.3	0.47	0	0.47	100.00%	Bottom up
Household Dishwashers	0.47	0	0.47	0.64	0	0.64	100.00%	Bottom up
Household Laundry Drier	0.34	0	0.34	0.4	0	0.4	100.00%	Bottom up
Vacuum Cleaners	0.25	0	0.25	0.32	0	0.32	2.12%	Residential appliances electricity
Industrial Fans >125W	0,67	0	0.67	1.49	0	1.49	4.82%	Electricity
Electric Motors LV 0.12-1000 kW	1.35	0	1.35	2.84	0	2.84	4.82%	Electricity
Water pumps	0.16	0	0.16	0.18	0	0.18	4.82%	Electricity
Standard Air Compressors	0	0	0	0.05	0	0.05	5.37%	Industry

TRAFO Utility Transformers	0.27	0	0.27	0.81	0	0.81	4.82%	Electricity
Tyres, total CI+C2+C3	0	0.39	0.39	0	0.7	0.7	1.21%	Car consumption

7.2 Norwegian: Bottom-up results

Below are the bottom-up results for 2030. The table also shows the main assumptions for sizes in litres, kilograms, place settings, and lifetime in years. All results are for households (not commercial or service uses).

Table 19: Norwegian bottom-up results

	Size	Lifetime	Baseline GWh/year	Scenario GWh/year	Saving GWh/year
Refrigerator	285	16	213.7	77.7	136
Refrigerator/-freezer	220/90	12	819.1	288.3	530.8
Freezer (chest)	265	18	434.5	132.1	302.4
Freezer (upright)	210	15	377.7	210.4	167.3
Washing machine	6	10	714.5	244	470.5
Dishwasher	12	12	1,239.2	594.5	644.7
Dryer	6	12	608.8	205.1	403.7

8. FINLAND

Table 20: Finnish results CO2

	2020		2030	
	Electricity	Fuel	Electricity	Fuel
Total savings TWh/year	9.29	3.54	15.9	8.14
Ton CO2eq (2022 average emissions; 146K T/TWh)	1,356,340		2,321,400	
Kg CO2eq per person (2021 population)	244		418	

8.1 Finland: Scale-down results

Scaling factors

Below is a list of available scales. Not all scales are used but can be used to indicate the country population/GDP size etc. The description column explains the data in terms of scale, source, and year. The scale represents the country's percentage of the total EU consumption.

Table 21: Finnish scaling factors

Name	Description	Scale	Times used
Electricity	Energy Available for Final Consumption 2020, Electrical energy; TOE (new)	3.30 %	2
Population	Population, 2021	1.24 %	0
GDP	GDP, 2022; Current prices, million euro	1.69 %	0
Houses	Stock of dwellings (permanently occupied), EUROSTAT; 2020	1.54 %	0
Car consumption	Car consumption 2013/2021; toe (NEW)	1.38 %	1
Industry	Final energy consumption in industry by type of fuel (elec) [ten00129]; ESTAT 2021	4.10 %	3
Service	Electricity consumption of services; Odyssee 2020; Mtoe (new)	3.45 %	4
Residential electricity	Final energy consumption in households by type of fuel (elec) [ten00125]; ESTAT 2021	3.28 %	0
Circulators	Country proportion of EU stock (water based heating x dwelligs) X degree days above EU avg (new)	2.16 %	1
Residential appliances electricity	Electricity consumption for dwellings for electrical appliances and lighting; Odyssee 2021 (new)	2.00 %	12
Central Heating combi, water heating	FI Stock * HDD / EU stock	0.58 %	1
CHB Central Heating boiler 2020	CHB Central Heating boiler 2020: FI stock * HDD factor / EU stock	1.28 %	1
Dedicated Water Heaters (2020)	FI stock * HDD factor / EU stock	0.73 %	1
Solid Fuel Boilers 2020	FI stock * HDD factor / EU stock	2.65 %	1
Local Space Heaters 2020	FI stock * HDD factor / EU stock	2.13 %	1
Air to Air HP	FI stock * HDD factor / EU stock (for heating)	6.87 %	1
Datacenters	0.25 TWh in 2018 Hiekkanen et al.	0.52 %	0
Residential ventilation	FI stock / EU stock 2020	6.90 %	1

Top-down results

The scale-down results are in TWh/year. Most products only have electricity savings, but several heating-related products have both electricity and fuel savings. Savings for tyres are only calculated for fuel and not for electric vehicles.[16]

Table 22: Finnish top-down results

	2020			2030			Scale	
Group	**Elec-tricity**	**Fuel**	**Final energy**	**Elec-tricity**	**Fuel**	**Final energy**	**Scale factor**	**Scale name**
Dedicated water heater	0.04	0	0.04	0.1	0	0.1	0.73%	Dedicated Water Heaters (2020)
Central heating combi, water heating	0	0.09	0.09	-0.01	0.23	0.22	0.58%	Central Heating combi, water heating
Central heating boiler, space heating	0.06	1.73	1.79	-0.03	3.43	3.4	1.28%	CHB Central Heating boiler 2020
Solid fuel boilers	0	0.11	0.11	0	0.29	0.29	2.65%	Solid Fuel Boilers 2020
Central air cooling	0.1	0	0.1	0.41	0	0.41	3.45%	Service
Central air heating	0.07	0.21	0.28	0.21	0.55	0.76	3.45%	Service
Local heaters	0.15	0.06	0.21	0.28	0.38	0.66	2.13%	Local Space Heaters 2020
Room air conditioner (of which cooling)	0	0	0	0	0	0		
Room air conditioner (of which heating)	0.76	0	0.76	0.89	0	0.89	6.87%	Air to Air HP
Circulator pumps <2.5 kW	0.28	0	0.28	0.3	0	0.3	2.16%	Circulators
Ventilation units (res. and nonres.)	0.35	0.9	1.25	1.17	2.42	3.59	6.90%	Res ventilation
Light sources	1.62	0	1.62	1.92	0	1.92	2.00%	Residential appliances electricity

16. The Impact Accounting report only calculate savings for fuel.

Electronic displays	0.4	0	0.4	1.02	0.02	1.04	2.00%	Residential appliances electricity
Set top boxes	0.1	0	0.1	0.08	0	0.08	2.00%	Residential appliances electricity
Video	0.08	0	0.08	0.08	0	0.08	2.00%	Residential appliances electricity
Enterprise servers and data storage	0.07	0	0.07	0.1	0	0.1	3.30%	Electricity
Personal computers	0	0	0	0	0	0	2.00%	Residential appliances electricity
Imaging equipment	0.14	0	0.14	0.14	0	0.14	2.00%	Residential appliances electricity
SB (networked) stand-by (rest)	0.38	0	0.38	0.32	0	0.32	2.00%	Residential appliances electricity
External power supplies	0.1	0	0.1	0.11	0	0.11	2.00%	Residential appliances electricity
UPS total	0	0	0	0	0	0		
Household refrigeration	0.99	0	0.99	1.23	0	1.23	100.00%	Bottom up
Commercial refrigeration	0	0	0	0.55	0	0.55	3.45%	Service
Professional refrigeration products	0.1	0	0.1	0.34	0	0.34	3.45%	Service
Cooking appliances	0.08	0	0.08	0.22	0.02	0.24	2.00%	Residential appliances electricity
Household coffee-makers	0.04	0	0.04	0.04	0	0.04	2.00%	Residential appliances electricity
Household washing machines	0.4	0	0.4	0.64	0	0.64	100.00%	Bottom up
Household dishwashers	0.32	0	0.32	0.54	0	0.54	100.00%	Bottom up
Household laundry dryers	0.44	0	0.44	0.6	0	0.6	100.00%	Bottom up
Vacuum Cceaners	0.24	0	0.24	0.3	0	0.3	2.00%	Residential appliances electricity

Industrial fans >125W	0.57	0	0.57	1.27	0	1.27	4.10%	Industry
Electric motors LV 0.12–1000 kW	1.15	0	1.15	2.42	0	2.42	4.10%	Industry
Water pumps	0.07	0	0.07	0.07	0	0.07	2.00%	Residential appliances electricity
Standard air compressors	0	0	0	0.04	0	0.04	4.10%	Industry
TRAFO utility transformers	0.19	0	0.19	0.55	0	0.55	3.30%	Electricity
Tyres, total CI+C2+C3	0	0.44	0.44	0	0.8	0.8	1.38%	Car consumption

8.2 Finnish: Bottom-up results

Below are the bottom-up results for 2030. The table also shows the main assumptions for sizes in litres, kilograms, place settings, and lifetime in years. All results are for households (not commercial or service).

Table 23: Finnish bottom-up results

	Size	Lifetime	Baseline GWh/year	Scenario GWh/year	Savings GWh/year
Refrigerator	345	12	296.2	122.2	174
Refrigerator/-freezer	240/90	12	1,105.5	409.2	696.3
Freezer (chest)	260	15	110.8	33.2	77,6
Freezer (upright)	260	12	450.9	167.4	283.5
Washing machine	7	12	1,005.9	361	644.9
Dishwasher	11	9	980.1	441.9	538,2
Dryer	7	10	902.1	305.6	596,5

9. ICELAND

Table 24: Icelandic results CO2

	2020		2030	
	Electricity	**Fuel**	**Electricity**	**Fuel**
Total savings TWh/year	0.495	0.05	0.866	0.1
Ton CO2eq (2022 average emissions; 3,3K T/TWh)	1633.5		2,857.8	
Kg CO2eq per person (2021 population)	4.3		7.6	

9.1 Iceland: Scale-down results

Scaling factors

Below is a list of available scales. Not all scales are used but can be used to indicate the country's population/GDP size etc. The description column explains the data in terms of scale, source, and year. The scale represents the country's percentage of the total EU consumption.

Table 25: Icelandic scaling factors

Name	Description	Scale	Times used
Electricity	Final energy consumption by product Eurostat [ten00123] 2022, electrical energy; TOE	0.74%	1
None	None	100.00%	5
Population	Population, 2021	0.08%	2
GDP	GDP, 2022; current prices, million euro	0.17%	6
Industry	Final energy consumption in the industry by type of fuel (elec.) [ten00129]; ESTAT 2021	1.62%	0
Service	Electricity consumption of services; Odyssee 2016; Mtoe	0.54%	0
Residential electricity	Final energy consumption in households by type of fuel (elec.) [ten00125]; ESTAT 2021	0.12%	13
Ref. stock	Ref. stock ICE / EU stock	0.07%	1
Washing stock	ICE washing stock / EU Stock	0.08%	1
Dishwasher stock	ICE dishwasher stock / EU stock	0.11%	1
Dryer stock	ICE dryer stock / EU stock	0.16%	1
Dedicated water heater	Stock ICE /stock EU	0.01%	1
Local space heaters ICE	ICE stock (10%) * HDD factor * area factor / EU stock	0.02%	1
Circulators ICE	Stock * HDD /EU stock	0.10%	1
Ventilation	Stock (same ownership as NO) / EU stock	0.20%	1
Data centres	ICE data centre consumption / EU consumption	1.77%	1
Houses	Stock of dwellings (permanently occupied), EUROSTAT; 2020	0.07%	0

Top-down results

The scale-down results are in GWh/year (other countries are reported in TWh/year, but Iceland is too small to use TWh/year). Most products only have electricity savings, but several heating-related products have both electricity and fuel savings. Savings for tyres are only calculated for fuel and not for electric vehicles.[17]

17. The Impact Accounting report only calculate savings for fuel.

Table 26: Icelandic top-down results

	2020			2030			Scale	
Group	**Elect-ricity**	**Fuel**	**Final energy**	**Elec-tricity**	**Fuel**	**Final energy**	**Scale factor**	**Scale name**
Dedicated water heater	0	0	0	0	0	0	0.73 %	Dedicated Water heaters
Central heating combi, water heating	0	0	0	0	0	0	100.00%	None
Central heating boiler, space heating	0	0	0	0	0	0	1	None
Solid fuel boilers	0	0	0	0	0	0	1	None
Central air cooling	3	0	3	10	0	10	0.08%	Population
Central air heating	0	0	0	0	0	0	1	None
Local heaters	2	0	2	3	0	3	0.02%	Local space heaters ICE
Room air conditioner (of which cooling)	0	0	0	0	0	0	1	None
Room air conditioner (of which heating)	0	0	0	0	0	0	0.12%	Residential electricity
Circulator pumps <2.5 kW	14	0	14	15	0	15	0.10%	Circulators ICE
Ventilation units (res. and nonres.)	10	0	10	34	0	34	0.20%	Ventilation
Light sources	97	0	97	115	0	115	0.12%	Residential electricity
Electronic displays	24	0	24	61	1	62	0.12%	Residential electricity
Set top boxes	6	0	6	5	0	5	0.12%	Residential electricity
Video	5	0	5	5	0	5	0.12%	Residential electricity
Enterprise servers and data storage	36	0	36	53	0	53	1.78%	Datacenters
Personal computers	0	0	0	0	0	0	0.12%	Residential electricity
Imaging equipment	8	0	8	8	0	8	0.12%	Residential electricity

SB (networked) stand-by (rest)	23	0	23	19	0	19	0.12%	Residential electricity
External power supplies	6	0	6	6	0	6	0.12%	Residential electricity
UPS total	3	0	3	11	0	11	0.08%	Population
Household Refrigeration	50	0	50	59	0	59	100.00%	None
Commercial refrigeration	0	0	0	27	0	27	0.17%	GDP
Professional refrigeration products	5	0	5	17	0	17	0.17%	GDP
Cooking appliances	5	0	5	13	0	13	0.12%	Residential electricity
Household coffee-makers	2	0	2	2	0	2	0.12%	Residential electricity
Household washing machines	20	0	20	26	0	26	100.00%	None
Household dishwashers	24	0	24	42	0	42	100.00%	None
Household laundry dryers	22	0	22	36	0	36	100.00%	None
Vacuum cleaners	14	0	14	18	0	18	0.12%	Residential electricity
Industrial fans >125W	23	0	23	52	0	52	0.17%	GDP
Electric motors LV 0.12–1000 kW	47	0	47	99	0	99	0.17%	GDP
Water pumps	4	0	4	4	0	4	0.12%	Residential electricity
Standard air compressors	0	0	0	2	0	2	0.17%	GDP
TRAFO utility transformers	42	0	42	124	0	124	0.74%	Electricity
Tyres, total CI+C2+C3	0	54	54	0	97	97	0.17%	GDP

9.2 Icelandic: Bottom-up results

Below are the bottom-up results for 2030. The table also shows the main assumptions for sizes in litres, kilograms, place settings, and lifetime in years. All results are for households (not commercial or service).

Table 27: Icelandic bottom-up results

	Size	Lifetime	Baseline GWh/year	Scenario GWh/year	Savings GWh/year
Refrigerator	260	12	13.3	5.1	8.2
Refrigerator/-freezer	240/90	12	53.2	19.8	33.4
Freezer (chest)	260	15	5.2	1.5	3.7
Freezer (upright)	260	12	21.1	7.9	13.2
Washing machine	7	12	47.5	21	26.5
Dishwasher	12	12	77.8	35.3	42.5
Dryer	6	15	56.1	20.2	35.9

10. SUMMARY OF RESULTS AND SENSITIVITY

10.1 Total savings: Top-down model

The table below shows the results from the top-down model in total savings per year. These calculations are based on the EU numbers from the EIA report.[18] For each product group in each country, a specific scale was assigned in an iterative process with representatives from Nordsyn authorities in each country. The total savings from the top-down model are in TWh/year.

Table 28: Total savings from the top-down model

	2020				2030			
	Primary energy	Only electricity	Only fuel	Final energy	Primary energy	Only electricity	Only fuel	Final energy
Denmark	16.61	6.61	2.73	9.34	27.52	10.16	6.18	16.34
Sweden	31.44	14.24	1.54	15.78	51.01	22.87	2.98	25.85
Norway	21.68	10.12	0.43	10.55	35.50	16.44	0.98	17.42
Finland	23.05	9.29	3.54	12.83	41.58	15.92	8.15	24.07
Iceland	1.08	0.49	0.05	0.54	1.93	0.87	0.10	0.97

10.2 Total savings: Bottom-up

The table below shows the total savings from the bottom-up model in GWh/year in 2030 for the products for which this calculation was performed. Note that bottom-up calculations were not possible for all products due to the lack of data, and this table thus does not show total savings in each country from the market surveillance of ecodesign and energy labelling.

18. European Commission, Directorate-General for Energy, *Ecodesign impact accounting annual report 2021 – Overview and status report*, Publications Office of the European Union, 2022, **https://data.europa.eu/doi/10.2833/38763**

Table 29: Total bottom-up savings 2030, GWh/year

2030	All refrigerators and freezers	Washing machines	Dishwashers	Dryers
Denmark	1,369.4	513.8	587	762
Sweden	2,256.7	866	942.2	591.2
Norway	1,411.2	161.3	240	137
Finland	1,231.4	644.9	538.2	596.5
Iceland	58.5	26.5	42.5	35.9

10.3 Sensitivity of the bottom-up model

Robustness of the bottom-up model. To examine the model's robustness, a sensitivity test was performed for refrigerators/freezers in Sweden. The results show that increasing the lifetime of products leads to higher savings due to a higher stock.

The table below shows the consequences of changing the assumptions. This is an example for refrigerators/freezers in Sweden. The first line shows the standard assumption. In this example, the sales numbers do not change. The first example is a decrease in the lifetime from 12 to 10 years, which causes the stock to decrease, and the savings thus decrease by 15%. In the second example, the lifetime is increased from 12 to 14 years. This causes the stuck to increase, and the savings then also increase by 14%. In the third example, the size of the refrigerator/freezer is increased by 10%, which increases the savings by 6%. In the last example, the volume is decreased by 10%, which causes the savings to fall by 5%.

Table 30: Sensibility of assumptions in the bottom-up model

Lifetime	Combined size in litres	Savings 2030 GWh/year	Stock 2030 old label	Stock 2030 new label	Total stock	% Change
12	**330**	**977.3**	**2,945,445**	**2,136,491**	**5,081,936**	0%
10	330	830	*2,502,930*	*2,084,611*	*4,587,541*	-15%
14	330	1,111.5	*3,352,567*	*2,143,140*	*5,495,707*	14%
12	**363**	1,036.4	2,945,445	2,136,491	5,081,936	6%
12	**297**	923.8	2,945,445	2,136,491	5,081,936	-5%

11. DISCUSSION

This project aimed to enhance the Nordcrawl tool by providing updated calculations of energy savings from ecodesign and energy-labelling policies in the Nordic countries. The study employs two complementary methodologies – a top-down approach and a bottom-up approach – implemented on the Nordcrawl online platform. This dual approach, combined with conservative assumptions throughout, aims to provide robust and reliable estimates of energy savings.

The top-down method, which scales down EU-level savings data from the latest EIA report, was significantly improved in this iteration. By utilising a range of country-specific scaling factors tailored to each product group, we enhanced the accuracy of these calculations. It is important to note that the EIA projections already account for various factors, including rebound effects, changes in user demand, and expected efficiency developments. Our approach of using conservative scaling factors further mitigates the risk of overestimation.

The bottom-up method, while more data-intensive, allows for a more nuanced consideration of country-specific factors. By incorporating local sales data and usage patterns, this approach provides a valuable cross-check to the top-down estimates. In cases where detailed data were available, the bottom-up method likely provides the most accurate estimates. The consistency between the two methods in cases where both could be applied lends credence to the overall results.

A key strength of this study is the incorporation of new data sources, particularly the survey conducted in Finland and Norway. This primary data collection of household energy use patterns, especially in heating, water heating, and ventilation, allowed for more precise estimations in these areas. The inclusion of data for the new, rescaled energy labels introduced in 2021 ensures that the calculations reflect the current regulatory environment.

While we sought accuracy and used conservative estimates, it is important to acknowledge areas of uncertainty and opportunities for future refinement:

1. Data limitations: For some product groups and countries (particularly Iceland), data availability was limited. Future studies could benefit from more comprehensive data-collection efforts.
2. Long-term projections: Estimates extending to 2030 inherently involve uncertainties. Regular updates to the model with the latest market data and regulatory changes will be crucial to maintain its accuracy.
3. Country-specific factors: While we attempted to account for national differences, there may be additional country-specific factors (e.g., variations in product usage patterns or compliance levels) that could also be incorporated into the model.
4. Technological changes: Rapid advancements in technology could alter the energy efficiency landscape faster than anticipated. The model would benefit from regular reviews to ensure that it captures such changes.

5. Policy interactions: The interplay between ecodesign/energy-labelling policies and other energy-efficiency initiatives could be explored more deeply in future iterations.

The Nordcrawl tool's flexibility, which easily allows modifications to assumptions and input data, is a significant asset. It ensures that the tool can evolve as new information becomes available, making the current results a conservative baseline that can be refined over time.

In conclusion, this enhanced Nordcrawl tool provides a valuable, conservative estimate of energy savings achieved through ecodesign and energy-labelling policies in the Nordic countries. The use of both top-down and bottom-up calculation methods allows for a comprehensive understanding of these savings. The tool's design for easy updates ensures its continued relevance as new data become available and policies evolve. While there are always areas for potential improvement, the current model provides a robust foundation for policy-makers and researchers to assess the impact of these important energy-efficiency policies.

ABOUT THIS PUBLICATION

Energy Savings from Ecodesign and Energy Labelling in the Nordics

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http://dx.doi.org/10.6027/NER2024-03

Layout: Mette Agger Tang
Coverphoto: Dan_darius / Freepik
Proofreading: Scribbr

Published: August 2024

This publication was funded by the Nordic Council of Ministers. Nordic Energy Research, which operates the Secretariat of the Nordsyn, a working group under the Nordic Council of Ministers, coordinated this report. Maj Dang Trong at Nordic Energy Research was the coordinator of the project.

The study was supervised and guided by representatives from Nordsyn, including Kirsti Hind Fagerlund and Terje Sagen Adsen from The Norwegian Water Resources and Energy Directorate (NVE), Carlos Lopes from the Swedish Energy Agency, and Thore Stenfeldt from the Danish Energy Agency.

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