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Making value by increasing efficiency of electricity utilization in Iceland

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Energy Efficiency is Important

Conference of the Parties of the UNFCCC:

Nations of the world have agreed to

- *transition away from fossil fuels*
- *triple renewable power*
- ***double energy efficiency***

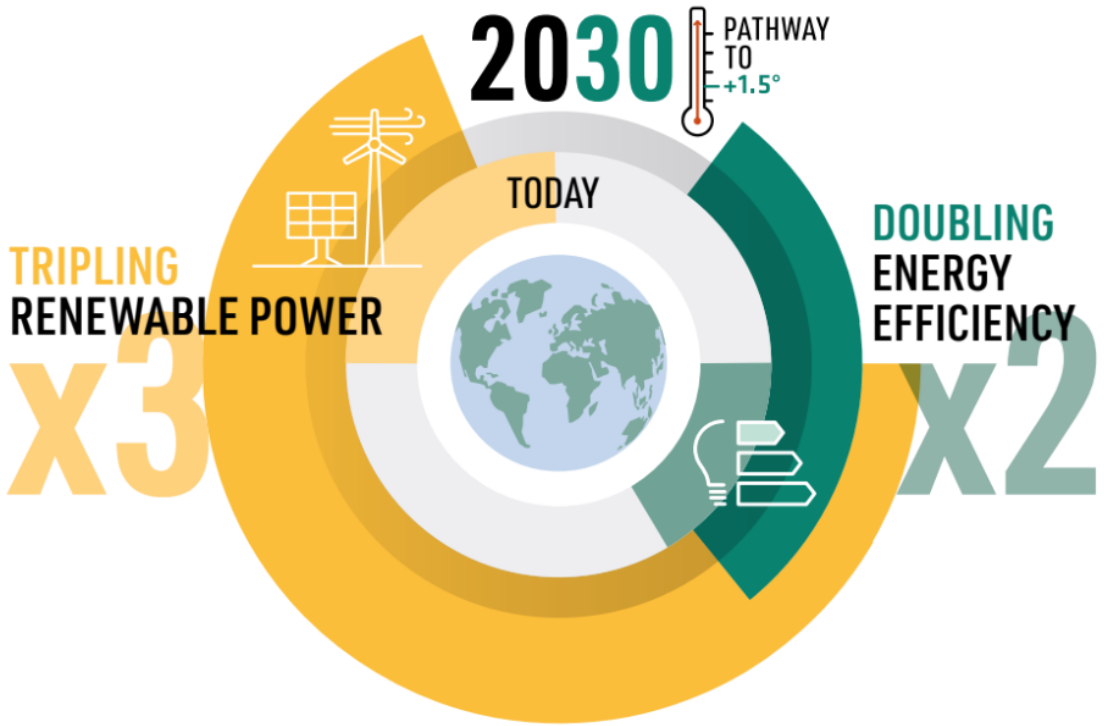
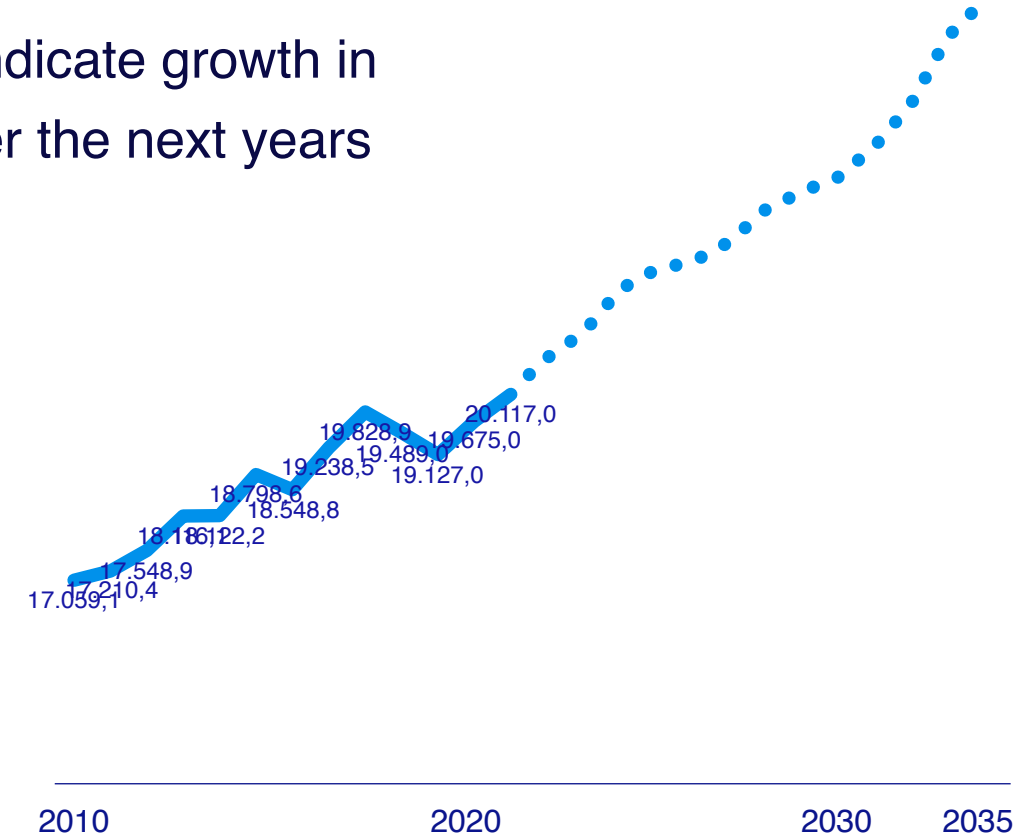


Image: IRENA

Transitioning from fossil fuels means increased need for renewable energy

Energy forecasts indicate growth in electricity need over the next years

Annual demand in TWh



Demand increases by **500 GWh** pr annum

* Landsnet (TSO) Forecast

Increased need for renewable energy

From Global Renewables and Energy Efficiency Pledge, COP 28:

Commit to put the principle of energy efficiency as the "first fuel" at the core of policy making, planning, and major investment decisions.

From the Government of Iceland's Energy Policy to the year 2050:

Improved energy efficiency and less waste will reduce the need for new power development projects.

Main research question:

How much potential is there for electricity savings in Iceland?

Project Objectives:

- Identify the **scope of opportunities** for improved energy efficiency and electricity savings in Iceland.
- Increase **awareness and understanding** of energy efficiency
- Promote **substantive discussion** on the country‘s energy needs

Collaboration between:

Government of Iceland
Ministry of the Environment, Energy and Climate

Landsvirkjun

ORKUSTOFNUN
National Energy Authority

An analysis conducted by the Danish consultancy Implement

Involving key stakeholders early leads to important decisions

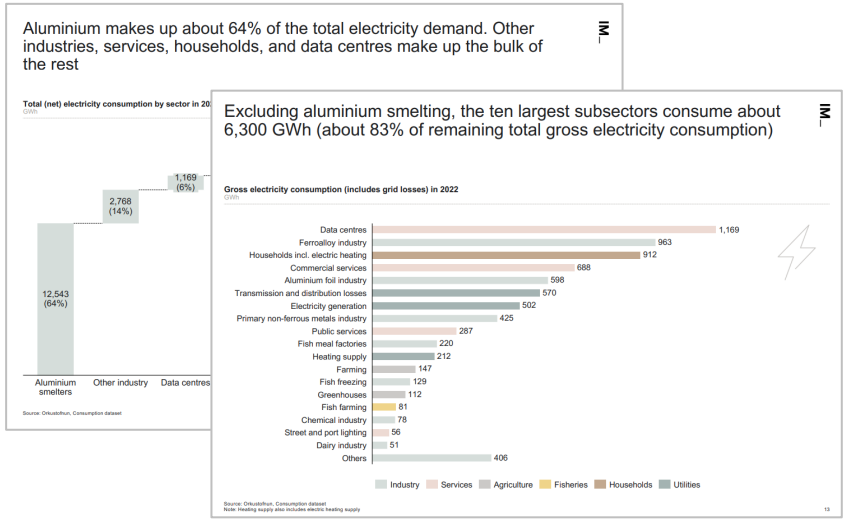
- One of them;
  to work with Implement Consulting Group

Over 28 different entities participated

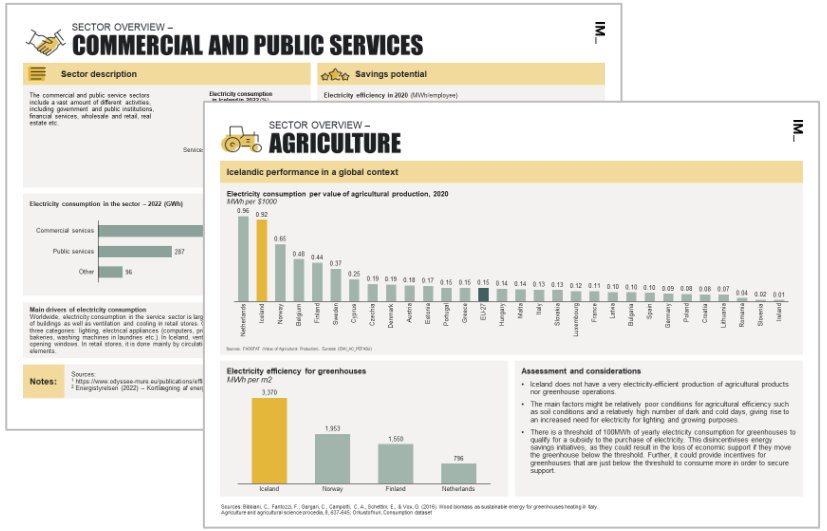
Entities contacted…		… and involved in data collection and validation…		… and sent preliminary results for the sector they are involved in.		
Ministries and governmental agencies	Fisheries Iceland (SFS)	Efla	the Icelandic Ministry of Finance and Economic Affairs	The Icelandic Housing and Construction Authority (HMS)	Landsnet	The Horticulturists' Sales Company (SFG)
Icelandic Association of Local Authorities	the Federation of Icelandic Industries (SI)	Rarik	The Government Property Agency (FSRE)	the Icelandic Federation of Trade & Services (SVÞ)	Data Centers Iceland (DCI)	The Icelandic Farmers Association
Nature conservation organizations	Corporate associations	The Icelandic Association of Fishmeal Manufacturers (FÍF)	University of Iceland	BRIM	PCC	Elkem
Individual companies	Consultancy firms	The Icelandic Federation of Energy and Utility Companies (Samorka)	The Association of Icelandic Aluminium Producers (Samál)	ÍSAL	Alcoa	Norðurál

… covering all sectors of the economy

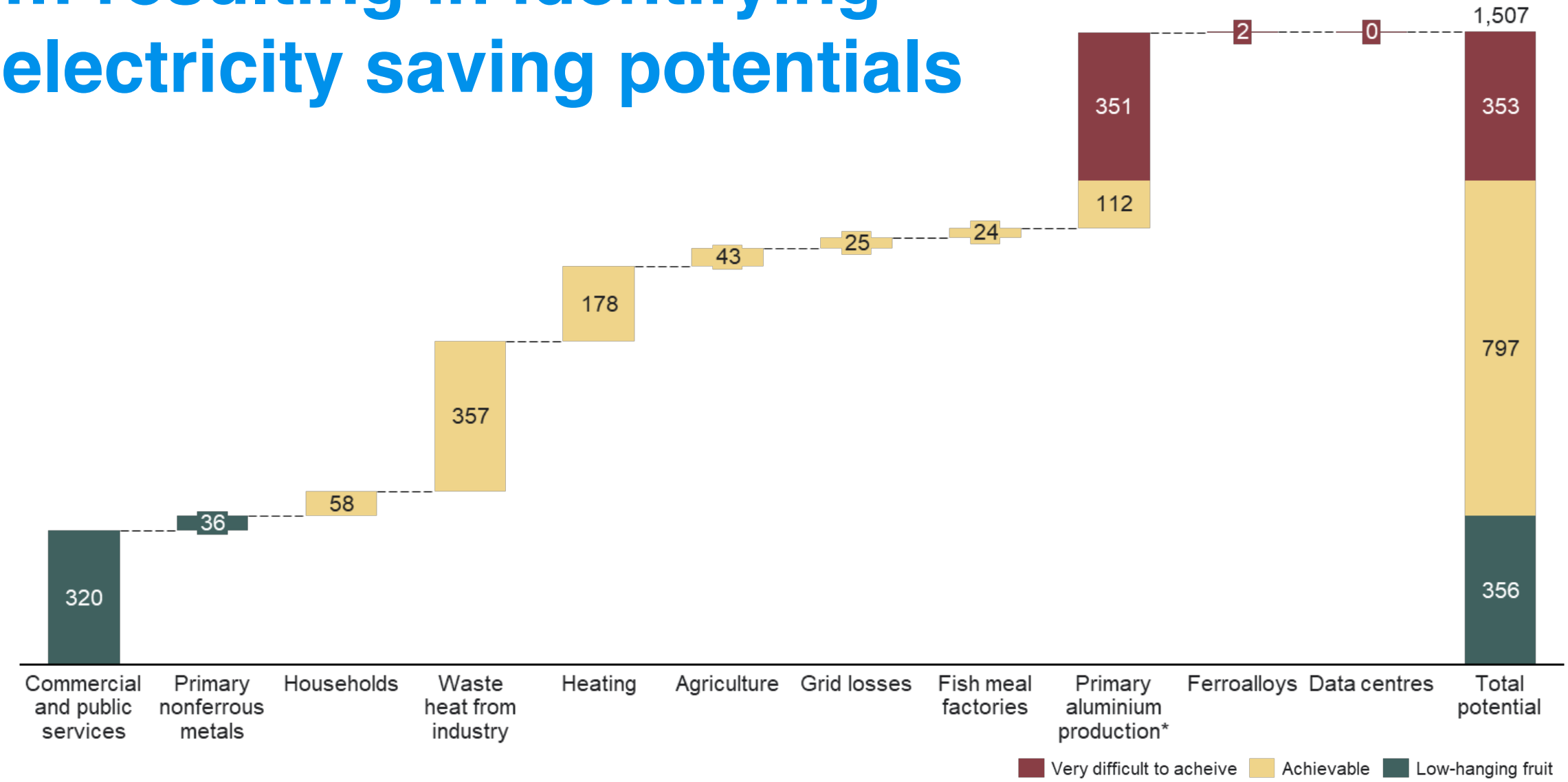
Define baseline electricity consumption



Analyse the structure of electricity consumption



… resulting in identifying electricity saving potentials



Sector Specific Deep Dives

For all sectors the report includes

- Sector overview
- Savings potential
- Confidence level
- Ease to achieve

Limitations are reflected on and the need for more granular end-use data is highlighted

SECTOR OVERVIEW –

HOUSEHOLDS (EXCL. HEATING)

Sector description

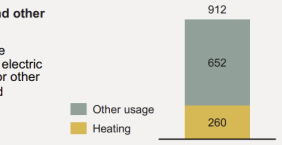
The population of Iceland was about 386,000 in 2022, living in 150,000 households. The number of households is expected to increase by 15,000 in 2027 and 37,000 in 2032.

Total electricity consumption in households increased by an average of 0.8% per year from 2012-2021, while population growth averaged 1.7% per year in the same period.

Distribution between heating and other purposes

Based on our own calculations, we assume that 260 GWh is used for electric heating, while 652 GWh is used for other uses such as cooking, lighting and appliances.

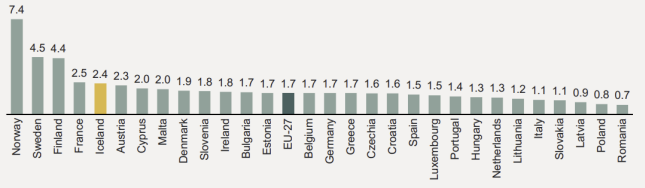
GWh, 2022



Household sector electricity consumption compared to Europe

Compared to Europe, Iceland's households are among the top user of electricity only surpassed by Norway, Sweden, Finland and France. These three countries have a larger share of direct electric heating. Electric heating is also an important driver of Iceland having a high use. We separate heating from non-heating below.

MWh per capita, 2021

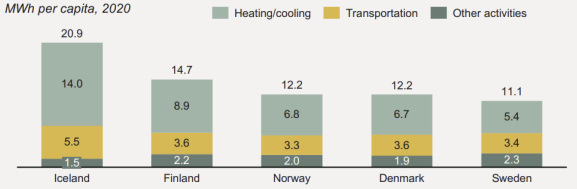


Source: Eurostat (NRG_CB_E and DEMO_PJAN)

Energy consumption of households in the Nordics

Looking at energy (not just electricity), Iceland has a much larger consumption per capita than the other Nordic countries (42-88% higher). This is mainly driven by a much larger heating consumption per capita than the other Nordic countries, which to a very large extent is non-electric energy (however, electricity is used directly as well as indirectly in the Icelandic hot water production, as elaborated below).

MWh per capita, 2020

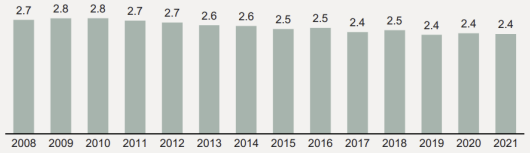


Source: Eurostat, ENV_AC_PEFA04

Household sector electricity consumption per capita over time in Iceland

Household electricity consumption per capita has been increasing up until 2009 where it peaked and has been declining until 2019. The reduction is primarily a result of the adoption of more energy-efficient light bulbs as well as more energy-efficient household appliances. In 2020, consumption started to increase again, which can mainly be attributed to an increase in the uptake of electric vehicles.

MWh per capita



Source: Eurostat (NRG_CB_E and DEMO_PJAN)

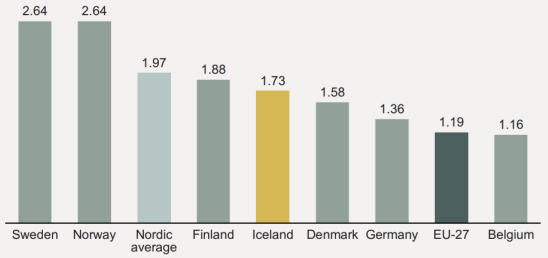
Sector description

Total electricity consumption for non-heating purposes by households is estimated at around 664 GWh in 2020. This includes lighting and electrical appliances in particular. In the EU, about 58% of household (non-heating) electricity is consumed by lighting and electrical appliances, about 13% by cooking and about 12-13% by water and space heating, respectively.

However, these numbers vary substantially, also between households where small homes typically use less electricity than large homes.

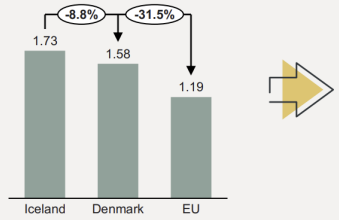
Consumption for cooking, lighting, electrical appliances etc. compared to the Nordics (MWh per capita)

When looking only at non-heating purposes, Iceland is still far below Sweden and Norway (around 30%) and slightly below Finland. Consumption per capita in Denmark is about 8.8% lower.



Savings potential

Electricity efficiency in 2022 (MWh/capita)



58 GWh/year

if same efficiency as Denmark.

Confidence	Ease to achieve
Medium	Achievable

Assessment of potential efficiency gains

- Electricity consumption in households for non-heating purposes varies substantially across countries. At the low end of the EU are countries like Germany, at 1.36 MWh per capita, and at the high end are countries like Finland and Sweden at 1.88 and 2.64 MWh per capita respectively. The EU average is 1.19 MWh per capita. Iceland stands close to the high end, with around 1.73 MWh per capita.
- Part of the difference is linked to the volume and quality of appliances as well as behaviour, whereas another part is linked to country geographies such as the yearly number of daylight hours.
- There is insufficient data available on the switch to LED lighting in Icelandic households, but international experience suggests that savings from this measure could be significant. In Denmark, for example, it has been estimated that continuing the roll-out of LEDs could reduce electricity consumption in households by as much as 18% compared to current roll-out.

Typical measures used to reap potential savings in different sectors

Sector	Typical efficiency measures	Ease to achieve in Iceland
Commercial and public services	Switching to LED lighting, improving efficiency of appliances, building renovations	
Primary non-ferrous metals	Increasing efficiency in smelter operation	
Households	Switching to LED lighting, improving efficiency of appliances, behavioural change	
Waste heat from industry	Utilising the potential for generating electricity from industrial waste heat	
Heating	Individual heat pumps in households and large (sea) heat pumps in areas not served by district heating	
Agriculture	Improving efficiency in pumping, ventilation, lighting and cooling	
Grid losses	Upgrading transmission and distribution networks	
Fish meal factories	Lowering cooking temperature, improving drying and evaporation processes	
Primary aluminium production	Optimising electrode design and disposition, improving process control tools	
Ferroalloys	Increasing efficiency in smelter operation	
Data centres	Improving efficiency in servers and cooling systems, increasing virtualisation	

6% increased efficiency possible in 10 years

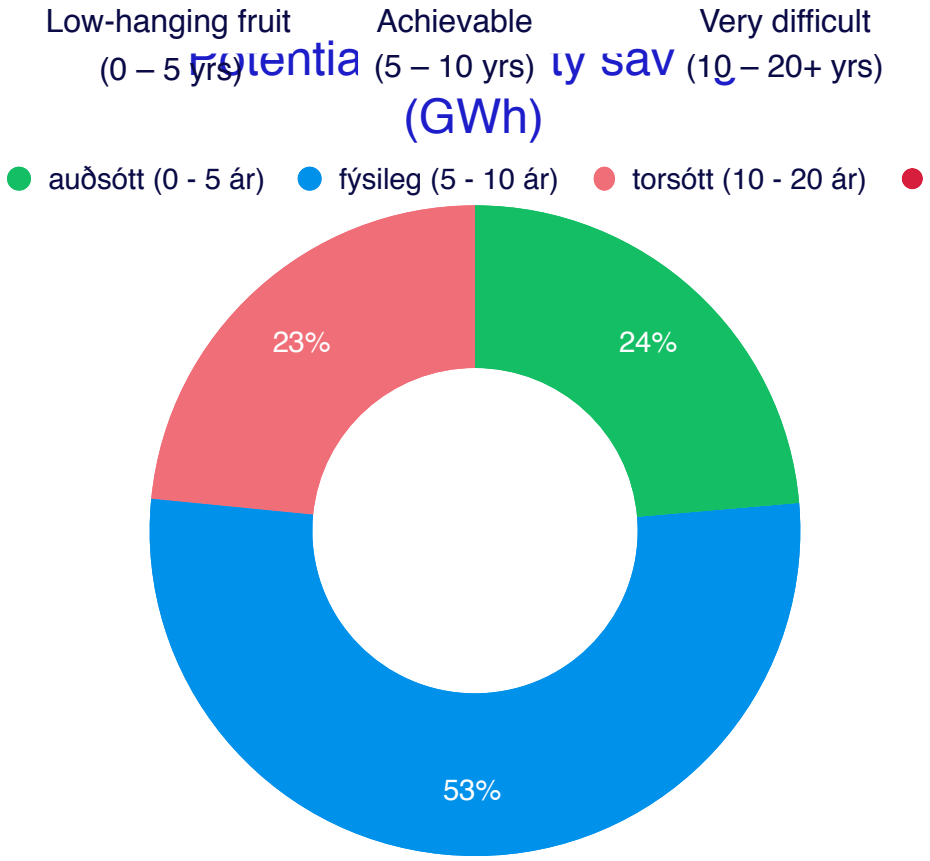
If all actions were initiated, it would be possible to save about **1.507 GWh/yr** of electricity.

In the next 10 years

- 356 GWh are considered readily available
- 797 GWh additional are deemed feasible

6%

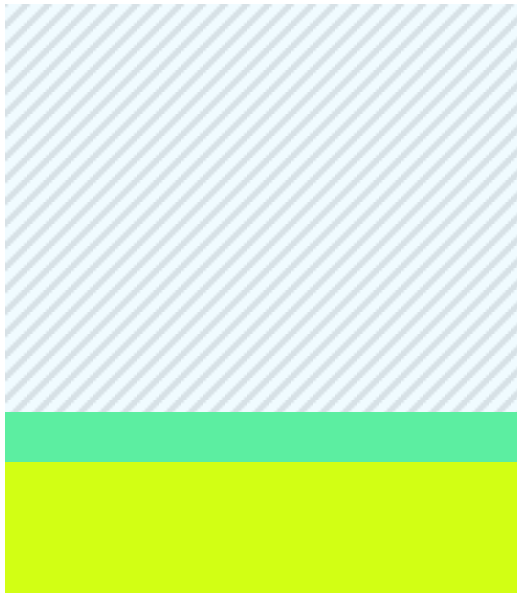
Greater uncertainty exists in other measures.



Results suggest that

improved efficiency can play a role in meeting increased energy demand

Energy demand* 2035: 26.490 GWh

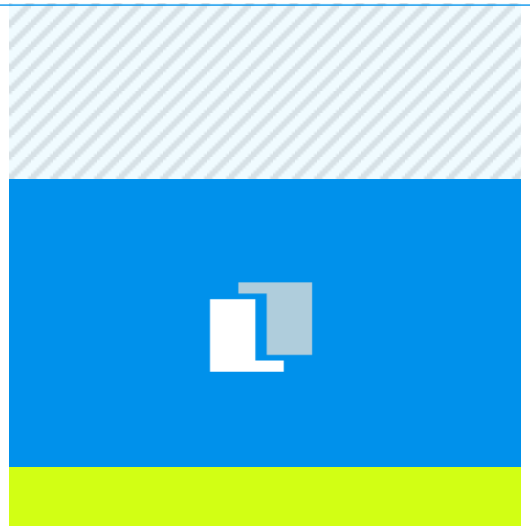


Excess demand 2.470 GWh

Impr. Transmis. system 300 GWh

Electricity efficiency 800 GWh

Energy demand* 2030: 22.920 GWh



Excess demand 1.040 GWh

Enlargement Sigalda Hydro 10 GWh

Theistareykir II Geothermal 590 GWh

Búrfellslundur Wind farm 430 GWh

Hvammur Hydro 720 GWh

1.750 GWh

Electricity efficiency 360 GWh

Energy generation 2023: 19.770 GWh

* Landsnet (Iceland TSO) Electricity forecast

More granular end-use data needed for deeper understanding

Potential next steps to strengthen research and action on increased energy efficiency include:

Studies on the exact processes driving how companies and households are consuming electricity	Sector specific Icelandic studies on efficiency potential
Integrating efficiency into planning and implement actions to incentivise efficiency	Improve information to consumers about energy performance and potential improvements