Effects of upgrading cultural heritage buildings

The Norwegian Directorate for Cultural Heritage

Hiorthhamn on Svalbard Photo: Einar Lund Sørensen, NFD

Hermetikken in Stavanger Photo: Base Gruppen

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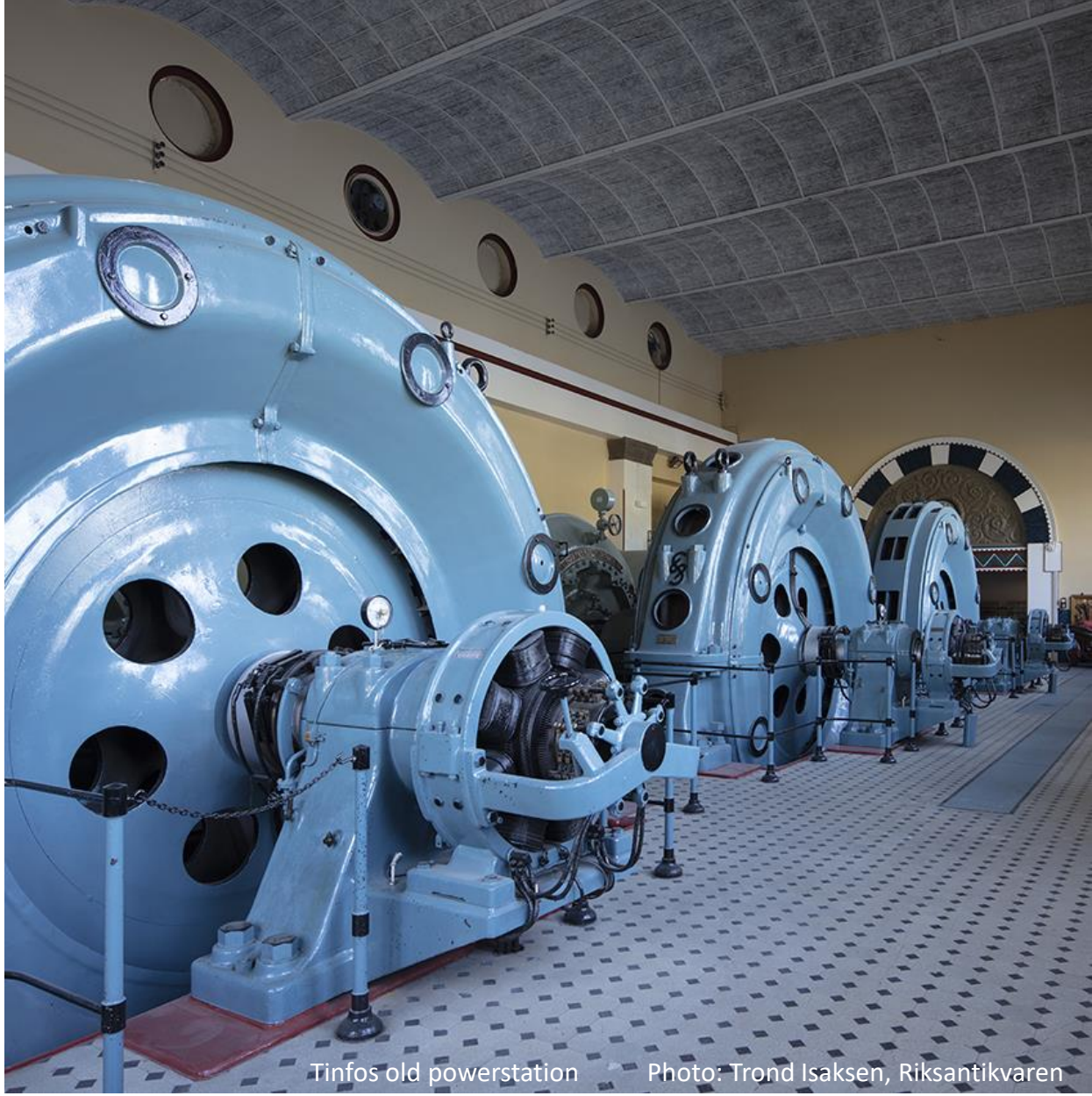


Tinfos old powerstation Photo: Trond Isaksen, Riksantikvaren

A strategy in two parts

Part 1 - Cultural heritage and the contribution to reducing greenhouse gas emissions

Part 2 - Cultural heritage and the management of adverse climate change consequences


Photo: Marte Boro, Riksantikvaren


Photo: Trond A. Isaksen

Part 1
Cultural heritage and the contribution to reducing greenhouse gas emissions

- Climate-friendly land use and spatial planning
- Reuse and preservation of buildings
- Improved energy performance in existing buildings

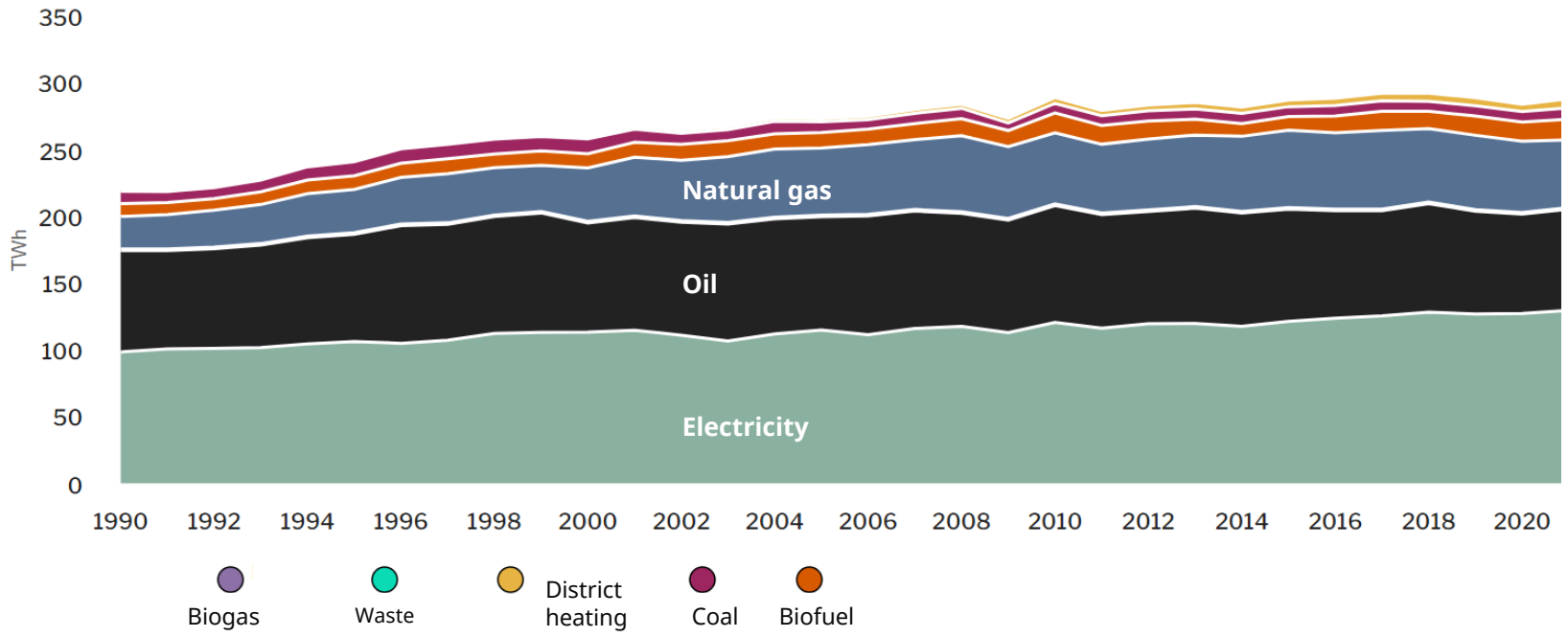
The NVE building after rehabilitation in 2011 Photo: Trond A. Isaksen, Rikstikvaren

Buildings: Energy savings and greenhouse gas reduction

Total use of energy - mainland Norway

Approx half is renewable energy, due to a high share of hydroelectric power

40% of energy consumption in 2020 is related to buildings*

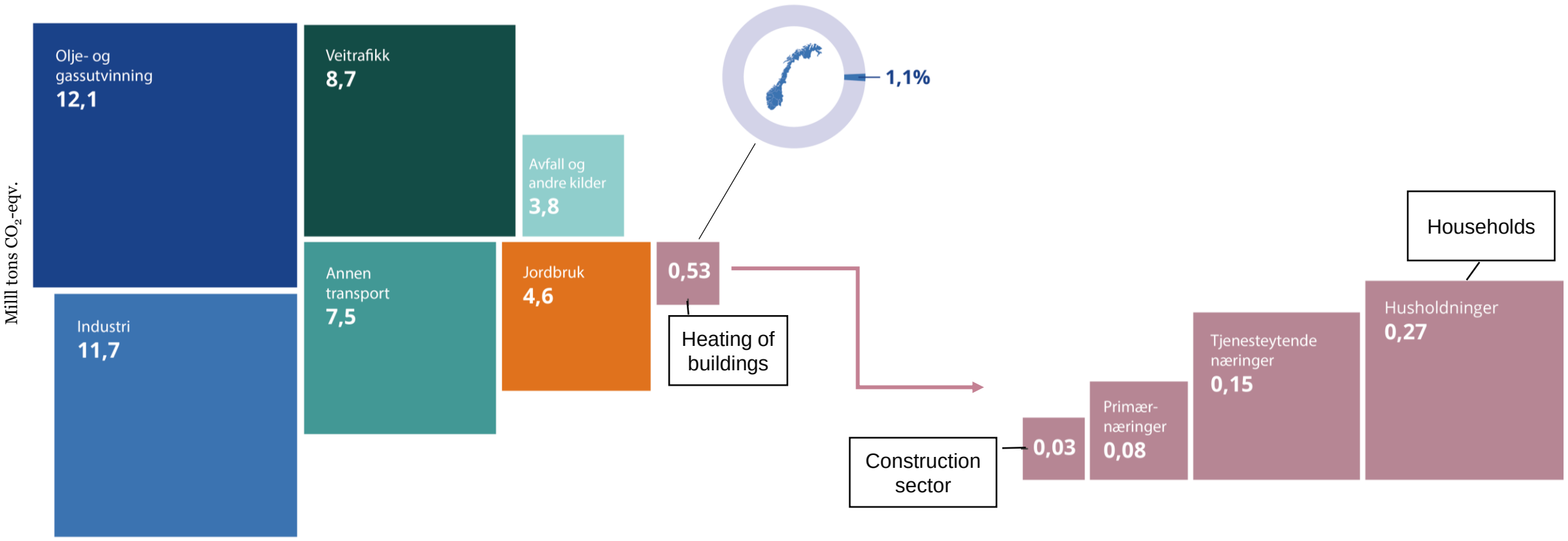


Source: www.tilnull.no/Statistics Norway 2021

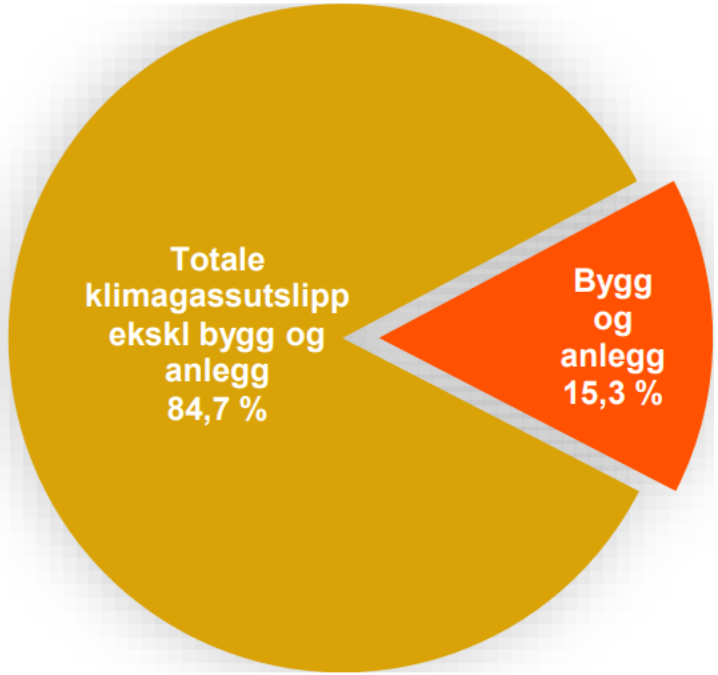
*www.energifaktanorge.no

Total greenhouse gas emissions Norway - mainland and offshore:

Heating of buildings is of less significance



Sources: Norwegian Environmental Agency/miljøstatus.no, Statistics Norway, 2021



Construction sector

Only 1-2% new buildings each year, but they account for 70% of the ghg emissions from the construction sector.

Low emissions within a narrow sector definition. Estimated 4.5% of ghg-emissions in mainland Norway 2021*.

However, following a production perspective (effect on other sectors + export), the share is **15%** of total ghg emissions**.

Sources: *Norwegian Environmental Agency, 2023. **Asplan Viak-report ghg emissions construction sector, 2019

To summarize:

- Buildings have a high share of energy consumption
- Relatively low share of ghg emissions
- Hydropower is a limited resource. Saving energy will contribute to electrification and reduction of ghg emissions in other sectors.
- Construction sector has a big indirect effect on ghg emissions and circular economy

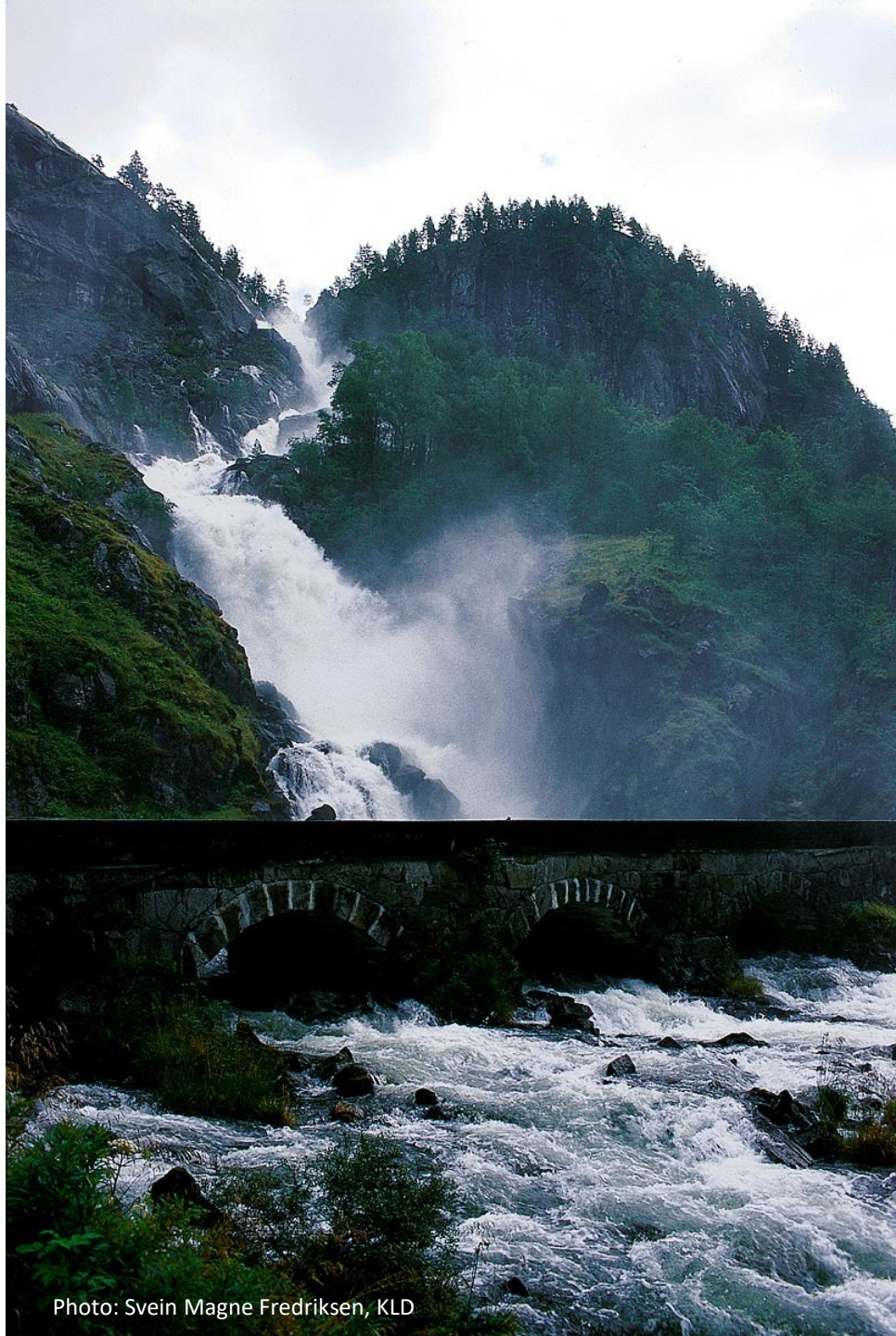


Photo: Svein Magne Fredriksen, KLD

Total building stock and relatively inexpensive measures: Potential for energy savings = 10-13 TWh

Equals 10 % of all electricity consumption in Norway 2020

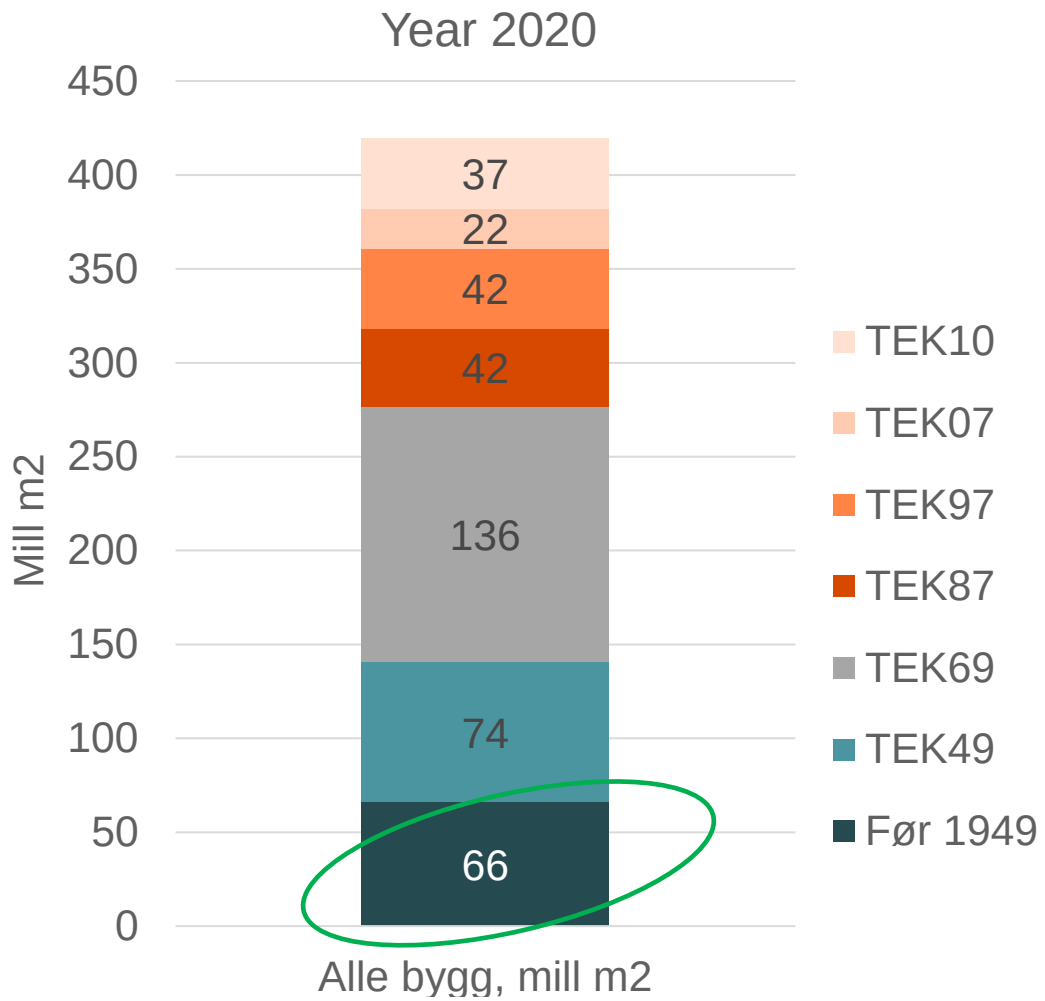
Equals Norwegian wind electricity production in 2020

Source: The Norwegian Water Resources and Energy Directorate, www.nve.no/energi/energisystem/energibruk/energieffektivisering

Tyssedal power station/museum
Photo: Øystein Hagland, Riksantikvaren

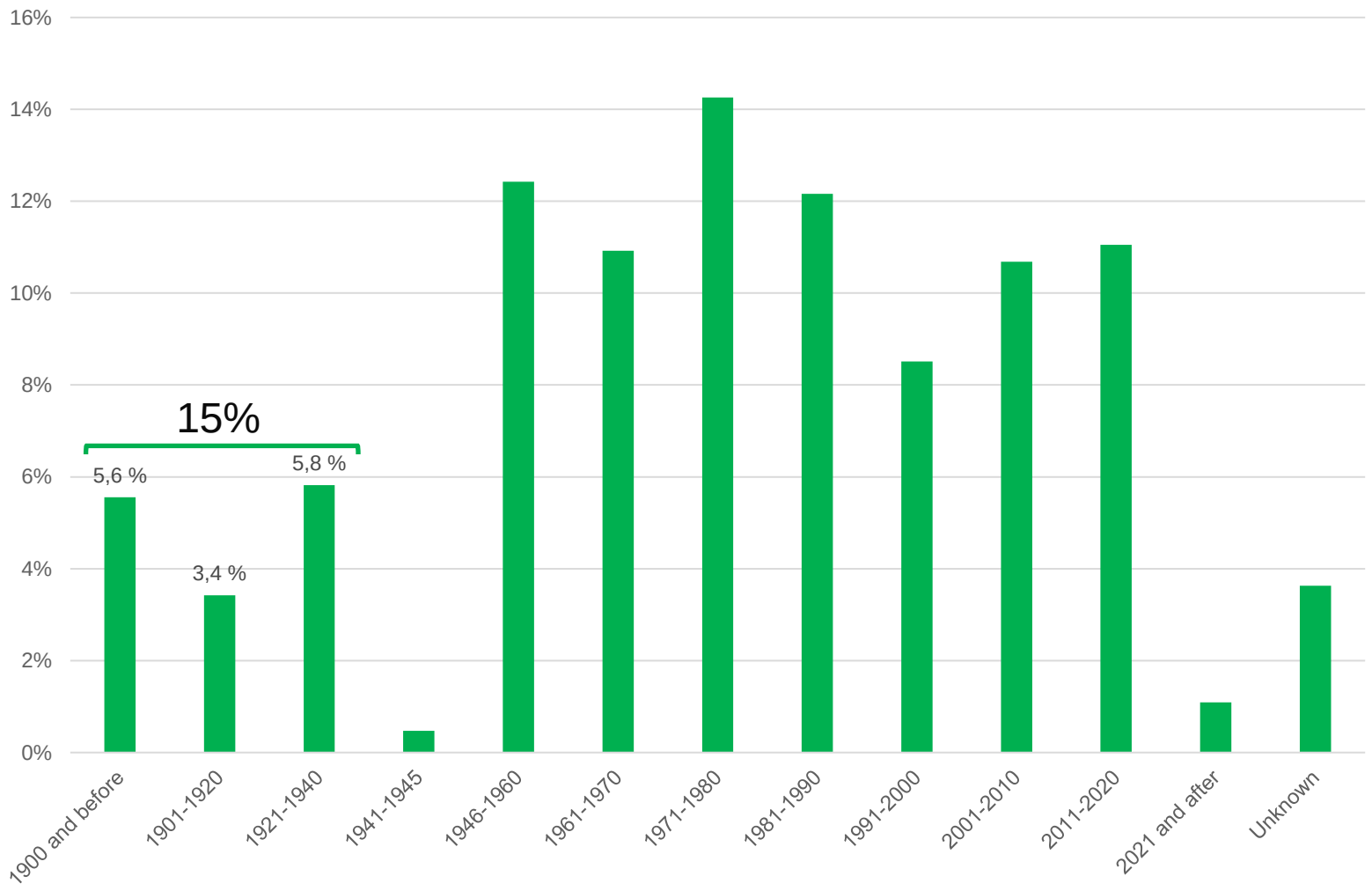
Heritage buildings

About 16% of the building area in Norway has a prewar tech standard



Source: The Norwegian Water Resources and Energy Directorate

Prewar homes = approx. 15 percent of all homes

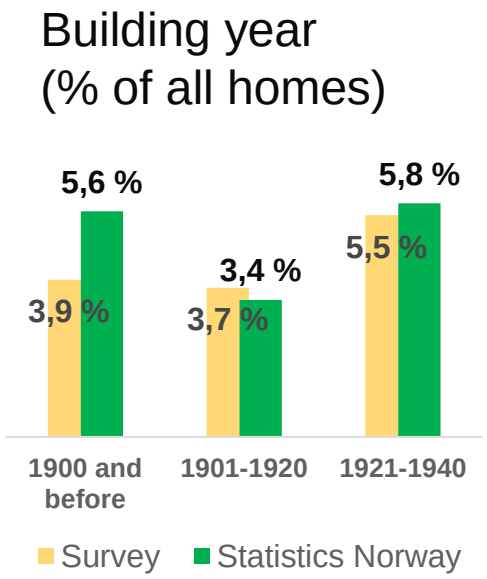


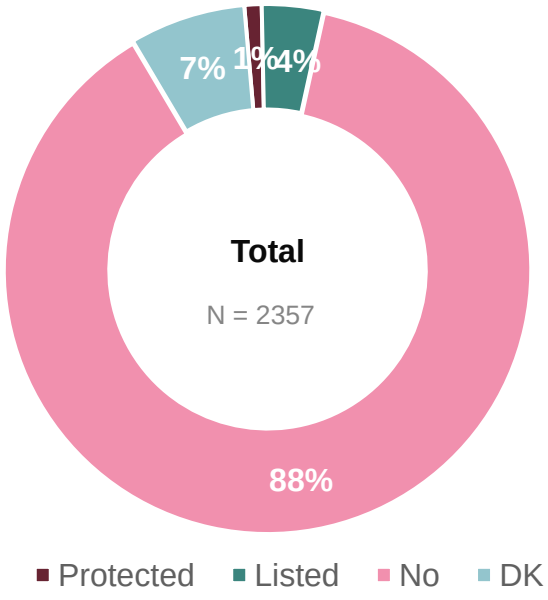
We have official statistics for building year for homes but not for the total building stock.

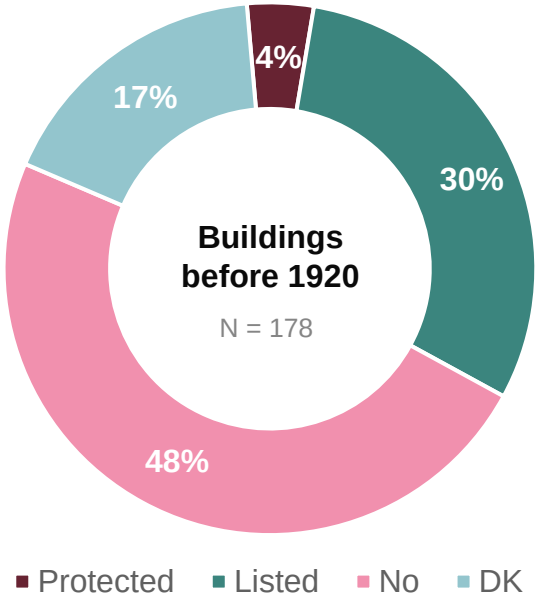
Homes account for about 37% of the total building stock.

Source: Statistics Norway

Population survey: 5% report to live in a protected or officially listed building. For those living in older homes it is one third.

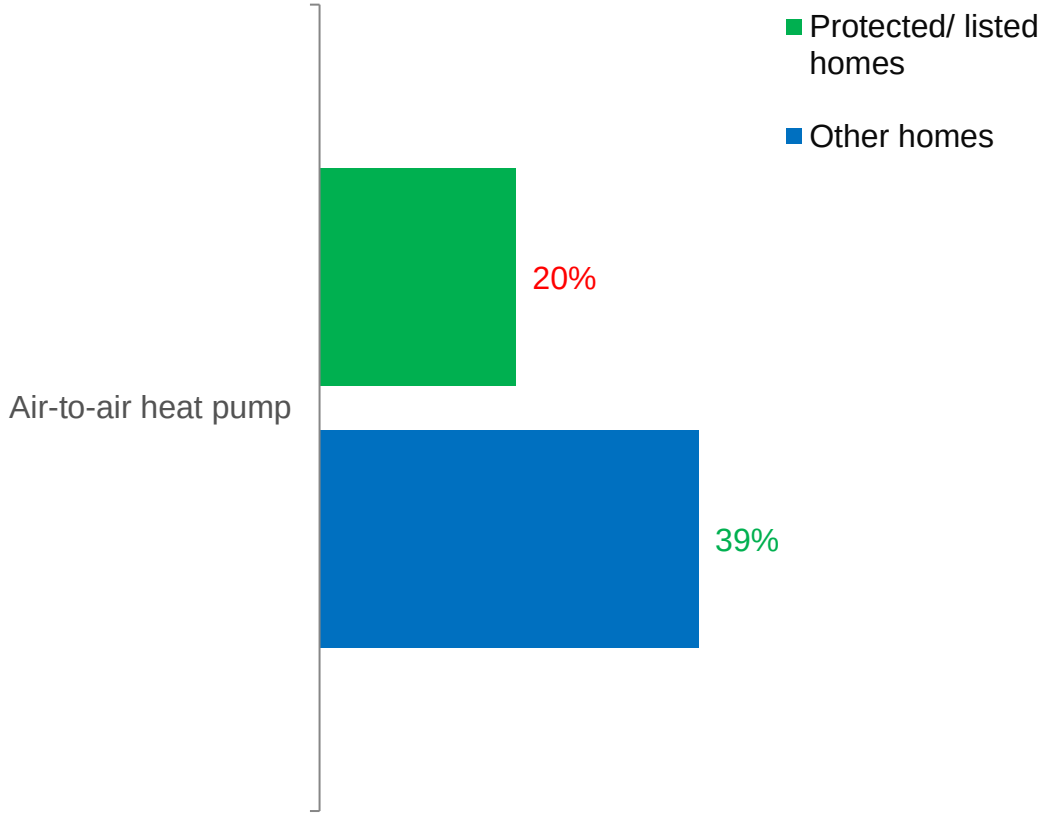






Source: The Norwegian Directorate for Cultural Heritage

Fewer owners of protected/listed homes have installed air-to-air heat pumps.



Guide to heat pump installations in heritage buildings
(Directorate for Cultural Heritage, 2022)

Source: The Norwegian Directorate for Cultural Heritage

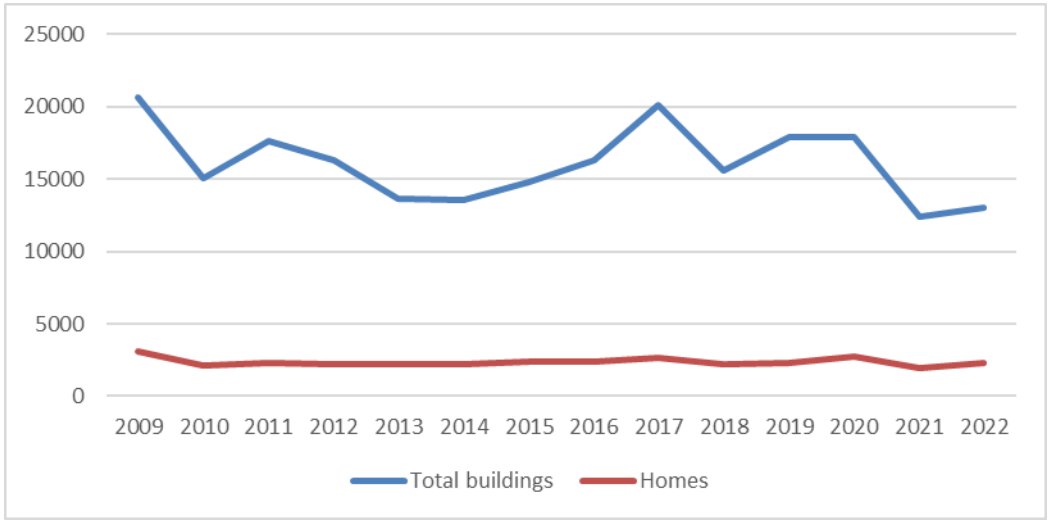
Demolition statistics

Number of demolished buildings. Renovation instead of demolition?

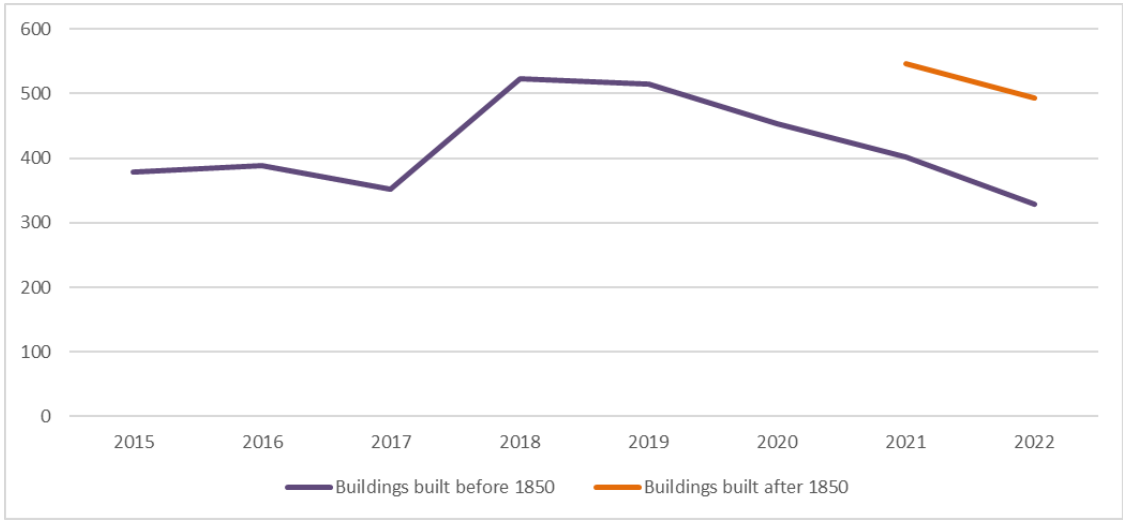
No available data for cause of demolition

Upgrading not always a valid option. Overestimation of potential.

Loss of buildings due to demolitions, fire etc.

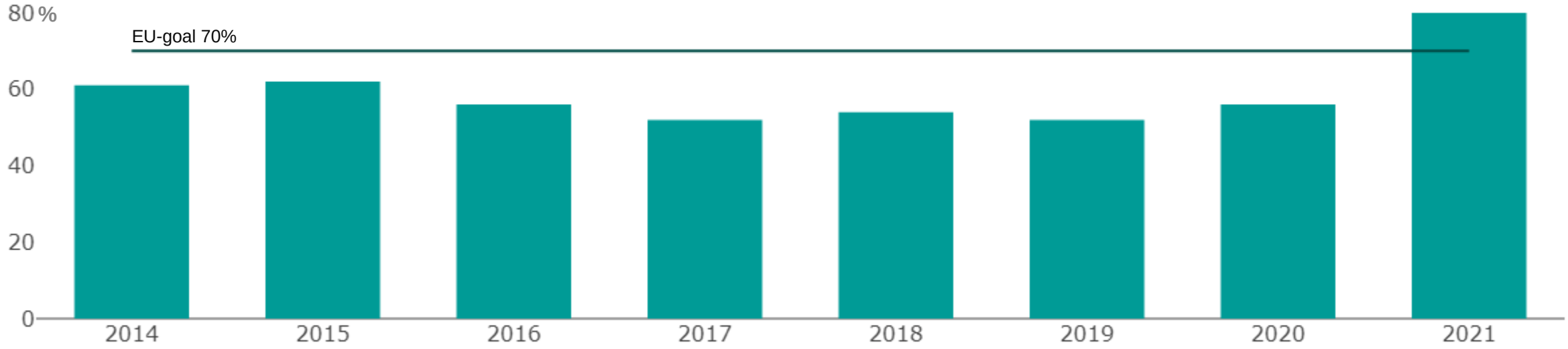


Heritage buildings: County council cases about demolition/major alteration



Source: Statistics Norway

Share of construction waste delivered for recycling



Source: Norwegian Environmental Agency/Statistics Norway 2022

Heritage buildings:
Effect of energy savings

Life cycle analysis 60 years time span

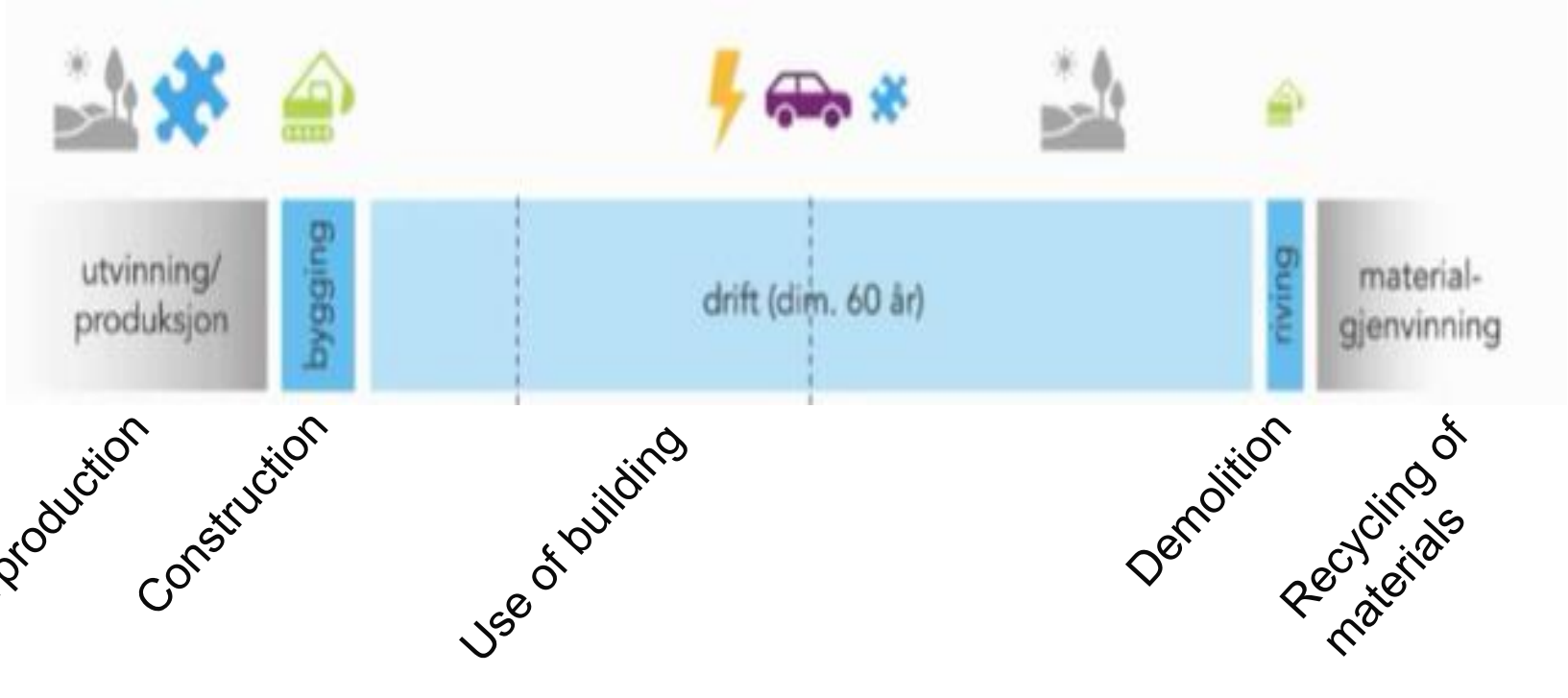
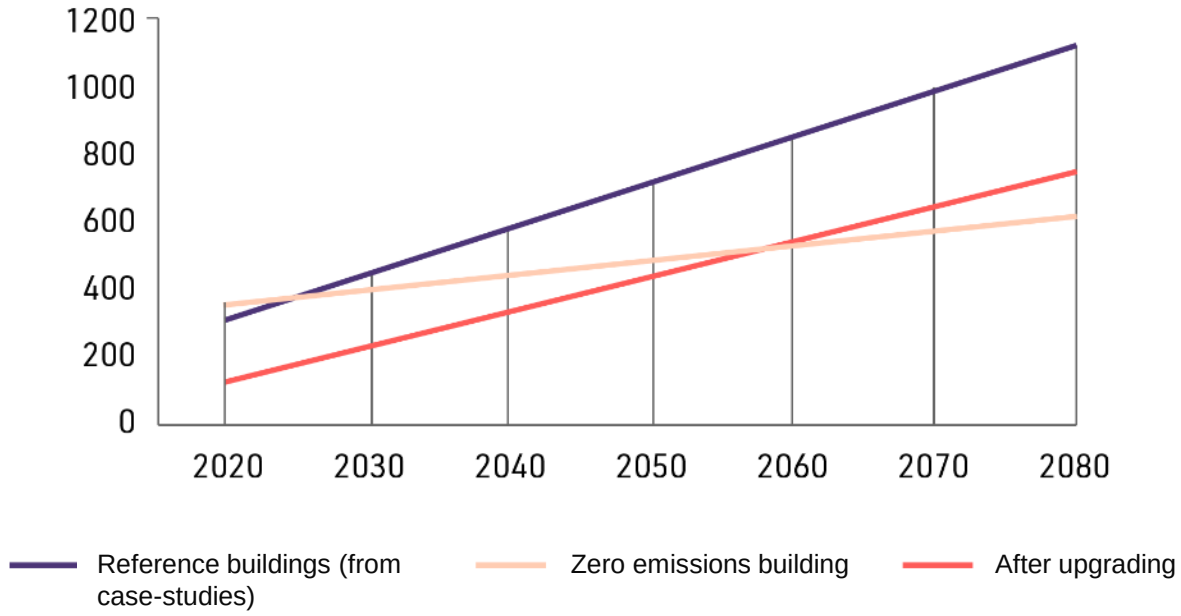


Illustration: Norwegian Green Building Council

Sustainable buildings already exist

- Assessment and meta-analysis of relevant life cycle analyses connected to rehabilitation and upgrading of existing buildings
- 80-90% of buildings will still exist in 2050.
- Rehabilitation is preferable in the short and medium terms (30-year perspective)
- It may take up to 80 years before a new «green» building can offset the GHG emissions generated during its construction

Total ghg-emissions during a span of 60 years time



Source: SINTEF-report commissioned by the directorate for cultural heritage: "Green is not only a colour: sustainable buildings already exist, 2020"

Regional case study

24 cases of greenhouse gas emission calculations and energy saving for a wide range of buildings **with heritage value**.

Søndre Land Rådhus
Rådhus, 1966

Vestsidevegen 1126
Bolig, ca. 1930

Ringelien Gård
Bolig, 1950

Granum Gård
Pensjonat, 1933

Setton Gård
Sommerfjøs, ca. 1890

Steig Gård
Fjøs (ukjent byggeår)

Anders Sandvigsgt. 30
Kontor, 1900-1913

Rekka i Våler
9 boligbygg, 1959

Toten Montesorriskole
Skole, 1890/1907

Melkefabrikken på
Kapp. Kontor, 1912

Lena VGS
Skole, 1921-27

Storgata 35
Lager, ca. 1890

Melkefabrikken på
Hamar, Kontor, 1875

Breie
Bolig, 1923-25

Jorderik
Bolig, 1725-50

Hytte på Gran
Bolig (ukjent byggeår)

Grøna hovedbygg og
stabbur. Bolig, ca.1800

Søndre Land
Næringshage
Industri/lager, 1960-tallet

Nerby gård
Våningshus ca.1600/1700
Oppgradert 1986-88

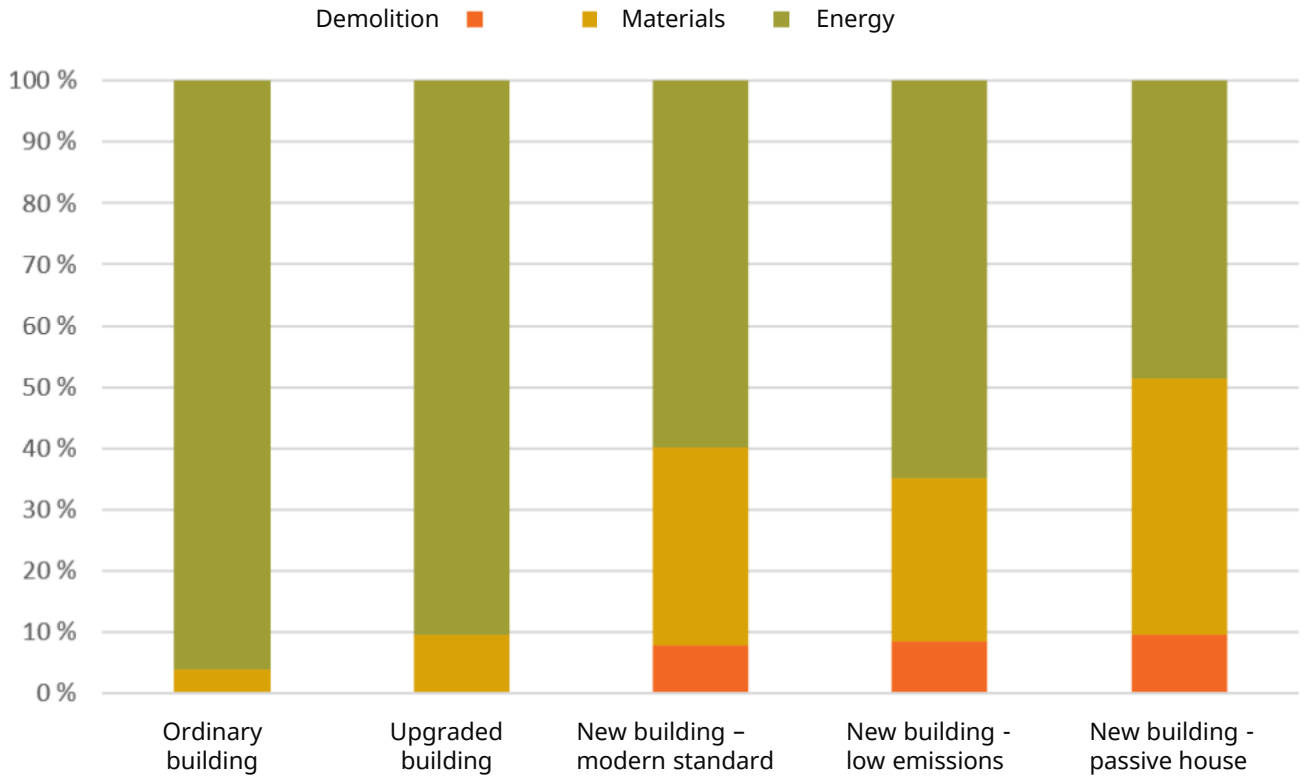
Bankbygget på
Heggenes. Kontor/
næringsbygg, 1965/ 1985

Enhetslåven på Blak
Holo
Låve, tidl. 1900-tall

Findings

- Potential of 41% energy savings through upgrading
- Immediate effect
- Comparatively small upgradings and in accordance with house owners plans, budget priorities and heritage values (= realistic estimate for energy savings)
- Lower emissions for a majority of buildings through upgrading instead of demolition
- The specifics of the building determine outcome

Life cycle analysis greenhouse gas emissions



Ordinary buildings -> ghg emissions from use of energy

New buildings -> ghg emissions split between energy and materials (+ demolition)

Source: Asplan Viak/Innlandet fylkeskommune: Rapport – Effekt på klimagassutslipp av økt oppgradering

Calculations four scenarios

1) Energy upgrading, same building area

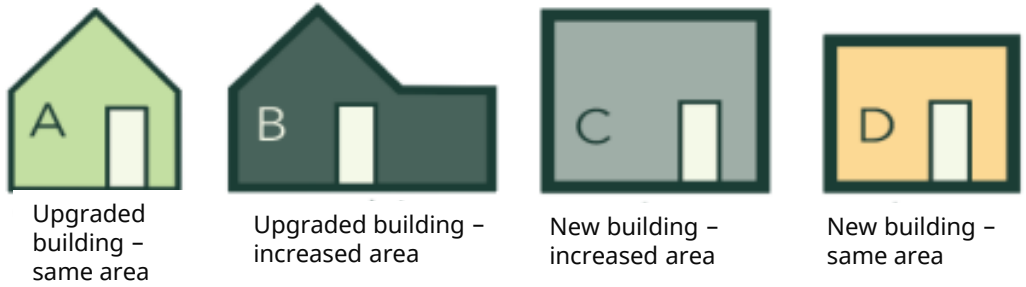
2) Energy upgrading, but increasing area based on relevant statistics

3) Demolish building and build a new building, increased area based on relevant statistics

4) Demolish building and build a new building with the same area as the old building

60 years life cycle

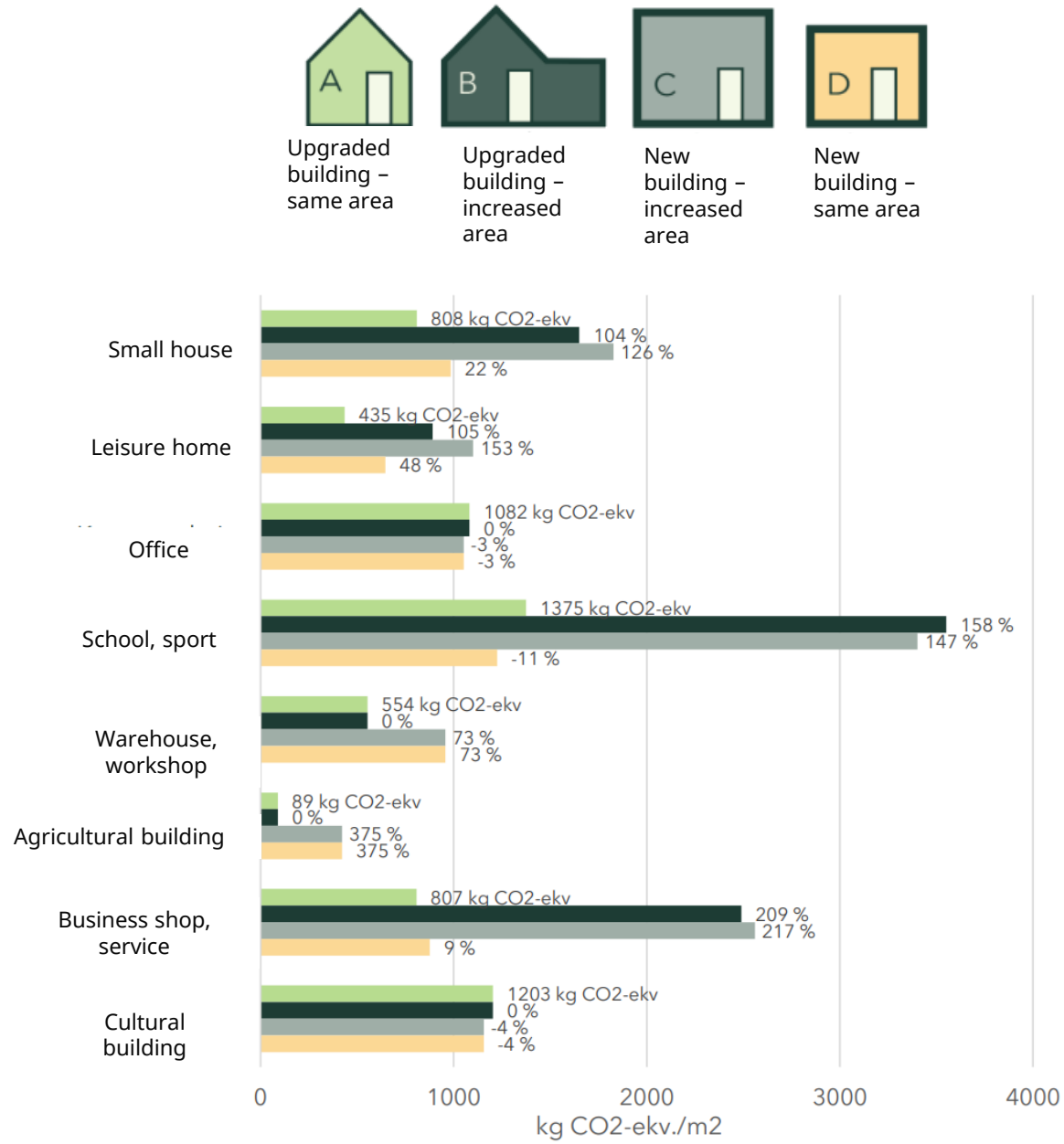
Simulations based on the 24 case studies and available demolition data



Source: Asplan Viak/Innlandet fylkeskommune: Rapport – Effekt på klimagassutslipp av økt oppgradering

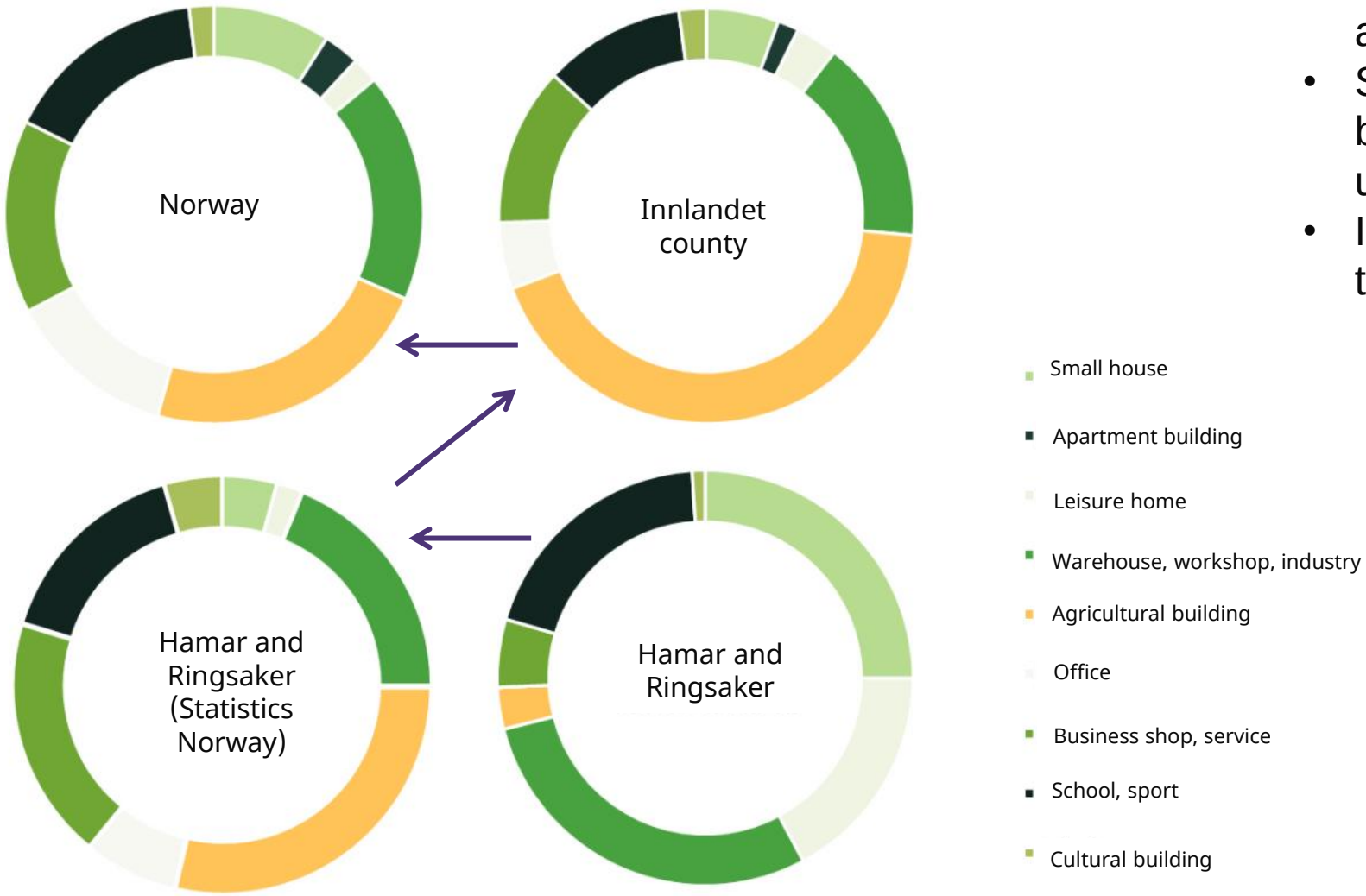
Findings

- 20% bigger emissions with a new building within the small house-category
- Upgrading is an option to be considered before demolition, especially in the short/medium long term.
- Schools were better off with a new building.
- Statistics show that a demolished building is likely to be replaced by a bigger building. Increase in area may offset energy savings.



Source: Asplan Viak/Innlandet fylkeskommune: Rapport – Effekt på klimagassutslipp av økt oppgradering

Possible to extrapolate findings to a national level



- Using distribution of demolished area, per building type 2014-2019.
- Same pattern as for case studies, but able to show the effect of upgrading nationwide.
- Introducing more uncertainties though.

Source: Asplan Viak/Innlandet fylkeskommune: Rapport – Effekt på klimagassutslipp av økt oppgradering og ombruk

Improving energy performance and reducing greenhouse gas emissions

Villa Dammen has an electricity consumption at passive house level. Photo: Trond A. Isaksen

- Reduce energy consumption in buildings as a climate measure
- Small and medium-sized energy efficiency measures constitute significant effects with regards to greenhouse gas reductions and economy
- Consider upgrading before demolition when this is a valid option
- Take into account the effect of increased area

Thank you for your attention

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