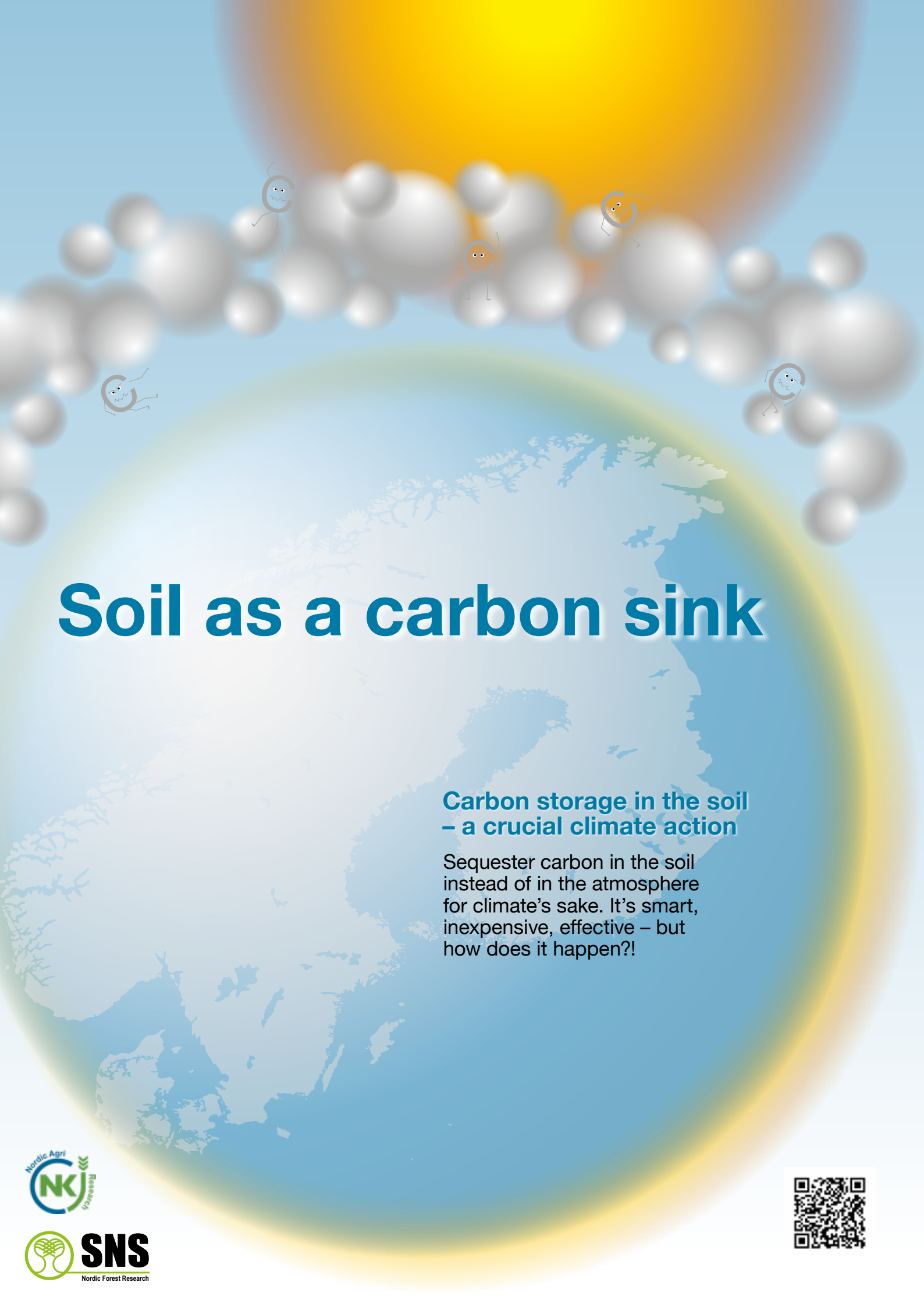


Soil as a carbon sink

Carbon storage in the soil – a crucial climate action

Sequester carbon in the soil instead of in the atmosphere for climate's sake. It's smart, inexpensive, effective – but how does it happen?!

Nordic Agri NKJ Research

SNS Nordic Forest Research

Why in the soil

Increased carbon storage in the soil is one of the most cost effective climate actions. Besides being good for the climate, it can also benefit biodiversity. Research is now underway to develop models of how different activities affect Earth's climate. Soil-based carbon sequestration is a complex and challenging question, both for policymakers and researchers.

Similar soils, climate and politics make good ground for...

Nordic cooperation

The 4 per 1 000 initiative

One of several important initiatives in the global arena is the '4 per 1000 Initiative'. Its proponents believe that CO_2 emissions from fossil could be sequestered in the ground by increasing soil carbon content by 0.4% per year. The initiative was launched by France during the 2015 climate conference in Paris. The goal is to make the potential of soil carbon storage known and put this issue on the political agenda.

https://www.4p1000.org/

This is what we can do:

It is possible to increase soil carbon storage, but more research is needed to find out which methods are most effective. Here are some possibilities:

I Restore peatland to wetland: The peatland that emits the most CO_2 should be prioritised. Wetland restoration also benefits biodiversity and reduces nutrient leakage into lakes and waterways.

II No-till and reduced-till agriculture: This can lead to greater carbon storage in upper soil layers compared to more intensive tillage.

III Pasture, protection zones and intercropping: Perennial hay, pasture or grain species grown on arable land or along shorelines. An intercrop is grown between two harvested crops and then left in the soil as a carbon sink.

IV Organic matter management: Harvest residues can be spread on fields. Another alternative is to apply organic fertiliser such as manure or treated sewage.

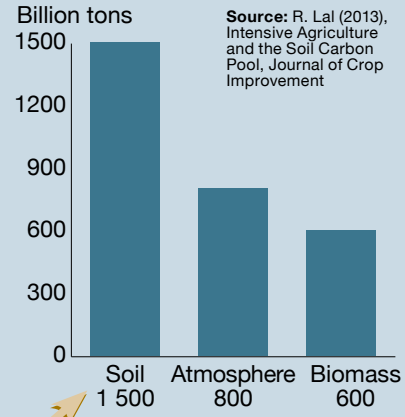
V Reforestation and forestry: Forest soils are affected by several factors like the type of tree planted and changes in the water table.

This is carbon sequestration

Carbon sequestration means that carbon is removed from the atmosphere where it causes climate change. The oceans play a vital role here since the surface water absorbs carbon dioxide and transports it to greater depths where it is stored. In terms of soil, there are three main ways to sequester carbon:

1 Above ground: In living biomass like trees or other plants.
2 In the ground: In soil, for example in fields and forests.
3 Underground: In porous rock strata (known as Carbon Capture and Storage, CCS).

SOIL: important storage



Source: R. Lal (2013), Intensive Agriculture and the Soil Carbon Pool, Journal of Crop Improvement

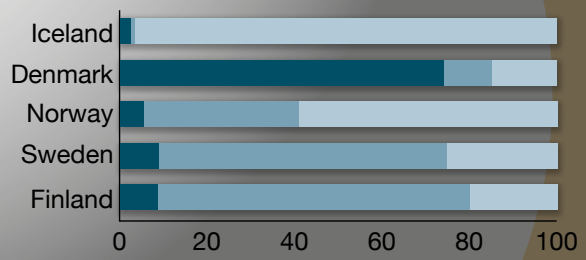
What soil does for the climate

The debate is most often about atmospheric CO_2, but soils contain about three times as much carbon as above-ground vegetation, and twice as much as the atmosphere. This means that even small shifts in soil carbon balance make a big difference – soil carbon is an important issue in climate debates. Moreover, soils with more carbon are more fertile, so climate action can help produce more food for a hungry world.

Carbon affects many sectors

Carbon sequestration and emissions from land use have several important impacts, such as the greenhouse effect, soil fertility and thus food-production efficiency and the transition to a bio-based economy. Therefore, these issues need to be addressed on several fronts, with everything from policymaking to scientific investigations. Much research is needed before we have all the answers! Uncertainties in sinks and sources must be reduced. Existing models and processes for data acquisition must be refined and developed. Different models and systems must be harmonized.

Nordic Land Use



Agriculture: Cultivated land and pasture
Forestry: Both broadleaved and coniferous
Other land covers: Artificial surfaces, semi-natural vegetation, bare ground, wetlands, open water

Source: https://www.eea.europa.eu/themes/landuse/land-cover-country-fact-sheets

The Nordic Council of Ministers decided in 2017 to map soil carbon sequestration in the Nordic region as an interesting way to counter climate change. Nordic Agri Research (NKJ) and Nordic Forest Research (SNS) have carried out the mapping.

Nordic Council of Ministers

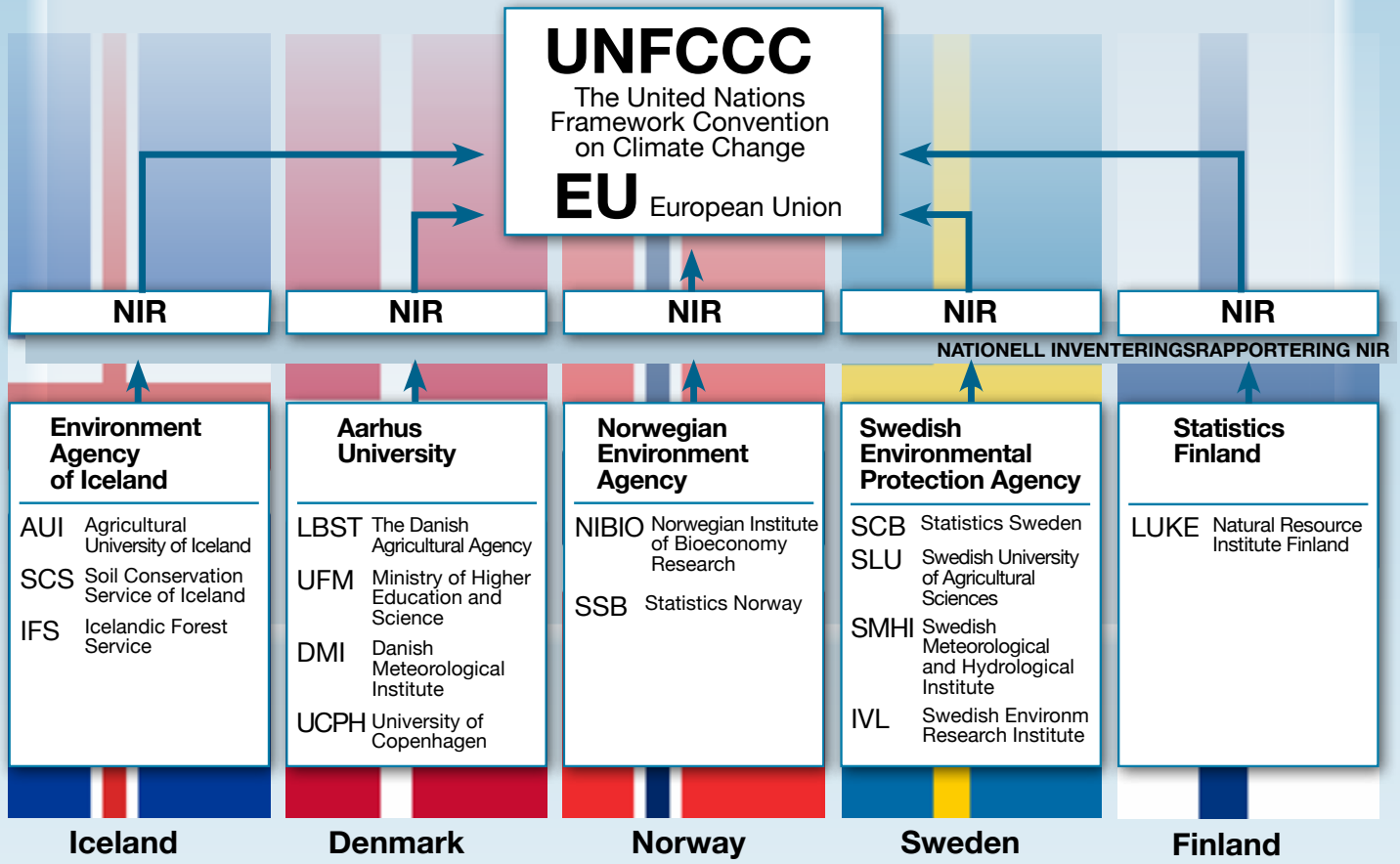
Climate report – how it works

According to the UN climate convention (UNFCCC) and the Kyoto Protocol, greenhouse gas emissions should be reported to the Intergovernmental Panel on Climate Change (IPCC). This is done in a National Inventory Report (NIR).

All of the Nordic countries have ratified the convention and so must submit annual accountings of emissions and sinks. The division of responsibilities and the reporting structures differ among countries.

Carbon storage above and below ground

Changes in carbon storage are reported for the categories of forest, agricultural fields, pasture, built environments, wetlands (peat production), other land uses and processed wood products. In each category changes in carbon storage are reported for living biomass, dead organic matter and soil carbon. Climate reports also contain information on carbon sequestration both above and below ground.



Carbon accounting models – how they work

The IPCC has classified methods for emissions accounting in three different tiers.

The classifications are based on the information that the method requires, and on how complex they are. Using a higher-tier method reduces uncertainty in greenhouse gas estimates. But more complex measurements and analyses mean higher costs and less transparency.

In all Nordic countries, new carbon accounting models are being developed.

- ✔ **Tier 1** is the simplest level, based on standardized emissions factors produced by the IPCC.
- ✔ **Tier 2** uses the same methods as tier 1, with country-specific data in place of the standardized emissions factors.
- ✔ **Tier 3** involves more advanced models developed or customized for specific regional conditions.

Here are three examples of tier 3 models:

- **Sweden:** Introductory Carbon Balance Model
- **Denmark:** C-tool
- **Finland:** Yasso07

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