Nordic Green to Scale for countries

Unlocking the potential of climate solutions in the Baltics, Poland and Ukraine

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to global challenges

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Nordic co-operation is one of the world's most extensive forms of regional collaboration, involving Denmark, Finland, Iceland, Norway, Sweden, the Faroe Islands, Greenland, and Åland.

Nordic co-operation has firm traditions in politics, the economy, and culture. It plays an important role in European and international collaboration, and aims at creating a strong Nordic community in a strong Europe.

Nordic co-operation seeks to safeguard Nordic and regional interests and principles in the global community. Shared Nordic values help the region solidify its position as one of the world's most innovative and competitive.

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PREFACE:
Everyone, together

READING NEWS about the devastating impacts of climate change today and the even more worrying projections for the future, it would be easy to despair. The challenge we face is both vast and urgent.

To safeguard current and future generations from the worst impacts of climate change, we need to replace despair with determination. And there is good reason for cautious optimism.

The Paris Agreement made history by bringing all countries together to set an ambitious climate target. Meeting the United Nations' Sustainable Development Goals will be essential for achieving that target – and implementing the Paris Agreement, in turn, is necessary to deliver on sustainable development in other areas.

Progress has not only happened on paper, but also in practice. Clean energy solutions such as solar power and battery storage have become much cheaper much faster than most of us expected. An increasing number of countries are phasing out coal, committing to carbon neutrality and divesting from fossil fuels.

The question therefore is no longer "Are we doing good things?", but rather "Are we doing enough, fast enough?".

Nordic countries are not global superpowers. We can, however, be explorers. We can chart a course to carbon-neutral well-being and prosperity. And we can share the lessons we learn on the way.

This Green to Scale report builds on those experiences. It looks at cases ranging from building energy efficiency in Sweden to electric cars in Norway, analysing how these solutions can help other countries reach their current climate commitments – and go beyond them.

Green to Scale is part of the Nordic Prime Ministers' initiative Nordic Solutions to Global Challenges. Nordic countries are willing and ready to share both inspiring success stories and mistakes others would be wise to avoid. And we are eager to learn from other countries to help us move faster.

To tackle the climate crisis, we need to involve everyone: all countries, sectors and people. And to be successful, we need to take determined action together.

We hope this report inspires everyone to work together to tackle the climate crisis.

Dagfinn Høybråten
Secretary General
Nordic Council of Ministers


GEORG JENSEN
Foto: Yadid Levy/Norden.org

Executive summary

Introduction

Climate crisis is the defining challenge of our times. The Paris Agreement creates the framework for countries to take action together. However, national commitments are not yet enough. We need to go further.

Green to Scale can help countries do that. The project analyses the potential of scaling up existing climate solutions to the extent that some countries have already achieved to date.

This study looks at Estonia, Latvia, Lithuania, Poland and Ukraine. We analyse the emission reduction potential and costs of scaling up 10 proven climate solutions from Nordic and other countries. We also highlight barriers slowing down implementation and policies to remove them.

Climate impact

Scaling up the 10 solutions can cut emissions by around 150 Mt or 13% of the projected 2030 emissions of the five target countries. This is more than the current emissions of Finland, Denmark, Norway and Iceland combined.

Improving energy efficiency in buildings (53 Mt) and industry (25 Mt) provides the largest potential. In relative terms, the greatest potential is in wind power which could cut emissions in the Baltic States by close to 15%.

Scaling up 10 solutions can cut emissions by close to 40% in Estonia and more than 30% in Latvia and Lithuania

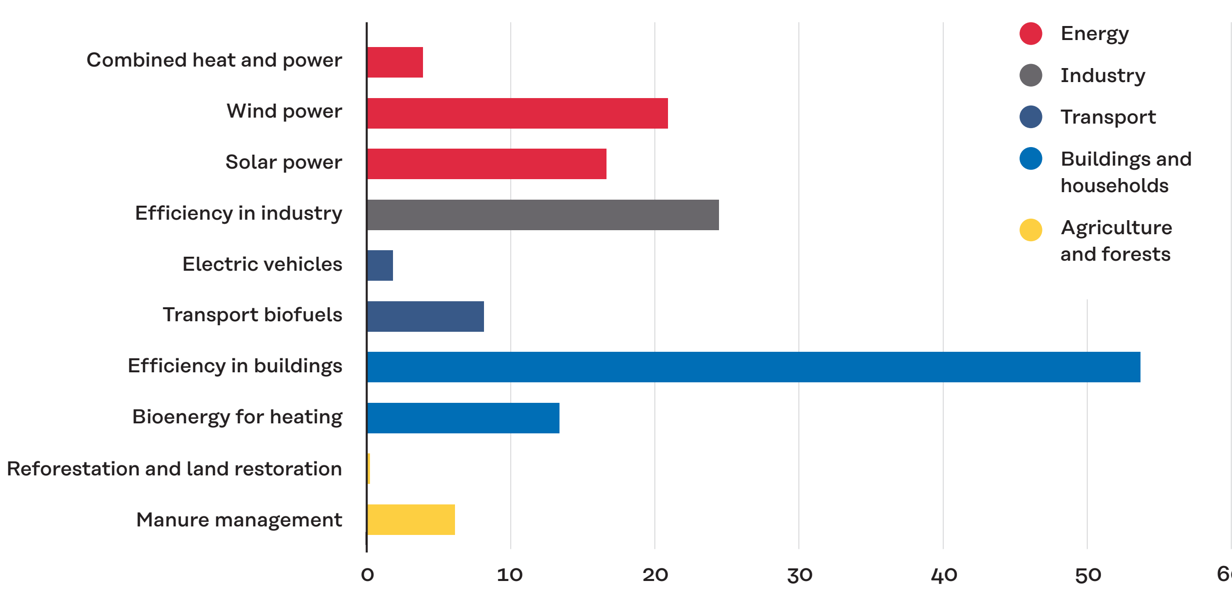
Country results

For most solutions, the largest emission reductions come from the two biggest countries, Poland and Ukraine. However, in relative terms the impact is much higher in the Baltic States: close to 40% in Estonia and more than 30% in both Latvia and Lithuania of 2030 emissions.

In Estonia, scaling up the solutions would cut emissions by 5.2 Mt in 2030 – almost twice as much as Iceland produces today. The largest potential comes from wind power (1.7 Mt, 12%), followed by energy efficiency in industry (1.4 Mt, 9%).

The potential in Latvia is 3.4 Mt, equal to the current emissions of Montenegro. Like in Estonia, wind power has the largest potential (1.4 Mt, 14%), followed by energy efficiency in buildings (0.7 Mt, 7%).

Figure 1: Potential of scaling up the solutions in the five target countries in 2030



Scaling up the solutions in Lithuania would cut emissions by 5.9 Mt. This would be more than twice as much as Iceland produces today. By far the most promising solution is wind power, with a potential of 2.8 Mt (17%).

In Poland, the solutions can cut emissions by 71 Mt. To put the figure into perspective, it is more than Austria produces today. Energy efficiency solutions have the largest potential: efficiency in buildings would cut emissions by 26 Mt (7%) and in industry by 16 Mt (4%).

The potential in Ukraine is 64 Mt – more than the total emissions of Portugal today. Energy efficiency in buildings achieves the largest emission reductions (25 Mt, 4%), followed by wind power (12 Mt, 2%).

Costs and savings

Taking into account both costs and savings, implementing the solutions would actually save money over time. The net saving for the five countries in 2030 could be as much as 1.2 billion euros.

Energy efficiency in buildings would bring total net savings of 2.9 billion euros and energy efficiency in industry some 500 million euros in 2030. At the other end of the range, bioenergy for heating (€1 billion) and wind power (€500 million) have the highest costs.

Other benefits

The solutions would also provide other benefits to people and the environment. These include cutting air pollution and health impacts; improving energy security; creating jobs; and providing income and tax revenue.

For some solutions the primary motivation may be other benefits than climate action. Saving money is likely to be an attractive selling point for improving energy efficiency in the Baltic States, for example. Similarly cutting air pollution in cities may encourage investing in electric cars in Poland and achieving energy independence can drive investment into renewable energy in Ukraine.

Barriers, enablers and policy recommendations

Even the best solutions can be held back by various barriers. Some common factors slowing down implementation include large investment costs and lack of financing, weak carbon pricing and lack of awareness and skills.

Luckily, these barriers can be removed. Countries can build on the experiences of Nordic countries and others that have succeeded in widely implementing the solutions.

Several cross-cutting policies can help. These include ambitious targets and clear road maps, phasing out fossil fuel subsidies, stable legal frameworks and support instruments and enforcing existing regulations better.

Implementing the solutions also requires targeted measures, some of which are highlighted in this report. All policies should be tailored to the specific needs and circumstances of each country.

Scaling up the solutions can save money by as much as €1.2 billion in 2030

Introduction

CLIMATE CRISIS is the defining challenge of our times. Succeeding in the fight against it would allow us to meet sustainable development goals, create wealth and improve the well-being of people. Failing, on the other hand, could endanger most things we hold dear.

The landmark Paris Agreement creates the framework for countries to take climate action together. However, current national commitments are not yet enough to meet the Paris climate goals. The emissions gap – the difference between current and required emission pathways – may in 2030 be roughly equal to the current annual emissions of China and the United States combined.

In other words, we need to do much more, much faster.

Many studies have looked at how to do just that. For instance, a recent Ecofys report, "Sectoral Greenhouse Gas Emission Reduction Potentials in 2030", identified a total reduction potential of more than 30 gigatonnes (Gt) – more than enough to bridge the emissions gap.

Based on this and other studies, we know that reducing emissions rapidly enough is possible, at least in principle. But is it really feasible? Is it realistic?

This is where Green to Scale comes in. The project has developed a unique yet simple approach.

Green to Scale analyses the potential of scaling up existing climate solutions. No new technologies or innovations – just what we already know and have: solutions that have been deployed at scale somewhere.

But there is more. Green to Scale applies these existing solutions only to the extent that some countries have achieved to date. Basically, countries would just be expected to reach by 2030 where some are already today.

Many leaders have understandable concerns about the feasibility of climate solutions. With Green to Scale they can draw inspiration from the lessons Nordic countries, and others, have learnt in implementing them.

In the first phase, Green to Scale showed that scaling up 17 existing solutions to comparable countries would cut around 12 Gt – equal to a quarter of global emissions. Reductions of this scale could be achieved with a cost that would equal, at most, a fifth of global direct fossil fuel subsidies.

The project's next focus was on a set of 15 Nordic solutions. They, too, could cut global emissions significantly: by more than 4 Gt, or as much as the emissions of the European Union. The price tag would be the equivalent of just nine days of direct fossil subsidies.

We need to do much more, much faster

So, the potential is there: we can reduce emissions significantly by scaling up existing solutions. We also know it is feasible because some countries have done so already.

However, for national decision-makers it is essential to understand what different solutions would mean for their own country. They are interested in the country-specific measures that would allow them to realise the potential.

This report provides precisely that. The study takes a closer look at five European countries: Estonia, Latvia, Lithuania, Poland and Ukraine.

For each of the countries, we analyse the emission reduction potential and costs of scaling up 10 proven climate solutions from Nordic and other countries, selected specifically for the target region. In addition, we highlight barriers preventing countries from implementing the solutions – and policies they can use to remove those barriers, suited to their specific circumstances.

The results will hopefully help in meeting the national commitments under the Paris Agreement – and going beyond them. And successes in the five target countries – on combined heat and power production or bioenergy, for example – can, in turn, inspire Nordic and other nations.

Key results

SCALING UP EXISTING climate solutions has great potential for cutting emissions at affordable costs, with additional benefits to people and the environment. Below we summarise the key results for the five target countries.

Climate impact

The selected 10 solutions have the potential to cut emissions by 149 Mt (CO_2e) in 2030 – more than the current emissions of Finland, Denmark, Norway and Iceland combined. Scaling up the solutions would reduce emissions from the five target countries by 13% in 2030 compared to what would happen with just existing measures.

Improving energy efficiency provides the largest absolute potential. Efficiency measures in buildings would cut emissions by 53 Mt and efficiency in industry by an additional 25 Mt in 2030.

In relative terms, the greatest potential is in wind power. In 2030, wind alone could cut emissions in the Baltic States by close to 15%.

The sector with the greatest potential is buildings and households as the proposed solutions would reduce emissions by about 67 Mt. The energy sector comes second with a potential of about 41 Mt, especially from wind and solar power. Scaling up reforestation and electric vehicles holds the least potential, mostly because the countries used for reference have not yet reached very high levels of implementation either.

For most solutions, the largest emission reductions come from the two biggest countries, Poland and Ukraine. However, in relative terms the impact is much higher in the Baltic States. The total potential as a share of expected 2030 emissions is as high as 38% in Estonia and 34% in both Latvia and Lithuania, compared to 19% in Poland and 9% in Ukraine. This potential would come in addition to existing measures.

Another way to put the potential into perspective is to compare it with the current emission reduction targets. The potential identified in this study is about six times as large as the reductions required from the four EU member countries outside of the emissions trading sector. Although much of the potential lies in the trading sector, the results show that there is significant promise for reducing emissions.

Figure 2: Potential of scaling up the solutions in the five target countries in 2030

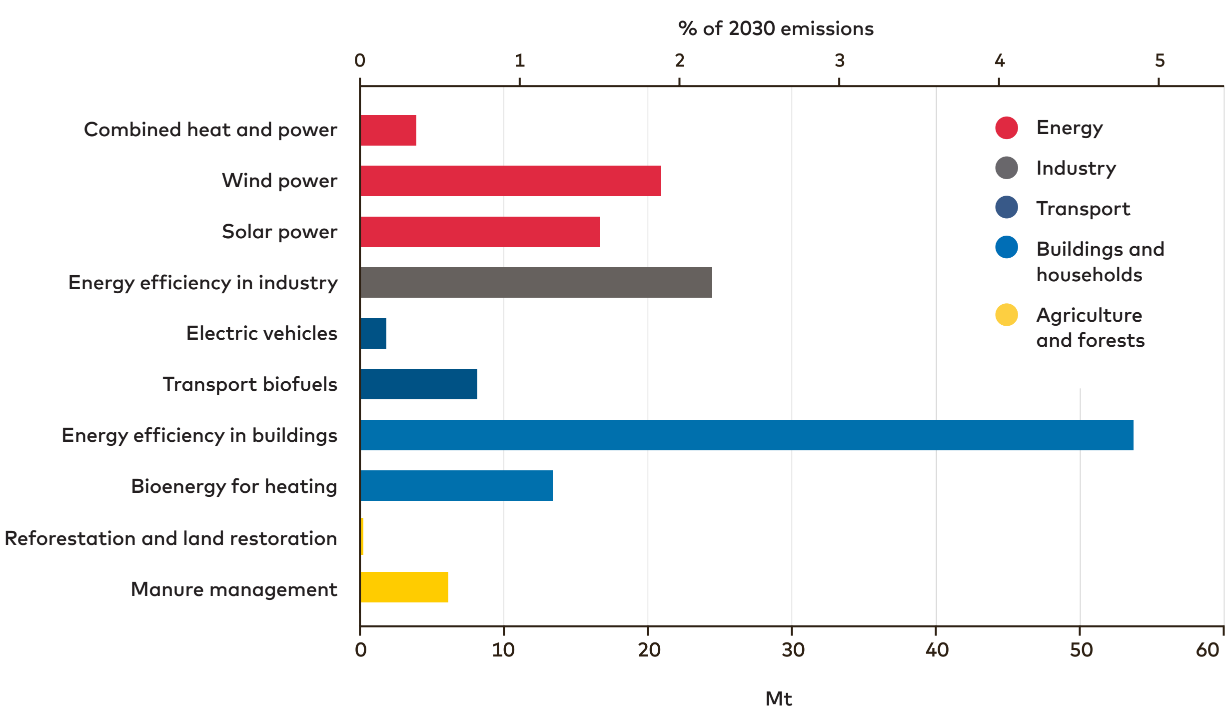


Table 1: Emission reduction potential for all solutions and countries (Mt)

	Estonia	Latvia	Lithuania	Poland	Ukraine	Total[b]
Energy						
Combined heat and power	0.06	–[a]	0.07	–[a]	3.77	3.91
Wind power	1.67	1.43	2.83	3.27	11.69	20.89
Solar power	0.41	0.33	0.59	8.83	6.49	16.65
Industry						
Energy efficiency in industry	1.40	0.34	0.64	16.36	5.71	24.45
Transport						
Electric vehicles	0.06	0.07	0.12	1.06	0.51	1.82
Transport biofuels	0.14	0.21	0.28	3.63	3.87	8.13
Buildings and households						
Energy efficiency in buildings	1.28	0.72	0.87	26.09	24.71	53.68
Bioenergy for heating	–[a]	–[a]	–[a]	9.40	3.99	13.39
Agriculture and forests						
Reforestation and land restoration	0.02	0.03	0.02	0.08	0.09	0.24
Manure management	0.11	0.28	0.43	2.33	2.99	6.14
Total[b]	**5.15**	**3.41**	**5.85**	**71.05**	**63.82**	**149.28**
% of 2030 emissions	**37.6**	**33.8**	**34.0**	**18.9**	**9.2**	**13.5**

a: Solutions not analysed for these countries as they have already reached higher levels than in the reference countries.
b: Totals may slightly differ from the sums of their parts as a result of rounding.

Not all solutions were applicable to all countries. For instance, the Baltic States already have higher shares of bioenergy in heating than the reference case of Finland, so scaling up to that level would provide no additional emission reductions.

Costs and savings

Taking into account both costs and savings, implementing the solutions would actually save money over time. The net saving in 2030 could be as much as 1.2 billion euros for the five countries combined. This figure does not include the additional benefits that would arise from reducing health problems caused by air pollution, for example.

The solutions with the largest potential to cut emissions are also very cost-efficient. Energy efficiency in buildings would bring total net savings of 2.9 billion euros and energy efficiency in industry some 500 million euros in 2030. The reduced energy consumption and the savings are therefore larger over time than the costs of implementing the solutions.

The other solutions come with a price tag. The highest costs are for scaling up bioenergy for heating (€1 billion), wind power (€500 million) and solar power (€400 million). However, these solutions also have relatively large potential to cut emissions.

The costs for even the most expensive solutions would be more than offset by savings from energy efficiency. Moreover, the costs are quite manageable compared with public fossil fuel and energy subsidies in many countries. For example, analysis by the Overseas Development Institute suggests that Poland spends more than half a billion euros annually supporting fossil fuel production and consumption

Figure 3: Net costs of scaling up the solutions in the target countries in 2030

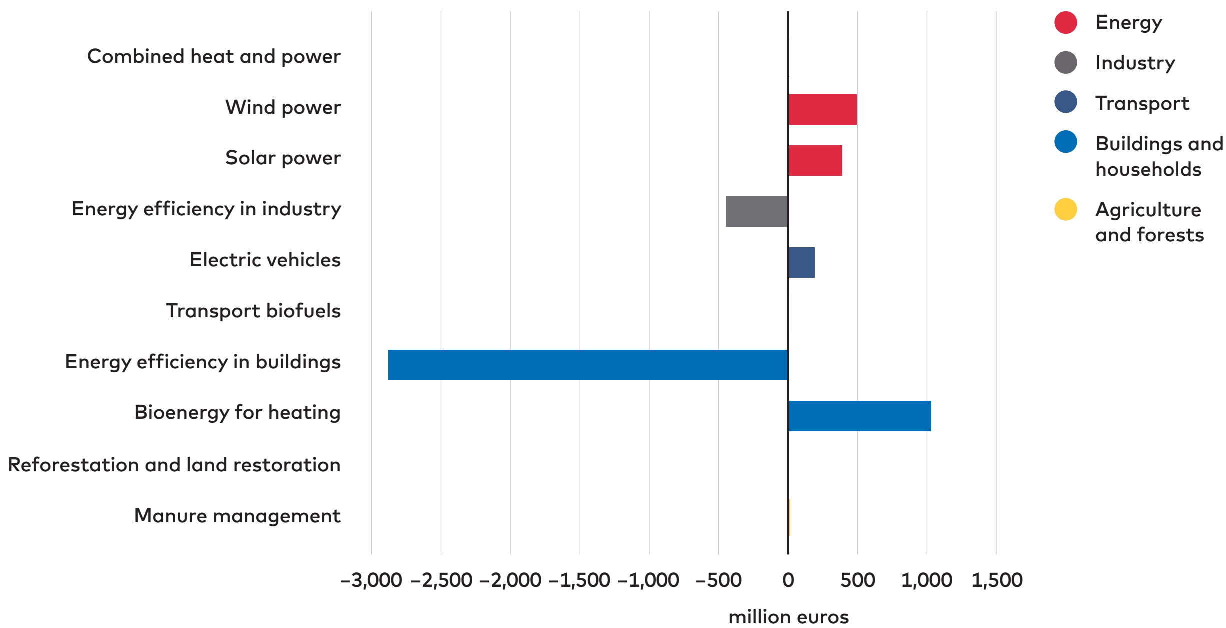
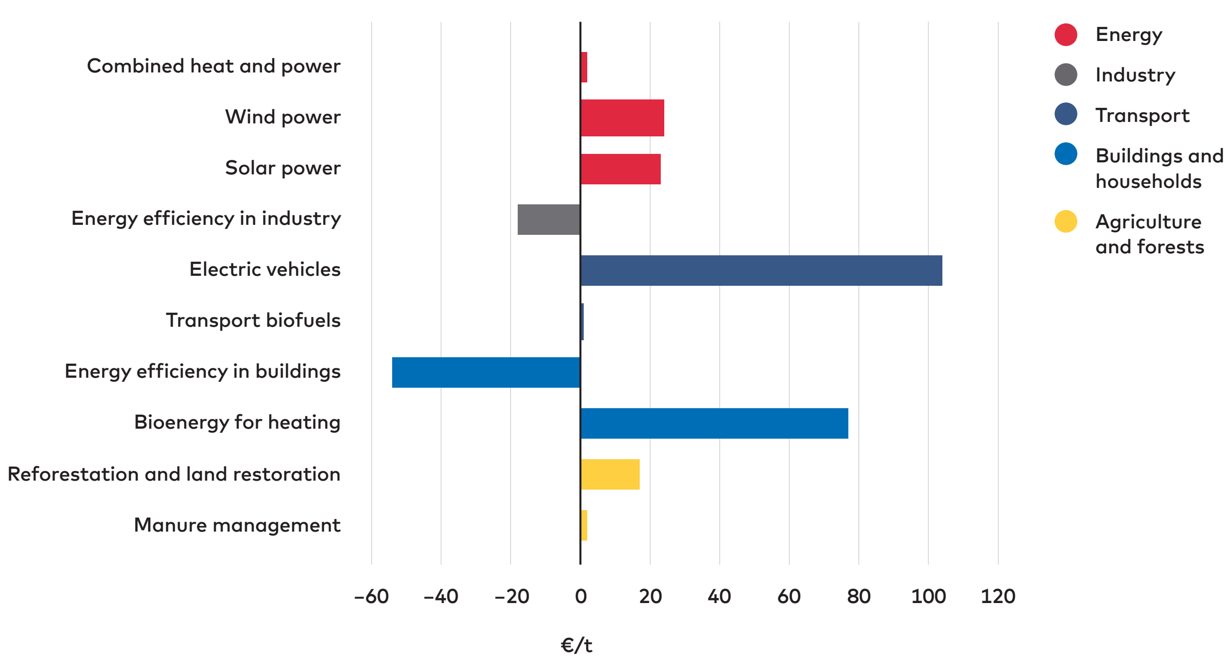


Figure 4: Net unit abatement costs for the solutions in 2030



– a sum that would go a long way in financing the climate solutions.

The unit abatement costs are estimated to be the highest for electric vehicles (104 €/t CO_2 reduced) and bioenergy for heating (77 €/t). Solar power, wind power and reforestation would each cost about 20 €/t, compared with current allowance price of around 13 €/t in the EU emissions trading system. Energy efficiency is most cost-effective: the price of cutting one tonne of emissions would be −54 euros for efficiency in buildings and −18 euros for efficiency in industry – in other words the solutions would actually save money.

Other benefits

The solutions would also provide a range of other benefits to people and the environment (what are known as co-benefits). These include:

- cutting air pollution and related health impacts;
- reducing energy imports and improving energy security;
- creating or retaining jobs;
- increasing or maintaining ecosystem services;
- providing new income streams and tax revenue.

When considering different solutions, the full benefits to society need to be taken into account. Even if some solutions may not deliver large reductions in greenhouse gas emissions or significant savings, on balance they may still be worth implementing.

For some solutions the primary motivation may actually be the various benefits not directly related to climate. Saving money is likely to be an attractive selling point for improving energy efficiency in the Baltic States, for example. Similarly cutting air pollution in cities may encourage investing in electric cars in Poland and achieving energy independence can drive investment into renewable energy in Ukraine.

As the world transitions to a low-carbon economy, there will be a vast and growing market for climate solutions. Countries ahead of the curve will have a competitive advantage. They get an opportunity to sell technology and expertise to other countries. They will also be better prepared for increasing demands from international agreements, markets and citizens.

Climate solutions provide many other benefits to people and the environment

Barriers and enablers

The analysed solutions are feasible, affordable and attractive. So why are countries not implementing them on a larger scale already?

Even the best solutions can be held back by various barriers. The issues slowing down implementation vary from one country and solution to another, but some common factors can be identified:

- large investment costs and lack of financing;
- outdated infrastructure and policies, such as subsidies to fossil fuels;
- weak carbon pricing and lack of clear policy signals;
- competing uses for land;
- lack of awareness and skills;
- concerns about the sustainability of biomass;
- poor monitoring and enforcement of regulations.

Luckily, many of these barriers can be removed. Countries can learn from Nordic countries and others that have already succeeded in introducing the solutions to scale. Some of the enablers common to many solutions include:

- technology and market development bringing down costs;
- ambitious targets and clear road maps;
- targeted financial incentives and taxes differentiated according to emissions;
- strengthened carbon pricing and the phase-out of harmful subsidies;
- improved access to finance;
- information, training and technical assistance;
- legal obligations and regulation;
- co-operation between public authorities;
- enforcement of existing European and national regulations.

Policy recommendations

TO SEIZE THE POTENTIAL identified in this report, policy changes are required. Decision-makers can learn from the successes – and sometimes failures – of Nordic and other countries. This way they can choose the most effective tools suited to their national priorities and specific circumstances.

General recommendations

Several cross-cutting policies would make implementing climate solutions generally more attractive:

- set ambitious climate and energy targets compatible with the Paris Agreement;
- phase out direct and indirect fossil fuel subsidies to level the playing field;
- consider measures to strengthen carbon pricing (e.g. a price floor in the emissions trading system);
- keep legal frameworks and support instruments stable to ensure a predictable investment environment;
- enforce existing European and national regulations that help implement the solutions.

Key recommendations by solution

All solutions require targeted measures, some of which are summarised below. For more detailed proposals, please refer to the solution descriptions.

Combined heat and power (CHP)

- Prioritise CHP for big heat users in policies and planning
- Use financial incentives (e.g. investment support or differentiated taxes) to support building, retrofitting or running CHP plants
- Ensure co-operation between heat providers, users and planners to maximise the share of CHP

Wind power

- Draw up ambitious goals and road maps for wind power to provide visibility for investors
- Remove administrative and technical barriers from wind power development
- Invest in grid modernisation and connections to neighbouring countries
- Engage in dialogue with local communities and share benefits with them to increase acceptance

To seize the potential identified in this report, policy changes are required

Solar power

- Draw up ambitious goals and road maps for solar power to provide visibility for investors
- Mandate grid operators to remove technical barriers from solar power development
- Consider financial incentives (e.g. net metering or loan guarantees) for distributed solar power production
- Provide information and technical assistance for households, housing associations and small businesses

Energy efficiency in industry

- Set ambitious economy-wide and sectoral energy efficiency targets
- Provide training and technical assistance
- Promote energy management standards and require larger companies to carry out regular energy audits
- Introduce simple support measures (e.g. publicly funded energy audits) for small companies and establish guarantee schemes to derisk efficiency investments

Electric vehicles

- Set ambitious targets for electric vehicles
- Differentiate vehicle taxes and road charges based on CO_2 emissions and consider exempting electric vehicles from taxes (including VAT)
- Invest in public charging infrastructure

Transport biofuels

- Identify the availability of local sustainable feedstocks, especially waste and residues
- Increase blending obligations for sustainable, advanced biofuels
- Differentiate fuel taxes based on CO_2 emissions and phase out support for crop-based biofuels

Energy efficiency in buildings

- Offer targeted financial support (e.g. loans or investment support) for renovations to improve efficiency
- Provide information, guidance and training to apartment associations and homeowners

Bioenergy for heating

- Differentiate taxes to prioritise low-carbon heating, such as using sustainable biomass
- Provide investment support to switch from fossil fuels to biomass and consider a premium for producing heat with biomass in efficient CHP plants
- Apply sustainability criteria and limit all subsidies only to sustainable biomass

Reforestation and land restoration

- Consider introducing payments for ecosystem services to reward landowners for increasing forest stocks
- Provide information and training on best forestry practices and their benefits
- Strengthen surveillance and prosecution of illegal wood cutting

Manure management

- Provide information and training on sustainable farming and its benefits
- Provide financial support for investments in producing biogas from manure
- Incentivise the use of biogas in transport

What can other countries learn from the Nordics?

Although a lot of work remains to be done, the five Nordic countries – Finland, Sweden, Denmark, Norway and Iceland – have been relatively successful in reducing emissions from different sectors. Importantly this has happened while growing their economies (figure 5).

Each Nordic country has its own strengths and challenges. For instance, Iceland is a world leader in geothermal energy and Denmark is known for cycling in cities. Other countries can use the Nordics as living laboratories, learning from their successes – and their failures.

Not all Nordic approaches will work in other countries and circumstances. However, many experiences can be helpful when devising policies fit for one's own country.

What is common to the Nordic countries is a commitment to work together, both within the region and internationally. These countries are open to sharing their experiences with others, this report being one example. Nordic countries, in turn, can learn from others – helping everyone move further and faster in taking climate action.

Figure 5: Emissions and economic development in the Nordic countries in 2000–15

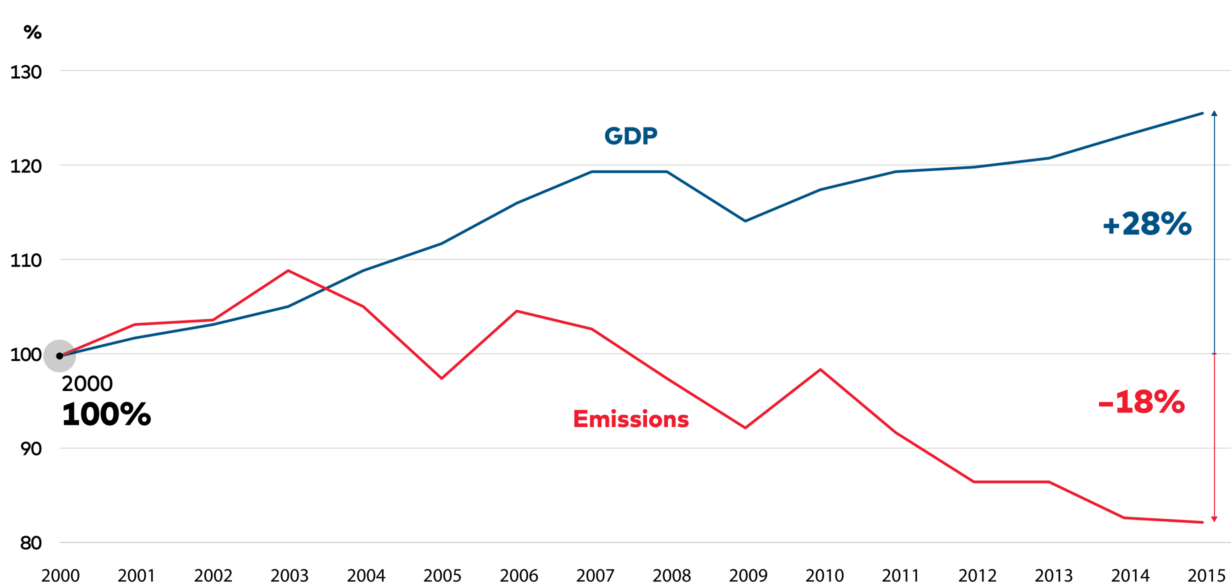


Foto: Istock

Country results

THE STUDY ANALYSES scaling up existing climate solutions in five European countries: Estonia, Latvia, Lithuania, Poland and Ukraine. The countries share many similarities, but also have important differences. The table below summarises key facts in numbers.

In EU member states Estonia, Latvia, Lithuania and Poland, climate and energy policy is defined by common EU decisions. The 2030 climate and energy package sets an overall goal of cutting emissions by at least 40% from 1990 levels. The package also includes EU-level targets for reductions in the emissions trading sector, increase in the share of renewable energy and improvements in energy efficiency, as well as country-specific targets for emissions outside of the trading sector.

The five countries share many similarities, but also have important differences

Estonia

The Estonian National Development Plan of the Energy Sector sets targets for the shares of renewable energy in final energy consumption (50%), heat (80%) and electricity (50%) by 2030. Emissions outside of the trading sector are proposed to be cut by 13% from 2005 levels.

Scaling up the analysed solutions in Estonia would cut emissions by 5.2 Mt in 2030, equalling a reduction of around 38% of projected 2030 levels. To put the figure into perspective, this would be almost twice as much as Iceland produces today.

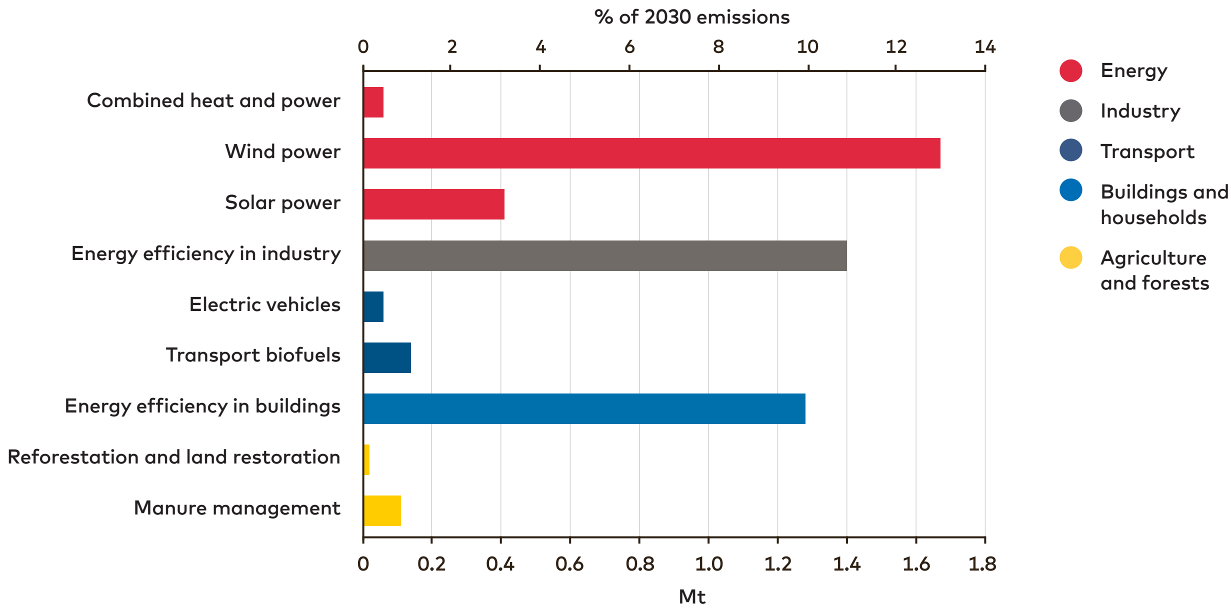
The largest potential comes from wind power (1.7 Mt), followed by energy efficiency in industry

Table 2: Country information in figures (2016)

	Estonia	Latvia	Lithuania	Poland	Ukraine
Basic information					
GDP (€ m)	21,083	24,909	38,611	425,842	84,262
GDP per capita (€)	16,016	12,707	13,442	11,221	1,974
GDP per capita (index, EU average = 100)	55	44	46	39	7
Population (thousand)	1,317	1,960	2,872	37,948	45,005*
Land area (km^2)	42,390	62,180	62,650	306,190	579,290*
Emissions					
Emissions (Mt CO_2e)	15.7	12.7	13.4	357	308.6
CO_2 emissions (t/capita)	14.8	3.5	4.4	7.5	5.0
CO_2 emissions (kg/GDP €)	0.8	0.3	0.3	0.5	1.6
Renewable energy					
Share of renewable energy (% of gross consumption)	15.5	37.2	20.8	8.8	–

* The data excludes the Autonomous Republic of Crimea with a population of 2,018,400 and a territory of 26,100 km^2.

Figure 6: Emission reduction potential in Estonia in 2030



(1.4 Mt) and buildings (1.3 Mt). Wind power would cut emissions by 12%, whereas energy efficiency in industry would contribute 9% and efficiency in buildings 8%. To seize the wind potential, Estonia could consider piloting auctions as a cost-effective tool to increase production.

Latvia

The Long-Term Energy Strategy up to 2030 was adopted in Latvia in 2013, but it does not include ambitious long-term renewable energy targets. The proposed EU target for reductions outside of the emissions trading sector is –6%.

The potential in Latvia is 3.4 Mt, cutting emissions by about 34% of projected 2030 levels. The emission reduction would be equal in size to the current emissions of Montenegro.

Like Estonia, wind power has the largest potential (1.4 Mt), followed by energy efficiency in buildings (0.7 Mt). In relative terms, wind power would cut emissions by 14%, whereas the role of efficiency in buildings would be 7% and in industry 3%.

Piloting auctions could be a cost-effective tool to increase wind power also in Latvia. To promote building energy efficiency, a requirement to establish apartment associations would help.

Figure 7: Emission reduction potential in Latvia in 2030

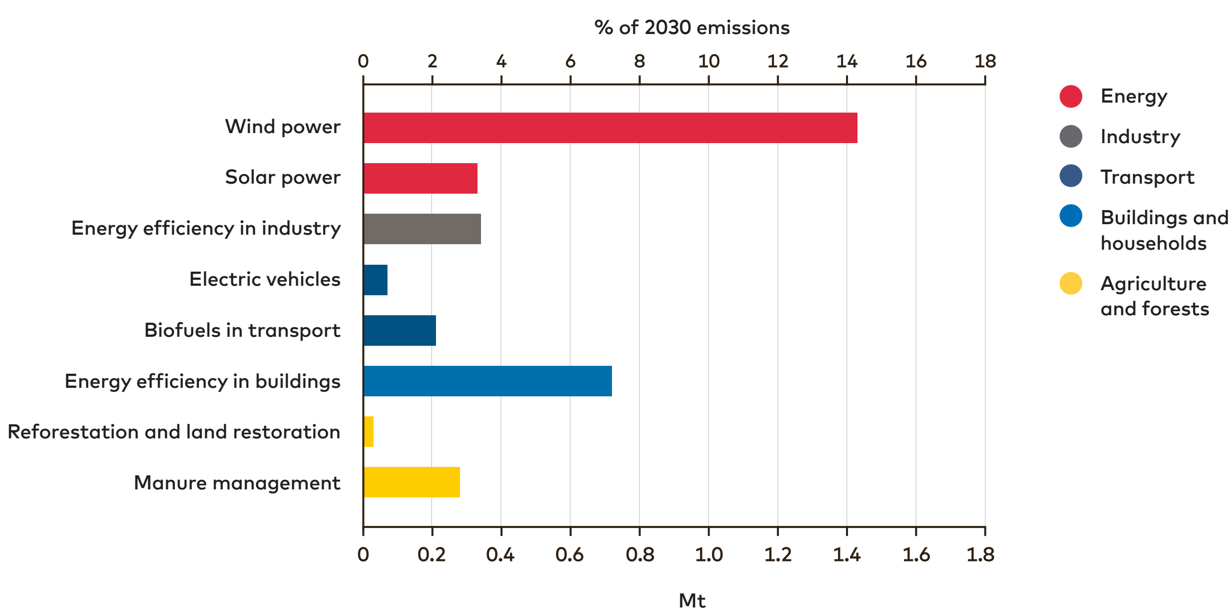
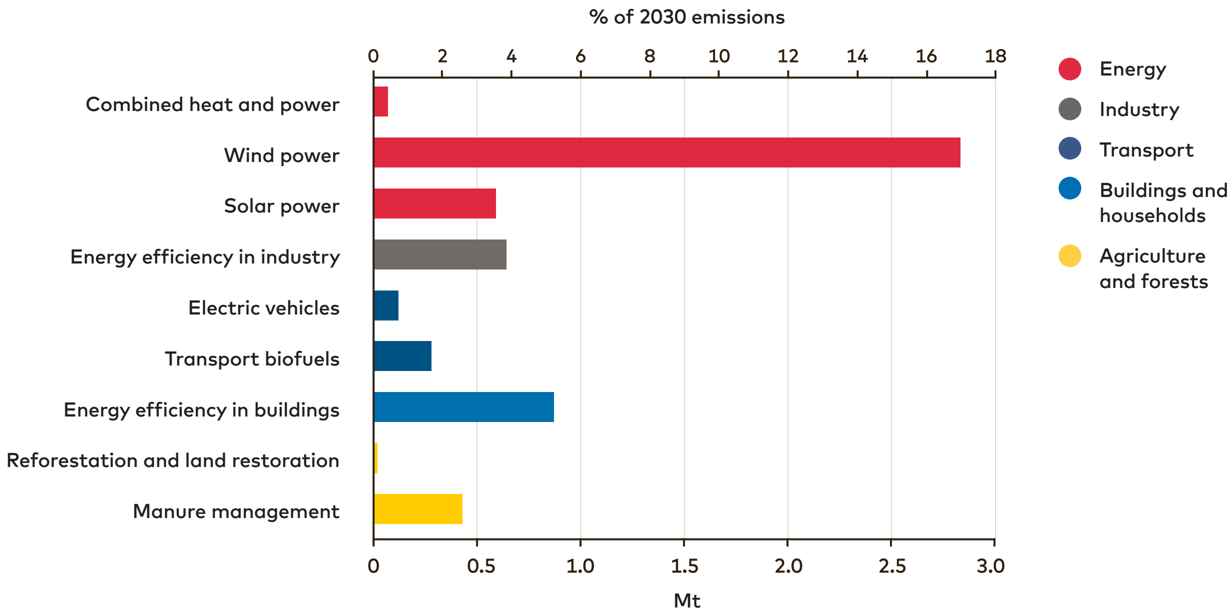


Figure 8: Emission reduction potential in Lithuania in 2030



Lithuania

The new national energy strategy in Lithuania includes targets for the share of renewable energy in the gross final energy demand of 45% in 2030 and 80% in 2050. The 2030 target for cutting emissions outside of the trading sector is proposed to be −9%.

Scaling up the solutions in Lithuania would cut emissions by about 5.9 Mt or 34% of the projected 2030 levels. This would be more than twice as much as Iceland produces today.

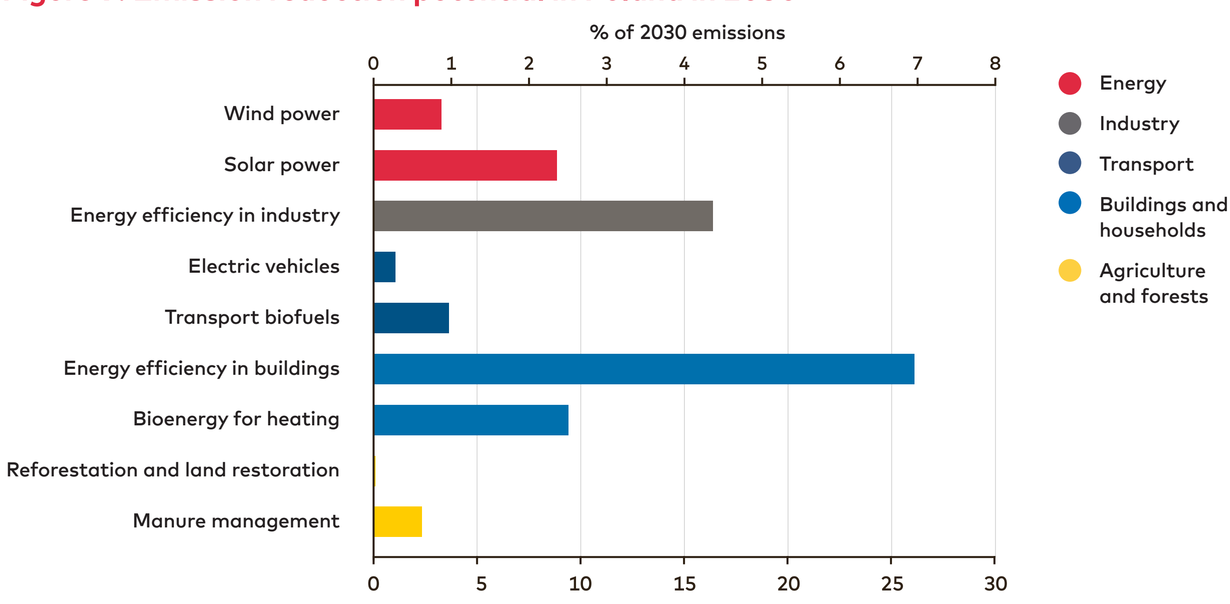
By far the most promising solution is wind power, with a potential of 2.8 Mt. Wind power alone could cut Lithuania's emissions by close to 17%, followed by 4% for energy efficiency in industry. As in Latvia, promoting the self-organisation of apartment owners for apartment buildings would facilitate improving energy efficiency in buildings.

Poland

The Polish government is preparing a new energy policy for up until 2050 with a focus on 2030. The proposed EU target for emissions outside of the trading sector is −7%.

Scaling up the solutions in Poland can cut emissions by 71 Mt, which equals 19% of Poland's projected 2030 emissions. To put the figure into perspective, it is more than Austria produces today.

Figure 9: Emission reduction potential in Poland in 2030



Energy efficiency solutions have the largest potential: efficiency in buildings would cut emissions by 26 Mt (7% of 2030 levels) and in industry by about 16 Mt (4%). Bioenergy for heating and solar power would both result in reductions of about 9 Mt (3%). A requirement to establish apartment associations would help to promote building energy efficiency also in Poland.

Ukraine

As a non-EU country, Ukraine has its own national emission target under the Paris Agreement. This Nationally Determined Contribution (NDC) commits to keeping emissions at 40% below 1990 levels in 2030. The recently adopted energy strategy sets a target of 25% of electricity from renewable sources in 2035.

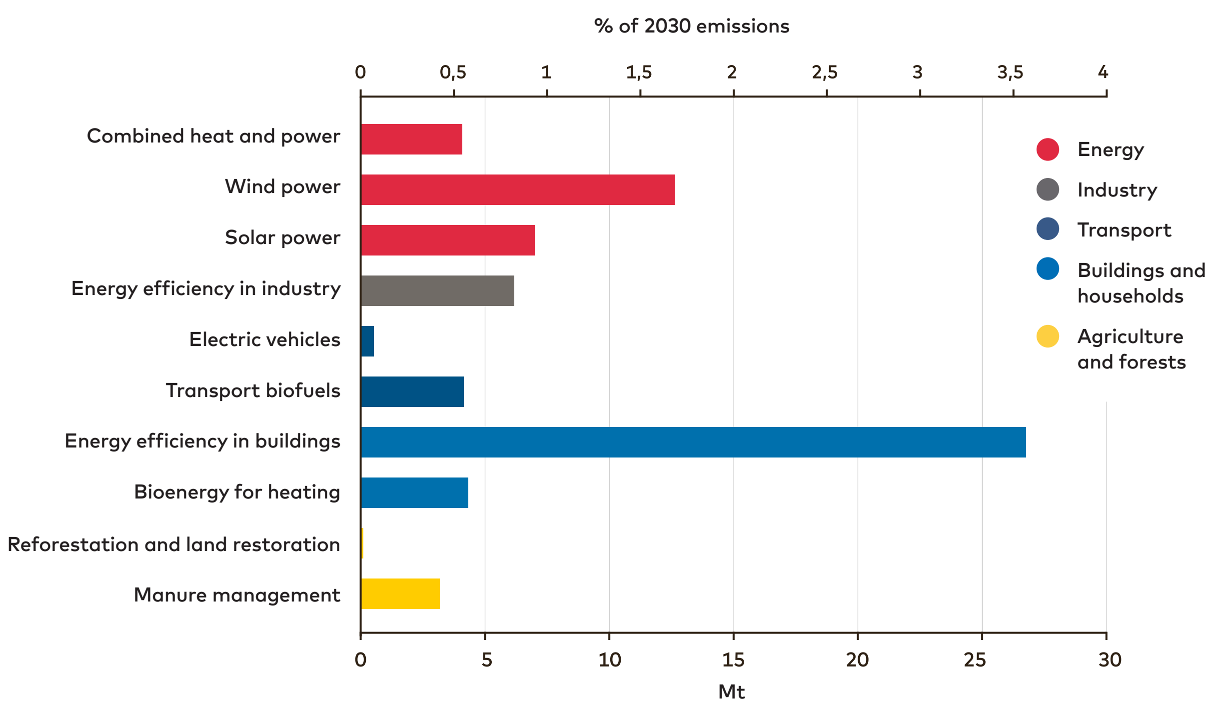
The potential in Ukraine is 64 Mt – quite similar to Poland. However, relatively speaking, the share is much smaller (9% of 2030 levels) because Ukraine's emissions are still projected to increase. Nevertheless, the reduction would be larger than the total emissions of Portugal today.

Energy efficiency in buildings has the largest potential (about 25 Mt), followed by wind power (12 Mt). As a share of 2030 emissions, efficiency in buildings would cut emissions by 4% and 2% for wind power.

Public guarantees would reduce the cost of lending for building efficiency investments in Ukraine. Improving monitoring and verification of energy efficiency projects would increase their impact.

Deregulating energy markets and prices would allow independent producers to compete by providing efficient solutions and increase incentives to improve energy efficiency. Auctions could be piloted as a cost-effective tool to increase wind and solar power. In general, enhancing anti-corruption and transparency initiatives in the energy sector would improve efficiency.

Figure 10: Emission reduction potential in Ukraine in 2030



Discussion: making sense of the results

Why these solutions and countries?

The solutions and countries were selected by the project steering group, informed by experts in the target countries and the advisory council. The number of both solutions and countries was limited by the resources available.

The 10 solutions were selected out of the more than 30 analysed in the previous Green to Scale reports. The main criteria used were emission reduction potential, scalability, balance between different sectors and reference countries, as well as analysis feasibility.

Many other solutions could have been included, given more resources. For example, offshore wind power, cycling in cities and solar heating could all hold promising potential.

The five target countries were selected because they have relatively strong links with the Nordic countries and their institutions. Some of the countries also play a particularly important role in climate policy and action – for example, Poland will host the UN Climate Conference COP24.

Are the solutions applicable to the countries?

We believe so, for at least a couple of reasons. First, the solutions were selected precisely to fit the needs of the target countries. Many others were left out as they might not work as well.

Second, while circumstances can vary, some solutions can be applied very widely. For example, solar panels and wind power plants rely on the same technology, whether they are used in Sweden or Poland.

Third, the same results can be reached in different countries with different tools. For example, not all countries may be able to rely on the considerable public subsidies Norway has used for promoting electric vehicles. However, they can choose different measures, better suited to them: free parking, priority lanes, quotas in public purchasing, taxes on high-polluting cars and so on.

How realistic is the potential?

The short answer is: broadly very realistic. However, it varies from one solution or country to another. There are also factors that make the estimates both optimistic and pessimistic.

The Green to Scale approach is, by definition, conservative. It only includes a small subset of existing solutions that have been implemented at scale somewhere else. The solutions are only scaled up by 2030 to the extent that some countries have already achieved today.

Moreover, reality checks have been applied to make sure none of the cases go beyond what can be considered generally feasible. For example, the share of wind power in the electricity mix is kept below a level the reference country Denmark has already passed.

The Green to Scale approach is, by definition, conservative

But can the solutions be implemented in practice?

It depends – and mostly on the policy choices countries make. If leaders take decisive action to remove the barriers delaying the implementation of these solutions, they can realise the potential identified in this study – and even go beyond (see Is this all countries can do?).

Sometimes introducing the required policies is not easy. However, decision-makers can learn from Nordic countries and others that have already been successful in implementing the solutions, to avoid mistakes and to ensure they choose the most effective tools.

How can the investments be financed?

Most analysed solutions are affordable or can even save money over time. However, they often require relatively large investments. In poorer countries especially, financing may not be easily available or may come at a high premium.

Luckily, various tools exist to finance climate projects. EU countries can benefit from tools like the European Fund for Strategic Investments (EFSI). The European Investment Bank (EIB) and the European Bank for Reconstruction and Development (EBRD) operate both inside and outside the Union. (For Nordic financing windows, please see the box below.)

Phasing out fossil fuel subsidies would cover large parts of the required investment

Nordic tools for financing climate action

Many multilateral Nordic financial institutions finance climate action in other countries. These include the Nordic Environmental Finance Corporation (NEFCO), the Nordic Investment Bank (NIB) and the Nordic Development Fund (NDF).

The regional focus of NIB and NEFCO has been in the Nordic, Baltic and Eastern European states, but it is broadening to cover other regions. The Nordic Development Fund's operations are primarily targeted at low-income countries in the global South.

NEFCO focuses on financing projects that generate positive environmental results, such as energy efficiency in buildings and renewable energy. NEFCO provides a wide range of instruments for both private and public organisations, ranging from equity and loans to grants. NIB finances projects that improve competitiveness and the environment through providing long-term loans and guarantees in various sectors, from energy and transport to investments improving the environment or manufacturing processes.

There are also national institutions in the Nordic countries providing climate financing. The Danish Investment Fund for Developing Countries (IFU), for example, has a dedicated Climate Investment Fund (KIF). In addition, all five Nordic nations provide funding for development co-operation, including low-carbon development.

Countries can also redirect spending to finance climate solutions. Phasing out subsidies to fossil fuels and energy use would cover large parts, if not all, of the required investment – and benefit the economy. Even relatively small taxes on fossil fuels could deliver additional revenue.

Is this all countries can do?

Absolutely not. Countries can do much, much more, mainly for two reasons.

First, this study only covers 10 solutions. However, there are many more out there: the previous Green to Scale reports included more than 30 solution cases, Project Drawdown has listed 100 climate solutions and Bertrand Piccard is working to identify 1,000 solutions. Not all of them will work in all countries, but many will, providing additional emission reduction potential.

Second, our analysis only applies the solutions to the extent some countries have reached already. However, this by no means fulfils their full potential. For example, by 2030 countries could be able to surpass the share of electric vehicles in Norway today, as technology develops and prices come down.

What about the cost estimates?

Take them with a pinch of salt. While we have selected the cost data for a reason (see Methodology for an explanation), the results are better seen as indicative rather than exact.

The underlying data is based on global average abatement costs. Understandably actual costs may vary significantly from one country to another.

Moreover, the cost estimates are already relatively old. The rapid reduction in the costs of many climate solutions, most notably wind and solar power, may make them even more competitive than these figures suggest. Including the economic impact of the various co-benefits related to implementing the solutions would make them even more attractive.

Can we increase biomass use sustainably?

Two of the solutions rely on biomass: transport biofuels and bioenergy for heating. In addition, combined heat and power production may use biomass as one fuel option.

Sustainability concerns related to biomass use need to be taken seriously. Impacts can vary widely depending on what feedstock is used and how it is sourced.

Burning the fuel releases the carbon contained in the biomass instantly, to be absorbed back into growing plants over years or decades. From a climate point of view the negative impact is immediate, but the positive impact only appears over time – and time is a luxury that tackling the climate crisis does not afford. Moreover, intensive forestry practices and the cutting down of natural forests may endanger biodiversity.

Two key safeguards are required to ensure the sustainability of biomass. First, policies should prioritise the most sustainable feedstocks (such as wastes and residues) and prevent the use of the most harmful ones (such as palm oil produced at the expense of tropical rainforests). Second, biomass can only play a role to the extent the available resources sustainably allow.

How can I use the results in my country?

The results can help in guiding climate action in several ways. First, the analysis highlights solutions which hold additional potential to reduce emissions in the target countries (and elsewhere). Second, the report makes concrete policy recommendations to help seize this potential. Third, the study identifies Nordic and other countries that have already been successful in implementing the solutions, providing interesting reference cases from which to learn.

The report is an effort to present key results and recommendations in a concise form. Further studies would help in exploring both the potential of solutions and the measures to promote them in more detail. Country-specific circumstances – political and otherwise – need to be kept in mind when considering different options.

The results can help decision-makers in guiding climate action

Foto: Ricky John Molloy/ Norden.org

Methodology

The basic concept of Green to Scale is straightforward: analysing the potential of scaling up existing climate solutions to the extent that some countries have already achieved. However, getting from a good idea to robust results requires several steps and important assumptions. In this chapter we explain how the analysis was carried out.

Selecting the solutions

First, 10 solutions were selected for scaling up by the project steering group. The decision was based on a proposal by SEI Tallinn, with guidance from the advisory council and experts in the target countries.

The solutions were picked from a pool of more than 30 solution cases studied in the previous Green to Scale projects. Four primary criteria were used.

1. **Potential.** The solutions are expected to have considerable emission reduction potential in one or more of the target countries.
2. **Scalability.** The solution is applicable to the target countries and can fit their national strategies.
3. **Balance.** The set of 10 solutions covers different sectors and reference countries.
4. **Feasibility.** Analysis is feasible with available data.

In addition, broader sustainable development was considered. A solution may not always deliver huge climate benefits as such, but it may be important for preserving biodiversity, for example.

The basic concept is straightforward: analysing the potential of scaling up existing climate solutions to the extent that some countries have already achieved

Scaling up

Identifying the degree of implementation. Green to Scale analyses scaling up climate solutions to the extent a reference country has achieved to date. The degree of implementation for each solution – e.g. the share of wind power potential built – was already defined in the previous Green to Scale reports. However, it was updated to take into account recent progress in reference countries.

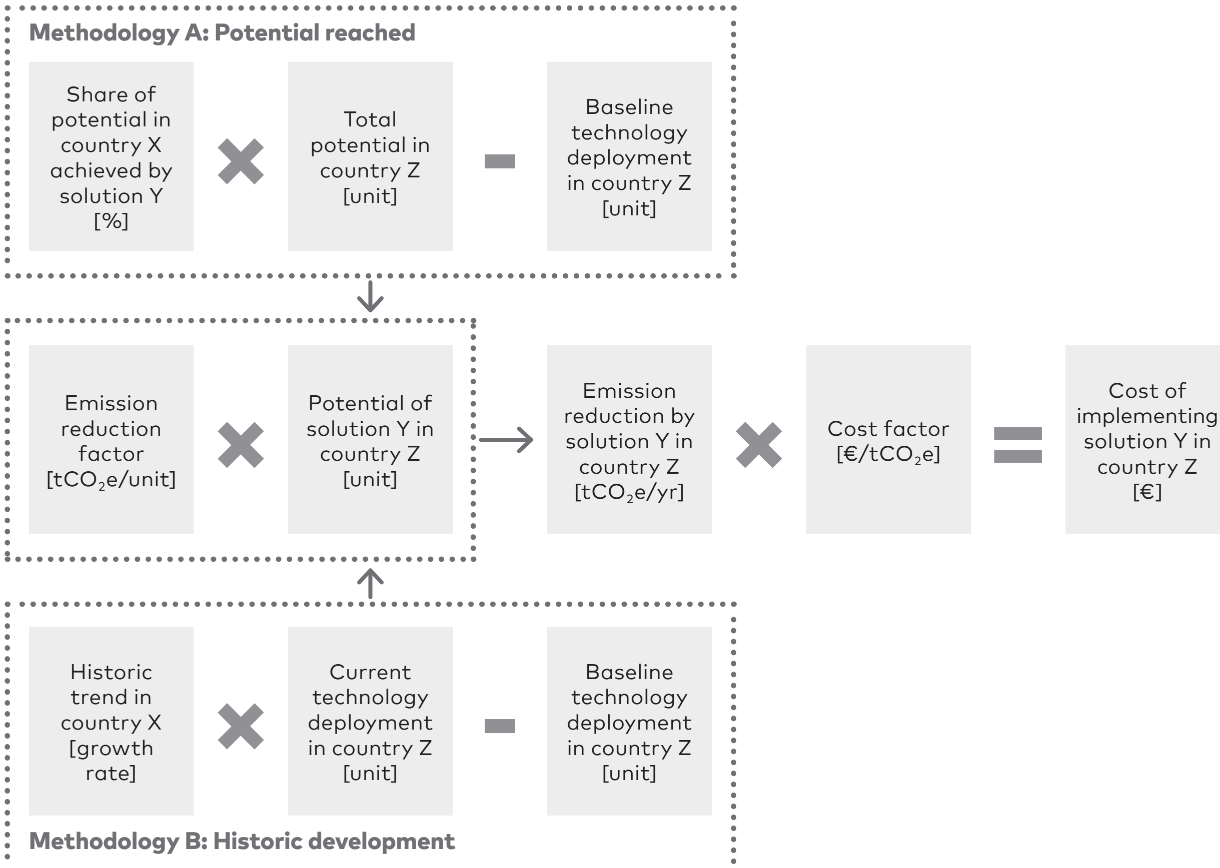
Defining a baseline. To isolate the additional potential of scaling up, we need to understand to what extent the solutions will already be applied with the current pathways. The baseline scenario broadly followed what countries would do if they implemented their current policies but did not introduce new measures. National targets were not included in the baseline, unless accompanied by sufficient policies.

Scaling up. For scaling up each solution, one of two approaches was used.

1. **Share of potential**. Expecting target countries to achieve by 2030 the same share of their respective potential as the reference country has achieved to date.
2. **Rate of change.** Expecting target countries to achieve the same annual rate of change by 2030 as the reference country has achieved in the past.

Calculating emission impact. The degree of implementation in the target countries was then translated into emission impact. For instance, for wind power we estimated how much it would replace other electricity production and how much this, in turn, would cut emissions. In the case of electric vehicles, we calculated the emission reduction from replacing fuel burnt in conventional cars minus the emissions from generating the electricity to power the cars. Finally, we subtracted the baseline level of implementation from the scale-up scenario, calculating the emissions reduction potential as the difference in emissions between the two scenarios (what would happen with current policies as opposed to what can happen if the solution is scaled up).

Figure 11: Schematic description of methodology



Estimating costs

Costs for each solution were calculated by multiplying the emission reduction potential with a unit abatement cost (€/t CO_2e). For cost data we have relied largely on version 2 of the Global Greenhouse Gas Abatement Cost Curve by McKinsey, updating the values to 2017 euros.

McKinsey data was used as it provides estimates for a broad range of solutions, allowing comparing costs across solutions and sectors. Although quite old, the cost curve is still the most comprehensive and internally consistent analysis broad enough to cover many of the solutions we included. It also allows a broad comparison of the results from this study with those from the previous two Green to Scale projects.

In cases where labour constitutes a large share of costs, data was adjusted for each country using purchasing power parity (PPP). For capital-intensive solutions the rates were only adjusted for inflation.

The estimates cover the direct investment and operational costs minus the direct savings of implementing the solution. As quantifying the economic impact of co-benefits (such as reduced air pollution) can be tricky, we assessed them qualitatively instead.

Abatement costs reflect the cost difference between the solution and its conventional alternative. For example, the fact that scaling up onshore wind is expected to have a net cost implies that wind would, on average and taking into account integration costs, still be slightly more expensive than fossil alternatives in 2030.

However, the estimate is highly sensitive to the relative cost of wind and fossil power. Even a minor improvement in favour of wind could turn the cost into a saving. Recent data suggests that many climate solutions may become cheaper faster than expected as technologies develop and they are applied more widely, creating economies of scale.

Other considerations

Qualitative analysis. Country-level enablers, barriers and co-benefits were identified based on literature and expert knowledge and further discussed with local experts in focus groups and interviews. Enablers are conditions and measures that facilitate the

All Green to Scale material can be downloaded at greentoscale.net

scaling up of the solutions whereas barriers are factors limiting wider deployment. Co-benefits are environmental, economic and social gains stemming from the implementation of the solution, in addition to cutting greenhouse gas emissions.

Policy recommendations. Country-specific policy recommendations were derived from the analysis of the solutions. The draft recommendations were discussed with local experts in focus groups and interviews.

Sanity checks. Following the method described above might in some cases lead to unrealistically high or fast levels of implementation. For instance, the share of wind power in the electricity mix could go beyond what may be considered feasible for some countries with current technologies. In these cases we have applied sanity checks, constraining the potential to make it more realistic (e.g. onshore wind not reaching more than a 40% share of electricity production).

Indirect emissions. The analysis covers emissions that are directly affected by the solution – for example fuel use reduced by electric vehicles. The results do not generally include indirect impacts, such as the carbon footprint of manufacturing the cars. In most cases indirect emissions would be difficult to determine reliably or relatively marginal. However, for transport biofuels we have included an approximation of life-cycle impacts, recognising that their production may result in significant emissions.

Overlap. Some of the solutions address emissions from the same sources. For instance, energy efficiency in buildings, combined heat and power (CHP) and bioenergy in heating all reduce emissions from heating buildings. Taking into account this overlap might reduce the combined emission reduction potential identified in this study. However, the net impact may not be particularly large for a couple of reasons.

First, the potential of CHP and bioenergy for heating has not been estimated for all countries, as they have already surpassed the levels of implementation in the reference countries. Second, there can also be positive overlap – for example replacing fossil fuels in power production increases the emission reduction potential of moving to electric cars. As quantifying the overlap with any degree of accuracy for the different countries would be challenging, it falls beyond the scope of this report.

Units. If not specified otherwise, all emission numbers refer to carbon dioxide equivalents (CO_2e). The most commonly used units are megatonnes (millions of tonnes, Mt) and gigatonnes (billions of tonnes, Gt). Electricity production is expressed in terawatt hours (TWh).

Further reading

More information on the methodology, assumptions, data and sources is available in the technical report. For more information about the different solutions and their application in the reference countries, please refer to the previous Green to Scale reports. All material can be downloaded at greentoscale.net.

Foto: Flickr/skatkraft

Project background

The Nordic Green to Scale for countries project was launched by the Finnish Innovation Fund Sitra (sitra.fi/en). Sitra served as the project secretariat and contributed both financial and in-kind resources.

Core funding was kindly provided by the Nordic Council of Ministers (NCM) Climate and Air Pollution Group KoL. The project is also included in the Nordic Prime Ministers' Initiative, Nordic Solutions to Global Challenges.

The project commissioned the Stockholm Environment Institute (SEI) Tallinn Centre (sei.org/centres/tallinn) to carry out the analysis, led by Director Lauri Tammiste. SEI Tallinn used local analysis partners in the target countries: the Institute of Physical Energetics in Latvia, the Lithuanian Energy Institute in Lithuania and the Institute for Environment and Energy Conservation in Ukraine.

The project steering group consisted of representatives of Nordic partner institutions: CICERO Center for International Climate Research from Norway, CONCITO from Denmark and the Institute for Sustainability Studies at the University of Iceland. NCM Climate and Air Pollution Group doubled as an advisory council to the project, providing further guidance.

Nordic Green to Scale for countries builds on two earlier phases of the project. In 2015, Green to Scale analysed the potential of 17 climate solutions globally. In 2016, Nordic Green to Scale looked at applying 15 Nordic climate solutions in comparable countries around the world. Another part of the current project focused on two countries in East Africa, Kenya and Ethiopia.

Reports, other material and further information can be found online at greentoscale.net. If you would like to know more, do not hesitate to contact the project secretariat (greentoscale.net/#contact-us). Please also let us know if you are interested in exploring possibilities for co-operation.

Green to Scale is included in the Nordic Prime Ministers' Initiative Nordic Solutions to Global Challenges

SOLUTIONS CATALOGUE

Contents

ENERGY

Combined heat and power

Finland and Denmark provide large shares of heat for buildings and industry by using efficient combined heat and power production. Scaling up the solution would cut emissions by as much as taking 2.7 million new cars off the road.

Solution description

Combined heat and power (CHP) production generates both heat and electricity, extracting more useful energy out of the same fuel. The technology captures the heat generated as a side product of electricity and uses it for heating houses and industrial processes, increasing efficiency and saving fuel.

Denmark and Finland are global leaders in CHP. Finland is used as a benchmark for scaling up as it uses high levels of CHP in both buildings and industry. About three quarters of district heating and most of the heat for industries in Finland is delivered from CHP.

Climate impact

If the target countries were to reach the same level of CHP use by 2030 as Finland has achieved so far, they would cut emissions by almost 4 Mt in 2030. By far the highest potential is in Ukraine. The solution is not analysed for Latvia and Poland, as their current CHP share already exceeds the Finnish benchmark level.

	Mt	% of 2030 emissions
Estonia	0.06	0.4
Latvia	–	–
Lithuania	0.07	0.4
Poland	–	–
Ukraine	3.77	0.5
Total	**3.91**	

Costs and savings

The abatement cost for CHP is negative for industry and new buildings. In other words, implementing the solution would actually save money over time, as it increases efficiency and saves fuel. However, retrofitting existing urban structures with district heating would be quite expensive.

Abatement cost in 2030	
Urban district heating average (€/t)	1.6
New buildings (€/t)	–188.5
Existing buildings (€/t)	216.6
Industry (€/t)	–5.3
Total abatement cost (€ m)	8.08

Other benefits

CHP increases fuel efficiency and uses heat that would otherwise be wasted. District heating networks allow for more flexible changes in fuels compared to regular heating installations, increasing energy security. With lower fuel use, CHP reduces local air pollution and creates health benefits. Constructing and operating CHP plants and district heating networks also creates jobs.


Foto: Istock

Barriers

Building CHP and district heating is capital intensive, which can be a significant barrier for cash-strapped municipalities and industries. Previous investments into heat-only boilers, as in Ukraine, can limit the adoption of CHP, as retrofitting or replacing the installation is expensive. Improving building energy efficiency and declining populations in small towns reduce the demand for heat, making CHP and district heating economically less attractive.

Enablers

Financial incentives to establish or maintain CHP and district heating may be necessary. The Baltic States and Poland have investment support for district heating available under EU programmes, as well as national feed-in tariffs for CHP. Specific support programmes for district heating exist in Ukraine, for example from the World Bank.

Co-operation between heat providers and local governments can maximise the deployment of CHP and district heating in urban planning. For example, the two biggest cities in Estonia have made it obligatory for all new buildings and those undergoing a major renovation in a district heating area to connect to the heating network.

The EU Energy Efficiency Directive and other environmental requirements facilitate the use of CHP as it can cut fuel use and reduce pollution.

Using CHP can save money – if planned well from the start

Policy recommendations

- Prioritise CHP for big heat users in policies and planning
- Maintain or introduce financial incentives (e.g. feed-in tariffs, investment support or taxes) to support building, retrofitting or running CHP plants
- Ensure co-operation between heat providers, users and planners to maximise the share of CHP
- Open district heating networks for all heat producers (including sources of waste heat)

Wind power

Denmark and Sweden produce large and growing shares of electricity with wind power. Reaching their current average level would cut emissions in the target countries by as much as taking 15 million new cars off the road.

Solution description

Wind power provides low-carbon, renewable energy to replace fossil fuels. Rapid reductions in costs and advances in technology have made it an increasingly attractive option.

In Denmark, thanks to decades of consistent work, wind today produces more than 40% of power. Sweden is one of the few European countries with a total wind capacity of more than 6 GW, with a share of more than 10% of electricity from wind.

The two neighbouring countries have quite different circumstances: Denmark is small, but has a high population density, whereas Sweden is the opposite. To make the case more applicable for scaling up, we use the average share of the technical wind potential Denmark and Sweden have already realised (7.3%).

Climate impact

If the target countries were to reach the same average share of their respective technical wind potentials by 2030 as Denmark and Sweden already have, they would produce about 30 TWh more wind power. A majority of this, 19 TWh, would be produced by Ukraine.

Scaling up could result in unrealistically high wind power shares in Estonia and Latvia. We have therefore limited the use of onshore wind to a maximum of 40% of electricity in each country.

	Addition* (TWh)	Reduction (Mt)	% of 2030 emissions
Estonia	2.75	1.67	12.2
Latvia	2.35	1.43	14.2
Lithuania	4.65	2.83	16.5
Poland	5.38	3.27	0.9
Ukraine	19.24	11.69	1.7
Total	**34.37**	**20.89**	

* Potential above baseline in 2030

Costs and savings

The abatement cost of wind power is estimated at 24 €/t by 2030. In total, scaling up would cost €492 million in 2030 in the five target countries.

Abatement cost in 2030	
Unit cost (€/t)	24
Total cost (€ m)	492

The estimates are very sensitive to assumptions about the costs of wind power and the traditional power sources they compete with. In some European countries onshore wind is already the cheapest form of new electricity production. If wind power costs fall or fossil fuel costs rise more than anticipated, scaling up can get much cheaper – or require no extra cost at all.

Other benefits

Wind power generates new jobs in manufacturing, construction and operations, some locally. For example, in Ukraine the wind industry is estimated to employ a total of 900 people. Replacing imported energy with domestic production can increase energy security.

For land owners, wind power provides financial benefits (such as rent) which in turn produce tax revenues. Wind power helps to reduce air pollution resulting in public health benefits.

Barriers

Limited land availability and land-use restrictions (e.g. for military purposes) can be a considerable obstacle. Environmental concerns (e.g. noise, impacts on birds) also limit areas suitable for wind power development.

As building wind farms is expensive, political uncertainty about carbon pricing and support mechanisms can deter investors. Access to the grid, including the costs of connecting, can pose additional constraints.

Wind is a variable power source, creating the need to balance its output to meet electricity needs at all times. With higher shares, the technical challenges and costs related to integrating wind power get progressively larger.

Enablers

Wind development requires suitable wind resources and sufficient land area. Denmark has shown that measures for greater citizen involvement in planning and generating local economic benefits are essential in increasing the sense of ownership and reducing opposition.

A rapid fall in wind technology prices has been one of the primary drivers in the last few years. Predictable and stable support schemes, such as feed-in tariffs, green certificates and auctions, have mobilised large private investments. State policies prioritising grid access can result in wind farms not requiring any support, apart from a publicly funded grid connection.

Grid connections with neighbouring countries can help states balance their own wind power fluctuations. Adequate reserve capacity, energy storage (e.g. batteries, pumped hydro storage) and demand-side management also enable integrating large shares of wind power. For example in Lithuania, up to 500 MW of additional wind can be integrated into the grid without significant costs.

Wind power already employs around 900 people in Ukraine

Policy recommendations

- Draw up ambitious long-term goals and road maps for wind power to provide visibility for investors
- Keep legal frameworks and support instruments predictable and stable over long periods
- Remove administrative and technical barriers and streamline permit procedures
- Invest in grid modernisation and connections to neighbouring countries
- Engage in dialogue with local communities and share benefits with them to increase acceptance
- Pilot renewable power auctions where they are not yet in place (Estonia, Latvia and Ukraine)

Solar power

Germany produces a relatively high share of electricity from solar power. Scaling up to Germany's level would cut emissions by as much as taking 12 million new cars off the road.

Solution description

Solar panels harness the power of the sun to produce electricity, replacing fossil fuels. Germany already produces 7.2% of its electricity from solar power, with plans to increase production further. The success is the result of both rapidly falling technology prices and consistent policy support, including generous subsidies in the past. Of the Nordic countries, Denmark has been a pioneer in solar power, with nearly a 3% share of electricity in 2017.

Until recently – with the exception of Ukraine – solar investments in the five target countries have remained modest. In scaling up, we expect the countries to reach the same share of solar electricity by 2030 that Germany had achieved in 2016.

Climate impact

If the solution is scaled up, the five countries can produce about 27 TWh more solar power in 2030 than in the baseline, cutting emissions by more than 16 Mt. While the absolute impact would be largest in Poland and Ukraine, in relative terms the potential is bigger in the Baltic States.

	Addition* TWh	Mt	% of 2030 emissions
Estonia	0.68	0.41	3.0
Latvia	0.54	0.33	3.3
Lithuania	0.97	0.59	3.4
Poland	14.54	8.83	2.4
Ukraine	10.69	6.49	0.9
Total	**7.43**	**16.65**	

* Potential above baseline in 2030

Costs and savings

The abatement cost is estimated at 23 €/t by 2030. Total costs for scaling up solar power would be 390 million euros in 2030.

As with wind power, cost estimates are very sensitive to assumptions. With plummeting solar cell costs, solar power may turn out to be cheaper and more attractive than expected. If used to cover consumer's own consumption only, solar power may in many cases already be cheaper than buying electricity from the grid, with all the associated taxes and other costs.

Abatement cost in 2030	
Unit cost (€/t)	23
Total cost (€ m)	390

Other benefits

Solar power does not release pollution during operation and thus improves air quality and public health. Distributed power generation can increase energy security and grid resilience. Solar-powered mini-grids may bring electricity to some people who reside farther from the grid in rural areas.

As solar panels get cheaper, they provide economic savings in an increasing number of cases. In Estonia, farms and other rural businesses have started to build solar plants to reduce energy costs. Installation and maintenance of solar panels provides local jobs.

Foto: Istock

Barriers

High investment cost is still one of the main barriers for solar power. Some subsidy schemes have turned out to be more expensive than expected, increasing public criticism. The need for grid reinforcement and modernisation can be an impediment for developers, as grid capacity is limited in all target countries.

Dedicated solar farms compete for land with other uses, such as farming. Urban planning rarely integrates optimising solar use. For smaller generators, the bureaucracy surrounding permits can also be a challenge.

Enablers

Plummeting technology prices have made solar power dramatically more attractive economically, shortening payback times for investments. Residential solar power systems are today cheaper by as much as two thirds compared to 2010.

An EU directive on the energy performance of buildings requires making all new buildings nearly zero-energy. To meet the goal, some of the energy needs to be produced on-site or nearby, making solar panels an attractive option. In Ukraine, a corresponding law was adopted by Parliament in 2017.

Targeted financial incentives have been successful in kickstarting and driving solar markets. For households, net metering – used in most of the target countries – provides compensation for the solar power fed into the grid. For large solar projects, auctions are an increasingly popular tool, cutting solar project costs significantly. Increasing energy storage makes it easier to balance variable solar production with electricity use.

Providing information and technical assistance can increase solar adoption. In Germany, co-operatives have played a major role in solar development, increasing public acceptance of the energy transition.

Solar power is today 2/3 cheaper than in 2010

Policy recommendations

- Draw up ambitious long-term goals and road maps for solar power to provide visibility for investors
- Mandate grid operators to remove technical barriers from solar power development, streamline permit-issuing procedures and strengthen the grid
- Consider financial incentives (e.g. preferential loans or net metering) for distributed solar power production
- Provide information and technical assistance for households, housing associations and small businesses

Energy efficiency in industry

Improvements in industrial energy efficiency can cut costs and increase productivity. Scaling up the solution can reduce emissions by as much as taking 17 million new cars off the road.

Solution description

Industrial processes are large energy users in some countries. China's Top 10,000 programme set mandatory efficiency targets for large energy consumers, covering two thirds of China's energy consumption. Using tools such as energy measurement and management systems, regular audits and conservation plans, the programme cut energy use in participating companies by 10%.

For scaling up, a 10% improvement in energy efficiency for the whole industrial sector is expected. While the target countries may not rely on the same measures as in China, they can reach similar results with different tools, tailored to their national circumstances.

Climate impact

Achieving a 10% improvement in industrial energy efficiency would cut emissions by 24.5 Mt. The largest absolute reduction would be in Poland, whereas in relative terms Estonia has the highest potential.

	Mt	% of 2030 emissions
Estonia	1.40	10.2
Latvia	0.34	3.4
Lithuania	0.64	3.7
Poland	16.36	4.4
Ukraine	5.71	0.8
Total	**24.45**	

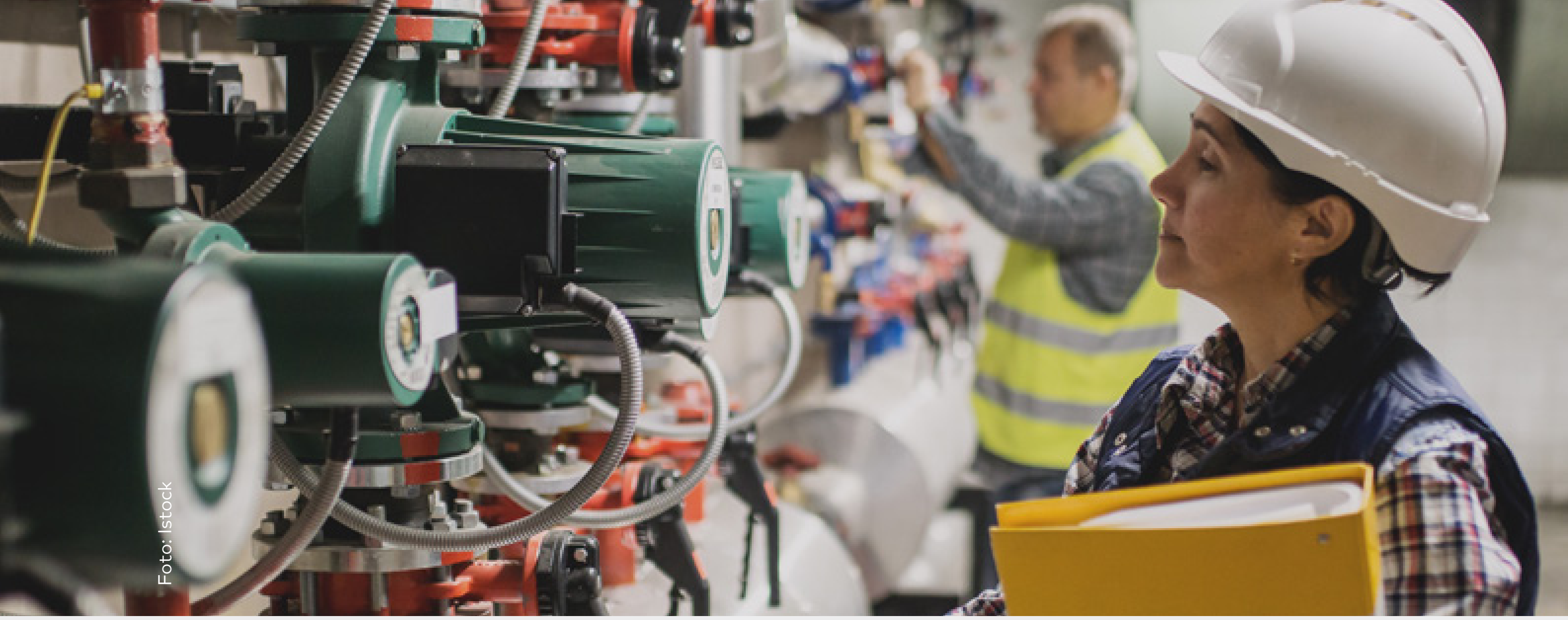
Costs and savings

The average abatement cost for the target countries is estimated at –18 €/t, meaning a saving over time. When adjusting the cost for different countries taking into account differences in labour costs, the range would be –12 to –27 €/t, bringing the total savings to 450 million euros in 2030.

Abatement cost in 2030	
Average unit cost (€/t)	–18
Estonia	–27
Latvia	–24
Lithuania	–22
Poland	–20
Ukraine	–12
Total cost (€ m)	–450

Other benefits

Energy efficiency can help industries enhance their productivity and become more competitive because of cost savings. Increased productivity can, in turn, lead to more jobs in the industry. Additional jobs are created through efficiency investments and management which tend to be more labour-intensive than energy production. Reduced fossil fuel use improves air quality, which results in health benefits.



Barriers

Large investment costs and a lack of capital can slow down energy efficiency improvements in industries. The cost of capital can be high as financial institutions may perceive efficiency investments as risky.

A lack of strong and stable public policy increases risks. Low energy prices, market volatility and subsidies for energy use also reduce the incentive for efficiency investments. Even if financial support is available, it may not always be attractive for industries and accessible to small companies.

Many companies lack specific knowledge and skills to identify efficiency potential and carry out improvements. Failure to recognise the various benefits of efficiency can act as an additional barrier.

Enablers

Knowledge, skills and awareness play a key role and can be promoted by training programmes, capacity building and guidelines. For large energy users, mandatory energy audits should be in place, together with a requirement to employ energy managers and set energy conservation targets. Expressing energy efficiency as a priority in their business strategy enables companies to manage energy strategically.

Public support can help industries overcome financial barriers. Investment support to promote energy efficiency is available from EU funds in member countries. Poland has chosen a market-based instrument, white certificates, to implement the EU directive on energy efficiency and is introducing the Energy Service Company (ESCO) approach for industries.

Poland uses tradable white certificates to improve industrial energy efficiency

Policy recommendations

- Set ambitious economy-wide and sectoral energy efficiency targets
- Provide training, advice, capacity building and technical assistance
- Promote energy management standards and require larger energy users to carry out regular audits
- Introduce or continue simple support measures (e.g. publicly funded energy audits) for small companies and establish guarantee schemes to derisk energy efficiency investments

TRANSPORT

Electric vehicles

Norway is a clear world leader in electric vehicles, with already over half of new cars electric. Scaling up the solution would cut emissions by as much as taking 1.3 million new (non-electric) cars off the road.

Solution description

Electric cars – full electric vehicles (EV) and plug-in hybrids (PHEV) – improve energy efficiency and replace fossil fuels with often cleaner electricity. Norway is the uncontested leader in the field, with already more than half of new cars sold electric. In 2017, the share of electric vehicles in the whole car fleet reached about 8%.

The Norwegian success is based on a comprehensive list of strong incentives. These include no purchase taxes (1990), low annual road tax (1996), no charges on toll roads (1997) or ferries (2009), free municipal parking (1999, now decided locally), 50% reduced company car tax (2000), exemption from 25% VAT on purchase (2001) and leasing (2015), and access to bus lanes (2003). The tax breaks make EV prices competitive with regular cars.

For scaling up, we expect the target countries to reach the same level of electric vehicles in their car fleet by 2030 as Norway has now. The current levels and projections for EV use in these countries are very low.

Climate impact

Reaching the current Norwegian share of electric vehicles by 2030 would cut emissions by 2 Mt, with more than half coming from Poland. The figure takes into account both reduced car fuel use and increased electricity demand, but does not cover life-cycle emissions from manufacturing the cars.

For estimating emissions from increased electricity demand, an average regional 2030 power mix is used, with still relatively high emissions. If the cars used green electricity instead, the emission reductions would be much larger.

	Mt	% of 2030 emissions
Estonia	0.06	0.4
Latvia	0.07	0.7
Lithuania	0.12	0.7
Poland	1.06	0.3
Ukraine	0.51	0.1
Total	**1.82**	

Costs and savings

Despite saving fuel, adopting electric vehicles is still relatively expensive because of high purchase prices. The weighted average abatement cost is estimated at 105 €/t for both electric vehicles and plug-in hybrids. The total costs for scaling up the solution would therefore be 190 million euros in 2030.

Abatement cost in 2030	
Weighted average (€/t)	105
Electric vehicles (€/t)	132
Plug-in hybrids (€/t)	28
Total cost (€ m)	190

Other benefits

Electric vehicles reduce local air pollution and noise. This results in health benefits and savings in healthcare costs, particularly in big cities. Reducing harmful impacts from traffic also allows siting housing and services closer to roads.

Transition to electric vehicles reduces total energy use and fuel imports, improving energy security. With smart grids, car batteries can be harnessed as electricity storage, helping to balance the power grid.

Barriers

For most consumers, the price of electric vehicles can still be prohibitively high. Rapid technological and market developments may change the picture in the future, but in the meantime public support is likely to be needed.

Some car drivers have range anxiety, worrying about running out of power. Countries can alleviate concerns by building an extensive network of charging stations, but variations in the plugs make the stations less useful.

Norway has relied on extensive support measures, including exempting electric vehicles from very high taxes. Countries with lower taxes and stronger budget constraints may not be able to use similar tools, although falling electric car prices reduce the need for public subsidies.

Enablers

Falling prices will drive electric car adoption in the medium and long term. In the short run, targeted public support (e.g. reductions and exemptions on taxes and road charges) can help smooth the way forward.

An extensive charging network allows car owners everywhere to consider electric vehicles. In Estonia, a country-wide quick-charging network has been in operation since 2013.

Targets, mandates and regulations provide a clear signal to vehicle manufacturers, sellers and customers. All target countries already have in place, or are considering, measures to support electric cars. In Poland, a new Electro-Mobility Act aims for one million electric vehicles by 2025. Information and awareness raising can get more citizens to consider an electric option.

Estonia has had a country-wide quick-charging network since 2013

Local governments can also use various tools. These include allowing electric cars to use bus lanes, free parking and restrictions on polluting cars. Local authorities can also move to electric vehicles in their own car fleet.

Policy recommendations

- Set ambitious targets for electric vehicles and integrate them into national strategies
- Differentiate vehicle taxes and road charges strongly based on CO_2 emissions and consider exempting electric vehicles from taxes (including VAT)
- Invest in public charging infrastructure compatible with international standards
- Prioritise electric vehicles when procuring cars for public authorities

Transport biofuels

Biofuels already cover close to a fifth of road transport fuels in Sweden. If done sustainably, scaling up the solution would cut emissions by as much as taking 5.6 million new cars off the road.

Solution description

Transport fuels made from biomass can, if produced sustainably, reduce emissions and dependence on fuel imports. Sweden has been successful in introducing biofuels (particularly bioethanol and biogas), reaching a share of 18.5% for road transport in 2016. Finland, as another Nordic example, has introduced biodiesel and developed advanced fuels from cellulose.

For scaling up, the target countries are expected to reach the same share of biofuels in road transport by 2030 as Sweden has achieved already. Current shares of renewable energy in transport in the target countries are relatively low, ranging from less than 1% in Estonia to close to 4% in Poland.

Climate impact

Scaling up biofuels would cut emissions in the target countries by 8 Mt in 2030. Most of the impact would come from Poland and Ukraine, whereas in relative terms the highest reduction would be in Latvia.

	Mt	% of 2030 emissions
Estonia	0.14	1.0
Latvia	0.21	2.1
Lithuania	0.28	1.6
Poland	3.63	1.0
Ukraine	3.87	0.6
Total	8.13	

The carbon footprint of biofuels varies widely depending on the feedstock and production methods. For calculating the emission reductions we have assumed an average emission reduction of 60% compared with conventional fuels.

Costs and savings

The average abatement cost for the target countries is estimated at 0.86 €/t, adjusted in the table for each country. Total costs for scaling up the solution would be about seven million euros in 2030.

Abatement cost in 2030	
Average unit cost (€/t)	0.86
Estonia	1.47
Latvia	1.34
Lithuania	1.22
Poland	1.09
Ukraine	0.65
Total cost (€ m)	7.27

Other benefits

When produced locally, biofuels reduce dependence on imported fossil fuels. Production supports local economies by creating new jobs and opportunities for agricultural producers and forest-related industries. Depending on the feedstock, biofuels can provide additional environmental benefits, such as reducing water pollution or increasing soil carbon content.

Barriers

Biofuels are held back by concerns related to their sustainability. Fuels made from crops specifically grown for the purpose have relatively high life-cycle emissions and compete with food production. Palm oil production for biodiesel has contributed to rainforest loss, with negative effects on biodiversity. Biofuels only deliver emission reductions if the biomass is replanted – and even in that case over the lifetime of the plants, which in the case of trees can be decades.

The availability of sustainable biomass at competitive prices remains limited. Multiple uses compete for the same resource, including heat and power production, materials for building and packaging, and the production of bioplastics.

When fossil oil prices are low, biofuels struggle to compete. Domestic production may also be challenged by imports from cheaper countries.

Enablers

EU targets – 10% renewable energy in transport by 2020 – set the direction for promoting biofuels. Mandatory blending requirements have been established in Latvia, Lithuania and Poland. Blending will start in Estonia in May 2018 and Ukraine is intending to follow.

Technology improvements for more sustainable feedstocks (e.g. agricultural and forest residues, municipal waste) would enable countries to achieve commercial-scale production and reduce prices. Government support is vital in the long run for their research and development. Sustainable and efficient agricultural and forestry supply chains and a well-functioning local biofuel market also constitute important enablers for competitive biofuel production.

Ukraine is a large exporter of biomass

The leading Nordic countries in this field – Finland and Sweden – have reached relatively high shares of biofuels in road transport as a result of blending obligations and taxation. In Finland, fuel taxes are differentiated based on CO_2 emissions.

Biofuels also provide relatively rapid emission reductions in the transport sector. Whereas electric vehicles and public transport often require large investments, modern biofuels can be used in existing cars with no additional investment or changes in infrastructure.

Policy recommendations

- Identify and use local sustainable feedstocks, especially waste and residues
- Increase blending obligations for sustainable, advanced biofuels
- Differentiate fuel taxes based on CO_2 emissions and phase out support for biofuels made from purpose-grown crops

Energy efficiency in buildings

Sweden has been able to reduce energy use in buildings, cutting energy bills. Scaling up the solution would reduce emissions by as much as taking 37 million new cars off the road.

Solution description

Improving energy efficiency in buildings cuts both costs and emissions. Sweden has been able to reduce building energy use by 1% per year with a range of measures, such as building codes, efficiency standards for appliances and information provision.

Many buildings in Central and Eastern Europe were built between the 1960s and 1990s, with large heat losses caused by insufficient insulation. Common problems also include poor ventilation and uneven indoor temperatures.

Scaling up this solution, target countries are expected to improve building efficiency by 1% per year. While not all measures used in Sweden may be applicable to all countries, a different set of policies, tailored to local needs, can have the same effect.

Climate impact

Energy efficiency in buildings has the highest potential among all solutions in this study. Replicating the Swedish annual efficiency improvement would cut emissions by 54 Mt in 2030. The largest contributors would be Poland and Ukraine, but the solution also has great potential in relative terms in the Baltic States.

	Mt	% of 2030 emissions
Estonia	1.28	9.3
Latvia	0.72	7.1
Lithuania	0.87	5.1
Poland	26.09	7.0
Ukraine	24.71	3.6
Total	53.68	

Costs and savings

The average abatement cost for the target countries is estimated at –54 €/t, adjusted in the table for each country. Scaling up the solution would save close to three billion euros in 2030.

Abatement cost in 2030	
Average unit cost (€/t)	-54
Estonia	–89
Latvia	–81
Lithuania	–74
Poland	–66
Ukraine	–39
Total cost (€ m)	–2,880

Other benefits

Increasing energy efficiency in buildings improves living comfort by reducing draught and by controlling and stabilising temperatures better. Efficiency improvements cut energy costs, tackling energy poverty. For home owners, investments in energy efficiency can increase the resale value.

Reduced energy demand cuts imports and increases energy security. Smaller energy use also results in less air pollution and better public health.

Additional benefits include the creation or retention of jobs as efficiency improvements are largely local work. In Estonia, it is estimated that one million euros of investment in building renovation creates around 17 jobs.

Barriers

Energy efficiency improvements can suffer from high investment costs and uncertainties about payback times. Low energy prices and taxes, and even subsidies on energy use, reduce the economic incentives for investment.

Residents, particularly those on low income, tend to prefer cheap and fast single measures (e.g. limited insulation of roofs or walls) instead of comprehensive and more expensive retrofitting. Partial solutions may lock in high consumption levels until the next major renovation projects.

With apartment buildings, decision-making is often complex and slow. Additional barriers include the lack of knowledge about efficiency potential and its benefits. People making decisions may not be aware of measures to improve efficiency or financing opportunities.

In Estonia, 17 jobs are created for every 1 M€ in building renovation

Enablers

EU legislation requires new buildings to reach nearly zero-energy levels and calls for the renovation of existing buildings. Ukraine has a corresponding law on energy efficiency in buildings.

EU investment programmes support building efficiency in member states. In Ukraine, EBRD programmes provide loans for improvements in residential and public buildings and a government programme partially compensates the cost of loans. The Energy Efficiency Fund, launched in 2018, aims to co-finance the modernisation of buildings.

Information, technical assistance and training provide practitioners with knowledge and tools to carry out efficiency improvements. In Sweden, information is provided by municipal energy advisors and the Swedish Energy Agency. Mandatory energy labels inform the real estate market and empower home buyers to make smart choices.

Since 2018, there has been a requirement to establish associations to manage apartment buildings in Estonia, making decisions about renovations more structured. Energy service companies (ESCOs) can offer comprehensive refurbishing solutions as they carry the overall responsibility for the investment.

Policy recommendations

- Offer targeted financial support (e.g. loans or investment support) for renovations to improve efficiency
- Provide information, guidance and training to apartment associations and homeowners
- Consider tools to promote the self-organisation of inhabitants in apartment buildings, by requiring the establishment of apartment associations, for example
- Improve monitoring and verification of energy efficiency projects

Bioenergy for heating

Replacing fossil fuels with bioenergy in heating can improve energy security and create jobs. Scaling up the solution would cut emissions by as much as taking 9.3 million new cars off the road.

Solution description

Producing heat with bioenergy can cut emissions over time if the biomass is sourced sustainably. Finland produces 42% of its district heating from biofuels such as forestry residues and wood pellets. The success is down to the large availability of biomass and consistent policymaking over the years, including investment support and differentiated taxation.

When scaling up, the target countries are expected to reach by 2030 the same share of bioenergy in heating Finland has today. As the Baltic States are already at, or exceed, the Finnish level, the potential is only estimated for Poland and Ukraine.

Climate impact

If Poland and Ukraine reach the Finnish level of bioenergy in district heating, they can cut a total of 13.4 Mt emissions in 2030. In relative terms, the impact would remain fairly small.

	Mt	% of 2030 emissions
Poland	9.4	2.5
Ukraine	4.0	0.6
Total	**13.4**	

Costs and savings

As no abatement costs were found for Poland and Ukraine, we used the closest available estimate (Russia 66 €/t), PPP adjusted for each country. Using these figures, the total cost of the solution would be a little more than a billion euros in 2030.

Abatement cost in 2030	
Unit cost in Poland (€/t)	88
Unit cost in Ukraine (€/t)	52
Total cost (€ m)	1,031

Other benefits

Domestic biomass supply can increase energy security in heating by reducing the dependence on imported fossil fuels. Additional economic benefits include improving the trade balance and creating or retaining jobs in the fuel supply, especially in rural areas. One terawatt hour of bioenergy is estimated to create about 600 job years. The pulp and paper industry and the forestry industry can benefit by gaining another source of revenue from the use of residues and waste.

Barriers

Bioenergy struggles to compete if fossil fuels are subsidised and energy prices are regulated, not allowing energy producers to recover their full costs on the market. Securing a stable supply of quality biomass at an affordable price can be challenging, as prices can fluctuate and supply chains may be undeveloped. Limited biomass resources have various competing uses, including as transport biofuels, materials for industry and replacements for plastics. On the other hand, if biomass prices are low, they may not provide a strong enough incentive for landowners to collect residues.

The life-cycle emissions of bioenergy depend on the feedstock. Some biomass resources reduce emissions only marginally and over long periods of time, making them unattractive from a climate perspective. Industrial forestry and agriculture, which can include the removal of too much biomass, can have negative impacts on ecosystems. Burning wood inefficiently in small boilers contributes to air pollution, which can cause health problems.

Underdeveloped district heating networks, especially in smaller towns and communities, may make bioenergy less attractive. In cities, it may be difficult or expensive to find sufficient storage for biomass if the power plant has been originally designed for fossil fuels.

Enablers

A key precondition for using bioenergy is a sufficient supply of sustainable biomass within a reasonable distance. In the target countries this potential is rather high as they possess large forested areas and agricultural land. Bioenergy is well suited to district heating systems, because they allow for the more flexible use of fuels than small local boilers and avoid air pollution.

Support schemes (e.g. investment subsidies, feed-in tariffs, green certificates) can facilitate investments in bioenergy plants and improve the competitiveness of biomass over fossil fuels. EU funds are available for investing in biomass boilers in member countries and similar programmes exist in Ukraine.

One TWh of bioenergy creates 600 job years

EU or national targets for increasing the share of renewable energy and regulations for cutting emissions boost bioenergy. In the reference country, Finland, a target of phasing out coal by 2029 is encouraging energy companies to consider investments in bioenergy.

Policy recommendations

- Differentiate energy taxes to prioritise low-carbon heating, such as using sustainable biomass
- Provide support for investments that enable the switch from fossil fuels to biomass
- Consider a premium for producing heat with biomass in efficient CHP plants
- Apply sustainability criteria and limit all subsidies only to sustainable biomass

Reforestation and land restoration

Reforesting and restoring degraded land can tackle climate change while supporting ecosystem services. Scaling up the solution to the Icelandic extent would have a minor climate benefit, but the full potential is larger.

Solution description

Reforesting and restoring land can enhance natural carbon sinks and provide various ecosystem services. Iceland has taken steps to replace part of its lost vegetation cover. Measures have included various reforestation projects and state support for farms and landowners.

It has been estimated that more than half of Iceland's vegetation cover has disappeared as a result of erosion caused since the island was settled. Some 1.4% of lost woodland and 0.65% of eroded land have since been restored.

When scaling up, the target countries are expected to reach the same level in terms of restoration of lost land. The starting point is already encouraging, because all five countries have much larger shares of remaining forests (up to 50% of the land in Estonia and Latvia) and fewer degraded areas.

Climate impact

Scaling up the solution to the target countries would yield only a marginal emission reduction of 0.24 Mt, of which 0.23 Mt would come from reforestation and 0.01 Mt from the restoration of degraded lands. Most of the potential would come from the two largest countries, Poland and Ukraine.

The small potential can be explained by the fact that in the Icelandic reference case only a minor fraction of the island's degraded land has been restored so far. The five target countries have also lost much smaller areas in the past. However, the full potential of reforestation and land restoration would be larger.

	Mt	% of 2030 emissions
Estonia	0.02	0.1
Latvia	0.03	0.3
Lithuania	0.02	0.1
Poland	0.08	0
Ukraine	0.09	0
Total	**0.24**	

Costs and savings

The abatement cost can be estimated roughly at 16.5 €/t for reforestation and 12 €/t for land restoration. The total cost of the solution would be four million euros in 2030.

Abatement cost in 2030	
Reforestation (€/t)	16.5
Land restoration (€/t)	12
Total cost (€ m)	4

Other benefits

While the potential to reduce emissions is marginal, reforestation and land restoration would provide many additional benefits. Increased vegetation cover would maintain or increase ecosystem services such as the prevention of soil erosion, improvements in soil fertility, the treatment of pollution and support for biodiversity. Forests can also provide recreational and economic value through tourism, for example.

Estonia requires mining companies to restore land after use

Barriers

A major barrier to reforestation and land restoration is alternative land use with higher perceived economic value, such as farming or real estate development. If the value of ecosystem services is not recognised, landowners may not have enough incentives to take action.

Reforestation needs knowledgeable planning to restore natural forest habitats and avoid creating monoculture plantations. Degraded land also provides habitats of its own, although for different species. Illegal logging remains a problem in some of the target countries.

Enablers

Regulations can require landowners to restore degraded land. In Estonia for example, the Earth's Crust Act mandates the holder of an extraction permit to convert the land into forest or other valuable land once mining has been completed.

Economic incentives can contribute to the success of this measure. In the reference country Iceland, restoration activities are mainly financed from national funds, but industry also plays a role.

Information and awareness can help landowners understand the private and public value of restoring lands. Guidance, handbooks, training and other knowledge dissemination can support reforestation efforts.

Policy recommendations

- Consider introducing payments for ecosystem services to reward landowners for increasing forests
- Provide information and training on sustainable forestry practices and their benefits
- Strengthen surveillance and prosecution of illegal logging

Manure management

Managing manure on farms can help reduce both greenhouse gas emissions and water pollution. Scaling up the Danish achievement would cut emissions by as much as taking 4.3 million new cars off the road.

Solution description

Storing and treating manure from farm animals releases nitrous oxide (N_2O), a potent greenhouse gas. Emissions are also released from agricultural soil after using nitrogen fertilisers. Denmark has been successful in cutting N_2O emissions from agriculture by almost 30% in 25 years as a result of strict requirements for fertiliser and manure management.

In Denmark animal manure must be tilled into the soil within six hours. There are strict limits on the application of manure per hectare. Slurry containers must be located at least 100 metres from the nearest stream or lake. They must also be made of durable materials and covered. Finally, there are limits on how much fertiliser can be applied to various crops.

Scaling up the solution, target countries are expected to reach a similar annual reduction in agricultural N_2O emissions as Denmark has achieved. Currently the target countries produce around 130 Mt CO_2e as agricultural N_2O emissions, with most of it from agricultural soil and the rest from manure.

Climate impact

Scaling up the solution in the target countries would cut emissions by 6 Mt (CO_2e) in 2030, with the largest contributions coming from the big agricultural producers, Poland and Ukraine. In terms of relative emission reductions, the solution has the largest potential in Latvia and Lithuania, where it could reduce emissions by close to 3% of the projected 2030 levels.

	Mt CO_2e	% of 2030 emissions
Estonia	0.11	0.8
Latvia	0.28	2.8
Lithuania	0.43	2.5
Poland	2.33	0.6
Ukraine	2.99	0.4
Total	**6.14**	

Costs and savings

For estimating the abatement costs of manure management, information from Iceland was used, converting the cost into country-specific values using PPP correction. The total costs of scaling up the solution would be 13.9 million euros in 2030.

Abatement cost in 2030	
Weighted average unit cost (€/t)	1.30
Estonia	2.27
Latvia	2.06
Lithuania	1.89
Poland	1.68
Ukraine	0.96
Total cost (€ m)	13.90

Foto: Istock

Other benefits

The main environmental benefit is the reduction of nitrogen leaching into the environment, improving groundwater quality and preventing eutrophication. Manure management creates opportunities for renewable energy generation through the burning of biogas. The nutrient-rich digestate from producing biogas can be used to fertilise crops, replacing chemical fertilisers.

Denmark has cut N_2O emissions from agriculture by almost 30% in 25 years

Barriers

A key barrier is the lack of knowledge and skills to manage manure sustainably. Manure has been undervalued as a fertiliser and fuel. Farmers may also be unwilling to change their current practices.

Producers, especially small farmers, may lack the funds to invest in infrastructure and equipment. Monitoring compliance with manure regulations is complicated and can be insufficient, failing to enforce how quickly and where manure is tilled into the soil, for example.

Enablers

National and EU regulations on farming practices and water quality are driving more efficient manure management and mitigation of emissions. This can be enhanced by close collaboration between all the ministries involved.

According to the Danish experience, general regulation can be useful in limiting excessive application of nitrogen fertilisers. However, further measures should be targeted at fields and areas providing the biggest benefit.

Financial incentives can help farmers to invest in appropriate manure and fertiliser management. Sharing manure storage and application equipment can reduce costs for farmers and stimulate more action. More targeted spreading of manure on appropriate fields can further help.

Systematic dissemination of knowledge is needed about improved management techniques and cost savings to farmers. Important issues include the timing and quantity of manure application, the storage times and conditions, and reducing the nitrogen in manure through methods such as dietary control and livestock selection.

Policy recommendations

- Provide information and training on sustainable farming and its benefits
- Provide financial support for investments in producing biogas from manure
- Incentivise the use of biogas in transport (e.g. by differentiating fuel taxes based on emissions)
- Strengthen the enforcement of existing regulations

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Nordic Green to Scale

Green to Scale is a series of analysis projects that have highlighted the potential of scaling up existing climate solutions. Nordic Green to Scale for countries zooms in on two regions: the Baltic States, Poland and Ukraine in Europe; and Kenya and Ethiopia in East Africa. This report presents the emission reduction potential of 10 selected solutions for the European target countries. The study highlights the costs, savings and co-benefits of implementing the solutions as well as makes policy recommendations for capturing the potential. The project was carried out by the Finnish Innovation Fund Sitra, together with its partners CICERO, CONCITO and Institute of Sustainability Studies at the University of Iceland. The technical analysis was produced by the Stockholm Environment Institute Tallinn Centre. The project is part of the Nordic Council of Ministers' Prime Ministers' Initiative.

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