



Observatoire
de la Politique
Climatique

Annual **20** Report **22**

ABSTRACT

PREFACE: The Heat is On!



“The cumulative scientific evidence is unequivocal: Climate change is a threat to human well-being and planetary health. Any further delay in concerted anticipatory global action on adaptation and mitigation will miss a brief and rapidly closing window of opportunity to secure a liveable and sustainable future for all.
(very high confidence)”

With the accumulation of extreme events in recent years, the scale and interconnectedness of impacts of climate change on individuals, organisations, and nations, can no longer be ignored, not even in Luxembourg, which usually finds itself sheltered from the storm.

The Government of the Grand Duchy of Luxembourg – more precisely the Government in Council – thus nominated the members of the ‘Climate Policy Observatory’ (OPC; Observatoire de la politique climatique) in October 2021, which was set up in the framework of Luxembourgish climate law² to address challenges caused by climate change. The OPC is a scientific council currently composed of seven members with expertise in various fields of climate-related sciences. Its mission encompasses advising on projects, actions or measures that may have an impact on climate policy, scientifically evaluating the measures carried out or envisaged in the field of climate policy and analysing their effectiveness, as well as proposing new measures. Its tasks also include writing an annual report for the Government on the implementation of the climate policy, and proposing research and studies in all fields related to the climate.

This document presents a summary of the first annual report of the OPC setting the scene by providing background information, establishing the OPC’s main principles and providing a first (cross-) sectoral assessment of Luxembourgish climate policies. The Luxembourgish climate law sets clear targets of reducing greenhouse gas emissions (GHG) by 55% by 2030 (compared to levels of 2005), and to become climate neutral (net zero emissions) by 2050 at the latest. One of the executive regulations of the law specifies how the emissions targets shall be distributed by sector until 2030³. The measures to reach these targets for each sector are laid out in the first integrated National Energy and Climate Plan (Plan national intégré en matière d’énergie et de climat, PNEC)⁴. Each country needs to submit a progress report every two years. The OPC’s report and recommendations will be valuable input for the creation of the update of the PNEC. The following recommendations follow the OPC’s analyses for transforming Luxembourg’s policies & society into a more climate friendly environment.



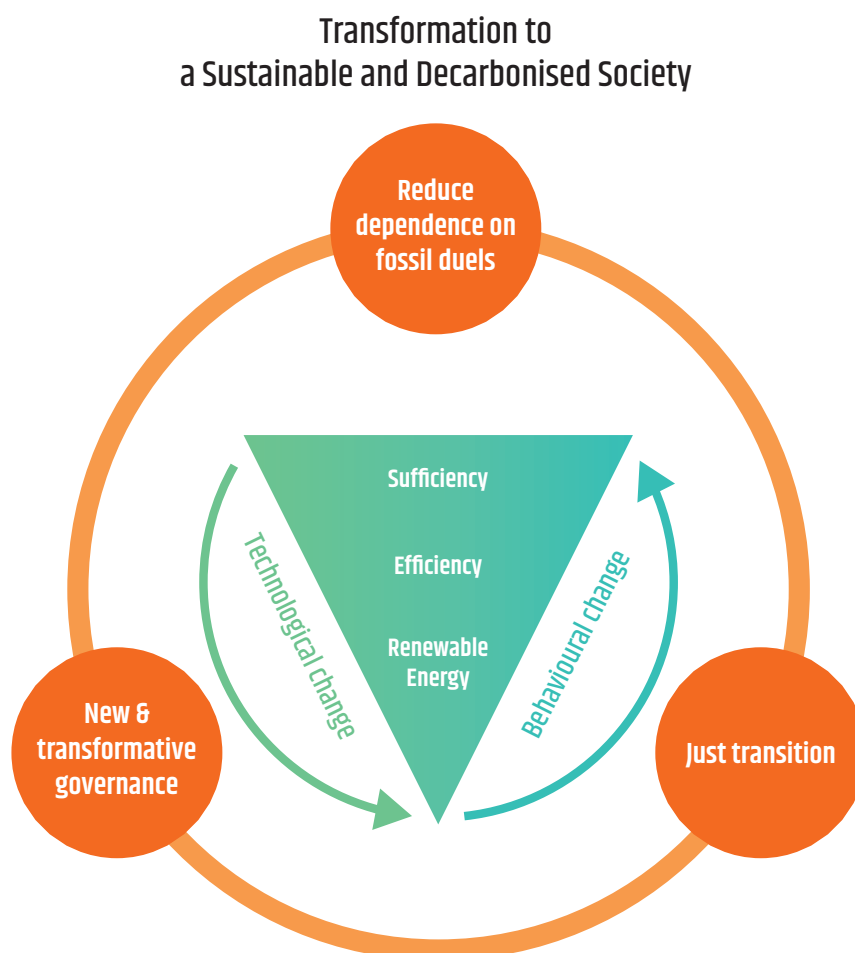
Principles for a rapid and just transformation towards a sustainable and decarbonised society



Luxembourg's climate law fixes a target of GHG emission reduction by 55% compared to 2005 by 2030 and achieving climate neutrality by 2050, at the latest. In order to achieve the 2030 goal and, even more, the climate neutrality goal in 2050, incremental measures will not be sufficient, and systemic changes need to be implemented as highlighted in the 6th Assessment Report (AR6) by the Intergovernmental Panel on Climate Change (IPCC)⁵.

The OPC recommends that further climate mitigation policies be guided by the following principles (see Figure 1).

Figure 1: Overview principles



1 Reduce dependence on fossil fuels

In all sectors, the Luxembourg economy's dependence on fossil fuels (coal, oil, and natural gas) should be strongly reduced. Not only is this decarbonisation process important in achieving the emission reduction targets, but also in reducing the dependence on imported fuels that have recently become very expensive.

Decarbonising the economy to meet targets such as a carbon neutral territory in Luxembourg by 2050 at the latest requires deep structural changes. The decarbonisation approach can be decomposed into three main levers:

- **Sufficiency:** popularise low-energy sufficient lifestyles
- **Energy efficiency:** increase the energy efficiency of the Luxembourg economy
- **Renewable energy production:** decarbonise energy production and imports

Traditionally, climate policies focus on the latter two. Both, energy efficiency improvements and *renewable energy production* are based on **technological change**. This can be incentivised by carbon pricing, energy performance standards, banning all forms of fossil fuel subsidies, and investments in renewables production capacity. These are important first steps but will not be sufficient.

To allow the adoption of low-energy and sufficient lifestyles, **behavioural change** as well as **changes in the societal system** are needed. The possibilities to make such changes should be accessible to all, not just to those segments of society who can afford to take the time and make the monetary investments. This implies both raising awareness and opening up learning spaces for citizens and professionals about possibilities of change, as well as developing policies to ensure citizens and professionals are empowered to engage in making such changes, or experimenting with what solutions might work best in their specific situations⁶. Changes in the education system⁷ will also play a fundamental role in equipping citizens and professionals for contributing and coping with changes at work and at home. Particularly, affluent consumers, both at individual and systemic level, private individuals, and professionals, are contributing significantly to shaping and stabilising patterns of high emission (and consumption) behaviour⁸. In efforts to foster the transition, considering the demand side of emissions is thus at least as important in crafting mitigation policies as are considerations of supply side emissions. To this aim policies promoting an understanding of possibilities for change, outreach, and policies for empowerment on these topics are required for a just transition. An emerging lever, which is intrinsically related to openness for change and learning as well, is the promotion of well-being policies, which have been positively correlated to sufficiency and climate-friendly lifestyles.

Relatedly, it is necessary to **account for consumption-based emissions**. This means the counting of emissions needs to consider carbon embedded in imported goods as the transformation of the Luxembourg economy must take into account the need for a global decarbonisation.

2 Just Transition towards a climate-resilient development

The Intergovernmental Panel on Climate Change (IPCC) AR6 WGII⁹ referred to “climate-resilient development” as “the process of implementing GHG mitigation and adaptation measures to support sustainable development for all.” The rationale behind linking mitigation, adaptation, and sustainable development in this way is that the calls for rapid societal transformations towards a sustainable and decarbonized society are most effective if implemented in the wider context of the United Nations 17 Sustainable Development Goals (SDGs). These were launched with the overarching goal of ‘transforming our world’ in an integrated way. The AR6 WGII makes the following important points in that respect: “*Climate resilient development is enabled when governments, civil society and the private sector make inclusive development choices that prioritise risk reduction, equity and justice, and when decision-making processes, finance and actions are integrated across governance levels, sectors and timeframes (very high confidence).*” And “*Climate resilient development is facilitated by international cooperation and by governments at all levels working with communities, civil society, educational bodies, scientific and other institutions, media, investors and businesses; and by developing partnerships with traditionally marginalised groups, including women, youth, Indigenous Peoples, local communities and ethnic minorities (high confidence).*” (Figure 2).

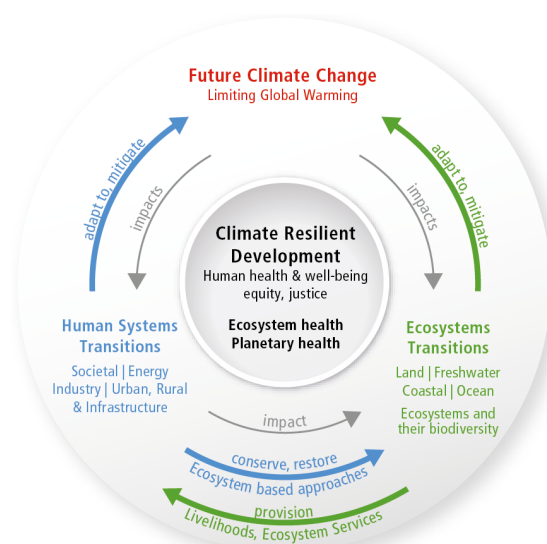


Figure 2: Meeting the objectives of climate resilient development thereby supporting human, ecosystem, and planetary health, as well as human well-being, requires society and ecosystems to move over (transition) to a more resilient state. The recognition of climate risks can strengthen adaptation and mitigation actions and transitions that reduce risks. Taking action is enabled by governance, finance, knowledge and capacity building, technology, and catalysing conditions. Transformation entails system transitions strengthening the resilience of ecosystems and society. Arrow colours represent human system interactions (blue), ecosystem (including biodiversity) interactions (green) and reduced impacts from climate change and human activities (grey). Source: IPCC AR6 WGII, Figure SPM.1 (b)¹⁰



The rapid and just transition or transformation of the Luxembourg economy and society towards climate resilient development needs to be “just” to be accepted by all. This can be achieved by targeted and proactive measures that ensure that any negative social, environmental, or economic impacts of economy-wide transitions are minimised, whilst costs are covered, and benefits are maximised for those disproportionately affected. These proactive measures include eradication of poverty, regulating prosperity and creating jobs in “green” sectors. In addition, the government, polluting industries, corporations, and those able to pay higher associated taxes, can pay for transition costs by providing a welfare safety net and adequate compensation to people, communities, and regions that have been impacted by pollution, or are marginalised, or are negatively impacted by a transition from a high- to low- carbon economy and society.

When designing and implementing climate policies, at least three questions should thus always be raised in the context of just transformations¹¹: What are the costs, benefits and risks associated with a policy and/or implementation measure? How are these costs, risks and benefits distributed amongst people with rights and responsibilities and other stakeholders in regard to the policy? And last but not least, how can we assess and evaluate the policies and their implementation in order to better understand whether the range of diverse impacts meets initial intentions or plays out in other ways as well. All these questions relate to the distributional implications (mostly within a country itself) of policies and are thus important in the context of just transition. For example, in the case of carbon taxes, the focus usually lies on the level of the Taxes, whereas the use of the revenues gets less attention – although it is shown that the revenue recycling determines who profits and who loses out from carbon tax. The same is true in the case of subsidy programmes, where usually little attention is given to how they are financed (e.g., through the state budget or a special levy). Similarly, setting standards for energy efficiency also requires careful analysis of who may benefit of a policy, who has to pay, and who carries risks. Luxembourg has comparably high standards for energy efficiency in newly built homes in the EU, e.g. by promoting passive houses. Subsidies contribute to reducing the problem of associated building costs, which can exclude some segments of the population from acquiring homes or apartments. However it is also important when it comes to distributional implications of the policies insuring that tenants would not suffer under higher rental prices. These considerations have implications not only for contents but also for the processes of policy making and governance at large.¹²

3 New and transformative governance

The just transformation described above requires new and transformative governance: this means transforming not only the mix of policy instruments, but also the governance processes and structures in place. Traditional top-down, command-and-control policymaking processes are simply inadequate given the scale, scope, and complexity of the transformation required. The risk of sticking to traditional governance forms when societal transformation is necessary is the erosion of democratic governance and public trust and goodwill because of inadequate transparency, accountability, and (perceived) legitimacy.

We highlight three key areas for the development of legitimate transformative governance efforts across all stages of the policy cycle (from framing and agenda setting, to problem definition and policy development, without forgetting policy implementation and evaluation):

- **Integrated governance** implies that governance processes must facilitate coherent policy goals across multiple levels of governance (local-national-European) and across policy and societal sectors.
- **Participative governance** means that knowledge about policy problems (framing) and approaches to address these (policy instruments) is co-created with a wide range of communities, groups, citizens, and stakeholders, through explicitly open, transparent, and participative governance mechanisms, such as citizen's assemblies, citizen science projects and multi-stakeholder interaction processes. Not only must the governance structures be renewed for meaningful participation, but the knowledge architecture informing governance choices needs to be reframed.
- **Fair governance** means that the new transformative governance structures and processes alleviate the inequalities of access, resources and benefits associated with problem and solution framing (for example across generations, rural/urban communities, minority groups, people with disabilities, etc.).

4 Summary of Sectoral recommendations

The rapid and just transformation to a sustainable and decarbonised society requires action across all sectors of society. In the following, we provide recommendations on how to proceed in a selection of sectors. The recommendations listed here are limited: they do not cover all sectors; they are not to be considered exhaustive within the sectors discussed; and there is no hierarchy of importance attached to them. What is important to note is that the recommendations aim to translate the principal goal of a rapid and just transformation to a sustainable and decarbonised society into urgent action in a selection of sectors.

Specifically, the decarbonisation approach can be decomposed into three main levers¹³:

- **Sufficiency**: popularise low-energy sufficient lifestyles
- **Energy efficiency**: increase the energy efficiency of Luxembourg's economy
- **Renewable energy production**: decarbonise energy production and imports

4.1 Buildings

Sufficiency

- ▲ **Reduce ambient temperature in homes, apartments and offices**: At the time of writing this report, the most prominent is the voluntary energy savings campaign "Zesummen spueren, zesummenhaalen", that aims at reducing gas consumption this winter by 15% compared to the reference period 2017-2021. Such efforts should be continued after the energy crisis.
- ▲ **Reduce floor area per person**: Luxembourg holds the European record for highest energy use per dwelling¹⁴. At 132 m²/dwelling for 2.5 persons on average, surface area could be reduced to reach about 90 m² in 2050, based on a recent UNEP Resource Panel study¹⁵. The total surface area could be reduced partly by reclaiming unused office or parking garage space.

Efficiency

- ▲ **Promote resilient buildings**: There is a large overlap between mitigation and adaptation measures in the buildings sector. When renovating buildings, they need to be prepared for climate extremes. Possible measures include the use of sustainable construction materials as well as adding green infrastructure around and on top of buildings. Finally, maladaptation (e.g. air conditioning) needs to be prevented.
- ▲ **Require landlords to invest in renovations of leased homes or apartments**: House owners living in their own house have stronger incentives to renovate as this helps to save energy and carbon costs. In the case of landlords of leased homes or apartments, incentives to renovate are largely missing. An interesting example of such incentive would be to link the possibility for landlords to index the rents to the energy performance of the buildings they rent.
- ▲ **Make use of "special events"**: For example, when the new generation takes over a house or when tenants change, the situation is ideal to do renovations as the house or apartment is vacant.

Renewable Energy

- ▲ **Ban fossil heating systems**: For example, the regulation for new buildings should also be implemented for existing buildings. It needs to apply whenever a heating system has to be replaced. Of course, this policy needs to be complemented with hardship rule in cases the replacement is not possible and financial support for households that cannot afford it.



4.2 Transport

Sufficiency

- ▲ **Land use and urban planning to reduce space for cars**, either on roads or for parking: A very clear signal would be to ban the building of new roads as has been done by the Welsh government¹⁶.
- ▲ **Develop plans for a 15-minute city**, where amenities and necessities are within a 15-minute walk or bicycle ride from residences.
- ▲ **Promoting working from home** instead of travelling to workplaces.

Efficiency

- ▲ **Incentivise the modal shift from a car-centric to a shared, soft mobility system**: Shift to an integrated system connecting (renewable-powered) public transport, bicycle infrastructure, safe infrastructure for pedestrians. Literature suggests that shifting away from cars can be accomplished by communicating about the positive sides of alternatives, as was done in Copenhagen, whose successful cycling communication never mentioned cars or climate change¹⁷.
- ▲ **Spatial planning** efforts to make it easier to benefit from the excellent initiative to provide free public transport, e.g., by making it easier for bicycles and pedestrians to connect to and use the public transport infrastructure and by making it more difficult for the private car to remain a central mode of transport, by, e.g.:
 - a. Expanding the public transport offer;
 - b. connecting to bicycle parking (bike and ride);
 - c. building more protected bicycle lanes and develop more pedestrian zones;
 - d. reducing speed limits to limit emissions, increase safety and reduce the time-incentive for car travel;
 - e. Implementing low emission zones and traffic calming infrastructure or increasing car-free zones.

Renewable Energy

- ▲ **Increase share of electric vehicles (EV) and ban fossil fuel vehicles**: The ban of the sale of fossil fuel cars in the EU is planned for 2035. Luxembourg could increase taxes on fossil fuel cars so as to make them less attractive compared to EVs to accelerate the transition before the ban. As a complementary measure, the subsidy for EVs could be continued and adjusted at a lower amount if necessary. The subsidy should be conditional on the subscription of an electricity contract supporting the increase of local renewable energy capacity to unlock the full decarbonisation potential of EVs.

4.3 Energy Systems

Sufficiency and Efficiency

- ▲ **Continue and strengthen the measures in place aiming for a reduction of final energy demand of between 40% and 44% by 2030 compared to the EU PRIMES¹⁸ baseline**. In addition, efforts put into place to reduce gas consumption this winter by 15% compared to the reference period 2017-2021 as highlighted by the campaign “Zesummen spueren, zesummenhaalen” should be continued after the energy crisis.

Renewable Energy

- ▲ **Increase the capacity of renewable energy production and thereby decrease the dependence on imports from foreign markets**. Priority should be given to the increase of local capacity of clean electricity production, mainly from renewables, and to direct investments into capacity of renewable generation abroad. It is recommended not to rely on energy certificates (certificates of origin); but instead directly invest in building renewable energy production capacity both on the national territory and abroad, which can consistently be allocated to national accounts.
- ▲ **Increasing the share of renewable power production**, e.g., rooftop solar panels or the use of panels over agricultural production fields. Favour the combination of small-scale capacity in proximity to demand sources and mid-size power units for optimal trade-off between transmission losses and good production efficiency

The war in Ukraine and the current energy crisis

Recent geopolitical upheavals have exacerbated the energy situation in Luxembourg and the EU. Russia's war on Ukraine has severely reduced the supply of previously cheap gas to European countries, resulting in an energy crisis that affects households as well as industrial and agricultural production. It is important to note that the energy crisis began in late 2021, well before the Russian invasion, but was dramatically and rapidly aggravated by the invasion.

In addition to limited gas supply and very high gas prices, electricity markets are suffering from low nuclear production in France due to inspections and repairs and low hydroelectric production in many European countries due to low water levels following droughts. As a result, gas prices, but also electricity prices, have soared, and Europe is bracing for power shortages this winter.

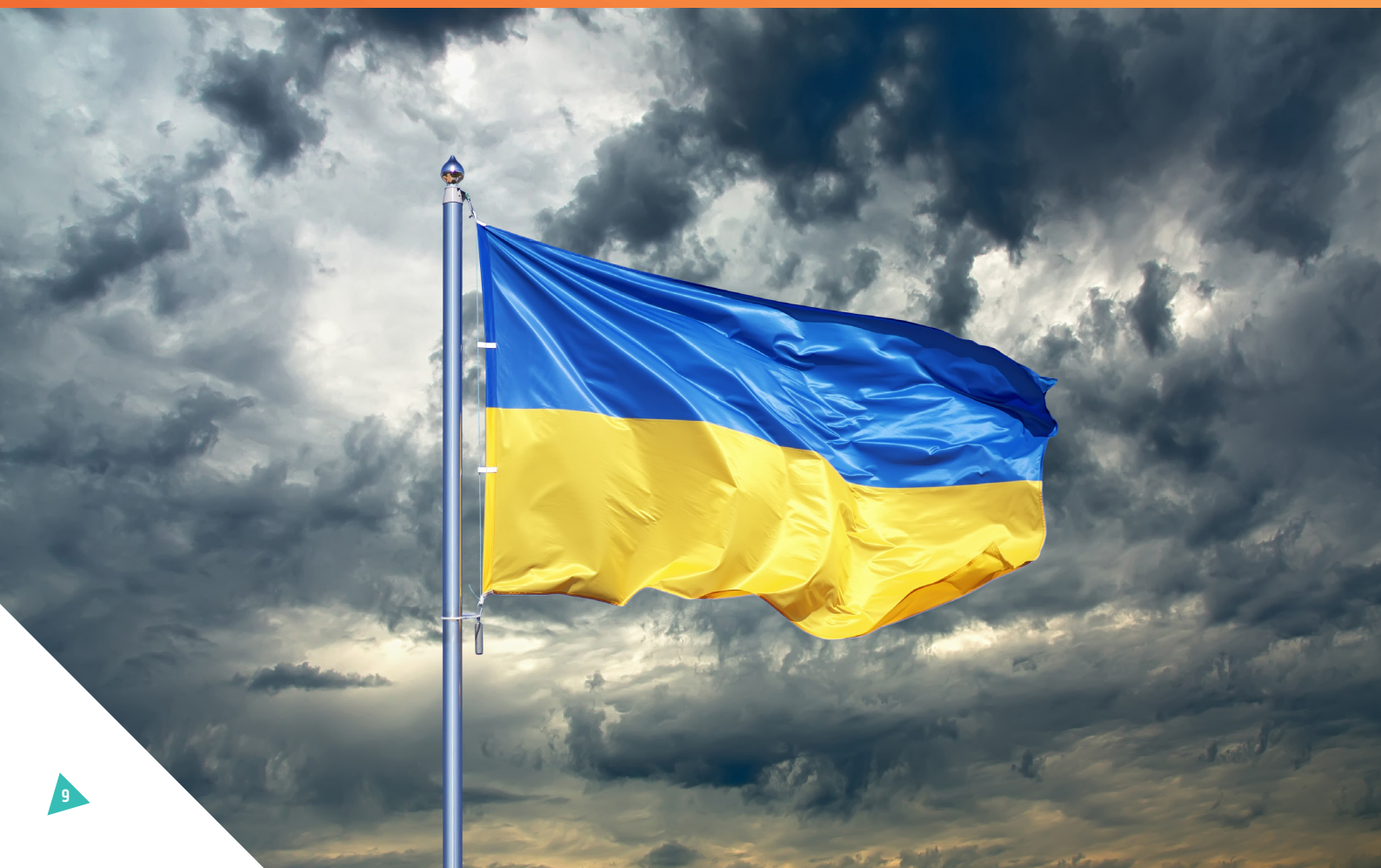
These developments have led to two types of measures in Luxembourg and throughout Europe:

First, financial support for households and companies: An immediate measure taken in Luxembourg included the allocation of a subsidy on petrol between April and August 2022, a controversial measure that directly counteracts the CO₂ tax. In addition, in March 2022, the Luxembourg government also introduced an "energy tax credit" for lower income households to compensate for rising energy prices¹⁹.

Second, the gas and electricity saving programmes: At the time of writing, the most prominent programme is the voluntary energy saving campaign "Zesummen spueren, zesummenhaalen", which aims to reduce gas consumption this winter by 15% compared to the reference period 2017-2021²⁰.

Against this background, the OPC makes two recommendations:

- ▲ **Financial support for vulnerable households and companies:** In times of inflation and high energy prices, financial support for vulnerable households and companies is important. Such support must reach precisely those who need it most.
- ▲ **No subsidies to fossil energy:** General subsidies to fossil fuels must be avoided at all times, as these directly counteract the CO₂ tax.



4.4 Food, Agriculture and Forestry

Sufficiency

- ▲ **Shift to balanced, sustainable healthy diets:** A profound adaptation is required in individual and societal demands, looking at the types, quality, and quantity of agricultural products that are purchased and used. A shift towards more plant-based diets would not only promise health benefits compared to consuming high levels of red meat, but additionally help to reduce the demand side option of reduced livestock in Luxembourg. Strategies to better align demand to the biophysical capacity of the Luxembourg territory will also have profound implications for land use for food and fibre production. An awareness-raising campaign on the relation between dietary and climate change and attention to affordability of regional, seasonal, and organically grown food could be a first step in this direction.

Efficiency

- ▲ **Reduce food loss and food waste:** Continue and accelerate the promotion of concepts behind the current “Anti gaspi” campaign, to reduce the food waste by consumers to a minimum. In addition, raise awareness in the agricultural and gastronomy sector to reduce food loss. This will require profound and disruptive social innovations in the value chain and access to food in particular by more vulnerable groups in society.
- ▲ **Reduce methane and nitrous oxide emissions in agriculture:** For Luxembourg, 70-80% of methane emissions and nearly all nitrous oxide emissions are caused by agricultural activities. Measures aiming at reducing the livestock size in Luxembourg would lower the methane emissions, while the reduced use of fertilisers would reduce the nitrous oxide emissions.
- ▲ **Minimise dependency on production-related inputs,** including chemical pesticides and fertilisers and fossil fuels, that in themselves are energy-intensive to produce and the supply of which is becoming increasingly uncertain. More targeted measures to reduce dependency on chemical fertilisers and pesticides are needed with more targeted promotion of their replacement with nature-based solutions (NBS) such as those used in integrated pest management and modern agroforestry systems. Experimentation with different nature based solutions in test beds should be actively encouraged and supported. More stringent standards for judicious use of chemical pesticides and fertilisers should be set for conventional farmers.
- ▲ **Increase efficiency in extracting valuable resources** from to date unused by-products, such as looking at unused manure as a source of nutrients such as phosphate and closing other material flow loops in the logic of the circular economy.



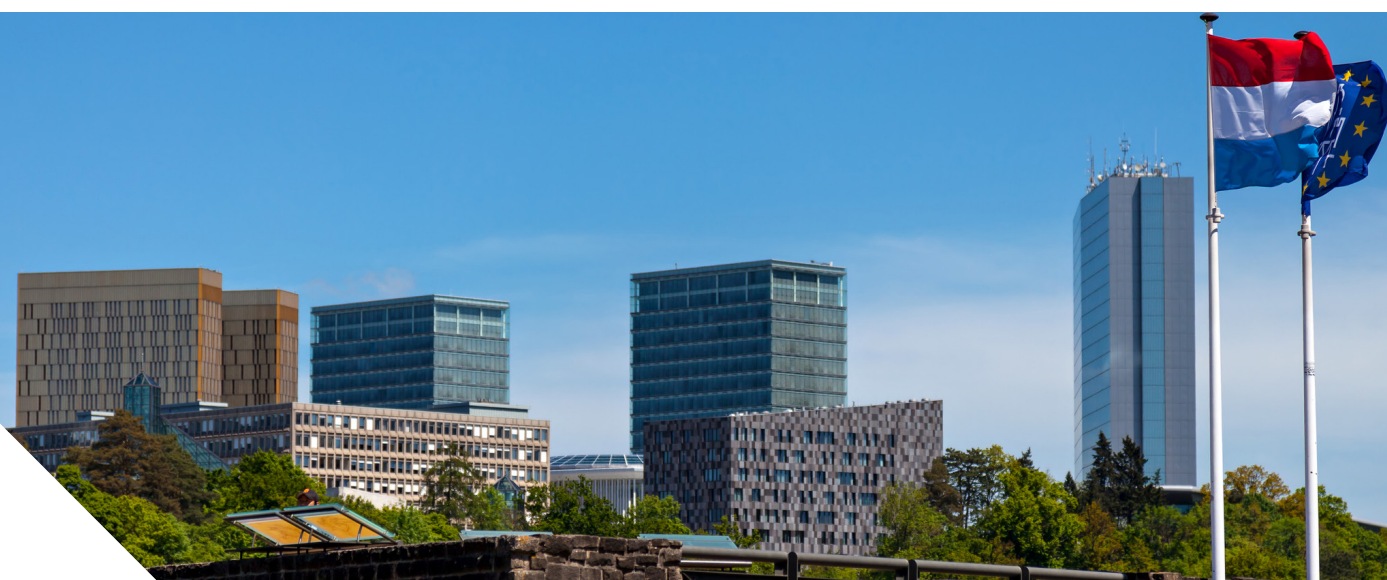
Promoting carbon sequestration and self-regeneration capacity of ecosystems

- ▲ **Promote carbon sequestration in healthy and resilient forests: Reduced conversion of forests and afforestation, reforestation:** The main driver here in Luxembourg is the conversion of forest and agricultural land to built-up areas. This is an important factor to slow down and stop sealing of land surfaces in order to keep the maximum of land surface possible that can contribute to carbon sequestration. **Improved sustainable forest management:** This measure should help the national forest to move away from monocultures, which in turn would help to reduce their vulnerability to the impacts of climate change, increase biodiversity as well as carbon sequestration. **Improve approaches to reach and engage private forest owners.** Explore potential to restore built-up areas in Luxembourg to forested areas.
- ▲ **Promote carbon sequestration on agricultural land in woody structures and soil:** In order to strongly increase the carbon sequestration in agriculture in Luxembourg, targeted measures and monitoring of humus content and soil life and its remuneration as ecosystem service provision are necessary, on and beyond farmland. Furthermore, to promote more woody structures on farmland, agroforestry potential should be explored and promoted. Agroforestry is not only of interest to increase carbon sequestration but also to help the agricultural sector to adapt to climate change, while helping to address biodiversity loss and promote local fruit production.
- ▲ **Promote ecosystem restoration, and planting trees in urbanised areas** can help make cities more resilient to impacts of extreme weather events. Within settlements, the maintenance or creation of green spaces and planting of trees can increase the carbon sequestration and also help to reduce local temperatures and thus helping to adapt settlements to climate change.
- ▲ **Reduce net land take from about 0.5 ha per day to 0 ha per year:** by reducing the sealing of new surfaces for settlements, economic activities, or transport to zero or compensate by unsealing surfaces for newly sealed surfaces.

4.5 Finance sector

Align and strengthen national co-financing to industrial/economic investment programmes, e.g., the “Fit for 55” and circular economy, both of which are pillars of sustainable industrial and economic development, and continue investment to *reduce Luxembourg’s greenhouse gas emissions (GHG)*, specifically in the industries analysed in this report.

- ▲ **Maintain public spending on projects that lead to and/or support sustainability transformation** to help redesign industries according to sustainability principles. This includes substantial investment in jobs, training, and *new sustainable job profiles*.
- ▲ **Attract sustainable financing for sustainable projects/investments with a particular focus on Luxembourg and the Greater Region.** Financial instruments of new design and *focus* (e.g., on sustainable industries in the Greater Region) could be developed, with blended finance and (more) equal risk sharing between private and public partners. Wherever reasonable, a regional focus further helps to shorten and strengthen supply chains, and make the *regional economy* more robust, more sustainable/more efficient, and less dependent.
- ▲ **Identify financial support for sustainable initiatives at the community level.** This comprises long-term financial support for *community economies*²¹, including, for example, their transition towards doing things alternatively (with focus on sufficiency and efficiency) and citizen-driven *energy communities*²² to help pave the way for a clean energy transition.





References

- ¹ Each finding of the IPCC reports is grounded in an evaluation of underlying evidence and agreement. A level of confidence is expressed using five qualifiers: very low, low, medium, high and very high, and typeset in *italics*, for example, *medium confidence*.
- ² Loi modifiée du 15 décembre 2020 relative au climat. <http://data.legilux.public.lu/eli/etat/leg/loi/2020/12/15/a994/jo>
- ³ Règlement grand-ducal du 22 juin 2022 déterminant les allocations d'émissions de gaz à effet de serre annuelles pour la période allant jusqu'au 31 décembre 2030 des secteurs visés à l'article 5 de la loi modifiée du 15 décembre 2020 relative au climat. <http://data.legilux.public.lu/eli/etat/leg/rgd/2022/06/22/a328>
- ⁴ PLAN NATIONAL INTÉGRÉ EN MATIÈRE D'ÉNERGIE ET DE CLIMAT DU LUXEMBOURG POUR LA PÉRIODE 2021-2030 <https://mea.gouvernement.lu/dam-assets/energie/energie-renouvelable/Plan-national-integre-en-matiere-d-energie-et-de-climat-du-Luxembourg-2021-2030-version-definitive-traduction-de-courtoisie.pdf> . Il est basé sur le règlement (UE) 2018/1999 sur la gouvernance de l'union de l'énergie et de l'action pour le climat.
- ⁵ IPCC, 2022: Summary for Policymakers. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.001.
- ⁶ Nathan J. Bennett, Jessica Blythe, Andres Cisneros-Montemayor, Gerald G. Singh, and U. Rashid Sumaila. 2019. Just Transformations to Sustainability. *Sustainability*. 11, 3881–3899.
- ⁷ Stevenson, R.B., Nicholls, J. et Whitehouse, H. What Is Climate Change Education ? *Curric Perspect* 37, 67–71 (2017). <https://doi.org/10.1007/s41297-017-0015-9>
- ⁸ Wiedemann et al. 2020. *Nature Communications*. 11, 3107. <https://doi.org/10.1038/s41467-020-16941-y>
- ⁹ IPCC, 2022: Summary for Policymakers [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem (eds.)]. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 3–33, doi:10.1017/9781009325844.001.
- ¹⁰ IPCC, 2022: Summary for Policymakers [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem (eds.)]. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 3–33, doi:10.1017/9781009325844.001.
- ¹¹ Nathan J. Bennett, Jessica Blythe, Andres Cisneros-Montemayor, Gerald G. Singh, and U. Rashid Sumaila. 2019. Just Transformations to Sustainability. *Sustainability*. 11, 3881–3899.
- ¹² Jasanoff, S. (2003). Technologies of humility: Citizen participation in governing science. *Minerva* 41 (3): 223–244. doi:10.1023/A:1025557512320
- ¹³ Association négaWatt : La démarche négaWatt <https://negawatt.org/La-demarche-negaWatt>
- ¹⁴ ODYSEE-MURE project, available at <https://www.odyssee-mure.eu/publications/efficiency-by-sector/households/household-eu.pdf>
- ¹⁵ UNEP IRP (2020) Resource Efficiency and Climate Change. <https://www.resourcepanel.org/reports/resource-efficiency-and-climate-change>
- ¹⁶ The Welsh government, for example, announced in 2021 that it would stop building new roads: <https://gov.wales/freeze-new-roads-projects-be-announced>.

- ¹⁷ Gössling, S. (2013). Urban transport transitions: Copenhagen, city of cyclists. *Journal of Transport Geography*, 33, 196-206.
- ¹⁸ <https://e3modelling.com/modelling-tools/primes/>
- ¹⁹ https://gouvernement.lu/fr/actualites/toutes_actualites/communiqués/2022/04-avril/20-solidariteitspak.html
- ²⁰ https://gouvernement.lu/fr/actualites/toutes_actualites/communiqués/2022/09-septembre/08-presentation-campagne-energie.html
- ²¹ <https://altfin.uni.lu/2022/03/02/what-are-community-economies/>
- ²² https://energy.ec.europa.eu/topics/markets-and-consumers/energy-communities_en