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SYSTEMIC SOLUTIONS, A NECESSITY

Despite the active environmental policy of the past decades, the improvements to our environment are too little and too slow. Many environmental indicators are improving, but various positive trends are slowing down. Other indicators illustrate the major impact on humans, nature and the economy. Moreover, our societal systems – energy, mobility, food – are also under pressure from global megatrends such as demographic developments and climate change. Conventional environmental policy is reaching its limits. To make our societal systems more resilient and more sustainable, a novel approach is needed that develops solutions from an integrative perspective.

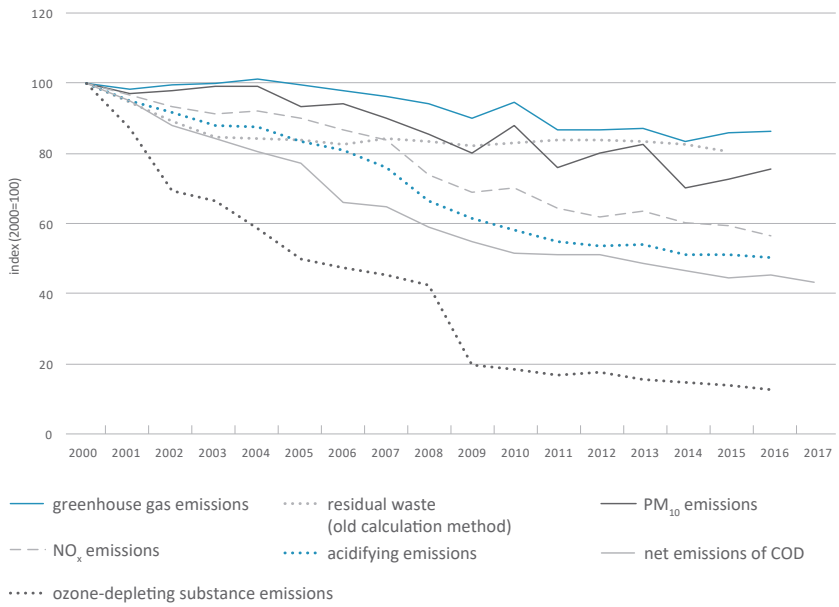
1.1 Environmental indicators show progress, but much work remains to be done

Indicators are particularly useful to document, analyse and monitor the state of the environment. By monitoring over two hundred indicators, MIRA keeps the finger on the pulse of the environment in Flanders (**www.milieurapport.be**). The question is how these Flemish environmental indicators have evolved over the past decades. There are certainly numerous positive trends, but recently they appear to have slowed down. Moreover, the impact on humans, nature and the economy remains significant and a substantial part of the environmental pressure in Flanders is also passed on to other regions. Some indicators even show a persistently negative trend. Despite the attention to, and relative growth of, environmentally friendly alternatives, their share is still small. The examples below illustrate these findings.

Favourable trends are slowing down

Many environmental indicators in Flanders have developed positively, but recently these favourable trends have, to a greater or lesser extent, been slowing down (see figure on next page).

WEAKENING FAVOURABLE TRENDS (FLANDERS, 2000-2017)



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Emissions of **ozone-depleting substances** detrimentally affect the stratospheric ozone layer (in the upper atmosphere, at 10 to 30 km altitude). The most important substances are chlorinated and brominated compounds such as chlorofluorocarbons (CFCs), hydrochlorofluorocarbons, halons, methyl bromide and carbon tetrachloride. They are used as refrigerants, blowing agents, propellants or solvents. Agreements have been made at international level to initially limit, and ultimately ban, the use of ozone-depleting substances. Emissions in Flanders fell by 87 per cent between 2000 and 2016, but the rate of decline has slowed in recent years. However, in the meantime, the first signs of a global restoration of the ozone layer can be seen.

The carrying capacity of nature (forests, heathland and species-rich grasslands) for atmospheric deposition is expressed as the critical load. The **acidification** critical load takes into account the combined effect of acidifying sulphur and nitrogen deposition. The percentage of total area of terrestrial ecosystems where the acidification critical load is exceeded, fell from 79 per cent in 2000 to 22 per cent in 2015. In recent years, the downward trend has clearly slowed down, and in 2016 the percentage even increased again to 26 per cent. Sulphur dioxide (SO_2), nitrogen oxides (NO_x, expressed as NO_2) and ammonia (NH_3) emissions do

not equally contribute to potentially acidifying emissions. That is why the sum is expressed in acid equivalents (Aeq), which take into account the acidifying capacity of each substance. Acidifying emissions were halved between 2000 and 2016, but this positive trend has markedly slowed down in recent years. In the past, ammonia emissions from agriculture declined due to, among other factors, low-emission stables and manure processing. Desulphurisation of fuels has led to a significant decline in SO_2 emissions. However, the large number of diesel cars in the passenger car fleet has an adverse effect on NO_x emissions.

NO_x emissions contribute not only to acidification, but, in combination with non-methane volatile organic compounds, to the formation of ozone in the troposphere (the lowest layers of the atmosphere), where it is harmful to the environment and people. The significant reduction in NO_x emissions is the result of new standards and environmental policy agreements in industry and the energy sector and the increasingly stringent Euro emission standards for vehicles.

The annual average **PM_{10}** and **$PM_{2.5}$** concentrations show a remarkable improvement. Since recently, however, these favourable trends appear to be slowing down. The downward trend is related to the reduction in emissions of primary particulate matter and precursors (such as NO_x, NH_3 and SO_2 – see also above) that give rise to secondary particulate matter. But these emissions, too, have shown little, if any, improvement in recent years. An increased share of natural gas, more flue gas purification, the reduced deployment of conventional power plants, and increased energy imports from abroad account for the decreasing primary particulate matter emissions in the energy sector. The introduction of emission limit values for large combustion plants, the gradual switch from solid fuels to natural gas, and the introduction of flue gas filters all played an important role in industry. In the transport sector, and road transport in particular, exhaust emissions have decreased due to the renewal of the vehicle fleet. Households are important contributors to particulate matter emissions, mainly from solid fuel heating. These emissions depend largely on temperatures in winter.

Total **greenhouse gas** emissions in Flanders showed a modest positive trend between 2004 and 2011, when they declined by 14 per cent. Since then, however, the trend has largely stagnated. This is the net result of the emissions reduction in the energy sector, the stagnating trend in industry and households, and the increasing emissions in agriculture, transport and trade & services. Greenhouse gas emissions reduced primarily due to specific measures for fluorinated gases, nitrous oxide and methane in industry and agriculture. Also CO_2 emissions, which are generated mainly from the combustion of fossil fuels, have been declining since 2005. This decrease is due, among other things, to the higher energy efficiency in industry, the closure of conventional power plants, and the co-combustion of biomass in the energy sector. Moreover, households are increasingly saving energy and switching to renewable energy forms for electricity and heat generation. Despite the increasing fuel efficiency of vehicles and vessels and the increasing use of biofuels, greenhouse gas emissions from passenger and freight transport have increased compared to 2000.

Sufficient dissolved oxygen in the water is an important prerequisite for a diversified ecosystem. The **average oxygen concentration in the surface water** gradually increased in the period 2000-2013, but this favourable trend has largely ground to a halt since then. This can to a large extent be explained by the evolution of the pollutant load to the surface water or the net emissions of chemical oxygen demand (COD), which experienced a steep fall, but the

downward trend has been far less pronounced in recent years. The decline in net emissions by industries is a result of the efforts made by companies and the development of the public water treatment system. The percentage of inhabitants whose wastewater is treated by a public wastewater treatment plant (WWTP) has increased significantly, from 48 per cent in 2000 to 84 per cent in 2017. Moreover, the treatment efficiency of the WWTPs has improved. Also, an increasing number of homes not connected to the sewage system now have an individual wastewater treatment unit. The rate at which additional households are connected to public WWTPs, however, is beginning to slow down. Also the average treatment efficiency (for COD) of the WWTPs has stopped increasing.

Excessive **nitrate and phosphate concentrations in surface water** can lead to eutrophication or excessive algae growth. The percentage of monitoring sites in agricultural areas where the nitrate threshold is exceeded, improved significantly between 2005-2006 and 2013-2014 as a result of the manure action plans. However, the improvement has stalled. Phosphate has not shown a positive trend since 2003. One reason for the current phosphate losses from agricultural land to the surface water is historical: saturation of the soil's sorption capacity.

In 2016, 3.19 million tonnes of **household waste** were collected, or 490 kg per inhabitant. Of this waste, 69 per cent was collected selectively, mainly for the purpose of recovering materials (through recycling), fermentation or composting. Most non-selectively collected waste (residual waste) is incinerated with energy recovery. Between 1991 and 2004, the selective collection rate for household waste rose from 18 per cent to over 71 per cent. This was accompanied by a halving of the amount of residual waste. Since then, however, these positive trends have not continued to the same extent. The level of selective collection has stagnated and the reduction in residual waste has slowed down significantly.

Environmental disruption has a great impact on humans, nature and the economy

Despite the environmental policy of the past decades, the negative impact of certain environmental problems continues to weigh on our society. This has an impact both on humans and nature and on the economic fabric, and therefore represents a significant social cost.

Exposure to environmental pollutants can lead to a variety of **health effects**. In Flanders, environmental pollution leads to a total annual health impact of over 100,000 lost healthy life years. Lifetime exposure to current pollution levels means that every Flemish citizen loses, on average, one healthy life year. The health impact for sensitive groups is probably greater. In 2010, particulate matter accounted for over two-thirds of the health impact of environmental pollution in Flanders. Short-term effects of particulate matter include heart and lung problems, potentially leading, in the long term, to premature death and chronic bronchitis. Long-term exposure to smaller particulate matter ($PM_{2.5}$ and less) does the most damage to health. In 2015, the external health costs due to particulate matter in Flanders amounted to around 4 billion euros. Noise can cause sleep disturbances, stress and even cardiovascular disorders. With 7 per cent, noise is the second-most important factor in the health impact of environmental pollution in Flanders. This is because a major part of the population is exposed to traffic noise due to the dense road network, the growing car fleet, the increasing number of kilometres driven, and the high population density.

The objective of the European Water Framework Directive is to achieve **'good status' for all water bodies**. For natural surface waters, this means, among other things, good ecological status. For artificial and heavily modified surface waters, the targets can be lower (= good ecological potential). Biological quality elements (such as macroinvertebrates, aquatic plants and fish), hydromorphological characteristics (such as meandering and bank structure) and physico-chemical parameters (such as oxygen and nutrients) together determine the ecological status. Only one of the 499 assessed water bodies met the target - good ecological status - in the period 2010-2015. Around 80 per cent of the water bodies have 'bad' or 'poor' status. This means there is still a long way to go before the targets of the Water Framework Directive are met. Although the quality of the surface water is improving, it is still insufficient in most places. Phosphorus presents the biggest problem. Moreover, the majority of the water bodies are only of moderate or poor hydromorphological quality. The sub-standard physico-chemical and hydromorphological quality hampers the development of a healthy and diverse aquatic ecosystem.

When airborne nitrogen compounds are deposited on the soil surface, they act as nutrients. An excessive amount of nitrogen in ecosystems leads to changes in the composition of plant communities. This **eutrophication** therefore causes damage to nature. In 2016, the critical load for eutrophication was exceeded on 82 per cent of the total Flemish surface area of terrestrial ecosystems. This was the case in all forest and heathland areas in Flanders. For species-rich grassland, 39 per cent of the surface area suffered from excessive nitrogen depositions.

More extreme weather patterns also have a clear impact on our society. Floods and heat are natural phenomena that are intensified by human activities. Thus, the increase in paved surfaces increases the likelihood of floods and housing and economic activities in flood-prone areas make for a greater potential impact. In Flanders, more than 220,000 people are potential victims of exceptional floods (order of magnitude once per thousand years). The annual average damage caused by flooding for the whole of Flanders amounts to over 50 million euros. The impact of periods of hot weather is often less visible than the damage caused by, for example, floods or hurricanes. However, exposure to heat appears to claim considerably more victims. In the period 2000-2017, Belgium recorded the highest excess mortality rates during the warm summers of 2003, 2006 and 2010. In all three cases, increases of over 6 per cent, or more than 2,000 extra mortalities, were recorded during heat periods. Especially in cities, people are exposed to heat stress as a result of climate change. Due to the blocking of wind and the retention of heat in concrete, asphalt and bricks, temperatures in cities can be much higher than in the surrounding areas. Cities may thus develop into actual heat islands.

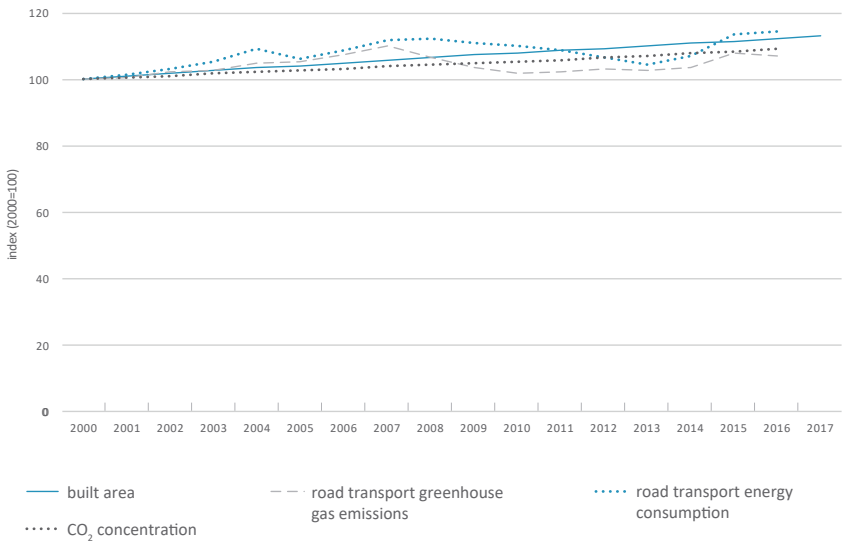
Footprint indicators, such as ecological footprint and carbon footprint, indicate how many resources a country or region uses worldwide for its consumption and/or the amount of pollution that is caused worldwide by that consumption. It also takes into account the environmental pressure created outside of Flanders as a result of our consumption. The ecological footprint is expressed in global hectares (gha), which is one hectare of land or sea surface of global average biological productivity. The **ecological footprint** of the average Flemish citizen is approximately 9 gha. However, the biologically productive land on Earth is only 1.8 gha per inhabitant. The ecological footprint of the average Flemish citizen is therefore too high by a factor of 5. The carbon footprint of Flanders is the total amount

of greenhouse gases produced worldwide as a result of Flemish consumption. The **carbon footprint** in Flanders amounts to about 20 tonnes per inhabitant. To limit the average global temperature rise to 2 degrees Celsius, global greenhouse gas emissions need to be reduced to an average of 2 tonnes per capita by 2050. Both the ecological footprint and the carbon footprint of Flanders is therefore many times higher than what is ecologically sustainable in the long term. Limited changes in consumption patterns and in production efficiency will therefore not be sufficient.

A few unfavourable trends persist

Some indicators show a thoroughly negative trend (see figure below). Even though these problems have been known for some time and despite the numerous policy measures taken, no change has been forthcoming.

UNFAVOURABLE TRENDS
(FLANDERS, 2000-2017)



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The **amount of built area** in Flanders continues to grow. On 1 January 2017, over one-quarter of the total surface area of Flanders consisted of built land. This represents an increase in the percentage of built plots by almost 30 per cent compared to 1990, and is attributable mainly to new-build homes and business premises. The construction of houses, roads, public buildings, businesses and other structures seals off soil and adversely affects natural soil formation and functions such as infiltration and water storage. In addition, building activities outside the centres of cities and municipalities exert strong pressure on, and fragmentation of, open spaces (such as agricultural land, forests or dunes). Also climate change and the resulting rainfall and heat extremes require space for the construction of floodplains and infiltration areas, for green space in urbanised areas and for renewable energy production.

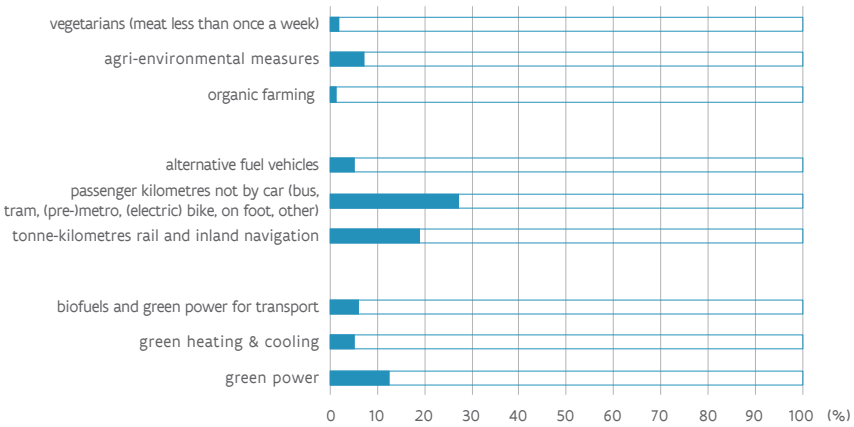
Energy use and greenhouse gas emissions from transport also continue to rise. The transport sector accounts for a major share of energy consumption and all kinds of emissions to the atmosphere, such as greenhouse gases, particulate matter and nitrogen oxides. Despite the increase in passenger and freight transport by road, the sector did manage to reduce its nitrogen oxide and $PM_{2.5}$ emissions by 41 and 64 per cent respectively between 2000 and 2016. Energy consumption and greenhouse gas emissions by the transport sector, however, continued to increase. Even though passenger cars and lorries are becoming more energy efficient, total energy consumption nevertheless increases due to the increase in the number of kilometres travelled. This led to a 7 per cent increase in greenhouse gas emissions between 2000 and 2016.

In 2016, the annual average **atmospheric CO_2 concentration** exceeded the threshold of 400 ppmv. At 403.3 ppmv, the concentration is now 45 per cent higher than the pre-industrial level of 278 ppmv. Of all the carbon dioxide emitted by human activities, about half remains in the atmosphere. The dwell time in the atmosphere is also long enough to obtain a globally homogeneous mixture. The exact location of emissions is therefore not really relevant. The current rate at which the atmospheric CO_2 concentration is increasing has also never been higher in the past twenty years. This is caused by the growing emissions at global level. Due to the increase in greenhouse gas concentrations, the average temperature on Earth rose by nearly 0.9°C between 1850 and 2017. In Belgium (Ukkel), it is now an average 2.5°C warmer than in the pre-industrial period. The effects of climate change as can already be observed today in Belgium, include more frequent heat waves, wetter winters, more extreme rainfall and a rise in the sea level.

Limited breakthrough of innovations

Ecologically more sustainable innovations cover a broad spectrum, from wind farms, solar panels, electric cars and bikes to reduced meat consumption. Interest is clearly growing, both among policy-makers, research institutions, citizens and businesses. This is evident from policy visions, research budgets, media coverage and new forms of economic activity. However, the breakthrough of sustainable innovations has thus far been limited (see figure opposite).

LIMITED BREAKTHROUGH INNOVATIONS (FLANDERS)



www.milieurapport.be, Department of Agriculture and Fisheries, Mobility Behaviour Survey Flanders 5.2 (commissioned by the Department for Mobility and Public Works)

Energy system

Green heat covers a variety of technologies whereby heat is generated from renewable energy sources. These include not only large-scale applications of biomass, but also relatively small-scale applications of thermal solar energy, wood boilers and burners, cold/heat storage and heat pumps. Some of these techniques can also be used for cooling. The share of **green heating and cooling** in gross final energy consumption for heating and cooling has increased from 2.7 per cent in 2005 to 5.1 per cent in 2016.

Green power is produced from renewable energy sources such as hydropower, solar power, wind energy, biomass, geothermal energy, wave energy and tidal energy. The share of green power in gross final electricity consumption has gone up from 1.8 per cent in 2005 to 12.3 per cent in 2016.

Biofuels are all fuels produced from vegetable or animal material that are used for transport. When used in replacement of fossil fuels, they help reduce greenhouse gas emissions from transport. The share of renewable energy used for transport – **green power and biofuels** – increased to 5.9 per cent in 2016.

Mobility system

On the whole, vehicles using alternative fuels and/or with alternative propulsion systems, such as natural gas, hydrogen, hybrid technology and electric battery, are more environmentally friendly than conventional fuel vehicles. The total number of new cars using alternative energy sources has increased by a factor of 19 in the period 2008-2016. However, they still represented only slightly less than 5 per cent of all new passenger cars in 2016.

Sustainable transport modes such as train (11.5 per cent), bus/tram/(pre-)metro (3.6 per cent), (electric) bike (4.5 per cent) and on foot (1.8 per cent) and others (5.7 per cent) together account for only 27 per cent of personal kilometres travelled in 2016. The car still accounts for the remaining 73 per cent. In freight transport, **rail and inland navigation** had a combined share of 19 per cent in the total number of tonne-kilometres in 2015. Here, too, road transport dominates the modal split with a share of 81 per cent.

Food system

As the pioneer of environmentally friendly farming methods, **organic farming** focuses strongly on preserving and improving soil fertility and achieving closed cycles. This involves, among other things, intensive crop rotation, suitable tillage practices and use of green manures and organic fertilisers. Chemical-synthetic pesticides, chemical fertilisers, feed with growth stimulants or antibiotics and genetically modified organisms are prohibited. The balance between animal and vegetable production is preserved by limiting stocking densities. In 2017, the area of organic farming was 7,367 hectares, more than twice the area in 2005 but still only 1.2 per cent of the total Flemish agricultural area.

An **agri-environmental measure** is a voluntary agreement between the farmer and the Flemish Land Agency (VLM) or the Agriculture and Fisheries Department. The agreement, which is generally concluded at plot level and runs over a period of five years, can relate to nature management at a farm, the achievement of certain environmental targets, the implementation of environmentally friendly agricultural production methods or the preservation of genetic diversity. The agricultural area under agri-environmental measures rose until 2008, but has since declined to around 7 per cent of the Flemish agricultural area in 2014.

Eating fewer animal products offers significant potential to improve the ecological sustainability of the food system. Meat consumption in Belgium fell by 22 per cent between 2005 and 2016. Yet the number of Flemish people consuming meat less than once a week is not even 2 per cent.

1.2 Megatrends are becoming increasingly present

MIRA attempts to present a systemic outlook. In recent years, a number of so-called megatrends were identified. These global trends appear to be so comprehensive and, above all, far-reaching for the environment in Flanders that they cannot be ignored in environmental policy.

What are megatrends and why do they matter?

Flanders cannot function as an island in today's highly globalised world. The environmental issues in our region and the societal developments that impact them, are in turn influenced by larger global trends. The term 'megatrends' is used to denote long-term, already apparent change processes with a very broad scope. Megatrends have profound, far-reaching and potentially even critical implications. They are already apparent today and can change society over a longer period of time. It cannot be predicted how this will exactly occur. Megatrends are in fact surrounded by considerable uncertainties and also mutually influence each other.

Flanders itself has no grip on such autonomous and powerful trends. Conversely, however, megatrends will fundamentally impact (environmental) policy in Flanders. In the MIRA report *Megatrends: far-reaching, but also out of reach? How do megatrends influence the environment in Flanders?* (2014, **en.milieurapport.be/publications**), we analysed six megatrends:

- changing demographic balances;
- accelerated technological developments;
- growing scarcity of raw materials and resources;
- growing multipolarity in society;
- climate change;
- increasing vulnerability of systems.

The analysis of the megatrends and their effects on the environment in Flanders - now and in the future - indicated that their impact is unavoidable. It manifests itself primarily through the societal systems - energy, mobility, production and consumption (including food) - and through spatial planning. These systems are made up of interconnected and matched elements such as technologies and infrastructures, policy, practices and institutions. But also the relevant societal actors, markets and networks are an integral part of the system. All these elements represent entry points where megatrends impact our societal systems. For Flemish environmental policy to be robust, resilient and effective today as well as tomorrow, it will have to take into account these large-scale developments and their implications.

Megatrends reinforce the need for systemic solutions

The results of the horizon scanning study carried out on behalf of MIRA (2017-2018) suggest that the six identified megatrends are still very relevant today. Their impact on society and the environment has become even more pronounced, also in Flanders.

In Flanders, **changing demographic balances** have contributed to a change in housing, living and working patterns, for example single-parent families, more leisure activities, teleworking, second earners, and more active seniors. This has led to a growing demand for space for housing, living and working. Growing urbanisation is noticeable, but is often not achieved through clustering or (spatial) densification of urban centres. This blurs the distinction between urban centres and open spaces, and has resulted in Flanders being referred to as 'urban haze'. A spatial vision that strengthens urban centres should promote the development of desirable sustainable options such as heating grids, high-quality public transport and more sustainable and extensive forms of agriculture.

Technological innovations occur at an ever increasing pace and profoundly change the way in which we work, live, communicate and consume. Technological innovations can be unexpected and disruptive, such as social media, 3D printing, artificial intelligence or blockchain technology. More than ever, the focus is on technology to maintain economic prosperity and address major challenges, from renewable energy and energy storage over more sustainable mobility alternatives to non-land-bound high-tech forms of agriculture. The risks posed by new technologies need to be managed and mitigated. It can thus be avoided that blind faith in technological solutions to environmental problems stands in the way of a profound transition, for which behavioural change is also required. More attention for the social aspects of technological innovation and the integration of technology into social innovations appears to be of great importance.

The growing shortage of raw materials and resources remains a point of concern in the face of the growing world population and economy. Both political and economic factors appear to play an important role. There is, however, increasing interest in the circular economy, which is also a priority in Flanders. This gradually results in increased attention for reuse, recovery, recycling and the closing of material loops. This counter trend is therefore gaining in importance, both with businesses and with governments. Behavioural change with consumers plays an important role in achieving this circularity. Even though initiatives are taken to reduce dependence on materials, they have thus far failed to generate sufficient impact. The decoupling between economic growth and materials intensity remains relatively limited, certainly at the global level.

There appears to be a **growing multipolarity in society**, both in the global economy, political power, social relationships, social patterns, and in behaviour and consumption. This trend is reflected both globally and at national, regional and individual levels. International consultation structures, including climate agreements, are being challenged or abandoned by certain countries. There is a growing polarisation in social movements and counter movements. Also the principle of solidarity, the basis of our welfare society, is being challenged. There is an increasing risk of privacy erosion and there are also fundamental doubts about the reliability of information. Public uncertainty and distrust in government decisions can weaken the support for sustainability transitions. Therefore, it seems to be of major importance to establish a new overall social pact inspired by common challenges, such as tackling climate change.

Climate change is an extremely far-reaching megatrend, the effects of which are becoming increasingly apparent, also in Flanders. Growing digitalisation and rising global purchasing power further push up global energy demand. Our high consumption of resources and raw materials accounts for a large part of our total greenhouse gas emissions. A radical change of course is needed to stop climate change before it is too late. In Flanders, summers are becoming hotter and drier, extreme weather conditions occur more frequently, winters are becoming wetter, and there is a greater risk of flooding. This is reflected in the food system, with more variable or declining crop yields. Space is believed to be an important factor in the transition to a low-carbon society. In the energy system, for example, there are sufficient possibilities for the construction of heating grids and wind turbines; in the mobility system, the focus is on strengthening of urban centres, thereby reducing demand for transport and the associated CO_2 emissions.

The existing **societal systems are becoming vulnerable** because they have difficulty in keeping pace with global changes. The interconnectedness of societal systems further adds to this vulnerability. The financial and monetary system in particular is a key driving force in this respect. Despite the need for radical choices regarding the approach to tackling climate change, for example, environmental protection is still too often considered outside the financial-monetary and economic realm. Changing this proves to be all the more difficult in Flanders, where there is still not enough attention being paid to the coherence between systems and to a coherent spatial vision. The systematic and significant weakening of virtually all systems constitutes some kind of 'meta-trend' that further strengthens the other five megatrends. A marked increase in bottom-up initiatives, such as citizen committees or cooperatives, represents a counter trend of which the effects are limited for the time being.

1.3 Systemic approach as a necessary new perspective

The evolution of environmental indicators shows that the environmental policy efforts fail to produce the desired results. The approach that has been adopted thus far, is reaching its limits. A continuation of the conventional (environmental) policy does not appear to adequately address persistent problems in a sufficiently far-reaching and fast enough manner. Hence the need for other approaches. It is apparent that system transitions for sustainability are essential to providing solutions to persistent environmental problems in order to ensure prosperity and well-being in the future. The challenges and uncertainties brought upon us by megatrends emphasise the need for structural interventions in the deeply embedded organisation of our societal systems. Only in this way can a transition to systems that are ecologically sustainable, be resilient and future-proof.

Structural changes or transitions in societal systems appear to take place quite abruptly, often within a time span of decades. Both administrative systems and social organisations are under pressure to adapt to this rapidly and profoundly changing context. Traditional policy instruments are inadequate to enable the successful transition to an ecologically sustainable society. The government cannot initiate the radical system innovations that are needed by relying only on conventional tools such as regulation and pricing instruments. A systemic approach is considered to be a necessary new perspective. The complex relationships within - and between - systems urgently require more attention. Systems thinking is crucial to understanding and trying to influence the behaviour of societal systems in transition. Only a systematic approach provides us with a good understanding of the technological, institutional, social and cultural innovations that will play a crucial role in these transitions.