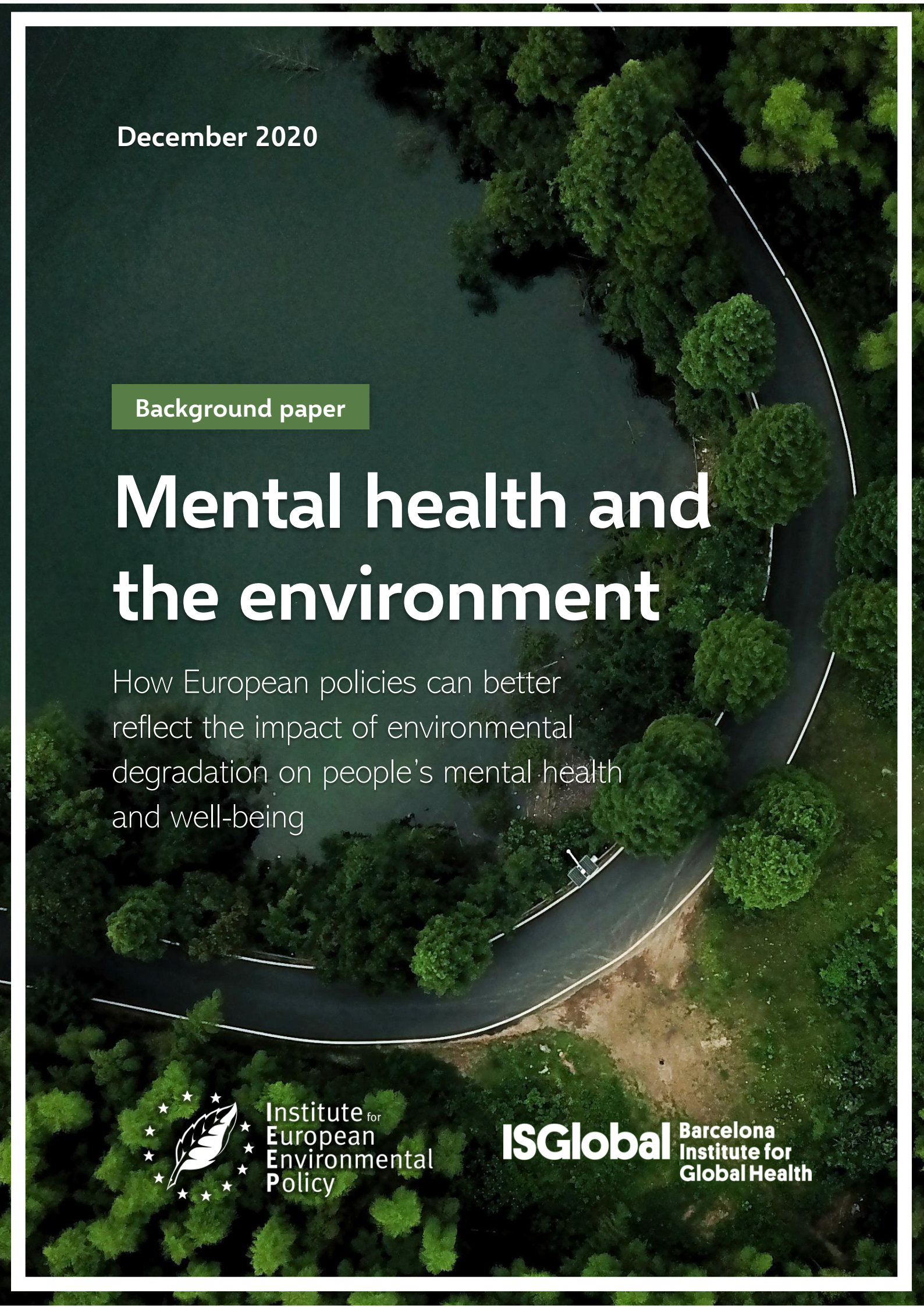

December 2020

Background paper

Mental health and the environment

How European policies can better reflect the impact of environmental degradation on people's mental health and well-being

Institute for European Environmental Policy

ISGlobal Barcelona Institute for Global Health

The **Institute for European Environmental Policy** (IEEP) is a sustainability think tank with offices in Brussels and London. As a not-for-profit research organisation with over 40 years of experience, we are committed to advancing evidence-based and impact-driven sustainability policy across the EU and the world.

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1. EXECUTIVE SUMMARY

Mental health is an essential component of human well-being, however mental disorders such as depression and anxiety affect more than one in six EU citizens representing a significant personal and societal burden. In addition, poor mental health is estimated to cost Europe over €600 billion/year or over 4% of GDP of which a third goes to direct health care spending (OECD/European Union, 2018; WHO, 2019b).

It is widely documented that human mental health and well-being emerges from a complex interplay between genetic, psychological, social and lifestyle factors and environmental exposures. Following a growing body of evidence on the poor state of our environment, not least our inability to prevent runaway climate change (Hoegh-Guldberg et al, 2018) and nature loss (IPBES, 2019), EU citizens are increasingly calling on governments to step up action.

In recent years, evidence on the interplay between mental health and the environment has grown significantly, and the COVID-19 crisis, with its foreseeable and unforeseen socio-economic implications, adds a more urgent need for policy- and decision makers to identify and implement win-win solutions to both challenges.

This paper aims to respond to this need by reviewing the available scientific evidence on the correlation between the environment and people's mental health and well-being in Europe. It looks, firstly into environmental degradation and pollution as a threat to mental health, and secondly, into nature as an enabler of good mental health and the role of nature in the treatment of mental health conditions. Its structure logically flows from a review of the various environmental determinants of mental health towards the possible solutions and mitigating actions via nature, ecosystem services and an overall improvement of the environment. The paper also discusses how the interplay between environment and mental health is incorporated in major policy documents and suggest ways for further integration.

The paper devises a set of policy recommendations to encourage an improvement in mental and environmental health and to ensure consistent consideration of the impact of the environment on mental health and well-being in relevant EU- and Member State policies. It also devises proposal for local level actions and for addressing inequalities and environmental justice aspects.

1.1 Policy context

Following high public support for environmental sustainability in the European elections, the European Commission made the European Green Deal its overarching growth strategy and roadmap for making the EU's economy sustainable[1]. Beyond introducing a legal proposal to make Europe the first climate-neutral continent by 2050, the Green Deal '*aims to protect, conserve and enhance the EU's natural capital and protect the health and well-being of citizens from environment-related risks and impacts'*. Through the EU Green Deal the European Commission took a cross-sectoral approach embedding sustainability in all policies. This also presents a unique opportunity to address environmental determinants of health and well-being in relevant policies, and better deliver on the Treaty on the Functioning of the EU regarding the integration of environmental- (Articles 11, 191) and human health protection (Article 168).

The COVID-19 outbreak triggered a much deeper recognition of the importance of strong public health systems and a need for better EU-wide cooperation[2]. Moreover, the lockdown measures highlighted the critical importance of mental health and well-being under conditions of uncertainty and confinement, widespread examples of reduced pollution pressures especially in urban areas, as well as a new valuation of access to green spaces, whether public or private. As a result, the European Commission included the new EU health programme as a central part of its COVID-19 Recovery Plan pillar on '*learning lessons from the crisis*'[3]. To support these lessons, this paper brings together evidence on the interface of mental health and the environment and recommendations on how these two priority objectives can be reinforced.

1.2 Main findings on the negative impacts of the environment on mental health

This paper considers the environment as one of the key determinants of mental health outcomes. The consulted literature indicates that there is varied degree of scientific certainty with respect to the negative impact of different environmental exposures and pressures on mental health and well-being (primarily anxiety and depression were considered) mainly due to the complexity of the determinants' interaction and interrelation (social, heredity physiological, environment and other determinants).

1 European Commission Webpage on the European Green Deal
2 EU4Health programme 2021-2027 – conference
3 Recovery plan for Europe

The scientific evidence on the effect of air pollution on people's mental health is promising but weak, largely due to the positive and negative confounding factors, which in their interaction influence the impact. Studies investigating the relationship between long-term fine particulate matter exposure and anxiety report statistically significant positive correlation. Emerging evidence also suggests causality between dementia/Alzheimer's and chronic exposure to particulate matter.

Climate change already has significant mental health implications noting the psychological distress and anxiety about the future that may result from acknowledging climate change as a global environmental threat (e.g., climate anxiety, eco-anxiety). Moreover, climate change has direct impacts on mental health (e.g., heat stress) and indirectly affects social support systems, cultural traditions, and the environmental conditions. Acknowledgement of the mental health threats associated with climate change and concerted efforts in their mitigation for the sake of improved prevention, early intervention, and treatment, is needed to properly respond to mental health needs from onset through to recovery.

A wealth of evidence suggests a relationship between human exposure to a wide range of chemical substances and negative mental health outcomes, including depression, anxiety ASD, ADHD and other psychiatric and neurological conditions. For example, some studies point to a significant relationship between lead exposure and risk of depression, anxiety, and general stress. However, research on many other substances identified as possibly risky is insufficient and therefore inconclusive. As public budgets for pre-competitive risk assessments are limited, key stakeholders are pointing to the need for a stricter application of the precautionary principle

There is strong evidence that noise pollution (particularly coming from traffic) is linked to mental health problems, including annoyance, poor sleep, cognitive impairment, and exacerbation of psychiatric problems. Noise is particularly relevant for children, as they are particularly vulnerable, including in settings such as schools.

It is important to note the existing and potential synergies of different risk factors, which concurrently can affect mental health. A combination of different risk factors creates or has the potential to generate a much stronger, cumulative impact on mental health.

Table 1: Summary of the paper's findings of the available scientific evidence on selected environmental determinants and exposures and the resulting outcomes on mental health

Determinants and exposure	Mental health outcomes	Scientific evidence on mental health
Outdoor air pollution: NOx, CO, O3, UFPs, particulate matters, heavy metals	Depression, anxiety, sadness, personality disorders	There is an emerging association between certain air pollutants and a range of mental health outcomes.
Climate change: Extreme weather events, acute weather condition (warming-cooling), chronic - long- term weather change	Post-traumatic stress disorder, nostalgia, solastalgia, distress, anxiety, depression	There is evidence that the consequences of climate change have a profound impact on mental health
Urban environment: Built environment, housing, crowding, poor indoor air quality, lights	Distress, aggression, trauma, poor cognitive development	There is a positive association between air pollution and urban exposure, through which the built environment does directly affect mental health
Noise pollution: Transport, industry, surroundings	Annoyance, poor sleep, cognitive impairment	There is worldwide recognition of noise pollution as a major environmental hazard and is linked to accelerating and intensifying the development of mental disorders
Chemical pollutants and pesticides: POPs BFA, BAP, EDCs,	Depression, anxiety, ASD&ADHD, behavioural disorders	Research widely suggests a positive association between environmental chemical substances and negative mental health outcomes
Metals, microplastics and pharmaceuticals in the environment	Depression, anxiety and stress, hormonal disruption	The studies reviewed suggest a relationship between lead exposure and psychiatric symptoms, however research in this area remains fairly limited.

1.3 Main findings on the benefits of nature and biodiversity on mental health and well-being

The reviewed studies found substantial evidence that supports an association between common types of nature experience and increased psychological well-being along with a reduction of risk factors and burden of some types of mental illness. However, research also points to the challenges of clearly identifying benefits to mental well-being as they can occur via different pathways, both by mitigation of negative external stressors (e.g. heat), direct mental health benefits (e.g. attention restoration, reduction of stress/inflammatory markers and reduction of perceived stress levels) and indirect mental health benefits (e.g. greater social cohesion). Moreover, mental health benefits depend for example on the natural feature studied, the exposure of users to it and their personal experience. The study identified knowledge gaps on the underlying causal mechanisms and pathways explaining the relationship between nature, biodiversity and human well-being. Within urban planning and decision-making contexts, gaining a deeper insight into this relationship could be an extremely important contribution. Given the complexities, possible benefits would be best assessed at the local level and in the given context.

Evidence also points to a significant economic savings potential to public care budgets of better integrating mental health benefits into urban planning, especially when tailored to neighbourhoods with poor exposure and access to green spaces. Several regions and cities have already put in place plans and programmes to better analyse and act on such findings, but there appears to be significant room for improvement through better exchange of best-practices and scaling up of projects. Investing a greater share of health care budgets to improve public access to green spaces optimised for mental health benefits would also provide nature-based solutions, contributing towards the achievement of biodiversity- and climate policy objectives and hereby creating a triple win. From both climate- and biodiversity perspectives, the protection of existing green spaces should be prioritized over the development of new ones, and evidence suggests these spaces also provide the largest health benefits. However, as access to green space is often unequally divided, maximising mental benefits would also involve creating new spaces for nature in places where it can be most effective.

2. INTRODUCTION

Mental health is an essential component of human wellbeing, however mental disorders such as depression and anxiety today affect more than one in six EU citizens representing a massive personal and societal burden. In addition, poor mental health is estimated to cost Europe over €600 billion/year or over 4% of GDP of which a third goes towards direct health care spending (OECD/European Union, 2018; WHO, 2019b).

The COVID-19 outbreak triggered a much deeper recognition of the importance of strong public health systems and a need for better EU-wide cooperation[2]. Moreover, the lockdown measures highlighted the critical importance of mental health and well-being under conditions of uncertainty and confinement, wide-spread examples of reduced pollution pressures especially in urban areas, as well as a new valuation of access to green spaces whether public or private. As a result, the European Commission included the new EU health programme as a central part of its COVID-19 Recovery Plan pillar on '*learning lessons from the crisis*'[3]. To support these lessons, this paper brings together evidence on the interface of mental health and the environment and recommendations on how these two priority objectives can be reinforced.

A clean and healthy environment is essential for human health and well-being. The health impacts of climate change and environmental pollution should be viewed as a critical global public health issue. Undoubtedly, the health of the EU population is negatively affected by pollution and the effects of climate change, which can impact well-being by threatening access to clean air, fresh water and healthy food. 78% of Europeans agree that environmental issues have a direct effect on their daily life and health (Kantar Belgium, 2020). While physical health impacts of climate change and pollution have been well documented, the mental health aspects are less well defined but climate justice and the inequities of the impacts from climate change are prominent in international discourse.

The opportunities for reducing environment-related health risks are significant. For example, the OECD has indicated that the benefits of many environmental policies in terms of reduced health care costs and increased productivity significantly exceed the costs of implementing these policies. Similarly, the WHO's Global Strategy on Health, Environment and Climate Change highlights that governments should continue to prioritise environmental determinants of health and well-being in policy-making (WHO, 2020).

Human health and well-being are intimately linked to the state of the environment. Well-integrated policies that allow for synergies and encompass a wide array of factors affecting our lives, therefore, have a direct positive impact on the economy and citizens' health and well-being (Seymour, 2016). However, currently

only 3% of health budgets across EU Member States is spent on health promotion and disease prevention[4].

Box 1. COVID-19 and mental health in Europe

The COVID-19 pandemic is expected to significantly increase the incidence of mental health problems in the population, in particular in terms of post-traumatic stress disorder, anxiety, depression, abusive use of drugs, self-harm and suicide. Some of these consequences are directly associated with the characteristics of COVID-19. For example, the high risk of infection has promoted a **generalised state of alarm** that can lead to pathological fear of contagion and feelings of threat, increasing levels of stress and anxiety (Jungmann and Witthöft, 2020). Also, the pandemic is particularly affecting **front-line healthcare professionals**, who have been presented with situations in which they have to make a life-or-death decision without clear guidelines and information, which provides a setting for trauma-related mental health disorders.

Other mental health consequences are not directly associated to the infection itself but rather to the response measures. Uncertainty about the future and lack of control relative to different aspects of daily life such as work, mobility, and education can lead to a chronic activation of high levels of stress that has the potential to affect neurobiological processes and trigger mental health problems including burnout, depression and anxiety (Holmes et al, 2020). **Social isolation** can impact mental health through key emotional states such as loneliness and worthlessness, elevating the risk for depression and self-harm. Work-related burden, both in terms of work overload and unemployment, which is expected to be particularly high in some European countries, are also expected to impact emotional states. In the context of wellbeing and mental health, vulnerability is not only associated with financial resources, but also related to a decline in the perception of safety and security both in public spaces (the streets, the work place) and in private areas, mainly through domestic violence. Changes in the household such as increases in the burden associated with caregiving activities and interpersonal conflicts – in particular violence against women - further challenges the mental state of the population.

The effects of the emergency on mental health will have a particularly detrimental impact on people more susceptible to disease such as those in

4 European Commission diagnoses state of health in each Member State

previous and ongoing treatment or **older adults**. Importantly, people with mental health problems are more susceptible to present other non-communicable diseases (NCDs) such as cardiovascular diseases and therefore a rise in mental health conditions will likely also increase the prevalence of NCDs in general. Social dynamics and health inequalities are expected to modulate the impact on mental health in particularly vulnerable groups, including women with children and people living in poverty. In this respect, it is expected that the highest impact will be observed among those most at risk.

2.1 The post-COVID-19 world

The COVID-19 global health emergency is re-shaping political priorities and will greatly impact health policy within the EU and its Member States. The pandemic has placed a renewed focus on the integral relationship between the natural environment and human health. With more intense calls for a 'One Health' or 'planetary health'[5] approach across sectors and decision-making pathways, and Germany calling on the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Service (IPBES) to gather science for policy options to prevent pandemics and protect people and nature, this is the opportune time to integrate health and nature conservation priorities and mainstream them across sectors. An IPBES article stated that: "all levels of decision-making, from the global to local, need to recognise the complex interconnections among the health of people, animal, plants and our shared environment"[6]. At the EU level, members of the European Parliament (MEPs) wrote to President Von der Leyen to request an ambitious Biodiversity Strategy 2030 showing strong leadership and acknowledging the link between the functioning of ecosystems, health and disease outbreaks[7]. By recognising the pathways and mechanisms by which healthy natural environments can deliver mental health benefits within urban environments, human health and environmental priorities can be achieved simultaneously, strengthening the resilience of urban systems to future pandemics.

2.1.1 Objectives

The paper aims to review the available scientific evidence on the correlation between the environment and people's mental health and wellbeing in Europe. It looks, firstly into the impact of environmental degradation and pollution as a

5 The Lancet Planetary Health
6 IPBES Guest Article on COVID-19 Stimulus Measures
7 Letter to von der Leyen: EU Biodiversity Strategy must show ambitious leadership

threat to mental health, and secondly, into nature as an enabler of good mental health and the role of nature in the treatment of mental health conditions.

The paper reviews available literature looking into the cause-and-effect relationship between the environment and mental health. It explores both the known and perceived benefits and threats of the environment on the mental health of EU citizens.

The paper devises a set of policy recommendations to ensure consistent integration of the impact of the environment on mental health in relevant policies. The paper offers best practices from EU Member States and beyond to reduce the prevalence and severity of mental health conditions through relevant environmental interventions (toxic-free environment, restoration of biodiversity, access to nature, etc.) and the promotion of health, disease prevention and environmental health policies.

2.1.2 Definitions

According to the World Health Organization's definition, 'health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity'. For the purposes of this paper the National Centre for Biotechnology Information (NCBI) definition of mental health will be our reference: 'emotional, psychological, and social well-being of an individual or group[8].

The WHO definition of health as 'complete wellbeing' is no longer sufficiently fit for purpose given the rise of chronic disease. M. Huber and colleagues propose changing the emphasis towards the ability to adapt and self-manage in the face of social, physical, and emotional challenges (Huber et al, 2011). Most criticism of the WHO definition concerns the absoluteness of the word "complete" in relation to wellbeing. The main problem is that it unintentionally contributes to the medicalisation of society. The requirement for 'complete health' would leave most of us unhealthy most of the time.

Mental health is not just the absence of illness. Mental health is a state of wellbeing in which every individual realises their own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to contribute to her or his community[9]. Mental health requires cognitive, emotional, and social skills, which develop when we provide people with a sense of identity and self-

8 NCBI official definition of mental health

9 Joint Action on Mental Health and Well-being; Metal health in all policies; Situation analysis and recommendations for action

respect, meaning in life, mastery, belonging, safety, social support and participation.

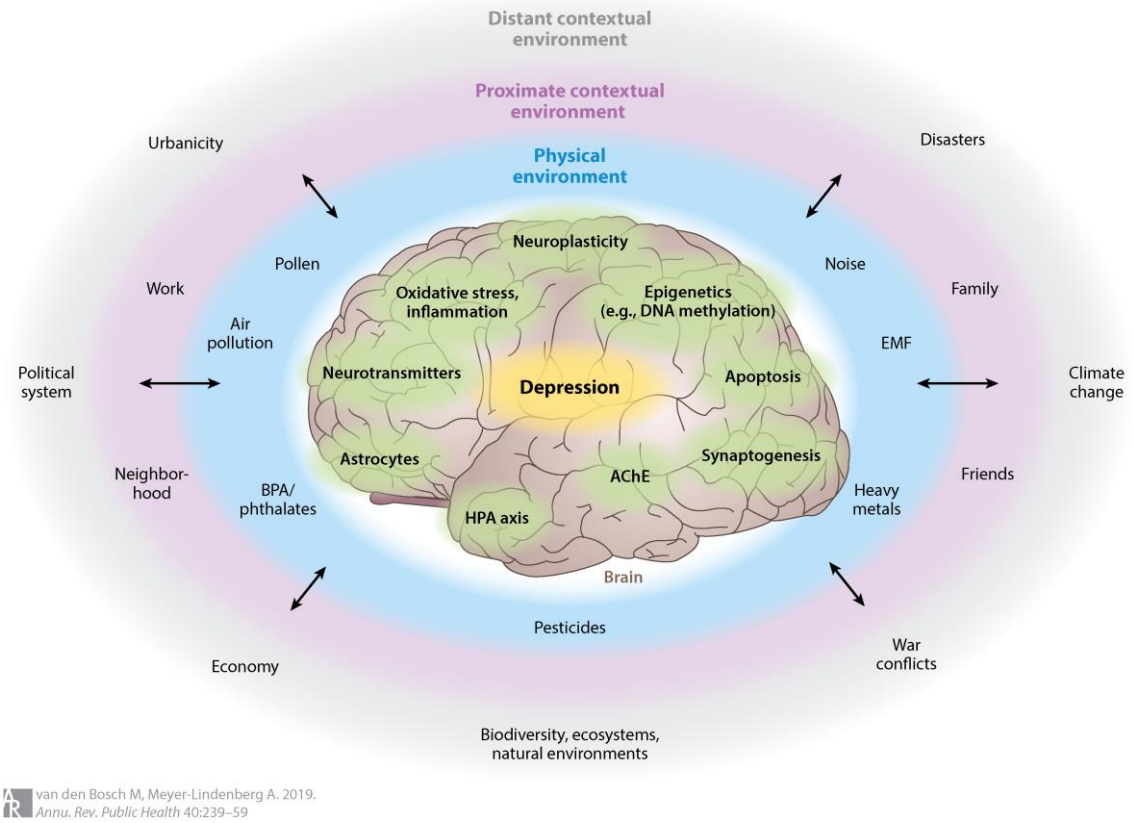
This paper will focus on **mental health** as an outcome (Galderisi et al, 2015), which encompasses:

- Emotional well-being, psychological well-being, and social well-being (usually self-perceived)
- Some highly prevalent psychological and mental disorders and illnesses such as sleeping disorders, stress, anxiety, and depression
- A life-course perspective on basic cognitive and social skills needed in each life period (e.g., cognitive neurodevelopment and children or neurodegenerative disease at advanced age)
- A holistic perspective of mental health, from health promotion, to prevention, early diagnosis, and treatment.

The paper takes a broad **definition of environment** as 'the surroundings or conditions in which EU citizens live or operate' but in its selection of issues places an emphasis on shared and outdoor environments most relevant for public policy and in particular the EU's areas of competence.

The innovative conceptual framework behind the plausible relationship between environmental exposures (both health detrimental and promoters) is based on complex interactions between different biophysical environmental stressors and buffers (immersed in proximal and distal contextual environments—city living, nature, natural disasters, and climate change—), and how those factors interact with central structures and functions of the brain and thus influence the neurobiology of different mental health issues, such as depression (see Figure 1).

Figure 1. Environmental exposures and depression



Taken with authors' permission from Matilda van den Bosch and Andreas Meyer-Lindenberg. Environmental Exposures and Depression: Biological Mechanisms and Epidemiological Evidence. Annu. Rev. Public Health 2019.40 (van den Bosch and Meyer-Lindenberg, 2019).

2.1.3 Scope limitations

There is abundant research focusing on the direct impact of the environment on people's physical health. Focusing on air pollution, for instance, there is a lot of evidence regarding its contribution to physical conditions such as respiratory disease. Even though these conditions would fall technically outside of the scope of this study, they can both directly and indirectly cause various mental disorders. However, the primary impacts of air pollution on physical health will not be the focus of this paper.

Although this paper has taken a life-course perspective on basic cognitive and social skills needed in each life period, the literature review considers general mental health outcomes and not single neurological or psychiatric mental conditions, such as Autism Spectrum Disorder (ASD) or Attention Deficit Hyperactivity Disorder (ADHD) or any specific, disorders and illnesses which the environment might contribute to.

3. CONTEXT

3.1 Mental health in the EU institutions and Member States

The EU Member States hold primary responsibility[10] for organising and delivering health services and medical care. The European Union's role mostly serves to complement national policies, and to ensure health protection in all EU policies. The only area of shared competence between the EU and Member States is "common safety concerns in public health matters" (Greer et al, 2019). Overall, health ministers of Member States have been reluctant to see EU policy affect national healthcare systems. Therefore, there is currently no EU strategy or legislation implementing health policies or addressing mental health issues.

Although there is a lack of concerted cross-sectoral EU action on mental health, a number of Member States have introduced new strategies[11] and more progressive approaches in addressing mental health holistically and to avoid the fragmentation of efforts. The 'Mental health: fact sheet' (WHO, 2019b) notes that nearly all the countries in the European Region (94%) that responded to a recent survey for the Mental Health Atlas, conducted by WHO in 2017, stated that they had a stand-alone or integrated mental health policy or plan. However, these strategies rarely acknowledge the natural environmental as a determinant of mental health and rather focus on social conditions.

At the *European Commission*, the Directorate-General for Health and Food Safety (DG SANTE) is responsible for issues related to mental health. At the Parliament hearing prior to her appointment, Health Commissioner Stella Kyriakides committed to do her utmost to put mental health back on the agenda and to work with other Commissioners to bring in a mental health thread across many policies.

At the *European Parliament*, the topic of health is part of the Committee on Environment, Public Health and Food Safety (ENVI). An MEP Alliance for Mental Health was formed in 2019 (European Parliament Interest Group on Mental Health, Wellbeing and Brain disorder) with GAMIAN-Europe as the secretariat. The aim being to bring together MEPs and relevant stakeholders to advocate for the development of sound EU policies which contribute to the prevention of mental health issues and to ensure appropriate and high-quality services and person-centred care, empowering those affected. Another recent development has been the call by the Coalition for Mental Health and Wellbeing for the European Commission to launch a Mental Health Strategy for the EU.

10 EU Health Policy
11 Friends of Europe Article: Pioneering mental health strategies across Europe

A Working Party on Public Health deals with topics related to public health and medical care within the *European Council*. According to its 2008 mandate "the Working Party should offer Member States and the Council a forum for greater involvement and ownership in shaping and implementing EU health actions. It should bring more focus, coherence, direction and prioritization to EU health policy and thus enable it to be more efficient and effective"[12]. The Council invited the European Commission to issue a Communication regarding the cross-sectoral impacts of different policy sectors on mental health. The Council resolution also called for a mental health strategy under the Finnish Presidency[13]. Members of the Parliament were very supportive of the resolution[14].

3.2 Relevant EU policy frameworks and mental health

The European Green Deal aims to protect, conserve, and enhance the EU's natural capital, and protect the health and well-being of citizens from environment-related risks and impacts. It emphasises that the policy response to the challenges it tackles must be bold and comprehensive and seek to maximise benefits for health, quality of life, resilience, and competitiveness. Through the EU Green Deal the European Commission took a cross-sectoral approach embedding sustainability in all policies. **This will present a unique opportunity to address environmental determinants of health and well-being in environmental and other relevant policies**.

The European Green Deal presents the Commission's plans for a sustainable green transition, with a roadmap of actions to boost efficient resource use by transitioning to a circular economy, addressing climate change by achieving climate neutrality by 2050, halting biodiversity loss and cutting pollution. At its core, the EU Green Deal is a **public health strategy** if the planned actions are properly designed and implemented in a just and fair way[15]. The EU Green Deal, and its related key initiatives such as a new EU Biodiversity Strategy for 2030 and EU Adaptation Strategy (planned for 2021) offer opportunities to scale up ecosystem restoration projects in both rural and urban areas. Furthermore, the foreseen Zero-pollution strategy will aim to address the environmental and lifestyle factors that impact human health & well-being.

The EU proposal for a regulation on the EU4Health programme for the period 2021-2027 recognises poor mental health as a critical contributor to the disease burden of non-communicable diseases – one of five key challenges the programme intends to address. Another key challenge highlighted in the proposed

12 Three year work programme of the Working Party on Public Health at Senior Level
13 The Economy of Wellbeing-Council Conclusions
14 MHE's reaction to the Draft Council Conclusions on the Economy of Well-being
15 European Public Health Alliance Article: Recipe for a healthy EU Green Deal

regulation is the growing health burden from environmental degradation and pollution, in particular air, water and soil quality, and also from demographic changes. In order to respond to these challenges, the regulation states that the EU programme should '…contribute to (…) the reduction of exposure to environmental pollution, and foster supportive environments for healthy lifestyles in order to complement Member States action in these areas' and therefore 'contribute to the objectives of the European Green Deal, the Farm to Fork Strategy and the Biodiversity Strategy.'

The EU Biodiversity Strategy for 2030 strengthened EU commitments on nature protection but also increased emphasis and ambition on restoring nature for human wellbeing which includes opportunities for incentives to reduce pollution pressures as well as improve green spaces[16]. Unlike the 2020 strategy, the new strategy proposes measures in the urban environment and includes a commitment that all European cities of at least 200,000 inhabitants develop Urban Greening Plans by 2030. These are to include measures and actions that create a significant number of biodiverse urban forests, parks and gardens, urban farms, green roofs, green walls, and tree-lined streets and establish connections between green spaces. In coordination with the Covenant of Mayors, under a new Green City Accord with cities and mayors, the Commission will establish an EU Greening Platform. Member states are encouraged to use nature-based solutions in urban and peri-urban environments and contribute towards achieving a coherent trans-European nature network.

The renewed interest to nature and biodiversity opens new avenues to further increase understanding on how green spaces and mental health interrelate, as well as how green spaces and nature experience can support prevention as well as treatment of mental health disorders. These ambitions have the potential to achieve significant health benefits if the spaces are designed to deliver them and their use and access rights are just and inclusive.

16 IEEP Article: First impressions of the EU Biodiversity Strategy for 2030

Nature and biodiversity policies are a shared EU competence. The EU's 7th Environmental Action Plan included as two of its nine strategic priorities '*to safeguard the Union's citizens from environment-related pressures and risks to health and well-being*' and '*to enhance the sustainability of the Union's cities*'. Legal competence on both urban and health policy in the EU is a national (or sub-national) competence, hence EU cooperation is merely supportive e.g. through investment in joint research, coordination, or exchange of best practice.

Despite the absence of EU policy drive for nature and health mainstreaming, the implementation of EU nature- and biodiversity policy already provides an important contribution to safeguard the natural features required for nature experiences to happen. For example, the Natura 2000 network of protected nature areas covers over 18% of the EU's terrestrial surface including many (peri-) urban areas. Through its research programme Horizon 2020, the EU has invested significantly in the evidence base for Nature-Based Solutions (NBS) and Re-Naturing Cities which had a strong urban dimension[1]. The EU has promoted nature-based solutions in cities through for example the European Green Capital Award and the Covenant of Mayors. Other projects with a mental health-environment focus that can be built on include: H2020 Expert Group to develop R&I policy agenda for NBS and re-naturing cities, URBINAT H2020 project, NATURVATION, Nature4Cities, GrowGreen, OPPLA, URBACT, ENVSJUST, proGIreg, GoGreenRoutes.

The **current EU Strategy on the Adaptation to Climate Change** (European Commission, 2013) aims to contribute to a more climate resilient Europe. As a result, by 2017, 25 Member States have adopted adaptation strategies focusing on making action at all governance levels transformative enough to cope with systemic changes in our climate, environment, and society. The Covenant of Mayors Initiative on Adaptation to Climate Change (called Mayors Adapt) has encouraged local authorities to adopt local adaptation strategies and awareness-raising activities to bring the importance of adaptation and resilience into the foreground of urban settings. Furthermore, the strategy focuses on climate-proofing major infrastructure and exploring the need for additional guidance on ecosystem-based adaptation for authorities and decision makers, civil society, private businesses, and conservation practitioners. Additionally, there has been an increase in EU climate funding for 2014-2020. 20% of the 960 billion EUR EU budget should be spent on climate mitigation and adaptation, which is three

times the previous level.[17] Another direct outcome of the strategy has been the European Climate Adaptation Platform (Climate-ADAPT) which provides resources to support adaptation policy and decision making, including a toolset for adaptation planning at all administrative levels. The evaluation of the Adaptation Strategy (European Commission, 2018) has shown that greater emphasis needs to be placed on city-level adaptation plans, which need to cater to the specific vulnerabilities of certain communities and the different risks faced by diverse regions. Furthermore, the interplay, and positive feedback between biodiversity conservation and adaptation is vital and can be achieved through nature-based solutions which would also have significant positive effects on the determinants of mental health.

The need to include mental health among the priorities of the public health agenda has been increasingly recognised in Europe over the past decade[19].

Policy background

The European Commission adopted, in 2005, the Green Paper "Improving the mental health of the population. Towards a strategy on mental health for the European Union". The outcome of the consultation process, initiated after the adoption of the Green Paper, was a European Pact for mental health and well-being which launched in June 2008. The Joint Action on mental health and well-being was launched in 2013 and ran until 2018. It built on the work developed under the European Pact for mental health and wellbeing, resulting in the European Framework for Action on Mental Health and Wellbeing, which supported EU-countries in the review of their policies and encouraged the sharing of experiences in improving policy efficiency and effectiveness[18].

The *EU-Compass for action on mental health and well-being* was an online platform that, until 2018, facilitated the collection, exchange, and analysis of information on action on mental health. It monitored the mental health and wellbeing policies and activities of EU countries and non-governmental stakeholders.

17 Information Flyer on the EU strategy on adaptation to climate change
18 European Commission: non-communicable diseases
19 Joint action mental health and wellbeing

The European Mental Health Action Plan 2013- 2020 (WHO, 2015) focuses on seven interlinked objectives and proposes effective actions to strengthen mental health and well-being considerations in Member States in the WHO European Region, the European Commission and the Council of Europe in the European Declaration for Mental Health. In the Plan's 'cycle of mental well-being' the environment is considered as one of the material conditions (Economic assets) along with income and wealth.

The Health in All Policies (HiAP) approach aims to integrate health and wellbeing concerns across sectoral policies (Koivusalo, M). While it was approved as an EU approach to policy making in 2006, its implementation has been inconsistent. In this sense, the 2030 Agenda provides a consensual intersectoral arena that allows visualising the multiple interlinkages needed to implement HiAP successfully. Ramirez et al[20]. have coined the term SDG3+ as a way to reach non-public health stakeholders and compel them into putting HiAP into action. Indeed, the HiAP also provides an opportunity to consider mental health concerns and improve the uptake across sectors. HiAP is a broader approach than health impact assessment and at the European level requires the consideration of mechanisms that recognise the nature of European policy-making, as well as administrative tools, increased transparency, accountability and scope for health and health policy-related arguments within political decision-making (Koivusalo, 2010).

Mental Health in All Policies (MHiAP) is an approach to promote mental health and wellbeing at the population level by initiating and facilitating action within different non-health public policy areas. MHiAP emphasises the impacts of public policies on mental health determinants, strives to reduce mental health inequalities, aims to highlight the opportunities offered by mental health to different policy areas, and reinforces the accountability of policymakers for mental health impacts.

The **Sustainable Development Goals** present additional challenges and opportunities for mental health governance (WHO, 2019b). The promotion and protection of physical and mental health requires a multi-sectoral response, which in turn necessitates a whole-of-government approach. Sustainable Development Goals of particular relevance are the target on mental health (SDG3), reduced inequalities (SDG10), sustainable cities and communities (SDG11), and climate action (SDG13).

20 SDG3+: From the concept of HiAP to its implementation in Spain.

SDG3+ refers, following the "Health in All Policies" approach, to the permeability of health and well-being as a means and an end in the 2030 Agenda beyond SDG3. This idea is intended to serve as encouragement to delve into the analysis and implementation of the SDGs from a kaleidoscopic perspective i.e. multisectoral and multi-actor, which incorporates the impact of measures taken in various sectors, in principle, far from the health sector, on people's health, (Ramírez-Rubio et al, 2020).

The **Lancet Commission on Global Mental Health and Sustainable Development** aims to seize the opportunity offered by the Sustainable Development Goals to consider future directions for global mental health. Adopting the 'Planetary Health' concept, which recognises the interlinkages between various Sustainable Development Goals, would be a major step in the right direction.

The **7th Environment Action Programme (EAP)** had as a main priority objective to safeguard the Union's citizens from environment-related pressures and risks to health and well-being. To this end, the 7th EAP pledged to ensure that by 2020: outdoor air quality significantly improves; noise pollution significantly decreases; the combination effects of chemicals and safety concerns related to endocrine disruptors are effectively addressed, the usage of plant protection products does not have any harmful effects on human health or on the environment, and such products are used sustainably; and decisive progress is made in adapting to the impacts of climate change.

The **8th Environment Action Programme** aims to accelerate the transition to a regenerative economy that gives back to the planet more than it takes. The 8th EAP has the long-term priority objective for 2050 that citizens live well, within the planetary boundaries in a regenerative economy where nothing is wasted, no net emissions of greenhouse gases are produced, and economic growth is decoupled from resource use and environmental degradation. A healthy environment underpins the well-being of citizens, biodiversity thrives, and natural capital is protected, restored and valued in ways that enhance resilience to climate change and other environmental risks. Especially relevant to note is the fourth thematic policy objective: pursuing a zero-pollution ambition for a toxic free-environment, including for air, water and soil, and protecting the health and well-being of citizens from environment-related risks and impacts.

According to the European Environmental Agency (EEA), Europe is failing on its objectives in terms of: population exposure to environmental noise and impacts on human health, preservation of quiet areas, water pollution and its impact on

human health and chemical pollution and risks to human health and well-being[21]. The 2020 EEA report **Healthy environment, healthy lives: how the environment influences health and well-being in Europe** highlights how the quality of Europe's environment plays a key role in determining our health and well-being. The report reiterates that people are exposed to multiple environmental stressors at any one time, which combine and, in some cases, act synergistically, impacting health. In particular, air pollution and high temperatures are known to act synergistically, leading to increased morbidity and mortality. The urban environment is characterised by the presence of multiple stressors, with people in cities being more exposed to air pollution, noise and chemicals while also having less access to green space than people in rural environments. The most vulnerable people in our society are hardest hit by environmental stressors. Socially deprived communities are exposed to a higher burden of pollution, with citizens in poorer European regions exposed to high levels of air pollution, noise and to high temperatures. Poorer people, children, the elderly, and people with ill health are more negatively affected than others by environmental health hazards. Higher levels of exposure to environmental stressors and the greater burden of health impacts exacerbate existing health inequities.

The '**Economy of Wellbeing'** is a policy orientation and a governance approach, which aims to put people and their wellbeing at the centre of policy- and decision-making[22]. A horizontal approach based on cross-sectoral collaboration among different policy areas is fundamental to the realisation of the Economy of Wellbeing.

In the **Urban Agenda for the EU**, on the sustainable use of land and nature-based solutions, a partnership was launched in 2017. The Urban Innovative Actions initiative calls for proposals and allocates European Regional Development Fund (ERDF) budget to urban authorities to identify and test innovative solutions for sustainable urban development. Furthermore, green infrastructure has been included in the award criteria for the European Green Capital and Green Leaf Awards, which promote local-level efforts that show commitment and innovation to tackle environmental challenges in urban areas. Through its research programme Horizon 2020, the EU has also invested significantly in the evidence base for Nature-Based Solutions (NBS) and Re-Naturing Cities which has a strong urban dimension.

21 Europe's state of the environment 2020: change of direction urgently needed to face climate change challenges, reverse degradation and ensure future prosperity
22 2019 Council conclusions on the economy of wellbeing

The **EU Health Environment Research Agenda** addresses the European citizens' concerns about the effects of climate change and environmental deterioration on both human and ecosystem health. This might be the most relevant framework to support further innovative and creative research to assess the impact of the environment on people's mental health and well-being.

Platforms such as the EU Health Policy Platform, the European Parliament Coalition on Mental Health and Wellbeing, Steering Group on Health Promotion and Disease Prevention and others should establish joint flagship initiatives with the environment, social, education and employment networks. It is worth noting the work of the European Human Exposome Network, the world's largest network of projects studying the impact of environmental exposure on human health.

Two prominent ongoing projects supported by DG Regio's Horizon Europe programme are of particular interest: the *Equal-Life*, which focuses on the social and environmental determinants of mental health (based on combined exposure data, started in 2020). It will review the impact of blue and green spaces on mental health, assessing costs and benefits. And the project *Innovating actions for urban health and well-being - addressing environment, climate and socioeconomic factors*, which aims to build the evidence base of effective policies, developing and testing new initiatives to improve urban health and the environment in Europe.

4. OVERARCHING POLICY RECOMMENDATIONS

This section provides overarching policy recommendations mostly addressing European institutions and Member State governments, stemming from the review of the relevant policy context, scientific research and evidence with relevance to mental health, well-being and the environment. Some of the policy recommendations are focusing on the local level where their impact will potentially be significant, especially with respect to the urban environment and to inequality and environmental justice. More specific recommendations are further contained in the relevant sub-sections below. The recommendations were subject to consultations with relevant experts, EU stakeholders and professional networks and amended accordingly.

4.1 Mainstreaming of mental health and the environment

- **The EU is to develop a dedicated EU mental health and well-being strategy, with a strong focus on environmental determinants and prevention, as well as earmark investments for such measures within the EU4Health programme**
- **The EU institutions and member states are to ensure that, in the planning, implementation and evaluation of actions under the EU Green Deal, the Biodiversity Strategy for 2030 and the new EU Adaptation Strategy multiple 'win-win' programmes delivering co-benefits are prioritised. This should be done also in line with the Health in All Policies (HiAP)[23] approach.**

- The European Commission is to ensure the mainstreaming of health and well-being considerations into the implementation of the EU's new Biodiversity Strategy for 2030, starting with an analysis of health co-benefits as part of forthcoming impact assessments linked with the EU's restoration plan.
- The European Commission is to, within the zero-pollution ambition, the upcoming Zero pollution action plan for air, water and soil and the new chemicals and pharmaceutical strategies, prioritise actions, in line with the objective of the 8th Environmental Action Programme proposal and provide for concrete measures to prevent and mitigate the effects of environmental risks on mental health and well-being.
- The next WHO Europe mental health action plan should clearly acknowledge the environment as one of the major determinants of mental health and consistently mainstream it along the other crucial determinants defining mental health (social, economic, physiological, hereditary etc.).

23 Health in all policies (HiAP)

4.2 Benchmarks and monitoring indicators

- **Integrate resilience indicators, which consider interlinkages between mental health and the environment, into the European Semester, the forthcoming 8th Environmental Action Programme, and the future communication on the "economy of well-being".**

- The European Commission as part of the Green Deal implementation, should define a set of minimum requirements for health & well-being impact assessments of all sectoral policies which will consider the impacts of different policies on mental health, whilst jointly addressing the socio-economic and environmental determinants of mental health[24]. The set of minimum requirements can be incorporated within the impact assessment of the Better Regulation guidelines (toolbox), along with the mainstreaming of SDGs, so that the Better Regulation becomes a salient instrument for comprehensive impact assessment.

4.3 Stakeholder engagement and inequalities

- **As part of Europe's forthcoming zero-pollution action plan, ensure that those furthest behind benefit the most, by prioritising investments which increase access to nature and reduce exposure to pollution in low-income and marginalised communities throughout Europe.**

- A diverse set of individual groups and stakeholders should be engaged in developing evidence-based approaches considering the impact of the environment on mental health as a truly cross-sectorial issue which requires a multi-sectoral response.
- The European Commission can play a crucial coordinating role to ensure mental health and well-being are integrated in other policies building on the engagement of constituencies beyond the health and environment sectors, including social care, education and employment etc.
- Proper consideration of the rights of marginalised and underprivileged communities (frequently exposed and more vulnerable to negative environmental impacts and deprived from benefits of nature and a clean environment, therefore suffering mental health and well-being implications) to ensure horizontal integration of the environment, mental health and well-being but also a vertical equitable integration including all levels of society: from local communities to the EU-level.

24 Preliminary position on mental health strategy (MHE)

4.4 COVID-19 and the recovery plans

- **In the post COVID-19 recovery process the EU needs to put citizens' health and well-being at the centre of policymaking, including the environmental impacts on mental health as conditions for well-being and a prerequisite for sustainable development.**

- By recognising the pathways and mechanisms by which healthy natural environments can deliver mental health benefits within urban environments, human health and environmental priorities can be achieved simultaneously and can strengthen the resilience of urban systems to future pandemics.
- As part of green recovery plans, priority should be placed on the greening of public health infrastructure, including mental health facilities, to support the emergence of a green care economy for all. A matching grant scheme would facilitate investment (that would unlock a range of projects designed to meet environmental and health goals and could build on best practices).
- With the input of stakeholders, European institutions should assess European citizens' expectations in relation to the environmental impact on mental health and mental health promotion and prevention efforts in the EU.
- The EU should also study how citizens' relationship with nature was impacted by the COVID-19 crisis, how access to nature was supportive of mental health during the crisis (or not), and whether changes in how people relate to nature during the pandemic and the mental health outcomes of those relationships are durable or only temporary.
- Policies and measures should consider the greater impact of the uneven social distribution of environmental determinants of mental ill-health and access to nature benefits as an important dimension which has been magnified by COVID-19 social distancing/lockdown measures.

4.5 Enabling financing and data for mental health and environment

- **Public policy research to compile substantive evidence that quantifies the economic benefits of the environment on mental health (e.g., relative cost/efficiency of environmental factors in preventing harms and helping cures).**

- Member States to compile and exchange data to promote and support research on the impacts the environment can have on mental health. These impacts are widely undefined due to the complexity of interaction among different risk factors and determinants of mental health.
- Member States to program co-benefit initiatives for mental health and the environment in relevant funding streams not only for targeted health and environment interventions, but also for example through relevant European Structural and Investment Funds. This will reflect the complex dependence of

mental health on social investments, development of green spaces, built environment and biodiversity conservation and preservation.
- Address the funding gap for Europe's Biodiversity Strategy, for instance by ensuring that at the EU level adequate cohesion funding is allocated to biodiversity protection and ecosystem restoration projects, and that nature-based solutions are promoted within the RRF guidelines for Member States.
- Local authorities to consider developing innovative non-medical nature-based and socially supported solutions to promote mental well-being, e.g. community-based and nature-based referrals to address loneliness.

4.6 Specific recommendations for thematic policy areas

4.6.1 Air pollution and mental health

- There is a need for further targeted longitudinal and comprehensive research on air pollution and mental health outcomes.
- Local authorities are to invest in scaling up the implementation of clean and efficient transport and energy systems, a low-carbon economy (WHO, 2020), and healthier food systems with a minimised impact on air quality.

4.6.2 Climate change and mental health

- **The EU institutions are to ensure a human-centred approach to Europe's adaptation strategy by including a strong preventive health component and by prioritising strategies and actions which support a comprehensive approach to resilience.**

- Proper response to climate mental health threats from the onset through to recovery for their elimination or mitigation for the sake of improved prevention and early intervention to treatment is needed.
- Tackling social, environmental, and climate injustice is needed if actions to address climate change and mental health are to be rooted in health equity.
- Climate change adaptation/resilience planning should introduce measures on preparation and response in the mental health system.

4.6.3 Noise and mental health

- **Further research is needed to examine the coping strategies and the possible health consequences of adaptation to noise.**

- WHO Environmental Noise Guidelines should be considered in the development of the next mental health plan and other relevant policies, and review of the Environmental Noise Directive on outdoor noise abatement and management.

- The Environmental Noise Directive will need to be reviewed according to the WHO review of the health impacts of noise (WHO, 2018) which focus both on physical responses to stress reactions (e.g., stroke, ischemic heart disease), as well as psychological distress, including cognitive impairment in children, sleep disturbance, and annoyance.

4.6.4 Toxics and mental health

- **The European Commission should consider developing an inventory of substances which can allegedly contribute to mental illness and determine with scientific certainty the gravity of their impact on mental health. This will further shape the mental health strategy and define the concrete need for further research in grey areas.**

- The precautionary principle should be applied more consistently across EU policies if there is some evidence that certain chemicals can have negative impact on mental health and in cases where there is a lack of scientific certainty and conclusive evidence.
- The EU should oblige producers of relevant chemicals to provide sufficient evidence that allows for an assessment of their health risks on the nervous system, of their neurotoxicity and/or impacts to neurobehavior, neurodevelopment and neuromuscular systems.
- The Commission and Member States should fund targeted independent research to compile scientific evidence on the risks posed by endocrine disruptors, hazardous chemicals in products, combination effects of different chemicals and persistent chemicals on neurological health.
- In order to develop an appropriate analysis of the impacts of chemicals, pesticides, microplastics, metals and pharmaceuticals on mental health, research needs to include a comprehensive analysis of human's long-term exposures via drinking water, sewage, food (agriculture) and the environment.
- The European Commission's new chemicals strategy for sustainability needs to take account of the potential impact of chemicals on mental health and strengthen the European Regulation on Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) implementation.

4.6.5 Nature-based mental health

There are various mechanisms by which nature-based mental health can be encouraged through EU action. Biodiverse urban nature should be a priority for promoting mental health and well-being. Biodiversity should therefore be an integral part of policy- and decision-making processes in both health and urban- and green space planning contexts. Aligning biodiversity and mental health objectives can guarantee more natural, authentic green spaces, which is ultimately a win-win for ecology, mental health, cities and economies (cost-effective, multi-benefit

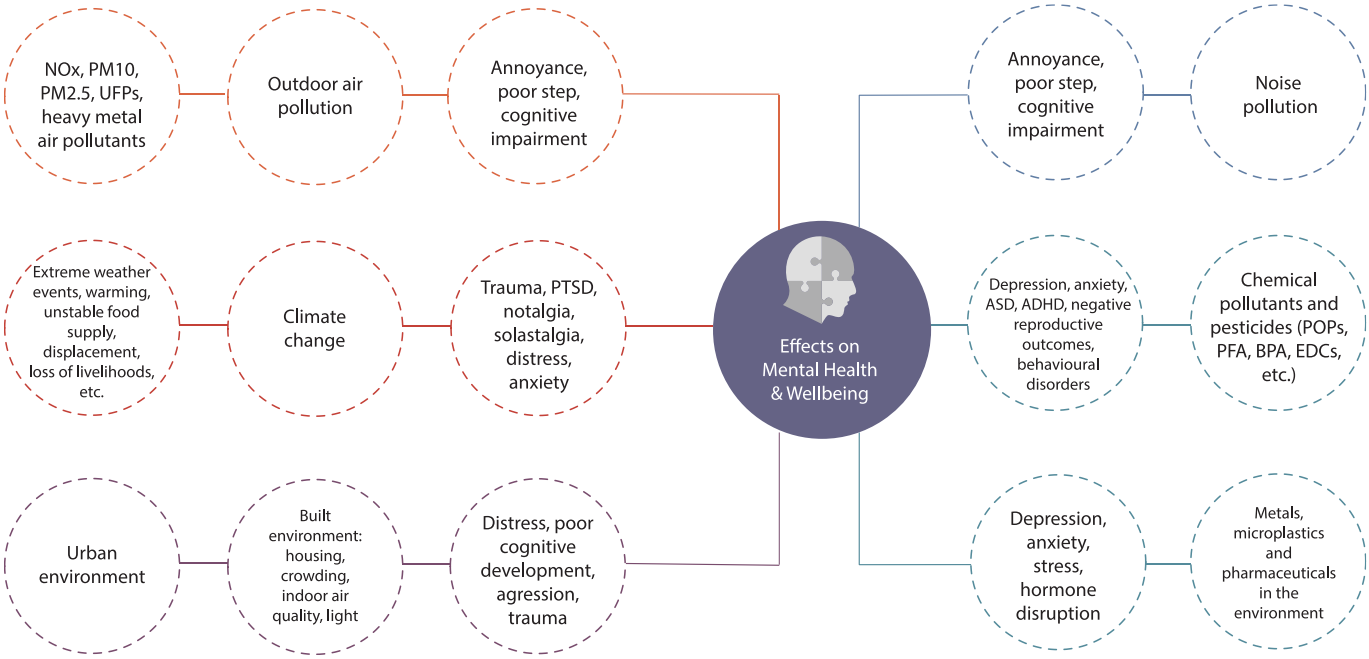
solution). From the ecosystem service perspective, mental health and well-being is a central benefit of nature-based solutions for climate change adaptation. Our findings should encourage practitioners and policymakers to consider how they can create, maintain, and improve existing accessible green spaces in deprived areas and to develop strategies and interventions for the utilisation of such green spaces by those who stand to benefit the most.

- **Secure adequate funding for biodiversity protection in Europe as a key investment in preventing health risks, in line with the European Framework for Action on Mental Health and Well-being. Increase prevention expenditure by investing in nature-based treatments.**

- Better incorporate the known links between nature and mental health in decision-making and planning contexts. One approach could be to integrate health into the planning processes of nature-based solutions and value mental health as a separate ecosystem service. This requires further understanding of the mechanisms by which natural environments deliver mental health benefits. A deeper insight into this relationship would enable valuation approaches of ecosystems to explicitly encompass their mental health contribution.
- Invest in further research on- and recognition of nature-based solutions as a valid concept that integrates climate, biodiversity and health objectives.
- More consideration of potential biodiversity, climate and health benefits of green spaces during urban spatial planning. Encourage the design and management of green spaces for wider biodiversity values (increases enjoyment, greater mental health benefit), ensure biological corridors using a range of ecological features connect existing natural spaces to increase the environmental quality of the city overall and make the urban environment more appealing for users (e.g., for physical activities).
- Foster the incorporation of health concerns into existing multi-stakeholder platforms and projects (e.g., Covenant of Mayors for Climate & Energy or ICLEI-Local Governments for Sustainability) so that local-level action can be tailored to deliver on mental health benefits alongside achieving the climate and biodiversity targets.
- Ensure that the mental health benefit of green spaces is accessible to all i.e. just, equitable, fair. Access, proximity etc. needs to be considered in spatial planning processes.
- Increase prevention expenditure by investing in nature-based treatments.

5. OVERVIEW OF SCIENTIFIC EVIDENCE

Figure 2. Environmental exposure and mental health outcomes



5.1 Environmental degradation as a threat to mental health

Mental health and many common mental disorders are shaped to a great extent by the social, economic, physical and cultural environments in which people live[19]. The environment is one of the determinants of mental health outcomes, and hence its significance is still to be further researched and promoted in the context of mental health and wellbeing.

Alan Brown, professor at Columbia Medical Centre, said "If environmental risk factors for [mental illness] can be validated and confirmed, there is every reason to expect they will point to preventive measures that lower their risks" (Schmidt, 2007). Scientists have traditionally been challenged in their efforts to link mental illness with underlying causes, in part because the diseases are so amorphous. Mental disorders yield vague behaviours that vary widely among individuals and do not have clearly visible end points, Brown notes.

Hereafter, we examined various indicative scientific research, surveys, and associated literature reviews on the cause and effect relationship between exposure to outdoor air pollution, urban environment, metals, chemicals and pharmaceuticals in the environment and mental health.

Inequalities in our society heavily affect and bring to the forefront the most vulnerable to the impacts of climate change and environmental degradation. The

uneven social distribution of environmental determinants of mental ill-health and access to nature benefits is an important dimension which has been magnified by COVID-19 social distancing /lockdown measures. The WHO Europe paper " Environmental health inequalities in Europe, Second assessment report" (WHO, 2019a), Chapter 5 addresses inequalities in the urban environment and section 5.4 addresses inequalities relating to the lack of access to recreational or green areas,. The report found that in almost all countries there is a clear socioeconomic gradient, with the lowest income quartile clearly reporting more difficulty accessing these areas than the higher income quartiles.

A number of papers examine the impacts of environmental injustice aspects such as the exposure to toxins, proximity to industrial/waste facilities or major road infrastructures and mental health/wellbeing. For instance a Roma environmental justice report (Heidegger and Wiese, 2020) notes that Roma communities in Central and Eastern Europe often live and work in poor environments. They are disproportionately affected by environmental burdens, such as pollution and environmental degradation stemming from waste dumps and landfills, contaminated sites or dirty industries. The consequences are devastating health impacts ranging from infectious diseases to mental health issues.

The uneven distribution of the impacts of air pollution, noise and extreme temperatures on the health of Europeans closely reflects the socio-demographic differences within our society (EEA, 2018). Across Europe there are pronounced large-scale regional differences in the levels of social vulnerability and exposure to environmental health hazards. For example, high temperatures and ozone pollution tend to affect the south of Europe to a greater extent than the north, while particulate matter pollution tends to be most concentrated in central and Eastern Europe. In many regions, the population's high social vulnerability overlaps with high levels of environmental health hazards, resulting in negative health outcomes.

5.1.1 Outdoor air pollution and mental health

Scientific evidence shows an **emerging association between certain air pollutants and a range of mental health outcomes** including depression, anxiety, psychosis, dementia, childhood cognitive development, and suicide (King, 2018). The present paper focuses on depression and anxiety as outcomes. A review of the literature found that the evidence for associations between air pollution and these mental health outcomes is 'promising but weak, largely due to the positive and negative confounding factors that are challenging to measure and frustrate efforts to identify the true size of the impact' (King, 2018). The evidence ranges from medium to low, setting out a new and promising area of research.

Currently, research focuses on the exposure of adults and youth to particulate matter resulting from air pollution. The exposures studied are psychiatric disorders, emotional state and general health, behavioural and psychological impacts of air pollution, mental illness in childhood, and depression, anxiety, bipolar syndrome, psychosis, and suicide risk.

A study in Denmark demonstrated a **strong positive association between exposure to environmental pollution and an increased prevalence of psychiatric disorders** in affected patients (Khan et al, 2019). Researchers used data from Denmark's national treatment and pollution registers. Using daily recorded data on pollution they assessed air pollution using the atmospheric concentration of 14 compounds linked to air pollution. They then looked at people born in Denmark during 1979 to 2002. **This group of 1.4 million people had data available from birth to 2016.** The causal link between exposure to environmental pollution and the development of mental illness is strengthened by the large sample size of this study, and its longitudinal nature. However, the study did not consider the variety of social and economic factors, hereditary disease or lifestyle, all of which influence and interact with mental health in a complex way. Therefore, these results are only exploratory. The same study notes that it remains unknown whether polluted air can directly cause depression, bipolar disorder, or other conditions. Nevertheless, the study indicates that people from more polluted areas are 162% more likely to suffer personality disorder and 50.5% more likely to experience depression.

Although the physical effects of air pollution on humans are well documented, another study demonstrates that there may be **even greater impacts on the emotional state and mental health. Surveys have traditionally been used to explore the impact of air pollution on people's subjective well-being** (SWB). Here, the scientists used air pollution data to simulate fixed-scene images and a psychophysical process to examine the impact from only air pollution on SWB (Li et al, 2019). These findings suggest that under the atmospheric conditions in Beijing, negative emotions occur when PM2.5 increases to approximately 150 AQI (air quality index).

To assess the **exposure to air pollution and self-reported effects** on Chinese students, a case study of 13 megacities including a total of 2,048 subjects, who were recruited from 54 universities and schools from 13 cities across China, was carried out (Rajper, Ullah and Li, 2018). They were expected to fill in questionnaires on the perceived impact of air pollution. A section of the questionnaire focused on the behavioural and psychological impacts of air pollution. In total, 62.1%, 78.1%, and 65.5% (3 cohorts) of the respondents suffered from depression/sadness/unpleasant moods, reduced exercise routines/jogging speed/jogging duration, and reduced walking speed, respectively, due to air pollution.

A total of 1,136 (55.4%) respondents reported that they felt anxiety and frustration during hazy days, when air pollution was highest. Of the total respondents, 44.1% reported that they became aggressive due to haze/air pollution.

Another study focused on early development when psychopathology commonly emerges (Roberts et al, 2019). It **analysed the relationship between air pollution exposure and the development of mental illness in childhood.** The study combined high-resolution air pollution exposure estimates and collected phenotypic data to explore concurrent and longitudinal associations between air pollutants of major concern in urban areas and mental health problems in childhood and adolescence. Exploratory analyses were conducted on 284 London-based children from the Environmental Risk (E-Risk) Longitudinal Twin Study. Exposure to annualized PM2.5 and NO_2 concentrations was estimated when children were aged 12. Symptoms of anxiety, depression, conduct disorder, and attention-deficit hyperactivity disorder were assessed at ages 12 and 18. Psychiatric diagnoses were ascertained from interviews with the participants at age 18. Age-12 pollution estimates were significantly associated with an increased likelihood of a major depressive disorder at age 18, even after controlling for common risk factors. This study demonstrates the potential utility of incorporating high-resolution pollution estimates into large epidemiological cohorts to robustly investigate associations between air pollution and mental health in youth.

A systematic review which aimed to synthesise and provide a comprehensive review of the epidemiological literature to date, investigated the quantitative associations between particulate matter and multiple adverse mental health outcomes (depression, anxiety, bipolar disorder, psychosis, or suicide) (Braithwaite et al, 2019). The review concluded that two of the included studies investigating the association between long-term PM2.5 exposure and anxiety reported statistically significant positive associations.

Recent evidence indicates that chronic exposure to polluted air is a major environmental risk factor for Alzheimer and dementia. There is a significant body of epidemiological works unveiling a strong correlation between exposure to particulate matter (PM) and associated air pollutants with accelerated cognitive decline across multiple stages of life, most prominently when exposed at young or old ages. More recently, growing evidence indicates increased risk of Alzheimer Disease and other dementias following chronic PM exposure (Kilian and Kitazawa, 2018). However, Alzheimer and dementia as well as cognitive decline are not in the main scope of this paper. It is reasonable to agree on the need for targeted further longitudinal and comprehensive research on air pollution and mental health outcomes.

A recent study on mental health consequences of urban air pollution, a prospective population-based longitudinal survey by Bakolis et al. (2020) found robust

evidence for interquartile range increases in PM2.5, NOx and NO_2 to be associated with 18–39% increased odds of common mental disorders, 19–30% increased odds of poor physical symptoms and 33% of psychotic experiences only for PM10. These longitudinal associations were more pronounced in the subset of non-movers for NO_2 and NOx (Bakolis et al, 2020).

Case study 1. Cities at the forefront: Nature conservation for clean air

Due to its location in a basin, the German city of Stuttgart suffers from poor air quality and is expected to experience increased average and extreme temperatures because of climate change. In response, the municipality adopted a strategy to use vegetation to alter the cities microclimate, change airflows and improve the cities air quality.

In 2008, a strategy was developed to prevent new developments on slopes surrounding the city. In addition, a climate atlas was developed which mapped urban climatic elements, such as local climate, the distribution of air temperature, airflows, and air pollution concentrations for the city.

Additional benefits from the project include noise abatement, providing space for recreation, aesthetics, and employment (Schweitzer J-P et al, 2016).

Failure to tackle air pollution and to mitigate climate change results in a lost opportunity to gain the multiple health, economic and environmental co-benefits derived from developing more efficient transport and energy systems, a low-carbon economy (WHO, 2020), and healthier food systems with a minimised impact on the environment. New approaches that consider the consequences of actions in their entirety, taking a longer-term and equity perspective are needed.

5.1.2 Climate change and mental health

This section explores the EU relevant aspects of climate change and mental health including sea level rise; need for climate adaptation; heat waves; natural disasters, biodiversity and habitats loss; life impact overall; environmental conditions associated with population displacement and job loss.

Human-made greenhouse gas emissions are a primary cause of climate change (UN Office of the High Commissioner for Human Rights, 2016), contributing to,

among other things, the increasing frequency of extreme weather events and natural hazards, rising sea levels, floods, heatwaves, drought and the spread of tropical and water-borne diseases . These alter ecosystems, disrupt food production and water supply, damage infrastructure and settlements and increase morbidity and mortality. They are also responsible for the displacement of affected communities, among which an important consequence is an increased incidence of poor mental and physical health. Indeed, climate change and health are connected in a myriad of complex ways (Watts et al, 2019). Thus, climate change directly and indirectly threatens the full and effective enjoyment of a range of human rights, including the rights to life, water and sanitation, food, health, housing, culture, and development.

The consequences of **climate change can have a profound impact on mental health** through both its direct impact and its impact on social support systems, cultural traditions and the environmental conditions. Climate change will bring more frequent, long-lasting, and severe adverse weather events, which will likely affect mental health. Berry et al offer an explanatory framework, which may assist in developing public health policy, practice and research (Berry et al, 2010).

According to Berry, Bowen and Kjellstrom's framework, the link between extreme anxiety reactions (such as post-traumatic stress disorder, or PTSD) and acute weather disasters, such as floods (the most common disasters at global level), forest fires, heat waves, storms, cyclones, is well established (Berry et al, 2010). However, limited research has been conducted into their long-term effects. There is **almost no quantitative epidemiological evidence for the mental health effects of sub-acute weather disasters**, such as long-term drought. Long-term underlying drying and warming are chronic events. The occurrence of such events is associated with increased mental health problems.

As climate strikes, heatwaves and natural disasters have intensified throughout 2019, the climate emergency has become a regular news item, while eco-anxiety has developed as an issue of concern[25]. "Eco-anxiety" refers to persistent worries about the future of Earth and the life it shelters[26].There are studies evaluating the impact of the climate crisis and eco-anxiety, often used as a synonym of climate anxiety, on the mental health of different age groups. Especially for the 8-16-year cohort, climate-related anxiety is of major concern.[27].

Climate change will have significant mental health implications noting **the psychological distress and anxiety about the future that may result from**

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[25] https://www.bbc.co.uk/bbcthree/article/b2e7ee32-ad28-4ec4-89aa-a8b8c98f95a5

[26] https://www.healthline.com/health/eco-anxiety#is-it-normal

[27]https://www.independent.co.uk/life-style/children-climate-change-sleep-nightmares-eco-anxiety-greta-thunberg-a9371191.html

acknowledging climate change as a global environmental threat (Berry et al 2010)**.** Immediate (direct) mental health impacts of climate change include disruptions that vulnerable communities, in particular, face with regard to the social, economic and environmental determinants of mental health.

Figure 3. Framework showing putative casual pathways linking climate change with mental health

Source: (Berry, Bowen and Kjellstrom, 2010).

Climate change affects mental health in a variety of direct, indirect, and overarching pathways—**disproportionately affecting those most marginalized** (Posner and Sunstein, 2008). The health implications of climate change can result in mental problems and illness as well as affirmative psychosocial outcomes.

Psychological adaptation requires a set of responses, and an acknowledgement of the grave threats posed by climate change and the profoundly

consequential global crisis (Hayes et al, 2018). This involves developing coping strategies to manage the feelings and thoughts that arise so that people can face, and come to terms with, these threats and consequences rather than avoiding the creeping problem of climate change. It also requires behavioural and psychological engagement, in which people adjust their behaviour and lifestyle to reduce the threat and to protect themselves.

The adaptation measures that address the psychosocial impacts of climate change come in a variety of forms, i.e. policies, practices, behavioural interventions, and community-based interventions to build emotional resilience. In addition, the list below contains some specific priority adaptation mechanisms that ought to be considered to support population-level mental health in a changing climate.

The exploitation of people's self-preservation, reflex and fear about their future to promote the climate agenda can be destructive for mental health (e.g. references to the imminence of climate change, related natural hazards, reaching the limits of the planet, or that individual efforts are futile and one's contribution is insignificant). This deprives many individuals from their eagerness to contribute and fight the 'climate battle', which may have an extreme negative impact on people's mental health, their adaptability to change, and preparedness to engage in mitigation efforts.

The previous concerns are linked to the concept of ecological grief, or whereby post-traumatic stress disorder is associated with environmental degradation, decline of biodiversity and climate change, which is a mental health condition (Cunsolo and Ellis, 2018). Furthermore, 'solastalgia' is a relatively new concept developed to give greater meaning and clarity to environmentally induced distress (Albrecht et al, 2007). Solastalgia is the pain experienced when there is recognition that the place where they and their loved ones reside, is under immediate threat (physical desolation). It is an intense desire for the place where one is a resident to be maintained in a state that continues to give comfort or solace.

Acknowledgement of the mental health threats associated with climate change and concerted efforts in their elimination or mitigation for the sake of improved prevention and early intervention to treatment, is needed to properly respond to mental health needs from onset through recovery. 'Climate change and mental health: A causal pathways framework' provides a set of useful recommendations (Berry, Bowen and Kjellstrom, 2010).

5.1.3 Urban environment and mental health

There is a growing amount of research pointing at the **positive association between air pollution and urban exposure** to multiple factors in the complex

interrelationship with mental health. Poorly planned and managed urban settings with unsustainable transport systems and a lack of access to public and green areas increase air pollution, noise and heat islands, reduce opportunities for physical activity and access to decent jobs and education, and have a negative impact on community life and people's physical and mental health (WHO, 2020).

Yet, the availability of green spaces, proximity to major roads and active transport initiatives, zoning of air polluting industries, and high-rise buildings are all features of urban environments identified as targets for improving the population mental health (King, 2018).

There is **renewed interest in how place shapes people's mental health,** and the conceptual and methodological focus has shifted from static toward dynamic exposures assessments. Exposures at people's daily activity places and along their daily paths, as well as over their residential histories, are increasingly recognized as determinants of mental health (Helbich, 2018). Through the former it is possible to address whether the traversed environment may serve as a trigger for an onset of a mental disorder. A residential life course perspective greatly facilitates addressing whether past environmental exposures may contribute to mental health disorders later in life. Such refinements toward dynamic exposure assessments provide much needed answers to several pressing questions, such as how people's mental health is affected by the duration, sequences, and accumulation of environmental exposures across space and over time. Such questions cannot be answered without focusing on people's mobility.

According to the latest IPBES report, urbanization can increase isolation from nature, which in turn prevents people from harnessing the mental health benefits of being surrounded by the natural environment. It also increases the risk of exposure to the type of air pollution that primarily affects mental health.

Evidence shows that the built environment directly affects mental health, for example through environmental characteristics like housing, crowding, noise, indoor air quality, and light as illustrated in the table below (Evans, 2003).

Table 2: Direct mental health effects of the physical environment (Evans, 2003).

Environmental characteristics	Mental health impacts
High-rise housing	Elevated psychological distress, especially among low-income mothers.
Residential floor level	Adults living on higher floors have more psychological distress.
Housing quality (structural defects, hazards, poor maintenance, climatic problems (e.g., heat, humidity)	Greater psychological distress in housing of poorer quality.
Neighborhood quality (aggregate bundle of social and physical attributes)	Greater psychological distress and poorer cognitive development in children.
Furniture placement (at social distances, around tables)	Increased social interaction and reduced passive, isolated behaviors in psychiatric patients.
Privacy (architecture, single rooms)	Severely retarded adults and psychiatric patients reveal better functioning with more ability to regulate social interaction.
Alzheimer's facilities (smaller scale units, more homelike, less noise, accommodation of wandering)	Improved functioning, including less disorientation, fewer behavioral problems.
Residential density (people/room)	More negative affect, greater psychological distress. Psychiatric disorder not related to crowding. Areal indices such as people per census tract unrelated to mental health.
Noise (aircraft)	Unrelated to psychiatric disorder. Elevated psychological distress in children.
Indoor air quality	Malodorous pollutants linked to negative affect. Behavioral toxins related to acting out, aggression. Community contamination reliably related to trauma.
Light	No reliable impacts of color. Levels of illumination but not spectrum effect depression.

5.1.4 Noise pollution

While noise may not yet be in the forefront of the environmental movement, it is recognised worldwide as a major environmental hazard. WHO released Environmental Noise Guidelines (WHO, 2018), demonstrating strong evidence that noise pollution is a top environmental hazard to both physical and mental health. Among the key impacts listed are annoyance; negative effects on sleep; cognitive impairment; quality of life and mental health and well-being.

The Environmental Noise Directive is to be revised to reflect the WHO guidelines because currently the Noise directive does not fully address the mental health impacts of noise. Annex III of the Environmental Noise Directive will describe the methods for calculating the burden of disease caused by exposure to specific noise levels. The methods will include dose-effect relationships for a set of health endpoints such as cardiovascular disease, annoyance and sleep disturbance. A revised Annex III is currently under development following the latest scientific review of the health effects of noise that is being performed by the WHO.

Recent community based studies suggest high levels of environmental noise are associated with mental health symptoms such as depression and anxiety but not with impaired psychological functioning (Stansfeld et al, 2000). Several studies find that self-reported noise sensitivity does not interact with noise exposure leading to increased vulnerability to mental ill-health. Chronic aircraft noise exposure in children impairs quality of life but does not lead to depression or anxiety.

Noise is a prominent feature of the urban environment including noise from transport, industry and neighbours. Exposure to transport noise disturbs sleep in the laboratory, but not generally in field studies where adaptation occurs (Stansfeld et al, 2000). Noise interferes in complex task performance, modifies social behaviour and causes annoyance. Studies of occupational and environmental noise exposure suggest an association with hypertension. Aircraft and road traffic noise exposure are associated with psychological symptoms but not with clinically defined psychiatric disorders. In both industrial studies and community studies, noise exposure is related to increased catecholamine secretion, a sign of physical or mental stress.

Noise pollution is not believed to be a cause of mental illness, but it is assumed to accelerate and intensify the development of latent mental disorders (Goines and Hagler, 2007). Noise pollution may cause or contribute to the following adverse effects: anxiety, stress, nervousness, nausea, headache, emotional instability, argumentativeness, sexual impotence, changes in mood, increase in social conflicts, neurosis, hysteria, and psychosis. Population studies have suggested associations between noise and mental-health indicators, such as the rating of well-

being, symptom profiles, the use of psychoactive drugs and sleeping pills. Noise levels above 80 dB are associated with both an increase in aggressive behaviour and a decrease in compassionate behaviour.

There is certainly sufficient research to warrant warnings that noise is harmful to mental and physical health. Yet, despite this growing body of literature attesting to the relationship between noise and health impacts, government bodies across the EU have not yet recognised sufficiently the need to abate noise nor to educate people about the dangers of noise.

5.1.5 Chemical pollutants and pesticides

In general, the scientific evidence on the impact of chemicals on mental health is overlooked and underdeveloped (Genuis, 2008). While there has been increasing research in this topic in the past years, the most recent research papers are inconclusive, revealing that the associations between human health and certain chemicals prevalent and ubiquitous in our daily environments are still uncertain. In general, there is growing concern in the scientific community regarding the links between chemicals and human mental health and wellbeing.

Research **suggests a positive association between environmental chemical substances and negative mental health outcomes**, including depression, anxiety, autism spectrum disorder, attention deficit hyperactivity disorder and other psychiatric and neurological conditions. However, research to date is inconclusive and insufficient on this topic.

Regarding persistent organic polluters (POP), the research in this area is also underdeveloped, and associations between POP and mental health remain unclear. In 2014, Berk published a paper on the association between POP, heavy metals and depressive symptoms (Berk et al, 2014).

Similarly, there is an absence of conclusive research to map out the impacts of chlorinated paraffin and Perfluoroalkoxy Alkane (PFA) on mental health. However, these are extremely relevant substances to consider when mapping out the negative impacts of environmental substances in mental health. In a 2006 study, a positive association between exposure to pesticides and depression was found among women (Beseler et al, 2006).

Regarding phthalates, a review from 2011 suggests associations between phthalates, negative reproductive outcomes and child health (Jurewicz and Hanke, 2011). The review concludes that exposure leads to an increased risk of allergy, asthma, neurodevelopment and alertness for children. Notably, the review highlights the urgent need for further research.

Research also has been carried out to study the relationship between prenatal exposure to BPA, phthalates and phenols to child behaviour, emotional symptoms and behaviour disorders. A 2017 study found positive associations between the environmental chemicals and child behaviour disorders. Unsurprisingly, children arise as a key demographic in this realm, as neurodevelopment is more at risk at a young age (Philippat et al, 2017). Environmental chemicals are a potential risk factor in children's neurodevelopment, as suggested by a number of publications (see for example, Bellinger, 2012). Other cohorts particularly at risk are older people, men and women with mental and physical health conditions and pregnant women (Philippat et al, 2017).

Regarding endocrine disruptor chemicals (EDCs), research has been carried out to clarify the associations between EDCs and autism spectrum disorder (ASD) (Marí-Bauset et al, 2018). Although some associations have been found, the research has so far been inconclusive.

5.1.6 Metals, microplastics, and pharmaceuticals in the environment

Studies suggest a relationship between lead exposure and psychiatric symptoms, thus increasing the risk of depression, anxiety and general stress (Rhodes et al, 2003).

Very little research has been published on the associations between microplastics and mental health. While causal links have been suggested between microplastics and physical ill health, and consequently well-being, (mainly disturbances in endocrine and reproductive systems), further research is required in this area in order to develop appropriate policies across sectors.

The risk resulting from the release of pharmaceutical products and their associated waste into the environment on mental health, (e.g. the release of hormones), is also largely overlooked. The European Union Strategic Approach to Pharmaceuticals in the Environment recognises that the issue of pharmaceutical residues cannot be ignored and refers to an earlier report which mentions the possible effects of long-term exposure on vulnerable populations. Hence, the need for a precautionary approach, consistent with the Commission's proposal to introduce a relevant parameter into the Drinking Water Directive.

5.2 Nature as an enabler of good mental health, and the role of nature in the treatment of mental health conditions

This section of the paper will provide a state of play on the evidence of mental health benefits of nature and its relevance in the EU context and policy-making, as well as a number of key recommendations to further optimise ecosystem and mental resilience. A growing body of evidence confirms the positive relation between human-nature experiences and both- increased psychological well-being

and a reduction of risk factors and burden of some types of illnesses. Moreover, evidence confirms that opportunities for some types of nature experience are decreasing in quantity and quality for many people in the world. Over three-quarters of EU citizens live in urban areas and over 40% in densely populated urban centres, with relatively low availability of nature and large variations in access, often strongly associated with income. Furthermore, intensification of land use in sub-urban- (housing, transport) and rural areas (agriculture, forestry) has reduced nature and biodiversity in most other places in Europe where people live and work.

Research has shown that various types of nature experiences are associated with mental health benefits in various ways. For instance, controlled laboratory studies have long demonstrated the beneficial psychological and stress relief impacts of nature images and sounds[28]. Experimental fieldwork has also shown the benefits of immersive nature experience. Research has found that the psychological well-being of a population can be associated, in part, with its proximity to green space, blue space (i.e., aquatic and marine environments) and street trees or private gardens in both urban and rural settings. An important aspect is the reference to nature-based solutions as a long term-alternative to pharmaceuticals to prevent the risk of over-medicalization for some mental conditions.

A growing public understanding of the importance of nature experiences for well-being including mental health more specifically has spurred a plethora of initiatives and projects across the EU in particular in cities. EU cooperation however has focussed traditionally on rural priorities (e.g., illustrated by over 75% of its budget reserved or regional-, cohesion- and agricultural funding).

There is substantial evidence that supports an association between common types of nature experience and increased psychological well-being along with a reduction of risk factors and burden of some types of mental illness (Bratman et al, 2019; Twohig-Bennett and Jones, 2018). Nevertheless, there is a lack of understanding of the underlying causal mechanisms and pathways explaining the relationship between the environment and human well-being. Within urban planning and decision-making contexts, **gaining a deeper insight into this relationship could be an extremely important contribution, providing benefits beyond the well-known ecosystem service** deliveries of water quality, flood security, urban cooling and recreation (Bratman et al, 2019).

5.2.1 Pathways of nature benefits to mental health

It is difficult to identify the mechanisms by which mental health benefits can result from contact with nature. A variety of biopsychosocial pathways have been

[28] See for example Ulrich et al (1991) Stress recovery during exposure to natural and urban environments, https://www.sciencedirect.com/science/article/abs/pii/S0272494405801847

proposed. Markevych et al. (2017) has organized these into three, interconnecting domains to highlight the different general functions of green space (Figure 3) (Markevych et al, 2017). Green space can positively influence mental health through mitigation, by reducing harm from environmental stressors such as air pollution, noise and heat. Nature-based experiences can also have restorative effects, for example through stress recovery and attention restoration. The third dimension is instoration, where green spaces can improve mental health by encouraging physical activity and facilitating social cohesion. Prior reviews focused on four general pathways: air quality, physical activity, social contacts and stress e.g. (Hartig et al, 2014). This new structure presents an enabling framework to guide future interdisciplinary research that acknowledges the interconnectedness and exchanges between the pathways within each domain. Blue spaces (Grellier et al, 2017) have also been found to have beneficial effects on mental health and well-being, however the evidence base is much more limited and the pathways explaining mental health outcomes are less clear in comparison to green spaces. Nevertheless, there are studies illustrating that blue spaces can improve mental health through restoration and instoration pathways (Beute et al, 2020).

Figure 3. Three domains of pathways linking green and blue spaces to positive health outcomes

All arrows reflect the interaction between green spaces and health (source: own combination of Markevych et al. 2017; Beute et al. 2020).

Mitigation pathway

Air pollution concentrations are generally lower around green spaces compared to the surrounding urban environment e.g. (Hirabayashi and Nowak, 2016). An explanation may be the lack of emission sources of primary pollutants, such as traffic (Su et al, 2011). Additionally, the vegetation within green spaces can effectively remove air pollutants via deposition. This has been proven for particulate matter of less than 10 µm and ozone (Kroeger et al, 2014). Street trees can also disperse traffic-related pollution and reduce near-road exposure, although this may simultaneously increase the on-road concentrations (Tong et al, 2015). Overall, consistent empirical evidence is still lacking on the relationship between green

space and air pollution. In fact, green spaces can also potentially increase the concentrations of particular air pollutants. Trees can affect air quality by their emissions of pollen, which may act as allergens, and of biogenic volatile organic compounds (which take part in the formation of ozone), secondary organic aerosols and particulate matter (Samson et al, 2017). Consequently, air pollution has been found to be a confounder in green space-health associations e.g. (Hystad et al, 2014). This raises the question whether a green space has an independent effect on health, aside from being an area where there are potentially lower air pollution levels.

In terms of heat exposure, vegetation can efficiently absorb direct solar radiation and through evapotranspiration has an overall cooling effect (cooling the air on average by 1°C) (Vargas-Hernández, Pallagst and Zdunek-Wielgołaska, 2018). This is especially valuable in cities, where heat is concentrated compared to rural areas, due to high-rise buildings, dense construction zones, asphalt and industry causing the so-called urban heat island (Voogt and Oke, 2003). Various studies have reported that green space within a city can have a cooling effect on the surrounding areas, however this depends on various characteristics of the green space like the overall size and the types of vegetation e.g. (Morais et al, 2016). In Vitoria-Gasteiz (Spain) the focus on naturalizing green areas and vacant plots to improve their ecological and environmental functionality has resulted in multiple benefits such as flood risk reduction, lower air pollution levels and improvement of temperature regulation, reducing the heat island effect[29]. Additionally, increasing the proportion of green space in a city can decrease noise levels through acoustic shielding (Garg and Maji, 2014), however the causal evidence for this effect remains limited thus far.

Restoration pathway

The majority of research has focused on the restoration pathway, specifically focusing on two theories: stress reduction theory (Box 2) and attention restoration theory (Box 3). Restoration in this context refers to the recovery of physiological or psychological resources that have been diminished through the demands of dealing with everyday life (Hartig, Berg and Hagerhall, 2011). Over time, the lack of restoration of these resources can lead to mental and physical ill health (Hartig, Berg and Hagerhall, 2011; von Lindern, Lymeus and Hartig, 2017). Restorative environments can facilitate the recovery of these depleted resources. Research has shown that restoration is more likely in environments that offer contact with nature, from wilderness to a window view of trees (Collado et al, 2017). Natural environments facilitate stress-recovery and can emphasise the restoration of one's

[29] https://climate-adapt.eea.europa.eu/metadata/case-studies/implementation-of-the-vitoria-gasteiz-green-urban-infrastructure-strategy

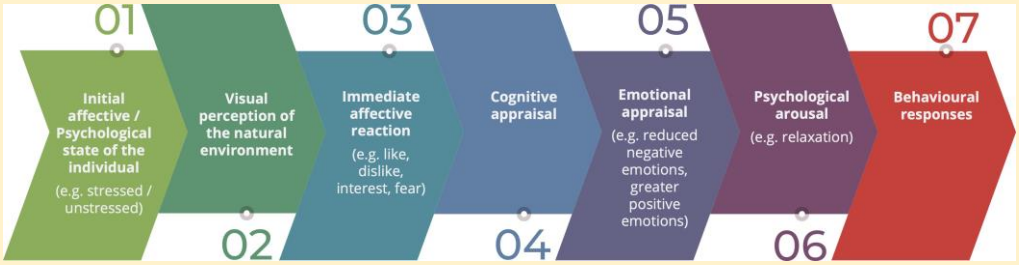
ability to concentrate because they encourage effortless attention and they foster the experience of being in another world, distant from everyday tasks or demands.

Experimental studies have investigated the restorative effects of a single, specific exposure to green space or natural features in an environment. Both a walk in a peri-urban park and viewing some stimulated natural setting (e.g. forested space, green roof) have shown to increase self-reported positive effects like cheerfulness and a decrease in negative effects such as anger, in comparison to pre-test reference values e.g. (Hartig et al, 2003; Lee et al, 2015). However, the relative importance of frequency, duration, quality of experience and type of encounter with the green space remains understudied.

Box 2. Stress reduction theory (SRT)

Focuses on psychophysiological stress as the antecedent condition. Proposes that viewing vegetation and natural-appearing environmental features can evoke positive emotions, thus blocking negative thoughts and emotions, shutting down the stress response. Studies explore how green space encounters can cause a reduction in physiological activation and self-reported emotions (Markevych et al, 2017).

Figure 4. Simplified version of the Stress Reduction Theory of affective/arousal response to a natural environment



Based on (Ulrich, 1983).

Blue spaces, especially coastal blue spaces have also been found to benefit mental health, especially due to the visual openness of the space and the fluidity of the water (Beute et al, 2020). Research has indicated that people prefer to relax and recover from daily stressors in blue spaces as compared to urban parks (White et al, 2013). It is important to note that the restorative experience must be considered within a broader context, for example considering when and from where people move into the green- or blue space. Consequently, the natural space must be viewed in relation to other places in recurrent activity cycles within a social ecology of stress and restoration (Markevych et al, 2017).

Box 3. Attention restoration theory (ART)

Developed by Rachel and Stephen Kaplan since the 1980's (Kaplan, 1987, 1995) this theory focuses on a depleted capacity to wilfully suppress distractions and direct attention as the antecedent condition. Vegetation and other natural-appealing environmental feature can facilitate recovery from directed attention fatigue by attracting and holding a person's attention without effort, enabling the other neurocognitive mechanism, on which effortful directed attention depends, to rest (Markevych et al, 2017). Studies focus on how greenspace encounters can enhance the ability to wilfully direct attention. In recent years, some studies have pointed out some of the limitations of the ART and recommended complementary approaches to better understand and define of the attributes of restorative environments e.g. (Neilson et al, 2019).

Instoration pathway

Physical activity has been demonstrated to have beneficial effects on mental health regardless of location (Bize, Johnson and Plotnikoff, 2007), however not only do green- and blue spaces encourage physical activity by providing a safe, accessible and attractive setting, but evidence shows that physical activity performed in a green space results in greater psychological and physiological benefits than physical activity in other settings e.g. (Thompson Coon et al, 2011). Blue spaces can offer an even wider range of opportunities for physical activities (e.g. swimming, sailing) at relatively low costs (Haeffner et al, 2017), thereby attractive to a large proportion of the population.

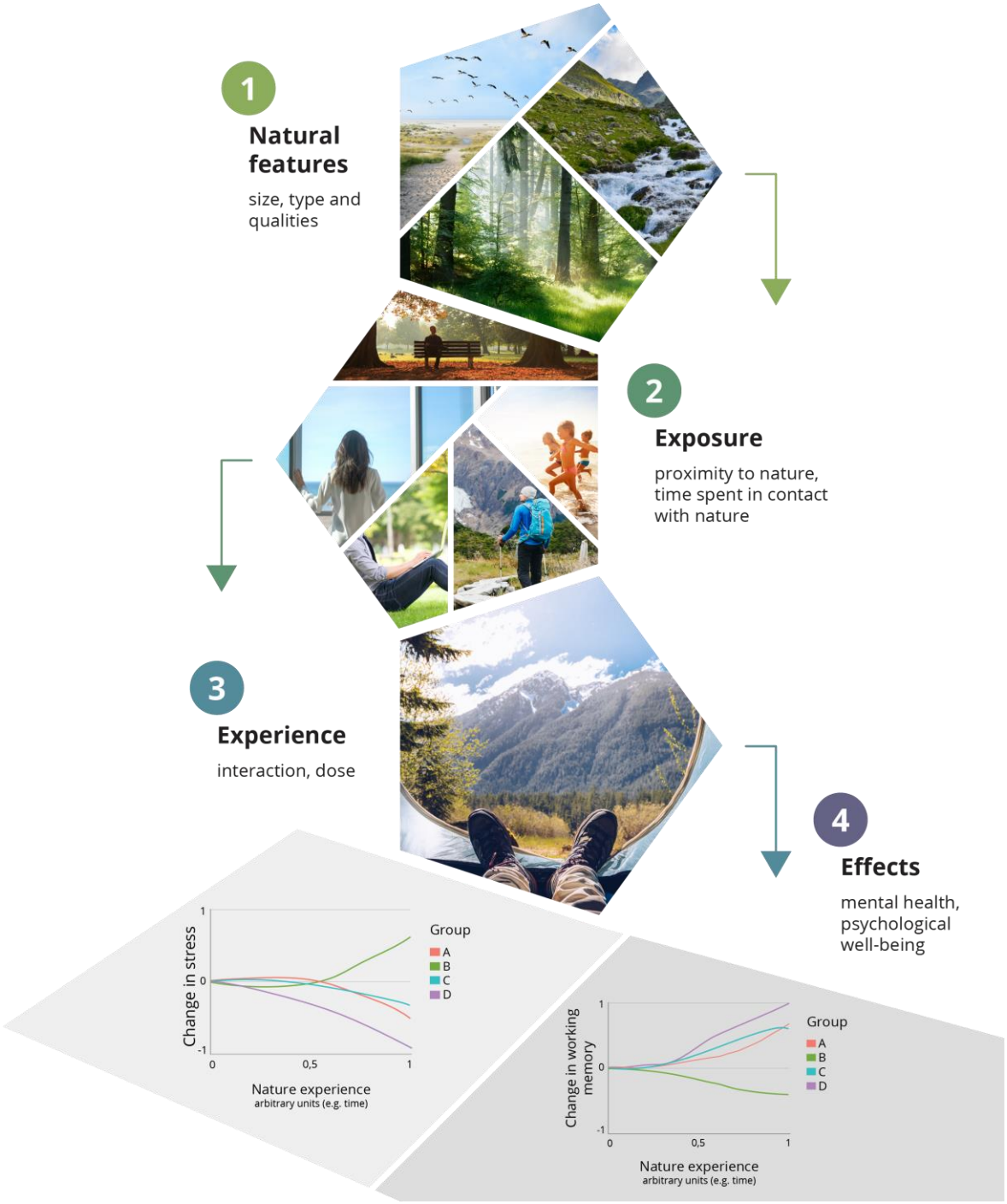
However, there remains inconsistent evidence on the association between green space and overall physical activity levels, in part because the majority of studies focus on the amount of physical activity rather than the setting (Markevych et al, 2017). Additionally, the mere presence of a green space does not necessarily imply its use and various characteristics (e.g. size and available facilities) of the space can render it unattractive for physical activity. For example, larger, well-maintained paths are likely to be more attractive to adults for physical activity whereas smaller parks may be better suited for more sedentary forms of recreation (Giles-Corti et al, 2013). Another interesting consideration is that that the greenest spaces may not be located near everyday destinations such as shops, post offices and pharmacies, resulting in car dependency and less active transportation (Hartig et al, 2014).

Alongside providing an attractive setting for physical activity, green- and blue spaces can also provide opportunities for social contact, thereby enhancing social cohesion within a neighbourhood e.g. (Weinstein et al, 2015). There is reliable evidence proving the link between social interaction and mental health in general (Holt-Lunstad, Smith and Layton, 2010) and some evidence for the beneficial effects of blue space on social interaction (de Bell et al, 2017). The social cohesion benefit of green spaces is considered to account for a considerable extent of the relationship between green space and mental health e.g. (de Vries et al, 2013). However, not all green spaces are equally suitable for positive social interactions and the importance of such social contacts may vary for different population groups. The utilisation and meaning of green spaces for children and the elderly are starkly different and neighbourhood social cohesion has been found to be especially important for the elderly (Elliott et al, 2014). For children, outdoor play in green spaces may positively affect socio-emotional development, helping to establish social cohesion, which may also spread to the parents (Markevych et al, 2017).

5.2.2 Factors that determine the mental health benefit

Ultimately, there is substantial evidence that explores the mentioned pathways demonstrating the mechanisms by which natural environments such as green- and blue spaces can have a positive effect on mental health. However, the size of these positive effects can be dependent on various factors. Research on green- and blue space is often focused on the amount or proximity of blue or green, rather than the specific qualities of the environments themselves. The natural features (i.e. size, type, qualities) of the space, the exposure time to the environment (i.e. the proximity to nature and the time spent in contact with nature) and the experience (i.e. interaction with the environment and dose) (Bratman et al, 2019) can influence the size of the mental health and well-being benefits resulting from interaction with natural environments (Figure 2). Additionally, the mental health benefits can vary by socioeconomic status, preferences, residential location, occupation, personality traits, culture, gender and age (Bratman et al, 2019). Depending on these characteristics, the use of green and blue spaces and the perceptions of nature can differ substantially, making it difficult to find studies that are comparable to summarise the overall mental health and well-being benefits of natural environments (Gascon et al, 2015).

Figure 5. A conceptual model for mental health as an ecosystem service



The pathways demonstrate that the mental health impacts will vary depending on the natural features of the nature under consideration, the exposure and duration of nature contact, and the experience within the natural environment. Source: (Bratman et al, 2019).

Natural features

The majority of epidemiological research thus far on nature and human health has focused on access and availability of nature and less attention has been directed to its characteristics, including the level of biodiversity (Hartig et al, 2014). Additionally, studies do not generally identify whether the nature in question can be considered part of an ecosystem, thereby taking into account the functional role of the area. There are certain elements of the natural environment that can facilitate the mentioned restorative responses. Changes to the amount and characteristics of urban green space affect the presence and abundance of species, the structure of vegetation, the ability of urban residents to access green space, and, subsequently, the ability of urban green spaces to actually supply ecosystem services (Wilkerson et al, 2018). Especially the size (total area), composition (proportions of different types of natural elements), and spatial configuration (degrees of fragmentation and connectivity between different green spaced) of natural landscapes can potentially influence mental health (Bratman et al, 2019).

The perceived complexity of the surroundings, which can be defined as the number of different elements to see in the environment, can affect the restorative potential of nature-immersive experiences (Marselle et al, 2019). Natural scenes are rated as more complex than urban scenes. Van den Berg et al. (2003) found that more complex natural scenes with information-rich treetops and forests were viewed longer and were rated as more restorative than less complex natural scenes with shrubs and fields (van den Berg, Koole and van der Wulp, 2003).

There is some evidence that areas with higher biodiversity may provide greater restorative benefits across different age, gender or ethnic groups (Wood et al, 2018). Biodiversity can be considered as a measure of an environment's complexity or at least co-varies with landscape complexity. There are mixed results indicating the potential of species richness and abundance to positively affect mental well-being. People tend to be more familiar with species abundance compared to species richness and therefore, species abundance has been shown to positively affect happiness, while richness seems to have no effect (Cracknell et al, 2017; Hedblom, Knez and Gunnarsson, 2017). For example, extant literature shows that not only visual encounters with birds in urban areas but also exposure to birdsongs can create positive memories and potentially reduce stress. The positive response is stronger when more species are heard (Hedblom, Knez and Gunnarsson, 2017). Nevertheless, there are clear research gaps, for example a lack of studies focusing on the effect of perceived species richness on mental health (Marselle et al, 2019). Ultimately, the dose-response relationship between biodiversity and mental health remains unclear as there is lack of evidence on how much biodiversity is needed to have a mental health effect, how long these effects last and how much immersion time within a biodiverse environment is needed to have a positive mental health effect.

It may be useful to consider evolutionary-based human preferences. Places that are intermediate on the wild-anthropogenic spectrum may have a stronger effect on mental health than less wild and more manicured green spaces. This relates to the biophilia hypothesis which "proposes that humans have an innate tendency to affiliate towards life and life-like processes as a consequence of evolution where survival and reproduction were dependent on interactions with the natural environment" (Wilson, 1984). Research has shown that humans prefer green and natural-looking spaces over built landscapes and even viewing biomorphic images can result in lower stress levels and ease visual processing (Albright, 2013). The level of biodiversity, in terms of species diversity may be directly related to the perceived naturalness of a given area, which has been shown to have a positive impact in the scenic beauty (de Vries and Snep, 2019). Urban images tend to consist of more angular edges compared to natural landscapes, which have been found to increase activation in the amygdala, where fear and anger comes from (Ross and Mason, 2017).

Studies investigating scenic beauty have often found better scores for environments containing water features (Beute et al, 2020) and from an evolutionary perspective, the presence of water is considered a positive element (Ulrich, 1983). Most research has been done on coastal compared to inland waters.

In contrast, few studies have compared the benefits of different characteristics of blue space. There is some evidence that higher levels of biodiversity result in better mood while viewing a video of coastal scenery. Furthermore, the fluidity and dynamics of water have been cited as important characteristics enhancing mental health benefits (Beute et al, 2020). Additionally, there is greater emotional attachment to blue spaces as these have strong associations with holidays and recreation (Beute et al, 2020). However, canals for example can be a hindrance to the generally positive effects of blue spaces on mental health, as they are perceived as dirty and people are fearful of slipping (Pitt, 2018).

The quantity of green space, both perceived and objective within an urban setting can also be a predictor of mental health. Residents living in urban areas with more green space in total have been found to have better mental health and were less affected by stressful life events than respondents living in urban areas with lower amounts of green space (van den Berg, Koole and van der Wulp, 2003; White et al, 2013). Additionally, the sheer quantity of green spaces i.e. the greenness of an area can be important, with Wood et al. (2017) reporting an increase in mental health with number of parks within the neighbourhood of the participant's home. Furthermore, in the same study, the effect of size on positive mental health was greater for the number of larger regional and district parks compared to small parks. However, these green spaces must also be accessible to have the mentioned positive effect on mental health. In this context, it is important to consider the role of socioeconomics. People with higher formal education levels and

greater socio-economic advantage have been shown to use local parks that incorporate native remnant ecosystems. Additionally, the people that choose to live in more natural areas are generally older, better educated and more environmentally oriented than those choosing to live in residential areas with less green space (Wilkerson et al, 2018). These factors can confound the links between mental health and green space.

Further study is currently being done by the EU science-policy-society mechanism, EKLIPSE (working group EKLIPSE EWG) to understand which types of urban and suburban blue and green spaces and which characteristics (components) of such spaces have a significant impact on human mental health and wellbeing.

Box 4. Functional ecology as important for urban nature

Most urban green spaces represent novel ecosystems. Urban ecosystems are fundamentally different from their natural counterparts in the dominant influence of human actions, both intentional and unintentional, on ecosystem function. This variability can alter species interactions with green spaces, the ecological function of green spaces and how green spaces can interact to support biodiversity. More research is needed to enhance our understanding of urban ecology and to utilise approaches based on ecological principles in the planning, designing and monitoring of cities. Examples of solutions that apply ecological principles to address environmental and social problems (e.g. air, water and soil pollution, resource depletion, aging infrastructure) focus on green infrastructure, habitat preservation and connectivity, urban metabolism and ecological footprints (Pataki, 2015). Some areas of focus for future research may be (Lepczyk et al, 2017):

- How large must an urban green space be to have biodiversity conservation benefits?
- How does heterogeneity within and across green spaces affect plant and animal assemblages?
- How connected should green spaces be to support biodiversity?
- When are green spaces more likely to act as ecological traps or population sinks?

These considerations can be important for conservation, management, and restoration within urban environments.

Exposure

According to Bratman et al. (2019) exposure refers to the amount of contact an individual or population has with nature. In general, greater contact with nature is expected to lead to greater mental health benefits up to a certain point. However, this has been especially difficult to measure and is often estimated using access/availability metrics. The presence of natural features mentioned above can be indicative of the resulting exposure. The spatial configuration and composition of a natural area can directly affect the amount of exposure a population will experience due to differences in accessibility. Additionally, the presence and quality of amenities, the perceived safety and upkeep of the natural space may affect the relationship between the natural features and exposure by encouraging or discouraging visitation and enabling different activities (Thompson, Aspinall and Bell, 2010). These effects are further influenced by the varying likelihood of seeking nature experiences depending on sociodemographic, cultural, perceptual, attitudinal and behavioural factors (Bell et al, 2014).

One important aspect is the proximity to nature i.e. green and blue spaces, street trees or private gardens both in urban and rural settings (Bratman et al, 2019). Multiple studies demonstrate that residential greenness is associated with lower prevalence of major depressive disorders, however the benefits are greater for people that live closest to the green spaces (having 10% more greenness than average within 1km was associated with 4% lower odds of depression, while the effect was 2% lower odds of depression within 3km; (Maas et al, 2009)). These effects can differ depending on the characteristics of the resident population, especially their intrinsic sociodemographic and vulnerability profiles (Sarkar, Webster and Gallacher, 2018). In deprived neighbourhoods, proximity to green space has been associated with lower self-reported psychological stress and these effects were found to be independent of physical activity and income (Ward Thompson et al, 2012). In a Danish study there was an association between the proximity to green space and decreased self-reported feelings of stress, independent of employment, education and other socioeconomic variables (Stigsdotter et al, 2010). In the Netherlands, the decrease in anxiety and depression prevalence was greatest for children and people with lower socioeconomic status living within a 1km radius of green spaces (Maas et al, 2009). Children prefer to spend time in yards or gardens close to their homes compared to green spaces that are farther away. They choose the most convenient habitat, which

aligns with the fact that children's independent mobility has been declining and therefore, they may be unwilling to move too far from home (Hand et al, 2017).

If local governments prioritise green space provisioning, designed to achieve the maximum health and well-being benefits, it is not enough to increase their abundance within cities without ensuring that all levels of society have access to them. In certain situations, urban greening (e.g., building a new park) may lead to increased property rents and taxes in adjacent areas, which could encourage the displacement of populations with lower socioeconomic status (Donovan and Butry, 2010; Wolch, Byrne and Newell, 2014). In Portland, Oregon, the presence of street trees increases house values by approximately 3% and decreases the length of time a house is on the market (Donovan and Butry, 2010), thereby making the potentially beneficial health effects of the trees only accessible to a small proportion of the population. This has also been proven in the Netherlands, where window views of green spaces and water bodies are estimated to increase home prices by 6-12%, while views of other buildings can decrease values (Luttik, 2000). In the UK, living next to green spaces such as parks, allotments, golf courses and playing fields can boost the price of a property by £2,500 on average[30]. In Porto, Portugal, the mean distance to green spaces increased with neighbourhood deprivation. Additionally, the green spaces in the more deprived neighbourhoods are associated with higher safety concerns, less amenities, signs of damage and lack of equipment to engage in leisure activities, decreasing their use and hindering the potential mental health benefit for deprived communities (Hoffimann, Barros and Ribeiro, 2017).

Experience

Bratman et al. (2019) identifies two important features of experience, namely the interaction and dose. The various ways that people interact with nature can account for differential impacts of nature exposure on mental health. Studies suggest that the mere presence of natural features and public open space within a neighbourhood may yield some mental health benefit. This is congruent with seminal findings from experimental studies which have shown that views of nature, or proximity to nature and green space is important for mental wellbeing, independent of whether it is actually used or visited (Wood et al, 2018). Workers

[30]https://www.ons.gov.uk/economy/nationalaccounts/uksectoraccounts/compendium/economicreview/july2018/estimatingtheimpacturbangreenspacehasonpropertyprice

with forest views from their offices have reported reduced psychological stress and frustration and greater lifestyle satisfaction compared to workers with built environment views (Kaplan, 1993; Sop Shin, 2007). Within neighbourhoods having a view of grass, trees or water can also improve self-reported measures of neighbourhood satisfaction and well-being compared to residents without such views (Kaplan, 2001).

However, the perception of the surroundings (e.g., neighbourhood aesthetics) can be just as important for delivering health benefits as the physical elements. For example, nature can impact health and well-being through landscape experiences, which are more complex than simply the presence of absence of nature. People can appreciate their environment objectively, even if not green or blue (Zijlema et al, 2020).

Aside from the visual aesthetics of natural environments, the related soundscapes found in natural settings such as running water and bird songs have also been found to be preferred as compared to anthropogenic sounds. Natural odours are also judged as pleasant such as plant odours and the grassy smell of "green odour" (Ross and Mason, 2017; Zupan et al, 2014). There is a lack of focus on the experience aspect of blue space with little insight into the specific sensory qualities of blue spaces. The experiential part of blue space exposure has been suggested as important, such as the smell of water, the wind in your hair, waves crashing against your body and the dynamics of tidal movements and waves, which have been reported as positive experiences (Beute et al, 2020).

There is also evidence that immersing oneself in natural environments is associated with mental health benefits. Forest bathing has been promoted by the Forest Agency of Japan since the 1980s, which involves spending time walking in and observing forests. Spending time in forests has been found to boost self-reported moods and result in physiological benefits as compared to spending time in urban areas, including increased parasympathetic activity and reduced sympathetic activity e.g. (Song et al, 2015). As mentioned previously, physical activity within natural environments is also associated with mental health benefits. Children have been found to prefer gardens, yards and sports grounds, prioritising green spaces based on the opportunities for sports and play (Hand et al, 2017).

The resulting dose, or the amount of benefit taken up by the person from nature experiences can vary depending on nature contact (Bratman et al, 2019). People have different levels of awareness and perceptions of natural environments depending on their attitudes, receptivity towards nature, childhood experiences and sense of nature connectedness. For example, people who already have a raised awareness of street trees are more likely to pay attention to them and find them more restorative than people with no prior awareness (Lin et al, 2014).

Box 5. Open Space Strategies, UK

The UK Government recognises that integrated policy and programmes that consider the increasingly important contribution of nature and parks for our physical, mental, cultural and spiritual health and well-being are essential. Along with commitments to biodiversity conservation and environmental protection, the UK's new 25-Year Plan for the Environment includes the following commitment: "Making sure that there are high quality, accessible, natural spaces close to where people live and work, particularly in urban areas, and encouraging more people to spend time in them to benefit their health and well-being". As a result, councils are required to prepare an Open Space Audit followed by an Open Space Strategy.

For example, the East Dunbartonshire Council in Scotland sets out standards for the quantity, quality and accessibility of open space, including parks, gardens, play areas and nature reserves, for its population in an Open Space Strategy 2015-2020. The Strategy sets the framework for current and future open space provision in the area and seeks to increase the quantity and quality of this resource. The Open Space Strategy aims to detail the plans through partnership working that will ensure that open spaces are inclusive, accessible and 'fit for purpose'. The opportunities for improvements to open spaces are set out by settlement area within the strategy.

Further information:

A Green Future: Our 25 Year Plan to Improve the Environment (PDF)

Parks, gardens and open spaces locations and facilities

5.2.3 Economic benefits of nature-based mental health and well-being

Overall, it is of economic and societal interest to invest in the relief of mental distress and mental illness as these account for considerable costs. In the European Region, governments spent on average US$ 22 per capita on mental health programmes and services in 2016, although there is large variation in spending (the median by country grouping ranging from <US$1per capita in the Newly Independent States to nearly US$200 in the EU countries) (WHO, 2019b). According to the World Health Organization, despite the massive global economic burden of mental health conditions, spending amounts only to 1% of total health expenditure by governments in the WHO European Region (WHO, 2019b). Nature-based treatments can therefore offer a cost-effective approach to addressing these prevalent mental health problems. On the one hand, by avoiding costs of mental illness and on the other hand through the economic benefits associated with happiness, well-being and thriving. Chisholm et al. (2016) have shown that through effective treatment coverage for depression and anxiety disorders, there is a benefit of $4 for every $1 spent as a result of restored health and the resulting productivity of affected individuals (Chisholm et al, 2016). Protected areas can also deliver important mental health benefits to visitors, which have been valued at US$ 6 trillion per year globally (Buckley et al, 2019). Providing access to nature and green spaces can provide a valuable and cost-effective approach to reduce and manage health risks. In the United States, increased exposure to green land cover seems to be linked to lower healthcare spending, however further studies are needed to prove this link definitively (Becker et al, 2019).

Non-economic measures of mental health include quality of life, well-being, and happiness, which can play an important role when valuing mental health as an ecosystem service. It is important to fully appreciate the contribution of ecosystems to mental health in policy frameworks, decision-making pathways, and urban planning contexts. The previously described pathways by which natural environments can influence mental health and the factors that can determine the size of mental health benefit of these environments (like natural characteristics, exposure and experience), need to be carefully considered to ensure that urban environments are designed to achieve the maximum mental health benefits for the majority of the population, while contributing towards achieving biodiversity and climate objectives.

Nature-based solutions operationalise the ecosystem service concept and integrate solutions to various societal challenges such as increasing human well-

being; urban regeneration; enhancing coastal resilience; multi-functional watershed management and ecosystem restoration; increasing sustainable use of matter and energy; developing the insurance value of ecosystems; and increasing carbon sequestration (Faivre et al. 2017). Although biodiversity conservation is an objective it is also the fundamental requirement for functioning ecosystems to ensure the delivery of ecosystem services, such as mental health and well-being (Faivre et al, 2017).

Currently prevention expenditure represents only 2-3% of health care in Europe (ten Brink et al, 2016). The health-social benefits of nature need to be more widely recognised and nature-based solutions that not only deliver on climate but also on biodiversity and health should be scaled up as cost-effective approaches to avoid health impacts and excessive societal and budgetary costs. At the EU level, integrating health-social-nature synergies across different policy domains is key to promoting change and cooperation across stakeholder communities.

5.3 How to encourage nature-based mental health through EU action

There is significant opportunity to utilise the existing scientific evidence (some of which, which has been presented in this white paper), to better incorporate the known links between nature and mental health into policy planning and decision-making processes, both into future and existing policies. As mentioned, nature-based solutions present a platform that can fully integrate biodiversity, climate and health challenges and develop approaches with significant positive economic and societal benefits. Since 2013, through consultations and dialogues, the European Commission has been trying to make the concept of nature-based solutions more concrete, however the knowledge and awareness of their effectiveness still needs to be improved (Faivre et al, 2017). Nevertheless, in an EU-wide study investigating the view of citizens on nature-based solutions in 2015[31], the majority of participants (53%) viewed better quality of life as the main benefit of introducing more natural features in a neighbourhood or city. Improved health and increased recreational activities were also considered important benefits for 36% and 27% of participants respectively. An interesting point is that the main fear of citizens (more than one in four) is that if more natural features were planned, they would not be properly maintained.

[31] https://data.europa.eu/euodp/en/data/dataset/S2081_84_4_444_ENG

Nature-based solutions are being mainstreamed through various European policies and actions and there is potential to better integrate the mental health perspective within these existing platforms. The most important are:

- the EU Adaptation Strategy and the Covenant of Mayors for Climate and Energy, which values ecosystem-based adaptation as important in enhancing urban resilience and delivering a range of benefits.
- the Green Infrastructure Strategy, which is embedded within the Biodiversity Strategy (both 2020 and the upcoming 2030) and aims to promote the deployment of green infrastructure in urban and rural areas of the EU.
- the Urban Agenda for the EU, including the 2018 Action Plan on Sustainable Use of Land and Nature-based Solutions Partnership.

Additionally, various EU-funded projects such as CONNECTING, GROW GREEN, UNALAB and URBAN GreenUP focus on implementing nature-based solutions for climate and water resilience in cities, to support other projects such as Nature4Cities and NATURVATION. However, although these approaches will surely benefit mental health by renaturing cities, these health benefits are not explicitly considered and therefore the full potential delivery of mental health benefits and well-being is not achieved.

Box 6. Best practice examples from Canada

(A) Ontario Parks-A Canadian leader in Healthy Parks Healthy People (Reference to IEEPs Guidance on area-based conservation and SDGs)

The link between health and nature has been promoted by Ontario Parks since 2013, making the organisation a leader of the IUCNs Healthy Parks Healthy People initiative (HPHP) in Canada. The commitment to health is embedded in Ontario Park's Strategic Direction, which includes health as one of the organisation's six core values and promises efforts to sustain and enhance the connection between the health of parks and human health.

A series of events have been organized as part of the HPHP initiative to encourage visitors and local citizens to spend time outdoors and to engage health and community partners. For example, the 30x30 Challenge invigorated Ontarians to spend 30 minutes a day in nature for 30 consecutive days. The Ontario government conducted a large-scale public consultation to better understand how to advance the role of green spaces in health and well-being. As a result, Ontario is developing a strategic plan for Healthy Parks Healthy People, using the data gathered.

(Ontario Parks. (2019). Healthy Parks Healthy People: Our Nature Our Health. Available at: OntarioParks.com/hphp)

(B) Sépaq- Quebec's Park Agency's linkage between health and nature

The Société des établissements du Québec (Sépaq) have initiated further research into the impacts of natural areas on human health in the province of Québec. In a partnership with Le Grand Chemin, Sépaq offer outdoor and adventure therapy for teenagers being treated for drug addiction, alcoholism, pathological gambling or cyber addiction. Forest expeditions of 3-5 days in one of Sépaq's national parks, have been beneficial, creating a soothing environment that adds another dimension beyond traditional therapy.

Box 7. Nature-based solutions for urban regeneration and wellbeing, Ljubljana

In the city of Ljubljana, numerous green initiatives have been undertaken to regenerate the city, mitigate climate change and preserve ecosystems while at the same time improving the quality of life. In the Vision Ljubljana 2025, the city adopted several sustainable-oriented strategic documents including the Urban Master Plan and the Environment Protection Programme, which aims to protect and enhance the natural environment in the city. The city centre is closed for motorised traffic and has been renovated to create and Ecological Zone covering 100,000m^2. Green areas for social and sporting activities have been provided on previously degraded areas and the river Ljubljanica has been the focus of a restoration project. The cumulative effect of these measures has enabled health-social-nature synergies by providing key ecosystem services.

Further information: Ljubljana: Nature-based Solutions (NBS) for Urban Regeneration and Wellbeing

Box 8. 'Healthy parks, healthy people'

Metsähallitus - Parks and Wildlife Finland launched their Health and Wellbeing 2025 Programme- Moving In Nature has a highly positive impact on our physical, mental and social well-being. The goal is to inspire people to move and stay in the natural environment more often and for longer periods.

Further information: Healthy parks healthy people Finland (PDF) and Health and Wellbeing 2020 programme (PDF)

Box 9. Prescribing nature to improve mental health in urban setting: An innovative approach

The Re-imagining Environments for Connection and Engagement: Testing Actions for Social Prescribing in Natural Spaces project (RECETAS) project has been selected for funding under the EU Horizon 2020 research programme. Led by ISGlobal, RECETAS (timeline 2021 to 2026) will explore the potential of nature-based solutions as an alternative to pharmaceutical prescriptions by testing a novel intervention – nature-based social prescribing – in six cities – Barcelona, Helsinki, Marseille, Prague, Melbourne (Australia) and Cuenca (Ecuador) . The interventions will be rigorously evaluated, including the use of randomized controlled trials and cost effectiveness studies, to measure impact on social cohesion and address loneliness and health-related quality of life, including connecting vulnerable populations with the broader community.

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